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**CBSE 2026**

# **SCIENCE**

**Including Case Based Questions**

**CLASS 7**

**Chapter-wise Question Bank**

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CBSE Class 7 Science Question Bank  
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# CHAPTER 1

## THE EVER-EVOLVING WORLD OF SCIENCE

### SUMMARY

#### 1. INTRODUCTION TO SCIENTIFIC EXPLORATION

Science is not just about facts but about exploring and questioning the world around us. From tiny cells to stars, it encourages curiosity. Simple things like paper planes have inspired great scientific ideas.

#### 2. SCIENCE AS A WAY OF THINKING

Science is a process of thinking critically and asking questions. This year, students are encouraged to step outside the classroom, do experiments, and understand their role in protecting nature and living responsibly.

#### 3. INTERCONNECTED FIELDS OF SCIENCE

The book covers physics, chemistry, biology, and earth science. Though taught separately, these subjects are deeply connected. Observing everyday things like turmeric stains or sour fruits can lead to big scientific ideas.

#### 4. CHANGES IN THE NATURAL WORLD

We see many changes around us—some reversible like melting ice, and some irreversible like ripening fruits. Heat plays a key role in these changes and also drives the water cycle, which connects air, land, and water.

#### 5. LIFE PROCESSES AND GROWTH

Our bodies change as we grow, especially during middle school. All living things need food, air, and a way to transport nutrients. Plants too have their own way of making and using food.

#### 6. TIME AND LIGHT

Time can be measured by clocks or by observing shadows. Light helps us see and also explains natural events like day and night or eclipses. Earth's rotation and the moon's movement are key to understanding these cycles.

#### 7. THINKING LIKE A SCIENTIST

Being a scientist means asking creative questions. This chapter ends with an activity that flips the usual pattern students are given answers and asked to think of fun or unusual questions to match them.

### MULTIPLE CHOICE QUESTION

1. What kind of deeper questions does the Grade 7 book encourage students to ask?  
(A) Only questions about facts and figures.  
(B) Questions like “How do things work?” and “Why do events happen?”.  
(C) Questions that already have known answers in the book.  
(D) Only questions related to biology.

Ans :

- (B) Questions like “How do things work?” and “Why do events happen?”.

The Grade 7 science book encourages students to think beyond memorization and ask meaningful questions about how things function and why natural events occur, promoting critical thinking and curiosity.

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2. Why is it suggested to step out of the book and classroom?
- (A) Because the book contains incorrect information.
- (B) To experience the world directly through activities and experiments for deeper understanding.
- (C) Because classrooms are not suitable for learning science.
- (D) To find answers exclusively on the internet.

Ans :

(B) To experience the world directly through activities and experiments for deeper understanding.

Hands-on activities and real-world experiments help reinforce concepts learned in books, making science more engaging, practical, and easier to understand.

3. The chapter highlights science as an ongoing process of discovery and also emphasizes what other aspect?
- (A) Competition
- (B) Memorization
- (C) Responsibility
- (D) Secrecy

Ans :

(C) Responsibility

Beyond discovery, the introduction links science exploration to responsibility, particularly concerning the connection between human activities, the natural world, society, and environmental sustainability.

4. How does the chapter describe the relationship between different fields of science like physics, chemistry, and biology?
- (A) They are completely separate and unrelated subjects.
- (B) They are interconnected, with ideas in one area often inspiring discoveries in another.
- (C) Physics is the most important field, followed by chemistry, then biology.
- (D) Learning one field makes learning others unnecessary.

Ans :

(B) They are interconnected, with ideas in one area often inspiring discoveries in another.

The text stresses the interconnectedness of scientific disciplines, suggesting that concepts and discoveries often cross boundaries between

fields like physics, chemistry, biology, and earth sciences.

5. Which topic is mentioned as the starting point for exploring the properties of materials in the Grade 7 book?
- (A) Electrical conductivity
- (B) Acids and bases (e.g., sour fruits, haldi stain reactions)
- (C) Magnetism
- (D) Density and buoyancy

Ans :

(B) Acids and bases (e.g., sour fruits, haldi stain reactions)

The preview mentions starting with everyday properties, using examples like why fruits are sour and the reaction of turmeric (haldi) stains, which relate to acids and bases.

6. Exploring which materials make a lamp glow leads to the study of what classification of materials?
- (A) Magnetic and non-magnetic materials
- (B) Solids, liquids, and gases
- (C) Acids and bases
- (D) Metals and non-metals (based on electrical conductivity)

Ans :

(D) Metals and non-metals (based on electrical conductivity)

Using electrical circuits with batteries and lamps to test materials, leading into the classification of materials as metals (conductors) and non-metals (insulators).

7. The book previews studying different types of changes, giving examples like batteries running out, ice melting, and fruits ripening. What is a key question asked about these changes?
- (A) Which changes are fastest?
- (B) Which changes involve color?
- (C) Which changes can be reversed, and which cannot?
- (D) Which changes require electricity?

Ans :

(C) Which changes can be reversed, and which cannot?

The preview explicitly mentions exploring reversible changes (like melting ice) and irreversible changes (like batteries running out or fruit ripening).

8. The study of how heat flows is previewed using examples like melting ice cubes and glaciers. What related natural phenomenon involving heat and water is also mentioned?
- (A) Formation of seasons
  - (B) The water cycle (evaporation, rain, seepage)
  - (C) Ocean currents
  - (D) Volcanic activity

Ans :

(B) The water cycle (evaporation, rain, seepage)  
The text links the flow of heat to the water cycle, mentioning the Sun's heat causing evaporation from seas, leading to rain and water trickling underground.

9. Besides changes in materials, what other significant changes happening during middle-school years does the book preview discussing?
- (A) Changes in weather patterns.
  - (B) Changes in the Earth's magnetic field.
  - (C) Changes in the human body (adolescence).
  - (D) Changes in star constellations.

Ans :

(C) Changes in the human body (adolescence).  
The introduction specifically mentions that as students grow, their bodies undergo rapid changes during the middle-school years, indicating a chapter on adolescence.

10. What essential life processes in animals, needed for growth and survival, are mentioned in the preview?
- (A) Hibernation and migration
  - (B) Camouflage and mimicry
  - (C) Eating, breathing, and circulation of nutrients
  - (D) Photosynthesis and transpiration

Ans :

(C) Eating, breathing, and circulation of nutrients  
The text previews chapters on animal life processes, highlighting the necessity of eating (nutrition), breathing (respiration), and blood circulating nutrients.

11. The preview raises questions about how plants get food and whether they breathe. This points towards a chapter on what topic?
- (A) Plant diseases
  - (B) Plant reproduction
  - (C) Life processes in plants (photosynthesis, respiration)
  - (D) Types of plant roots and stems

Ans :

(C) Life processes in plants (photosynthesis, respiration)

The questions posed directly relate to how plants obtain energy and exchange gases, which are key topics covered under life processes in plants, namely photosynthesis and respiration.

12. What human invention is mentioned as helping measure the passage of time, connecting to a chapter on time and motion?

- (A) Telescope
- (B) Microscope
- (C) Clock (or watch)
- (D) Computer

Ans :

(C) Clock (or watch)  
The text transitions from life evolving over time to how humans measure time, specifically mentioning clocks and watches telling us the time.

13. The preview mentions using shadows to tell time in the past. This connects the measurement of time to which other scientific topic discussed later?

- (A) Heat transfer
- (B) Electricity
- (C) Light and shadows
- (D) Chemical changes

Ans :

(C) Light and shadows  
Using shadows for timekeeping (like sundials) relies on the properties of light traveling in straight lines and casting shadows, linking time measurement to the study of light.

14. What fascinating phenomena involving the Earth, Moon, and Sun are mentioned as being related to light and shadows?

- (A) Tides and waves
- (B) Seasons and climate change
- (C) Earthquakes and volcanoes
- (D) Eclipses (solar and lunar)

Ans :

(D) Eclipses (solar and lunar)  
The text explicitly states that the Earth and Moon can cast shadows, leading to the phenomena of solar and lunar eclipses, which are covered later.



15. Understanding day and night requires knowledge of which movement of the Earth?
- Earth's revolution around the Sun.
  - Earth's rotation around its axis.
  - Earth's movement through the galaxy.
  - Earth's magnetic field flipping.

Ans :

(B) Earth's rotation around its axis.

The preview links the occurrence of day and night directly to the need to understand how the Earth rotates on its axis.

16. What is the main message conveyed about the nature of science in this introductory chapter?
- Science is a fixed set of facts to be memorized.
  - Science is primarily about complex calculations.
  - Science is an active, evolving process of curiosity, questioning, exploration, and discovery.
  - Science is only relevant for professional scientists.

Ans :

(C) Science is an active, evolving process of curiosity, questioning, exploration, and discovery. The chapter repeatedly emphasizes science as a dynamic journey driven by curiosity, asking questions ("whys person"), hands-on activities, and making connections, rather than just learning static facts.

17. Activity 1.1, "Question the Answer," encourages students to do what?
- Find the single correct answer to a question.
  - Memorize answers provided in the book.
  - Think creatively and ask interesting questions that could lead to a given answer.
  - Avoid asking questions during class.

Ans :

(C) Think creatively and ask interesting questions that could lead to a given answer.

This activity aims to develop scientific thinking by focusing on the importance of formulating good questions, highlighting that asking questions is as crucial as finding answers in science.

18. The chapter uses the analogy of a butterfly's flight and a paper plane soaring. What aspect of learning science is this analogy meant to represent?

- The difficulty and complexity of science.
- The way learning takes flight when driven by curiosity and exploration.
- The slow and gradual process of scientific discovery.
- The materials used in scientific experiments.

Ans :

(B) The way learning takes flight when driven by curiosity and exploration.

The fluttering butterfly and soaring plane symbolize how curiosity can lead learning, allowing imagination and exploration to "take flight" as students engage with science.

19. How does the chapter suggest students should view the relationship between science and society/environment?
- Science is separate from societal or environmental issues.
  - Science only causes environmental problems.
  - Scientific understanding helps see links between human actions, nature, and society, and can help address challenges.
  - Environmental issues are too complex for Grade 7 students to consider.

Ans :

(C) Scientific understanding helps see links between human actions, nature, and society, and can help address challenges.

The text connects scientific exploration with understanding the impact of human activities and suggests science plays a role in tackling environmental challenges and building a sustainable world.

## MATCHING TYPE QUESTION

20. Match the aspect of science in Column A with its description from the chapter in Column B :

	Column A		Column B
1.	Science is	A.	Asking "How do things work?" and "Why do events happen?"
2.	Exploration in Science	B.	An ongoing process of discovery and about responsibility

3.	Deeper Questions in Grade 7	C.	A process that welcomes curiosity and is open to the unknown
4.	Nature of Science	D.	Stepping out of the book/classroom for activities/experiments

- (a) 1-C, 2-D, 3-A, 4-B
- (b) 1-D, 2-C, 3-B, 4-A
- (c) 1-C, 2-A, 3-D, 4-B
- (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

Science is a curious process. Exploration involves activities. Deeper questions focus on “how” and “why.” Science is an ongoing, responsible discovery process.

21. Match the scientific topic overview from the chapter (Column A) with a related question or concept (Column B) :

	Column A		Column B
1.	Properties of Materials	A.	How heat flows, like in melting ice
2.	Electric Circuits	B.	Why are some fruits sour?
3.	Changes Around Us	C.	What kind of materials make a lamp glow?
4.	Heat Transfer	D.	Can a battery running out be reversed?

- (a) 1-A, 2-C, 3-D, 4-B
- (b) 1-C, 2-B, 3-A, 4-D
- (c) 1-B, 2-C, 3-D, 4-A
- (d) 1-B, 2-A, 3-C, 4-D

Ans :

- (c) 1-B, 2-C, 3-D, 4-A

Material properties include taste (sour fruits). Electric circuits involve making lamps glow. Changes include reversibility (batteries). Heat transfer explains melting ice.

22. Match the life science topic overview (Column A) with a specific inquiry mentioned (Column B) :

	Column A		Column B
1.	Changes in Human Body	A.	How the Earth rotates and revolves
2.	Life Processes in Animals	B.	How do plants get their food and do they breathe?
3.	Life Processes in Plants	C.	Why our bodies change rapidly in middle school
4.	Earth and Celestial Movements	D.	Need to eat, breathe, and circulate nutrients

- (a) 1-C, 2-D, 3-B, 4-A
- (b) 1-D, 2-C, 3-A, 4-B
- (c) 1-C, 2-A, 3-D, 4-B
- (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (a) 1-C, 2-D, 3-B, 4-A

Human body changes are notable in middle school. Animal life processes include eating and breathing. Plant life processes involve food acquisition. Earth’s movements cause day/night/eclipses.

23. Match the concept related to light and time (Column A) with its description or example from the chapter (Column B) :

	Column A		Column B
1.	Early Time Telling	A.	Phenomenon caused by Earth or Moon casting shadows
2.	Importance of Light	B.	Helps us see and its study reveals universe’s nature
3.	Shadows	C.	Using the position of Sun’s shadows to determine time
4.	Eclipses	D.	Useful for shadow puppets, formed by blocked light

- (a) 1-A, 2-D, 3-C, 4-B
- (b) 1-C, 2-B, 3-D, 4-A
- (c) 1-C, 2-A, 3-D, 4-B
- (d) 1-B, 2-C, 3-A, 4-D

Ans :

- (b) 1-C, 2-B, 3-D, 4-A



Early time telling used Sun's shadows. Light is crucial for vision and understanding the universe. Shadows are formed by blocked light. Eclipses are caused by celestial bodies casting shadows.

24. Match the scientific skill or attitude in Column A with its importance as highlighted in the chapter (Column B) :

	Column A		Column B
1.	Curiosity	A.	The spark that lights the flame of exploration
2.	Asking "Why?"	B.	A simple starting point for even groundbreaking discoveries
3.	Hands-on Experiments	C.	A way to experience the world and build deeper understanding
4.	Questioning the Answer (Activity 1.1)	D.	An exercise to foster creative and curious question formulation

- (a) 1-D, 2-A, 3-C, 4-B  
 (b) 1-A, 2-C, 3-B, 4-D  
 (c) 1-B, 2-D, 3-A, 4-C  
 (d) 1-A, 2-B, 3-C, 4-D

Ans :

- (d) 1-A, 2-B, 3-C, 4-D

Curiosity sparks exploration. Asking "Why?" can lead to discoveries. Experiments provide understanding. "Question the Answer" encourages asking good questions, like a scientist.

### VERY SHORT QUESTION

25. What approach does this textbook encourage besides just learning facts?

Ans :

It encourages questioning, performing experiments and exploring.

26. What simple toy mentioned in the text inspired scientific explorations of flight?

Ans :

A paper plane.

27. According to the text, science is not just about discovery but also about what?

Ans :

Responsibility (towards the natural world and society).

28. Are the different science topics (physics, chemistry, biology, earth science) presented as completely separate or interconnected?

Ans :

Interconnected.

29. Name one everyday question about materials mentioned as an example of scientific curiosity.

Ans :

Why are some fruits sour? (or What happens when we wash a haldi stain?).

30. What natural phenomenon involving the Sun and water is mentioned as a link between chapters?

Ans :

The water cycle (evaporation from seas due to Sun's heat, rain, water seeping underground).

31. What is one significant physical change mentioned that occurs during middle-school years?

Ans :

Rapid body changes (part of growing up/ adolescence).

32. Besides eating, what is another essential life process mentioned for animals?

Ans :

Breathing (or circulation).

33. Do plants need food to grow?

Ans :

Yes.

34. What ancient method used the Sun to tell time?

Ans :

Observing the position of shadows (Sundials).

### SHORT ANSWER QUESTION

35. According to the introduction, what is the "process" of science primarily about?

Ans :

Science as a process involves a way of thinking that welcomes curiosity, asks questions (like 'How?' and 'Why?'), is open to the unknown, and uses activities/experiments for deeper understanding.

36. How does the text suggest learning science should go beyond the textbook and classroom?

Ans :

It suggests experiencing the world through hands-on activities and experiments to gain a deeper understanding of the environment and see science as an ongoing discovery process.

37. Why does the text emphasize the interconnectedness of different scientific fields?

Ans :

It emphasizes interconnectedness because scientific ideas or discoveries in one area often inspire questions or breakthroughs in another, showing that science is a unified endeavor.

38. What connection does the introduction make between science, human activities, and responsibility?

Ans :

It highlights that human activities impact the natural world and society, and understanding science helps recognize these links and address environmental challenges responsibly for a sustainable world.

encourages students to be like explorers, making their own small discoveries fueled by their natural curiosity about the world.

40. How does this introductory chapter preview the topics covered in the Grade 7 textbook? Briefly mention the key areas hinted at and explain how the text suggests they are linked.

Ans :

The chapter previews topics by posing questions related to them : properties of materials (sour fruits, haldi stains, electrical conductivity), classification (metals/non-metals), types of changes (reversible/irreversible like batteries running out, ice melting), heat transfer (melting ice/glaciers), the water cycle, human growth/life processes (body changes, eating, breathing), plant life processes (food production, breathing), time measurement and motion (clocks, speed), and light/astronomy (shadows, reflections, eclipses, Earth's rotation/revolution). It suggests links implicitly, e.g., how heat affects changes, how heat/Sun drive the water cycle, and how understanding Earth's motion explains day/night and astronomical observations. It explicitly states different fields are interconnected.

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## LONG ANSWER QUESTION

39. The introduction chapter uses the analogy of a butterfly and a paper plane for learning. Explain this analogy and discuss how curiosity is central to the scientific journey described in the text.

Ans :

The analogy compares learning science to the free flight of a butterfly or a paper plane, suggesting that learning takes off when driven by curiosity. Just as a simple paper plane inspired real flight exploration, simple observations and questions spark scientific inquiry. Curiosity is central because the text frames science as a process of asking 'how' and 'why', welcoming the unknown, and actively exploring through experiments. It

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# CHAPTER 2

## EXPLORING SUBSTANCES : ACIDIC, BASIC AND NEUTRAL

### SUMMARY

#### 1. INTRODUCTION

The chapter introduces the classification of common substances into three categories : acidic, basic and neutral, based on their chemical properties.

#### 2. USING INDICATORS

##### 2.1 What are Indicators?

Indicators are defined as substances that exhibit a noticeable change, most commonly in colour, when they come into contact with acidic or basic solutions. This change allows for the identification of a substance's nature.

1. Natural Indicators : Several naturally derived indicators are discussed :
  - (i) Litmus : Obtained from lichens, it turns red in acids and blue in bases.
  - (ii) Red Rose Extract : Turns reddish in acids and greenish in bases.
  - (iii) Turmeric (Haldi) : Turns reddish-brown in bases but remains yellow in acids and neutral solutions.
2. Olfactory Indicators : Some substances, like onion, change their smell in acidic or basic media and are known as olfactory indicators.

#### 3. PROPERTIES OF ACIDS AND BASES

##### 3.1 Taste and Touch

General physical properties are linked to chemical nature : acids often taste sour, while bases typically taste bitter and feel slippery or soapy. (Caution against tasting is emphasized).

#### 4. NEUTRALISATION REACTION

Neutralisation is introduced as the fundamental chemical reaction occurring when an acid and a base are mixed. In this process, the acidic and basic properties effectively cancel each other out.

The reaction typically produces two main products : a salt (a compound formed from the reaction) and water. Importantly, neutralisation reactions are often exothermic, meaning they release heat into the surroundings. The general equation is represented as :



#### 5. NEUTRALISATION IN EVERYDAY LIFE

##### 5.1 Practical Applications

The principle of neutralisation has several real-world applications :

1. Ant Bites : Relieving the sting (caused by acidic formic acid) by applying a mild base like baking soda.
2. Soil Treatment : Adjusting soil pH for optimal plant growth by adding lime (base) to acidic soil or organic matter (acid-releasing) to basic soil.
3. Factory Waste : Treating acidic industrial effluents with basic substances before discharge to prevent environmental harm, particularly to aquatic life.

### NCERT ACTIVITY

#### Activity 2.1 : Let us explore

##### Materials needed :

1. Blue and red litmus paper
2. Dropper

3. Samples : lemon juice, soap solution, amla juice, tamarind water, vinegar, baking soda solution, lime water, tap water, washing powder solution, sugar solution, salt solution.

**Procedure :**

1. Cut blue and red litmus paper into small pieces.
2. Place them on a clean tile.
3. Using a dropper, put one drop of each sample on the litmus paper.
4. Observe the colour change.



Figure : (a) Colour change in blue litmus paper



Figure : (b) Colour change in red litmus paper

Ans :

**Table : Testing the nature of samples with blue and red litmus papers**

S. No.	Name of the Sample	Colour of Blue Litmus Paper	Colour of Red Litmus Paper
1	Lemon juice	Turns red	No change

2	Soap solution	No change	Turns blue
3	Amla juice	Turns red	No change
4	Tamarind water	Turns red	No change
5	Vinegar	Turns red	No change
6	Baking soda solution	No change	Turns blue
7	Lime water	No change	Turns blue
8	Tap water	No change	No change
9	Washing powder solution	No change	Turns blue
10	Sugar solution	No change	No change
11	Salt solution	No change	No change
12	Any other (e.g., tomato juice)	Turns red	No change

**Table : Grouping of samples tested in Table**

Group (Acidic) A	Group (Basic) B	Group (Neutral) C
Lemon juice	Soap solution	Tap water
Amla juice	Baking soda solution	Sugar solution
Tamarind water	Lime water	Salt solution
Vinegar	Washing powder solution	
Tomato juice (any other)		

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**Activity 2.2 : Let us relate and explore**

Are all the substances in Group A of Table 2.2 edible? Have you ever tasted these edible substances? Can you recall their taste?

You will find that all these substances taste sour. Thus, we can say that substances that taste sour tend to contain acids and are acidic in nature.

**Caution** — Do not taste anything unless asked to do so. Do not taste any unknown substance.

Some common edible substances and the names of the most common acids present in them are given in Figure :



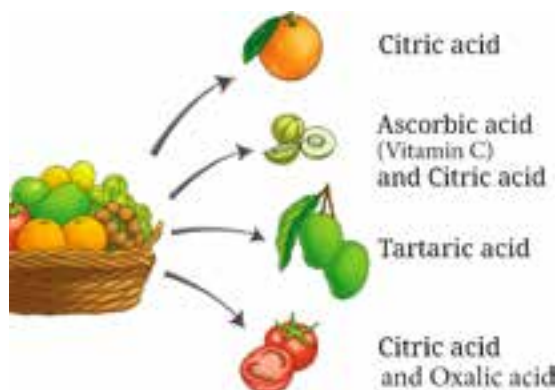


Figure : The most common acids present in some edible substances

Find out and write the names of the most common acids present in the following substances :

1. Lemon : \_\_\_\_\_
2. Curd : \_\_\_\_\_
3. Tamarind : \_\_\_\_\_
4. Vinegar : \_\_\_\_\_

Ans :

1. Lemon : Citric acid
2. Curd : Lactic acid
3. Tamarind : Tartaric acid
4. Vinegar : Acetic acid

### Activity 2.3 : Let us prepare

1. Collect some fallen petals of red roses available in your surroundings (Figure). It is advised not to pluck flowers. You may pick petals or flowers fallen on the ground.



Figure : Red roses

2. Take a fistful of the collected petals of red roses and wash them with water.
3. Crush the petals using a mortar and pestle.
4. Place them in a glass tumbler.
5. Pour some hot water into the glass tumbler to ensure that the crushed flower petals are completely immersed.

**Caution** — Perform this step under the supervision of an adult.

6. Cover the glass tumbler with a lid. Wait for 5–10 minutes till the water becomes coloured (Figure), and filter it.



Figure : Red rose petals immersed in hot water

7. The filtrate (liquid after filtration) is the required flower extract (Figure) to be used as an acid-base indicator.

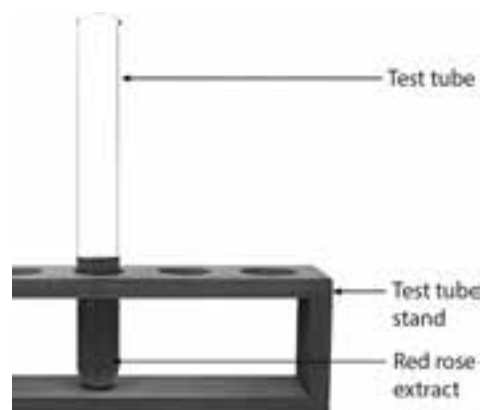


Figure : Test tube containing the red rose extract

### Activity 2.4 : Let us find out

1. Place 10–20 drops of the prepared red rose extract in each of two small transparent bottles or test tubes. Mark them A and B.
2. Add 20–30 drops of lemon juice in test tube A and 20–30 drops of soap solution in test tube B using droppers.
3. Observe and record any colour changes (see Figure) and enter your observations in table.
4. Repeat the same with the other samples used in Activity 2.1 and fill in the table.

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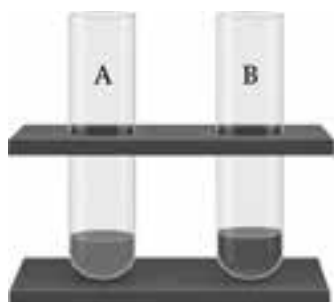


Figure : The changes in colour of the red rose extract on adding lemon juice (A) and soap solution (B)

**Table : Testing the nature of samples with the red rose extract**

S. No.	Name of the Sample	Colour of the Red Rose Extract After Adding the Sample	Nature of the Substance
1	Lemon juice	Red/Pink	Acidic
2	Soap solution	Green	Basic
3	Amla juice	Red	Acidic
4	Tamarind water	Red	Acidic
5	Vinegar	Red	Acidic
6	Baking soda sol.	Green	Basic
7	Lime water	Green	Basic
8	Tap water	No change	Neutral
9	Washing powder sol.	Green	Basic
10	Sugar solution	No change	Neutral
11	Salt solution	No change	Neutral

**Conclusion :**

From the observations :

1. Red rose extract turns red or pink in acidic solutions.
  2. It turns green in basic solutions.
  3. It shows no change in neutral solutions
- Hence, red rose extract can act as a natural acid-base indicator

**Activity 2.5 : Let us prepare**

1. Take a spoonful of turmeric (haldi) in a petri dish or container and add a little water to make a paste (Figure (a)). You may also use fresh turmeric.
2. Carefully dip a piece of filter paper in the turmeric paste until it gets a yellow colour.
3. Take it out and allow it to dry.
4. Cut this yellow paper into thin strips to make turmeric paper (Figure (b)).

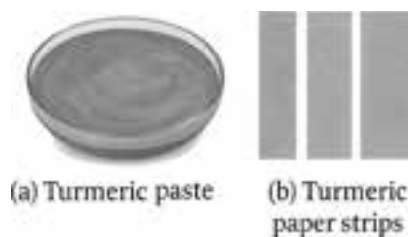


Figure : Preparing turmeric paper

**Caution** — Perform this activity under adult supervision.

**Testing with Turmeric Paper :**

1. Using a dropper, put a drop of each sample (used in Activity 2.1) on separate pieces of turmeric paper.
2. Record your observations in Table.

Ans :

**Table : Testing the nature of samples with turmeric paper**

S. No.	Name of the Sample	Colour of the Turmeric Paper After Adding the Sample
1	Lemon juice	No change (remains yellow)
2	Soap solution	Reddish-brown
3	Amla juice	No change
4	Baking soda solution	Reddish-brown
5	Vinegar	No change
6	Salt solution	No change
7	Washing powder	Reddish-brown
8	Tap water	No change

**Observation & Conclusion :**

1. Basic substances turn turmeric paper reddish-brown.
2. Acids and neutral substances show no colour change.
3. Turmeric paper is a natural indicator that can be used to test bases, but not acids.

**Activity 2.6 : Let us investigate**

1. Take some finely chopped onions in a container, along with some strips of clean cotton cloth or filter paper.
2. Tightly close the container and leave it overnight.



- The next day, take out two strips of the cotton cloth or filter paper from the container and check their odour.
- Place them on a clean surface and put a few drops of tamarind water on one strip and a few drops of baking soda solution on the other.
- Allow the drops to spread on the strips.
- Check the odour again.
- Do you notice any change in the odour of the onion strips before and after putting tamarind water and baking soda solution on them?
- Note your observations.
- Similarly, test the change in the odour with other acidic and basic substances and record your observations.

#### Conclusion :

Onion smell disappears in basic solutions like baking soda.

- Onion smell remains unchanged in acidic solutions like tamarind water.
- This shows that onion can act as a natural indicator to detect bases.

#### Activity 2.7 : Let us experiment

- Take one drop of lemon juice in a test tube and add around twenty drops of water to it. Observe the colour.
- Add a drop of blue litmus solution to it.



Figure : (a) The colour of the solution on adding blue litmus solution

- Do you observe any colour change (Figure (a))?
- Slowly add drops of lime water to this test tube with the help of a dropper and swirl it well.
- What do you observe? Is there any change in the colour of the solution?
- A stage comes when the colour of the solution changes from red to blue (Figure (b)).



Figure : (b) The colour of the solution on adding lime water

- Again, add one drop of lemon juice to the above solution.

Can you predict why there is a change in colour?

Ans :

Here are the answers based on the steps in the activity:

- The colour of the solution on adding blue litmus solution: When blue litmus is added to the lemon juice solution, it turns red, indicating that lemon juice is acidic in nature.
- The colour of the solution on adding lime water: On slowly adding lime water (which is basic in nature), the red colour slowly changes to blue. This is because lime water neutralises the acid.

Explanation for the change in colour when lemon juice is added again:

When a drop of lemon juice (acid) is added again to the basic solution, the solution becomes acidic once more. As a result, the blue colour changes back to red. This is due to the neutralisation reaction between an acid (lemon juice) and a base (lime water), which alters the pH of the solution and hence changes the colour of the litmus indicator.

### NCERT EXERCISE

- A solution turns the red litmus paper to blue. Excess addition of which of the following solution would reverse the change?
  - Lime water
  - Baking soda
  - Vinegar
  - Common salt solution

Ans :

- Vinegar

The initial solution is basic because it turns red litmus blue. To reverse this, an acid is needed. Vinegar contains acetic acid. Adding excess vinegar neutralizes the base and makes the solution acidic, changing the litmus back. Lime water and baking soda are bases; salt solution is neutral.

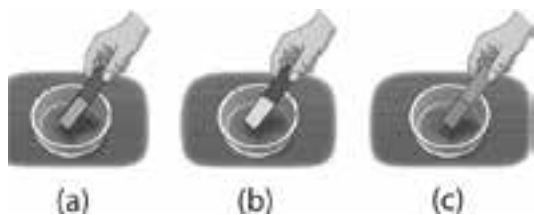
2. You are provided with three unknown solutions labelled A, B and C, but you do not know which of these are acidic, basic, or neutral. Upon adding a few drops of red litmus solution to solution A, it turns blue. When a few drops of turmeric solution are added to solution B, it turns red. Finally, after adding a few drops of red rose extract to solution C, it turns green. Based on the observations, which of the following is the correct sequence for the nature of solutions A, B, and C?
- (i) Acidic, acidic, and acidic
  - (ii) Neutral, basic, and basic
  - (iii) Basic, basic, and acidic
  - (iv) Basic, basic, and basic

Ans :

(iv) Basic, basic, and basic

Solution A turns red litmus blue, indicating it's basic. Solution B turns turmeric red, also indicating it's basic. Solution C turns red rose extract green, which is the characteristic colour change for basic solutions with this indicator. Thus, all three are basic.

3. Observe and analyse Figures (a), (b) and (c), in which red rose extract paper strips are used. Label the nature of solutions present in each of the containers.



Ans :

Red rose extract indicator turns green in basic solutions and red/pinkish in acidic solutions. In Figure (a), the strip is green, so the solution is basic. In the figure (b) the strip colour is not changed. So it is neutral and in the figure (c), strip becomes red therefore it is acidic in the nature.

4. A liquid sample from the laboratory was tested using various indicators :

Indicator	Red litmus	Blue litmus	Turmeric
Change	No change	Turned red	No change in colour

Based on the tests, identify the acidic or basic nature of the liquid and justify your answer.

Ans :

Nature : The liquid sample is Acidic.

The liquid is acidic because it turned blue litmus red, which is a definitive test for acids. The fact that it didn't change red litmus or turmeric colour is consistent with it being acidic (as these indicators only change colour for bases or remain unchanged for acids/neutral).

5. Manya is blindfolded. She is given two unknown solutions to test and determine whether they are acidic or basic. Which indicator should Manya use to test the solutions and why?

Ans :

Indicator : Manya should use an olfactory indicator, such as onion extract or vanilla extract.

Since she is blindfolded, she cannot use visual indicators. Olfactory indicators have a characteristic smell that changes or disappears in acidic or basic solutions, allowing identification through the sense of smell.

6. Could you suggest various materials which can be used for writing the message on the white sheet of paper (given at the beginning of the chapter) and what could be in the spray bottle? Make a table of various possible combinations and the colour of the writing obtained.

Ans :

Material for Writing (Invisible)	Material in Spray Bottle (Indicator)	Colour of Writing Obtained
Soap Solution (Basic)	Turmeric Solution	Reddish-Brown
Baking Soda Solution (Basic)	Turmeric Solution	Reddish-Brown
Lime Water (Basic)	Turmeric Solution	Reddish-Brown
Soap Solution (Basic)	Red Cabbage Juice	Green/Yellow



Baking Soda Solution (Basic)	Red Cabbage Juice	Green/Yellow
Lemon Juice (Acidic)	Red Cabbage Juice	Pink/Red
Vinegar (Acidic)	Red Cabbage Juice	Pink/Red

7. Grape juice was mixed with red rose extract; the mixture got a tint of red colour. What will happen if baking soda is added to this mixture? Justify your answer.

**Ans :**

If baking soda is added to the mixture of grape juice and red rose extract, the red colour will change to green or blue.

Justification : Grape juice is acidic, making the red rose extract turn red. Baking soda is basic. Adding it neutralizes the acid and makes the solution basic, causing the red rose extract to turn green.

8. Keerthi wrote a secret message to her grandmother on her birthday using orange juice. Can you assist her grandmother in revealing the message? Which indicator would you use to make it visible?

**Ans :**

Gently heating the paper is the most common method. The acid in the orange juice weakens the paper, causing it to char/brown faster than the surrounding paper when heated.

Indicator : While heating is preferred, red cabbage juice could potentially be sprayed (orange juice is acidic, red cabbage juice turns pink/red in acid), but the effect might be faint.

9. How can natural indicators be prepared? Explain by giving an example.

**Ans :**

How to prepare : Crush the coloured part of a plant (like petals, leaves, or roots). Soak the crushed material in a solvent like warm water or alcohol to extract the pigment. Filter the mixture to get the coloured indicator solution.

Example (Red Rose Extract) : Crush red rose petals, soak them in warm water until the water gets coloured, then filter the liquid. This coloured liquid is the red rose indicator.

10. Three liquids are given to you. One is vinegar, another is a baking soda solution, and the third is a sugar solution. Can you identify them only

using turmeric paper? Explain.

**Ans :**

Yes, we can identify the three liquids using turmeric paper.

Turmeric paper is a natural indicator.

1. It turns reddish-brown in a basic solution.
2. It shows no change in acidic or neutral solutions.

Now test each liquid :

1. Baking soda solution is a base, so turmeric paper will turn reddish-brown.
2. Vinegar is an acid, so no change will be seen on turmeric paper.
3. Sugar solution is neutral, so turmeric paper will also show no change.

To find out which is vinegar and which is sugar solution (since both show no change), smell them.

1. Vinegar has a strong sour smell.
2. Sugar solution has no smell or a sweet smell.

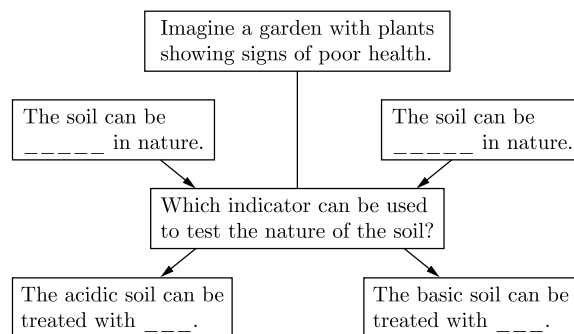
11. The extract of red rose turns the liquid X to green. What will the nature of liquid X be? What will happen when excess of amla juice is added to liquid X?

**Ans :**

Nature of liquid X : Since red rose extract turns green in basic solutions, liquid X is Basic.

When amla juice is added : Amla juice is acidic. Adding excess amla juice will neutralize the basic liquid X and make it acidic. The red rose extract indicator will change colour from green back to red/pinkish.

12. Observe and analyse the information given in the following flowchart. Complete the missing information.



**Ans :**

1. The soil can be Acidic in nature.
2. The soil can be Basic in nature.

3. The acidic soil can be treated with Lime (Calcium Oxide/Hydroxide)/Basic substances.
4. The basic soil can be treated with Organic Matter/Compost/Manure.

- (A) Soap solution
- (B) Baking soda solution
- (C) Lemon juice
- (D) Washing powder solution

Ans :

(C) Lemon juice  
Lemon juice turns blue litmus paper red, indicating its acidic nature, as observed when testing various samples with litmus paper.

## MULTIPLE CHOICE QUESTION

1. What type of substances are defined by their ability to turn blue litmus paper red?
  - (A) Basic substances
  - (B) Neutral substances
  - (C) Acidic substances
  - (D) Salty substances

Ans :

(C) Acidic substances  
Acidic substances are characterized by several properties, one of which is their reaction with litmus indicator, specifically changing blue litmus paper to a red color.

2. From which natural source is litmus commonly obtained?
  - (A) Red roses
  - (B) Turmeric roots
  - (C) Lichens
  - (D) Hydrangea flowers

Ans :

(C) Lichens  
Litmus, a widely used natural acid-base indicator, is extracted from lichens, which are composite organisms formed from algae and fungi living in symbiosis.

3. If a substance does not change the color of either red or blue litmus paper, what is its nature?
  - (A) It must be acidic.
  - (B) It must be basic.
  - (C) It could be salty.
  - (D) It is likely neutral.

Ans :

(D) It is likely neutral.  
Substances that do not cause a color change in either red or blue litmus paper are classified as neutral, meaning they are neither acidic nor basic.

4. Which of the following common household items is acidic according to the litmus test?

5. Why is litmus referred to as an acid-base indicator?
  - (A) Because it is made from lichens.
  - (B) Because it only works on acids.
  - (C) Because it shows different colors in acidic and basic solutions.
  - (D) Because it is available as paper strips.

Ans :

(C) Because it shows different colors in acidic and basic solutions.  
Litmus is called an acid-base indicator because it exhibits distinct color changes depending on whether it is in an acidic (red) or basic (blue) medium.

6. How does the effect of a basic substance differ from an acidic substance on litmus paper?
  - (A) Basic turns blue litmus red; Acidic turns red litmus blue.
  - (B) Basic turns red litmus blue; Acidic turns blue litmus red.
  - (C) Both turn blue litmus red, but at different speeds.
  - (D) Both turn red litmus blue, but with different shades.

Ans :

(B) Basic turns red litmus blue; Acidic turns blue litmus red.  
The key difference in their reaction with litmus is that basic substances change red litmus to blue, while acidic substances change blue litmus to red.

7. What needs to be done to prepare lime water (calcium hydroxide solution)?
  - (A) Mix lemon juice with water.
  - (B) Dissolve sugar in water.
  - (C) Mix 'chuna' (calcium oxide) with water and filter.
  - (D) Boil tamarind in water.

Ans :

(C) Mix 'chuna' (calcium oxide) with water and filter. Lime water is prepared by mixing calcium



oxide (chuna) in water, letting it settle, and then filtering the supernatant liquid, which is the calcium hydroxide solution.

8. Which of these substances is NOT basic?

- (A) Soap solution
- (B) Lime water
- (C) Vinegar
- (D) Washing powder solution

Ans :

(C) Vinegar

Vinegar is acidic, turning blue litmus red. Soap solution, lime water, and washing powder solution are basic, turning red litmus blue.

9. What term describes substances like tap water or sugar solution that show no change with litmus?

- (A) Indicators
- (B) Acids
- (C) Bases
- (D) Neutral

Ans :

(D) Neutral

Substances that do not affect the color of either blue or red litmus paper are termed neutral; they possess neither acidic nor basic properties.

10. Lichens, the source of litmus, are sensitive to environmental conditions. Where do they typically thrive?

- (A) In dry desert areas with polluted air.
- (B) On rocks and trees in areas with clean air and ample rainfall.
- (C) Deep inside caves away from sunlight.
- (D) In salty marshlands near the coast.

Ans :

(B) On rocks and trees in areas with clean air and ample rainfall.

Lichens require specific environmental conditions to grow, favouring habitats like rocks and trees in regions known for abundant rainfall and unpolluted air.

11. What is the characteristic taste associated with most acidic substances like lemon juice?

- (A) Bitter
- (B) Salty
- (C) Sour
- (D) Sweet

Ans :

(C) Sour

A common characteristic of many edible acidic substances, such as lemon juice and vinegar, is their sour taste, although tasting unknown substances is not advised.

12. Which acid is commonly found in citrus fruits like oranges and lemons?

- (A) Tartaric acid
- (B) Acetic acid
- (C) Citric acid
- (D) Lactic acid

Ans :

(C) Citric acid

Citrus fruits, including oranges and lemons, are well-known sources of citric acid contributing to their characteristic tangy or sour taste.

13. Amla (Indian gooseberry) is a source of which two acids?

- (A) Citric acid and Oxalic acid
- (B) Ascorbic acid (Vitamin C) and Citric acid
- (C) Tartaric acid and Acetic acid
- (D) Lactic acid and Formic acid

Ans :

(B) Ascorbic acid (Vitamin C) and Citric acid

Amla is particularly rich in Ascorbic acid, also known as Vitamin C, and it also contains Citric acid, contributing to its nutritional value and taste.

14. What physical sensation is often associated with basic substances like baking soda solution when rubbed between the fingers?

- (A) Gritty or sandy feel
- (B) Sticky or gluey feel
- (C) Soapy or slippery feel
- (D) Warm or hot sensation

Ans :

(C) Soapy or slippery feel

Basic substances typically feel soapy or slippery to the touch, a characteristic property demonstrated by rubbing baking soda solution between the fingers.

15. While many bases taste bitter, why is bitter gourd (karela) not considered basic despite its taste?

- (A) It turns blue litmus red.
- (B) It contains specific acids.
- (C) Taste alone doesn't determine basicity; it lacks other basic properties.
- (D) It neutralizes acids effectively.

**Ans :**

(C) Taste alone doesn't determine basicity; it lacks other basic properties.

Although many bases are bitter, bitterness itself is not a definitive test for basicity. Bitter gourd tastes bitter but does not exhibit the chemical properties of a base.

16. If you wanted to test if your floor cleaning liquid is acidic or basic without tasting it, what could you use?
- (A) Sugar solution  
(B) Salt solution  
(C) An acid-base indicator like litmus  
(D) Plain water

**Ans :**

(C) An acid-base indicator like litmus  
Acid-base indicators, such as litmus paper or other natural indicators, are used to safely determine the chemical nature (acidic or basic) of substances like cleaning liquids.

17. What are natural substances, like red rose extract or turmeric, called when they change color in acids or bases?
- (A) Neutralizers  
(B) Acid-base indicators  
(C) Catalysts  
(D) Reactants

**Ans :**

(B) Acid-base indicators  
Substances that exhibit different colors when exposed to acidic or basic solutions are known as acid-base indicators; examples include litmus, red rose extract, and turmeric.

18. How is the red rose extract indicator prepared ?
- (A) Boiling petals in water  
(B) Crushing petals and soaking them in hot water, then filtering  
(C) Mixing petals with alcohol  
(D) Drying and grinding petals into a powder

**Ans :**

(B) Crushing petals and soaking them in hot water, then filtering  
The preparation involves crushing red rose petals, immersing them completely in hot water for 5-10 minutes, allowing the water to become colored, and then filtering the liquid.

19. What color change is observed when red rose extract is added to an acidic solution like lemon juice?
- (A) It turns green.  
(B) It turns a shade of red (e.g., dark pink/magenta).  
(C) It becomes colorless.  
(D) It remains unchanged.

**Ans :**

(B) It turns a shade of red (e.g., dark pink/magenta).

Red rose extract acts as an indicator by turning into a shade of red (specifically mentioned as red or dark pink/magenta in different contexts) when added to acidic solutions.

20. What color change occurs when red rose extract is mixed with a basic solution like soap solution?
- (A) It turns red.  
(B) It turns blue.  
(C) It turns green.  
(D) It becomes yellow.

**Ans :**

(C) It turns green.

In the presence of a basic substance, such as soap solution, the red rose extract indicator changes its color to green.

21. Which common kitchen spice can be used to create an acid-base indicator paper?
- (A) Cumin  
(B) Coriander  
(C) Turmeric  
(D) Black pepper

**Ans :**

(C) Turmeric  
Turmeric (haldi) powder can be made into a paste with water, applied to filter paper, and dried to create turmeric paper strips, which function as an indicator.

22. What color does turmeric paper turn when a drop of a basic substance like soap solution is put on it?
- (A) It remains yellow.  
(B) It turns blue.  
(C) It turns green.  
(D) It turns red.

**Ans :**

(D) It turns red.

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Turmeric paper shows a distinct color change from yellow to red when it comes into contact with basic substances, like the reaction seen with soap on a curry stain.

23. How does turmeric paper react when an acidic substance like lemon juice is applied?

(A) It turns red.  
 (B) It turns blue.  
 (C) It remains yellow.  
 (D) It turns green.

Ans :

(C) It remains yellow.

Turmeric paper does not change color with acidic or neutral substances; it remains yellow. Therefore, it's useful for identifying bases but not acids.

24. Ashwin made a greeting card using turmeric paste on paper. He wanted to write a message that would appear in a different color. Based on indicator properties, which solution should he use for writing so the message appears red on the yellow paper?

(A) Lemon juice  
 (B) Vinegar  
 (C) Sugar solution  
 (D) Soap solution

Ans :

(D) Soap solution

Since turmeric paste turns red in the presence of a base, Ashwin should use a basic solution like soap solution to write his message. The basic soap will react with the yellow turmeric, making the writing appear red.

25. What are indicators called that use the sense of smell to differentiate between acidic and basic substances?

(A) Visual indicators  
 (B) Olfactory indicators  
 (C) Natural indicators  
 (D) Synthetic indicators

Ans :

(B) Olfactory indicators

Olfactory indicators are substances whose odor changes depending on whether they are mixed with an acidic or basic solution, allowing identification through smell.

26. Finely chopped onions and cloth strips as a potential olfactory indicator. What is the procedure?

(A) Boiling onions and dipping cloth.  
 (B) Rubbing onion juice on cloth.  
 (C) Soaking cloth strips with chopped onions overnight.  
 (D) Drying onion paste onto cloth strips.

Ans :

(C) Soaking cloth strips with chopped onions overnight.

The activity involves placing finely chopped onions with clean cotton cloth strips in a tightly closed container overnight to infuse the cloth with the onion's smell for testing.

27. The color of Hydrangea flowers can depend on the soil's nature. What color flowers are typically produced in acidic soil?

(A) Pink  
 (B) Red  
 (C) White  
 (D) Blue

Ans :

(D) Blue

Hydrangea plants act somewhat like natural indicators, producing blue-colored flowers when grown in acidic soil conditions.

28. What color Hydrangea flowers are expected if the soil is basic?

(A) Blue  
 (B) White  
 (C) Yellow  
 (D) Pink or red

Ans :

(D) Pink or red

Conversely, when Hydrangea plants are grown in basic (alkaline) soil, the flowers tend to be pink or red in color.

29. Which Indian scientist, known as the 'Father of Modern Indian Chemistry', established India's first pharmaceutical company?

(A) C.V. Raman  
 (B) Jagadish Chandra Bose  
 (C) Prafulla Chandra Ray (P.C. Ray)  
 (D) Homi J. Bhabha

Ans :

(C) Prafulla Chandra Ray (P.C. Ray)

Acharya Prafulla Chandra Ray (P.C. Ray) is celebrated as the 'Father of Modern Indian Chemistry' and founded India's first pharmaceutical company in 1901.

- 30.** Besides his scientific contributions, what else did P.C. Ray advocate for in education?  
 (A) Studying only chemistry  
 (B) Use of English as the primary medium  
 (C) Use of the mother tongue for instruction  
 (D) Establishing schools abroad

**Ans :**

(C) Use of the mother tongue for instruction  
 P.C. Ray was also a social reformer who strongly advocated for using students' mother tongues as the medium of instruction within educational institutions.

- 31.** What is the name of the reaction that occurs when an acid and a base are mixed in sufficient quantities?  
 (A) Oxidation reaction  
 (B) Reduction reaction  
 (C) Neutralisation reaction  
 (D) Precipitation reaction

**Ans :**

(C) Neutralisation reaction  
 The chemical process where an acid and a base react, typically cancelling out each other's properties, is called a neutralisation reaction.

- 32.** What are the typical products formed during a neutralisation reaction, besides heat?  
 (A) Acid and Water  
 (B) Base and Water  
 (C) Salt and Water  
 (D) Salt and Acid

**Ans :**

(C) Salt and Water  
 In a standard neutralisation reaction, an acid reacts with a base to produce a salt and water, often accompanied by the release of heat energy.

- 33.** Imagine lemon juice (acid) is mixed with blue litmus, turning it red. What happens when lime water (base) is slowly added?  
 (A) The solution turns green.  
 (B) The red color intensifies.  
 (C) The solution eventually turns blue again.  
 (D) The solution becomes colorless.

**Ans :**

(C) The solution eventually turns blue again.  
 Adding the basic lime water neutralizes the acidic lemon juice. Once enough base is added to neutralize the acid, the solution becomes basic, turning the litmus indicator back to blue.

- 34.** What does the evolution of heat during a neutralisation reaction indicate?  
 (A) The reaction is very slow.  
 (B) The reaction absorbs energy.  
 (C) The reaction is exothermic (releases energy).  
 (D) The reaction requires sunlight.

**Ans :**

(C) The reaction is exothermic (releases energy).  
 The release or evolution of heat is a common characteristic of neutralisation reactions, signifying that the process is exothermic, meaning it gives off energy.

- 35.** An ant bite injects formic acid, causing stinging pain. Why does applying moist baking soda provide relief?  
 (A) Baking soda cools the skin.  
 (B) Baking soda is an acid that fights formic acid.  
 (C) Baking soda is a base that neutralises the formic acid.  
 (D) Baking soda acts as a painkiller.

**Ans :**

(C) Baking soda is a base that neutralises the formic acid.  
 Baking soda (sodium bicarbonate) is a base. Applying it to an ant bite helps relieve the pain because the base neutralizes the acidic formic acid injected by the ant.

- 36.** What acidic substance do ants typically inject when they bite?  
 (A) Acetic acid  
 (B) Citric acid  
 (C) Lactic acid  
 (D) Formic acid

**Ans :**

(D) Formic acid  
 The stinging sensation from many ant bites is caused by the injection of formic acid into the skin during the bite.

- 37.** A farmer finds their plants are not growing well due to excessive use of chemical fertilisers, making the soil too acidic. What common substance can be added to the soil to remedy this situation by neutralizing the excess acid?  
 (A) More fertiliser  
 (B) Vinegar  
 (C) Lime (a base)  
 (D) Sand



Ans :

(C) Lime (a base)

If soil becomes too acidic, plant growth suffers. Adding a basic substance like lime (calcium oxide or calcium hydroxide) helps neutralise the excess acidity, bringing the soil pH closer to a level suitable for plant growth.

38. What is added to soil if it becomes too basic?

- (A) Lime
- (B) Baking soda
- (C) Organic matter (manure, compost)
- (D) Ash

Ans :

(C) Organic matter (manure, compost)

If soil is overly basic, adding organic matter such as manure or compost helps. Decomposition of organic matter releases acids, which neutralise the excess base in the soil.

39. How does the treatment for acidic soil differ from the treatment for basic soil?

- (A) Both are treated with lime.
- (B) Acidic soil needs a base (lime); basic soil needs organic matter (releases acids).
- (C) Acidic soil needs organic matter; basic soil needs lime.
- (D) Both are treated with neutral substances like water.

Ans :

(B) Acidic soil needs a base (lime); basic soil needs organic matter (releases acids).

The treatments are opposite : acidic soil requires the addition of a base (like lime) for neutralisation, while basic soil requires acidic components, often supplied by decomposing organic matter.

40. Factory waste released into lakes can harm aquatic life if it's too acidic. What process should be applied to the waste before release?

- (A) Filtering the waste
- (B) Boiling the waste
- (C) Neutralizing the waste with basic substances
- (D) Diluting the waste with more water

Ans :

(C) Neutralising the waste with basic substances

To protect aquatic ecosystems, acidic factory waste should be treated by neutralisation, involving the addition of basic substances to counteract the acidity before discharge.

41. Which of the following is NOT an example of neutralisation ?

- (A) Treating an ant bite with baking soda.
- (B) Adding lime to acidic soil.
- (C) Preparing lime water from chuna.
- (D) Treating acidic factory waste before release.

Ans :

(C) Preparing lime water from chuna.

Treating ant bites, acidic soil, and factory waste are examples of neutralisation applications. Preparing lime water involves dissolving calcium oxide, not a neutralisation reaction itself.

42. In the 'magic writing' scenario at the science fair, turmeric solution might have been sprayed on paper written with soap solution. Why would this make the writing appear?

- (A) Turmeric reacts with acid to turn red.
- (B) Soap reacts with paper to change color.
- (C) Turmeric (indicator) reacts with soap (base) to turn red.
- (D) Soap solution bleaches the turmeric color.

Ans :

(C) Turmeric (indicator) reacts with soap (base) to turn red.

The invisible writing could be done with a basic soap solution. Spraying with turmeric solution (yellow indicator) causes a reaction where the turmeric turns red in contact with the base, revealing the message.

43. **Assertion (A)** : Mixing lemon juice and baking soda solution produces salt, water, and heat.

**Reason (R)** : Lemon juice is acidic and baking soda solution is basic, leading to a neutralisation reaction.

- (A) Both A and R are true, and R is the correct explanation of A.
- (B) Both A and R are true, but R is not the correct explanation of A.
- (C) A is true, but R is false.
- (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.

Lemon juice (acid) reacts with baking soda (base) in a neutralisation reaction, producing salt, water, and heat, consistent with the general equation  $\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water} + \text{Heat}$ .

44. Which indicator gives a red color in acidic solutions and a green color in basic solutions?  
 (A) Litmus  
 (B) Turmeric  
 (C) Red rose extract  
 (D) Phenolphthalein

Ans :

(C) Red rose extract

Red rose extract yields a red color with acids and a green color with bases, confirming its behavior as observed in the activities.

45. If a solution turns red litmus paper blue, what does this indicate about the solution?  
 (A) It is acidic.  
 (B) It is basic.  
 (C) It is neutral.  
 (D) It is pure water.

Ans :

(B) It is basic.

The defining characteristic of a basic substance's interaction with litmus is its ability to turn red litmus paper to a blue color.

46. A solution turns red litmus blue. Adding which substance would reverse this change (turn it back towards red/neutral)?  
 (A) More lime water (basic)  
 (B) Baking soda (basic)  
 (C) Vinegar (acidic)  
 (D) Common salt solution (neutral)

Ans :

(C) Vinegar (acidic)

Since the solution is basic (turns red litmus blue), adding an acid like vinegar will neutralize the base, eventually making the solution acidic enough to turn blue litmus red.

47. Consider solutions A, B, and C from .  
 (1) A turns red litmus blue.  
 (2) B turns turmeric solution red.  
 (3) C turns red rose extract green.  
 What is the nature of A, B, and C respectively?  
 (A) Acidic, Basic, Neutral  
 (B) Basic, Basic, Basic  
 (C) Basic, Acidic, Basic  
 (D) Neutral, Basic, Acidic

Ans :

(B) Basic, Basic, Basic

A turning red litmus blue indicates it's basic. B turning turmeric red indicates it's basic. C

turning red rose extract green indicates it's basic. Thus, all three solutions are basic.

48. Examine the given figure, where red rose extract paper shows a green color. What is the nature of the solution in that container?



- (A) Acidic  
 (B) Basic  
 (C) Neutral  
 (D) Salty

Ans :

(B) Basic

Red rose extract turns green in the presence of a basic solution. Therefore, the green color on the paper strip in Figure indicates the solution is basic.

49. A liquid sample tested in shows no change with red litmus or turmeric, but turns blue litmus red. What is its nature?  
 (A) Basic  
 (B) Neutral  
 (C) Acidic  
 (D) Cannot be determined

Ans :

(C) Acidic

Turning blue litmus red is a definitive test for an acidic substance. No change with red litmus or turmeric is also consistent with an acidic nature.

50. Manya is blindfolded and needs to identify unknown solutions as acidic or basic. Which type of indicator would be most suitable for her to use, considering she cannot see color changes?  
 (A) Litmus paper  
 (B) Turmeric solution  
 (C) Red rose extract  
 (D) An olfactory indicator (like onion/clove oil)

Ans :

(D) An olfactory indicator (like onion/clove oil)



Since Manya cannot rely on visual cues, an olfactory indicator, which changes smell in acidic or basic media, would allow her to differentiate the solutions using her sense of smell.

51. Grape juice mixed with red rose extract turns red. What does this suggest about grape juice, and what would happen if baking soda (a base) is added?
- (A) Grape juice is basic; adding base makes it greener.  
 (B) Grape juice is acidic; adding base neutralizes it, potentially turning it green.  
 (C) Grape juice is neutral; adding base turns it green.  
 (D) Grape juice is basic; adding base makes it redder.

Ans :

(B) Grape juice is acidic; adding base neutralizes it, potentially turning it green.

Red rose extract turns red in acidic solutions, so grape juice is likely acidic. Adding baking soda (base) will neutralize the acid and, if added in excess, make the solution basic, causing the indicator to turn green.

52. Keerthi wrote a secret message with orange juice. Orange juice contains citric acid. Which indicator could reveal the message, likely by reacting differently with the acidic writing?
- (A) Plain water spray  
 (B) Sugar solution spray  
 (C) Gentle heating (acid chars faster) or possibly a pH indicator spray.  
 (D) Salt solution spray

Ans :

(C) Gentle heating (acid chars faster) or possibly a pH indicator spray.

Acidic lemon/orange juice writing can sometimes be revealed by gentle heating, as the acid weakens the paper, causing it to char or brown slightly faster than the surrounding paper. A suitable pH indicator could also potentially show a color difference.

53. How can natural indicators like turmeric or red rose be prepared ?
- (A) By mixing them directly with acids.  
 (B) By dissolving them in strong bases.  
 (C) By extracting color using water (sometimes hot) or making a paste.  
 (D) By exposing them to sunlight for extended periods.

Ans :

(C) By extracting color using water (sometimes hot) or making a paste.

Indicators by making a paste (turmeric) or crushing and steeping in hot water to extract the colored juice (red rose).

54. Can you distinguish between vinegar (acid), baking soda solution (base), and sugar solution (neutral) using only turmeric paper?
- (A) Yes, all three give different colors.  
 (B) No, vinegar and sugar solution will show no change (remain yellow).  
 (C) Yes, vinegar turns red, baking soda blue, sugar yellow.  
 (D) No, baking soda and sugar solution will turn red.

Ans :

(B) No, vinegar and sugar solution will show no change (remain yellow).

Turmeric paper turns red only with bases (baking soda solution). It remains yellow with both acids (vinegar) and neutral solutions (sugar solution), making it impossible to distinguish between those two using only turmeric.

55. Liquid X turns red rose extract green . What is its nature, and what happens if excess amla juice (acidic) is added?
- (A) X is acidic; adding acid makes it redder.  
 (B) X is basic; adding acid neutralizes it, potentially turning it red.  
 (C) X is neutral; adding acid turns it red.  
 (D) X is basic; adding acid makes it greener.

Ans :

(B) X is basic; adding acid neutralizes it, potentially turning it red.

Red rose extract turns green in basic solutions, so X is basic. Adding acidic amla juice will neutralize the base. If enough acid is added, the solution becomes acidic, turning the indicator red.

56. In the flowchart about unhealthy plants, what are the two possible natures of the soil mentioned?
- (A) Wet or Dry  
 (B) Sandy or Clay  
 (C) Acidic or Basic  
 (D) Fertile or Infertile

Ans :

(C) Acidic or Basic

The flowchart explicitly branches into possibilities where the soil causing poor plant health could be either acidic or basic in nature.

57. What is used to treat acidic soil?  
 (A) Organic matter  
 (B) Vinegar  
 (C) Lime (base)  
 (D) Water

Ans :

(C) Lime (base)  
 The acidic soil is treated with a base, such as lime.

58. Why might vinegar cause bubbling when spilt on eggshells (calcium carbonate), while soap solution does not? (Deeper Dive section)  
 (A) Soap solution is too thick.  
 (B) Eggshells only react with liquids.  
 (C) Vinegar (acid) reacts with calcium carbonate releasing CO<sub>2</sub> gas; soap (base) does not.  
 (D) Vinegar is hotter than soap solution.

Ans :

(C) Vinegar (acid) reacts with calcium carbonate releasing CO<sub>2</sub> gas; soap (base) does not.  
 Acids like vinegar react with carbonates (like eggshell/marble) to produce carbon dioxide gas bubbles. Bases like soap solution generally do not react this way.

59. Which of these is NOT suggested as an exploratory project or activity in the final sections?  
 (A) Creating rangoli with indicators.  
 (B) Testing water from various sources (rain, tap, river).  
 (C) Testing local soil samples.  
 (D) Measuring the exact pH value using a pH meter.

Ans :

(D) Measuring the exact pH value using a pH meter.  
 Creating rangoli, testing various water sources, and testing local soil are suggested projects. While pH is related, using a specific pH meter isn't explicitly mentioned as a project here, focusing instead on natural indicators.

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## MATCHING TYPE QUESTION

60. Match the following Column A with Column B :

	Column A		Column B
1.	Litmus	A.	Green in basic solution
2.	Red Rose Extract	B.	Turns red with baking soda solution
3.	Turmeric	C.	Obtained from lichens
4.	Neutral Substance	D.	No change with red or blue litmus paper

- (a) 1-C, 2-A, 3-B, 4-D  
 (b) 1-C, 2-D, 3-A, 4-B  
 (c) 1-D, 2-A, 3-B, 4-C  
 (d) 1-A, 2-B, 3-D, 4-C

Ans :

(a) 1-C, 2-A, 3-B, 4-D  
 Litmus is a natural indicator obtained from lichens. Red rose extract turns green in basic solutions. Turmeric turns red with basic substances like baking soda solution. Neutral substances show no color change with litmus paper.

61. Match the following Column A with Column B :

	Column A		Column B
1.	Formic Acid	A.	Found in Tamarind
2.	Acetic Acid	B.	Found in Citrus Fruits
3.	Tartaric Acid	C.	Ant Sting
4.	Citric Acid	D.	Found in Vinegar

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-B, 2-A, 3-D, 4-C  
 (c) 1-C, 2-B, 3-D, 4-A  
 (d) 1-D, 2-C, 3-A, 4-B

Ans :

(a) 1-C, 2-D, 3-A, 4-B  
 Formic acid is injected during an ant sting. Acetic acid is the primary component of vinegar. Tartaric acid is naturally found in tamarind. Citric acid is commonly found in citrus fruits like lemons and oranges.

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62. Match the following Column A with Column B :

	Column A		Column B
1.	Baking Soda Solution	A.	Turns blue litmus red
2.	Lemon Juice	B.	Slippery to touch
3.	Salt Solution	C.	Neutralisation Product
4.	Calcium Hydroxide	D.	Used to prepare lime water

- (a) 1-D, 2-A, 3-C, 4-B  
 (b) 1-B, 2-A, 3-C, 4-D  
 (c) 1-B, 2-C, 3-A, 4-D  
 (d) 1-A, 2-B, 3-D, 4-C

Ans :

- (b) 1-B, 2-A, 3-C, 4-D

Baking soda solution is basic and feels slippery. Lemon juice is acidic and turns blue litmus red. Salt is a product of neutralisation. Calcium hydroxide (from calcium oxide/chuna) is used to prepare lime water.

63. Match the following Column A with Column B :

	Column A		Column B
1.	Neutralisation Reaction	A.	Blue flowers in acidic soil
2.	Olfactory Indicator	B.	Adding lime (a base)
3.	Hydrangea Flower	C.	Heat is evolved
4.	Treating Acidic Soil	D.	Change in odour

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-B, 2-A, 3-D, 4-C  
 (c) 1-C, 2-A, 3-B, 4-D  
 (d) 1-D, 2-C, 3-A, 4-B

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

Heat is evolved during a neutralisation reaction. Olfactory indicators exhibit a change in odour. Hydrangea flowers are typically blue in acidic soil. Acidic soil is treated by adding bases like lime.

64. Match the following Column A with Column B :

	Column A		Column B
1.	Acids	A.	Do not change colour of litmus

2.	Bases	B.	Turns red rose extract green
3.	Indicators	C.	Substances that taste sour
4.	Neutral Solutions	D.	Show different colours in acidic/basic solutions

- (a) 1-C, 2-B, 3-D, 4-A  
 (b) 1-B, 2-D, 3-A, 4-C  
 (c) 1-C, 2-A, 3-B, 4-D  
 (d) 1-D, 2-C, 3-A, 4-B

Ans :

- (a) 1-C, 2-B, 3-D, 4-A

Acids generally taste sour. Bases turn red rose extract to a green color. Indicators are substances that show different colours in acidic and basic solutions. Neutral solutions do not change the colour of either red or blue litmus paper.

## VERY SHORT QUESTION

65. What colour does blue litmus paper turn in an acidic solution?

Ans :

Blue litmus paper turns red in an acidic solution.

66. What colour does red litmus paper turn in a basic solution?

Ans :

Red litmus paper turns blue in a basic solution.

67. What are substances called that show different colours in acidic and basic solutions?

Ans :

They are called acid-base indicators.

68. Name the two organisms that form lichens.

Ans :

Lichens are formed by a fungus and an alga.

69. What is the general taste of acidic substances?

Ans :

Acidic substances generally taste sour.

70. Name the acid present in lemon.

Ans :

Citric acid is present in lemon.

71. What is the general taste of basic substances?

Ans :

Basic substances generally taste bitter.

72. How do basic substances generally feel to touch?

Ans :

Basic substances generally feel soapy or slippery to touch.

73. Name a natural indicator that can be prepared from flower petals.

Ans :

Red rose extract can be used as a natural indicator.

74. What colour does red rose extract give in an acidic solution?

Ans :

Red rose extract gives a red colour in an acidic solution.

75. What colour does red rose extract give in a basic solution?

Ans :

Red rose extract gives a green colour in a basic solution.

76. What happens to the yellow colour of turmeric paper in a basic solution?

Ans :

The yellow colour of turmeric paper turns red in a basic solution.

77. What is the chemical name for 'chuna' used to make lime water?

Ans :

'Chuna' is calcium oxide.

78. What products are formed in a neutralisation reaction?

Ans :

Salt and water are formed in a neutralisation reaction.

79. What else is released during a neutralisation reaction besides salt and water?

Ans :

Heat is evolved (released) during a neutralisation reaction.

80. What acid does an ant inject when it bites?

Ans :

An ant injects formic acid when it bites.

81. Name a common substance used to neutralise an ant bite.

Ans :

Moist baking soda can be used to neutralise an ant bite.

82. What are substances called that are neither acidic nor basic?

Ans :

Substances that are neither acidic nor basic are called neutral.

83. What are indicators called whose odour changes in acidic or basic media?

Ans :

Indicators whose odour changes are called olfactory indicators.

## SHORT ANSWER QUESTION

84. Explain why litmus is called an acid-base indicator.

Ans :

Litmus is called an acid-base indicator because it shows different colours in acidic and basic solutions; it turns red in acid and blue in base, helping identify the nature of the substance.

85. How is lime water prepared from 'chuna'?

Ans :

Lime water is prepared by mixing lime (chuna, calcium oxide) in water, leaving it undisturbed for about an hour, and then filtering the liquid into another container.

86. Why are substances like tap water, sugar solution, and salt solution classified as neutral?

Ans :

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These substances are classified as neutral because they do not change the colour of either blue or red litmus paper, indicating they are neither acidic nor basic in nature.

87. Although acids taste sour, why should unknown substances not be tasted to check if they are acidic?

**Ans :**

Unknown substances should not be tasted because some substances might be harmful or poisonous, even if they possess properties like a sour taste associated with common edible acids.

88. How can red rose extract be prepared for use as an indicator?

**Ans :**

Crush washed red rose petals, immerse them completely in hot water, let it stand for 5-10 minutes until the water gets coloured, and then filter the liquid to get the extract.

89. How does red rose extract help differentiate between acidic and basic solutions?

**Ans :**

Red rose extract acts as an indicator by turning red in acidic solutions and green in basic solutions, thus helping to identify the nature of the tested substance.

90. Explain how turmeric paper can be prepared using turmeric powder.

**Ans :**

Make a paste by adding a little water to turmeric powder. Dip filter paper in this paste until yellow, let it dry, and then cut it into thin strips.

91. Why is turmeric paper not suitable for distinguishing between acidic and neutral substances?

**Ans :**

Turmeric paper is unsuitable because it remains yellow (unchanged colour) in both acidic and neutral solutions, only changing colour (to red) in basic solutions.

92. Explain the concept of olfactory indicators using the example of onion strips.

**Ans :**

Olfactory indicators change their odour in acidic or basic media. Onion-soaked cloth strips lose their characteristic smell when a base (like baking soda solution) is added, but retain it with an acid.

93. Describe what happens during a neutralisation reaction in terms of reactants and products.

**Ans :**

In neutralisation, an acid reacts with a base. This reaction nullifies the effects of both, producing salt and water as the main products, along with the release of heat energy.

94. Why does applying moist baking soda provide relief from an ant bite?

**Ans :**

An ant injects acidic formic acid. Baking soda is a base. Applying moist baking soda neutralises the effect of the acid, thus relieving the stinging pain caused by the bite.

95. Why might a farmer add lime (chuna) to their field?

**Ans :**

A farmer might add lime (a base) if excessive use of chemical fertilisers has made the soil too acidic, as plants may not grow well in overly acidic soil.

96. Why might a farmer add organic matter like manure to their field?

**Ans :**

If the soil is too basic, organic matter is added. It releases acids as it decomposes, which helps to neutralise the basic nature of the soil, improving conditions for plant growth.

97. Explain why factory waste might need treatment before being released into a lake.

**Ans :**

Factory waste can be acidic (or basic). Releasing it untreated can harm aquatic life, like fish. Treating it, for instance by adding basic substances to acidic waste, neutralises it.

98. What are lichens and where do they typically grow?

**Ans :**

Lichens result from an association between a fungus and an alga. They commonly grow on rocks and trees, particularly in areas with plenty of rainfall and clean air.

99. Name four substances listed in the chapter that are acidic in nature.

Ans :

Four acidic substances mentioned are lemon juice, amla juice, tamarind water and vinegar. These substances were observed to turn blue litmus paper red.

100. Name four substances listed in the chapter that are basic in nature.

Ans :

Four basic substances mentioned are soap solution, baking soda solution, lime water and washing powder solution. These turned red litmus paper blue.

101. Explain the likely reason behind the “magic” writing appearing at the science fair.

Ans :

The paper likely had writing done with a basic solution (like soap solution). Spraying it with an indicator like turmeric solution (which turns red in base) made the writing visible.

103. Compare and contrast the action of litmus, red rose extract, and turmeric paper as acid-base indicators based on the activities described. Discuss the limitations of turmeric paper.

Ans :

Litmus, red rose extract, and turmeric are all natural indicators but differ in their responses. Litmus clearly distinguishes acids (blue turns red) and bases (red turns blue). Red rose extract also distinguishes both, giving a red shade in acids and a green shade in bases. Turmeric paper, however, primarily identifies bases, turning from yellow to red in their presence. Its limitation is that it shows no colour change in either acidic or neutral solutions, remaining yellow in both. Therefore, while litmus and red rose extract can identify acids, bases, and infer neutrality, turmeric can only definitively identify bases and cannot differentiate between acids and neutral substances.

104. Explain the concept of neutralisation. How does the activity demonstrate the neutralisation of an acid by a base and vice-versa?

Ans :

The neutralisation using lemon juice (acid), lime water (base), and blue litmus solution (indicator). Initially, adding blue litmus to diluted lemon juice turns it red, confirming acidity. Then, lime water (base) is added drop wise. The base starts neutralizing the acid. Eventually, enough base is added to neutralise all the acid, and the solution becomes basic, indicated by the colour changing from red back to blue. This shows the base neutralizing the acid. Adding another drop of lemon juice (acid) reverses this, turning it red again, showing the acid neutralizing the excess base. The reaction produces salt, water, and heat.

105. Discuss three different scenarios from daily life described in the chapter where neutralisation plays a crucial role in managing problems. Explain the acid and base involved in each case.

Ans :

1. Ant Bite : Ants inject formic acid (acid) causing pain. Applying moist baking soda (a base) neutralizes the acid, providing relief.
2. Soil Treatment : Soil can become too acidic due to chemical fertilisers. Treating it with lime (calcium oxide/hydroxide, a base) neutralizes the excess acid, improving plant growth. Conversely, if soil is too basic, adding

## LONG ANSWER QUESTION

102. Describe Activity of testing various common household solutions in detail. Explain how the results led to the classification of substances into acidic, basic, and neutral groups.

Ans :

The testing various common household solutions (lemon juice, soap, amla, vinegar, baking soda, lime water, tap water, sugar, salt solutions etc.) using both blue and red litmus paper strips. Small pieces of litmus paper are placed on a tile, and a drop of each sample is added. Observations are recorded based on colour changes. Substances that turned blue litmus red were grouped as acidic (Group A, e.g., lemon juice). Those turning red litmus blue were grouped as basic (Group B, e.g., soap solution). Substances causing no change in either litmus paper were grouped as neutral (Group C, e.g., sugar solution). This systematic testing allows classification based on interaction with litmus indicators.



organic matter which releases acids helps neutralise it.

3. **Factory Waste :** Industrial waste might be acidic. Releasing it into water bodies harms aquatic life. Neutralizing the acidic waste by adding basic substances before discharge prevents this environmental damage. These examples show practical applications of neutralisation.

- 106.** How does the colour of Hydrangea flowers relate to the nature of the soil? Explain how a gardener might potentially influence the flower colour based on this phenomenon.

**Ans :**

The Hydrangea plant acts like a natural indicator for soil pH. The chapter states that in acidic soil, Hydrangea produces blue-coloured flowers. However, if the soil is basic, the flowers produced are pink or red. This dependency suggests the plant pigments responsible for flower colour change based on the soil's acidity or basicity. Therefore, a gardener could potentially influence the flower colour by adjusting the soil's nature. Adding acidic substances (like peat moss or sulphur) might encourage blue flowers, while adding basic substances (like lime) might encourage pink or red flowers, effectively altering the soil chemistry.

- 107.** Explain why applying soap to a turmeric (curry) stain on a white shirt changes its colour. What does this tell you about the nature of soap?

**Ans :**

The turmeric acts as an indicator, turning red in basic solutions while remaining yellow in acidic/neutral ones. A curry stain contains turmeric. When soap is applied to the stain, the colour changes (typically to reddish-brown). This colour change occurs because soap solution is basic in nature. The basic soap reacts with the turmeric indicator in the stain, causing the observed colour shift from yellow to red/reddish-brown. This everyday observation confirms that soap solutions are basic, consistent with the findings from litmus tests and turmeric paper tests.

- 108.** Imagine you have three unlabeled solutions : vinegar, baking soda solution, and sugar solution. Explain if you can identify all three using only turmeric paper. Justify your answer based on the properties of turmeric as an indicator.

**Ans :**

Using only turmeric paper, you cannot definitively identify all three solutions. Turmeric paper changes colour from yellow to red only in the presence of a base. Baking soda solution is basic, so it will turn the yellow turmeric paper red. This identifies the baking soda solution. However, vinegar is acidic and sugar solution is neutral. Turmeric paper remains yellow in both acidic and neutral solutions. Therefore, while you can identify the basic baking soda solution, you cannot distinguish between the acidic vinegar and the neutral sugar solution using only turmeric paper, as both will leave it yellow.

- 109.** Consider the experiment where Aman spills vinegar on eggshells/marble (Activity in 'Dive Deeper'). Why did bubbles appear with vinegar but not with soap solution? Relate this to the nature of the substances involved.

**Ans :**

Eggshells and marble are primarily made of calcium carbonate. Vinegar contains acetic acid. Acids react with carbonates (like calcium carbonate) to produce carbon dioxide gas, water, and a salt. The bubbles observed when vinegar was spilled on the eggshell/marble were bubbles of carbon dioxide gas being released due to this chemical reaction. Soap solution, on the other hand, is basic. Bases generally do not react with carbonates in the same way acids do to produce gas. Therefore, when soap solution was poured, no bubbling occurred because the characteristic acid-carbonate reaction did not happen. This difference highlights a specific chemical property of acids reacting with carbonates.

- 110.** The Acharya P.C. Ray. Summarise his contributions to science and education in India based on the information provided.

**Ans :**

Acharya Prafulla Chandra Ray (P.C. Ray) is called the 'Father of Modern Indian Chemistry'. After earning a doctorate in chemistry abroad, he returned to India and significantly contributed to advancing scientific research. A major practical contribution was establishing India's first pharmaceutical company in 1901. He was also a historian of science, highlighting ancient India's chemical expertise through his writings. Furthermore, P.C. Ray was a social reformer and strongly advocated using the mother tongue as the medium of instruction in education, showing

his deep connection to Indian culture and educational philosophy. He was a multifaceted personality dedicated to science, industry, history, and education in India.

## CASE BASED QUESTION

111. Keerthi is helping her mother in the kitchen. She notices a bottle of floor cleaner. Remembering her science class, she decides to test its nature. She doesn't have litmus paper, but finds turmeric powder and red rose petals from the garden puja.
1. How can Keerthi use turmeric to test the floor cleaner? What colour change would indicate it is basic?
  2. How can Keerthi use red rose petals? What colour change would indicate the cleaner is basic?
  3. Which of these two indicators (turmeric or red rose) would be better if she also wanted to test vinegar (acidic)? Why?

Ans :

- (1) Keerthi can make a turmeric paste or turmeric paper. Applying the floor cleaner to it, a change from yellow to red would indicate the cleaner is basic.
  - (2) She can prepare red rose extract by crushing petals and adding hot water, then filtering. Adding the floor cleaner to this extract, a change to green colour would indicate it is basic.
  - (3) Red rose extract would be better. Turmeric does not change colour in acids (remains yellow), while red rose extract turns red in acids, allowing identification.
112. A farmer notices poor plant growth in a section of his field despite adequate watering. He suspects a soil issue. He collects a soil sample, mixes it with water, filters it, and tests the filtrate. Using litmus paper, the blue litmus paper turns slightly reddish.
1. What is the likely nature of the farmer's soil based on the litmus test?
  2. What remedy, mentioned in the chapter, should the farmer apply to treat this soil condition?
  3. If the farmer accidentally adds too much lime, making the soil basic, what problem might

arise, and what could be added to counteract it?

Ans :

- (1) The soil is likely acidic, as the filtrate turned blue litmus paper reddish.
  - (2) The farmer should treat the acidic soil with a base, such as lime (chuna).
  - (3) If the soil becomes too basic, plant growth might still be poor. To counteract excess basicity, organic matter like manure or compost should be added, as it releases acids upon decomposition.
113. Ashwin writes a secret message on a white paper using baking soda solution and lets it dry. He wants to reveal the message using a natural indicator spray prepared from a common kitchen ingredient mentioned in the chapter.
1. Which common kitchen ingredient indicator should Ashwin use to reveal the message?
  2. Could Ashwin have used lemon juice for writing and red rose extract spray for revealing? Explain the expected result.
  3. What colour will the message appear when sprayed with this indicator?

Ans :

- (1) Ashwin should use turmeric paste/solution as the spray. Baking soda is basic, and turmeric turns red in basic solutions.
  - (2) The message written with basic baking soda solution will appear red (or reddish-brown) when sprayed with the yellow turmeric solution.
  - (3) Yes, he could have. Lemon juice is acidic. Red rose extract turns red in acidic solutions. So, spraying red rose extract would make the lemon juice writing visible as red/pink text.
114. Effluents (waste water) from a factory making soaps and detergents are being released into a nearby river. Environmental activists test the river water near the discharge point using red litmus paper, and it turns blue. They also observe that fish populations downstream are declining.
1. What is the nature of the factory effluent based on the litmus test?
  2. How might this effluent be affecting the fish population?
  3. What treatment process involving neutralisation could the factory implement before discharging the wastewater?



Ans :

- (1) The effluent is basic, as it turns red litmus paper blue. Soaps and detergents often contain bases.
- (2) The basic effluent changes the water's natural conditions, making it unsuitable for fish, potentially leading to the observed decline in population.
- (3) The factory could treat the basic effluent by adding a suitable acidic substance in a controlled manner to neutralise its basicity before releasing it into the river. This would make the water safer for aquatic life.

115. A student performs activity using litmus paper. They test four unknown clear liquids P, Q, R, and S. Blue litmus turns red in P. Red litmus turns blue in Q. Neither litmus paper changes colour in R. Blue litmus turns red in S, and S tastes sour.

1. What is the likely nature (acidic, basic, neutral) of liquids P, Q, and R?
2. What is the nature of liquid S? Give a reason based on the observations.
3. If the student mixes solution P and solution Q, what type of reaction is likely to occur? What products would form?

Ans :

- (1) P is acidic (turns blue litmus red). Q is basic (turns red litmus blue). R is neutral (no change in either litmus).
- (2) S is acidic. Reason : It turns blue litmus red, and it also tastes sour, which is a characteristic property of acids.
- (3) A neutralisation reaction is likely to occur because P is acidic and Q is basic. The products formed would be salt and water, along with the release of heat.

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# CHAPTER 3

## ELECTRICITY—CIRCUITS AND THEIR COMPONENTS

### SUMMARY

#### 1. INTRODUCTION TO ELECTRICITY

Electricity is widely used in our daily life—for lighting, cooking, heating, transportation and communication. It can be generated from various sources such as water, wind, sun, coal, and gas. To understand how electrical devices work, we begin with simple setups like a torchlight.

#### 2. COMPONENTS OF A TORCHLIGHT

A torch typically contains electric cells (batteries), a lamp (bulb or LED), and a switch. When the switch is turned on, it completes the electrical circuit, allowing current to flow and the lamp to glow.

#### 3. ELECTRIC CELL AND BATTERY

An electric cell has a positive terminal (metal cap) and a negative terminal (flat metal disc). When two or more cells are connected properly (positive to negative), they form a battery, which can provide more energy or last longer than a single cell.

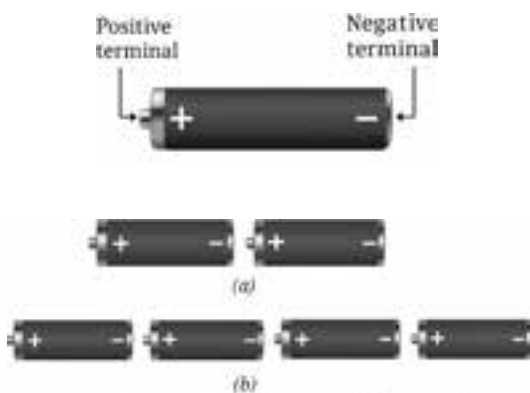


Figure : A battery made up of (a) two cells (b) four cells

#### 4. LAMPS : INCANDESCENT AND LED

Incandescent lamps have a filament that glows when current passes through. LEDs, however, do not have filaments and glow only when connected correctly—positive terminal of the battery to the longer leg (positive) of the LED and negative to the shorter leg.

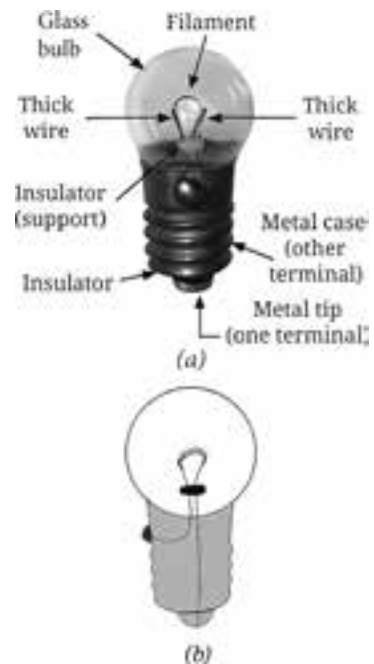


Figure : (a) A small incandescent lamp used in a torch, (b) its simplified drawing showing the connection of wires to the terminals



Figure : An LED lamp for torch

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## 5. BUILDING A SIMPLE CIRCUIT

A circuit consists of a cell, connecting wires, and a lamp. For a lamp to glow, the current must flow in a closed path from the positive terminal of the cell, through the wire and lamp, and back to the negative terminal. A circuit will not work if there's a gap or wrong connection.



Figure : An electrical circuit

## 6. SWITCH AND ITS FUNCTION

A switch is used to open or close a circuit. When the switch is “on”, it allows the current to pass, lighting the lamp. When it is “off”, the path is broken and the lamp does not glow. Switches can be homemade or professionally designed, but their function remains the same.

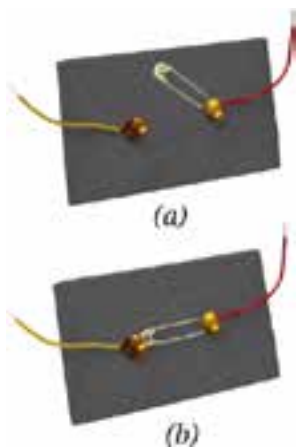


Figure : A switch (a) in ‘OFF’ position, (b) in ‘ON’ position

## 7. CIRCUIT DIAGRAMS

Symbols are used to represent components in a circuit diagram, making it easier to draw and understand circuits. For example, a long line represents the positive terminal of a cell, and a

zigzag line represents a lamp. These standard symbols are used internationally

## 8. CONDUCTORS AND INSULATORS

Materials that allow electric current to pass through easily are conductors (e.g., metals like copper and aluminum). Those that do not allow current to pass are insulators (e.g., plastic, rubber, wood). This is why wires are metal inside but covered with plastic for safety.

## NCERT ACTIVITY

### Activity 3.1 : Let us explore

1. Take a torchlight similar to the one shown in Figure.



2. Observe it carefully. Do you notice a lamp? And a switch?
3. Slide its switch and observe. Does the torch lamp glow?
4. Now slide the switch back to its original position and observe the torch lamp. You might have noticed that in the first position of the switch, the torch lamp glows and in the other position the lamp does not glow.
5. Now, open the torchlight. What do you find inside?
6. Inside the torchlight, you may find two or more electric cells.

Ans :

1. Yes, when observing a torchlight, a lamp (or bulb/LED) and a switch are noticeable.
2. When the switch is slid to one position (usually the ‘ON’ position), the torch lamp glows.
3. When the switch is slid back to its original position (usually the ‘OFF’ position), the torch lamp does not glow.

- Upon opening the torchlight, one typically finds one or more electric cells (batteries), and the internal connections to the lamp and switch.

**Activity 3.2 : Let us observe**

- Take an electric cell, turn it around and look at it carefully (Figure). Do you notice a positive (+) sign and a negative (-) sign marked on the electric cell?



- Do you also notice that it has a small protruding metal cap on one side and a flat metal disc on the other side?

Ans :

- Yes, an electric cell typically has a positive (+) sign and a negative (-) sign marked on it.
- Yes, it has a small protruding metal cap on one side (which is the positive terminal) and a flat metal disc on the other side (which is the negative terminal).

**Activity 3.3 : Let us experiment**

- Take a torch which uses two cells. Open its cell compartment and take out the cells.
- Put the cells back in a different order. Also, try reversing the direction of one cell. Then, slide the switch and check whether the lamp glows in each case.
- Check the order in which the cells were placed in the torch when the lamp glows.

The lamp glows when the cells are placed in the order as shown in Figure. Notice how the terminals of the two cells are connected. The positive terminal of one cell is connected to the negative terminal of the next cell. Such a combination of two or more cells is called a battery.

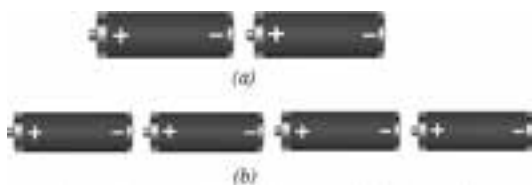


Figure : A battery made up of (a) two cells (b) four cells

Ans :

- Different order/reversing one cell : If the cells are put back in a different order such that the positive terminal of one cell is not connected to the negative terminal of the next cell (e.g., two positives touching, or two negatives touching, or one cell reversed), the lamp will likely not glow.
- Order for lamp to glow : The lamp glows when the cells are placed in series correctly, meaning the positive terminal of one cell is in contact with the negative terminal of the adjacent cell. This creates a continuous path for the electrical energy.

**Activity 3.4 : Let us observe**

For this activity, you will require a torchlight with an incandescent lamp (or light bulb). Many old torchlights still use such lamps. With your teacher’s help, confirm that your torchlight uses an incandescent lamp.

- Take the torch and examine its lamp. What do you see? Do you notice a thin wire fixed in the middle of the glass bulb?
- Now, switch on the torch. Which part of the lamp glows?

The thin wire inside the glass bulb of the lamp glows. The glowing thin wire is called the filament of the lamp.

- Take out the lamp with the help of your teacher and inspect it from all sides. How is the filament fixed?

The filament is attached to two thicker wires that support it, as shown in Figure (a). One thick wire connects to the metal case at the lamp’s base, while the other connects to the metal tip at the centre of the base Figure (b). These form the two terminals of the lamp, and are fixed in a way that they do not touch each other.

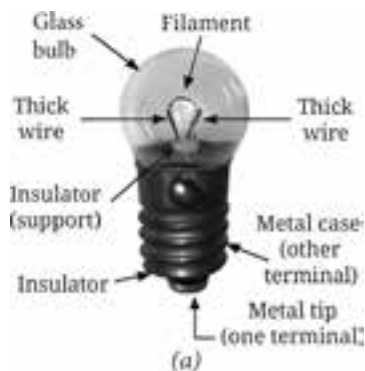




Figure : (a) A small incandescent lamp used in a torch (b) its simplified drawing showing the connection of wires to the terminals

Ans :

1. Yes, upon examining an incandescent lamp from a torch, a thin wire can be seen fixed in the middle of the glass bulb. This is the filament.
2. When the torch is switched on, the filament (the thin wire) is the part of the lamp that glows.
3. The filament is fixed by being attached to two thicker support wires. One of these support wires connects to the metal casing at the base of the lamp (one terminal), and the other support wire connects to the metal tip at the very bottom center of the base (the other terminal). These two terminals are insulated from each other.

### Activity 3.5 : Let us observe

1. Take an LED of any colour Figure and observe. Do you see any filament inside it?
2. Notice the length of two wires attached to the LED. Do you find one of those longer than the other?
3. Unlike incandescent lamps, LEDs do not have filaments Figure. They also have two terminals, but one is positive (attached to a longer wire) and the other is negative (the shorter wire).

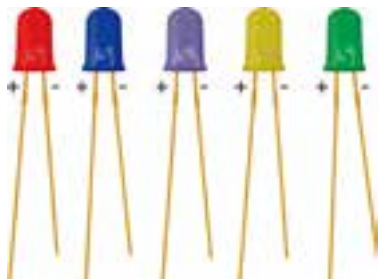


Figure : LEDs of different colours

Ans :

1. No, upon observing an LED (Light Emitting Diode), there is no visible filament inside it like in an incandescent bulb.
2. Yes, the two wires (leads) attached to an LED are typically of different lengths. The longer wire is usually the positive terminal (anode), and the shorter wire is usually the negative terminal (cathode).

### Activity 3.6 : Let us construct

1. Take an electric cell, an incandescent lamp used in a torch, a cell holder, a lamp holder, and four lengths of electric wire.
2. Remove about 1 cm of the plastic covering from both ends of each wire to expose the metal.
3. Attach two wires to the two ends of the cell holder as shown in Figure (a).

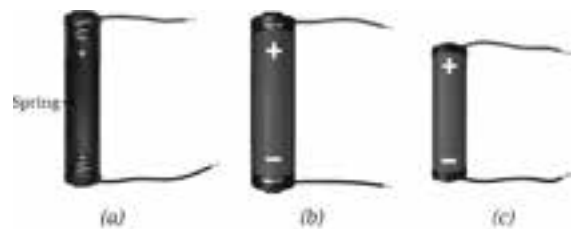


Figure : (a) An electric cell holder with two wires attached, (b) An electric cell inside the cell holder, (c) Wires connected to an electric cell using electrical tape

4. Insert the cell in the holder such that its negative terminal is towards the spring side of the holder Figure (b). In case a cell holder is not available, fix the two wires to the cell using electrical tape Figure (c).
5. Attach two wires to the screws of the lamp holder as shown in Figure (a). Fix the lamp in the holder by turning it around in the holder Figure (b). In case a lamp holder is not available, use electrical tape to attach two wires to the two ends of the lamp Figure (c).



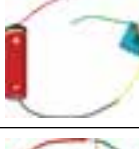





Figure : (a) An electric lamp holder with wires attached, (b) An incandescent lamp inside the lamp holder, (c) Wires connected to incandescent torch lamp with electrical tape

Now, we are ready to connect the cell to the lamp to make it glow.



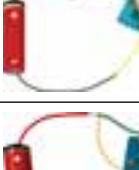

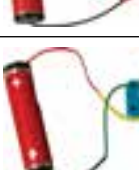
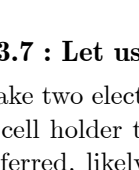
6. We will conduct this activity in two parts-prediction and observation. Some of the ways in which the lamp and the cell can be connected are shown in Table.
7. Predict, for each arrangement, if the lamp will glow or not and write your prediction in Table.
8. Now, connect the lamp and the cell, and observe if the lamp glows or not. Note down your observation in Table. Also, for the lamps which glow, colour their glass bulbs yellow.

**Table : Trying to make the lamp glow**

S. No.	Arrangement of Cell and Lamp	Prediction	Observation
1			
2			
3			
4			
5			
6			

Ans :

This activity requires predicting and observing whether a lamp glows in different connection arrangements with a cell. The general principle is that the lamp will glow only if there is a complete, closed circuit allowing current to flow from one terminal of the cell, through the lamp, and back to the other terminal of the cell.

S. No.	Arrangement of Cell and Lamp	Prediction	Observation
1		complete circuit :	Glow
2		incorrect/ incomplete circuit	No Glow
3		incorrect/ incomplete circuit	No Glow
4		incorrect/ incomplete circuit	No Glow
5		incorrect/ incomplete circuit	No Glow
6		complete circuit :	Glow

**Activity 3.7 : Let us experiment**

1. Take two electric cells, an LED of any colour, a cell holder that can fit two cells Figure (e) referred, likely a typo, should be Figure (a), and two lengths of electric wire.



Figure : (e)

2. Remove about 1 cm of the plastic covering from both ends of each wire to expose the metal.
3. Connect the two wires to the cell holder as shown in Figure (a).



4. Insert two cells in the holder, taking care that for each cell, its negative terminal is towards the spring side of the holder Figure (b) and the battery is ready to use. How will you decide which is the positive terminal of this battery?

The terminal of the holder which is connected to the positive terminal of one cell is positive and the one connected to the negative terminal of the other cell is the negative terminal.

5. Now, connect the free end of the battery positive terminal wire to the longer wire of LED, and the free end of the second wire to the shorter wire of LED Figure (c). Does the LED glow?
6. Repeat the above step but interchange the wires connected to the LED Figure (d). Does the LED glow again?

You would have observed that the LED glows in the first case Figure (c) and does not glow in the other Figure (d). It is because the current can pass through the LED in one direction only. The current passes through the LED only when the positive terminal (longer wire) of the LED is connected to the positive terminal of the battery, and negative terminal (shorter wire) of the LED is connected to the negative terminal of the battery. When current passes through the LED, it glows. Always take care to connect an LED correctly in a circuit to make it glow.

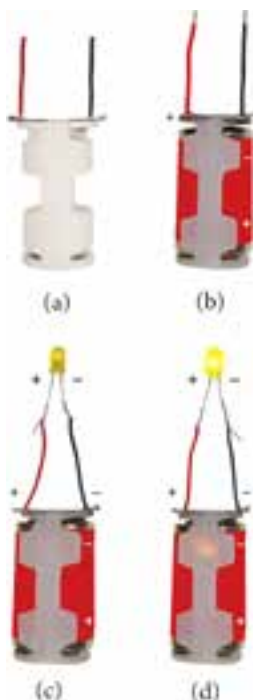


Figure : Making an LED glow

Ans :

1. Deciding positive terminal of battery : In a two-cell holder where cells are in series, the positive terminal of the battery will be the terminal of the holder that is connected to the positive terminal of the first cell in the series. The negative terminal of the battery will be the terminal of the holder connected to the negative terminal of the last cell in the series.
2. Connecting battery positive to LED longer wire (positive), and battery negative to LED shorter wire (negative) Figure (c) : Yes, the LED will glow. This is the correct polarity for an LED.
3. Interchanging wires connected to the LED Figure (d) : No, the LED will not glow. This is because an LED is a diode, meaning it allows current to flow in only one direction. Reversing the connections means applying reverse polarity, and the LED will block the current flow.

### Activity 3.8 : Let us construct

1. Collect two drawing pins, a safety pin (or a paper clip), two wires, and a small piece of cardboard.
2. Insert a drawing pin through the ring of the safety pin and fix it to the cardboard piece, ensuring that the safety pin can rotate freely Figure (a).
3. Fix the second drawing pin to the cardboard piece so the free end of the safety pin can touch it Figure (b).
4. Connect a wire to each drawing pin—our switch is ready!

Let us now test our switch.

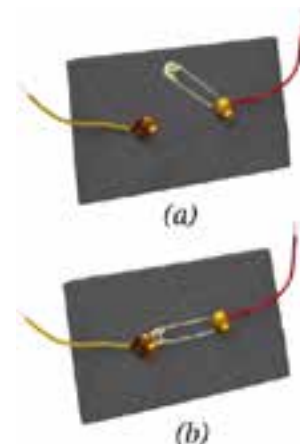


Figure : A switch (a) in 'OFF' position, (b) in 'ON' position

Ans :

This activity describes the construction of a simple switch.

1. A drawing pin is inserted through the coiled end (ring) of a safety pin and fixed to cardboard. This allows the safety pin to pivot.
2. A second drawing pin is fixed on the cardboard such that the free end of the safety pin can be rotated to touch it.
3. A wire is connected to each drawing pin. These wires will then be connected into a circuit.

When the safety pin is rotated to touch the second drawing pin, the switch is 'ON' (closed), completing the circuit. When the safety pin is not touching the second drawing pin, the switch is 'OFF' (open), breaking the circuit.

**Activity 3.9 : Let us test**

1. Connect the electric cell, lamp, and switch as shown in Figure (e) (likely a typo, should refer to a diagram like Figure (a) which shows the constructed switch in a circuit). Does the lamp glow?
2. Rotate the free end of the safety pin till it touches the other drawing pin as shown in Figure (f) (likely Figure (b)). Does the lamp glow now?



(e) (f)

When the safety pin touches both drawing pins, it closes the gap and completes the path, and allows the current to flow. We call this the ON position (Figure (f) / (b)) where the circuit is closed and current flows from the cell's positive to negative terminal making the lamp glow. When the safety pin does not touch the second drawing pin, the gap in the circuit prevents current flow, and the lamp does not glow. In this OFF position (Figure (e) / (a)), we say that the circuit is open.

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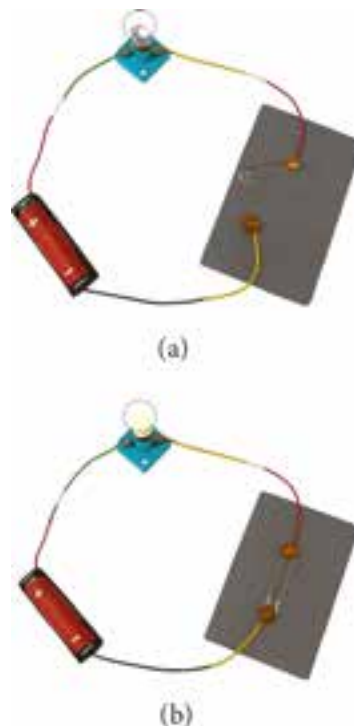


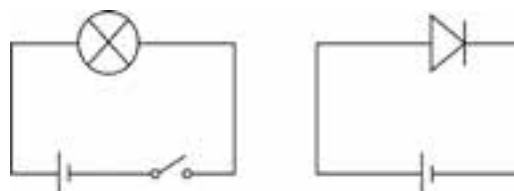
Figure : An electrical circuit with a switch in (a) 'OFF' position, (b) 'ON' position

Ans :

1. When the safety pin is NOT touching the second drawing pin (Switch 'OFF', Figure (a) : No, the lamp will not glow. The circuit is open, and there is no complete path for the current.
2. When the safety pin is touching the second drawing pin (Switch 'ON', Figure (b) : Yes, the lamp will glow. The safety pin bridges the gap between the two drawing pins, completing the circuit and allowing current to flow.

**Activity 3.10 : Let us draw**

1. Using symbols shown in Table 3.2, draw the circuit diagram of an electrical circuit which is given in the activity 3.9 Figure (a) and Figure (b). Are your circuit diagrams similar to Figure (c) and Figure (d) respectively?



(c) (d)

Figure : A circuit diagram (c) with an incandescent lamp, (d) with an LED lamp

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Ans :

This activity involves translating pictorial representations of circuits into schematic circuit diagrams using standard symbols.

1. Circuit diagram for Figure (a) (Cell, open switch, incandescent lamp) :
  - (i) Symbol for an electric cell (one long line for positive, one short thick line for negative).
  - (ii) Symbol for an incandescent lamp.
  - (iii) Symbol for a switch in the 'OFF' position (open). Lines representing connecting wires.

The diagram should look similar to Figure (c), showing these components connected in series with the switch open.

2. Circuit diagram for Figure (b) (Battery of two cells, closed path, LED) :
  - (i) Symbol for a battery of two cells (two cell symbols connected in series, positive to negative).
  - (ii) Symbol for an LED (triangle pointing in the direction of current flow, with two small arrows indicating light emission, and ensuring the anode is connected towards the positive of the battery and cathode towards the negative).
  - (ii) Lines representing connecting wires, forming a closed circuit.

The diagram should look similar to Figure (b), showing these components connected in series with the LED oriented correctly for current flow. A textual representation : Battery symbol (two cells), wire from positive of battery to anode of LED symbol, cathode of LED symbol via wire back to negative of battery symbol.)

Yes, if drawn correctly, the circuit diagrams should be similar to those shown in Figure (a) and Figure (b).

### Activity 3.11 : Let us identify

1. Connect an electric cell and a lamp while leaving the two ends of wires free as shown in Figure (a).
2. Touch the two free ends of the wires momentarily. Does the lamp glow? If yes, our tester is ready. We can use this tester to identify the materials through which electric current passes.
3. Collect objects of different materials, such as metal spoons, coins, cork, rubber, glass, keys, pins, plastic scale, wooden block, aluminium

foil, candle, sewing needle, cardboard, paper, and pencil lead.

4. One by one, touch the free ends of the tester's wires to both ends of each object you have collected Figure (b). Make sure the wires don't touch each other. Does the lamp glow every time?



Figure : (a) Conduction tester, (b) Using the conduction tester for testing a material

Table : Identifying Conductors and Insulators

S. No.	Object	Material it is made up of	Lamp glows (Yes/No)	Conclusion (Conductor/Insulator)
1	Stick	Wood	No	
2	Scale	Plastic		
3	Bangle	Glass		
4	Paper strip	Paper		
5	Candle	Wax		
6	Key	Metal		
7	Eraser	Rubber		
8				
9				
10				
11				

Ans :

1. Touching free ends of wires : Yes, if the tester is working correctly, the lamp should glow when the two free ends of the wires

are touched together, as this completes the circuit.

2. No, the lamp will not glow every time. It will only glow if the material of the object being tested is an electrical conductor.

**Table : Identifying Conductors and Insulators**

S. No.	Object	Material it is made up of	Lamp glows (Yes/No)	Conclusion (Conductor/Insulator)
1	Stick	Wood	No	Insulator
2	Scale	Plastic	No	Insulator
3	Bangle	Glass	No	Insulator
4	Paper strip	Paper	No	Insulator
5	Candle	Wax	No	Insulator
6	Key	Metal	Yes	Conductor
7	Eraser	Rubber	No	Insulator
8	Metal Spoon	Metal	Yes	Conductor
9	Coin	Metal	Yes	Conductor
10	Cork	Cork	No	Insulator
11	Aluminium Foil	Aluminium	Yes	Conductor

2. Observe the given figure. With which material connected between the ends A and B, the lamp will not glow?



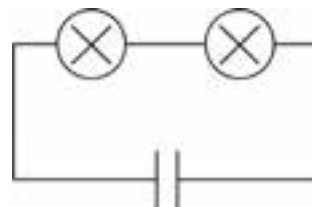
Ans :

The lamp will glow if an insulator is connected between ends A and B.

Examples of materials that would prevent the lamp from glowing :

1. Rubber band
2. Plastic strip
3. Wooden stick
4. Glass rod
5. Piece of paper or cloth

3. In figure, if the filament of one of the lamps is broken, will the other glow? Justify your answer.



Ans :

No, if the filament of one of the lamps is broken, the other lamp will not glow. The lamps are connected in series. In a series circuit, there is only one path for the current to flow. If the filament of one lamp breaks, it creates an open circuit (a break in the path). Since the current cannot flow through the broken filament, it cannot flow through the rest of the circuit, including the other lamp. Therefore, the other lamp will also not glow.

4. A student forgot to remove the insulator covering from the connecting wires while making a circuit. If the lamp and the cell are working properly, will the lamp glow?

Ans :

No, the lamp will not glow.

### NCERT EXERCISE

1. Choose the incorrect statement.
  - (i) A switch is the source of electric current in a circuit.
  - (ii) A switch helps to complete or break the circuit.
  - (iii) A switch helps us to use electricity as per our requirement.
  - (iv) When the switch is in 'OFF' position, there is an air gap between its terminals.

Ans :

- (i) A switch is the source of electric current in a circuit.

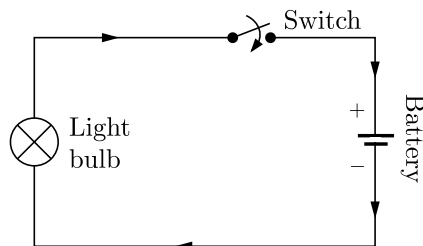
The source of electric current in a typical simple circuit is the electric cell or battery. A switch is a device to control the flow of current by opening or closing the circuit.



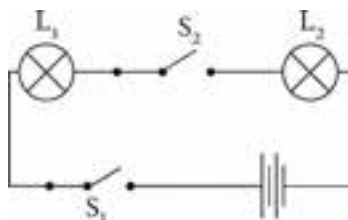
The insulator covering on the connecting wires prevents electrical contact between the metal part of the wire and the terminals of the cell or lamp holder. For current to flow, there must be a continuous path of conducting material. If the insulation is not removed at the connection points, the circuit will remain open, and no current will flow, so the lamp will not light up.

5. Draw a circuit diagram for a simple torch using symbols for electric components.

Ans :



6. In below figure :



- If  $S_2$  is in 'ON' position,  $S_1$  is in 'OFF' position, which lamp(s) will glow?
- If  $S_2$  is in 'OFF' position,  $S_1$  is in 'ON' position, which lamp(s) will glow?
- If  $S_1$  and  $S_2$  both are in 'ON' position, which lamp(s) will glow?
- If both  $S_1$  and  $S_2$  are in 'OFF' position, which lamp(s) will glow?

Ans :

- Lamp  $L_2$  will glow.  $L_1$  will not glow because  $S_1$  is OFF.
  - Lamp  $L_1$  will glow.  $L_2$  will not glow because  $S_2$  is OFF.
  - Both lamps  $L_1$  and  $L_2$  will glow.
  - Neither lamp ( $L_1$  nor  $L_2$ ) will glow.
7. Vidyut has made the circuit as shown in figure. Even after closing the circuit, the lamp does not glow. What can be the possible reasons? List as many possible reasons as you can for this faulty operation. What will you do to find out why the

lamp did not glow?



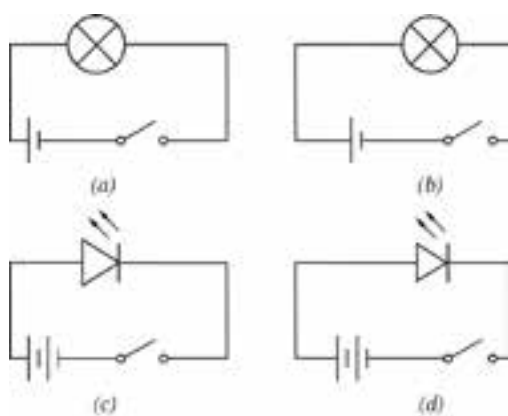
Ans :

**Possible reasons for the lamp not glowing :**

- Fused lamp/bulb : The filament of the lamp might be broken.
- Dead or weak cell/battery : The cell might be exhausted and unable to provide enough current.
- Incorrect cell connection : If it's a battery of multiple cells, they might be connected incorrectly (e.g., positive to positive). If it's a single cell, it might be inserted the wrong way in the holder (if polarity matters for the holder's contacts).
- Loose connections : The wires might not be securely connected to the terminals of the cell, switch, or lamp holder.
- Broken wire : There might be a break in one of the connecting wires that is not visible.
- Faulty switch : The switch itself might be broken internally and not making proper contact even when in the 'ON' position.
- Insulation not removed : If new wires were used, the insulation might not have been stripped from the ends where connections are made.
- Short circuit (less likely to cause no glow, more likely to drain battery quickly or damage components, but could be a factor if it bypasses the lamp entirely in a complex setup, though figure is simple) : A short circuit might be present elsewhere, though in a simple series circuit this usually means the lamp would glow brightly until the cell dies, unless the short bypasses the lamp.
- Lamp not properly seated in the holder : The lamp might not be making good contact with the terminals inside the lamp holder.
- If using an LED : The LED might be connected with incorrect polarity (longer lead not to positive, shorter lead not to negative).

**Troubleshooting steps :**

1. Check the switch : Ensure the switch is firmly in the 'ON' position.
  2. Check connections : Verify that all wires are securely connected to the terminals of the cell, switch, and lamp. Make sure insulation is removed at connection points.
  3. Check the cell :
    - (i) Try a new, known-to-be-working cell.
    - (ii) Ensure the cell is inserted correctly in the holder (correct polarity).
  4. Check the lamp :
    - (i) Try a new, known-to-be-working lamp.
    - (ii) Visually inspect the filament of the incandescent lamp for breaks.
    - (iii) If it's an LED, double-check its polarity.
  5. Bypass the switch : Temporarily remove the switch and connect the wires directly to see if the lamp glows. This helps identify if the switch is faulty.
  6. Check wires : Inspect wires for any visible breaks. Try replacing wires one by one if other steps fail.
  7. Test components individually (if possible) : Use a known good cell to test the lamp directly (and briefly). Use a known good lamp and cell to test the switch.
8. In figure, in which case(s) the lamp will not glow when the switch is closed?



Ans :

The lamp will not glow in any case where :

1. There isn't a complete path from the positive terminal of the cell, through the switch (when closed), through the lamp, and back to the negative terminal of the cell.
2. The wires are connected in such a way that they short-circuit the cell (e.g., a wire

directly connecting the positive and negative terminals of the cell without passing through the lamp – in this case, the lamp wouldn't glow, and the cell would drain quickly and get hot).

3. The lamp itself is short-circuited by the wiring when the switch is closed (e.g., switch connected in parallel to the lamp, so closing the switch creates a low-resistance path bypassing the lamp).
  4. If an LED is used, and its polarity is reversed with respect to the cell.
9. Suppose the '+' and '-' symbols cannot be read on a battery. Suggest a method to identify the two terminals of this battery.

Ans :

One common method is to use an LED (Light Emitting Diode) which has a known polarity (longer lead is positive, shorter lead is negative).

1. Materials needed : The battery in question, an LED, and two connecting wires (optional, you can touch the LED leads directly if safe and possible).
2. Procedure : Connect one terminal of the battery to one lead of the LED, and the other terminal of the battery to the other lead of the LED.

**Observation 1 :**

If the LED lights up, then the battery terminal connected to the longer lead (anode) of the LED is the positive (+) terminal of the battery, and the terminal connected to the shorter lead (cathode) of the LED is the negative (-) terminal of the battery.

**Observation 2 :**

If the LED does not light up, reverse the connections of the battery terminals to the LED leads. If the LED now lights up, the battery terminal connected to the longer lead of the LED is positive (+), and the one connected to the shorter lead is negative (-).

10. You are given six cells marked A, B, C, D, E and F. Some of these are working and some are not. Design an activity to identify which of them are working.
1. List the items that you require.
  2. Write the procedure that you will follow.
  3. With the items, carry out the activity to identify the cells that are working.

Ans :



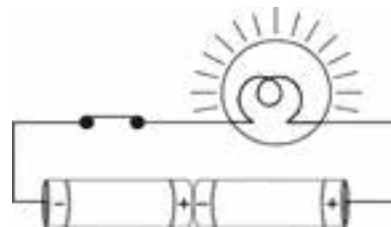
- List the items that you require :
    - The six cells (A, B, C, D, E, F).
    - A low-voltage incandescent lamp (torch bulb) or an LED (with appropriate knowledge of its polarity and voltage, a resistor might be needed if cells are high voltage and combined). For simplicity, a torch bulb is easier.
    - A lamp holder (optional, but makes connections easier).
    - Two connecting wires with ends stripped (or a cell holder and lamp holder with wires).
  - The procedure that you will follow :
    - Set up a simple test circuit : Connect one wire to one terminal of the lamp (or lamp holder). Connect the other wire to the other terminal of the lamp (or lamp holder). This leaves two free ends of the wires.
    - Alternatively, use a cell holder and connect it to the lamp/lamp holder.
    - Take cell A. Connect its positive terminal to one free end of the wire (or place it in the cell holder) and its negative terminal to the other free end of the wire (completing the circuit with the lamp).
    - Observe if the lamp glows.  
If the lamp glows (even dimly), cell A is working.  
If the lamp does not glow, cell A is likely not working (or the connections are poor – recheck connections before concluding).
    - Record your observation for cell A.
    - Disconnect cell A.
    - Repeat steps 3-6 for each of the remaining cells (B, C, D, E, F), testing them one at a time. Ensure to note down which cells make the lamp glow.
  - With the items, carry out the activity to identify the cells that are working.
    - Cell A : Working (Lamp glows)
    - Cell B : Not working (Lamp does not glow)
    - Cell C : Working (Lamp glows)
    - Cell D : Working (Lamp glows)
    - Cell E : Not working (Lamp does not glow)
    - Cell F : Working (Lamp glows)
11. An LED requires two cells in series to glow. Tanya made the circuit as shown in figure. Will the lamp glow? If not, draw the wires for correct

connections.



Ans :

No, the lamp will not glow because the two cells are not connected in series properly. To make it work, the positive terminal of one cell should be connected to the negative terminal of the other.



## MULTIPLE CHOICE QUESTION

- How is electricity generated at the Bhakra Nangal Dam's hydroelectric power house?
  - By using wind energy
  - By using solar panels
  - By using the force of falling water
  - By burning natural gas

Ans :

(C) By using the force of falling water  
Bhakra Nangal Dam, specifically highlighting the hydroelectric power house where electricity generation relies on the energy of falling water.

- Which of the following is listed in the use of electricity in the 'Heating and Cooling' category?
  - Electric kettle
  - Television
  - Room heater
  - Mobile phone

Ans :

(C) Room heater

The uses of electricity into categories. Room heaters, along with fans, geysers, and air conditioners, are placed under the 'Heating and Cooling' heading.

3. Why is it emphasized that experiments with electricity should only use batteries or cells and not the main power supply?  
 (A) Batteries provide alternating current (AC).  
 (B) Main power supply is too weak for experiments.  
 (C) Main power supply electricity can be dangerously high voltage.  
 (D) Batteries are cheaper to use for experiments.

Ans :

(C) Main power supply electricity can be dangerously high voltage.

The electricity from the main power supply (or portable generators) is dangerous due to high voltage and potential for severe shock, unlike low-voltage cells/batteries.

4. What are the essential components typically found inside a simple torchlight when opened?  
 (A) Wires and a motor  
 (B) A switch, a lamp, and electric cells  
 (C) A solar panel and a battery  
 (D) A filament and a glass case only

Ans :

(B) A switch, a lamp, and electric cells

Opening a torchlight, revealing its key internal components. One or more electric cells (providing power), a lamp (bulb or LED), and a switch mechanism.

5. What are the two connection points on an electric cell called?  
 (A) Poles  
 (B) Sockets  
 (C) Terminals  
 (D) Nodes

Ans :

(C) Terminals

Every electric cell features two connection points known as terminals. These are specifically designated as the positive (+ve) and negative (-ve) terminals for establishing electrical connections.

6. On a standard cylindrical electric cell, which part typically represents the positive terminal?  
 (A) The flat metal disc base  
 (B) The side casing of the cell  
 (C) The small protruding metal cap  
 (D) The negative sign marking

Ans :

(C) The small protruding metal cap

The physical features corresponding to the terminals the small metal cap that protrudes slightly is the positive terminal of the electric cell.

7. Which part of a standard cylindrical electric cell serves as the negative terminal?  
 (A) The positive sign marking  
 (B) The flat metal disc on the base  
 (C) The protruding metal cap  
 (D) The insulating outer layer

Ans :

(B) The flat metal disc on the base

Complementary to the positive terminal, the flat metal disc located at the base of the cylindrical electric cell functions as its negative terminal.

8. What is the primary function of an electric cell in devices like torchlights?  
 (A) To store light energy  
 (B) To act as a switch  
 (C) To provide a portable source of electrical energy  
 (D) To convert electrical energy to heat

Ans :

(C) To provide a portable source of electrical energy

The electric cell's main role is to serve as a self-contained, portable source of electrical energy, enabling devices like torches to operate without being plugged in.

9. What is formed when two or more electric cells are connected together, usually positive to negative?  
 (A) A circuit  
 (B) A switch  
 (C) A filament  
 (D) A battery

Ans :

(D) A battery

The term 'battery' refers to a combination of two or more electric cells connected in a specific manner, typically positive terminal to negative terminal, to provide more energy or voltage.

10. What is the correct way to connect two cells in series to form a battery, ensuring the device works?  
 (A) Positive terminal to positive terminal  
 (B) Negative terminal to negative terminal  
 (C) Positive terminal of one cell to the negative terminal of the next  
 (D) Placing them side-by-side without connection



**Ans :**

(C) Positive terminal of one cell to the negative terminal of the next

To create a functional battery by connecting cells in series, the positive terminal of the first cell must be connected to the negative terminal of the second cell.

- 11.** If you reverse the direction of one cell in a two-cell torchlight, why might the torch fail to light up?
- (A) The lamp filament breaks instantly.  
 (B) The switch stops working.  
 (C) The connection sequence (positive to negative) is broken.  
 (D) The cells overheat and shut down.

**Ans :**

(C) The connection sequence (positive to negative) is broken.

Reversing one cell disrupts the required positive-to-negative series connection. This incorrect arrangement prevents the proper flow of electricity needed to light the lamp.

- 12.** What is the thin wire inside the glass bulb of an incandescent lamp called, which glows when heated by electricity?
- (A) Terminal  
 (B) Filament  
 (C) Insulator  
 (D) Base

**Ans :**

(B) Filament

The key component responsible for producing light in an incandescent lamp is the filament, a thin wire that heats up and glows brightly when electric current passes through it.

- 13.** How many terminals does an incandescent lamp typically have for connection in a circuit?
- (A) One  
 (B) Two  
 (C) Three  
 (D) Four

**Ans :**

(B) Two

An incandescent lamp has two terminals – typically the metal tip at the bottom centre and the metal casing around the base – which allow it to be connected into an electrical circuit.

- 14.** What is a key difference between an LED lamp and an incandescent lamp?

- (A) LEDs have filaments, incandescent lamps do not.  
 (B) Incandescent lamps have terminals, LEDs do not.  
 (C) LEDs do not have filaments, incandescent lamps do.  
 (D) Incandescent lamps use less energy than LEDs.

**Ans :**

(C) LEDs do not have filaments, incandescent lamps do.

A primary distinction highlighted is that incandescent lamps rely on a filament glowing hot, whereas LEDs (Light Emitting Diodes) produce light without a filament.

- 15.** How can the positive and negative terminals of an LED usually be identified?
- (A) By the color of the LED  
 (B) The positive terminal wire is usually longer than the negative one.  
 (C) The negative terminal wire is usually longer than the positive one.  
 (D) Both wires are always the same length.

**Ans :**

(B) The positive terminal wire is usually longer than the negative one.

LEDs have polarity. The positive terminal is typically indicated by a longer connecting wire (lead), while the negative terminal has a shorter wire.

- 16.** For an incandescent lamp to glow when connected to a cell, what condition must be met regarding the connections?
- (A) Only the positive terminal of the cell needs to be connected.  
 (B) Only one terminal of the lamp needs connection.  
 (C) A complete path must exist between the cell's terminals through the lamp.  
 (D) The wires must be covered in thick insulation.

**Ans :**

(C) A complete path must exist between the cell's terminals through the lamp.

The lamp glows only when there is an unbroken, continuous path, called a complete or closed electrical circuit, allowing electric current to flow from the cell, through the lamp's filament, and back to the cell.

17. What is the term for the complete path required for electric current to flow from a source, through a device, and back to the source?

- (A) An electrical component
- (B) An electrical insulator
- (C) An electrical circuit
- (D) An electrical terminal

Ans :

(C) An electrical circuit

An electrical circuit is defined as the complete, closed loop or path through which electric current can flow, typically including a source (cell/battery), wires, and a device (lamp).

18. What is the conventional direction of electric current flow in a circuit diagram?

- (A) From the negative terminal to the positive terminal of the cell.
- (B) From the positive terminal to the negative terminal of the cell.
- (C) Flowing in both directions simultaneously.
- (D) From the lamp towards the cell.

Ans :

(B) From the positive terminal to the negative terminal of the cell.

By convention, the direction of electric current in a circuit is represented as flowing out from the positive terminal of the source (cell/battery) and returning to the negative terminal.

19. What does it mean if an incandescent lamp is 'fused'?

- (A) The glass bulb has melted.
- (B) The battery connected is too strong.
- (C) The filament inside the lamp is broken.
- (D) The switch connected to it is faulty.

Ans :

(C) The filament inside the lamp is broken.

A 'fused' lamp typically means its filament has broken. This break creates an open circuit, preventing current from flowing through the lamp, thus it cannot glow.

20. Why does an LED glow only when connected to a battery in a specific way (positive to positive, negative to negative)?

- (A) LEDs require alternating current (AC).
- (B) Current can only pass through an LED in one direction.
- (C) LEDs only work with specific types of batteries.
- (D) The LED filament only heats up in one

direction.

Ans :

(B) Current can only pass through an LED in one direction.

Unlike incandescent lamps, LEDs are diodes, meaning they allow significant current flow in only one direction. They must be connected with the correct polarity to light up.

21. What is the function of an electric switch in a circuit?

- (A) To generate electricity
- (B) To increase the brightness of the lamp
- (C) To measure the electric current
- (D) To complete or break the circuit

Ans :

(D) To complete or break the circuit

A switch is a device designed to conveniently open (break) or close (complete) an electrical circuit, thereby controlling the flow of current and turning devices ON or OFF.

22. In the simple switch made with drawing pins and a safety pin (Activity 3.8), when is the switch considered in the 'ON' position?

- (A) When the safety pin is removed entirely.
- (B) When the safety pin touches only one drawing pin.
- (C) When the safety pin touches both drawing pins, closing the gap.
- (D) When the cardboard base is wet.

Ans :

(C) When the safety pin touches both drawing pins, closing the gap.

The 'ON' position is achieved when the safety pin bridges the gap between the two drawing pins, creating a continuous path for the current to flow through the switch.

23. What term describes the state of a circuit when the switch is in the 'OFF' position?

- (A) Closed circuit
- (B) Short circuit
- (C) Parallel circuit
- (D) Open circuit

Ans :

(D) Open circuit

When the switch is 'OFF', it creates a break or gap in the path. This prevents current flow, and the circuit state is referred to as 'open'.



24. Consider a simple circuit with a cell, a lamp, and a switch.

1. When the switch is ON, the circuit is closed.
2. When the circuit is open, the lamp glows.
3. A switch can be placed anywhere in the circuit path.

Which statements are correct?

- (A) 1 and 2 only
- (B) 2 and 3 only
- (C) 1 and 3 only
- (D) 1, 2, and 3

Ans :

(C) 1 and 3 only

Statement 1 is correct (ON = closed). Statement 2 is incorrect (lamp glows only in a closed circuit). Statement 3 is correct (a switch interrupts the path wherever placed).

25. In the standard symbol for an electric cell used in circuit diagrams, what does the longer line represent?

- (A) The negative terminal
- (B) The positive terminal
- (C) The filament
- (D) The switch

Ans :

(B) The positive terminal

The conventional symbol for an electric cell uses two parallel lines of unequal length; the longer line specifically denotes the positive (+) terminal.

26. What does the shorter, thicker line represent in the symbol for an electric cell?

- (A) The positive terminal
- (B) The insulator
- (C) The negative terminal
- (D) The direction of current

Ans :

(C) The negative terminal

In the standard electric cell symbol, the shorter, thicker parallel line represents the negative (-) terminal of the cell.

27. Which symbol is used to represent an electric lamp (incandescent) in a circuit diagram?

- (A) A circle with an 'L' inside
- (B) A rectangle with two lines coming out
- (C) A circle with a cross inside it
- (D) A zig-zag line

Ans :

(C) A circle with a cross inside it.

The standard symbol commonly used in circuit diagrams to represent an incandescent electric lamp or bulb is a circle containing a cross (X).

28. How is a switch in the 'ON' (closed) position typically represented in a circuit diagram?

- (A) A gap between two points on the wire
- (B) A continuous line showing the connection is made
- (C) A circle with an 'S' inside
- (D) Two parallel lines

Ans :

(B) A continuous line showing the connection is made

The symbol for a switch in the 'ON' or closed state shows a completed path, often depicted as a line connecting the two switch terminals without a break.

29. What is a drawing that uses standard symbols to represent an electrical circuit called?

- (A) An electrical map
- (B) A component list
- (C) A circuit diagram
- (D) A power schematic

Ans :

(C) A circuit diagram

A circuit diagram is a simplified, standardized representation of an electrical circuit that uses specific symbols for each component (like cells, lamps, switches, wires).

30. Why are symbols used in circuit diagrams instead of drawing realistic pictures of components?

- (A) Realistic drawings are too colorful.
- (B) Symbols make diagrams easier and quicker to draw and universally understand.
- (C) Symbols take up more space on the paper.
- (D) Realistic drawings do not show the connections clearly.

Ans :

(B) Symbols make diagrams easier and quicker to draw and universally understand.

Using standardized symbols simplifies the process of drawing circuits, saves time, and ensures clarity and universal understanding among people from different backgrounds or countries.

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31. What are materials called through which electric current can flow easily?  
 (A) Insulators  
 (B) Resistors  
 (C) Conductors  
 (D) Semiconductors

Ans :

(C) Conductors

Materials that allow electric current to pass through them with very little resistance are known as electrical conductors or good conductors of electricity.

32. What term describes materials that do NOT allow electric current to pass through them easily?  
 (A) Conductors  
 (B) Insulators  
 (C) Amplifiers  
 (D) Batteries

Ans :

(B) Insulators

Materials that strongly resist the flow of electric current are called electrical insulators or poor conductors of electricity.

33. A conduction tester is made using a cell, lamp, and wires. How does this tester identify a conductor?  
 (A) The lamp glows when the object is touched by the wires.  
 (B) The lamp turns off when the object is touched.  
 (C) The wires become hot when touching the object.  
 (D) The cell starts buzzing when touching the object.

Ans :

(A) The lamp glows when the object is touched by the wires.

If the object placed between the tester's free ends is a conductor, it completes the circuit, allowing current to flow and causing the lamp to glow.

34. Which of the following materials, when tested with the conduction tester, would likely NOT cause the lamp to glow?  
 (A) Metal key  
 (B) Aluminium foil  
 (C) Plastic scale  
 (D) Sewing needle (metal)

Ans :

(C) Plastic scale

Metal keys, aluminium foil, and metal needles are conductors and would complete the circuit, making the lamp glow. Plastic is an insulator and would keep the circuit open.

35. Which type of material is typically used for making electrical wires?  
 (A) Rubber  
 (B) Plastic  
 (C) Glass  
 (D) Metal (like copper)

Ans :

(D) Metal (like copper)

Metals, particularly copper, are excellent electrical conductors and are therefore commonly used to manufacture wires that carry electric current efficiently.

36. Why are electrical wires usually covered with materials like plastic or rubber?  
 (A) To make the wires look colorful.  
 (B) To make the wires conduct electricity better.  
 (C) To act as insulators and prevent electric shocks.  
 (D) To keep the wires cool during use.

Ans :

(C) To act as insulators and prevent electric shocks.

Plastic and rubber are electrical insulators. They cover the conductive metal wire to prevent accidental contact and protect users from dangerous electric shocks.

37. **Assertion (A)** : Metals like copper and aluminum are good conductors of electricity.  
**Reason (R)** : Insulators like rubber and plastic are used to cover electrical wires for safety.  
 (A) Both A and R are true, and R is the correct explanation of A.  
 (B) Both A and R are true, but R is not the correct explanation of A.  
 (C) A is true, but R is false.  
 (D) A is false, but R is true.

Ans :

(B) Both A and R are true, but R is not the correct explanation of A.

Both statements are factually correct. Metals are conductors, and insulators cover wires for safety. However, the reason insulators are used is because the wires are conductive, not why metals are conductive.



38. Why is the human body considered a conductor of electricity, making electrical safety crucial?
- (A) Because humans wear clothes made of insulators.  
 (B) Because the body contains water and salts that allow current flow.  
 (C) Because the skin is a very thick insulator.  
 (D) Because humans generate their own electricity.

Ans :

(B) Because the body contains water and salts that allow current flow.

The fluids and electrolytes (salts) within the human body allow it to conduct electricity, which is why touching live electrical parts can lead to dangerous shocks.

39. What is a key difference mentioned between Direct Current (DC) and Alternating Current (AC)?
- (A) DC comes from wall sockets, AC comes from batteries.  
 (B) DC powers large appliances, AC powers small devices.  
 (C) DC typically comes from batteries, AC typically comes from power plants/wall sockets.  
 (D) DC flows in two directions, AC flows in one direction.

Ans :

(C) DC typically comes from batteries, AC typically comes from power plants/wall sockets.

The distinguishes DC, the type usually supplied by batteries for portable devices, from AC, the type supplied by power plants to homes via wall sockets for larger appliances.

40. Which material is listed as one of the best electrical conductors, although often too expensive for common wiring?
- (A) Rubber  
 (B) Plastic  
 (C) Silver  
 (D) Wood

Ans :

(C) Silver

While copper is commonly used, the text mentions that silver, copper, and gold are the best electrical conductors, with silver being slightly better than copper but costlier.

41. Which statement about an electric switch is INCORRECT according to ?

- (A) A switch helps complete or break the circuit.  
 (B) A switch helps use electricity as required.  
 (C) A switch is the source of electric current.  
 (D) An OFF switch creates an air gap.

Ans :

(C) A switch is the source of electric current.

A switch controls the flow of current but does not generate it. The source of current in a simple circuit is the electric cell or battery.

42. In the setup of figure, which material connected between A and B would act as an insulator and prevent the lamp from glowing?



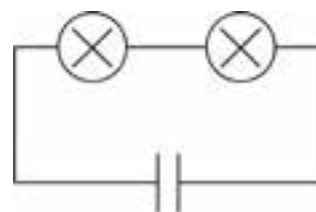
- (A) Copper wire  
 (B) Iron nail  
 (C) Graphite pencil lead  
 (D) Rubber band

Ans :

(D) Rubber band

Copper, iron, and graphite (pencil lead) are conductors that would complete the circuit. Rubber is an insulator and would keep the circuit open, preventing the lamp from glowing.

43. In figure, two lamps are connected in series. If the filament of one lamp breaks, will the other lamp glow?



- (A) Yes, because they are in the same circuit.  
 (B) Yes, because the other lamp is still intact.  
 (C) No, because the break creates an open circuit, stopping current flow.  
 (D) No, because the battery voltage drops to zero.

Ans :

(C) No, because the break creates an open circuit, stopping current flow.

In a series circuit, components are connected in a single path. If one component (like a filament) breaks, the entire path is interrupted (open circuit), and no current flows to any component.

44. A student builds a circuit but forgets to remove the plastic insulation from the ends of the connecting wires where they touch the terminals. Assuming the cell and lamp work, will the lamp glow? Why?
- (A) Yes, insulation makes the connection stronger.
  - (B) No, the plastic insulation acts as an insulator, preventing electrical contact.
  - (C) Yes, current can flow through thin plastic insulation.
  - (D) Maybe, it depends on the color of the insulation.

Ans :

(B) No, the plastic insulation acts as an insulator, preventing electrical contact.

The plastic covering on wires is an electrical insulator. If it's not removed at the connection points, it will block the flow of current, keeping the circuit open, and the lamp will not glow.

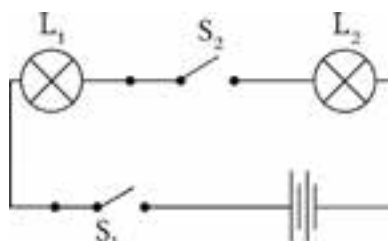
45. Using standard symbols, which components would be included in a circuit diagram for a simple torch?
- (A) Cell(s), Switch, Wire only
  - (B) Battery (one or more cells), Switch, Lamp, Wires
  - (C) Motor, Switch, Lamp, Wires
  - (D) Cell, Resistor, LED, Wires

Ans :

(B) Battery (one or more cells), Switch, Lamp, Wires

A basic torch circuit consists of a power source (cell or battery), a control device (switch), the light source (lamp/LED) and connecting wires, all represented by their standard symbols.

46. In figure, if switch  $S_1$  is ON and switch  $S_2$  is OFF, which lamp(s) will glow?



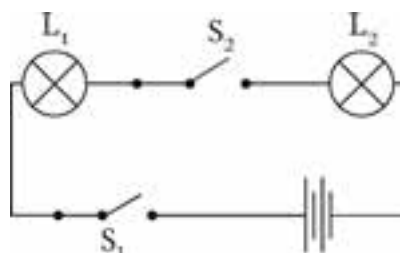
- (A) Only  $L_1$
- (B) Only  $L_2$
- (C) Both  $L_1$  and  $L_2$
- (D) Neither  $L_1$  nor  $L_2$

Ans :

(A) Only  $L_1$

With  $S_1$  ON and  $S_2$  OFF, there is a complete circuit path from the battery through switch  $S_1$  and lamp  $L_1$ . The path through  $S_2$  and  $L_2$  is open because  $S_2$  is OFF.

47. In figure, if both switches  $S_1$  and  $S_2$  are ON, which lamp(s) will glow?



- (A) Only  $L_1$
- (B) Only  $L_2$
- (C) Both  $L_1$  and  $L_2$
- (D) Neither  $L_1$  nor  $L_2$

Ans :

(C) Both  $L_1$  and  $L_2$

When both  $S_1$  and  $S_2$  are ON (closed), there are complete paths for current to flow through both lamp  $L_1$  (via  $S_1$ ) and lamp  $L_2$  (via  $S_2$ ) independently (parallel connection).

48. Electric's circuit figure, doesn't work even when closed. Which is NOT a possible reason?



- (A) The cell is dead (used up).
- (B) The lamp filament is broken (fused).
- (C) The switch is actually in the ON position.
- (D) A wire connection is loose or broken.

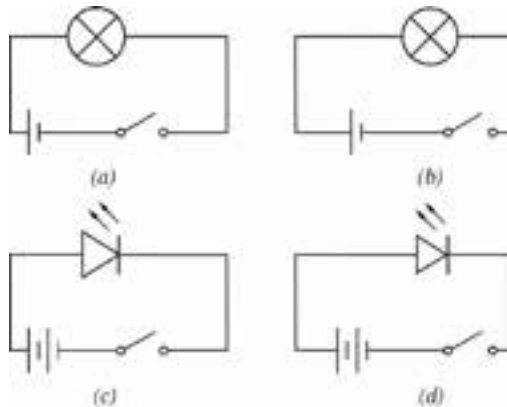
Ans :

(C) The switch is actually in the ON position.



A working switch in the ON position should make the lamp glow if everything else is fine. Dead cell, fused bulb, or bad connections are all valid reasons for the lamp not glowing.

49. In which case(s) in Figure will the lamp NOT glow even if the switch is closed, due to incorrect cell connection?



- (A) Only (a)  
 (B) Only (c)  
 (C) Both (b) and (d)  
 (D) Both (a) and (c)

Ans :

(D) Both (a) and (c)  
 Cases (a) and (c) show incorrect battery connections (positive-to-positive or negative-to-negative), which will prevent proper current flow. Cases (b) and (d) show correct series connections.

50. How could you identify the positive and negative terminals of a cell if the markings are unreadable?
- (A) Connect it to a lamp; the brighter side is positive.  
 (B) Use a known LED; connect it both ways, it glows only when positive-to-longer lead.  
 (C) Taste the terminals; the sour one is positive. (DANGEROUS - DO NOT DO)  
 (D) Measure its weight; the heavier end is negative.

Ans :

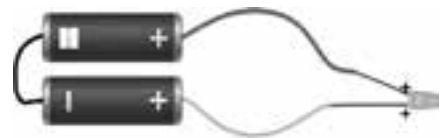
(B) Use a known LED; connect it both ways, it glows only when positive-to-longer lead. An LED's known polarity (longer lead is positive) can be used. Connect the cell to the LED; the cell terminal connected to the longer lead when the LED lights up is the positive terminal.

51. You need to test six cells (A-F) to see which ones work. What essential items would you need, and what's the basic procedure?
- (A) A voltmeter; measure voltage of each cell.  
 (B) A lamp and wires; connect each cell individually to the lamp and see if it glows.  
 (C) An ammeter; measure the current from each cell.  
 (D) Water and salt; see if bubbles form.

Ans :

(B) A lamp and wires; connect each cell individually to the lamp and see if it glows. The simplest test requires a known working lamp (preferably low power like a torch bulb) and connecting wires. Create a simple circuit with each cell one by one. If the lamp glows, the cell is working.

52. Tanya's circuit figure connects two cells incorrectly for an LED requiring two cells in series. How should the wires be connected correctly?



- (A) Connect positive of Cell 1 to positive of Cell 2.  
 (B) Connect negative of Cell 1 to negative of Cell 2.  
 (C) Connect positive of Cell 1 to negative of Cell 2, then connect battery ends to LED correctly.  
 (D) Connect both cells directly to the LED's shorter wire.

Ans :

(C) Connect positive of Cell 1 to negative of Cell 2, then connect battery ends to LED correctly. To connect cells in series, positive must connect to negative. The combined battery terminals must then connect to the LED with correct polarity (battery positive to LED longer lead, battery negative to LED shorter lead).

53. If the power supply is disrupted for two days, which daily activity relying on mains electricity would become impossible?
- (A) Reading a book using daylight  
 (B) Using a battery-powered torchlight  
 (C) Watching television  
 (D) Talking to someone in the same room

Ans :

(C) Watching television  
Televisions require mains electricity (AC power). Battery-powered devices or activities not needing electricity would still be possible.

54. What type of energy source is suggested for running a toy fan in one of the exploratory projects?
- (A) Multiple electric cells
  - (B) A hand crank generator
  - (C) A connection to the wall socket
  - (D) A solar panel

Ans :

(D) A solar panel

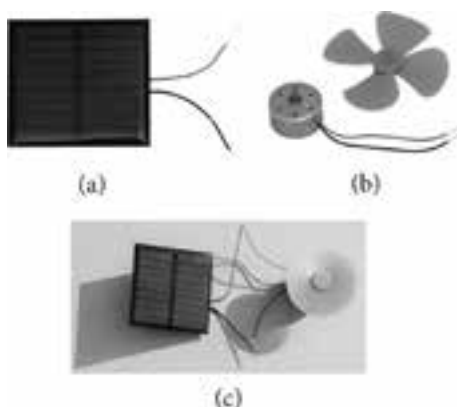


Figure explicitly shows using a solar panel as the source of electrical energy to power a toy fan in a simple circuit project.

55. What are the small, flat, round batteries often used in watches and hearing aids called?
- (A) Cylindrical cells
  - (B) Button cells
  - (C) Rechargeable batteries
  - (D) Solar cells

Ans :

(B) Button cells

The “Science and Society” section describes various battery types, identifying the small, coin-shaped ones used in watches and hearing aids as button cells.

56. How does an incandescent lamp differ from an LED in terms of polarity requirement?
- (A) Both require specific polarity.
  - (B) Neither requires specific polarity.
  - (C) Incandescent works either way; LED requires specific polarity.
  - (D) LED works either way; Incandescent requires specific polarity.

Ans :

(C) Incandescent works either way; LED requires specific polarity.

An incandescent lamp filament glows regardless of current direction. An LED allows current flow and lights up only when connected with the correct positive/negative orientation.

57. What is the general term for the arrangement of components like cells, wires, switch, and lamp that allows electricity to flow?
- (A) Power grid
  - (B) Electrical circuit
  - (C) Conductor array
  - (D) Insulator network

Ans :

(B) Electrical circuit

The complete path consisting of a source, load (device), and connecting wires, often including a switch, is collectively known as an electrical circuit.

58. Which organisation is mentioned as helping create standard symbols for electrical components?
- (A) World Health Organization (WHO)
  - (B) National Aeronautics and Space Administration (NASA)
  - (C) International Electrotechnical Commission (IEC)
  - (D) United Nations Educational, Scientific and Cultural Organization (UNESCO)

Ans :

(C) International Electrotechnical Commission (IEC)

The “Deeper Dive” section on circuit diagrams mentions international bodies like IEC, ANSI, and IEEE that establish standardized symbols for electrical parts.

59. If you have a battery holder where cells are placed side-by-side, how is the series connection usually made inside the holder?
- (A) The cells are not actually connected.
  - (B) Through the plastic casing of the holder.
  - (C) Via a thick wire or metal strip connecting the positive of one cell to the negative of the next.
  - (D) Using external wires clipped to each cell.

Ans :

(C) Via a thick wire or metal strip connecting the positive of one cell to the negative of the next.



Battery compartments for side-by-side cells typically have internal metal strips or contacts that automatically connect the positive terminal of one cell slot to the negative terminal of the adjacent slot.

**60. Assertion (A) :** A closed switch allows electric current to flow through a circuit.

**Reason (R) :** In the ‘ON’ position, the switch completes the electrical path between its terminals.

- (A) Both A and R are true, and R is the correct explanation of A.
- (B) Both A and R are true, but R is not the correct explanation of A.
- (C) A is true, but R is false.
- (D) A is false, but R is true.

**Ans :**

(A) Both A and R are true, and R is the correct explanation of A.

A closed (‘ON’) switch indeed allows current flow (Assertion A). It does this precisely because it closes the gap and provides a continuous path (Reason R), thus R correctly explains A.

### MATCHING TYPE QUESTION

**61. Match the following Column A with Column B :**

	Column A		Column B
1.	Electric Cell	A.	Allows current to flow in one direction
2.	Battery	B.	Thin wire that glows when current passes
3.	Incandescent Lamp	C.	Combination of two or more cells
4.	LED Lamp	D.	Source of electrical energy with two terminals

- (a) 1-D, 2-C, 3-B, 4-A
- (b) 1-C, 2-D, 3-A, 4-B
- (c) 1-D, 2-A, 3-C, 4-B
- (d) 1-A, 2-B, 3-D, 4-C

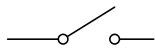



**Ans :**

(a) 1-D, 2-C, 3-B, 4-A

An electric cell is a source of electrical energy with positive and negative terminals. A battery is formed by combining cells. An incandescent

lamp’s filament glows. An LED allows current in one direction.

**62. Match the following symbols with their components :**

	Column A (Symbol)		Column B (Component)
1.		A.	Switch in ‘OFF’ position
2.		B.	Electric Lamp
3.		C.	Electric Cell
4.		D.	Wire

- (a) 1-C, 2-B, 3-A, 4-D
- (b) 1-A, 2-D, 3-C, 4-B
- (c) 1-C, 2-A, 3-D, 4-B
- (d) 1-B, 2-C, 3-A, 4-D

**Ans :**

(a) 1-C, 2-B, 3-A, 4-D

The symbol with a long positive and short negative line represents an electric cell. A circle with a cross depicts an electric lamp. A break in the line represents an open (OFF) switch. A straight line symbolizes a wire.

**63. Match the following terms related to electric circuits :**

	Column A		Column B
1.	Closed Circuit	A.	Path for current is broken
2.	Open Circuit	B.	From positive to negative terminal
3.	Electric Current Direction	C.	Allows current to flow completely
4.	Filament	D.	Part of incandescent lamp that gets hot

- (a) 1-A, 2-C, 3-D, 4-B
- (b) 1-C, 2-A, 3-B, 4-D
- (c) 1-C, 2-B, 3-A, 4-D
- (d) 1-B, 2-D, 3-C, 4-A

**Ans :**

(b) 1-C, 2-A, 3-B, 4-D

A closed circuit provides a complete path for current. An open circuit has a broken path.

Current direction is conventionally from positive to negative. The filament is the part of an incandescent lamp that heats up and glows.

64. Match the material property with its example :

	Column A		Column B
1.	Electrical Conductor	A.	Plastic coating on wires
2.	Electrical Insulator	B.	Copper wire
3.	Safety Device	C.	Broken filament
4.	Cause of Open Circuit	D.	Electric switch

- (a) 1-D, 2-A, 3-B, 4-C
- (b) 1-B, 2-A, 3-D, 4-C
- (c) 1-B, 2-C, 3-A, 4-D
- (d) 1-A, 2-B, 3-D, 4-C

Ans :

- (b) 1-B, 2-A, 3-D, 4-C

Copper wire is an electrical conductor. Plastic coating is an insulator. An electric switch is a safety and control device. A broken filament results in an open circuit, stopping current flow.

65. Match the component feature with the component :

	Column A		Column B
1.	Longer wire is positive terminal	A.	Battery
2.	Metal cap is positive terminal	B.	LED Lamp
3.	Completes or breaks the circuit	C.	Electric Cell
4.	Positive of one cell to negative of next	D.	Electric Switch

- (a) 1-C, 2-B, 3-A, 4-D
- (b) 1-B, 2-A, 3-D, 4-C
- (c) 1-B, 2-C, 3-D, 4-A
- (d) 1-D, 2-A, 3-C, 4-B

Ans :

- (c) 1-B, 2-C, 3-D, 4-A

In an LED, the longer wire is the positive terminal. In an electric cell, the metal cap is typically the positive terminal. An electric switch completes or breaks a circuit. In a battery, cells are connected positive to negative.

## VERY SHORT QUESTION

66. What is the name given to a portable source of electrical energy?

Ans :

Electric cell

67. How many terminals does an electric cell have?

Ans :

Two

68. Which terminal of an electric cell is the metal cap?

Ans :

Positive terminal (+ve)

69. What is the negative terminal of an electric cell?

Ans :

The metal disc

70. What is a combination of two or more cells called?

Ans :

A battery

71. What is the thin wire inside an incandescent lamp that glows called?

Ans :

Filament

72. Do LED lamps have filaments?

Ans :

No

73. Which wire attached to an LED represents the positive terminal?

Ans :

The longer wire

74. What provides a complete path for electric current to flow?

Ans :

An electrical circuit

75. What term is used when an incandescent lamp stops glowing due to a broken filament?

Ans :

Fused



76. What simple device completes or breaks an electrical circuit?

Ans :

A switch

77. In which position ('ON' or 'OFF') is a circuit considered 'closed'?

Ans :

'ON' position

78. What is a representation of an electrical circuit using symbols called?

Ans :

Circuit diagram

79. In the symbol for an electric cell, which line represents the positive terminal?

Ans :

The long line

80. What are materials through which electric current can flow easily called?

Ans :

Conductors

81. What are materials through which electric current cannot pass called?

Ans :

Insulators

82. Name one material commonly used for making electrical wires.

Ans :

Copper

83. Name one material used to cover electrical wires for safety.

Ans :

Plastic (or Rubber)

84. Is the human body a conductor or an insulator of electricity?

Ans :

Conductor

85. What type of current (AC or DC) is usually supplied by batteries?

Ans :

Direct Current (DC)

## SHORT ANSWER QUESTION

86. Why is it important to handle electricity carefully? Mention the caution given in the text.

Ans :

Electricity can be dangerous if not handled carefully. Never experiment with the main power supply or portable generators; use only cells for experiments.

87. How are cells connected to form a battery? Explain the terminal connection.

Ans :

To form a battery, the positive terminal of one cell is connected to the negative terminal of the next cell. This combination provides more energy.

88. Describe the two terminals of an incandescent lamp.

Ans :

An incandescent lamp has two terminals : the metal case at the base and the metal tip at the centre of the base. These are connected to the filament wires.

89. Explain why an incandescent lamp glows when connected in a complete circuit.

Ans :

When connected in a complete circuit, current passes through the filament of the incandescent lamp. The filament gets hot and glows, producing light.

90. How do the terminals of an LED differ from each other?

Ans :

An LED has two terminals, a positive and a negative one. The positive terminal is attached to a longer wire, while the negative terminal is attached to the shorter wire.

91. Why does an LED only glow when connected in a specific way in a circuit?

Ans :

Current can pass through an LED in only one direction. It glows only when its positive terminal connects to the battery's positive terminal and its negative terminal connects to the battery's negative terminal.

92. What is the purpose of an electric switch in a circuit?

**Ans :**

An electric switch is a simple device used to either complete ('ON' position) or break ('OFF' position) an electrical circuit, controlling the flow of current.

93. Differentiate between an open circuit and a closed circuit.

**Ans :**

A closed circuit provides a complete path for current to flow, usually when the switch is 'ON', allowing a lamp to glow. An open circuit has a break, preventing current flow.

94. Why are symbols used to draw circuit diagrams?

**Ans :**

Using standard symbols makes it easier to draw and understand electrical circuits. It allows for clear representation regardless of language or location.

95. Explain the meaning of the symbols for a battery.

**Ans :**

The symbol for a battery shows multiple cell symbols connected in series. Each cell symbol has a long line (positive) and a short line (negative).

96. What is the difference between electrical conductors and insulators? Give one example of each.

**Ans :**

Conductors allow electric current to flow easily (e.g., copper wire). Insulators do not allow current to pass through (e.g., plastic).

97. Why are electrical wires typically made of metal like copper?

**Ans :**

Metals, especially copper, are very good conductors of electricity, allowing current to flow efficiently. Copper is used commonly due to cost and availability.

98. Why are electrical wires covered with plastic or rubber?

**Ans :**

Plastic and rubber are electrical insulators. Covering wires with these materials protects people from electric shocks, as insulators prevent current from passing through them.

99. Explain why a 'fused' incandescent lamp does not glow.

**Ans :**

A 'fused' lamp usually has a broken filament. This break creates an open circuit, stopping the flow of current through the filament, thus preventing the lamp from glowing.

100. Describe how you would use a simple tester to check if a material is a conductor or an insulator.

**Ans :**

Connect the material between the free ends of the tester circuit (cell, lamp, wires). If the lamp glows, the material is a conductor; if it doesn't, it's an insulator.

101. What is the conventional direction of electric current in a circuit?

**Ans :**

The conventional direction of electric current in an electrical circuit is considered to be from the positive terminal to the negative terminal of the electric cell or battery.

102. Explain how cells are connected when placed side-by-side in a device compartment.

**Ans :**

Inside the battery compartment, a thick wire or metal strip usually connects the positive terminal of one cell to the negative terminal of the next cell placed beside it.

103. Why might a torch lamp glow only when the switch is in one position?

**Ans :**

The switch completes the electrical circuit in one position ('ON'), allowing current to flow from the cells through the lamp, making it glow. In the other position ('OFF'), the circuit is broken.

104. What is the difference between AC and DC electricity mentioned in the text?



**Ans :**

DC (Direct Current) comes from batteries and powers small devices. AC (Alternating Current) comes from power plants via wall sockets and can run larger appliances.

- 105.** Why are '+' and '-' symbols marked on cells and battery compartments?

**Ans :**

These symbols indicate the positive (+) and negative (-) terminals. They help ensure cells are inserted correctly to form a proper battery connection for the device to work.

## LONG ANSWER QUESTION

- 106.** Describe the construction of a simple torchlight, mentioning its key components like cells, switch, and lamp (incandescent or LED) and how they work together.

**Ans :**

A torchlight typically contains electric cells combined as a battery, providing power. A switch controls the circuit. When switched ON, it completes the path for current to flow from the battery's positive terminal, through the lamp, and back to the negative terminal. This current makes the lamp's filament (incandescent) or LED glow, producing light. The switch breaks the circuit when OFF. The components are housed within a casing.

- 107.** Explain the process of making a simple electric circuit using a cell, an incandescent lamp, wires, and a switch, as described in Activities 3.6 and 3.9. Draw the corresponding circuit diagram using standard symbols.

**Ans :**

First, prepare wires by removing insulation from ends. Connect wires to a cell holder (or tape to cell) and a lamp holder (or tape to lamp). Construct a simple switch using drawing pins and a safety pin. Connect the cell, lamp, and switch in series using the wires. When the switch closes the circuit (safety pin touches both pins), current flows from the cell's positive terminal, through the switch, through the lamp's filament, and back

to the cell's negative terminal, making the lamp glow. Opening the switch breaks the circuit.

**Circuit Diagram :** (Should show symbols for cell, switch (ON/OFF), lamp, and connecting wires in series).

- 108.** Compare and contrast an incandescent lamp and an LED lamp used in torches, considering their structure, terminals, and how they produce light.

**Ans :**

Incandescent lamps have a glass bulb containing a thin filament. Current heats the filament, making it glow. They have two terminals (metal case, metal tip) connected internally to the filament, and current direction doesn't matter. LEDs, however, have no filament. They are diodes that emit light when current flows through them in a specific direction only. LEDs have two distinct terminals (positive - longer wire, negative - shorter wire). LEDs are generally more energy-efficient than incandescent lamps.

- 109.** You are given a conduction tester Figure (a) and various materials (metal key, plastic scale, rubber eraser, pencil lead, glass bangle). Describe how you would classify each as a conductor or insulator and explain the scientific reason behind the classification.



**Ans :**

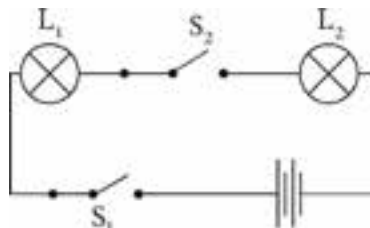
Use the tester by touching its free wire ends to each object. Observe if the lamp glows.

- (1) Metal Key : Lamp glows. Reason : Metals are good conductors, allowing easy current flow.
- (2) Plastic Scale : Lamp doesn't glow. Reason : Plastic is an insulator, blocking current flow.
- (3) Rubber Eraser : Lamp doesn't glow. Reason : Rubber is an insulator.
- (4) Pencil Lead : Lamp glows. Reason : Pencil lead (graphite, a form of carbon) is a conductor.
- (5) Glass Bangle : Lamp doesn't glow. Reason : Glass is an insulator. Classification depends on whether a material permits (conductor)

or resists (insulator) the passage of electric current.

110. Refer to Figure. Analyse the circuit and determine which lamp(s) ( $L_1$ ,  $L_2$ ) will glow under the following conditions :

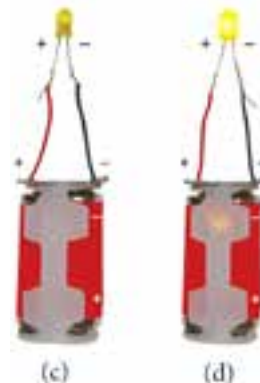
- (i)  $S_1$  ON,  $S_2$  OFF,
- (ii)  $S_1$  OFF,  $S_2$  ON,
- (iii)  $S_1$  ON,  $S_2$  ON,
- (iv)  $S_1$  OFF,  $S_2$  OFF. Justify each case.



Ans :

- (i)  $S_1$  ON,  $S_2$  OFF : Current flows from the battery through  $S_1$  and  $L_1$ . The path through  $S_2$  and  $L_2$  is broken. Only  $L_1$  will glow.
- (ii)  $S_1$  OFF,  $S_2$  ON : Current flows from the battery through  $S_2$  and  $L_2$ . The path through  $S_1$  and  $L_1$  is broken. Only  $L_2$  will glow.
- (iii)  $S_1$  ON,  $S_2$  ON : Current flows from the battery and splits. Path  $_1$  goes through  $S_1$  and  $L_1$ . Path  $_2$  goes through  $S_2$  and  $L_2$ . Both circuits are complete. Both  $L_1$  and  $L_2$  will glow.
- (iv)  $S_1$  OFF,  $S_2$  OFF : Both switches are open, breaking both parallel paths. No current flows through either lamp. Neither  $L_1$  nor  $L_2$  will glow.

111. Imagine you have two cells and an LED. Explain why simply connecting the cells in series might not be enough to make the LED glow. Describe the correct way to connect the battery (two cells in series) to the LED, referring to Figure.



Ans :

Connecting two cells in series correctly creates a battery, but the LED still needs correct polarity. LEDs allow current flow in only one direction. Therefore, the positive terminal of the battery (derived from the positive terminal of the first cell in series) must be connected to the LED's positive terminal (longer wire). Simultaneously, the negative terminal of the battery (derived from the negative terminal of the second cell) must connect to the LED's negative terminal (shorter wire). If connected in reverse Figure (d), the LED blocks the current, and it will not glow, even if the battery is functional.

112. Explain the importance of both conductors and insulators in everyday electrical appliances and wiring, giving examples of where each is used.

Ans :

Both are crucial for safe and functional electrical systems. Conductors (like copper in wires, metal parts in switches and plugs) are needed to allow electric current to flow easily to operate the appliance. Insulators (like plastic or rubber coverings on wires, casings of plugs, switches, and appliances) are essential for safety. They prevent the current from flowing to unintended places, like our hands, thus protecting us from electric shocks. Without conductors, devices wouldn't work; without insulators, they would be extremely dangerous.

113. Nihal's group listed uses of electricity under headings like Cooking, Lighting, Transportation etc.. Analyse this list and suggest two other ways these uses could be grouped, providing examples for your new categories.

Ans :



Nihal's grouping is functional (by purpose). Alternative groupings could be :

- (1) By Location : Grouping uses based on where they occur. Examples : Home (TV, refrigerator, fan, microwave), Public Spaces (streetlights, traffic signals, escalators), Industry (factory machinery, large motors, cranes).
- (2) By Energy Transformation : Grouping based on the primary energy output. Examples : Light (lamps, LEDs, TV screen), Heat (heater, oven, toaster, geyser), Motion (fan, mixer, train, water pump), Sound/Communication (radio, mobile phone, internet modem).

114. Refer to figure where Vidyut's lamp doesn't glow even after closing the circuit. List at least four possible reasons why the circuit might be faulty, based on the components discussed in the chapter.



Ans :

Possible reasons for the lamp not glowing in Figure could include :

- (1) Fused Lamp : The filament of the lamp might be broken, creating an open circuit.
- (2) Dead Cell : The electric cell might be exhausted and unable to provide sufficient current.
- (3) Incorrect Cell Connection : If it uses multiple cells (implied by 'circuit'), they might be connected incorrectly (e.g., positive to positive).
- (4) Loose Connections/Broken Wire : A wire might be broken internally, or connections at the cell holder, lamp holder, or switch terminals might be loose, causing an incomplete path.
- (5) Faulty Switch : The switch itself might not be making proper contact even when closed.
- (6) Insulation Not Removed : The insulation might not have been properly removed from the ends of the connecting wires.

## CASE BASED QUESTION

115. Ria found her old torchlight (using an incandescent lamp and two cells) wasn't working. She opened it and saw the cells looked fine. She took the lamp out and noticed the thin wire inside seemed intact. She cleaned the metal contacts inside the torch casing and where the lamp screws in, put everything back, but it still didn't work.
1. Besides a fused lamp (which Ria thinks is okay), what is another common reason related to the cells that could cause the torch to fail?
  2. Ria suspects the lamp might be fused despite looking intact. How could she test just the lamp using a known good cell and a piece of wire?
  3. If both the cells and the lamp are working, what could be a likely issue with the switch mechanism inside the torch?

Ans :

- (1) The cells might be inserted incorrectly, perhaps with the positive terminal of one touching the positive terminal of the other, or placed in reverse order.
  - (2) She could touch one terminal of the good cell to the metal tip (base center) of the lamp and use the wire to connect the other cell terminal to the lamp's metal casing. If the lamp glows, it's working; if not, it's likely fused.
  - (3) The internal contacts of the switch might be dirty, corroded, or bent, preventing them from making proper contact when the switch is moved to the 'ON' position, thus keeping the circuit open.
116. Arjun is building a simple circuit tester like the one in Figure (a). He uses a cell, a small LED, and wires. He tests it by touching the free wire ends together, but the LED doesn't light up. He checks the cell is new and the wires are properly stripped. He knows LEDs work differently from incandescent lamps.



1. What is the most likely reason the LED is not lighting up, assuming the cell and wires are fine?
2. How should Arjun connect the wires from the cell to the LED's terminals (longer and shorter wires) to make it glow?
3. If Arjun replaces the LED with a small incandescent lamp from a torch, would he need to worry about connecting it in a specific direction? Why or why not?

Ans :

- (1) The LED is likely connected in reverse polarity. Current can only flow through an LED in one direction.
- (2) He should connect the wire from the positive terminal of the cell to the longer wire (positive terminal) of the LED, and the wire from the negative terminal of the cell to the shorter wire (negative terminal) of the LED.
- (3) No, he wouldn't need to worry. An incandescent lamp glows regardless of which terminal is connected to the positive or negative side of the cell, as long as the circuit is complete.

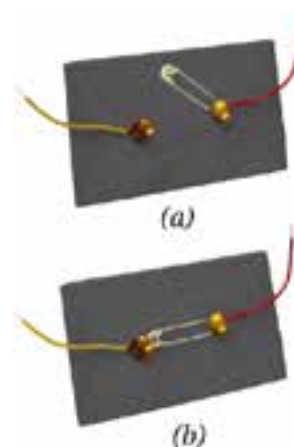
117. A science teacher demonstrates conductors and insulators. She uses a circuit with a battery and a lamp. When she places a copper strip between the test points, the lamp glows brightly. When she uses a piece of dry wood, the lamp doesn't glow. Then, she uses a graphite rod (pencil lead), and the lamp glows again.

1. Classify copper, dry wood, and graphite as conductors or insulators based on the demonstration.
2. Why is it important that the handles of tools used by electricians (like screwdrivers and pliers) are covered with plastic or rubber?
3. Could the teacher use pure water in this setup? Would the result likely change if salt was dissolved in the water?

Ans :

- (1) Copper is a conductor, dry wood is an insulator, and graphite is a conductor.
- (2) Plastic and rubber are insulators. This covering prevents the electricity from flowing through the metal tool into the electrician's hand, protecting them from electric shock.
- (3) Pure water is a poor conductor (almost an insulator), so the lamp might not glow or glow very dimly. However, salt water is a good conductor, so adding salt would likely make the lamp glow.

118. Maya is making a model house for a project and wants to install a simple light (using an LED) in one room, operated by a switch she made (like Figure). She uses a battery made of two cells correctly connected in series. She connects the battery, switch, and LED using wires, ensuring the LED polarity is correct.



1. Draw a circuit diagram for Maya's setup using standard symbols.
2. When Maya closes her handmade switch (the safety pin touches both drawing pins), what completes the circuit, allowing the LED to light up?
3. If Maya wanted the light to be brighter, what is one change she could consider regarding the battery (assuming the LED can handle it)?

Ans :

- (1) The diagram should show symbols for a two-cell battery, a switch (in open or closed state), and an LED, all connected in series with lines representing wires. Ensure the LED symbol points correctly relative to the battery polarity.
- (2) The metal safety pin bridges the gap between the two drawing pins, providing a continuous path made of conducting material for the current to flow through the switch.
- (3) She could try adding another cell in series to her battery (making it three cells). Connecting more cells in series generally provides more energy/voltage, which could make the LED brighter (if it's within the LED's safe operating range).

119. During a power outage, Aman tries to use an emergency lamp that works on a rechargeable battery. It doesn't turn on. He remembers it was working fine last week. He plugs it in to charge for



an hour using the house electricity (AC power), but it still doesn't work. He wonders if the battery or the lamp bulb is the problem.

1. The emergency lamp uses a battery (DC source) but is charged using AC power from the wall socket. What must be inside the lamp or its charger to make this possible?
2. If the lamp uses an LED, could Aman easily test if the LED itself is working using a small standard battery (like two AA cells)?
3. Besides the bulb or the battery, what other component, crucial for turning the lamp on and off, might have failed?

**Ans :**

- (1) There must be a circuit inside the lamp or charger that converts the AC power from the wall socket into DC power suitable for charging the battery.
- (2) Yes, if he can access the LED's terminals. He would need to connect the positive terminal of the AA battery (cells in series) to the LED's positive (longer) lead and the negative battery terminal to the LED's negative (shorter) lead.
- (3) The switch that turns the lamp on and off might be broken or faulty. Even if the battery is charged and the bulb is okay, a faulty switch could prevent the circuit from being completed.

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# CHAPTER 4

## THE WORLD OF METALS AND NON-METALS

### SUMMARY

#### 1. INTRODUCTION

Yashwant and Anandi explore how ironsmiths create tools using metals like iron. Their curiosity leads them to understand the unique properties that distinguish metals from other materials

#### 2. PROPERTIES OF METALS AND NON-METALS

##### 2.1 Malleability

Metals like copper, iron, and aluminum can be hammered into thin sheets without breaking. This property is called malleability. Non-metals like coal and sulfur are brittle and break upon hammering

##### 2.2 Ductility

Metals can be drawn into thin wires, a property known as ductility. For instance, copper and gold wires are used in jewellery and electrical appliances. Non-metals cannot be stretched into wires

##### 2.3 Sonority

Metals produce a clear ringing sound when struck, a property called sonority. Non-metals, in contrast, produce dull sounds when dropped

##### 2.4 Conductivity of Heat

Metals like iron and copper conduct heat well and are used for cooking vessels, while wood and plastic do not. That's why handles of cooking utensils are often made of non-metallic materials.



##### 2.5 Conductivity of Electricity

Metals are good conductors of electricity, making them ideal for electrical wiring. Non-metals and materials like rubber and wood are poor conductors and used as insulators

#### 3. INTERACTION WITH AIR AND WATER

##### 3.1 Rusting of Iron

Iron reacts with moist air, leading to the formation of rust, a reddish-brown deposit. Rusting requires both air and water. It can be prevented by painting, oiling, or galvanizing the metal

##### 3.2 Other Metals

Magnesium reacts with air to form magnesium oxide which is basic in nature. Some metals like sodium are highly reactive and must be stored in kerosene to prevent contact with moisture and air

##### 3.3 Non-metals in Air and Water

Non-metals like sulfur behave differently. When burned, sulfur forms sulfur dioxide, which dissolves in water to form an acidic solution. Non-metals generally do not react with water and are poor conductors

#### 4. IMPORTANCE OF NON-METALS

Despite not being shiny or hard, non-metals like oxygen, nitrogen, carbon, chlorine, and iodine

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play essential roles in life processes, agriculture, medicine, and water purification. This shows that non-metals are just as important as metals in daily life.

## NCERT ACTIVITY

### Activity 4.1 : Let us explore

**Caution :** *Caution-Conduct this activity under the supervision of your teacher or an adult.*

1. Collect some waste pieces of copper and aluminium, an iron nail, a piece of coal, a pea-sized lump of sulfur (gandhak), and a block of wood.
2. Recall the chapter 'Materials Around Us' in the Grade 6 Science textbook Curiosity and observe the appearances of the above items. Are they lustrous? Also, note whether they are hard or soft and record your observations in Table.
3. Now, place each of these items one by one on any hard surface and beat them with a hammer (Figure).



Figure : Beating an iron nail with a hammer

4. What do you think will happen? Do the objects become slightly flattened or do they break into pieces?
5. Record your observations in Table.

**Table : Appearance, hardness and effect of hammering on different objects or materials**

S. No.	Object/ Material	Appearance (lustrous/non-lustrous)	Hard/ Soft	Effect of hammering (flattens /breaks into pieces)
1.	Piece of copper			
2.	Piece of aluminium			

3.	Iron nail			
4.	Piece of coal			
5.	Lump of sulfur (pea-sized)			
6.	Block of wood			

Ans :

S. No.	Object/ Material	Appearance (lustrous/non-lustrous)	Hard/ Soft	Effect of hammering (flattens /breaks into pieces)
1.	Piece of copper	Lustrous	Hard	Flattens
2.	Piece of aluminium	Lustrous	Hard	Flattens
3.	Iron nail	Lustrous	Hard	Flattens
4.	Piece of coal	Non-lustrous	Hard	Breaks into pieces
5.	Lump of sulfur (pea-sized)	Non-lustrous	Soft	Breaks into pieces
6.	Block of wood	Non-lustrous	Hard	Breaks into pieces

### Activity 4.2 : Let us investigate

**Caution :** *Be careful while dropping the objects.*

1. Take a few objects, such as a metal spoon, a coin, a piece of coal, and a block of wood.
2. Drop them one by one from a certain height.
3. Do you notice any difference in the sound produced by these objects?

Ans :

Yes, there is a noticeable difference in the sound produced by these objects when dropped.

- (1) Metal spoon and coin : These objects produce a ringing sound. This property is called sonority.
- (2) Piece of coal : This produces a dull thud or breaks with a non-ringing sound.
- (3) Block of wood : This produces a dull thud. The difference in sound is due to the materials' ability to vibrate and produce resonant sounds. Metals are generally sonorous, while non-metals like coal and materials like wood are not.

**Activity 4.3 : Let us investigate**

**Caution :** This activity must be performed under the supervision of your teacher or an adult. Be careful while handling hot water.

1. Place a glass tumbler on a table. Fill it with hot water.
2. Take a metal spoon and a wooden spoon of almost the same size and thickness. Immerse both the spoons simultaneously into the hot water (Figure) and leave them undisturbed for a few minutes.



Figure : : Metal and wooden spoons immersed in hot water

3. Now, carefully touch the upper end of each spoon.

**Some discussion points :**

1. Which of the spoons get hotter?
2. What does this experiment tell us about heat transfer along the two spoons?

**Ans :**

- (1) The metal spoon will get hotter at its upper end.
- (2) This experiment tells us that the metal spoon is a good conductor of heat, meaning heat travels easily and quickly from the hot water through the metal to its upper end. The wooden spoon is a poor conductor of heat (an insulator), so its upper end does not get as hot, or takes much longer to get warm, because heat does not travel easily through wood.

**Activity 4.4 : Let us design and create**

Design an electric circuit, like the ‘tester’ circuit in the chapter ‘Electricity : Circuits and their Components’. Repeat the same activity using the materials listed below and record your observations in Table.

- (i) You may collect a few objects, such as a piece of aluminium foil, an iron nail, a lump of sulfur (pea-sized), a copper wire, a piece of

coal, a piece of dry wood, a stone, an eraser made of rubber and a piece of nylon rope.

- (ii) Predict which of these could make the bulb of the tester glow and which could not.

**Table : Conduction of electricity by different objects or materials**

S. No.	Object/ Material	Observation (bulb glows/ does not glow)	Good conductor of electricity or poor conductor of electricity
1.	Piece of aluminium foil		
2.	Iron nail		
3.	Lump of sulfur (pea-sized)		

**Ans :**

S. No.	Object/ Material	Observation (bulb glows/ does not glow)	Good conductor of electricity or poor conductor of electricity
1.	Piece of aluminium foil	Bulb glows	Good conductor
2.	Iron nail	Bulb glows	Good conductor
3.	Lump of sulfur (pea-sized)	Bulb does not glow	Poor conductor
4.	Copper wire	Bulb glows	Good conductor
5.	Piece of coal	Bulb does not glow	Poor conductor
6.	Piece of dry wood	Bulb does not glow	Poor conductor
7.	Stone	Bulb does not glow	Poor conductor
8.	Eraser made of rubber	Bulb does not glow	Poor conductor
9.	Piece of nylon rope	Bulb does not glow	Poor conductor

**Activity 4.5 : Let us experiment**

**Caution :** Be careful while handling iron nails.



1. Take a few shining iron nails. If you are using old iron nails, make sure to remove brown deposits from their surface by scrubbing them with the help of a small piece of sandpaper.
2. Take three clean, dry glass bottles or test tubes with tight-fitting caps or stoppers. Label them A, B, and C.
3. Take three iron nails and tie each iron nail with a thread.
4. Place one iron nail and some silica gel in the glass bottle 'A', and tighten the cap or stopper (Figure (a)). Silica gel makes the air dry. It is the substance that is used in small pouches in some medicine bottles, water bottles, shoe boxes, etc., to keep them dry.
5. Place one iron nail in the glass bottle 'B'. Pour freshly boiled and cooled water (to remove dissolved gases) into it until the iron nail is completely dipped in it. Now, pour some oil to form a layer over the surface of the water (Figure (b)). The layer of oil on the surface of the water prevents the air from dissolving in the water. Cap the glass bottle tightly.
6. Place one iron nail in the glass bottle 'C', and pour some water so that the iron nail is partially dipped. Keep this glass bottle unstoppered. This allows the iron nail to come into contact with both water and air, as shown in Figure (c).
7. Place all the glass bottles undisturbed at room temperature and observe the changes for 8-10 days.
8. Record your observations in Table .

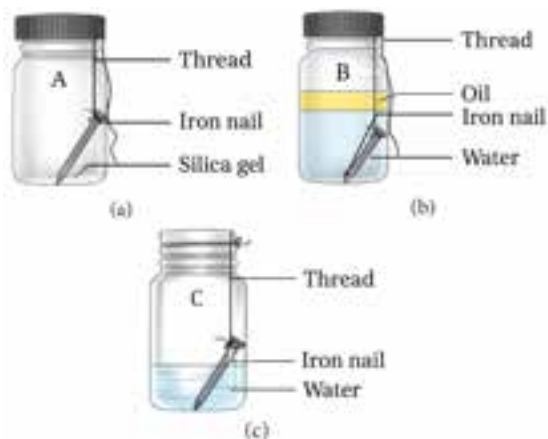


Figure : Glass bottles containing iron nails

Table : Formation of brown deposit on iron nails

Glass Bottle	Conditions		Observations (Brown deposit forms/does not form)
	Presence of water (Yes/No)	Presence of air (Yes/No)	
A	No	Yes	
B			
C			

Ans :

Glass Bottle	Conditions		Observations (Brown deposit forms/does not form)
	Presence of water (Yes/No)	Presence of air (Yes/No)	
A	No	Yes	Does not form
B	Yes	No	Does not form
C	Yes	Yes	Brown deposit forms

#### Activity 4.6 : Let us investigate (demonstration activity)

The teacher may demonstrate this activity.

**Caution :** It is advisable for students to wear protective eyeglasses and keep safe distance.

1. Take a magnesium ribbon about 3-4 centimetres long. Clean it by rubbing with a piece of sandpaper.
2. Hold it with a pair of tongs. Ignite the other end using a spirit lamp or a candle (Figure).



Figure : Burning magnesium ribbon

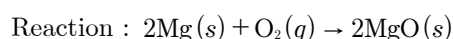
3. Let the magnesium ribbon burn. What do you observe?
4. You must have observed that magnesium ribbon burns with a dazzling white flame and changes into a white powder. Collect it on a watch glass. This powder is magnesium oxide. It is formed due to the reaction between magnesium and oxygen present in the air.

- Add a few drops of warm water to this white powder, stir it well, and check its nature.
- Recall the chapter 'Exploring Substances : Acidic, Basic and Neutral'. Find out whether the solution of magnesium oxide is acidic or basic or neutral in nature. You can use any acid-base indicator.
- What effect does this solution have on blue and red litmus papers?

Ans :

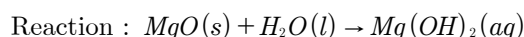
#### Observation of burning magnesium :

Magnesium ribbon burns with a dazzling, bright white flame and produces a white, powdery ash. This ash is magnesium oxide (MgO).



#### Checking the nature of magnesium oxide solution:

When the white powder (magnesium oxide) is dissolved in warm water, it forms magnesium hydroxide  $\text{Mg}(\text{OH})_2$ .



#### Effect on litmus paper :

- The solution of magnesium oxide in water (which is magnesium hydroxide) will turn red litmus paper blue.
- It will have no effect on blue litmus paper (or it might make it a slightly more intense blue if the original blue was pale).
- This indicates that the solution of magnesium oxide is basic in nature. Generally, oxides of metals are basic.

#### Activity 4.7 : Let us experiment (demonstration activity)

The teacher may demonstrate this activity.

**Caution :** This activity must be performed in a fume hood or well-ventilated area. Burning sulfur produces gases, which can be harmful if inhaled.

- Take a small amount of powdered sulfur in a deflagrating spoon (it is a long-handled metal spoon used in experiments to safely heat and burn substances Figure (a)). If a deflagrating spoon is not available, you may take a metallic cap of any bottle, wrap a metallic wire around it and give it the shape as shown in Figure (b).

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(a) Deflagrating spoon



(b) Improved deflagrating

- Heat it on a flame, and as soon as the sulfur starts burning, introduce the deflagrating spoon into a gas jar or glass tumbler Figure (c). Cover the gas jar or glass tumbler with a lid to ensure that the gas produced does not escape.



(c) Burning of sulfur

- Remove the lid after 3-4 minutes and take out the deflagrating spoon. Add a small quantity of water into the gas jar, quickly place the lid back and shake it so that the gas dissolves.
- Again, recall the chapter 'Exploring Substances : Acidic, Basic, and Neutral'. Using an acid-base indicator, check whether

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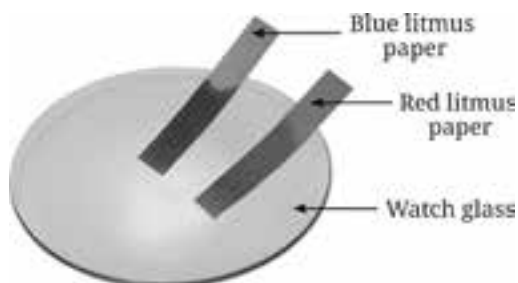
the solution obtained after the addition of water to the gas jar is acidic or basic or neutral.

5. What do you observe?

Ans :

Checking the nature of the solution with an indicator :

- (i) The solution obtained will turn blue litmus paper red.
- (ii) It will have no effect on red litmus paper.



(d) Testing of solution with litmus papers

This indicates that the solution of sulfur dioxide in water (sulfurous acid) is acidic in nature. Generally, oxides of non-metals are acidic.

#### Activity 4.8 : Let us explore

1. Take some sulfur powder in a glass tumbler.
2. Add a small amount of water to it.
3. What do you observe?

Ans :

When sulfur powder is added to water, you will observe that the sulfur does not dissolve in water. It may float on the surface or settle at the bottom, or form a suspension if stirred, but it does not chemically react with water at room temperature nor does it dissolve to form a solution.

### NCERT EXERCISE

1. Which metal is commonly used to make food packaging materials as it is cheaper and its thin sheets can be folded easily into any shape?
  - (i) Aluminium
  - (ii) Copper
  - (iii) Iron
  - (iv) Gold

Ans :

- (i) Aluminium

Aluminium is lightweight, highly malleable (can be beaten into thin sheets like foil), non-toxic, resistant to corrosion (forms a protective oxide layer), and relatively inexpensive compared to other metals like gold. Copper and iron are not typically used for flexible food packaging foil in the same way aluminium is (iron rusts, copper can react with some foods).

2. Which of the following metal catches fire when it comes in contact with water?
  - (i) Copper
  - (ii) Aluminium
  - (iii) Zinc
  - (iv) Sodium

Ans :

- (iv) Sodium

Sodium is a highly reactive alkali metal. It reacts vigorously and exothermically with water, producing hydrogen gas and sodium hydroxide. The heat generated by the reaction is often sufficient to ignite the hydrogen gas, causing it to catch fire or even explode. Copper, aluminium, and zinc do not react with water in this manner.

3. Why are only a few metals suitable for making jewellery?

Ans :

Only a few metals are suitable for making jewellery due to a combination of desirable properties :

1. Lustre : Jewellery metals should be shiny and attractive. Gold, silver, and platinum have high lustre.
2. Malleability and Ductility : They need to be easily workable – beaten into shapes (malleable) and drawn into wires (ductile) to create intricate designs. Gold and silver are highly malleable and ductile.
3. Resistance to Corrosion/Tarnish : Jewellery is often worn in contact with skin and exposed to air and moisture. Metals that do not easily corrode, rust, or tarnish are preferred. Gold and platinum are very resistant to corrosion. Silver tarnishes but can be polished.
4. Rarity and Value : Historically, the rarity of metals like gold and silver contributed to their value and desirability for ornamentation.
5. Non-reactivity/Hypoallergenic : Metals used for jewellery should ideally not react with the skin or cause allergic reactions. Gold and platinum are generally good in this regard.

Some people can be allergic to nickel, which is sometimes alloyed with other metals.

6. Hardness (when alloyed) : Pure gold is very soft, so it is often alloyed with other metals (like copper or silver) to increase its hardness and durability for everyday wear.

4. Match the uses of metals and non-metals given in Column I with the jumbled names of metals and non-metals given in Column II.

	Column I		Column II
(i)	Used in electrical wiring	(a)	OXYGEN
(ii)	Most malleable and ductile	(b)	CHLORINE
(iii)	Living organisms cannot survive without it.	(c)	COPPER
(iv)	Plants grow healthy when fertilisers containing it are added to the soil.	(d)	NITROGEN
(v)	Used in water purification	(e)	GOLD

Ans :

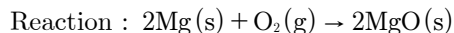
- (i) Used in electrical wiring → (c) COPPER (Copper is an excellent conductor of electricity and is ductile)
- (ii) Most malleable and ductile → (e) GOLD (Gold is known for its exceptional malleability and ductility)
- (iii) Living organisms cannot survive without it. → (a) OXYGEN (Oxygen is essential for respiration in most living organisms)
- (iv) Plants grow healthy when fertilisers containing it are added to the soil. → (d) NITROGEN (Nitrogen is a key component of fertilisers essential for plant growth)
- (v) Used in water purification → (b) CHLORINE (Chlorine is widely used as a disinfectant in water treatment)

5. What happens when oxygen reacts with magnesium and sulfur. What are the main differences in the nature of products formed?

Ans :

**When oxygen reacts with magnesium :**

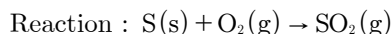
Magnesium (a metal) reacts with oxygen (usually when heated or ignited) to form magnesium oxide, a white solid powder.



The product, magnesium oxide (MgO), is a metallic oxide.

**When oxygen reacts with sulfur :**

Sulfur (a non-metal) reacts with oxygen (when heated or ignited) to form sulfur dioxide, a pungent gas.



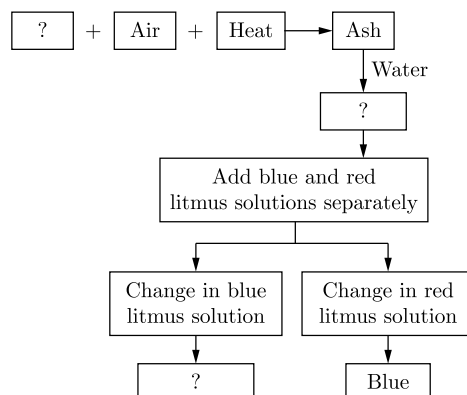
The product, sulfur dioxide  $\text{SO}_2$ , is a non-metallic oxide.

**Main differences in the nature of products formed :**

1. Type of Oxide : Magnesium forms a metallic oxide, while sulfur forms a non-metallic oxide.
2. Physical State at Room Temperature : Magnesium oxide is a solid. Sulfur dioxide is a gas.
3. Acidic/Basic Nature of Oxides (when dissolved in water) :
  - (i) Magnesium oxide (MgO), when dissolved in water, forms magnesium hydroxide  $\text{Mg(OH)}_2$ , which is basic in nature. Basic solutions turn red litmus blue.
  - (ii) Sulfur dioxide  $\text{SO}_2$ , when dissolved in water, forms sulfurous acid  $\text{H}_2\text{SO}_3$ , which is acidic in nature. Acidic solutions turn blue litmus red.

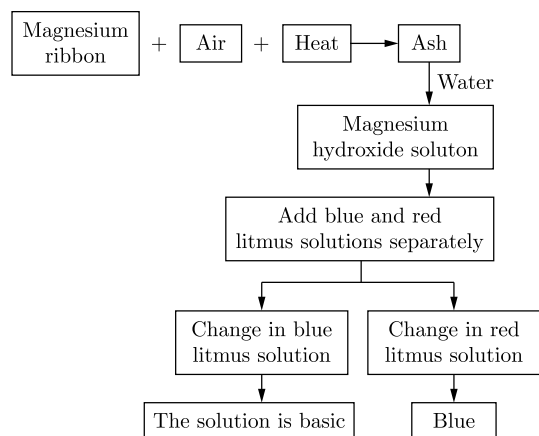
This is a general trend : metallic oxides are usually basic, and non-metallic oxides are usually acidic.

6. Complete the following flow chart :



Ans :





7. You are provided with the following materials. Discuss which material would be your choice to make a pan that is most suitable for boiling water and why?

Iron, copper, sulfur, coal, plastic, wood, cardboard

**Ans :**

My choice to make a pan most suitable for boiling water would be copper.

**Reasons :**

- Excellent Heat Conductor : Copper is one of the best conductors of heat among common materials. This means it will transfer heat from the stove to the water quickly and efficiently, allowing the water to boil faster and using less energy.
  - Malleability and Durability : Copper is malleable, so it can be shaped into a pan. It is also durable enough for regular use, although it might be softer than iron.
  - Resistance to Rust (compared to iron) : While copper can tarnish (form a greenish patina over time), it does not rust like iron, making it better for contact with water.
8. State with reason(s) whether the following statements are True [T] or False [F].
- Aluminium and copper are examples of non-metals used for making utensils and statues.
  - Metals form oxides when combined with oxygen, the solution of which turns blue litmus paper to red.
  - Oxygen is a non-metal essential for respiration.
  - Copper vessels are used for boiling water because they are good conductors of electricity.

**Ans :**

- (1) False

- (2) False  
(3) True  
(4) False

9. You are provided with three iron nails, each dipped in oil, water and vinegar. Which iron nail will not rust, and why?

**Ans :**

The iron nail dipped in oil will not rust (or will rust the least and very slowly).

**Why :**

Oil forms a protective barrier on the surface of the iron nail. This barrier prevents both air (oxygen) and moisture (water) from coming into direct contact with the iron. Since rusting requires both oxygen and water, the oil layer effectively inhibits the rusting process.

10. How do the different properties of metals and non-metals determine their uses in everyday life?

**Ans :**

Property	Metals (e.g., Iron, Copper, Aluminium)	Non-Metals (e.g., Sulfur, Oxygen, Carbon)
Conductivity	Good conductors of heat and electricity – used in wires and cooking utensils	Poor conductors – used as insulators
Malleability	Can be hammered into thin sheets – used in foil, car bodies	Cannot be hammered – break into pieces
Ductility	Can be drawn into wires – used in electric cables	Not ductile – cannot make wires
Lustre (Shininess)	Shiny – used in jewellery	Dull – not used for decoration
Strength	Strong and hard – used in construction and tools	Brittle – break easily

Importance in life	Not essential for life processes	Essential for oxygen breathing, nitrogen for plants	–
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11. One of the methods of protecting iron from getting rusted is to put a thin coating of zinc metal over it. Since sulfur does not react with water, can it be used for this purpose? Justify your answer.

Ans :

No, sulfur cannot be used to protect iron from rusting.

Although sulfur does not react with water, it is brittle and cannot form a protective coating on iron. Also, it does not stop air and water from reaching the iron.

Zinc is used because it forms a strong coating and protects iron even if scratched.

So, sulfur is not suitable for preventing rust.

12. An ironsmith heats iron before making tools. Why is heating necessary in this process?

Ans :

An ironsmith heats iron before making tools for several important reasons related to the properties of iron :

1. Increased Malleability and Ductility : Heating iron to a high temperature (making it red hot or even yellow hot) significantly increases its malleability (ability to be hammered into shape) and ductility (ability to be stretched or drawn). Cold iron is very hard and difficult to shape by hammering alone. Hot iron becomes much softer and more plastic, allowing the ironsmith to hammer it into the desired tool shape with less effort and without fracturing the metal.
2. Relief of Internal Stresses : The process of hammering and shaping can introduce internal stresses into the metal. Heating can help to relieve these stresses, making the final tool stronger and less prone to cracking.
3. Refinement of Grain Structure : Controlled heating and cooling (processes like annealing or normalizing) can help to refine the grain structure of the iron or steel. This can improve its mechanical properties, such as toughness and strength.
4. Forge Welding (Historically) : In some traditional blacksmithing techniques, pieces of

iron could be joined together by heating them to a very high temperature and hammering them together (forge welding).

5. Preparation for Hardening and Tempering (for steel) : If the iron contains enough carbon to be considered steel, heating is the first step in processes like hardening (heating and then rapidly cooling, e.g., by quenching in water or oil) and tempering (reheating to a lower temperature after hardening to reduce brittleness and increase toughness). These heat treatments are crucial for making tools that can hold a sharp edge and withstand impact.

### MULTIPLE CHOICE QUESTION

1. What common material do ironsmiths, like Sudarshan uncle, primarily use to make items like tawas, buckets and farming tools?  
(A) Copper (B) Aluminium  
(C) Iron (D) Wood

Ans :

(C) Iron

The introductory conversation reveals that the ironsmiths predominantly use iron metal to craft various daily use items and agricultural tools mentioned in the text.

2. Why does the ironsmith heat the iron block in a furnace before beating it with a hammer?  
(A) To clean the surface of the iron.  
(B) To make the iron softer and easier to shape.  
(C) To make the iron magnetic.  
(D) To add carbon to the iron.

Ans :

(B) To make the iron softer and easier to shape.

Heating metals like iron makes them more malleable and less resistant to deformation, allowing the ironsmith to shape the hot metal effectively by hammering it.

3. Which property refers to the shine typically exhibited by metals like copper, aluminium, and iron?  
(A) Ductility  
(B) Sonority  
(C) Hardness  
(D) Lustre (Metallic lustre)

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Ans :

(D) Lustre (Metallic lustre)

Lustre, specifically metallic lustre, is the term used to describe the characteristic shine or reflective quality observed on the surface of most metals.

4. How do materials like coal, sulfur and wood generally differ from metals like copper and iron in terms of appearance and hardness?
- (A) They are lustrous and harder than metals.  
 (B) They are non-lustrous and harder than metals.  
 (C) They are lustrous and softer than metals.  
 (D) They are non-lustrous and not as hard as metals.

Ans :

(D) They are non-lustrous and not as hard as metals.

The comparison based on Activity 4.1 observations, highlights that non-metals like coal and sulfur are typically dull (non-lustrous) and less hard compared to metals.

5. While most metals are hard solids, which metal is mentioned as being liquid at room temperature?
- (A) Sodium  
 (B) Potassium  
 (C) Mercury  
 (D) Gold

Ans :

(C) Mercury

The exceptions to the general hardness of metals, pointing out that mercury is unique among metals for being in a liquid state at standard room temperature.

6. Which metals are mentioned as being exceptions to the general rule of hardness, being soft enough to be cut with a knife?
- (A) Iron and Copper  
 (B) Gold and Silver  
 (C) Sodium and Potassium  
 (D) Aluminium and Zinc

Ans :

(C) Sodium and Potassium

Sodium and potassium are highlighted as unusual metals because they are exceptionally soft, unlike most other metals, and can easily be cut with a simple knife.

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7. What is the property called by which materials like copper and iron can be beaten into thin sheets without breaking?

- (A) Ductility  
 (B) Malleability  
 (C) Sonority  
 (D) Conductivity

Ans :

(B) Malleability

Malleability is defined as the physical property of a material, predominantly metals, that allows it to be hammered, pressed, or rolled into thin sheets without fracturing.

8. The use of thin silver foil on sweets and aluminium foil for wrapping food demonstrates which property of these metals?

- (A) High density  
 (B) Good conductivity  
 (C) Malleability  
 (D) Brittleness

Ans :

(C) Malleability

The ability to form very thin foils from silver and aluminium is a direct application of their high malleability, allowing them to be beaten or rolled extensively.

9. Which two metals are mentioned as being the MOST malleable?

- (A) Iron and Copper  
 (B) Aluminium and Zinc  
 (C) Gold and Silver  
 (D) Sodium and Potassium

Ans :

(C) Gold and Silver

The text explicitly states that gold and silver exhibit the highest degree of malleability among metals, meaning they can be hammered into extremely thin sheets.

10. What happens to materials like coal or sulfur when they are hammered, demonstrating they are not malleable?

- (A) They become flattened into sheets.  
 (B) They bend easily without breaking.  
 (C) They break into smaller pieces (brittle).  
 (D) They produce a ringing sound.

Ans :

(C) They break into smaller pieces (brittle).

Unlike malleable metals, coal and sulfur are described as brittle. When hammered, they shatter or break into pieces instead of flattening.

11. How is wood described in terms of its response to hammering, compared to metals and brittle non-metals?
- (A) It flattens like metals.
  - (B) It breaks into pieces like coal.
  - (C) It is neither malleable nor brittle.
  - (D) It becomes very hot instantly.

Ans :

(C) It is neither malleable nor brittle. Wood's behavior under hammering is distinct; it neither flattens into a sheet (like metals) nor shatters into pieces (like brittle non-metals).

12. What property allows materials, mainly metals, to be drawn out into thin wires?
- (A) Malleability
  - (B) Lustre
  - (C) Ductility
  - (D) Hardness

Ans :

(C) Ductility  
Ductility is the property of a material that enables it to be stretched or drawn out into the form of a thin wire without breaking.

13. The use of copper and aluminium in electrical fittings, and gold/silver in jewellery making often involves forming wires. This utilizes which property?
- (A) Sonority
  - (B) Brittleness
  - (C) High melting point
  - (D) Ductility

Ans :

(D) Ductility  
Making electrical wiring from copper/aluminium or wire-based jewellery from gold/silver relies heavily on the high ductility of these metals, allowing them to be drawn into wires.

14. Which metal is highlighted for its extreme ductility, where 1 gram can be drawn into a 2 km long wire?
- (A) Copper
  - (B) Aluminium
  - (C) Iron
  - (D) Gold

Ans :

(D) Gold  
The remarkable ductility of gold by stating that just one gram of it can be stretched into an incredibly long wire measuring about 2 kilometers.

15. Based on the property of ductility, would you expect to find wires made of coal or sulfur? Why?
- (A) Yes, because they are very strong materials.
  - (B) No, because coal and sulfur are non-metals and lack ductility.
  - (C) Yes, but only very thick wires can be made.
  - (D) No, because they melt easily when drawn.

Ans :

(B) No, because coal and sulfur are non-metals and lack ductility. Coal and sulfur are non-metals that are brittle, not ductile. Therefore, they cannot be drawn into wires like metals can.

16. Steel wires (mixture of iron and carbon) are used in suspension bridges and cranes primarily due to which combined properties?
- (A) Lustre and low density
  - (B) Brittleness and low cost
  - (C) High strength and ductility
  - (D) Poor conductivity and high malleability

Ans :

(C) High strength and ductility  
Steel is chosen for applications requiring support of heavy loads, like bridges and cranes, because it possesses both high tensile strength and sufficient ductility to be formed into strong cables/wires.

17. What is the property of metals that causes them to produce a ringing sound when struck or dropped?
- (A) Malleability
  - (B) Ductility
  - (C) Lustre
  - (D) Sonority

Ans :

(D) Sonority  
Sonority is the term describing the characteristic property of metals to produce a distinct ringing sound when they are hit or struck. Metals exhibiting this are called sonorous.

18. The ringing sound of a school bell or ghungroos (dancing bells) is attributed to which property of the metal they are made from?



- (A) Electrical conductivity
- (B) Sonority
- (C) Malleability
- (D) Hardness

Ans :

- (B) Sonority

The use of metals in bells and ghungroos is specifically to take advantage of their sonority – their ability to produce a clear, ringing sound upon impact.

19. How does the sound produced by dropping a piece of coal or wood typically differ from dropping a metal coin?
- (A) Coal/wood produce a louder ringing sound.
  - (B) Metal coins produce a dull thud.
  - (C) Coal/wood produce a dull sound; metal produces a ringing sound.
  - (D) Both produce identical sounds.

Ans :

- (C) Coal/wood produce a dull sound; metal produces a ringing sound.

Activity 4.2 contrasts the sounds : metals like coins produce a ringing (sonorous) sound, while non-metals like coal or wood produce a dull sound when dropped.

20. What is the process called where heat transfers from one point to another within a material?
- (A) Radiation
  - (B) Convection
  - (C) Conduction
  - (D) Insulation

Ans :

- (C) Conduction

Conduction is the mode of heat transfer occurring within a material (or between materials in contact) where heat energy moves from a hotter region to a colder region without bulk movement of the material itself.

21. Imagine why does the metal spoon become hotter than the wooden spoon when both are placed in hot water?
- (A) Wood absorbs coldness from the water.
  - (B) Metal is a better conductor of heat than wood.
  - (C) Wood has a higher density than metal.
  - (D) Metal attracts heat energy more strongly.

Ans :

- (B) Metal is a better conductor of heat than wood.

The experiment demonstrates that metals are good conductors of heat, allowing heat to travel quickly along the spoon, while wood is a poor conductor (insulator), transferring heat slowly.

22. Why are cooking vessels typically made of metals, while their handles are often made of wood or plastic?
- (A) Metals are cheaper; handles need flexibility.
  - (B) Metals conduct heat well (for cooking); handles are insulators (prevent burns).
  - (C) Metals are sonorous; handles need to be quiet.
  - (D) Metals are malleable; handles need to be strong.

Ans :

- (B) Metals conduct heat well (for cooking); handles are insulators (prevent burns).

Cooking requires efficient heat transfer, hence metal vessels (good conductors). Handles are made of poor conductors (insulators) like wood/plastic to prevent heat from reaching the user's hand.

23. Materials that allow electricity to flow through them easily are known as what?
- (A) Poor conductors (Insulators)
  - (B) Semiconductors
  - (C) Good conductors of electricity
  - (D) Resistors

Ans :

- (C) Good conductors of electricity

The definition provided states that materials permitting easy passage of electric current are called good conductors of electricity. Metals are prime examples.

24. Based on electrical conductivity tests (Activity 4.4), materials like aluminum foil and iron nails are classified as good conductors. Why?
- (A) They are very hard materials.
  - (B) They complete the circuit, allowing the tester bulb to glow.
  - (C) They produce a ringing sound when tested.
  - (D) They prevent the bulb from glowing.

Ans :

- (B) They complete the circuit, allowing the tester bulb to glow.

The glowing bulb in the tester circuit indicates that the material being tested allows current to

flow, completing the circuit, which is characteristic of a good conductor.

25. Why do electricians often use screwdrivers with plastic handles and wear rubber gloves?
- (A) Plastic and rubber provide a better grip.  
 (B) Plastic and rubber are good conductors of electricity.  
 (C) Plastic and rubber are poor conductors (insulators), protecting from electric shock.  
 (D) Plastic and rubber are more durable than metal.

Ans :

(C) Plastic and rubber are poor conductors (insulators), protecting from electric shock.

Plastic and rubber are electrical insulators. Using them for handles and gloves prevents electricity from flowing through the electrician's body, providing crucial protection against shocks.

26. Which list correctly summarizes the general physical properties of MOST metals?
- (1) Lustrous, Malleable, Ductile  
 (2) Poor conductors of heat and electricity  
 (3) Generally hard and sonorous
- (A) 1 and 2 only  
 (B) 2 and 3 only  
 (C) 1 and 3 only  
 (D) 1, 2, and 3

Ans :

(C) 1 and 3 only

Metals are typically lustrous, malleable, ductile, hard, sonorous, and good conductors of heat/electricity. Statement 2 incorrectly describes them as poor conductors. Statements 1 and 3 are generally correct.

27. What is the brownish deposit called that forms on iron objects when left exposed to moist air?
- (A) Corrosion  
 (B) Oxide  
 (C) Rust  
 (D) Tarnish

Ans :

(C) Rust

The specific term for the reddish-brown coating that develops on iron surfaces due to reaction with air and moisture is rust.

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28. According to Activity 4.5, what two conditions are essential for the rusting of iron?
- (A) Presence of dry air only  
 (B) Presence of water only  
 (C) Presence of both air (oxygen) and water (moisture)  
 (D) Presence of oil and sunlight

Ans :

(C) Presence of both air (oxygen) and water (moisture)

The experiment with three bottles demonstrates that rust forms on iron only when it is exposed simultaneously to both air (specifically oxygen) and water (moisture).

29. What substance was placed in bottle 'A' in Activity 4.5 to ensure the air inside remained dry?
- (A) Cotton wool  
 (B) Oil  
 (C) Boiled water  
 (D) Silica gel

Ans :

(D) Silica gel

Silica gel is a drying agent (desiccant) used in bottle A to absorb any moisture present in the air, creating a dry environment for the iron nail.

30. Why was boiled and cooled water used in bottle 'B' and covered with oil in Activity 4.5?
- (A) To make the water acidic.  
 (B) To remove dissolved air/oxygen from the water and prevent more from dissolving.  
 (C) To keep the iron nail clean.  
 (D) To speed up the rusting process.

Ans :

(B) To remove dissolved air/oxygen from the water and prevent more from dissolving.

Boiling removes dissolved gases like oxygen from water. Cooling it prevents re-absorption, and the oil layer acts as a barrier against atmospheric air dissolving back into the water.

31. What is the general term for the gradual deterioration of metal surfaces caused by reactions with air, water, or other substances in the environment?
- (A) Rusting  
 (B) Galvanisation  
 (C) Malleability  
 (D) Corrosion

Ans :

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(D) Corrosion

Corrosion is the broad term for the process where metals degrade due to chemical reactions with their surroundings. Rusting is a specific type of corrosion affecting iron.

32. Besides the brown coating on iron (rust), what color coating is mentioned as forming on copper objects due to corrosion?

(A) Black  
(B) White  
(C) Green  
(D) Yellow

Ans :

(C) Green

The copper objects exposed to the atmosphere can develop a characteristic green coating or patina as a result of corrosion.

33. What color coating typically forms on silver objects due to corrosion/tarnishing?

(A) Green  
(B) Brown  
(C) White  
(D) Black

Ans :

(D) Black

Silver objects are noted to develop a black coating on their surface over time due to reaction with substances in the air, a process commonly called tarnishing.

34. Painting, oiling, greasing, and galvanisation are mentioned as methods for what purpose related to iron?

(A) Making iron more lustrous  
(B) Increasing iron's hardness  
(C) Preventing the rusting of iron  
(D) Making iron easier to bend

Ans :

(C) Preventing the rusting of iron

These methods create a protective barrier between the iron surface and the moist air, thereby preventing or slowing down the process of rusting.

35. What is galvanisation, mentioned as a method to prevent rusting?

(A) Applying a layer of paint on iron.  
(B) Applying a layer of oil on iron.  
(C) Applying a protective layer of zinc metal on iron.  
(D) Mixing iron with carbon to make steel.

Ans :

(C) Applying a protective layer of zinc metal on iron.

Galvanisation is specifically defined as the process of coating iron or steel with a layer of zinc to protect it from corrosion (rusting).

36. The Iron Pillar of Delhi is famous for resisting rust for over 1600 years. What does this indicate about ancient Indian technology?

(A) They preferred using copper over iron.  
(B) They had advanced skills in metal technology and rust prevention.  
(C) They built the pillar in a very dry location.  
(D) The pillar is actually made of stainless steel.

Ans :

(B) They had advanced skills in metal technology and rust prevention.

The pillar's remarkable resistance to rusting over centuries suggests sophisticated knowledge of metallurgy and techniques for creating corrosion-resistant iron alloys in ancient India.

37. What happens when a magnesium ribbon is burnt in air (Activity 4.6)?

(A) It melts into a silver liquid.  
(B) It burns with a dazzling white flame, forming a white powder.  
(C) It produces a black soot.  
(D) It turns green and brittle.

Ans :

(B) It burns with a dazzling white flame, forming a white powder.

The demonstration activity shows magnesium burning intensely with a bright white flame upon ignition in air, leaving behind a white powdery residue.

38. What is the white powder formed when magnesium burns in air?

(A) Magnesium sulfate  
(B) Magnesium hydroxide  
(C) Magnesium carbonate  
(D) Magnesium oxide

Ans :

(D) Magnesium oxide

The white powder is identified as magnesium oxide, formed by the chemical reaction between magnesium metal and oxygen present in the air during combustion.

39. When magnesium oxide powder is dissolved in water and tested with litmus paper, what result indicates its nature?
- (A) It turns blue litmus red, indicating it is acidic.
  - (B) It turns red litmus blue, indicating it is basic.
  - (C) It causes no change in either litmus, indicating it is neutral.
  - (D) It bleaches both litmus papers.

Ans :

(B) It turns red litmus blue, indicating it is basic. The solution of magnesium oxide turns red litmus paper blue, which is the characteristic behavior of a basic substance.

40. Based on the magnesium oxide result, what is the general nature of oxides formed by metals?
- (A) Acidic
  - (B) Basic
  - (C) Neutral
  - (D) Variable

Ans :

(B) Basic  
The experiment with magnesium leads to the generalization that oxides produced by the reaction of metals with oxygen are typically basic in nature.

41. Which metal is mentioned as reacting vigorously with oxygen and water, requiring storage in kerosene?
- (A) Magnesium
  - (B) Iron
  - (C) Sodium
  - (D) Copper

Ans :

(C) Sodium  
Sodium is highlighted as a highly reactive metal that reacts strongly with both air (oxygen) and water, necessitating storage under kerosene to prevent contact.

42. What gas is produced when sulfur powder is burnt in a deflagrating spoon ?
- (A) Carbon dioxide
  - (B) Sulfur trioxide
  - (C) Sulfur dioxide
  - (D) Hydrogen sulfide

Ans :

(C) Sulfur dioxide

Burning sulfur in the presence of air (oxygen) results in the formation of sulfur dioxide gas, which has a pungent odor.

43. When the gas produced by burning sulfur (sulfur dioxide) is dissolved in water, what is the nature of the resulting solution (sulfurous acid)?
- (A) Basic (turns red litmus blue)
  - (B) Neutral (no change in litmus)
  - (C) Acidic (turns blue litmus red)
  - (D) Salty (precipitates form)

Ans :

(C) Acidic (turns blue litmus red)  
The solution formed by dissolving sulfur dioxide in water is sulfurous acid. Testing with litmus shows it turns blue litmus red, indicating an acidic nature.

44. Based on the sulfur experiment, what is the general nature of oxides formed by non-metals?
- (A) Basic
  - (B) Neutral
  - (C) Acidic
  - (D) Always gaseous

Ans :

(C) Acidic  
Contrasting with metals, the experiment with sulfur leads to the generalization that oxides formed by non-metals reacting with oxygen are typically acidic in nature.

45. Which non-metal is stored in water because it catches fire when exposed to atmospheric air?
- (A) Sulfur
  - (B) Carbon
  - (C) Nitrogen
  - (D) Phosphorus

Ans :

(D) Phosphorus  
Phosphorus is mentioned as a highly reactive non-metal that spontaneously ignites in air, hence it is commonly stored under water for safety.

46. Which set of properties generally describes non-metals like sulfur and phosphorus?
- (A) Lustrous, Malleable, Ductile, Good conductors
  - (B) Dull, Brittle, Non-ductile, Poor conductors
  - (C) Sonorous, Hard, Good conductors, Basic oxides
  - (D) Liquid at room temp, High density, Acidic oxides



Ans :

(B) Dull, Brittle, Non-ductile, Poor conductors  
Non-metals are typically characterized by being dull in appearance, brittle (neither malleable nor ductile), non-sonorous, and poor conductors of heat and electricity.

47. What is an element defined of an element?  
(A) A mixture of two or more substances.  
(B) A substance that can be broken down into simpler substances.  
(C) A substance that cannot be broken down into simpler substances.  
(D) A compound formed by metals and non-metals.

Ans :

(C) A substance that cannot be broken down into simpler substances.

An element is defined as a fundamental substance that cannot be chemically decomposed into simpler substances. Metals and non-metals are categories of elements.

48. Which non-metal is essential for respiration and survival of living organisms?  
(A) Nitrogen  
(B) Carbon  
(C) Oxygen  
(D) Chlorine

Ans :

(C) Oxygen

The explicitly states that oxygen, a non-metal, is vital for breathing (respiration) and thus essential for the survival of most life forms.

49. Which non-metal is described as the building block of all life forms and a key component of proteins, fats, and carbohydrates?  
(A) Oxygen  
(B) Nitrogen  
(C) Sulfur  
(D) Carbon

Ans :

(D) Carbon

Carbon is highlighted as fundamental to life, forming the backbone of essential organic molecules like proteins, fats, and carbohydrates necessary for growth and energy.

50. Which non-metal is crucial for plant growth and is a major component of fertilizers?  
(A) Carbon  
(B) Oxygen  
(C) Nitrogen  
(D) Iodine

Ans :

(C) Nitrogen

Nitrogen is mentioned as an essential nutrient for healthy plant growth and is a primary ingredient used in the manufacturing of agricultural fertilizers.

51. Chlorine (non-metal) is commonly used for which purpose?  
(A) Making electrical wires  
(B) Water purification  
(C) Making jewellery  
(D) Preventing rust

Ans :

(B) Water purification

The text lists chlorine as a non-metal frequently employed in processes to purify water, making it safe for drinking.

52. A solution of which non-metal is used as an antiseptic applied to wounds?  
(A) Sulfur  
(B) Phosphorus  
(C) Iodine  
(D) Carbon

Ans :

(C) Iodine

An iodine solution (like tincture of iodine) is mentioned as a common antiseptic applied to wounds to prevent infection, utilizing the properties of this non-metal.

53. What are alloys, mentioned in the “Science and Society” section?  
(A) Pure non-metals  
(B) Naturally occurring minerals  
(C) Mixtures of two or more metals, or a metal and a non-metal  
(D) Oxides of metals

Ans :

(C) Mixtures of two or more metals, or a metal and a non-metal

Alloys are defined as materials made by mixing two or more metals together, or by mixing a

metal with one or more non-metals (like carbon in steel).

54. Why is aluminium often used for food packaging ?
- (A) It is magnetic and strong.  
 (B) It is highly ductile and conducts electricity well.  
 (C) It is malleable (forms thin sheets), relatively cheap, and can be easily shaped.  
 (D) It is brittle and transparent.

Ans :

(C) It is malleable (forms thin sheets), relatively cheap, and can be easily shaped.

Aluminium foil is suitable for packaging because it's highly malleable (can be made very thin), cost-effective, and easily foldable, providing a good barrier.

55. **Assertion (A)** : Metal oxides are generally basic in nature.

**Reason (R)** : Solutions of metal oxides turn red litmus paper blue.

- (A) Both A and R are true, and R is the correct explanation of A.  
 (B) Both A and R are true, but R is not the correct explanation of A.  
 (C) A is true, but R is false.  
 (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.

Metal oxides are indeed generally basic (Assertion A). The fact that their solutions turn red litmus blue (Reason R) is the experimental evidence confirming their basic nature.

56. Why are metals like gold and silver suitable for making jewellery ?
- (A) They are poor conductors and very hard.  
 (B) They are brittle and react easily with air.  
 (C) They are lustrous, malleable, ductile, and relatively unreactive (don't corrode easily).  
 (D) They are magnetic and have low density.

Ans :

(C) They are lustrous, malleable, ductile, and relatively unreactive (don't corrode easily).

Jewellery requires materials that are attractive (lustrous), can be shaped easily (malleable, ductile), and resist tarnishing or corrosion over time (unreactive).

57. What is the main difference in the nature of the oxides formed when magnesium (metal) and sulfur (non-metal) react with oxygen ?

- (A) Both form acidic oxides.  
 (B) Both form basic oxides.  
 (C) Magnesium forms a basic oxide; sulfur forms an acidic oxide.  
 (D) Magnesium forms a neutral oxide; sulfur forms a basic oxide.

Ans :

(C) Magnesium forms a basic oxide; sulfur forms an acidic oxide.

Metals, such as magnesium, generally form basic oxides, whereas non-metals, such as sulfur, typically form acidic oxides.

58. You need to choose a material to make a pan for boiling water. From the list (Iron, copper, sulfur, coal, plastic, wood), which metal is generally the best choice and why?

- (A) Wood, because it doesn't get too hot.  
 (B) Copper, because it is an excellent conductor of heat.  
 (C) Sulfur, because it melts easily.  
 (D) Plastic, because it is lightweight.

Ans :

(B) Copper, because it is an excellent conductor of heat.

For boiling water efficiently, the pan material should transfer heat quickly from the stove to the water. Metals like copper and iron are good heat conductors, with copper being particularly excellent, making it a superior choice for cookware.

59. An iron nail dipped in vinegar (acid) will likely rust faster than one in plain water. Why might an iron nail dipped in oil not rust at all ?

- (A) Oil makes the iron stronger.  
 (B) Oil reacts with iron to form a protective layer.  
 (C) Oil prevents both air (oxygen) and water from reaching the iron surface.  
 (D) Oil dissolves the rust as it forms.

Ans :

(C) Oil prevents both air (oxygen) and water from reaching the iron surface.

Rusting requires both air and water. A layer of oil acts as a barrier, preventing contact between the iron nail and these essential components for rusting.

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60. Why can't sulfur be used instead of zinc for galvanising iron, even though sulfur doesn't react with water ?
- (A) Sulfur is too expensive.  
 (B) Sulfur is brittle and cannot form a protective coating; zinc protects sacrificially.  
 (C) Sulfur reacts violently with iron.  
 (D) Sulfur is a better conductor than zinc.

Ans :

(B) Sulfur is brittle and cannot form a protective coating; zinc protects sacrificially. Galvanising requires a malleable metal (like zinc) to form a continuous coating. Sulfur is brittle and non-metallic. Furthermore, zinc provides sacrificial protection, which sulfur cannot.

## MATCHING TYPE QUESTION

61. Match the physical property in Column A with its correct description or example in Column B :

	Column A		Column B
1.	Malleability	A.	Property of producing a ringing sound
2.	Ductility	B.	Allows heat to pass through easily
3.	Sonority	C.	Can be beaten into thin sheets like aluminium foil
4.	Heat Conduction	D.	Can be drawn into wires like copper wires

- (a) 1-C, 2-D, 3-A, 4-B    (b) 1-D, 2-C, 3-B, 4-A  
 (c) 1-C, 2-A, 3-D, 4-B    (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

Malleability is the ability to be hammered into sheets. Ductility is being drawable into wires. Sonority refers to producing a ringing sound. Heat conduction allows easy heat passage.

62. Match the substance in Column A with its characteristic property or behavior in Column B :

	Column A		Column B
1.	Iron	A.	Liquid metal at room temperature

2.	Sulfur	B.	Stored in kerosene due to high reactivity
3.	Mercury	C.	Forms rust in the presence of air and water
4.	Sodium	D.	Non-metal that is brittle and non-ductile

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-D, 2-A, 3-C, 4-B  
 (c) 1-C, 2-B, 3-D, 4-A  
 (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

Iron rusts when exposed to moist air. Sulfur is a brittle non-metal. Mercury is a liquid metal. Sodium is highly reactive and stored in kerosene to prevent reactions.

63. Match the reaction or product in Column A with the nature of the oxide or process in Column B :

	Column A		Column B
1.	Magnesium + Oxygen	A.	Forms an acidic oxide
2.	Sulfur + Oxygen	B.	Process of deterioration of metals
3.	Iron + Oxygen + Water	C.	Forms a basic oxide
4.	Corrosion	D.	Results in the formation of rust

- (a) 1-A, 2-C, 3-B, 4-D  
 (b) 1-C, 2-A, 3-D, 4-B  
 (c) 1-C, 2-D, 3-A, 4-B  
 (d) 1-B, 2-A, 3-D, 4-C

Ans :

- (b) 1-C, 2-A, 3-D, 4-B

Magnesium burns in oxygen to form magnesium oxide, which is basic. Sulfur burns to form sulfur dioxide, an acidic oxide. Iron reacts with oxygen and water to form rust. Corrosion is the general deterioration of metals.

64. Match the material in Column A with its common use based on its properties in Column B :

	Column A		Column B
1.	Copper	A.	Used as an antiseptic on wounds

2.	Gold	B.	Used for making electrical wires
3.	Nitrogen	C.	Used in fertilisers for plant growth
4.	Iodine	D.	Highly malleable, used for jewellery

- (a) 1-D, 2-B, 3-A, 4-C (b) 1-B, 2-C, 3-D, 4-A  
 (c) 1-B, 2-D, 3-C, 4-A (d) 1-A, 2-D, 3-B, 4-C

Ans :

- (c) 1-B, 2-D, 3-C, 4-A

Copper is an excellent conductor, used for electrical wires. Gold's malleability and lustre make it ideal for jewellery. Nitrogen is crucial for plant growth, used in fertilisers. Iodine solution is used as an antiseptic.

65. Match the general property of metals/non-metals in Column A with the correct classification in Column B :

	Column A		Column B
1.	Generally poor conductors of electricity	A.	Property of most metals
2.	Exhibit metallic lustre	B.	Property of most non-metals
3.	Can be cut with a knife (e.g., Potassium)	C.	Exception to general hardness of metals
4.	Oxides are generally acidic	D.	Chemical property of non-metals

- (a) 1-A, 2-B, 3-D, 4-C  
 (b) 1-B, 2-A, 3-C, 4-D  
 (c) 1-B, 2-C, 3-A, 4-D  
 (d) 1-D, 2-A, 3-C, 4-B

Ans :

- (b) 1-B, 2-A, 3-C, 4-D

Non-metals are generally poor electrical conductors. Metals typically exhibit lustre. Potassium being soft is an exception for metals. Oxides of non-metals are generally acidic in nature.

### VERY SHORT QUESTION

66. What is the property by which materials can be beaten into thin sheets called?

Ans :

Malleability

67. Name the most malleable metals mentioned in the text.

Ans :

Gold and silver

68. What term describes materials that break into pieces when hammered?

Ans :

Brittle

69. What is the property by which materials can be drawn into wires called?

Ans :

Ductility

70. Which metal is so ductile that 1 gram can be drawn into a 2 km long wire?

Ans :

Gold

71. What is the property of metals that enables them to produce a ringing sound called?

Ans :

Sonority

72. Are metals generally good or poor conductors of heat?

Ans :

Good conductors

73. Are non-metals generally good or poor conductors of electricity?

Ans :

Poor conductors

74. Name the metal that is found in a liquid state at room temperature.

Ans :

Mercury

75. Name two metals that are soft enough to be cut with a knife.

Ans :

Sodium and potassium

76. What is the brown deposit formed on iron objects when exposed to moist air called?



Ans :

Rust

77. What is the process of formation of rust on iron called?

Ans :

Rusting

78. What two conditions are essential for the rusting of iron?

Ans :

Presence of both water and air (oxygen)

79. What is the general term for the gradual deterioration of metal surfaces caused by air, water, or other substances?

Ans :

Corrosion

80. What colour flame is produced when magnesium ribbon burns?

Ans :

Dazzling white flame

81. What is the chemical nature (acidic/basic/neutral) of metal oxides generally?

Ans :

Basic

82. What is the chemical nature (acidic/basic/neutral) of non-metal oxides generally?

Ans :

Acidic

83. Name the non-metal that is stored in water because it catches fire in air.

Ans :

Phosphorus

84. What is a substance called that cannot be broken down into simpler substances?

Ans :

Element

85. Name the non-metal essential for breathing.

Ans :

Oxygen

## SHORT ANSWER QUESTION

86. Explain the property of malleability with an example of its use.

Ans :

Malleability is the property allowing materials to be beaten into thin sheets. For example, aluminium is malleable and is used to make thin foils for wrapping food.

87. Why are materials like coal and sulfur considered brittle?

Ans :

Coal and sulfur are brittle because they break into pieces when hammered or subjected to pressure, unlike metals which flatten. They do not show malleability.

88. Explain the property of ductility using the example of electrical wiring.

Ans :

Ductility allows materials to be drawn into wires. Metals like copper and aluminium are ductile and used for electrical wires because they conduct electricity well.

89. How does the property of sonority help us identify a metal object when dropped?

Ans :

Sonority is the property of producing a ringing sound. When a metal object like a spoon is dropped, it makes a distinct ringing sound, unlike wood or coal which produce dull sounds.

90. Why are cooking vessels commonly made of metals?

Ans :

Cooking vessels are made of metals because metals are good conductors of heat. This allows heat from the stove to transfer efficiently to the food being cooked.

91. Why are handles of cooking utensils often made of wood or plastic?

Ans :

Wood and plastic are poor conductors of heat (insulators). Using them for handles prevents heat from transferring to the user's hand, making the utensil safe to hold during cooking.

92. Explain why electricians wear rubber gloves while working.

Ans :

Rubber is a poor conductor of electricity (insulator). Rubber gloves protect electricians from electric shock by preventing electricity from flowing through their hands.

93. How can you distinguish between a metal and a non-metal based on electrical conductivity?

Ans :

Metals are generally good conductors of electricity, allowing current to pass easily (making a tester bulb glow). Non-metals are generally poor conductors, resisting current flow (tester bulb doesn't glow).

94. What is corrosion? Give an example other than rusting of iron.

Ans :

Corrosion is the gradual deterioration of metal surfaces due to reactions with substances like air or water. An example is the green coating formed on copper objects.

95. What happens when magnesium ribbon is burnt in air? What is the product formed?

Ans :

Magnesium ribbon burns in air with a dazzling white flame, producing a white powder. This powder is magnesium oxide, formed by the reaction between magnesium and oxygen.

96. How can you show that the oxide of magnesium is basic in nature?

Ans :

Dissolve the magnesium oxide powder in water and test the solution with litmus paper. The solution turns red litmus paper blue, indicating it is basic in nature.

97. What happens when sulfur is burnt in air and the resulting gas is dissolved in water?

Ans :

Burning sulfur in air produces sulfur dioxide gas. When this gas dissolves in water, it forms sulfurous acid.

98. How can you show that the solution formed by dissolving burnt sulfur gas in water is acidic?

Ans :

Test the solution with litmus paper. The solution turns blue litmus paper red, indicating it is acidic in nature.

99. Why is sodium metal stored in kerosene?

Ans :

Sodium reacts vigorously with both oxygen (air) and water, generating heat. Storing it in kerosene prevents contact with air and moisture, thus preventing these reactions.

100. Give two physical properties that generally differentiate metals from non-metals.

Ans :

Metals are generally lustrous (shiny) and malleable (can be beaten into sheets), while non-metals are typically non-lustrous (dull) and brittle (break easily).

101. Name two non-metals and state one important use for each in daily life or nature.

Ans :

1. Oxygen : Essential for respiration in living organisms.
2. Nitrogen : Used in fertilizers for plant growth (or Carbon : building block of life).

102. What is meant by 'metallic lustre'?

Ans :

Metallic lustre refers to the characteristic shiny appearance exhibited by the surface of most metals when freshly cut or polished.

103. Why are steel ropes used in suspension bridges and cranes?

Ans :

Steel (an alloy containing iron) wires are very strong and ductile. Ropes made from them can support very heavy loads, making them suitable for bridges and lifting heavy objects.

104. Are materials like plastic, glass, and wood classified as elements? Why or why not?

Ans :

No, they are not classified as elements. Elements cannot be broken down into simpler substances, whereas plastic, glass, and wood are complex materials made up of combinations of elements.



## LONG ANSWER QUESTION

- 105.** Compare metals and non-metals based on the following physical properties malleability, ductility, sonority, and thermal conductivity. Give one example for each property related to metals.

**Ans :**

- (1) **Malleability :** Metals are generally malleable (can be beaten into thin sheets, e.g., aluminium foil), while non-metals are brittle (break easily).
- (2) **Ductility :** Metals are generally ductile (can be drawn into wires, e.g., copper wires), while non-metals are not ductile.
- (3) **Sonority :** Metals are sonorous (produce a ringing sound when struck, e.g., school bell), while non-metals produce a dull sound.
- (4) **Thermal Conductivity :** Metals are good conductors of heat (e.g., iron used in cooking pans), while non-metals are generally poor conductors.

- 106.** Explain the experiments demonstrating the reaction of a metal (magnesium) and a non-metal (sulfur) with oxygen. Compare the nature of the oxides formed in each case.

**Ans :**

- (1) **Magnesium (Metal) :** Magnesium ribbon is burnt in air . It burns brightly, forming white magnesium oxide powder. When dissolved in water, this oxide forms a solution that turns red litmus blue, indicating it is basic.
- (2) **Sulfur (Non-metal) :** Sulfur powder is burnt in a deflagrating spoon . It burns, producing sulfur dioxide gas. When this gas dissolves in water, it forms a solution (sulfurous acid) that turns blue litmus red, indicating it is acidic.  
Comparison : Metals generally react with oxygen to form basic oxides, while non-metals react with oxygen to form acidic oxides.

- 107.** Yashwant and Anandi observed an iron smith heating an iron block red hot before hammering it into the shape of an axe. Explain which property of iron is being utilized and why heating is necessary for this process.

**Ans :**

The property being utilized is malleability the ability of iron (a metal) to be beaten or hammered into different shapes without breaking. Heating

the iron block red hot makes it much softer and more pliable. This significantly reduces the force required to deform the metal and shape it into the axe using the hammer. Hammering cold iron would be much harder and less effective in changing its shape significantly.

- 108.** Based on their properties, justify why copper or aluminium is used for electrical wiring, while plastic or rubber is used as covering for these wires.

**Ans :**

Copper and aluminium are metals that are highly ductile (can be drawn into thin wires) and are excellent conductors of electricity, allowing current to flow efficiently. This makes them ideal for wiring. Plastic and rubber are non-metals (or derived materials) that are poor conductors of electricity (insulators) and are flexible. They are used to cover the wires to prevent accidental contact with the live conductor, thus preventing electric shocks and short circuits. The combination utilizes the conductivity of metals and the insulating properties of non-metals/polymers.

- 109.** Discuss the significance of the Iron Pillar of Delhi mentioned in the text. What does its condition after 1600 years suggest about ancient Indian metallurgy?

**Ans :**

The Iron Pillar of Delhi, over 1600 years old, is remarkable because it shows very little rust despite prolonged exposure to weather. Rusting is a common form of corrosion for iron. The pillar's resistance to rusting indicates that ancient Indian metallurgists possessed advanced knowledge and skills. They were able to produce iron with a composition or surface treatment that made it highly resistant to corrosion, showcasing a sophisticated understanding of metal technology far ahead of its time.

- 110.** Why are metals like gold and silver preferred for making jewellery, considering their properties ? Mention at least three relevant properties.

**Ans :**

Gold and silver are preferred for jewellery due to :

- (1) **Lustre :** They have a natural, attractive shine (metallic lustre) that doesn't easily tarnish (especially gold), making them visually appealing.

- (2) Malleability and Ductility : They are highly malleable and ductile, meaning they can be easily beaten into intricate shapes, thin foils, or drawn into fine wires, allowing for complex designs.
- (3) Corrosion Resistance : Gold, in particular, is very resistant to corrosion from air, water, and acids, ensuring the jewellery lasts long without degrading. Silver is also relatively resistant, though it can tarnish (form black coating).

11. Define an element. How are elements classified based on the properties? Are all materials around us elements? Explain.

Ans :

An element is a fundamental substance that cannot be broken down into simpler substances by chemical means. Based on their physical and chemical properties (like lustre, malleability, conductivity, type of oxide formed), elements are broadly classified into metals and non-metals. Not all materials are elements; many materials like water ( $H_2O$ ), plastic, wood, or salt ( $NaCl$ ) are compounds (made of two or more elements chemically combined) or mixtures. Elements are the basic building blocks.

12. Although non-metals might seem less prominent than metals in structures and tools, explain why they are crucial for life and technology, citing examples like oxygen, carbon, nitrogen and chlorine.

Ans :

Non-metals are vital :

- (1) Oxygen : Essential for respiration in almost all living organisms; without it, life as we know it wouldn't exist.
- (2) Carbon : Forms the backbone of all organic molecules (proteins, fats, carbohydrates), making it the fundamental building block of life. Also used in fuels and materials.
- (3) Nitrogen : A key component of proteins and DNA; crucial for plant growth (used in fertilizers). Makes up most of the air.
- (4) Chlorine : Used widely for water purification, killing harmful bacteria and making water safe to drink. These examples show non-metals are indispensable for biological processes, agriculture, and public health technology.

13. Rusting of iron is described as a serious problem. Explain why it is considered serious and mention two common methods used to prevent it.

Ans :

Rusting is serious because it weakens iron structures. Rust is flaky and porous, offering no protection; the process continues, eventually destroying the object. This leads to huge economic losses due to the need to replace or repair bridges, vehicles, ships, railings, and other iron-based infrastructure. Two common prevention methods are :

- (1) Painting/Oiling/Greasing : Applying a protective layer that prevents air and moisture from reaching the iron surface.
- (2) Galvanisation : Applying a protective coating of zinc metal onto the iron. Zinc corrodes preferentially, protecting the iron.

## CASE BASED QUESTION

14. A student is given four small cubes of identical size : one made of copper, one of sulfur, one of aluminium, and one of carbon (coal). They are asked to test them using a hammer and a simple electrical circuit tester (battery, bulb, wires). They need to identify which are metals based on the tests.

1. What result would the student expect when hammering the copper and aluminium cubes? Why?
2. What result would the student expect when hammering the sulfur and carbon cubes? Why?
3. Which cubes would make the bulb in the electrical tester glow? What property does this indicate?
4. Based on both tests, which materials can the student confidently classify as metals?

Ans :

- (1) The copper and aluminium cubes would flatten when hammered because they are metals and exhibit malleability.
- (2) The sulfur and carbon (coal) cubes would likely break into smaller pieces because they are non-metals and are brittle.
- (3) The copper and aluminium cubes would make the bulb glow, indicating they are good

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conductors of electricity, a typical property of metals.

- (4) The student can classify copper and aluminium as metals because they are malleable and good electrical conductors.

**115.** An old iron gate in a coastal town shows significant rusting, especially near the bottom. The owner decides to replace it. They are considering a new gate made entirely of aluminium or one made of galvanised iron. They want the gate to last long without deteriorating like the old one.

1. Why would the iron gate rust more significantly in a coastal town compared to an inland desert town?
2. What does 'galvanised iron' mean, and how does it help prevent rusting?
3. Between aluminium and galvanised iron, which might offer better long-term resistance to deterioration in this environment? (Consider natural properties).

**Ans :**

- (1) Coastal towns have higher humidity (more moisture in the air) and possibly salt spray, both of which accelerate the rusting process of iron, as rusting requires both air and water.
- (2) Galvanised iron is iron coated with a layer of zinc. The zinc coating acts as a barrier and also corrodes preferentially (sacrificial protection), protecting the underlying iron from rusting.
- (3) Aluminium naturally forms a tough, protective oxide layer that resists further corrosion very well, especially in moist/salty air. While galvanisation protects iron, the zinc layer can eventually be consumed. Therefore, aluminium might offer better long-term resistance in this environment.

**116.** A jeweller has a small, shiny yellow piece of material. To check if it's real gold, they try to draw it into a very thin wire and hammer it into a very thin sheet. They find it can be easily shaped in both ways without breaking. They also notice it doesn't react when a drop of common acid is placed on it.

1. Which two properties of metals are being tested by trying to draw the material into a wire and hammer it into a sheet?
2. Why is the lack of reaction with acid a relevant observation when identifying gold?
3. Based on the tests (malleability, ductility,

lustre, acid resistance), is it likely that the material is real gold? Justify briefly.

**Ans :**

- (1) Ductility (drawing into wire) and Malleability (hammering into a sheet) are being tested.
- (2) Gold is known for being very unreactive and resistant to corrosion, including attack by many common acids. This chemical inertness is a characteristic property.
- (3) Yes, it is likely real gold. The material exhibits high ductility and malleability, is lustrous (implied by "shiny yellow"), and shows chemical resistance (no reaction to acid), all of which are characteristic properties of gold.

**117.** A school lab needs to store samples of sodium metal and phosphorus (a non-metal). The lab technician knows both react with components of the air but behave differently with water. The sodium is stored under kerosene, while the phosphorus is stored underwater.

1. Why can't sodium be stored underwater like phosphorus?
2. Why is phosphorus stored underwater instead of just being left in a sealed jar of air?
3. Kerosene prevents sodium from reacting with air and moisture. What property must kerosene have regarding water?

**Ans :**

- (1) Sodium reacts vigorously and dangerously with water, generating heat and potentially catching fire. Phosphorus does not react significantly with water.
- (2) Phosphorus reacts spontaneously with oxygen in the air (catches fire). Storing it underwater prevents contact with air, thus preventing this reaction.
- (3) Kerosene must not mix with water (it must be immiscible) and should be denser or form a protective layer to keep both air and any trace water away from the sodium. (Implicit : Kerosene itself must not react with sodium).

**118.** An experiment involves heating magnesium powder and sulfur powder separately in the air and testing the products. The magnesium oxide formed dissolves slightly in water to give a solution that turns red litmus blue. The sulfur dioxide formed dissolves to give a solution that turns blue litmus red.

1. What do the litmus test results indicate about the chemical nature of magnesium oxide?

2. What do the litmus test results indicate about the chemical nature of the solution formed from sulfur dioxide?
3. This experiment supports a general rule about the oxides of metals and non-metals. State this rule.

**Ans :**

- (1) Turning red litmus blue indicates that magnesium oxide forms a basic solution in water.
- (2) Turning blue litmus red indicates that the solution formed from sulfur dioxide (sulfurous acid) is acidic.
- (3) The general rule supported is that oxides of metals (like magnesium) are typically basic in nature, while oxides of non-metals (like sulfur) are typically acidic in nature.

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# CHAPTER 5

## CHANGES AROUND US – PHYSICAL AND CHEMICAL

### SUMMARY

#### 1. OBSERVING EVERYDAY CHANGES

Changes are happening around us constantly—ice melts, fruits ripen, flowers bloom, and metal rusts. These changes can be observed using our senses and affect an object's size, shape, smell, or state.

#### 2. PHYSICAL CHANGES

A physical change alters the appearance of a substance but does not form a new one. Examples include folding paper, inflating a balloon, melting ice, and chopping vegetables. The materials involved remain the same, and such changes are usually reversible.

#### 3. CHEMICAL CHANGES

Chemical changes produce entirely new substances. A clear example is when lime water turns milky after exhaling into it due to the formation of calcium carbonate. Mixing vinegar with baking soda releases carbon dioxide, indicating a chemical reaction. These changes are generally irreversible.

#### 4. RUSTING AND COMBUSTION

Rusting of iron and the burning of magnesium are both chemical changes as they form new substances iron oxide and magnesium oxide, respectively. Combustion involves a substance reacting with oxygen to release heat or light. For combustion to happen, three elements are required : fuel, oxygen, and heat (ignition temperature).



Figure : Rusted iron nails



Figure : Burning magnesium ribbon

#### 5. COMBINED CHANGES

Sometimes physical and chemical changes occur together, such as when a candle burns. The melting and re-solidifying of wax are physical changes, while the burning of wax vapor is a chemical one. Thus, multiple types of changes can happen at the same time.

#### 6. REVERSIBLE AND IRREVERSIBLE CHANGES

Some changes like freezing water or rolling dough into balls can be reversed. Others like cutting fruit or popping corn cannot. Understanding which changes are permanent helps in classifying them effectively.

**7. DESIRABLE AND UNDESIRABLE CHANGES**

Useful changes like cooking or composting are desirable. Undesirable ones include rusting and spoilage. Sometimes, the same process can be both—like decomposition, which is bad in food but useful in composting.

**8. NATURAL SLOW CHANGES**

Processes like weathering and erosion are slow changes in nature. Weathering breaks rocks into soil through both physical and chemical actions, while erosion moves soil and sediments from one place to another. These changes happen over many years and are irreversible.

**NCERT ACTIVITY**

**Activity 5.1 : Let us think and reflect**

You might have observed various changes happening around you. Some of them are listed in Table , you may notice that something is changing in each case. Take a moment to reflect on the changes in each case. Record your observations in Table .

**Table : Some changes observed around us**

S. No.	Change	Observation(s)
1.	Melting ice cubes	
2.	Chopping vegetables	
3.	Boiling water	
4.	Making popcorn from corn	
5.	Cutting a piece of paper	
6.	Adding beetroot extract to water	
7.	Burning wood	
8.	Drying wet clothes	
9.	Making small balls of dough	

10.	Rolling small balls of dough into chapatis	
11.	Any other	

Ans :

S. No.	Change	Observation(s)
1.	Melting ice cubes	Ice changes to water (physical change, reversible)
2.	Chopping vegetables	Vegetables are cut into smaller pieces (physical change)
3.	Boiling water	Water turns to steam (physical change, reversible)
4.	Making popcorn from corn	New substance formed, puffing (chemical change, irreversible)
5.	Cutting a piece of paper	Paper is divided, no new substance (physical change)
6.	Adding beetroot extract to water	Colour spreads in water (physical change, mixing)
7.	Burning wood	New substances like ash, smoke formed (chemical change)
8.	Drying wet clothes	Water evaporates (physical change, reversible)
9.	Making small balls of dough	Shape changes, no new substance (physical change)
10.	Rolling small balls of dough into chapatis	Shape change, reversible before cooking (physical change)
11.	Any other – e.g., cooking rice	Rice becomes soft, new texture (chemical change, irreversible)

**Activity 5.2 : Let us create and discuss**

**A. Creating some objects with paper**

1. Take a few sheets of paper and fold them to create new objects (Figure).





Figure : Objects made from paper

- Do you get the same paper back when you unfold these objects?

### B. Playing with a balloon

- Take a balloon and inflate it. Now, loosen your grip and let the air escape out.
- Do you get the uninflated balloon back?
- Take another balloon; inflate it and grip the opening tightly. Now, prick it with a pin.

**Caution :** *Caution-Be careful while using a pin.*

What happens? Will you be able to get the uninflated balloon back?

### C. Crushing a piece of chalk

- Crush a small piece of chalk into powder.
- Can you get the chalk piece back from the powder?

Is there any similarity in the changes listed in A, B, and C?

Ans :

#### A. Creating some objects with paper

Yes, when you unfold the paper objects, you get the same original sheets of paper back, although they might have creases.

#### B. Playing with a balloon

When you inflate a balloon and then let the air escape, yes, you get the uninflated balloon back, largely in its original form.

When you inflate a balloon and then prick it with a pin, the balloon bursts. You will get pieces of the balloon back, but you will not be able to get the original, intact uninflated balloon back easily (it's broken).

#### C. Crushing a piece of chalk

No, you cannot easily get the original single piece of chalk back from the powder. While the substance (chalk) is the same, its form has drastically changed and reassembling the powder into the original piece is not a simple reversal.

Yes, a similarity in most of these changes (folding paper, inflating/deflating a balloon, crushing chalk) is that no new substance is formed. The original material (paper, rubber of the balloon, chalk) is still present, even if its shape, size, or form has changed. The bursting of the balloon is a more destructive change to its form.

### Activity 5.3 : Let us explore

- Take two glass tumblers or small transparent bottles. Mark them A and B.
- Fill one-fourth of glass tumbler A with tap water and one-fourth of glass tumbler B with lime water.
- Now, blow air (exhale) into each glass tumbler, one at a time, using separate straws (Figure) and observe them.

**Caution :** *Do not suck the water or lime water while doing this.*

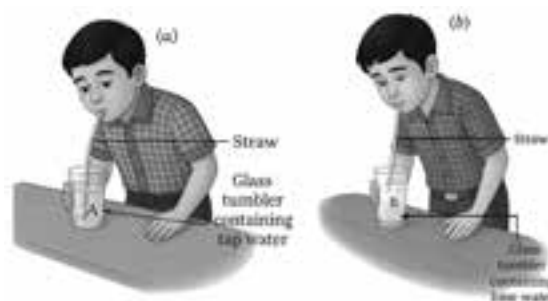


Figure : Blowing air in (a) tap water, (b) lime water

Do you notice any changes?

Ans :

- Glass tumbler A (tap water) : When air is blown into tap water, bubbles will be seen forming and rising through the water. The appearance of the tap water itself will not change significantly; it will remain clear.
- Glass tumbler B (lime water) : When air (which contains carbon dioxide from exhalation) is blown into lime water (calcium hydroxide solution), bubbles will also be seen. Additionally, the lime water will turn milky or cloudy. If left to stand, a white precipitate (calcium carbonate) may settle at the bottom.

### Activity 5.4 : Let us experiment

- Take a teaspoonful of vinegar or lemon juice in a test tube. Add a pinch of baking soda (sodium hydrogen carbonate) to it.
- What do you observe?

- You would hear a fizzing bubbling sound and see the gas bubbles forming. Pass this gas through freshly prepared lime water kept in another test tube, as shown in Figure.

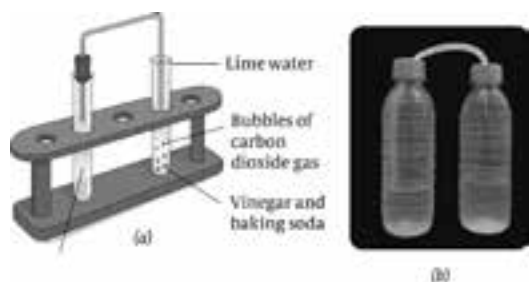


Figure : Reaction of vinegar and baking soda

- What do you observe?
- The lime water turns milky. What do you infer about the gas formed by mixing vinegar and baking soda?

This activity can also be performed using two small used bottles instead of test tubes and a flexible tube as shown in Figure (b).

Repeat the above activity using baking soda and water. Do you observe any bubble formation? Is this a physical or a chemical change?

Ans :

**Mixing vinegar (or lemon juice) and baking soda :**

**Observation :**

You will observe fizzing, bubbling, and the production of a gas. A hissing sound might also be heard.

- Passing the gas through lime water : The lime water will turn milky.
- Inference about the gas : The gas formed is carbon dioxide  $CO_2$ , as it turns lime water milky. This is a chemical change because new substances (carbon dioxide, water, and a salt like sodium acetate if vinegar is used) are formed.

Example reaction (Vinegar - Acetic Acid).



**Repeating the activity using baking soda and water :**

**Observation :**

When baking soda is added to plain water, you might see some baking soda dissolving, but there will be no significant bubble formation or fizzing(unless the water is very acidic, which is not typical for plain water). A small amount of  $CO_2$  might be released if the baking soda reacts

with dissolved  $CO_2$  in water forming carbonic acid, but it won't be the vigorous reaction seen with vinegar.

**Physical or a Chemical change :**

Primarily, this is a physical change(dissolution of baking soda in water if it dissolves). If there's any minor reaction due to impurities or dissolved gases in water, it would be minimal. The distinct chemical change (vigorous gas production) observed with vinegar/lemon juice does not occur significantly with plain water.

**Activity 5.5 : Let us investigate**

- Place two identical candles on two separate petri dishes and light them.
- Cover one of these with a glass tumbler, as shown in Figure.

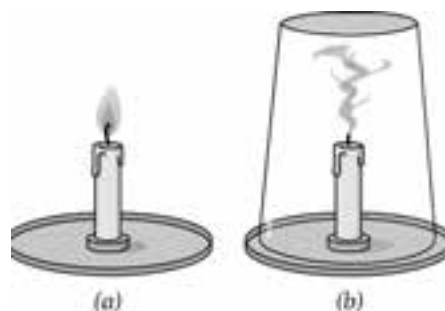


Figure : Candle (a) burning, (b) covered with a glass tumbler

- What happens to the candle flames in the two cases?

Ans :

**Candle not covered :**

This candle will continue to burn steadily as long as there is wax (fuel).

**Candle covered with a glass tumbler (Figure (b)):**

This candle flame will gradually become smaller and then go out (extinguish) after a short period. Soot (black carbon particles) might be observed on the inside of the tumbler.

**Activity 5.6 : Let us investigate**

**Caution :** Perform this activity under the supervision of your teacher or an adult.

- Hold a piece of paper with a pair of tongs and bring a lighted matchstick to it. It quickly catches fire. Do we say that we need a fire to start the burning process?





Figure : (a) Focusing the sunrays using a magnifying glass

2. Take another piece of paper. Using a magnifying glass, focus the sunrays to make the smallest and brightest spot on the paper, as shown in the Figure (a). Hold it there for some time.



Figure : (b) Paper catching fire

#### Questions :

1. What do you observe?
2. We observe that the paper starts to emit smoke, and then catches fire (Figure (b)). Thus, we find that a substance can burn even without fire. How do we explain this change?

#### Ans :

After holding the focused spot of sunlight on the paper for some time, the paper will start to char (turn brown/black), emit smoke, and then eventually burst into flame.

The magnifying glass concentrates the sun's rays (heat energy) onto a small spot on the paper. This concentrated heat raises the temperature of that spot on the paper. When the temperature of the paper at that spot reaches its ignition temperature (the minimum temperature at which it will catch fire and burn in the presence of oxygen), the paper ignites. This demonstrates that a substance can burn if it reaches its ignition temperature, even if the initial heat source is not a flame itself. Both the matchstick and the focused

sunlight provide the necessary heat to reach the ignition temperature.

#### Activity 5.7 : Think, pair and share

Look at the Figure. Analyse what students are discussing about the burning candle. What do you think?



Figure : What changes occur when a candle burns?

#### Ans :

The students are discussing various observations and inferences about a burning candle. All their points contribute to understanding the process :

“The wax melts and evaporates...” : This is correct. The heat from the flame melts the solid wax near the wick. This molten wax is then drawn up the wick by capillary action. The heat further vaporizes the liquid wax into wax vapour. This melting and evaporation are physical changes.

“I think the wax burns, and new substances are formed...” : This is also correct. The wax vapour (fuel) reacts with oxygen from the air in the flame. This is a combustion reaction, which is a chemical change. New substances like carbon dioxide, water vapour, soot (carbon), light, and heat are produced.

“Wax melts, flows, and solidifies in different shapes...” : This is correct. Some of the melted wax may drip down the side of the candle and solidify again as it cools, often taking on new shapes. This melting and solidification are physical changes.

#### Activity 5.8 : Let us think

Think again about all the changes that we have discussed or talked about so far. In which of these can we get back the object or substance in the form we started with? Record your observations in Table.

**Table : Can changes be reversed?**

S. No.	Change	The original state can be brought back (Yes/No)
1.	Melting ice cubes	Yes
2.	Chopping vegetables	No
3.	Boiling water	Yes
4.	Making popcorn from corn	No
5.	Cutting a piece of paper	
6.	Adding beetroot extract to water	
7.	Burning wood	
8.	Drying wet clothes	
9.	Making small balls of dough	
10.	Rolling small balls of dough into chapatis	
11.	Blowing air into lime water (turns milky)	
12.	Burning magnesium ribbon	

Ans :

S. No.	Change	The original state can be brought back (Yes/No)
1.	Melting ice cubes	Yes
2.	Chopping vegetables	No
3.	Boiling water	Yes
4.	Making popcorn from corn	No
5.	Cutting a piece of paper	No
6.	Adding beetroot extract to water	Yes
7.	Burning wood	No
8.	Drying wet clothes	Yes
9.	Making small balls of dough	Yes

10.	Rolling small balls of dough into chapatis	Yes
11.	Blowing air into lime water (turns milky)	No
12.	Burning magnesium ribbon	No

## NCERT EXERCISE

1. Which of the following statements are the characteristics of a physical change?
  1. The state of the substance may or may not change.
  2. A substance with different properties is formed.
  3. No new substance is formed.
  4. The substance undergoes a chemical reaction.

(a) (i) and (ii)  
 (b) (ii) and (iii)  
 (c) (i) and (iii)  
 (d) (iii) and (iv)

Ans :

(c) (i) and (iii)

  - (1) The state of the substance may or may not change : True for physical changes (e.g., ice melting changes state; cutting paper does not change state but is still a physical change).
  - (2) A substance with different properties is formed : False, this is characteristic of a chemical change.
  - (3) No new substance is formed : True for physical changes. The chemical composition remains the same.
  - (4) The substance undergoes a chemical reaction : False, this defines a chemical change.
  
2. Predict which of the following changes can be reversed and which cannot be reversed. If you are not sure, you may write that down. Why are you not sure about these?
  1. Stitching cloth to a shirt
  2. Twisting of straight string
  3. Making idlis from a batter
  4. Dissolving sugar in water
  5. Drawing water from a well
  6. Ripening of fruits
  7. Boiling water in an open pan
  8. Rolling up a mat



9. Grinding wheat grains to flour
10. Forming of soil from rocks

Ans :

1. Stitching cloth to a shirt : Can be reversed (by unpicking the stitches).
2. Twisting of straight string : Can be reversed (by untwisting the string).
3. Making idlis from a batter : Cannot be reversed (cooked idlis cannot be turned back into batter).
4. Dissolving sugar in water : Can be reversed (by evaporating the water, sugar can be recovered).
5. Drawing water from a well : Can be reversed (water can be poured back into the well, though it might not be the exact same water molecules returning to their exact same original state within the well's ecosystem, the general action of returning water is possible).
6. Ripening of fruits : Cannot be reversed (a ripe fruit cannot become unripe again).
7. Boiling water in an open pan : Can be reversed (the steam can be condensed back into water, though if it escapes into the atmosphere, collecting it all is difficult).
8. Rolling up a mat : Can be reversed (by unrolling the mat).
9. Grinding wheat grains to flour : Cannot be reversed (flour cannot be easily turned back into whole wheat grains).
10. Forming of soil from rocks : Cannot be reversed (this is a very slow, complex process involving physical and chemical weathering; reversing it to get the original rock is not practically possible on human time scales).

3. State whether the following statements are True or False. In case a statement is False, write the correct statement.

1. Melting of wax is necessary for burning a candle. (True/False)
2. Collecting water vapour by condensing involves a chemical change. (True/False)
3. The process of converting leaves into compost is a chemical change. (True/False)
4. Mixing baking soda with lemon juice is a chemical change. (True/False)

Ans :

- (1) True.
- (2) False. Correct statement : Collecting water vapour by condensing involves a physical change (change of state from gas to liquid, no new substance is formed).
- (3) True.
- (4) True.

4. Fill in the blanks in the following statements :

1. Nalini observed that the handle of her cycle has got brown deposits. The brown deposits are due to \_\_\_\_\_ and this is a \_\_\_\_\_ change.
2. Folding a handkerchief is a \_\_\_\_\_ change and can be \_\_\_\_\_.
3. A chemical process in which a substance reacts with oxygen with evolution of heat is called \_\_\_\_\_ and this is a \_\_\_\_\_ change.
4. Magnesium, when burnt in air, produces a substance called \_\_\_\_\_. The substance formed is \_\_\_\_\_ in nature. Burning of magnesium is a \_\_\_\_\_ change.

Ans :

- (1) The brown deposits are due to rusting (of iron) and this is a chemical change.
- (2) Folding a handkerchief is a physical change and can be reversed.
- (3) A chemical process in which a substance reacts with oxygen with evolution of heat is called combustion and this is a chemical change.
- (4) Magnesium, when burnt in air, produces a substance called magnesium oxide. The substance formed is basic in nature. Burning of magnesium is a chemical change.

5. Are the changes of water to ice and water to steam, physical or chemical? Explain.

Ans :

The changes of water to ice (freezing) and water to steam (boiling/evaporation) are both physical changes.

Water to Ice (Freezing) : When liquid water changes to solid ice, its state changes, and its shape and volume (density) may change. However, the substance itself remains water ( $H_2O$ ). No new chemical substance is formed. The molecules are just arranged differently and have less kinetic energy. This change is reversible (ice can melt back to water).

Water to Steam (Boiling/Evaporation) : When liquid water changes to gaseous steam (water vapour), its state changes. Again, the substance is still water (H<sub>2</sub>O). No new chemical substance is formed. The molecules have more kinetic energy and are further apart. This change is also reversible (steam can condense back to water). In both cases, only the physical properties (state, appearance, density) change, but the chemical identity of water H<sub>2</sub>O remains the same.

6. Is curdling of milk a physical or chemical change? Justify your statement.

Ans :

Curdling of milk is a chemical change. This is because a new substance (curd) is formed from milk, and the change cannot be reversed. The bacteria or an acid added to milk causes a permanent change in its properties like taste and texture. Since the original substance (milk) changes into something new (curd) and cannot be changed back, it is a chemical change.

7. Natural factors, such as wind, rain, etc., help in the formation of soil from rocks. Is this change physical or chemical and why?

Ans :

It is a physical change because the rocks are only broken down into smaller pieces without forming a new substance.

8. Read the following story titled 'Eco-friendly Prithvi', and tick the most appropriate option(s) given in the brackets. Provide a suitable title of your choice for the story

Prithvi is preparing a meal in the kitchen. He chops vegetables, peels potatoes, and cuts fruits (physical changes). He collects the seeds, fruits, and vegetable peels into a clay pot (physical change). The fruits, vegetable peels, and other materials begin to decompose due to the action of bacteria and fungi, forming compost (chemical change). He decides to plant seeds in the compost and water them regularly. After a few days, he notices that the seeds begin to germinate and small plants start to grow, eventually blooming into colourful flowers (chemical change/ both physical and chemical changes- growth involves chemical processes like photosynthesis and cell division, leading to physical enlargement and development). His efforts are appreciated by all his family members.

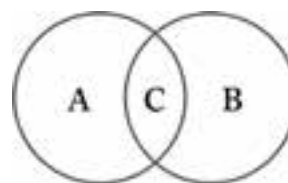
Ans :

- (1) Chopping vegetables, peeling potatoes, and cutting fruits – Physical change
- (2) Collecting seeds, fruits, and vegetable peels into a clay pot – Physical change
- (3) Decomposition of waste into compost – Chemical change
- (4) Germination of seeds and growth of plants – Both physical and chemical changes

**Justification (in brief for students) :**

- (1) Physical changes involve changes in shape or size without forming a new substance.
- (2) Chemical changes create a new substance (like compost).
- (3) Plant growth involves both physical and chemical changes like cell division and photosynthesis.

9. Some changes are given here. Write physical changes in the area marked 'A' and chemical changes in the area marked 'B'. Enter the changes which are both physical and chemical in the area marked 'C'.



Process of burning a candle; Tearing of paper; Rusting; Curdling of milk; Ripening of fruits; Melting of ice; Folding of clothes; Burning of magnesium and Mixing baking soda with vinegar.

Ans :

**A (Physical Changes Only) :**

- (i) Tearing of paper
- (ii) Melting of ice
- (iii) Folding of clothes

**B (Chemical Changes Only) :**

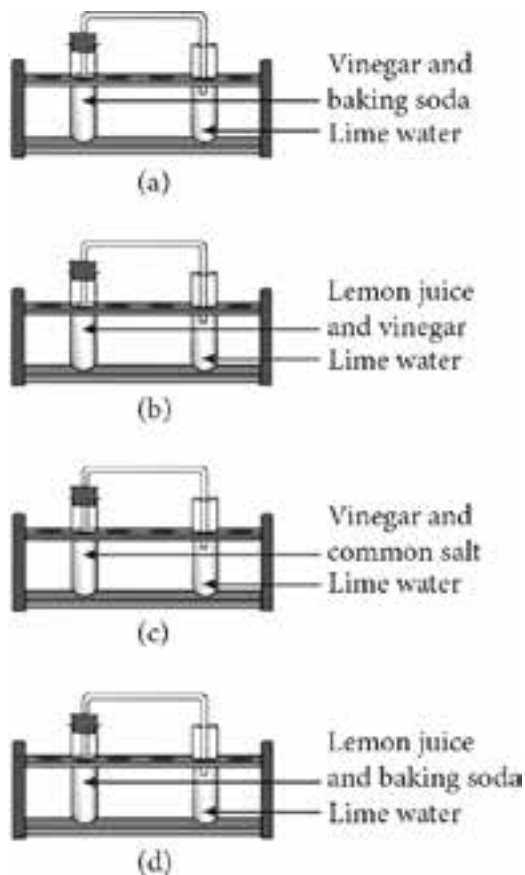
- (i) Rusting
- (ii) Curdling of milk
- (iii) Ripening of fruits
- (iv) Burning of magnesium
- (v) Mixing baking soda with vinegar

**C (Both Physical and Chemical Changes) :**

Process of burning a candle

10. The experiments shown in Figure (a), (b), (c) and (d) were performed. Find out in which case(s) did lime water turn milky and why?





Ans :

In the given experiments, lime water turns milky in cases (a) and (d). In case (a), vinegar reacts with baking soda, and in case (d), lemon juice reacts with baking soda. Both these reactions produce carbon dioxide gas. When this gas passes through lime water, it reacts with calcium hydroxide present in the lime water to form calcium carbonate, which is a white, milky substance. This is why the lime water turns milky in these two cases. In cases (b) and (c), no carbon dioxide is produced, so the lime water does not change. Therefore, lime water turns milky only when carbon dioxide is released, as seen in experiments (a) and (d).

## MULTIPLE CHOICE QUESTION

- Which of the following changes involves a change primarily in the state of matter?
  - A bud blooming into a flower
  - A banana developing brown spots
  - An ice cube melting into water
  - A cold water bottle becoming warm

Ans :

(C) An ice cube melting into water  
The melting of ice is a change of state from solid to liquid. While other changes occur, melting specifically represents a transition between physical states of water.

- When you chop vegetables, what kind of property is primarily changing?
  - Chemical composition
  - Color
  - Size and shape
  - Taste

Ans :

(C) Size and shape  
Chopping vegetables alters their physical form – reducing their size and changing their shape – but does not change the vegetable substance itself into something new.

- What observation might be made when making popcorn from corn?
  - Corn kernels simply get hotter.
  - Corn kernels change size, shape, and texture to become popcorn.
  - Popcorn turns back into corn kernels when cooled.
  - The color of the corn remains unchanged.

Ans :

(B) Corn kernels change size, shape and texture to become popcorn.  
The process of making popcorn involves a significant transformation where the hard corn kernel dramatically changes its size, shape and texture upon heating.

- If you fold a sheet of paper to make a paper boat and then unfold it, do you get the original sheet of paper back?
  - No, the paper has chemically changed.
  - Yes, only the shape was temporarily changed.
  - No, the paper loses its strength.
  - Yes, but it will be smaller in size.

Ans :

(B) Yes, only the shape was temporarily changed.  
Folding paper changes its shape, but the paper itself remains paper. Unfolding it returns it to its original sheet form, indicating the change was physical.

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5. Inflating a balloon changes its size and shape. Letting the air out returns it to its original state. What type of change is primarily demonstrated here?
- (A) Chemical change  
 (B) Irreversible change  
 (C) Physical change  
 (D) Combustion

Ans :

(C) Physical change  
 Inflating and deflating a balloon mainly involves changes in its size and shape due to the air inside. The rubber material itself doesn't change, signifying a physical change.

6. How does pricking an inflated balloon differ from simply letting the air out in terms of reversibility?
- (A) Both are easily reversible chemical changes.  
 (B) Letting air out is reversible; pricking (bursting) is not easily reversible.  
 (C) Pricking is reversible; letting air out is not.  
 (D) Both are irreversible physical changes.

Ans :

(B) Letting air out is reversible; pricking (bursting) is not easily reversible.  
 Deflating allows the balloon to return to its original state (reversible). Pricking causes the balloon to burst, permanently damaging it and making the change essentially irreversible.

7. When chalk is crushed into powder, does a new substance form?
- (A) Yes, the powder is chemically different from chalk.  
 (B) Yes, the chalk reacts with air during crushing.  
 (C) No, the substance is still chalk, only its form (size) has changed.  
 (D) No, but the change is irreversible.

Ans :

(C) No, the substance is still chalk, only its form (size) has changed.  
 Crushing chalk breaks it into smaller particles, changing its size and form, but the chemical composition remains chalk. No new substance is created.

8. What defines a physical change?
- (A) A change where a new substance with different properties is formed.  
 (B) A change involving only the physical properties like shape, size, or state.  
 (C) A change that always involves heat or light.  
 (D) A change that can never be reversed.

Ans :

(B) A change involving only the physical properties like shape, size, or state.

The physical change is one where only the physical attributes (such as shape, size, state of matter) of a substance alter, without the formation of any new substance.

9. Changing water from solid (ice) to liquid (water) to gas (steam) involves changes in its state. Are these considered physical or chemical changes?
- (A) Chemical changes, because energy is involved.  
 (B) Physical changes, because the substance ( $H_2O$ ) remains the same.  
 (C) Both physical and chemical changes occur simultaneously.  
 (D) Neither, they are state transitions.

Ans :

(B) Physical changes, because the substance ( $H_2O$ ) remains the same.

Changes of state (melting, freezing, boiling, condensation) are classic examples of physical changes because the chemical identity of the substance (water,  $H_2O$ ) does not change.

10. Imagine why does blowing exhaled air into lime water (glass B) cause it to turn milky, while blowing into tap water (glass A) does not?
- (A) Tap water already contains the milky substance.  
 (B) Exhaled air contains carbon dioxide, which reacts with lime water.  
 (C) Lime water reacts with oxygen in the exhaled air.  
 (D) Blowing into tap water cools it down, preventing change.

Ans :

(B) Exhaled air contains carbon dioxide, which reacts with lime water.

Exhaled air is rich in carbon dioxide. Carbon dioxide undergoes a chemical reaction with lime water (calcium hydroxide) to form insoluble calcium carbonate, causing the milky appearance. Tap water doesn't react this way.

11. What is the defining characteristic of a chemical change?
- (A) A change in the shape or size of a substance.  
 (B) The formation of one or more new substances.  
 (C) A change that is always easily reversible.  
 (D) A change that only involves melting or boiling.



Ans :

(B) The formation of one or more new substances. A chemical change is fundamentally defined by the transformation of the original substance(s) into one or more entirely new substances with different properties, resulting from a chemical reaction.

12. What is the white, insoluble substance formed when carbon dioxide reacts with lime water?
- (A) Calcium oxide  
 (B) Calcium bicarbonate  
 (C) Calcium carbonate  
 (D) Carbonic acid

Ans :

(C) Calcium carbonate  
 The chemical reaction between carbon dioxide ( $\text{CO}_2$ ) and lime water (calcium hydroxide,  $\text{Ca}(\text{OH})_2$ ) produces calcium carbonate ( $\text{CaCO}_3$ ), a white solid that is insoluble in water, making the solution appear milky.

13. The fact that lime water turning milky is used as a test for which gas?
- (A) Oxygen  
 (B) Nitrogen  
 (C) Hydrogen  
 (D) Carbon dioxide

Ans :

(D) Carbon dioxide  
 The specific reaction causing lime water to turn milky upon contact with a gas is a standard chemical test used to confirm the presence of carbon dioxide.

14. Imagine what gas is produced when vinegar (or lemon juice) is mixed with baking soda?
- (A) Oxygen  
 (B) Hydrogen  
 (C) Carbon dioxide  
 (D) Nitrogen

Ans :

(C) Carbon dioxide  
 The fizzing and bubbling observed when mixing an acid (vinegar/lemon juice) with baking soda (sodium hydrogen carbonate) is due to the release of carbon dioxide gas, confirmed by testing with lime water.

15. Why is the reaction between vinegar and baking soda considered a chemical change?

- (A) Because the substances dissolve in each other.  
 (B) Because the temperature changes slightly.  
 (C) Because a new substance (carbon dioxide gas) is formed.  
 (D) Because the mixture changes color.

Ans :

(C) Because a new substance (carbon dioxide gas) is formed.

The formation of carbon dioxide, a substance not present initially, along with other products, signifies that a chemical reaction has occurred, classifying the process as a chemical change.

16. How does mixing baking soda with water differ from mixing it with vinegar, in terms of gas production?
- (A) Water produces more gas than vinegar.  
 (B) Vinegar produces  $\text{CO}_2$  gas; water typically does not produce gas.  
 (C) Both produce  $\text{CO}_2$  gas, but at different rates.  
 (D) Neither reaction produces any gas bubbles.

Ans :

(B) Vinegar produces  $\text{CO}_2$  gas; water typically does not produce gas.

Baking soda reacts with acids (like vinegar) to release  $\text{CO}_2$ . Simply dissolving baking soda in water does not usually cause this chemical reaction and gas release.

17. The process where iron reacts with oxygen and water to form rust (iron oxide) is classified as what type of change?
- (A) Physical change  
 (B) Reversible change  
 (C) Chemical change  
 (D) State change

Ans :

(C) Chemical change

Rusting involves the formation of a new substance, iron oxide (rust), which has different properties from the original iron. This formation of a new substance defines it as a chemical change.

18. When a magnesium ribbon burns, it produces magnesium oxide along with what else?
- (A) Only smoke  
 (B) Only water vapor  
 (C) Heat and light  
 (D) Carbon dioxide gas

Ans :

(C) Heat and light

The burning of magnesium is described as producing a dazzling white flame (light) and being an exothermic reaction (producing heat), in addition to forming the magnesium oxide powder.

19. Why is the burning of a magnesium ribbon considered a chemical change?
- (A) Because the ribbon changes shape.
  - (B) Because heat and light are produced.
  - (C) Because a new substance (magnesium oxide) is formed.
  - (D) Because the change is very fast.

Ans :

(C) Because a new substance (magnesium oxide) is formed.

Although heat and light are often accompaniments, the defining reason it's a chemical change is the formation of magnesium oxide, a compound chemically different from magnesium and oxygen.

20. What is the term for a chemical reaction where a substance reacts with oxygen, producing heat and/or light?
- (A) Melting
  - (B) Rusting
  - (C) Combustion
  - (D) Evaporation

Ans :

(C) Combustion

Combustion is specifically defined as a chemical process involving rapid reaction between a substance and an oxidant, usually oxygen, to produce heat and light.

21. What are substances called that can undergo combustion?
- (A) Insulators
  - (B) Conductors
  - (C) Combustible substances
  - (D) Non-reactive substances

Ans :

(C) Combustible substances

Materials that are capable of burning (undergoing combustion) are referred to as combustible substances or fuels. Examples include wood, paper, and kerosene.

22. Covering a burning candle with a tumbler demonstrates that which component of air is essential for combustion?
- (A) Nitrogen
  - (B) Carbon dioxide
  - (C) Water vapor
  - (D) Oxygen

Ans :

(D) Oxygen

The candle under the tumbler extinguishes once the oxygen inside is consumed, while the uncovered candle continues to burn, showing that oxygen is required to support combustion.

23. How can the presence of carbon dioxide inside the tumbler, after the candle extinguishes, be tested?
- (A) By adding more oxygen.
  - (B) By checking for water vapor condensation.
  - (C) By adding lime water, which will turn milky.
  - (D) By smelling the gas inside.

Ans :

(C) By adding lime water, which will turn milky. Adding lime water to the gas inside the tumbler and observing if it turns milky is the standard test confirming the presence of carbon dioxide, produced during the candle's combustion.

24. If a person's clothes catch fire, why is wrapping them tightly in a blanket (made of non-synthetic material like wool or cotton) an effective way to extinguish the flames, according to the 'Science and Society' box?
- (A) The blanket cools the person down rapidly.
  - (B) The blanket cuts off the supply of oxygen needed for the fire to burn.
  - (C) The blanket absorbs the heat from the fire.
  - (D) The blanket material reacts chemically with the fire.

Ans :

(B) The blanket cuts off the supply of oxygen needed for the fire to burn.

Fire requires oxygen to burn (part of the fire triangle). Wrapping a person tightly in a suitable blanket smothers the flames by depriving them of the necessary oxygen supply from the air, thus extinguishing the fire.

25. What is the phenomenon called where living organisms like fireflies produce light through chemical changes, typically without significant heat?
- (A) Photosynthesis
  - (B) Combustion
  - (C) Bioluminescence
  - (D) Fluorescence

Ans :

(C) Bioluminescence

Bioluminescence is the specific term for the production and emission of light by a living



organism as the result of internal chemical reactions.

26. Paper is combustible and oxygen is present in the air. Why doesn't paper spontaneously catch fire without an external factor?
- (A) Paper is not truly combustible.  
 (B) Oxygen concentration in air is too low.  
 (C) Paper needs to reach its ignition temperature to start burning.  
 (D) Paper requires darkness to burn.

Ans :

(C) Paper needs to reach its ignition temperature to start burning.

For combustion to start, the combustible substance (fuel) must be heated to its specific ignition temperature, the minimum temperature required for it to catch fire and sustain burning.

27. What is the minimum temperature at which a substance catches fire called?
- (A) Melting point  
 (B) Boiling point  
 (C) Ignition temperature  
 (D) Flash point

Ans :

(C) Ignition temperature

The ignition temperature is defined as the lowest temperature to which a combustible substance must be heated in air for it to ignite and begin to burn.

28. Imagine how does using a magnifying glass to focus sunlight cause paper to catch fire?
- (A) The glass chemically reacts with the paper.  
 (B) The focused sunlight concentrates heat, raising the paper's temperature to its ignition point.  
 (C) The magnifying glass creates sparks that ignite the paper.  
 (D) The bright light itself causes the paper to burn.

Ans :

(B) The focused sunlight concentrates heat, raising the paper's temperature to its ignition point.

The magnifying glass focuses solar energy (heat) onto a small spot on the paper. This concentrated heat raises the paper's temperature until it reaches its ignition temperature, causing it to burn.

29. What are the three essential requirements for combustion, often represented as the 'fire triangle'?
- (A) Fuel, Water, Carbon Dioxide  
 (B) Fuel, Oxygen, Heat (to reach ignition temperature)  
 (C) Nitrogen, Heat, Spark  
 (D) Wood, Paper, Matchstick

Ans :

(B) Fuel, Oxygen, Heat (to reach ignition temperature)

The fire triangle illustrates the three necessary components for fire : a combustible substance (fuel), an oxidizing agent (usually oxygen from air), and sufficient heat to raise the fuel to its ignition temperature.

30. When a candle burns, the melting of wax is considered what type of change?
- (A) Chemical change  
 (B) Combustion  
 (C) Physical change  
 (D) Irreversible change

Ans :

(C) Physical change

The melting of wax is a change of state from solid to liquid. The chemical composition of the wax does not change during melting, making it a physical change.

31. In a burning candle, the actual burning of the wax vapor in the flame is what type of change?
- (A) Physical change  
 (B) Melting  
 (C) Evaporation  
 (D) Chemical change (Combustion)

Ans :

(D) Chemical change (Combustion)

The wax vapor reacts with oxygen in the air, producing heat, light, carbon dioxide, and water vapor. This formation of new substances is a chemical change, specifically combustion.

32. The burning of a candle is described as involving both physical and chemical changes. Which option best summarizes this?
- (A) Only chemical changes occur.  
 (B) Only physical changes (melting) occur.  
 (C) Melting/evaporation of wax (physical) and burning of wax vapor (chemical).  
 (D) Solidification of wax (chemical) and flame production (physical).

Ans :

(C) Melting/evaporation of wax (physical) and burning of wax vapor (chemical).

The process includes physical changes (solid wax melts to liquid, liquid evaporates to gas) and a chemical change (wax gas burns, reacting with oxygen).

33. Which scientist, known for contributions to electricity and magnetism, delivered lectures called “Chemical History of a Candle”?

(A) Isaac Newton  
(B) Albert Einstein  
(C) Marie Curie  
(D) Michael Faraday

Ans :

(D) Michael Faraday

Michael Faraday and his famous series of lectures using the burning candle to explain various scientific principles, including physical and chemical changes.

34. What does it mean if a change is ‘reversible’?

(A) It involves the formation of a new substance.  
(B) It happens very quickly.  
(C) The original object or substance can be obtained back after the change.  
(D) It only occurs at high temperatures.

Ans :

(C) The original object or substance can be obtained back after the change.

A reversible change is one where the process can be undone, allowing the substance or object to return to its initial state or form.

35. Why is the burning of wood considered an irreversible change?

(A) Because wood becomes hot.  
(B) Because the ash and gases produced cannot easily be converted back into wood.  
(C) Because the wood changes color.  
(D) Because it requires oxygen.

Ans :

(B) Because the ash and gases produced cannot easily be converted back into wood.

Burning wood results in new substances (ash, carbon dioxide, water vapor). Reassembling these products back into the original wood is practically impossible, hence it’s irreversible.

36. Changes like the ripening of fruits or cooking of food, which are generally useful or intended, are called what?

(A) Irreversible changes  
(B) Undesirable changes  
(C) Physical changes  
(D) Desirable changes

Ans :

(D) Desirable changes

Changes that bring about outcomes we want or find useful, such as making food edible or palatable, are termed desirable changes.

37. Changes like the rusting of iron or the spoilage of food are often referred to as what?

(A) Reversible changes  
(B) Desirable changes  
(C) Undesirable changes  
(D) Physical changes

Ans :

(C) Undesirable changes

Changes that lead to damage, spoilage, or unwanted outcomes are generally considered undesirable changes.

38. Can a change be both desirable and undesirable depending on the context? Give an example mentioned.

(A) No, changes are always one or the other.  
(B) Yes, for example, melting ice is always desirable.  
(C) Yes, for example, decomposition of food is undesirable as spoilage but desirable for making compost.  
(D) No, only physical changes can be desirable.

Ans :

(C) Yes, for example, decomposition of food is undesirable as spoilage but desirable for making compost.

The desirability of a change can depend on the situation. Food decomposition is bad if it’s food meant for eating, but good if it’s waste being turned into useful compost.

39. What is the collective term for the physical and chemical processes that break down rocks over time?

(A) Erosion  
(B) Sedimentation  
(C) Weathering  
(D) Combustion

Ans :

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(C) Weathering

Weathering encompasses both the physical disintegration (breaking into smaller pieces) and chemical alteration (changing composition) of rocks at the Earth's surface.

40. Temperature changes, growing tree roots, and freezing water causing rocks to break are examples of what type of weathering?

(A) Chemical weathering  
 (B) Physical (or mechanical) weathering  
 (C) Biological weathering only  
 (D) Erosional weathering

Ans :

(B) Physical (or mechanical) weathering

These processes break rocks apart without changing their chemical makeup, fitting the description of physical or mechanical weathering.

41. The formation of a red-coloured layer on an originally black basalt rock due to the reaction of iron minerals with water/air is an example of what?

(A) Physical weathering only  
 (B) Erosion  
 (C) Chemical weathering  
 (D) Sedimentation

Ans :

(C) Chemical weathering

This involves a chemical reaction (oxidation of iron) that changes the composition of the rock minerals, characteristic of chemical weathering. Rusting is a key indicator here.

42. What is the process called where weathered rock material (soil, sand, pebbles) is moved from one place to another by forces like wind and water?

(A) Weathering  
 (B) Erosion  
 (C) Combustion  
 (D) Compaction

Ans :

(B) Erosion

Erosion specifically refers to the transport or movement of weathered materials (sediments) away from their original location by natural agents like wind, water, or ice.

43. Is erosion, such as soil being carried away by wind or water, primarily a physical or chemical change?

(A) Chemical change, as the soil dissolves.  
 (B) Physical change, as the material is just moved,

not chemically altered.

- (C) Both, as the water reacts with the soil during transport.  
 (D) Neither, it is a geological process.

Ans :

(B) Physical change, as the material is just moved, not chemically altered.

Erosion mainly involves the physical movement and sometimes further physical breakdown (like smoothing of pebbles) of materials, without changing their fundamental chemical nature.

44. **Assertion (A)** : Physical changes do not result in the formation of new substances.

**Reason (R)** : Melting of ice involves a change from solid to liquid state, but the substance remains water ( $H_2O$ ).

- (A) Both A and R are true, and R is the correct explanation of A.  
 (B) Both A and R are true, but R is not the correct explanation of A.  
 (C) A is true, but R is false.  
 (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.

Assertion A correctly defines physical changes. Reason R provides a valid example (melting ice) where no new substance forms, thus correctly illustrating and explaining Assertion A.

45. Which of the changes listed in is clearly irreversible?

(A) Dissolving sugar in water  
 (B) Rolling up a mat  
 (C) Twisting of straight string  
 (D) Grinding wheat grains to flour

Ans :

(D) Grinding wheat grains to flour

Once wheat is ground into flour, it's practically impossible to reassemble the flour particles back into whole wheat grains, making it an irreversible physical change. Others listed are generally reversible.

46. Is the process of leaves decomposing into compost a physical or chemical change?

(A) Physical change, as leaves just break down.  
 (B) Chemical change, as microorganisms transform the leaves into new substances.  
 (C) Both physical and chemical changes.  
 (D) Neither, it's a biological process only.

Ans :

(B) Chemical change, as microorganisms transform the leaves into new substances.

Decomposition involves complex chemical reactions carried out by bacteria and fungi, breaking down the organic matter in leaves into simpler, different chemical compounds that form compost.

47. Fill in the blank : Magnesium, when burnt in air, produces magnesium oxide. The substance formed is \_\_\_\_\_ in nature.

- (A) acidic
- (B) basic
- (C) neutral
- (D) salty

Ans :

(B) basic

Magnesium oxide dissolves in water to form a basic solution, as demonstrated in a previous activity.

48. Why is curdling of milk considered a chemical change?

- (A) Because the milk changes state from liquid to semi-solid.
- (B) Because the taste and smell change, indicating new substances have formed.
- (C) Because it requires a change in temperature.
- (D) Because the change is reversible by adding water.

Ans :

(B) Because the taste and smell change, indicating new substances have formed.

Curdling involves the formation of lactic acid and changes in milk proteins (casein), resulting in new substances with different properties (taste, smell, texture), defining it as a chemical change.

49. In the story 'Eco-friendly Prithvi', the decomposition of vegetable peels into compost is what type of change?

- (A) Physical change
- (B) Chemical change
- (C) Reversible change
- (D) Undesirable change

Ans :

(B) Chemical change

Decomposition is a chemical process where bacteria and fungi break down complex organic matter into simpler substances, forming compost. This involves chemical reactions.

50. In the same story, the germination of seeds and growth of plants into flowers involves what type of change?

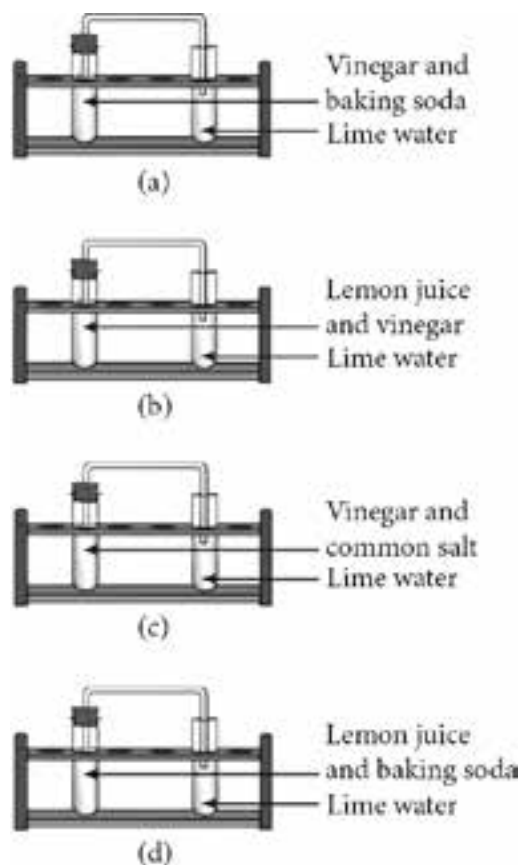
- (A) Primarily physical changes (increase in size)
- (B) Primarily chemical changes (photosynthesis, metabolism creating new tissues)
- (C) Only reversible changes
- (D) Only undesirable changes

Ans :

(B) Primarily chemical changes (photosynthesis, metabolism creating new tissues)

Growth involves complex chemical processes like photosynthesis (creating food) and metabolism (building new cells and tissues), making it fundamentally based on chemical changes.

51. In the experiment setups in Figure, which mixtures will produce carbon dioxide gas and thus turn lime water milky?



- (A) Only (a) Vinegar and baking soda
- (B) Only (d) Lemon juice and baking soda
- (C) Both (a) and (d)
- (D) All four setups

Ans :

(C) Both (a) and (d)



Carbon dioxide is produced when an acid reacts with baking soda (sodium hydrogen carbonate). Vinegar and lemon juice are acids. Common salt and vinegar (another acid) won't react with each other this way. Therefore, setups (a) and (d) will produce  $\text{CO}_2$ .

52. Which of these processes should be placed in area 'C' (both physical and chemical changes) in the Venn diagram of ?
- Tearing of paper
  - Rusting
  - Process of burning a candle
  - Melting of ice

Ans :

(C) Process of burning a candle

The burning a candle involves both physical changes (melting, evaporation of wax) and chemical changes (combustion of wax vapor).

53. Making invisible ink with lemon juice that appears when heated relies on what principle?
- Lemon juice evaporating completely.
  - Lemon juice chemically reacting with paper when heated, causing charring/browning.
  - Lemon juice reflecting light differently after heating.
  - Lemon juice melting the paper fibers.

Ans :

(B) Lemon juice chemically reacting with paper when heated, causing charring/browning.

The organic compounds in lemon juice oxidize or char more easily than the paper itself when heated, causing the writing to turn brown and become visible. This is a chemical change.

54. What gas is likely produced by yeast acting on sugar solution in the exploratory project, causing the balloon to inflate and turning lime water milky?
- Oxygen
  - Hydrogen
  - Nitrogen
  - Carbon dioxide

Ans :

(D) Carbon dioxide

Yeast performs fermentation on sugar, a process that produces alcohol and carbon dioxide gas. The  $\text{CO}_2$  inflates the balloon and is confirmed by the lime water test.

55. The process of yeast fermenting sugar solution is primarily what type of change?
- Physical change (dissolving sugar)
  - Chemical change (fermentation producing new substances)
  - Reversible change
  - Change of state

Ans :

(B) Chemical change (fermentation producing new substances)

Fermentation is a biological process involving chemical reactions where yeast breaks down sugar into ethanol and carbon dioxide, which are new chemical substances.

56. Which type of change is MOST fundamental to the formation of soil from rocks over long periods?
- Only physical changes (breaking)
  - Only chemical changes (reactions)
  - Both physical (weathering, erosion) and chemical (weathering) changes
  - Reversible changes only

Ans :

(C) Both physical (weathering, erosion) and chemical (weathering) changes

Soil formation involves rocks being broken down physically (by temperature, roots, ice) and altered chemically (by water, air, acids), as described under weathering, followed by transport (erosion).

57. **Assertion (A)** : Combustion requires a substance to be heated to its ignition temperature.  
**Reason (R)** : Focusing sunlight with a magnifying glass can ignite paper by concentrating heat.
- Both A and R are true, and R is the correct explanation of A.
  - Both A and R are true, but R is not the correct explanation of A.
  - A is true, but R is false.
  - A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.

Assertion A states the need for ignition temperature. Reason R provides a practical example of how sufficient heat can be supplied to reach that temperature, thus explaining how the condition in A can be met.

58. Compare melting ice and burning wood. Which statement is correct?  
 (A) Both are reversible chemical changes.  
 (B) Melting ice is physical and reversible; burning wood is chemical and irreversible.  
 (C) Melting ice is chemical and irreversible; burning wood is physical and reversible.  
 (D) Both are physical changes, but only melting ice is reversible.

Ans :

(B) Melting ice is physical and reversible; burning wood is chemical and irreversible. Melting ice changes state (physical) and can be refrozen (reversible). Burning wood forms new substances (chemical) and cannot be easily undone (irreversible).

59. Which of the following is NOT typically associated with a chemical change?  
 (A) Formation of a new substance  
 (B) Change in color  
 (C) Production of gas bubbles (effervescence)  
 (D) Change in state (like melting or boiling)

Ans :

(D) Change in state (like melting or boiling) Formation of new substances, color changes, and gas production are common indicators of chemical changes. Changes of state are characteristic physical changes.

### MATCHING TYPE QUESTION

60. Match the type of change in Column A with its characteristic or example in Column B :

	Column A		Column B
1.	Physical Change	A.	Formation of one or more new substances
2.	Chemical Change	B.	Melting of ice into water
3.	Reversible Change	C.	Ripening of a banana
4.	Irreversible Change	D.	Water turning back into ice upon freezing

- (a) 1-B, 2-A, 3-D, 4-C  
 (b) 1-A, 2-B, 3-C, 4-D  
 (c) 1-B, 2-D, 3-A, 4-C  
 (d) 1-D, 2-C, 3-B, 4-A

Ans :

(a) 1-B, 2-A, 3-D, 4-C  
 Melting ice is a physical change. Chemical changes involve new substances. Freezing water back to ice is reversible. Ripening of a banana is generally irreversible and a chemical change.

61. Match the process in Column A with the primary type of change it represents or a key feature in Column B :

	Column A		Column B
1.	Burning of Magnesium Ribbon	A.	Only change in state, no new substance
2.	Dissolving Sugar in Water	B.	New substance (ash) and heat/light produced
3.	Rusting of Iron	C.	Formation of a new brown substance (iron oxide)
4.	Boiling Water to form Steam	D.	A physical change where sugar disperses

- (a) 1-C, 2-A, 3-D, 4-B  
 (b) 1-B, 2-D, 3-C, 4-A  
 (c) 1-B, 2-A, 3-D, 4-C  
 (d) 1-D, 2-C, 3-A, 4-B

Ans :

(b) 1-B, 2-D, 3-C, 4-A  
 Burning magnesium produces new substances (magnesium oxide), heat, and light. Dissolving sugar is a physical change. Rusting forms iron oxide. Boiling water changes its state to steam, a physical change.

62. Match the term related to combustion in Column A with its correct definition or requirement in Column B :

	Column A		Column B
1.	Combustion	A.	Substance that undergoes combustion



2.	Combustible Substance	B.	Minimum temperature for a substance to catch fire
3.	Ignition Temperature	C.	A chemical reaction with oxygen producing heat/light
4.	Fire Triangle Component	D.	Oxygen

- (a) 1-D, 2-C, 3-A, 4-B  
 (b) 1-A, 2-B, 3-D, 4-C  
 (c) 1-C, 2-A, 3-B, 4-D  
 (d) 1-C, 2-B, 3-D, 4-A

Ans :

- (c) 1-C, 2-A, 3-B, 4-D

Combustion is a chemical reaction with oxygen producing heat/light. A combustible substance is the fuel. Ignition temperature is the minimum temperature to catch fire. Oxygen is essential for combustion (fire triangle).

63. Match the observation in Column A with the inference or related process in Column B :

	Column A		Column B
1.	Lime water turns milky	A.	Weathering of rocks
2.	Fizzing and gas bubbles from vinegar & baking soda	B.	Indication of Carbon Dioxide presence
3.	Breaking of large rocks into smaller pieces	C.	Melting of wax (physical change)
4.	Solidification of melted wax	D.	Production of Carbon Dioxide gas

- (a) 1-B, 2-D, 3-A, 4-C  
 (b) 1-A, 2-C, 3-D, 4-B  
 (c) 1-B, 2-A, 3-C, 4-D  
 (d) 1-D, 2-B, 3-A, 4-C

Ans :

- (a) 1-B, 2-D, 3-A, 4-C

Milky lime water indicates carbon dioxide. Vinegar and baking soda reaction produces carbon dioxide. Rock breaking is weathering. Wax solidifying is a physical change, opposite of melting.

64. Match the change described in Column A with its classification or characteristic in Column B :

	Column A		Column B
1.	Cutting paper into small pieces	A.	Chemical change essential for plant growth
2.	Burning of a candle wick	B.	Undesirable chemical change for iron structures
3.	Germination of a seed	C.	Physical change, no new substance formed
4.	Formation of rust on a gate	D.	Chemical change (burning of wax vapour)

- (a) 1-D, 2-A, 3-C, 4-B  
 (b) 1-C, 2-B, 3-D, 4-A  
 (c) 1-A, 2-D, 3-B, 4-C  
 (d) 1-C, 2-D, 3-A, 4-B

Ans :

- (d) 1-C, 2-D, 3-A, 4-B

Cutting paper is a physical change. Burning the candle wick involves the chemical change of wax vapour combustion. Seed germination is a chemical change vital for plant growth. Rusting is an undesirable chemical change.

## VERY SHORT QUESTION

65. What type of change involves altering only physical properties like shape, size, or state?

Ans :

Physical change

66. In a physical change, is a new substance formed?

Ans :

No

67. What type of change results in the formation of one or more new substances?

Ans :

Chemical change

68. What is the process called through which new substances are formed in a chemical change?

Ans :

Chemical reaction

69. What happens to lime water when carbon dioxide gas is passed through it?

Ans :

It turns milky (or cloudy)

70. What new substance is formed when carbon dioxide reacts with lime water?

Ans :

Calcium carbonate

71. What gas is produced when vinegar reacts with baking soda?

Ans :

Carbon dioxide

72. Is rusting of iron a physical or a chemical change?

Ans :

Chemical change

73. What new substance is formed during the rusting of iron?

Ans :

Rust (Iron oxide)

74. What is the chemical reaction called in which a substance reacts with oxygen, producing heat and/or light?

Ans :

Combustion

75. What are substances called that undergo combustion?

Ans :

Combustible substances

76. Which component of air is essential for combustion?

Ans :

Oxygen

77. What is the minimum temperature at which a substance catches fire called?

Ans :

Ignition temperature

78. List the three requirements for combustion (the 'fire triangle').

Ans :

Fuel (combustible substance), Oxygen, Heat (to reach ignition temperature)

79. Does the melting of candle wax represent a physical or chemical change?

Ans :

Physical change

80. Does the burning of wax vapour in a candle flame represent a physical or chemical change?

Ans :

Chemical change

81. What term describes changes that can return to their original state?

Ans :

Reversible changes

82. Give an example of an irreversible change mentioned in the text.

Ans :

Chopping vegetables (or making popcorn)

83. What is the collective term for the physical and chemical changes that break down rocks?

Ans :

Weathering

84. What is the process called where rock, soil, and sediment are moved by natural forces like wind and water?

Ans :

Erosion

## SHORT ANSWER QUESTION

85. Give two examples of physical changes from daily life where only shape or size changes.

Ans :

Examples include cutting paper into pieces or crushing chalk into powder. In both, the substance (paper/chalk) remains the same, only its form changes.



86. Explain why melting ice is considered a physical change.

**Ans :**

Melting ice changes its state from solid to liquid (water), but the substance remains  $H_2O$ . No new substance is formed, only a change in physical state occurs.

87. Explain why burning wood is considered a chemical change.

**Ans :**

Burning wood involves combustion, where wood reacts with oxygen to form new substances like ash, carbon dioxide, and water vapour, along with heat and light.

88. Describe the test for carbon dioxide using lime water.

**Ans :**

Pass the gas suspected to be carbon dioxide through freshly prepared lime water. If the lime water turns milky or cloudy, it indicates the presence of carbon dioxide.

89. What observations indicate a chemical change when vinegar is mixed with baking soda?

**Ans :**

A fizzing sound is heard, gas bubbles (carbon dioxide) are seen forming, and this gas turns lime water milky, indicating a new substance has been produced.

90. Why is rusting considered a chemical change? What new substance is formed?

**Ans :**

Rusting is a chemical change because iron reacts with oxygen and water to form a completely new substance, rust (iron oxide), which has different properties from iron.

91. Define combustion and give an example of a combustible substance.

**Ans :**

Combustion is a chemical reaction where a substance reacts with oxygen, producing heat and/or light. Wood is an example of a combustible substance.

92. Explain why a candle covered with a glass tumbler extinguishes after some time.

**Ans :**

The candle flame requires oxygen from the air to burn. Covering it limits the oxygen supply; once the trapped oxygen is used up, combustion stops, and the flame extinguishes.

93. What is ignition temperature? Why does paper catch fire quickly with a matchstick?

**Ans :**

Ignition temperature is the minimum temperature a substance must reach to catch fire. A matchstick flame is already above paper's ignition temperature, so it catches fire quickly.

94. How can sunrays focused by a magnifying glass ignite paper without a flame?

**Ans :**

The magnifying glass concentrates sunrays, heating the paper. When the paper's temperature reaches its ignition temperature due to this focused heat, it starts burning.

95. Identify one physical change and one chemical change that occurs when a candle burns.

**Ans :**

Physical change : Melting of solid wax into liquid wax. Chemical change : Burning of wax vapour (combustion) to produce heat, light, carbon dioxide, and water vapour.

96. Differentiate between reversible and irreversible changes using examples.

**Ans :**

Reversible changes can return to the original state (e.g., melting ice can be refrozen). Irreversible changes cannot (e.g., burnt wood cannot become wood again).

97. Give an example of a change that is desirable and one that is undesirable.

**Ans :**

Desirable : Ripening of fruits makes them edible. Undesirable : Rusting of iron damages structures.

98. Can a change be desirable in one context and undesirable in another? Explain with an example.

**Ans :**

Yes. Decomposition of food is undesirable when it spoils stored food but desirable when converting food waste into useful compost.

99. What is weathering of rocks? Mention one physical and one chemical aspect.

Ans :

Weathering is the breakdown of rocks. Physical aspect : Rocks breaking due to temperature changes or freezing water. Chemical aspect : Rock minerals reacting with water/air, changing composition (e.g., iron rusting).

100. Explain how erosion contributes to changing landscapes.

Ans :

Erosion involves natural forces like wind and water carrying away weathered rock fragments (soil, sand, pebbles). This sculpts landforms and deposits materials elsewhere, like sand on riverbeds.

101. Is chopping vegetables a physical or chemical change? Explain why.

Ans :

Chopping vegetables is a physical change because it only alters the size and shape of the vegetables. The substances composing the vegetables do not change into new substances.

102. Is making idlis from batter a reversible or irreversible change? Explain.

Ans :

Making idlis from batter is an irreversible chemical change. Steaming cooks the batter, forming new substances and changing its properties permanently; you cannot get the original batter back.

103. Why is the formation of soil from rocks considered a very slow change?

Ans :

Soil formation involves weathering (physical and chemical breakdown of rocks) and erosion, processes that typically occur gradually over thousands or millions of years due to climatic factors and natural forces.

104. How does bioluminescence in fireflies represent a chemical change?

Ans :

Fireflies produce light through chemical reactions within their bodies, converting chemical energy into light energy. This involves the formation of new substances and is therefore a chemical change.

## LONG ANSWER QUESTION

105. Explain the key differences between physical and chemical changes using at least two examples for each type. How can you generally identify which type of change has occurred?

Ans :

Physical changes alter properties like shape, size, or state, but no new substance forms (e.g., melting ice, cutting paper). Chemical changes produce one or more new substances with different properties (e.g., burning wood, rusting iron). Chemical changes often involve indicators like gas production (bubbles), colour change, heat/light emission, or formation of a precipitate (insoluble solid). Physical changes are often reversible, while chemical changes are usually irreversible. To identify the type, check if the fundamental substance remains the same (physical) or if something new is created (chemical).

106. Describe the experiment involving mixing vinegar and baking soda. Explain the observations and what they indicate about the type of change occurring. Include the chemical equation representation.

Ans :

Vinegar (acetic acid) is mixed with baking soda (sodium hydrogen carbonate) in a test tube. Observations : Fizzing sound and gas bubbles are produced. When this gas is passed through lime water, the lime water turns milky. Indication : The formation of gas (carbon dioxide, confirmed by the lime water test) shows a new substance is produced, meaning it's a chemical change. Equation : Vinegar + Baking soda  $\rightarrow$  Carbon dioxide + Other substances.

107. Explain the 'fire triangle' concept. Describe an experiment that demonstrates the necessity of one of these components for combustion.

Ans :

The fire triangle illustrates the three essential requirements for combustion : Fuel (a combustible substance), Oxygen (usually from air), and Heat (enough to reach the fuel's ignition temperature). A lit candle continues burning in open air but extinguishes when covered by a glass tumbler because the limited oxygen supply inside gets used up, stopping combustion. It shows the need



for heat : Paper doesn't burn in air until heated to its ignition temperature, either by a flame or focused sunlight.

- 108.** Analyse the process of burning a candle. Explain why it is considered an example where both physical and chemical changes occur simultaneously.

**Ans :**

Burning a candle involves :

- (1) Physical Changes : The heat melts the solid wax into liquid wax. The liquid wax travels up the wick and evaporates into wax vapour. Some melted wax may drip down and solidify again, changing shape. These are changes of state or shape, with the wax substance remaining wax.
- (2) Chemical Change : The wax vapour reacts with oxygen from the air in the flame (combustion). This chemical reaction produces new substances like carbon dioxide, water vapour, soot (carbon), along with heat and light. This is an irreversible formation of new substances. Thus, melting, evaporation and solidification are physical, while burning is chemical.

- 109.** Discuss the concept of reversible and irreversible changes. Provide examples from the chapter for each and explain why they are classified as such. Can physical changes be irreversible? Can chemical changes be reversible?

**Ans :**

Reversible changes allow the original substance/state to be recovered (e.g., melting ice to water, then freezing water back to ice ). Irreversible changes do not allow recovery of the original state (e.g., burning wood to ash ). Chopping vegetables or tearing paper are physical changes (substance is the same) but are practically irreversible in terms of restoring the original form. Most chemical changes are irreversible (like cooking or rusting). However, some chemical changes can be reversed under specific conditions, though this is less common at this level.

- 110.** Explain the natural processes of weathering and erosion. How do these processes involve both physical and chemical changes, and how do they contribute to the formation of soil and changing landscapes over time?

**Ans :**

Weathering is the breakdown of rocks at the Earth's surface. It involves :

- (1) Physical changes : Rocks broken by temperature fluctuations (expansion/contraction), freezing water in cracks, plant roots growing into crevices. The rock material remains chemically the same, just smaller.
- (2) Chemical changes : Minerals in rocks reacting with water, oxygen, or acids (like acid rain), forming new substances (e.g., iron in basalt rusting to form red iron oxide ). Erosion is the movement of weathered material (sediments, soil) by wind, water, or ice. This is primarily a physical process, transporting material and depositing it elsewhere, carving valleys, smoothing pebbles, and building up deltas or riverbeds. Together, weathering breaks rocks down, and erosion moves the pieces, leading to soil formation and shaping the landscape over long periods.

- 111.** The environmental impacts of some changes, like burning fuels and drying paint. Explain how these seemingly everyday changes can lead to larger environmental problems.

**Ans :**

Burning fuels (like petrol in cars, coal in power plants) is combustion, a chemical change releasing large amounts of carbon dioxide ( $\text{CO}_2$ ). Increased atmospheric  $\text{CO}_2$  is a major contributor to climate change. Drying paint involves the evaporation (physical change) of volatile organic compounds (VOCs). These VOCs contribute to air pollution and can harm human health and the environment. Though individual instances seem small, the cumulative effect of these widespread changes significantly impacts air quality and global climate.

- 112.** Compare the reaction of lime water ( $\text{Ca}(\text{OH})_2$ ) with exhaled air (containing  $\text{CO}_2$ ) and the reaction when baking soda ( $\text{NaHCO}_3$ ) is added to vinegar ( $\text{CH}_3\text{COOH}$ ). What is the common product responsible for the observed change in lime water in both scenarios (if applicable)?

**Ans :**

- (1) Lime water + Exhaled air : Exhaled air contains  $\text{CO}_2$ .  $\text{CO}_2$  reacts chemically with lime water ( $\text{Ca}(\text{OH})_2$ ) forming insoluble calcium carbonate ( $\text{CaCO}_3$ ), which makes the solution milky.

- (2) Vinegar + Baking soda : Acetic acid (vinegar) reacts chemically with sodium hydrogen carbonate (baking soda) producing sodium acetate, water, and carbon dioxide ( $\text{CO}_2$ ) gas.
- (3) Comparison : In the first case,  $\text{CO}_2$  is directly introduced. In the second case,  $\text{CO}_2$  gas is produced by the reaction. If this  $\text{CO}_2$  gas is then passed through lime water (as in Activity 5.4), it will cause the same reaction as in the first case, turning the lime water milky due to the formation of  $\text{CaCO}_3$ . The common product causing the milky appearance is calcium carbonate ( $\text{CaCO}_3$ ).

**113.** Michael Faraday used the burning candle to explain scientific principles. What key scientific concepts related to physical changes, chemical changes, and combustion could be demonstrated or discussed using a simple burning candle?

**Ans :**

A burning candle demonstrates several concepts :

- (1) States of Matter & Physical Changes : Solid wax melts to liquid, liquid evaporates to gas (vapour)- illustrating phase transitions (physical changes). Dripping wax solidifies, showing change of state and shape (physical).
- (2) Chemical Change : The burning of wax vapour is combustion, reacting with oxygen to produce new substances ( $\text{CO}_2$ , water vapour, soot) and releasing energy as heat and light- a clear chemical change.
- (3) Combustion Requirements : Shows need for fuel (wax vapour) and oxygen (from air - flame extinguishes if covered). Heat is needed to start (lighting the wick) and sustain the process (flame melts/vaporizes more wax).
- (4) Energy Transformation : Chemical energy stored in wax is converted to heat and light energy during combustion.

## CASE BASED QUESTION

**114.** Anita adds sugar to warm water and stirs until it dissolves completely. She then boils the solution in an open pan until all the water evaporates, leaving behind a white crystalline solid in the pan. She tastes the solid and confirms it is sugar.

1. Is dissolving sugar in water a physical or chemical change? Why?

2. Is boiling the water away to recover the sugar a physical or chemical change? Why?
3. Is the overall process (dissolving and then evaporating) reversible? Explain.

**Ans :**

- (1) Physical change. The sugar molecules spread out in the water, but no new substance is formed; it's still sugar and water.
- (2) Physical change. Water changes state from liquid to gas (steam), but it's still  $\text{H}_2\text{O}$ . The sugar is left behind unchanged chemically.
- (3) Yes, the overall process is reversible. The sugar was recovered, and the water vapour could theoretically be collected and condensed back into liquid water, restoring the original components.

**115.** Rohan takes a clean iron nail and leaves it partially submerged in tap water in an open beaker for a week. He observes a reddish-brown, flaky coating forming on the part of the nail exposed to both air and water. The part solely underwater shows less coating.

1. What is the reddish-brown coating likely to be? What type of change is its formation?
2. Why did more coating form on the part exposed to both air and water?
3. Suggest one simple method Rohan could have used to prevent or slow down this change on a similar nail.

**Ans :**

- (1) The coating is likely rust (iron oxide). Its formation is a chemical change (rusting).
- (2) Rusting requires both oxygen (from air) and water. The area at the air-water interface has the best access to both reactants, leading to faster rusting compared to the part only underwater (limited dissolved oxygen).
- (3) Rohan could have coated the nail with paint, oil, or grease. This would create a barrier preventing air and water from reaching the iron surface, thus inhibiting rust formation.

**116.** A baker mixes flour, water, sugar, and yeast to make dough. They leave the dough in a warm place for an hour. The dough rises significantly, becoming larger and filled with gas bubbles. When baked, it becomes bread, which has a different texture and taste from the original dough.

1. What causes the dough to rise and form gas bubbles? Is this primarily a physical or chemical change?



- Is baking the dough into bread a physical or chemical change? Justify your answer.
- Can the baker get the original flour, water, sugar, and yeast back from the baked bread? What does this indicate about the reversibility of the process?

**Ans :**

- Yeast undergoes fermentation (a biological process involving chemical changes), consuming sugar and producing carbon dioxide gas bubbles, which make the dough rise. This is a chemical change.
  - Baking is primarily a chemical change. The heat causes complex reactions within the dough, altering its structure, texture, and taste, forming new substances. It's irreversible.
  - No, the original ingredients cannot be recovered from the bread. This indicates that the overall process of making and baking bread involves irreversible chemical changes.
- 117.** During a science experiment, students heat a blue crystalline solid (copper sulfate) in a test tube. They observe water vapour escaping, and the solid turns into a white powder. After cooling, they add a few drops of water to the white powder, and it turns blue again, releasing some heat.
- Is removing water by heating the blue crystals a physical or chemical change?
  - Is adding water back to the white powder to get the blue solid a physical or chemical change? What evidence supports this?
  - Is the overall cycle (heating blue crystals to white, then adding water back to blue) reversible?

**Ans :**

- This is generally considered a chemical change, as the water was chemically bound within the crystal structure (hydrated copper sulfate), and removing it forms a different substance (anhydrous copper sulfate - the white powder).
- This is a chemical change. A new substance (hydrated copper sulfate) is formed, indicated by the colour change (white to blue) and the release of heat (exothermic reaction).
- Yes, the overall cycle is reversible. Although each step involves chemical changes, the original blue hydrated copper sulfate can be regenerated from the white anhydrous form by adding water.

- 118.** A group of friends are having a bonfire. They burn dry leaves and twigs. They observe flames, feel the heat, and see smoke rising. Afterwards, only a pile of grey ash remains where the leaves and twigs were.

- What is the scientific term for the process of burning the leaves and twigs?
- Is this process a physical or chemical change? Give two pieces of evidence from the description.
- Can the friends get the original leaves and twigs back from the ash? What does this imply about the change?

**Ans :**

- Combustion.
- Chemical change.

Evidence :

- Production of heat and light (flames).
  - Formation of new substances (ash, smoke/gases) which are different from the original leaves/twigs.
- (3) No, they cannot get the original materials back from the ash. This implies the change (combustion) is irreversible.

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# CHAPTER 6

## ADOLESCENCE – A STAGE OF GROWTH AND CHANGE

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### SUMMARY

#### 1. INTRODUCTION TO GROWTH AND CHANGE

Just like a plant matures before it can reproduce, humans also need to grow before becoming capable of reproduction. This stage of growth between childhood and adulthood is called adolescence, which typically occurs between the ages of 10 and 19. It involves physical, emotional, and behavioural changes.

#### 2. PHYSICAL CHANGES DURING ADOLESCENCE

During adolescence, individuals experience rapid physical development. This includes an increase in height and weight, broadening of shoulders in boys, and breast development in girls. Changes in voice are also noticeable boys often develop a deeper, hoarse voice due to the growth of the voice box, known as the Adam's apple. The appearance of body hair, facial hair in boys, and pimples due to oily skin are also common. These changes vary in timing and extent among individuals, which is completely normal.

#### 3. SECONDARY SEXUAL CHARACTERISTICS AND PUBERTY

Features such as changes in voice, facial hair in boys, and breast development in girls are known as secondary sexual characteristics. These changes indicate the body is approaching reproductive maturity. Puberty is the stage at which a child's body develops into an adult body capable of reproduction.

#### 4. REPRODUCTIVE MATURITY AND MENSTRUATION

Girls begin menstruation during adolescence, which is a regular discharge of blood every 21–35 days. This process is natural and signals reproductive health. Menstruation may cause discomfort, but it is normal and ends naturally between the ages of 45–55. Myths and taboos around menstruation should be addressed scientifically to ensure dignity and hygiene for all women.

#### 5. EMOTIONAL AND BEHAVIOURAL CHANGES

Adolescents often experience stronger emotions and mood swings. They may become more sensitive or curious, and may explore new interests or social causes. Understanding and managing these emotional changes positively helps in healthy development.

#### 6. HEALTHY HABITS FOR ADOLESCENTS

##### 6.1 Nutrition

A balanced diet rich in proteins, iron, calcium, vitamins, and minerals is essential during adolescence. Foods like milk, paneer, spinach, and dried fruits support growth, bone development, and blood formation.

##### 6.2 Personal Hygiene

Maintaining hygiene, especially in the armpits and pubic area, is vital. Menstrual hygiene should be managed using sanitary products, which are now widely supported by government initiatives like the MHS and Savidha scheme.

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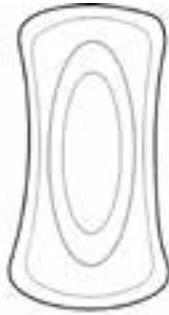


Figure : Sanitary pad

### 6.3 Physical Activity

Exercise and outdoor play improve physical health and mental well-being. Activities like sports and yoga boost stamina and help in managing stress.



Figure : Physical activities for fitness

### 6.4 Responsible Social Life

Adolescents must use social media mindfully. Respectful communication, privacy protection, and avoiding cyberbullying are key to maintaining healthy online interactions. Support from parents and teachers can guide responsible behaviour.



Figure : Collaborative learning in action

### 6.5 Avoiding Harmful Substances

Peer pressure may push adolescents towards harmful substances like tobacco or alcohol. These substances are addictive and damage the body.

Saying 'NO' and seeking help early can prevent substance abuse. The government's "Nasha Mukh Bharat Abhiyaan" and national helplines support addiction recovery.

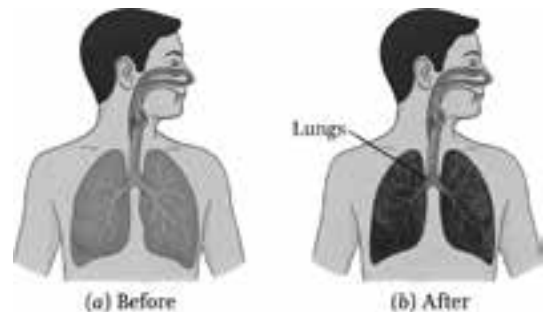


Figure : Condition of the lungs before and after prolonged exposure to bidi/cigarette smoke

## 7. ROLE OF HORMONES

Most of the changes in adolescence are triggered by hormones—chemicals produced in the body that regulate growth, reproduction, and mood. These hormones act in response to signals from the brain and help the body transition into adulthood.

## NCERT ACTIVITY

### Activity 6.1 : Let us discuss

1. Take a jar and some paper slips.
2. Write down the changes you can notice among students as they go from Grades 5 to 8. These could be related to height, strength, behaviour, or any other aspect. Please avoid writing names on the slips.
3. Fold the slips and place them in the jar.
4. Mix all the slips received from the students in the class and unfold the collected slips one by one. Based on the information on the slips, discuss the changes with the students in the class.

What were the most commonly observable changes among students, as mentioned on the slips? List these in Table.

**Table : Most common changes during growing up**

S. No.	Changes	Your observations
1.	Height	
2.	Weight and strength	
3.	Appearance	
4.	(Other)	

Ans :

S. No.	Changes	Your observations
1.	Height	Increases gradually during growth
2.	Weight and strength	Both increase as body develops and muscles grow
3.	Appearance	Changes in facial features, hair growth, etc.
4.	(Other)	Voice change, emotional changes, new skills

**Activity 6.2 : Let us list**

Take a moment to think if there are any changes in your emotions or behaviour or that of your classmates and friends in the past one or two years. These changes may be exciting, confusing, or both.

Let us list some emotional changes in Table along with their probable effects on behaviour and ways for positive growth and development.

**Table : Emotional changes, their probable effects on behaviour and ways for positive growth and development**

Key emotional changes	Probable effects on behaviour	Ways for positive growth and development
Mood swings	Sudden changes in behaviour, irritability	Engage in varied activities like music, dance, or sports
Strong emotions	Aggression, excitement, or sadness	Self-exploration and involvement in activities that may lead to creativity and innovation

Increased sensitivity	Easily hurt, overreacting to small issues	Compassion, involvement in social work
Any other (e.g., anxiety)		

Ans :

Key emotional changes	Probable effects on behaviour	Ways for positive growth and development
Mood swings	Sudden changes in behaviour, irritability	Engage in varied activities like music, dance, or sports
Strong emotions	Aggression, excitement, or sadness	Self-exploration and involvement in activities that may lead to creativity and innovation
Increased sensitivity	Easily hurt, overreacting to small issues	Compassion, involvement in social work
Any other (e.g., anxiety)	Feeling nervous or unsure about changes	Open communication with parents/teachers, relaxation techniques like meditation

**Activity 6.3 : Let us list**

Based on the locally available foods, fill Table with the healthy food sources, nutrients present in them and how these nutrients can help our growth and development.

**Table : Food sources, nutrients present in them, and functions of these nutrients**

Food Sources	Nutrients We Get From Them	Functions of These Nutrients
Milk, millets, curd, cheese, and paneer	Calcium, proteins, fats	To help optimal bone growth
-----	Proteins	To help proper growth, gain strength, and improve levels of energy

Spinach, kidney beans, and dried fruits like raisins, figs	Iron -----	To help in the formation of blood
--	---------------	-----------------------------------

Ans :

Food Sources	Nutrients We Get From Them	Functions of These Nutrients
Milk, millets, curd, cheese, and paneer	Calcium, proteins, fats	To help optimal bone growth
Pulses, eggs, fish, meat, soybeans	Proteins	To help proper growth, gain strength, and improve levels of energy
Spinach, kidney beans, and dried fruits like raisins, figs	Iron	To help in the formation of blood

#### Activity 6.4 : Let us spread awareness

Work in groups to design posters and pamphlets about various aspects of responsible social media behavior and paste them at designated places in the school. Also, fill in Table based on your collective observations.

**Table : Dos and don'ts to be followed on social media**

Dos	Don'ts
Be respectful and kind.	Do not share personal photos with strangers/virtual friends.
Think before posting.	Do not post or forward fake news or misinformation.
Protect privacy.	
Use strong passwords.	
Report inappropriate behavior.	

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Ans :

Dos	Don'ts
Be respectful and kind.	Do not share personal photos with strangers/virtual friends.
Think before posting.	Do not post or forward fake news or misinformation.
Protect privacy.	Do not click on unknown or suspicious links.
Use strong passwords.	
Report inappropriate behavior.	

## NCERT EXERCISE

- Ramesh, an 11-year-old boy, developed a few pimples on his face. His mother told him that this is because of ongoing biological changes in his body.
  - What could be the possible reasons for the development of these pimples on his face?
  - What can he do to get some relief from these pimples?

Ans :

- Ramesh is 11 years old and is going through a stage called adolescence. During this time, the body undergoes many changes due to the activity of hormones. One of the changes is increased oil production in the skin. This oil can block the tiny pores on the face, which may lead to the development of pimples. This is a common and natural part of growing up.
  - To get relief from pimples, Ramesh should wash his face gently twice a day using mild soap and clean water. He should avoid touching or popping the pimples as it can make them worse. Eating healthy food, drinking plenty of water, and keeping the skin clean are helpful. If the pimples become too many or painful, he should consult a doctor.

- Which of the following food groups would be a better option for adolescents and why?



Ans :

Food group (ii) is a better option for adolescents because it is balanced and rich in nutrients like proteins, vitamins, and minerals needed for growth. Food group (i) contains junk food, which is unhealthy and low in nutrition.

3. Unscramble the underlined word in the following sentences :

1. The discharge of blood in adolescent girls which generally occurs every 28-30 days is nstmnoiaretu.
2. The hoarseness in the voice of adolescent boys is due to enlarged iceov xob.
3. Secondary sexual characteristics are natural signs that the body is preparing for adulthood and mark the onset of urtypeb.
4. We should say NO to lahoclo and srugd as they are addictive.

Ans :

- (1) The discharge of blood in adolescent girls which generally occurs every 28-30 days is menstruation.
- (2) The hoarseness in the voice of adolescent boys is due to enlarged voice box.
- (3) Secondary sexual characteristics are natural signs that the body is preparing for adulthood and mark the onset of puberty.
- (4) We should say NO to alcohol and drugs as they are addictive.

4. Shalu told her friend, “Adolescence brings only physical changes, like growing taller or developing body hair.” Is she correct? What would you change in this description of adolescence?

Ans :

Shalu is not completely correct. Adolescence brings not only physical changes but also emotional and mental changes.

A better way to describe adolescence is :  
 “Adolescence is a stage of life when a person goes through physical, emotional, and mental changes.

Along with changes like growing taller and developing body hair, adolescents also experience mood swings, stronger emotions, and begin to think more deeply and independently.”

5. During a discussion in the class, some of the students raised the following points. What questions would you ask them to check the correctness of these points?

1. Adolescents do not need to worry about behavioural changes.
2. If someone tries a harmful substance once, they can stop anytime they want.

Ans :

- (1) “Adolescents do not need to worry about behavioural changes.”

**Question to ask :**

Why do you think behavioural changes are not important during adolescence, when this is the time emotions and thinking patterns are changing rapidly?

- (2) “If someone tries a harmful substance once, they can stop anytime they want.”

**Question to ask :**

Is it really easy to stop using harmful substances once someone starts, or can it lead to addiction and serious health problems?

6. Adolescents sometimes experience mood swings. On some days, they feel very energetic and happy, while on other days, they may feel low. What other behavioural changes are associated with this age?

Ans :

Apart from mood swings, adolescents may want more independence, feel emotions more strongly, spend more time with friends, and become more curious. They may also be influenced by their friends. These changes are normal while growing up.

7. While using a toilet, Mohini noticed that used sanitary pads were scattered near the bin. She got upset and shared her feelings with her friends. They discussed the importance of menstrual hygiene and healthy sanitary habits. What menstrual hygiene and sanitary habits would you suggest to your friends?

Ans :

I would suggest the following menstrual hygiene and sanitary habits to my friends :



- (1) Always use clean sanitary pads or menstrual cups during periods.
- (2) Change the pad every 4-6 hours to avoid infections.
- (3) Wrap used pads in paper and throw them in the bin—never leave them lying around.
- (4) Do not flush sanitary pads in the toilet as it can block the drain.
- (5) Wash hands properly after changing the pad.
- (6) Keep the genital area clean and dry to prevent infections.

8. Mary and Manoj were classmates and good friends. On turning 11, Mary developed a little bulge on the front of her neck. She visited the doctor who gave her medication and asked to take iodine-rich diet. Similarly, a bump was developed on the front of Manoj’s neck when he turned 12. However, the doctor told him that it was a part of growing up. According to you, what could be the possible reason for advising Mary and Manoj differently?

Ans :

The doctor advised Mary and Manoj differently because the reasons for the bulge on their necks were not the same.

In Mary’s case, the bulge was likely due to a swelling of the thyroid gland, which can happen because of iodine deficiency. This condition is called a goitre, and it needs treatment with medicine and an iodine-rich diet (like iodised salt, fish, and dairy).

For Manoj, the bump on his neck was likely his Adam’s apple, which is a normal part of puberty in boys. It happens as the voice box (larynx) grows, and it does not need any treatment.

So, the doctor gave different advice because Mary’s condition was a medical issue, while Manoj’s was a normal part of growing up.

9. During adolescence, the boys and girls undergo certain physical changes, a few of which are given below.
1. Change in voice
  2. Development of breasts
  3. Growth of moustache
  4. Growth of facial hair
  5. Pimples on the face
  6. Growth of hair in the pubic region
  7. Growth of hair in armpits

Categorise these changes in the table given below:

Physical changes during adolescence		
Observed only in boys	Common in boys and girls	Observed only in girls

Ans :

Physical changes during adolescence		
Observed only in boys	Common in boys and girls	Observed only in girls
Growth of facial hair	Increase in height	Development of breasts
Deepening of voice	Growth of body hair (armpits, etc.)	Start of menstruation (periods)
Broadening of shoulders	Increase in oil secretion (pimples)	Widening of hips

10. Prepare a poster mentioning the tips for adolescents to live a healthy lifestyle.

Ans :

### Tips for Adolescents to Live a Healthy Lifestyle

- ★ **Eat a Balanced Diet**  
Include fruits, vegetables, milk, pulses, and whole grains. Avoid excess junk food and sugary drinks.
- ★ **Stay Active**  
Exercise or play outdoor games for at least 1 hour daily.
- ★ **Maintain Good Hygiene**  
Bathe daily, wear clean clothes. Keep nails and hair trimmed and clean.
- ★ **Get Enough Sleep**  
Sleep 8-9 hours every night to stay fresh and focused.
- ★ **Drink Plenty of Water**  
Keep your body hydrated throughout the day.
- ★ **Avoid Harmful Substances**  
Say NO to smoking, alcohol, and other harmful substances.
- ★ **Stay Positive and Confident**  
Talk to primary trusted adults or friends. Believe in yourself, and respect others.

## MULTIPLE CHOICE QUESTION

1. Why can't a seedling or a newborn animal reproduce immediately after germination or birth?
- (A) They lack the necessary genetic material.  
 (B) They need to learn the process from parents.  
 (C) They need time to grow and reach reproductive maturity.  
 (D) Reproduction is only possible during specific seasons.

**Ans :**

(C) They need time to grow and reach reproductive maturity.

Both plants and animals, including humans, must undergo a period of growth and development to reach a stage of physical maturity before they become capable of reproduction.

2. Which are the typical stages of a human life journey mentioned?
- (A) Seedling, Sapling, Plant, Tree  
 (B) Egg, Larva, Pupa, Adult  
 (C) Infancy, Childhood, Adolescence, Adulthood, Old age  
 (D) Childhood, Teenage, Middle age, Senior citizen

**Ans :**

(C) Infancy, Childhood, Adolescence, Adulthood, Old age

The different stages of human life as infancy, childhood, adolescence, adulthood, and old age, acknowledging individual variations in timing.

3. What is the approximate age range typically associated with the onset and duration of adolescence?
- (A) 5-10 years  
 (B) 10-19 years  
 (C) 20-25 years  
 (D) 25-40 years

**Ans :**

(B) 10-19 years

Adolescence is defined as the period of rapid growth and development occurring roughly between the ages of 10 and 19 years, bridging childhood and adulthood.

4. What marks the transition from childhood to adolescence, according to the text?

- (A) Starting school  
 (B) Losing baby teeth  
 (C) Noticeable physical, emotional, and behavioural changes beyond just height/weight gain.  
 (D) Reaching a specific height or weight.

**Ans :**

(C) Noticeable physical, emotional, and behavioural changes beyond just height/weight gain.

While height and weight increase throughout childhood, adolescence is marked by the onset of more significant and varied changes related to puberty and preparing for adulthood.

5. In the conversation between Venkatesh and Devyani, what change did Devyani notice in Venkatesh?
- (A) He had become much taller.  
 (B) He had developed pimples.  
 (C) He had grown a thin moustache and his voice had changed.  
 (D) He had gained a lot of weight.

**Ans :**

(C) He had grown a thin moustache and his voice had changed.

Devyani specifically points out the appearance of a thin moustache and a change in Venkatesh's voice, which are common changes for boys during adolescence.

6. What change did Venkatesh notice in his cousin Devyani?
- (A) Her voice had become deeper.  
 (B) She had grown facial hair.  
 (C) She had become very tall.  
 (D) She had developed broader shoulders.

**Ans :**

(C) She had become very tall.

Venkatesh observes and comments on Devyani's significant increase in height, a prominent growth spurt often experienced during adolescence, particularly by girls initially.

7. What is the term for the stage of development between childhood and adulthood, typically occurring between ages 10-19?
- (A) Infancy  
 (B) Puberty  
 (C) Adolescence  
 (D) Maturity

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Ans :

(C) Adolescence

Adolescence is explicitly as the transitional stage from childhood to adulthood, characterized by rapid physical and psychological changes, usually spanning the teenage years.

8. The timing, nature, and extent of changes during adolescence vary from person to person. What does this suggest?
- (A) Some individuals skip adolescence entirely.  
 (B) Everyone experiences the exact same changes at the exact same age.  
 (C) Variations are normal, and individuals develop at their own pace.  
 (D) Only physical changes vary; emotional changes are uniform.

Ans :

(C) Variations are normal, and individuals develop at their own pace.

It is crucial to understand that the developmental timeline and specific manifestations of adolescent changes differ from person to person, and these variations are entirely normal.

9. Which physical change becomes particularly prominent during adolescence, often involving a rapid growth spurt?
- (A) Change in eye color  
 (B) Increase in height  
 (C) Development of teeth  
 (D) Thickening of hair

Ans :

(B) Increase in height

While growth occurs throughout childhood, adolescence is marked by a significant and often rapid increase in height, commonly referred to as a growth spurt.

10. Besides height and weight gain, what change in body structure is commonly observed in adolescent boys?
- (A) Narrowing of hips  
 (B) Development of breasts  
 (C) Broadening of shoulders and widening of chest  
 (D) Decrease in muscle mass

Ans :

(C) Broadening of shoulders and widening of chest  
 During adolescence, boys typically experience changes in body shape, such as broader shoulders

and a wider chest, which contribute to a more adult male physique.

11. What is a common change in body structure for adolescent girls mentioned in the text?
- (A) Growth of facial hair  
 (B) Deepening of the voice  
 (C) Development of breasts  
 (D) Broadening of shoulders

Ans :

(C) Development of breasts

Alongside increases in height and weight, the development of breasts is cited as a key physical change occurring in girls during adolescence.

12. What causes the voice to become hoarse or deeper in adolescent boys?
- (A) Growth of facial hair  
 (B) Increase in height  
 (C) Growth of the voice box (larynx)  
 (D) Development of chest hair

Ans :

(C) Growth of the voice box (larynx)

The change in voice pitch in boys is due to the enlargement of the voice box (larynx) during adolescence, which makes the vocal cords longer and thicker.

13. What is the visible bump in the throat region, resulting from the growth of the voice box in adolescent boys, commonly called?
- (A) Thyroid gland  
 (B) Adam's apple  
 (C) Epiglottis  
 (D) Tonsil

Ans :

(B) Adam's apple

The protrusion in the neck often seen in adolescent boys and men, caused by the enlarged larynx (voice box), is commonly referred to as the Adam's apple.

14. How does the change in voice typically differ between adolescent girls and boys?
- (A) Girls' voices become much deeper than boys'.  
 (B) Boys experience noticeable deepening; girls' voices change only slightly.  
 (C) Only boys experience a voice change.  
 (D) Girls' voices become hoarse; boys' voices become higher pitched.

Ans :

(B) Boys experience noticeable deepening; girls' voices change only slightly.

The voice box grows significantly more in boys, leading to a marked deepening or hoarseness, while in girls the growth is less pronounced, resulting in only slight voice changes.

15. Besides armpits and the pubic region, where else do boys often develop hair during adolescence?
- (A) On the palms and soles
  - (B) Inside the ears
  - (C) Facial hair (moustache, beard) and sometimes chest/back hair
  - (D) Only on the head

Ans :

(C) Facial hair (moustache, beard) and sometimes chest/back hair

The text specifies that boys typically experience facial hair growth (moustache, beard) and may also develop hair on their chest and back during adolescence.

16. What causes acne or pimples to become common during adolescence?
- (A) Poor diet only
  - (B) Lack of sleep
  - (C) Increased oily secretions from skin glands clogging pores
  - (D) Exposure to sunlight

Ans :

(C) Increased oily secretions from skin glands clogging pores

Hormonal changes during adolescence stimulate the skin's oil glands (sebaceous glands) to produce more oil (sebum), which can clog pores and lead to inflammation (pimples/acne).

17. What term describes physical characteristics that appear during puberty, distinguishing males from females, but are not directly involved in reproduction?
- (A) Primary sexual characteristics
  - (B) Hormonal characteristics
  - (C) Secondary sexual characteristics
  - (D) Adolescent characteristics

Ans :

(C) Secondary sexual characteristics

Secondary sexual characteristics are defined as traits like breast development in females, facial hair and deepened voice in males, which emerge during puberty due to hormones but aren't reproductive organs themselves.

18. What is the stage called where the adolescent body undergoes internal and external changes to become capable of reproduction?

- (A) Childhood
- (B) Infancy
- (C) Old age
- (D) Puberty

Ans :

(D) Puberty

Puberty is the specific biological process within adolescence during which sexual maturity is attained, involving hormonal changes that lead to the development of reproductive capability and secondary sexual characteristics.

19. An important internal change signifying reproductive capability in adolescent girls is the onset of what?

- (A) Increased height spurt
- (B) Change in voice
- (C) Menstrual cycle
- (D) Growth of body hair

Ans :

(C) Menstrual cycle

The beginning of the menstrual cycle is a key biological milestone indicating the maturation of the reproductive system in adolescent girls.

20. What is the typical frequency of the menstrual cycle?

- (A) Every week
- (B) Once a year
- (C) Generally every 28-30 days
- (D) Twice a year

Ans :

(C) Generally every 28-30 days

The menstrual cycle typically recurs about every 28 to 30 days, although normal variations (21-35 days) exist among individuals.

21. What is the phase of the menstrual cycle involving blood discharge from the body called?

- (A) Ovulation
- (B) Fertilization
- (C) Menstruation
- (D) Puberty

Ans :

(C) Menstruation

Menstruation specifically refers to the part of the menstrual cycle where there is a flow of blood



and tissue from the uterus, commonly known as the 'period'.

22. Why is it important to address myths and taboos surrounding menstruation?
- (A) Because menstruation only happens to a few people.  
 (B) Because myths can lead to unnecessary fear, shame, and hinder good reproductive health.  
 (C) Because menstruation is a sign of illness.  
 (D) Because taboos help maintain hygiene.

Ans :

(B) Because myths can lead to unnecessary fear, shame, and hinder good reproductive health. It is important to debunk myths because they are not scientifically valid, can lead to negative emotional effects, and may hinder open discussions and practices essential for maintaining good reproductive health.

23. At approximately what age range does menstruation naturally stop in women, marking the end of reproductive capability?
- (A) 20-25 years  
 (B) 30-35 years  
 (C) 45-55 years  
 (D) 60-65 years

Ans :

(C) 45-55 years  
 The natural cessation of menstruation, known as menopause, typically occurs between the ages of 45 and 55, signifying the end of a woman's reproductive years.

24. Adolescence is often marked by stronger emotions and mood swings compared to childhood. Why is understanding this important?
- (A) To ignore these feelings completely.  
 (B) To realize that these feelings are abnormal.  
 (C) To help adolescents manage their behavior thoughtfully and make better choices.  
 (D) To encourage impulsive actions.

Ans :

(C) To help adolescents manage their behavior thoughtfully and make better choices. Recognizing that heightened emotions are a normal part of adolescence allows individuals and those around them to develop strategies for managing feelings constructively and making responsible decisions.

25. Why is a nutritious diet particularly important during adolescence?
- (A) Because adolescents eat less than children.  
 (B) Because it's a period of rapid growth and significant body changes.  
 (C) Because nutritional needs decrease during this period.  
 (D) Because adolescents only need carbohydrates for energy.

Ans :

(B) Because it's a period of rapid growth and significant body changes. The rapid physical growth, development of organs, and hormonal changes during adolescence demand increased nutrients to support these processes properly.

26. According to Table 6.3, which nutrients found in milk, curd, and paneer are important for optimal bone growth?
- (A) Iron and Vitamin C  
 (B) Carbohydrates and Fats  
 (C) Calcium and Proteins  
 (D) Fiber and Water

Ans :

(C) Calcium and Proteins  
 The table explicitly lists calcium, proteins, and fats from dairy sources like milk and curd, noting their function in aiding optimal bone growth.

27. Foods like spinach, kidney beans, raisins, and figs are good sources of which mineral, essential for the formation of blood?
- (A) Calcium  
 (B) Sodium  
 (C) Iron  
 (D) Potassium

Ans :

(C) Iron  
 Table 6.3 identifies these food items as sources of iron and states that iron plays a crucial role in the formation of blood (specifically hemoglobin).

28. Which scientist won the Nobel Prize in Chemistry for determining the structure of Vitamin B12, a nutrient important for human body function?
- (A) Marie Curie  
 (B) Rosalind Franklin  
 (C) Dorothy Hodgkin  
 (D) Isaac Newton

Ans :

(C) Dorothy Hodgkin

The “Know a Scientist” box features Dorothy Hodgkin and highlights her Nobel Prize-winning work on the structure of Vitamin B12.

29. Besides a balanced diet, what else is mentioned as crucially important for health during adolescence, especially concerning potential infections?
- (A) Avoiding physical activity  
 (B) Getting minimal sleep  
 (C) Maintaining personal hygiene  
 (D) Spending more time online

Ans :

(C) Maintaining personal hygiene

Maintaining personal hygiene such as regular bathing and keeping sweat-prone areas clean is important to help prevent infections.

30. Why is maintaining proper hygiene during menstruation particularly important for girls?
- (A) To prevent excessive blood loss.  
 (B) To ensure comfort and prevent infections.  
 (C) To shorten the duration of the period.  
 (D) To hide the fact that they are menstruating.

Ans :

(B) To ensure comfort and prevent infections.

Good menstrual hygiene practices, such as regular changing of sanitary products and cleaning, are essential for personal comfort and reducing the risk of reproductive tract infections.

31. What are items like sanitary pads and reusable cloth pads used for?
- (A) General body cleaning  
 (B) Absorbing sweat during exercise  
 (C) Managing menstrual flow  
 (D) Applying medication to wounds

Ans :

(C) Managing menstrual flow

These products are specifically designed to absorb and manage the blood discharge that occurs during menstruation, aiding hygiene and comfort.

32. What is the recommended way to dispose of used sanitary pads?
- (A) Flushing them down the toilet.  
 (B) Throwing them openly in any bin.  
 (C) Burning them immediately.  
 (D) Wrapping them (e.g., in newspaper) and placing them in a dustbin.

Ans :

(D) Wrapping them (e.g., in newspaper) and placing them in a dustbin.

Proper disposal involves wrapping the used pad to contain it and placing it in a designated waste bin, ensuring community health and environmental cleanliness.

33. Which government initiative aims to provide sanitary pads free or at reduced prices to adolescent girls in rural India?
- (A) Rashtriya Kishor Swasthya Karyakram (RKSK)  
 (B) Suvidha Sanitary Napkin Initiative  
 (C) Menstrual Hygiene Scheme (MHS)  
 (D) Shuchi Scheme

Ans :

(C) Menstrual Hygiene Scheme (MHS)

The Menstrual Hygiene Scheme (MHS) under the Government of India is specifically mentioned as providing sanitary pads at low cost or free to rural adolescent girls.

34. Which government program encourages peer education among students about adolescent health topics, including menstrual health?
- (A) Menstrual Hygiene Scheme (MHS)  
 (B) Rashtriya Kishor Swasthya Karyakram (RKSK)  
 (C) Suvidha Sanitary Napkin Initiative  
 (D) Nasha Mukh Bharat Abhiyaan

Ans :

(B) Rashtriya Kishor Swasthya Karyakram (RKSK)

RKSK is described as aiming to improve overall adolescent health and specifically encourages peer education, where older students help educate younger ones.

35. Besides maintaining physical health, what is another benefit of regular exercise and physical activities during adolescence mentioned?
- (A) Decreasing appetite  
 (B) Improving eyesight  
 (C) Boosting mood and keeping the mind fit  
 (D) Increasing screen time

Ans :

(C) Boosting mood and keeping the mind fit

Physical activity is highlighted not only for bodily fitness and stamina but also for its positive effects on mental well-being, including mood enhancement.



36. What does responsible behaviour on social media platforms involve?
- (A) Sharing personal information freely with strangers.
- (B) Posting content without thinking about its impact.
- (C) Being respectful, kind, thinking before posting, and protecting privacy.
- (D) Spreading rumours and engaging in teasing.

Ans :

(C) Being respectful, kind, thinking before posting, and protecting privacy.

Responsible online conduct includes mindful communication, respecting others, considering consequences before posting, and safeguarding personal information and privacy.

37. What is cyberbullying?
- (A) Playing online video games competitively.
- (B) Using digital devices/platforms to harass, mislead, or spread false information about others.
- (C) Learning coding and programming online.
- (D) Collaborating on online school projects.

Ans :

(B) Using digital devices/platforms to harass, mislead, or spread false information about others. Cyberbullying is defined as using electronic means (phones, computers, internet platforms) to bully or harass others, including sending harmful messages, spreading lies, or non-consensual sharing of private information.

38. Why is it important to say 'NO' to harmful substances like tobacco, alcohol, and drugs, especially when first offered?
- (A) Because they are expensive.
- (B) Because they can be addictive and cause serious health problems.
- (C) Because trying them once makes you immune.
- (D) Because only adults should use them.

Ans :

(B) Because they can be addictive and cause serious health problems.

These substances pose significant risks due to their addictive nature (leading to substance abuse) and their detrimental effects on physical and mental health. Saying no from the start prevents these harms.

39. What does it mean if a substance is 'addictive'?
- (A) It provides essential nutrients.
- (B) It causes a strong urge to take it repeatedly after initial use.
- (C) It can only be obtained with a prescription.
- (D) It improves physical performance.

Ans :

(B) It causes a strong urge to take it repeatedly after initial use.

Addiction implies developing a dependency where the user feels a compelling need or craving to use the substance regularly, often finding it difficult to stop.

40. What is the name of the Government of India campaign aimed at spreading awareness and preventing substance abuse?
- (A) Menstrual Hygiene Scheme (MHS)
- (B) Rashtriya Kishor Swasthya Karyakram (RKSK)
- (C) Nasha Mukh Bharat Abhiyaan
- (D) Suvidha Sanitary Napkin Initiative

Ans :

(C) Nasha Mukh Bharat Abhiyaan

The Nasha Mukh Bharat Abhiyaan is explicitly mentioned as the government campaign focused on creating a substance-abuse-free India, particularly targeting youth.

41. What are hormones, and what is their primary role during adolescence?
- (A) Nutrients obtained from food that provide energy.
- (B) Cells in the blood that fight infection.
- (C) Chemicals produced in the body that regulate growth, development, and puberty.
- (D) External factors like sunlight and air quality.

Ans :

(C) Chemicals produced in the body that regulate growth, development, and puberty.

Hormones are described as chemical messengers produced internally that play a crucial role in controlling and regulating the various physical, biological, and even emotional changes associated with adolescence and puberty.

42. Where are hormones produced, and how is their release controlled?
- (A) Produced outside the body; absorbed through skin.
- (B) Produced only in the brain; released constantly.

- (C) Produced in different body parts; released in response to brain signals.
- (D) Produced only during illness; released randomly.

Ans :

(C) Produced in different body parts; released in response to brain signals.  
Hormones are produced by various glands throughout the body, and their release is typically regulated by signals originating from the brain, ensuring they act at the appropriate times.

- 43. Assertion (A) :** Adolescence involves significant physical, emotional, and biological changes.  
**Reason (R) :** These changes are primarily controlled by chemicals called hormones produced within the body.
- (A) Both A and R are true, and R is the correct explanation of A.
  - (B) Both A and R are true, but R is not the correct explanation of A.
  - (C) A is true, but R is false.
  - (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.  
Assertion accurately describes the multifaceted nature of adolescent changes. Reason correctly identifies hormones as the key internal chemical regulators responsible for initiating and controlling these changes.

- 44.** Which food group represents a more balanced and nutritious option for adolescents compared to chips and sugary drinks?
- (A) Only fruits
  - (B) Only dairy products
  - (C) A meal including roti/rice, dal, vegetables, and curd.
  - (D) Pizza and burgers

Ans :

(C) A meal including roti/rice, dal, vegetables, and curd.  
A traditional balanced meal with grains, pulses (dal), vegetables, and dairy (curd) provides a wider range of essential nutrients (carbs, proteins, vitamins, minerals) needed during adolescence than processed snacks.

- 45.** Unscramble ‘nstmnoiaretu’ to find the term for the discharge of blood in adolescent girls.

- (A) Nutrition
- (B) Menstruation
- (C) Mutation
- (D) Transition

Ans :

(B) Menstruation  
Unscrambling ‘nstmnoiaretu’ correctly yields ‘Menstruation’, the biological term for the process described.

- 46.** Unscramble ‘urtypeb’ to find the term for the stage marking the onset of reproductive capability.
- (A) Purity
  - (B) Rupture
  - (C) Puberty
  - (D) Beauty

Ans :

(C) Puberty  
The letters ‘urtypeb’ unscramble to form ‘Puberty’, the stage when adolescents become biologically capable of reproduction.

- 47.** Is Shalu correct in saying adolescence brings only physical changes like height and body hair? What else occurs?
- (A) Yes, Shalu is completely correct.
  - (B) No, adolescence also involves significant emotional, behavioural, and internal biological changes.
  - (C) No, adolescence only involves emotional changes.
  - (D) Yes, but these physical changes happen very slowly.

Ans :

(B) No, adolescence also involves significant emotional, behavioural, and internal biological changes.  
Shalu’s statement is incomplete. Adolescence is a holistic process involving not just physical growth but also emotional development, behavioural shifts, and internal changes related to reproductive maturity.

- 48.** Why is the statement “If someone tries a harmful substance once, they can stop anytime they want” potentially incorrect or dangerous?
- (A) Because harmful substances are usually expensive.
  - (B) Because many harmful substances are addictive, making it hard to stop after starting.
  - (C) Because trying something once means you have to continue.
  - (D) Because stopping requires permission from friends.



Ans :

(B) Because many harmful substances are addictive, making it hard to stop after starting. The danger lies in the addictive nature of many substances. Even initial experimentation can lead to dependence and loss of control, making it very difficult to stop voluntarily.

49. Mary (age 11) develops a neck bulge needing medication and iodine, while Manoj (age 12) develops a neck bump considered normal growth. What might explain the difference?
- (A) Mary has a common cold; Manoj has a growing voice box.
- (B) Mary might have a thyroid issue (goitre due to iodine deficiency); Manoj has a developing Adam's apple.
- (C) Both have the same condition, but treatment differs by gender.
- (D) Mary's bump is cosmetic; Manoj's is related to puberty.

Ans :

(B) Mary might have a thyroid issue (goitre due to iodine deficiency); Manoj has a developing Adam's apple.

A bulge needing iodine suggests a possible thyroid problem like goitre, often linked to iodine deficiency. A bump in a boy's neck at puberty is likely the Adam's apple, a normal secondary sexual characteristic.

50. Which physical change during adolescence is observed ONLY in boys from the list provided?
- (A) Pimples on the face
- (B) Growth of hair in armpits
- (C) Change in voice (significant deepening)
- (D) Growth of moustache/facial hair

Ans :

(D) Growth of moustache/facial hair  
While voice changes, pimples, and hair growth in armpits/pubes region occur in both (though differing in degree), the growth of moustache and significant facial hair is exclusive to boys.

51. Which physical change from the list is common to both boys and girls during adolescence?
- (A) Development of breasts
- (B) Growth of moustache
- (C) Growth of hair in the pubic region and armpits
- (D) Significant deepening of voice

Ans :

(C) Growth of hair in the pubic region and armpits  
While breast development is specific to girls and moustache/deep voice to boys, both genders experience hair growth in the pubic region and under the arms during puberty.

52. Preparing a poster on healthy lifestyles for adolescents should include tips on what?
- (A) Balanced diet, hygiene, physical activity, avoiding harmful substances, mental well-being.
- (B) Focusing only on academic performance.
- (C) Increasing screen time and social media use.
- (D) Avoiding interactions with peers.

Ans :

(A) Balanced diet, hygiene, physical activity, avoiding harmful substances, mental well-being.  
A healthy adolescent lifestyle encompasses multiple aspects covered in the chapter : nutrition, cleanliness, exercise, responsible social behavior, avoiding substance abuse, and managing emotional health.

53. A role play on 'Child marriage : A social evil' would likely highlight which negative impacts, especially on girls' health, as discussed implicitly in the context of adolescent development?
- (A) Better financial security for the family.
- (B) Early completion of education.
- (C) Physical and mental health risks due to early pregnancy before full maturity.
- (D) Increased social status for the girl.

Ans :

(C) Physical and mental health risks due to early pregnancy before full maturity.  
Child marriage forces girls into adult responsibilities, including pregnancy, before their bodies and minds are fully developed, posing significant health risks and curtailing their overall well-being and opportunities, contradicting the natural progression through adolescence.

54. What activity is suggested in relation to International Yoga Day (June 21st)?
- (A) Writing an essay about yoga.
- (B) Organizing a camp to practice yoga asanas.
- (C) Watching videos about yoga's history.
- (D) Debating the benefits of yoga versus other exercises.

Ans :

(B) Organizing a camp to practice yoga asanas.

The project idea explicitly suggests organizing a camp with teachers' help to actively practice yoga postures (asanas) in observance of International Yoga Day.

55. Adolescence is called a 'stage of growth and change'. Which statement best reflects this?
- (A) Only height changes during adolescence.
  - (B) Growth stops completely after childhood.
  - (C) Adolescents experience rapid and multifaceted changes : physical, biological, emotional, and behavioural.
  - (D) Changes during adolescence are always slow and gradual.

Ans :

(C) Adolescents experience rapid and multifaceted changes : physical, biological, emotional, and behavioural.

The title and content emphasize that adolescence is a dynamic period involving significant transformations across physical, reproductive, emotional, and social domains, preparing the individual for adulthood.

56. How do secondary sexual characteristics differ from primary sexual characteristics (reproductive organs)?
- (A) Secondary appear at birth; primary appear at puberty.
  - (B) Secondary are directly involved in reproduction; primary are not.
  - (C) Primary are present from birth (or differentiate early); secondary emerge at puberty and distinguish sexes externally.
  - (D) Primary occur only in males; secondary occur only in females.

Ans :

(C) Primary are present from birth (or differentiate early); secondary emerge at puberty and distinguish sexes externally.

Primary characteristics are the reproductive organs themselves. Secondary characteristics (like breasts, facial hair, Adam's apple) develop during puberty under hormonal influence and are outward signs of sexual maturation.

57. Why is seeking help from trusted adults (parents, teachers) important if an adolescent faces issues like cyberbullying or pressure to use harmful substances?
- (A) Adults can solve all problems instantly.
  - (B) Adolescents are incapable of handling any problems.

- (C) Trusted adults can provide guidance, support, and help navigate difficult situations safely.
- (D) It is mandatory by law to report everything to adults.

Ans :

(C) Trusted adults can provide guidance, support, and help navigate difficult situations safely.

Facing challenges like bullying or substance abuse pressure can be overwhelming. Trusted adults offer experience, support, and resources to help adolescents manage these situations effectively and safely.

58. Which of the following is NOT a recommended practice for a healthy adolescence?

- (A) Eating a balanced diet rich in nutrients.
- (B) Engaging in regular physical activity.
- (C) Maintaining good personal and menstrual hygiene.
- (D) Experimenting with harmful substances due to peer pressure.

Ans :

(D) Experimenting with harmful substances due to peer pressure.

Using harmful substances is strongly discouraged because they are addictive and have serious negative effects on health, highlighting the importance of confidently saying 'NO'.

### MATCHING TYPE QUESTION

59. Match the term related to adolescence in Column A with its correct description in Column B :

	Column A		Column B
1.	Adolescence	A.	Stage when the body becomes capable of reproduction
2.	Puberty	B.	Chemicals in the body that control growth and developmental changes
3.	Secondary Sexual Characteristics	C.	Period of rapid growth and change between childhood and adulthood (10-19 years)



4.	Hormones	D.	Physical features distinguishing males and females, not directly for reproduction
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- (a) 1-C, 2-A, 3-D, 4-B  
 (b) 1-A, 2-C, 3-B, 4-D  
 (c) 1-C, 2-D, 3-A, 4-B  
 (d) 1-D, 2-A, 3-C, 4-B

Ans :

- (a) 1-C, 2-A, 3-D, 4-B

Adolescence is the transitional stage from childhood to adulthood. Puberty is when reproductive capability develops. Secondary sexual characteristics distinguish sexes. Hormones are chemical messengers controlling these changes.

60. Match the physical change during adolescence in Column A with the group it primarily affects or its nature in Column B :

	Column A		Column B
1.	Development of Breasts	A.	More prominent in boys (Adam's apple)
2.	Growth of Facial Hair	B.	Common in both boys and girls
3.	Change in Voice (Hoarseness)	C.	Primarily observed in girls
4.	Appearance of Pimples	D.	Primarily observed in boys

- (a) 1-D, 2-C, 3-B, 4-A  
 (b) 1-C, 2-A, 3-D, 4-B  
 (c) 1-A, 2-D, 3-C, 4-B  
 (d) 1-C, 2-D, 3-A, 4-B

Ans :

- (d) 1-C, 2-D, 3-A, 4-B

Breast development occurs in girls. Facial hair growth (moustache, beard) is a change in boys. Voice hoarseness and Adam's apple are more prominent in boys. Pimples can appear in both.

61. Match the aspect of adolescent well-being in Column A with its important practice or concern in Column B :

	Column A		Column B
1.	Nutritional Needs	A.	Using sanitary pads and ensuring proper disposal

2.	Personal Hygiene	B.	Engaging in sports and regular exercise
3.	Physical Activity	C.	Consuming a balanced diet rich in iron and calcium
4.	Menstrual Hygiene	D.	Regular bathing and cleanliness of armpits/pubic region

- (a) 1-B, 2-D, 3-A, 4-C  
 (b) 1-C, 2-A, 3-B, 4-D  
 (c) 1-D, 2-C, 3-B, 4-A  
 (d) 1-C, 2-D, 3-B, 4-A

Ans :

- (d) 1-C, 2-D, 3-B, 4-A

Adolescents need a balanced diet for growth. Personal hygiene includes regular bathing. Physical activity is vital for fitness. Menstrual hygiene involves using and disposing of sanitary products correctly.

62. Match the emotional/social aspect in Column A with a related concept or advice in Column B :

	Column A		Column B
1.	Mood Swings	A.	Using digital platforms to harass others
2.	Cyberbullying	B.	Developing a strong urge to repeatedly use harmful things
3.	Substance Abuse	C.	Experiencing varied and sometimes strong emotions
4.	Responsible Social Media Use	D.	Thinking before posting and protecting personal information online

- (a) 1-C, 2-A, 3-B, 4-D  
 (b) 1-A, 2-C, 3-D, 4-B  
 (c) 1-C, 2-D, 3-A, 4-B  
 (d) 1-B, 2-A, 3-D, 4-C

Ans :

- (a) 1-C, 2-A, 3-B, 4-D

Mood swings are common emotional changes. Cyberbullying is online harassment. Substance abuse leads to addiction. Responsible social media use involves careful posting and privacy protection.

63. Match the biological process or term in Column A with its specific characteristic in Column B :

	Column A		Column B
1.	Menstruation	A.	Occurs generally every 28-30 days in adolescent girls
2.	Adam's Apple	B.	Increased oily secretions from skin leading to this condition
3.	Acne	C.	Control many bodily changes during adolescence
4.	Hormones	D.	Visible bump in the throat region, especially in boys

- (a) 1-D, 2-A, 3-C, 4-B
- (b) 1-A, 2-C, 3-B, 4-D
- (c) 1-B, 2-D, 3-A, 4-C
- (d) 1-A, 2-D, 3-B, 4-C

Ans :

- (d) 1-A, 2-D, 3-B, 4-C

Menstruation is the monthly blood discharge. Adam's apple is the enlarged voice box in boys. Acne is a skin condition due to oily secretions. Hormones regulate adolescent changes.

### VERY SHORT QUESTION

64. What is the stage of development between childhood and adulthood called?

Ans :

Adolescence

65. What is the typical age range for adolescence?

Ans :

10-19 years

66. What term describes the noticeable bump in the throat region, especially in adolescent boys?

Ans :

Adam's apple

67. What skin condition, characterized by pimples, is common during adolescence?

Ans :

Acne

68. What are the characteristic changes that help distinguish males from females but are not directly involved in reproduction called?

Ans :

Secondary sexual characteristics

69. What is the stage called when the body undergoes changes to become capable of reproduction?

Ans :

Puberty

70. What is the recurring monthly cycle involving blood discharge in adolescent girls and women called?

Ans :

Menstrual cycle

71. What is the phase of the menstrual cycle when blood discharge occurs called?

Ans :

Menstruation

72. At approximately what age range does menstruation usually stop naturally in women?

Ans :

45-55 years

73. Name one nutrient particularly important for bone growth during adolescence.

Ans :

Calcium

74. Name one nutrient important for the formation of blood, deficiency of which can cause health problems.

Ans :

Iron

75. Name one product used for maintaining menstrual hygiene.

Ans :

Sanitary pad (or reusable cloth pad)

76. What term describes the use of digital devices to harass others online?

Ans :

Cyberbullying



77. What does developing a strong urge to take harmful substances repeatedly indicate?

Ans :

Addiction

78. What is the term for regular use of harmful substances over time?

Ans :

Substance abuse

79. Name one harmful substance mentioned in the text that should be avoided.

Ans :

Tobacco (or Gutka, Cigarettes, Beedi, Alcohol, Illegal drugs)

80. What are the chemicals produced in the body that regulate growth and development called?

Ans :

Hormones

81. Name one government scheme mentioned that supports menstrual hygiene.

Ans :

Menstrual Hygiene Scheme (MHS) (or RKSK, Suvidha Sanitary Napkin Initiative)

82. Name one type of physical activity recommended for adolescents.

Ans :

Exercise (or games, sports, skipping, yoga)

83. What structure in the throat helps us to speak and grows significantly in adolescent boys?

Ans :

Voice box

## SHORT ANSWER QUESTION

84. Define adolescence. Why is it considered a crucial stage?

Ans :

Adolescence is the transitional stage from childhood to adulthood, typically between 10-19 years. It's crucial due to rapid physical, emotional,

and reproductive development preparing for adulthood.

85. List two common physical changes observed in boys during adolescence besides height increase.

Ans :

Boys experience voice deepening (due to enlarged voice box/Adam's apple) and growth of facial hair (moustache/beard). Shoulders may also broaden.

86. List two common physical changes observed in girls during adolescence besides height increase.

Ans :

Girls experience development of breasts and the onset of the menstrual cycle. Hips may also widen.

87. Explain why acne is common during adolescence.

Ans :

During adolescence, oily secretions from the skin increase. This excess oil can clog skin pores, leading to infections and the appearance of pimples, known as acne.

88. What are secondary sexual characteristics? Give one example for boys and one for girls.

Ans :

These are physical signs of sexual maturation that distinguish sexes but aren't directly involved in reproduction. Example for boys : facial hair growth. Example for girls : breast development.

89. What is puberty and how does it relate to adolescence?

Ans :

Puberty is the specific stage within adolescence when the body undergoes changes (internal and external) making it capable of reproduction. It marks the onset of sexual maturity.

90. Describe the menstrual cycle briefly, mentioning menstruation.

Ans :

The menstrual cycle is a natural recurring process in adolescent girls/women, typically every 28-30 days. Menstruation is the phase involving blood discharge, lasting about 3-7 days.

91. Why is it important to dispel myths about menstruation?

Ans :

Myths cause unnecessary fear, shame, and harmful practices like isolation. Dispelling them with scientific understanding promotes good reproductive health and healthier lifestyles for women.

92. Mention two common emotional or behavioural changes experienced during adolescence.

**Ans :**

Adolescents often experience mood swings (feeling happy one moment, low the next) and stronger emotions (like increased sensitivity or passion for new interests/causes).

93. Why is a balanced, nutritious diet particularly important during adolescence?

**Ans :**

Adolescence is a period of rapid growth and significant bodily changes. A nutritious diet provides essential energy and nutrients (proteins, calcium, iron etc.) needed for this development.

94. Name two food sources rich in iron and state why iron is important.

**Ans :**

Sources include spinach, kidney beans, and dried fruits like raisins. Iron is important for the formation of blood, preventing deficiencies like anaemia.

95. Explain the importance of personal hygiene during adolescence, especially for girls during menstruation.

**Ans :**

Maintaining hygiene, especially in armpits/pubic region, prevents infections. For girls, proper menstrual hygiene using sanitary pads prevents infections and ensures comfort and health during periods.

96. How should used sanitary pads be disposed of properly? Why is this important?

**Ans :**

Wrap used pads in newspaper and dispose of them in a dustbin. Proper disposal is important for community health, environmental cleanliness, and reducing stigma.

97. State two benefits of engaging in regular physical activity during adolescence.

**Ans :**

Regular physical activity keeps the body and mind fit and healthy, builds stamina, boosts mood, and contributes to overall well-being during this growth phase.

98. What is cyberbullying? Give one example.

**Ans :**

Cyberbullying is using digital devices/online platforms to harass others. An example is spreading false rumours about someone online or sending hurtful messages.

99. Why is it important to use social media responsibly during adolescence?

**Ans :**

Adolescents interact frequently online. Responsible use involves being respectful, protecting privacy, and avoiding harmful behaviours like cyberbullying to ensure personal safety and collective well-being.

100. Why should adolescents strongly say 'NO' to harmful substances like drugs or alcohol?

**Ans :**

These substances are addictive and extremely harmful to physical and mental health, potentially causing long-term damage (e.g., to lungs, memory) and disrupting future life prospects.

101. What does it mean for a substance to be 'addictive'?

**Ans :**

An addictive substance creates a strong urge or dependency, making a person want to consume it repeatedly, often finding it very difficult to stop.

102. What role do hormones play during adolescence?

**Ans :**

Hormones are chemical messengers that trigger and regulate many changes during adolescence, including growth spurts, development of secondary sexual characteristics, maturation of reproductive organs, and even influencing mood/behaviour.

103. Why is it normal for adolescents to experience changes at different times and rates?

**Ans :**

Growth and development vary among individuals. Hormonal changes and maturation occur at each person's own pace; variations in timing and extent of changes are completely normal.



## LONG ANSWER QUESTION

- 104.** Describe the major physical changes that typically occur during adolescence in both boys and girls. Include changes in height, body shape, voice, and hair growth.

**Ans :**

During adolescence, both boys and girls experience a rapid increase in height (growth spurt). Boys typically develop broader shoulders and wider chests, while girls may experience widening of the hips and breast development. Boys' voices deepen significantly due to the growth of the voice box (Adam's apple), while girls' voices change less noticeably. Both sexes experience hair growth in armpits and the pubic region. Boys also develop facial hair (moustache, beard) and sometimes chest hair. Acne may appear in both due to increased skin oil secretion. These changes mark the transition towards physical adulthood.

- 105.** Explain what secondary sexual characteristics are and why they develop during puberty. Provide three examples specific to boys and three specific to girls.

**Ans :**

Secondary sexual characteristics are physical traits that appear during puberty, distinguishing males from females, but are not directly part of the reproductive system. They signal the body's maturation towards reproductive capability, driven by hormonal changes. Examples in boys : deepening of voice, growth of facial/body hair, broadening shoulders. Examples in girls : development of breasts, widening of hips, onset of menstruation (though menstruation itself is related to reproductive function, its onset is a key puberty marker). These changes indicate the body is preparing for adulthood.

- 106.** Discuss the common emotional and behavioural changes experienced during adolescence. How can adolescents manage these changes positively?

**Ans :**

Adolescence involves significant emotional/behavioural shifts, including mood swings, heightened sensitivity, strong emotions (positive or negative), increased self-awareness, and developing new interests. Peer influence becomes stronger. Positive management involves

understanding that these changes are normal, engaging in constructive activities (sports, arts, music, social work), developing communication skills, seeking support from trusted adults (parents, teachers), maintaining healthy habits (diet, exercise, sleep), and learning thoughtful decision-making to channel energy positively.

- 107.** Explain the importance of a balanced diet and personal hygiene for adolescents. Mention specific nutritional needs and hygiene practices relevant to this stage.

**Ans :**

Rapid growth during adolescence demands increased nutrients. A balanced diet rich in proteins (growth, energy), carbohydrates (energy), fats, vitamins, calcium (bone growth), and iron (blood formation, especially for girls due to menstruation) is crucial. Lack of nutrients like iron can cause health issues. Personal hygiene is vital due to increased sweat/oil production. Regular bathing, cleaning armpits/pubic regions prevents infections. Girls need specific menstrual hygiene practices, like using/changing sanitary pads regularly and proper disposal, for health and comfort.

- 108.** What is menstruation? Explain why it is a natural process and why societal myths surrounding it should be challenged.

**Ans :**

Menstruation is the periodic discharge of blood and tissue from the uterus, occurring roughly monthly in adolescent girls and women as part of the menstrual cycle. It signals reproductive health and is a normal, natural biological process. Myths often lead to shame, fear, and harmful practices like isolating menstruating individuals. These myths lack scientific basis. Challenging them promotes a scientific outlook, ensures better reproductive health management, encourages access to hygiene facilities/products, and fosters a supportive environment for women's well-being.

- 109.** Discuss the risks associated with substance abuse (tobacco, alcohol, drugs) during adolescence. Why might adolescents be vulnerable, and what strategies can help them avoid these substances?

**Ans :**

Substance abuse during adolescence is extremely harmful and addictive. Risks include severe damage to physical health (lungs, brain), mental

health issues, memory loss, poor academic performance, and lifelong addiction. Adolescents might be vulnerable due to curiosity, peer pressure, excitement seeking, or coping difficulties. Strategies to avoid abuse include : firmly saying ‘NO’ from the first time, understanding the severe risks, choosing healthy coping mechanisms, building self-confidence, having supportive friends, seeking guidance from trusted adults (parents/teachers), and engaging in positive activities.

110. Explain the concept of cyberbullying and responsible social media usage for adolescents. What steps can be taken if someone experiences cyberbullying?

**Ans :**

Cyberbullying is using digital platforms (phones, internet) to harass, threaten, or spread false information about others. Responsible social media use involves being respectful, kind, mindful before posting, protecting personal information/privacy, and not sharing misleading content. Adolescents should be cautious about sharing photos or personal details online, especially with strangers. If experiencing cyberbullying, one should not feel scared but handle it wisely : do not retaliate, save evidence, block the bully, and immediately seek help from trusted adults like parents or teachers.

111. Hormones play a key role in adolescence. Explain what hormones are and describe their general function in initiating and regulating the changes seen during this stage.

**Ans :**

Hormones are chemical substances produced by glands in the body that act as messengers, travelling through the bloodstream to target cells or organs to regulate various bodily functions. During adolescence, specific hormones are released in increased amounts. These hormones trigger and control the major changes associated with puberty, such as the growth spurt, development of secondary sexual characteristics (like facial hair in boys, breasts in girls), maturation of reproductive organs, onset of menstruation in girls, and can also influence mood and emotions. They orchestrate the transition from childhood to physical and reproductive adulthood.

112. Analyse the statement : “Each person experiences adolescence at his or her own pace, and its

duration also varies from one person to another.” Why is understanding this important?

**Ans :**

This statement highlights that the timing, sequence, and intensity of adolescent changes (like growth spurts, puberty onset, voice change) differ significantly among individuals. There’s a wide range of ‘normal’. Understanding this variability is crucial to prevent unnecessary anxiety or comparison among peers. It helps adolescents and adults recognize that developing earlier or later than friends is usually not a cause for concern. It fosters self-acceptance and reduces pressure related to conforming to a specific developmental timeline, promoting better mental well-being during this sensitive period.

113. How do the different aspects discussed – physical changes, emotional well-being, nutrition, hygiene, physical activity, social interactions, and avoiding harmful substances – interconnect to contribute to a healthy and positive adolescent experience?

**Ans :**

These aspects are deeply interconnected. Proper nutrition fuels the rapid physical growth. Good hygiene manages changes like acne and menstruation, boosting confidence. Physical activity supports physical health, manages stress, and improves mood. Understanding emotional changes helps navigate mood swings and build resilience. Positive social interactions and responsible online behaviour foster belonging and safety. Avoiding harmful substances protects physical and mental health, allowing healthy development. A holistic approach addressing all these areas leads to a well-rounded, healthy transition to adulthood, enabling adolescents to manage challenges and thrive.

## CASE BASED QUESTION

114. 14-year-old Arjun notices his voice sometimes cracks and sounds deeper. He also sees some hair growing above his lip. His friend Sameer, also 14, hasn’t experienced these changes yet and feels worried. Arjun sometimes feels moody, which is new for him.
1. What stage of development are Arjun and Sameer likely in?



2. Are the changes Arjun is experiencing normal? What are these specific changes called?
3. What advice would you give Sameer about his worry?

Ans :

- (1) They are likely in adolescence.
- (2) Yes, the voice change (due to growing voice box/Adam's apple) and facial hair growth (moustache) are normal secondary sexual characteristics for boys during puberty/adolescence. The moodiness is also a common emotional change.
- (3) Advise Sameer that everyone develops at their own pace, and it's completely normal for changes like voice deepening or facial hair to appear later in some boys than others. He shouldn't worry or compare himself negatively.

**115.** Priya, 13, recently started her menstrual cycle. She feels shy talking about it and sometimes misses school during her period due to discomfort and fear of staining her clothes. Her school has clean toilets but no proper disposal bins for sanitary pads.

1. Is Priya's experience (shyness, discomfort) uncommon during the onset of menstruation?
2. What specific hygiene practice is crucial for Priya during menstruation?
3. Besides Priya talking to a trusted adult, what two things could the school do to support students like Priya better?

Ans :

- (1) No, feeling shy or experiencing discomfort is quite common, especially initially, due to hormonal changes and societal attitudes.
- (2) Using and regularly changing sanitary pads (or suitable alternatives) and keeping the genital area clean is crucial for comfort and preventing infections.
- (3) The school could : 1. Install proper disposal bins with lids in the girls' toilets for used sanitary pads. 2. Conduct awareness sessions about menstruation being a natural process to reduce stigma and provide information on hygiene and managing discomfort.

**116.** A group of 15-year-old friends are discussing food. One friend eats mostly chips and sugary drinks but appears thin. Another friend tries to eat balanced meals including dal, roti, vegetables, and curd, along with playing football regularly.

1. Which friend's diet is more suitable for meeting the nutritional needs of adolescence? Why?
2. Why might the first friend's diet be inadequate, even if they appear thin?
3. Besides diet, what other habit of the second friend contributes positively to their health?

Ans :

- (1) The second friend's diet (dal, roti, vegetables, curd) is more suitable as it provides a balance of proteins, carbohydrates, vitamins, and minerals essential for growth and energy during adolescence.
- (2) Chips and sugary drinks lack essential nutrients like proteins, vitamins, iron, and calcium needed for proper growth, bone health, and blood formation, even if they provide calories. Malnutrition can occur despite appearing thin.
- (3) Playing football regularly provides essential physical activity, which keeps the body fit, builds stamina, and boosts mood.

**117.** Riya, 16, receives a mean message online from an unknown account, making fun of her appearance. She feels upset and scared. Her friend suggests she should reply angrily and post something mean back. Another friend suggests ignoring it.

1. What is the act of sending mean messages online called?
2. Evaluate the advice given by Riya's friends. Is either suggestion the best approach?
3. What should Riya prioritize to protect herself in such situations online?

Ans :

- (1) This is an example of cyberbullying.
- (2) Neither suggestion is ideal. Replying angrily can escalate the situation. Ignoring it might not stop the bullying. The best approach is not mentioned but involves not engaging directly, saving evidence, blocking the user, and reporting the incident to a trusted adult (parent/teacher) or the platform.
- (3) Riya should prioritize her safety and emotional well-being by not engaging with the bully, protecting her personal information, and seeking help from trusted adults.

**118.** During a party, some older teenagers offer 14-year-old Vikram a cigarette, saying "Just try it once, it's cool, everyone does it." Vikram feels pressured and unsure what to do. He knows cigarettes are

harmful.

1. What specific risk is associated with trying cigarettes, even “just once”?
2. What term describes the influence Vikram is feeling from the older teenagers?
3. What is the safest and most responsible action for Vikram to take in this situation? How should he respond?

**Ans :**

- (1) Cigarettes contain addictive substances (nicotine) and harmful chemicals. Trying it even once can lead to addiction and long-term health problems like lung damage.
- (2) Peer pressure.
- (3) The safest action is to refuse the offer firmly and confidently. He should say ‘NO’ clearly and perhaps state he doesn’t smoke or isn’t interested. He could also remove himself from the situation if needed 1 .

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# CHAPTER 7

## HEAT TRANSFER IN NATURE

### SUMMARY

#### 1. INTRODUCTION TO HEAT AND CLIMATE

Pema and Palden observe how different places have different climates and how metals are used for cooking due to their heat-conducting ability. This chapter explores how heat moves in nature and why some materials heat or cool faster than others.

#### 2. CONDUCTION OF HEAT

Heat travels from the hotter part of a material to the cooler part through a process called conduction. This is common in solids, especially metals. In a metal strip experiment, heat moves from one end to the other, melting wax and dropping pins in sequence. Materials like metal are good conductors, while wood, clay, and air are poor conductors (insulators).

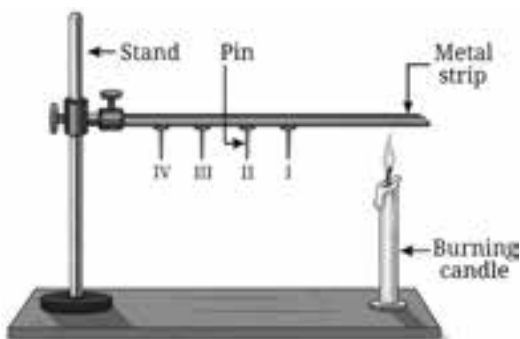


Figure : Heat transfer in a metal strip

#### 3. CONVECTION IN AIR AND LIQUIDS

In fluids (liquids and gases), heat transfer happens through convection, where warm particles move up and cooler ones sink. This creates a circulation.

Convection also causes sea breeze (cool air from sea to land during day) and land breeze (cool air from land to sea at night).

#### 4. RADIATION

Heat from the Sun and flames reaches us through radiation, which doesn't need a medium. All hot objects radiate heat. That's why we feel warmth near a fire and why dark clothes feel hotter in summer—they absorb more radiation than light-colored clothes, which reflect it.

#### 5. COMBINING THE THREE : A DAILY EXAMPLE

When heating water on a gas stove, conduction heats the metal pan, convection circulates the water inside, and radiation warms the surroundings. Traditional heaters like the bukhari in Himalayan homes use all three methods for efficient heating.



Figure : Heating water in a pan

#### 6. WATER CYCLE AND HEAT

Heat from the Sun drives the water cycle. It causes evaporation from oceans and transpiration from plants. Water vapor cools and condenses into clouds, which precipitate as rain or snow. This cycle maintains Earth's water balance and supports life.

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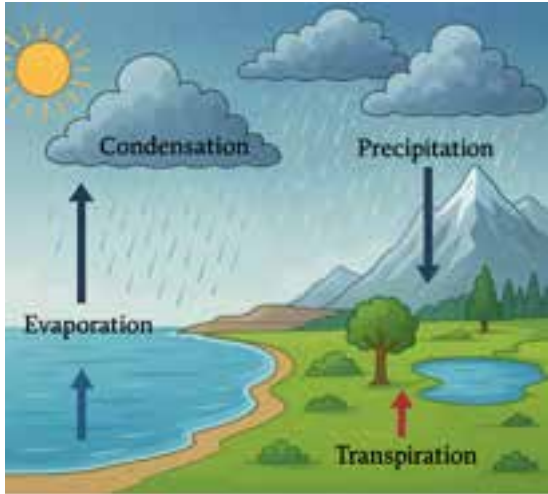
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**7. INFILTRATION AND GROUNDWATER**

Water from rain seeps into the ground at different rates depending on soil type—fast through gravel, slowest through clay. This seepage, called infiltration, collects as groundwater in porous rock layers called aquifers. Overuse and reduced infiltration in cities threaten groundwater supplies, so rainwater harvesting is essential for sustainability

**8. ICE STUPAS : A LOCAL INNOVATION**

In Ladakh, people conserve water by creating ice stupas—cone-shaped ice towers that slowly melt in spring to provide water. This is a practical application of controlling heat transfer for community benefit.

**NCERT ACTIVITY**

**Activity 7.1 : Let us experiment**

**Caution :** This activity should be carried out under the supervision of a teacher or an adult.

1. Take a strip of a metal, such as aluminium or iron, about 15 cm long.
2. Attach four pins to the strip with the help of wax such that they are arranged at nearly equal distances (about 2 cm apart), as shown in Figure.
3. Secure the strip to a stand and label the pins as I, II, III, and IV, as shown in Figure. (If a

stand is not available, place the strip between two bricks for support.)

4. Heat the end of the strip that is away from the stand with a candle or a spirit lamp.
5. What will happen to the pins? Will they remain attached to the strip or will they fall?
6. Predict the order in which the pins will fall from the strip.

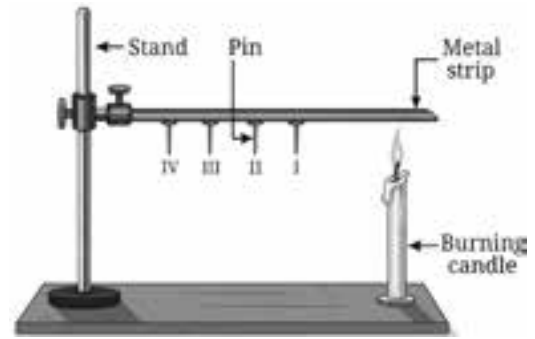


Figure : Heat transfer in a metal strip

7. Record your observations in Table .

**Table : Falling of pins**

Pin falling first		Reasons for what you observed
Prediction	Observation	

Ans :

	Pin falling first		Reasons for what you observed
	Prediction	Observation	
First	Pin I (nearest to the flame)	Pin I fell first	Heat travels through the metal strip by conduction. Pin I receives heat first and wax melts.
Second	Pin II	Pin II fell after Pin I	Heat continues to move along the strip; Pin II gets heated next and its wax melts.



Third	Pin III	Pin III fell after Pin II	Conduction transfers heat further along the strip; Pin III's wax melts next.
Fourth	Pin IV (farthest from the flame)	Pin IV fell last	It is farthest from the flame, so it receives the least heat last and falls after others.

**Activity 7.2 : Let us investigate**

1. Take two identical paper cups.
2. Hang them using threads of equal length in an inverted position on the two ends of a wooden stick, as shown in Figure (a).

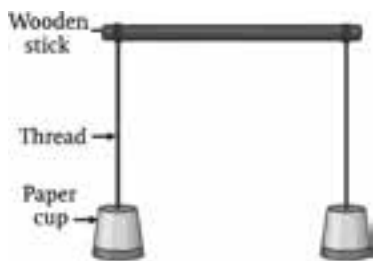


Figure : (a) Initial set-up

3. Now, adjust the positions of the cups, so that the stick is horizontal.
4. Place a burning candle below one of the cups Figure (b).



Figure : (b) Hot air rising up

5. Observe what happens to the cup.
6. Record your observations in Table and think of probable reasons.

**Table : Recording observations and probable reasons**

Observation about the cups	Probable reasons for the observation

Ans :

Observation about the cups	Probable reasons for the observation
One cup feels warm to touch	Warm water was poured into it.
Water level decreased in one of the cups	Water evaporated due to heat.
Cup made of metal cooled faster	Metal conducts heat better than plastic or paper.
Steam observed on the inner surface	Hot water released vapour which condensed on the inner side.

**Activity 7.3 : Let us find out**

**Caution :** This activity should be carried out under the supervision of a teacher or an adult.

1. Take a 500 mL beaker, half-filled with water as shown in Figure (a).
2. With the help of a straw, place a grain of potassium permanganate at the centre of the beaker's base (Figure (a)).
3. Place a candle right below the centre of the base of the beaker.
4. Observe the movement of the coloured streak in the water.
5. As you supply heat, a streak of colour starts moving up and then coming down from the sides (Figure (b)).

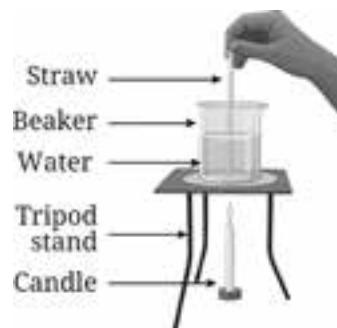


Figure : (a) Initial set-up for demonstration

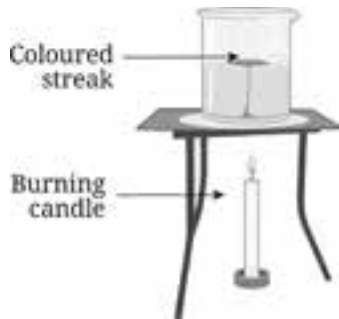


Figure : (b) Demonstration of convection in heated water

Ans :

When the base of the beaker is heated, the warm water becomes lighter and rises. The coloured particle (potassium permanganate) shows this movement clearly. This demonstrates the convection current in water due to heating.

**Activity 7.4 : Let us investigate**

**Caution :** This activity should be carried out on a clear, sunny day under the supervision of a teacher or an adult.

1. Take two identical bowls as shown in Figure.



Figure : Measurement of the temperature of soil and water

2. Fill one bowl halfway with soil and the other bowl halfway with water.
3. Fix a laboratory thermometer in each bowl as shown in Figure. Make sure that the bulbs of the thermometer are immersed in soil and water, and do not touch the bottoms or the sides of the bowls.
4. Place the set-up in sunlight.
5. Measure the temperature of soil and water every 5 minutes and record the data in Table.

**Table : Temperature of soil and water when heated**

S. No.	Time (min)	Temperature of soil (°C)	Temperature of water (°C)
1	0		

2	5		
3	10		
4	15		
5	20		

6. Study the rise in temperature of soil and water.
7. Did the temperature rise by the same amount for both the soil and the water at the same time?
8. If not, which one got heated faster?
9. How much was the rise in temperature of the soil and the water in 20 minutes?

Ans :

S. No.	Time (min)	Temperature of Soil (°C)	Temperature of Water (°C)
1	0	25	25
2	5	30	27
3	10	35	29
4	15	39	31
5	20	42	33

**Activity 7.5 : Let us investigate**

1. Take three transparent, used plastic bottles of 1 L capacity.
2. Cut them in the middle and make a small hole in the cap of each bottle.
3. Keep them inverted and put some clay in one bottle, sand in the second, and gravel in the third, as shown in Figure.



Figure : An activity to compare the flow of water through clay, sand and gravel

4. Place three identical beakers below each bottle.
5. Add 200 mL of water to each bottle.
6. Predict the amount of water flowing out of each bottle.



7. Collect the water that flows through each bottle for 10 minutes.
8. Compare the amount of water that comes through each bottle.

**Table : Seepage of water**

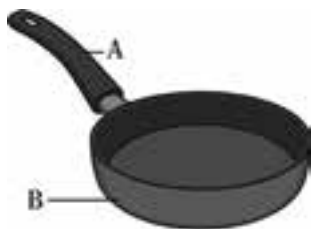
Bottles filled with	Prediction :	Observation :
	Seepage of water (very slow/slow/fast)	Seepage of water (very slow/slow/fast)
Bottle 1 (Clay)		
Bottle 2 (Sand)		
Bottle 3 (Gravel)		

Ans :

Bottles filled with	Prediction :	Observation :
	Seepage of water (very slow/slow/fast)	Seepage of water (very slow/slow/fast)
Bottle 1 (Clay)	Very slow	Very slow
Bottle 2 (Sand)	Slow	Slow
Bottle 3 (Gravel)	Fast	Fast

### NCERT EXERCISE

1. Choose the correct option in each case.
  - (1) Your father bought a saucepan made of two different materials, A and B, as shown in Figure. The materials A and B have the following properties-



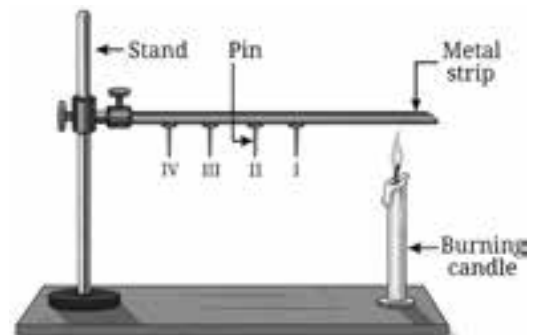
- (a) Both A and B are good conductors of heat
- (b) Both A and B are poor conductors of heat
- (c) A is a good conductor and B is a poor conductor of heat
- (d) A is a poor conductor and B is a good conductor of heat

Ans :

- (c) A is a good conductor and B is a poor conductor of heat

Material A (the main body of the saucepan) needs to be a good conductor of heat to efficiently transfer heat from the stove to the food being cooked. Material B (the handle) needs to be a poor conductor of heat (an insulator) so that it does not get too hot to hold.

- (2) Pins are stuck to a metal strip with wax and a burning candle is kept below the rod, as shown in Figure. Which of the following will happen?



- (a) All the pins will fall almost at the same time
- (b) Pins I and II will fall earlier than pins III and IV
- (c) Pins I and II will fall later than pins III and IV
- (d) Pins II and III will fall almost at the same time

Ans :

- (b) Pins I and II will fall earlier than pins III and IV

Heat is conducted along the metal strip from the end heated by the candle. Pin I is closest to the flame, so the wax holding it will melt first, causing it to fall. Pin II will fall next as the heat reaches it, and so on. Therefore, pins closer to the heat source (I and II) will fall before those further away (III and IV).

- (3) A smoke detector is a device that detects smoke and sounds an alarm. Suppose you are fitting a smoke detector in your room. The most suitable place for this device will be :
- Near the floor
  - In the middle of a wall
  - On the ceiling
  - Anywhere in the room

Ans :

- (c) On the ceiling

Smoke is generally composed of hot gases and tiny particles. Hot air (and thus smoke) is less dense than cooler air and therefore rises. Placing a smoke detector on the ceiling ensures that it can detect the rising smoke as early as possible in the event of a fire.

2. A shopkeeper serves you cold lassi in a tumbler. By chance, the tumbler had a small leak. You were given another tumbler by the shopkeeper to put the leaky tumbler in it. Will this arrangement help to keep the lassi cold for a longer time? Explain.

Ans :

Yes, this arrangement will help to keep the lassi cold for a longer time.

When the leaky tumbler containing cold lassi is placed inside another empty tumbler, an air gap is created between the walls of the two tumblers. Air is a poor conductor of heat (an insulator). This layer of trapped air will reduce the rate of heat transfer from the warmer surroundings to the cold lassi. It reduces heat gain by conduction through the walls of the tumbler. It can also reduce heat gain by convection if the air layer is relatively still.

Therefore, the insulating effect of the air layer between the two tumblers will slow down the process of the lassi warming up, keeping it colder for a longer period compared to if the leaky tumbler was directly exposed to the surroundings.

3. State with reason(s) whether the following statements are True [T] or False [F].
- Heat transfer takes place in solids through convection. [ ]
  - Heat transfer through convection takes place by the actual movement of particles. [ ]
  - Areas with clay materials allow more seepage of water than those with sandy materials. [ ]
  - The movement of cooler air from land to sea is called land breeze. [ ]

Ans :

- False Reason : Heat transfer in solids primarily takes place through conduction. Convection involves the bulk movement of fluids (liquids or gases), which is not possible for the fixed particles in a solid.
  - True Reason : Convection is defined as the transfer of heat through the mass movement of heated particles in a fluid (liquid or gas). Hotter, less dense parts of the fluid rise, and cooler, denser parts sink, creating convection currents.
  - False Reason : Sandy materials allow more seepage of water than clay materials. Sand particles are larger than clay particles, resulting in larger pore spaces between them, which allows water to pass through more easily (higher permeability). Clay particles are very fine and tightly packed, leading to very small pore spaces and low permeability, thus restricting water seepage.
  - True Reason : A land breeze occurs typically at night when the land cools down faster than the sea. The air above the warmer sea rises, and cooler air from the land moves towards the sea to replace it. This movement of air from land to sea is called a land breeze.
4. Some ice cubes placed in a dish melt into water after sometime. Where do the ice cubes get heat for this transformation?

Ans :

The ice cubes get heat for melting from their surroundings. This includes :

- The surrounding air : Air at room temperature is warmer than the ice. Heat is transferred from the air to the ice primarily through convection (air currents) and conduction (at the surface of contact).
- The dish : The dish itself is likely at room temperature and warmer than the ice. Heat is conducted from the dish to the ice cubes where they are in contact.
- Radiation : All objects radiate heat. The warmer surroundings (walls of the room, objects nearby) radiate heat, some of which is absorbed by the ice.

This absorbed heat energy increases the kinetic energy of the water molecules in the ice, causing them to break free from their fixed positions in the solid lattice structure and transition into

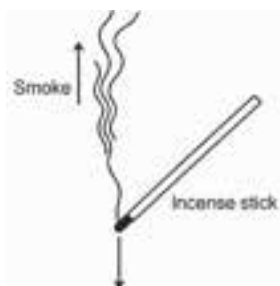


the liquid state (water). This process of melting requires energy, known as the latent heat of fusion.

5. A burning incense stick is fixed, pointing downwards. In which direction would the smoke from the incense stick move? Show the movement of smoke with a diagram.

Ans :

When an incense stick is burning and fixed pointing downwards, the smoke will move upwards. This happens because smoke rises due to convection. As the incense stick burns, it heats the air around it, making the air less dense. The cooler, denser air pushes the hot air (and smoke) upward. So, even if the incense stick is pointing downwards, the smoke will still rise.



6. Two test tubes with water are heated by a candle flame as shown in Figure. Which thermometers Figure (a) or Figure (b) will record a higher temperature? Explain.

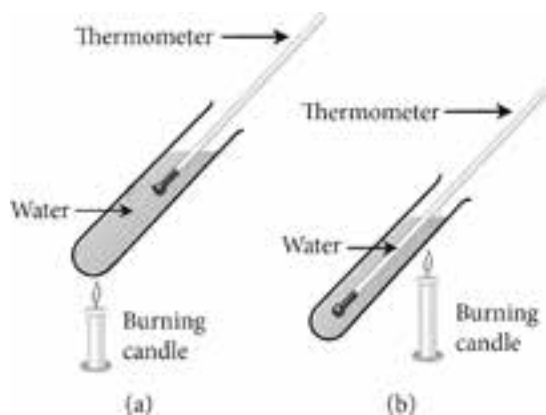


Figure : Two thermometers dipped in two test tubes

Ans :

The thermometer in Figure (b) will show a higher temperature because the bulb of the thermometer is directly in the hot water near the flame. In Figure (a), the bulb is in the upper part where

water is cooler. This shows that heat does not rise quickly in water, so the bottom gets hotter first.

7. Why are hollow bricks used to construct the outer walls of houses in hot regions?

Ans :

Hollow bricks are used in outer walls of houses in hot regions because they do not allow heat to pass easily. The air trapped inside the hollow spaces acts as an insulator, keeping the house cooler inside. This helps protect people from the outside heat.

8. Explain how large water bodies prevent extreme temperature in areas around them.

Ans :

Large water bodies like seas, lakes, and oceans help keep the temperature mild in nearby areas. Water heats up and cools down slowly, so during the day, it absorbs heat and keeps the surroundings cool. At night, it slowly gives off the stored heat and keeps the area warm. This stops the temperature from becoming too hot or too cold, and that is why places near water bodies have less extreme temperatures.

9. Explain how water seeps through the surface of the Earth and gets stored as groundwater.

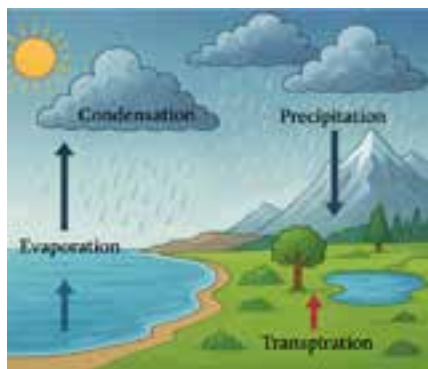
Ans :

When it rains, some of the water flows on the surface, but a part of it seeps into the soil. This water goes down through tiny spaces between soil and rocks. It keeps moving deeper until it reaches a layer where it can't go down anymore. Here, the water collects and gets stored—this is called groundwater. People use this water by digging wells, tube wells, or hand pumps.

10. The water cycle helps in the redistribution and replenishment of water on the Earth. Justify the statement.

Ans :

The water cycle moves water through different stages—evaporation, condensation, and precipitation. Water from rivers, lakes, and oceans evaporates and forms clouds. These clouds then give rain or snow, which replenishes water in rivers, lakes, soil, and underground. This way, the water cycle redistributes water and keeps it available for plants, animals, and people, making it an important natural process.



## MULTIPLE CHOICE QUESTION

- Why is Kerala generally warmer and more humid in winter compared to Gangtok, Sikkim, according to the grandfather?
  - Kerala has more mountains than Sikkim.
  - Kerala is closer to the equator and has a long coastline.
  - Sikkim receives less direct sunlight throughout the year.
  - Gangtok is at a much lower altitude than Kerala.

Ans :

(B) Kerala is closer to the equator and has a long coastline.

The grandfather attributes Kerala's warmer, humid winter climate to its proximity to the equator (receiving more direct sunlight) and the moderating effect of its long coastline.

- What is the main source of heat and light for the Earth mentioned in the introductory conversation?
  - Geothermal energy from Earth's core
  - Burning of fossil fuels
  - The Moon reflecting light
  - The Sun

Ans :

(D) The Sun

Palden recalls learning in previous grades that the Sun is the primary source of heat and light energy for our planet.

- Why are cooking utensils generally made of metals, as recalled by Palden?
  - Metals are poor conductors of heat, keeping food warm.

- Metals are good conductors of heat, allowing efficient cooking.
- Metals are lightweight and easy to handle.
- Metals do not react chemically with food.

Ans :

(B) Metals are good conductors of heat, allowing efficient cooking.

Metals transfer heat readily from the stove to the food, making them effective materials for cooking utensils where efficient heating is required.

- What is the process of heat transfer from the hotter part of an object to its colder part, mainly occurring in solids without particle movement?
  - Convection
  - Radiation
  - Conduction
  - Evaporation

Ans :

(C) Conduction

Conduction is defined as the transfer of heat through direct contact within a substance (or between substances in contact), from a region of higher temperature to lower temperature, without the bulk movement of the particles themselves.

- How do particles transfer heat during conduction in solids?
  - Particles move from the hot end to the cold end, carrying heat.
  - Particles remain in place but pass heat energy to neighboring particles.
  - Particles absorb heat and convert it into light energy.
  - Particles expand significantly, pushing heat along.

Ans :

(B) Particles remain in place but pass heat energy to neighboring particles.

In conduction, particles vibrate more intensely when heated and transfer this vibrational energy to adjacent particles, passing heat along without the particles themselves changing position significantly.

- Materials like metals that allow heat to pass through them easily are called what?
  - Insulators
  - Poor conductors
  - Good conductors of heat
  - Radiators



**Ans :**

(C) Good conductors of heat

Materials that facilitate the easy transfer of heat through them via conduction are termed good conductors of heat. Metals are excellent examples.

7. Materials such as glass, wood, clay, and porcelain that do not allow heat to pass through them easily are known as what?
- (A) Good conductors of heat  
 (B) Convector  
 (C) Poor conductors (insulators) of heat  
 (D) Reflectors

**Ans :**

(C) Poor conductors (insulators) of heat

Materials that resist the flow of heat are called poor conductors or insulators. This property makes them useful for handles or keeping beverages hot/cold.

8. Why do we prefer wearing woollen clothes in winter?
- (A) Wool directly generates heat.  
 (B) Wool is a very good conductor of heat.  
 (C) Wool traps air, and air is a poor conductor, reducing heat loss from the body.  
 (D) Wool reflects coldness away from the body.

**Ans :**

(C) Wool traps air, and air is a poor conductor, reducing heat loss from the body.

Woolen fibers create air pockets. Air is a poor heat conductor (insulator), so the trapped air layer minimizes the loss of body heat to the colder surroundings, keeping us warm.

9. Why might two thin blankets provide more warmth than one thick blanket of the same total thickness?
- (A) Thin blankets are made of warmer materials.  
 (B) Two blankets have more surface area.  
 (C) Air trapped between the two thin blankets acts as an additional layer of insulation.  
 (D) One thick blanket allows heat to escape faster.

**Ans :**

(C) Air trapped between the two thin blankets acts as an additional layer of insulation.

The layer of air captured between the two blankets acts as an effective insulator (poor conductor), reducing heat loss better than a single thick blanket might.

10. How do hollow bricks used in house construction help in regulating temperature?
- (A) They allow wind to pass through easily.  
 (B) They conduct heat very efficiently.  
 (C) Air trapped inside the hollow spaces acts as an insulator.  
 (D) The brick material itself generates heat or cold.

**Ans :**

(C) Air trapped inside the hollow spaces acts as an insulator.

The air enclosed within the hollow bricks is a poor conductor of heat. This trapped air layer slows down heat transfer, helping keep the house cooler in summer and warmer in winter.

11. Imagine why does the paper cup with a burning candle below it rise up?
- (A) The candle flame pushes the cup upwards.  
 (B) The paper cup becomes lighter as it burns.  
 (C) The air inside and around the cup heats up, becomes lighter, and rises.  
 (D) The wooden stick bends due to the heat.

**Ans :**

(C) The air inside and around the cup heats up, becomes lighter, and rises.

The candle heats the air. Hot air expands, becomes less dense (lighter) than the surrounding cooler air, and consequently rises, lifting the paper cup.

12. Why does smoke from a fire or an incense stick generally rise upwards?
- (A) Smoke particles are naturally lighter than air particles.  
 (B) Smoke consists of hot gases which are less dense than the surrounding cooler air.  
 (C) Air pressure pushes the smoke upwards.  
 (D) Smoke is attracted towards the ceiling or sky.

**Ans :**

(B) Smoke consists of hot gases which are less dense than the surrounding cooler air.

Smoke is composed of hot gases and particles produced by burning. Being hotter and thus less dense than the ambient air, it rises due to buoyancy.

13. What is the process of heat transfer called that involves the actual movement of particles, typically occurring in liquids and gases?
- (A) Conduction                      (B) Radiation  
 (C) Insulation                      (D) Convection

Ans :

(D) Convection

Convection is the mode of heat transfer characterized by the bulk movement of the fluid (liquid or gas) itself, where warmer, less dense portions rise and cooler, denser portions sink.

14. How does heat transfer in liquids and gases (convection) primarily differ from heat transfer in solids (conduction)?
- (A) Convection requires particles to move; conduction does not.
  - (B) Conduction requires particles to move; convection does not.
  - (C) Convection transfers coldness; conduction transfers heat.
  - (D) Conduction happens faster than convection.

Ans :

(A) Convection requires particles to move; conduction does not.

The key difference is particle movement. Convection relies on the actual flow of heated fluid particles, while in conduction, particles vibrate and transfer energy without changing their average position.

15. Which heats up faster when exposed to sunlight : soil (land) or water?
- (A) Water heats up faster.
  - (B) Soil (land) heats up faster.
  - (C) Both heat up at exactly the same rate.
  - (D) Neither heats up significantly in sunlight.

Ans :

(B) Soil (land) heats up faster.

The experiment demonstrates the principle of differential heating : land (represented by soil) absorbs heat and its temperature rises more quickly than water under the same sunlight exposure.

16. Which cools down faster after being removed from sunlight : soil or water?
- (A) Water cools down faster.
  - (B) Soil cools down faster.
  - (C) Both cool down at the same rate.
  - (D) Cooling rate depends on the initial temperature.

Ans :

(B) Soil cools down faster.

Materials that heat up quickly also tend to cool down quickly. The experiment shows that soil,

which heated faster, also loses heat and cools down more rapidly than water.

17. What is the movement of cooler air from the sea towards the land during the day called?
- (A) Land breeze
  - (B) Sea breeze
  - (C) Conduction wind
  - (D) Radiation current

Ans :

(B) Sea breeze

During the day, land heats faster than the sea, causing warm air over land to rise. Cooler, denser air from over the sea moves inland to replace it, creating the sea breeze.

18. Why are windows in houses in coastal areas often built facing the sea?
- (A) To get a better view of the ocean.
  - (B) To catch the cool sea breeze during the day.
  - (C) To block the strong land breeze at night.
  - (D) To allow more sunlight into the house.

Ans :

(B) To catch the cool sea breeze during the day.

Placing windows facing the sea allows residents to benefit from the cooling effect of the sea breeze that blows inland during hot days.

19. What phenomenon occurs at night in coastal areas when cooler air moves from the land towards the warmer sea?
- (A) Sea breeze
  - (B) Land breeze
  - (C) Convection cycle
  - (D) Thermal inversion

Ans :

(B) Land breeze

At night, land cools faster than the sea. The warmer air over the sea rises, and cooler, denser air from the land flows towards the sea to replace it, resulting in a land breeze.

20. Sea breezes and land breezes are natural examples of which mode of heat transfer?
- (A) Conduction
  - (B) Radiation
  - (C) Convection
  - (D) Insulation

Ans :

(C) Convection



These breezes are caused by the movement of large masses of air (a fluid) due to temperature differences, which is the mechanism of heat transfer known as convection.

21. How does heat from a fireplace or the Sun reach us, even when there is no direct contact (conduction) or air movement (convection) between the source and us?
- (A) Through sound waves  
 (B) Through magnetic fields  
 (C) Through radiation  
 (D) Through electrical currents

Ans :

(C) Through radiation

Radiation is the process of heat transfer through electromagnetic waves (like infrared radiation) which can travel through space or air without needing a material medium.

22. Which mode(s) of heat transfer require a material medium (solid, liquid, or gas) to occur?
- (A) Only Radiation  
 (B) Only Conduction  
 (C) Only Convection  
 (D) Conduction and Convection

Ans :

(D) Conduction and Convection

Conduction requires direct particle contact, and convection requires fluid particle movement. Radiation, however, can transfer heat through a vacuum (like space) or air.

23. Why does a hot utensil left away from the flame eventually cool down?
- (A) It absorbs coldness from the surroundings.  
 (B) Heat escapes through conduction into the air.  
 (C) Heat escapes through convection currents in the air.  
 (D) It loses heat to the surroundings through radiation.

Ans :

(D) It loses heat to the surroundings through radiation.

All objects radiate thermal energy. A hot utensil radiates heat energy to its cooler surroundings, causing the utensil to cool down over time. Convection also plays a role, but radiation is significant.

24. Why is it generally more comfortable to wear white or light-colored clothes in summer?

- (A) Light colors absorb more heat, keeping us cool.  
 (B) Light colors reflect most of the heat (radiation) falling on them.  
 (C) Light colors allow better air circulation.  
 (D) Light colors are poor conductors of heat.

Ans :

(B) Light colors reflect most of the heat (radiation) falling on them.

Light-colored surfaces are good reflectors and poor absorbers of radiant heat (like sunlight). By reflecting heat away, they help keep the wearer cooler in summer.

25. Why are dark-colored clothes often preferred in winter?
- (A) Dark colors reflect heat, keeping body heat in.  
 (B) Dark colors allow cold air to escape easily.  
 (C) Dark colors absorb more radiant heat (like sunlight) than light colors.  
 (D) Dark colors generate their own heat.

Ans :

(C) Dark colors absorb more radiant heat (like sunlight) than light colors.

Dark surfaces are good absorbers of radiant heat. Wearing dark clothes in winter helps absorb heat from sunlight or other sources, contributing to warmth.

26. Consider heating water in a metal pan on a stove. Which modes of heat transfer are involved?
- (1) Heat travels from the flame through the pan base by conduction.  
 (2) Water inside the pan heats up mainly by convection.  
 (3) Heat felt some distance away from the hot pan is mainly due to radiation.
- (A) 1 only  
 (B) 1 and 2 only  
 (C) 2 and 3 only  
 (D) 1, 2, and 3

Ans :

(D) 1, 2, and 3

Heating the pan involves conduction through the metal. The water heats via convection currents. Heat felt at a distance from the hot objects (flame, pan) travels via radiation. All three modes are typically present.

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27. What is a 'bukhari', described as a traditional room heater in the Himalayas?  
 (A) An electric heater  
 (B) A thick woolen blanket  
 (C) An iron stove burning wood/charcoal with a chimney pipe  
 (D) A hot water bag

Ans :

(C) An iron stove burning wood/charcoal with a chimney pipe

A bukhari is specifically described as an iron stove used for burning fuel (wood/charcoal) to heat a room, featuring a pipe to vent smoke.

28. How does a bukhari heater warm a room, likely involving which heat transfer processes?  
 (A) Only conduction through the floor.  
 (B) Only convection of air.  
 (C) Only radiation from the stove.  
 (D) Conduction (heating stove), convection (heating air), and radiation (from stove).

Ans :

(D) Conduction (heating stove), convection (heating air), and radiation (from stove).

The stove itself gets hot (conduction), it heats the surrounding air which circulates (convection), and it radiates heat directly outwards into the room (radiation).

29. What process in the water cycle involves the Sun's heat turning liquid water from oceans, rivers, and lakes into water vapor?  
 (A) Condensation  
 (B) Precipitation  
 (C) Infiltration  
 (D) Evaporation

Ans :

(D) Evaporation

Evaporation is the process where liquid water absorbs heat energy, primarily from the sun, and changes into its gaseous state, water vapor.

30. What is the process called where water vapor rises, cools down, and changes back into tiny liquid water droplets or ice crystals, forming clouds?  
 (A) Evaporation  
 (B) Condensation  
 (C) Precipitation  
 (D) Transpiration

Ans :

(B) Condensation

Condensation is the phase change where water vapor (gas) cools and turns back into liquid water (or solid ice crystals), which aggregate to form clouds.

31. Rain, snow, and hail falling from clouds back to Earth are forms of which part of the water cycle?  
 (A) Condensation  
 (B) Evaporation  
 (C) Infiltration  
 (D) Precipitation

Ans :

(D) Precipitation

Precipitation refers to any form of water (liquid or solid) that falls from the atmosphere (clouds) and reaches the ground, including rain, snow, sleet, and hail.

32. What is the continuous movement of water on, above, and below the surface of the Earth called?  
 (A) Weather cycle  
 (B) Water cycle  
 (C) Erosion cycle  
 (D) Carbon cycle

Ans :

(B) Water cycle

The water cycle describes the ongoing circulation of Earth's water through processes like evaporation, transpiration, condensation, precipitation, and runoff/infiltration.

33. How does the water cycle help maintain the amount of water on Earth?  
 (A) It creates new water from oxygen and hydrogen.  
 (B) It prevents water from ever leaving the planet.  
 (C) It redistributes and replenishes water sources like rivers and groundwater.  
 (D) It converts saltwater into freshwater.

Ans :

(C) It redistributes and replenishes water sources like rivers and groundwater.

The cycle ensures water continuously moves between the atmosphere, land, and oceans, effectively recycling and redistributing the existing water supply across the planet.

34. Which ancient Indian astronomer and mathematician provided methods for predicting seasonal rainfall based on observations of natural phenomena?



- (A) Aryabhata
- (B) Brahmagupta
- (C) Varahamihira
- (D) Bhaskara II

Ans :

- (C) Varahamihira

The “Know a Scientist” section highlights Varahamihira and his work Brihatsamhita, which included methods for rainfall prediction based on observations of clouds, wind, stars, etc.

- 35.** What is the process called where surface water seeps down through soil and rocks?
- (A) Evaporation
  - (B) Precipitation
  - (C) Infiltration
  - (D) Runoff

Ans :

- (C) Infiltration

Infiltration is the specific term for the process by which water on the ground surface enters and percolates down into the soil and underlying rock layers.

- 36.** According to Activity 7.5, through which material does water seep fastest : clay, sand, or gravel?
- (A) Clay
  - (B) Sand
  - (C) Gravel
  - (D) Seepage rate is the same for all three.

Ans :

- (C) Gravel

Gravel has the largest particles and widest, most interconnected spaces between them, allowing water to pass through most easily and quickly compared to sand or clay.

- 37.** Why does water seep slowest through clay?
- (A) Clay particles absorb water completely.
  - (B) Clay particles are very large, blocking flow.
  - (C) Clay particles are very small with tiny spaces between them, hindering water movement.
  - (D) Clay chemically reacts with water, stopping seepage.

Ans :

(C) Clay particles are very small with tiny spaces between them, hindering water movement. Clay consists of very fine particles packed closely together, leaving only very small pore spaces. This significantly restricts the rate at which water can seep through.

- 38.** What is the term for water that has seeped beneath the Earth’s surface and is stored in the pore spaces of sediments and rocks?

- (A) Surface water
- (B) Rainwater
- (C) Groundwater
- (D) Wastewater

Ans :

- (C) Groundwater

Groundwater refers specifically to the water held underground within the soil pore spaces and fractures of rock formations.

- 39.** What are the underground layers of sediments and rocks that hold and transmit groundwater called?

- (A) Aqueducts
- (B) Aquifers
- (C) Reservoirs
- (D) Sedimentary basins

Ans :

- (B) Aquifers

An aquifer is defined as a body of permeable rock or sediment that can contain or transmit groundwater, from which water can be extracted using wells.

- 40.** What factors have led to the depletion of groundwater levels ?

- (A) Decreased rainfall globally.
- (B) Excessive extraction due to population growth and reduced infiltration due to urbanization.
- (C) Increased evaporation rates from underground.
- (D) Natural drying up of aquifers over time.

Ans :

- (B) Excessive extraction due to population growth and reduced infiltration due to urbanization.

The text cites increased water demand leading to over-extraction and reduced recharge (due to less vegetation and more concrete surfaces limiting infiltration) as primary causes of groundwater depletion.

- 41.** What are methods like rainwater harvesting and recharge pits used for?

- (A) To purify surface water for drinking.
- (B) To prevent floods during heavy rains.
- (C) To artificially replenish or recharge groundwater levels.
- (D) To measure the rate of infiltration.

Ans :

(C) To artificially replenish or recharge groundwater levels.

These techniques are designed to capture rainwater and direct it underground, helping to counteract depletion and maintain sustainable groundwater resources.

42. What innovative water conservation method involving creating large ice structures is practiced in Ladakh?  
 (A) Building large dams  
 (B) Digging deep wells  
 (C) Constructing ice stupas  
 (D) Using desalination plants

Ans :

(C) Constructing ice stupas

The “Science and Society” box describes the creation of ice stupas in Ladakh, where winter stream water is frozen into large cones that melt slowly in spring/summer, providing water when needed.

43. How do ice stupas help address water scarcity in Ladakh during spring?  
 (A) They generate electricity from melting ice.  
 (B) They melt slowly, providing a steady water supply when natural streams might be low.  
 (C) They purify the water as it freezes and melts.  
 (D) They prevent floods by storing excess water.

Ans :

(B) They melt slowly, providing a steady water supply when natural streams might be low.

The large mass of ice melts gradually as temperatures rise in spring, releasing water steadily for agriculture and other uses during a period when natural meltwater might be insufficient.

44. In the saucepan shown Figure, Material A forms the main body and Material B forms the handle. What properties should A and B ideally have?



- (A) A : Good conductor (for heating); B : Poor conductor (for holding)  
 (B) A : Poor conductor; B : Good conductor

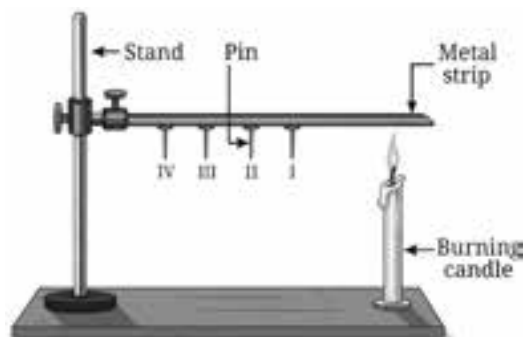
- (C) Both A and B should be good conductors.  
 (D) Both A and B should be poor conductors.

Ans :

(A) A : Good conductor (for heating); B : Poor conductor (for holding)

The main part of the pan (A) needs to conduct heat efficiently to the food. The handle (B) should be a poor conductor (insulator) to prevent the user’s hand from getting burnt.

45. In the heat transfer setup Figure, pins are attached with wax to a metal strip heated at one end. In what order will the pins likely fall?



- (A) All at once.  
 (B) Furthest from flame first (IV, III, II, I).  
 (C) Closest to flame first (I, II, III, IV).  
 (D) Middle pins first (II, III), then outer pins (I, IV).

Ans :

(C) Closest to flame first (I, II, III, IV).

Heat conducts progressively along the strip from the heated end. The wax melts sequentially as the heat reaches each pin, so the pins fall in order from nearest the flame (I) to furthest (IV).

46. Where is the most suitable place to install a smoke detector in a room, considering how smoke behaves?  
 (A) Near the floor, as smoke is heavy.  
 (B) On the ceiling, as smoke (hot gases) rises.  
 (C) In the middle of a wall, for average detection.  
 (D) Near a window, to detect outside smoke.

Ans :

(B) On the ceiling, as smoke (hot gases) rises. Smoke, being composed of hot gases and particles, is generally less dense than air and tends to rise. Placing a detector on the ceiling ensures the earliest possible detection.



47. If you place a leaking tumbler of cold lassi inside another non-leaking tumbler, will it help keep the lassi cold longer?
- (A) No, the outer tumbler will make it warm faster.  
 (B) Yes, the air trapped between the tumblers acts as an insulator.  
 (C) No, because the lassi will leak out anyway.  
 (D) Yes, because two tumblers absorb more coldness.

Ans :

(B) Yes, the air trapped between the tumblers acts as an insulator.

The layer of air caught between the inner and outer tumblers is a poor conductor of heat (insulator). This slows down the transfer of heat from the warmer surroundings to the cold lassi.

48. **Assertion (A)** : Heat transfer in solids occurs mainly through convection.

**Reason (R)** : Convection involves the actual movement of particles, which is restricted in solids.

- (A) Both A and R are true, and R is the correct explanation of A.  
 (B) Both A and R are true, but R is not the correct explanation of A.  
 (C) A is false, but R is true.  
 (D) Both A and R are false.

Ans :

(C) A is false, but R is true.

Assertion (A) is false; heat transfer in solids is mainly by conduction. Reason (R) is true; convection requires particle movement, which is why it dominates in fluids (liquids/gases) but not solids. The reason explains why A is false.

49. When ice cubes melt in a dish, where does the heat required for melting primarily come from?
- (A) Generated chemically within the ice.  
 (B) Absorbed from the surrounding air and the dish.  
 (C) From sunlight only, even indoors.  
 (D) From the Earth's internal heat.

Ans :

(B) Absorbed from the surrounding air and the dish.

Melting requires heat energy (latent heat of fusion). The ice absorbs this heat from its immediate surroundings – the air in contact with

it and the dish it rests on, causing them to cool slightly.

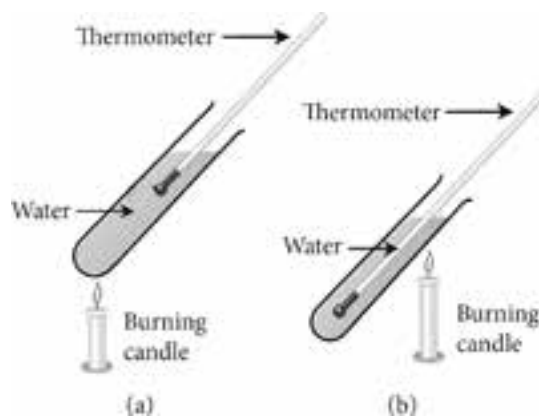
50. If a burning incense stick points downwards, in which direction will the smoke primarily move?
- (A) Downwards, following gravity.  
 (B) Upwards, because smoke is hot and less dense than air.  
 (C) Sideways, spreading horizontally.  
 (D) In random directions.

Ans :

(B) Upwards, because smoke is hot and less dense than air.

Regardless of the stick's orientation, the smoke produced is hot. Hot gases are less dense than cooler surrounding air and will rise due to buoyancy (convection).

51. In Figure, water is heated from the bottom in (a) and near the top in (b). In which case will the thermometer near the top record a higher temperature faster? Explain why.



- (A) Case (a), because heat rises directly via convection.  
 (B) Case (b), because heat conducts downwards slowly.  
 (C) Both will heat at the same rate via radiation.  
 (D) Case (b), because hot water sinks.

Ans :

(A) Case (a), because heat rises directly via convection.

In (a), heating from the bottom sets up convection currents, efficiently carrying hot water upwards to the thermometer. In (b), heating the top layer relies on slow conduction downwards, or minimal convection, making the bottom (and thus the average temperature) rise much slower.

52. Why are large bodies of water (like oceans or large lakes) said to prevent extreme temperatures in nearby areas?
- (A) Water reflects all sunlight, preventing heating.
  - (B) Water absorbs large amounts of heat with little temperature change and releases it slowly.
  - (C) Water generates its own cooling effect.
  - (D) Water bodies create strong winds that disperse heat.

Ans :

(B) Water absorbs large amounts of heat with little temperature change and releases it slowly. Water has a high specific heat capacity. It takes a lot of energy to change its temperature. This property moderates nearby land temperatures, preventing extreme highs in summer and extreme lows in winter (due to land/sea breezes as well).

53. Which process is primarily responsible for replenishing groundwater sources naturally?
- (A) Evaporation from oceans
  - (B) Condensation into clouds
  - (C) Infiltration of precipitation (rain, snowmelt)
  - (D) Transpiration from plants

Ans :

(C) Infiltration of precipitation (rain, snowmelt) Groundwater is recharged when water from rain or melting snow seeps (infiltrates) through the soil and rock layers down to the aquifer.

54. Tightly wrapping paper around a metal rod prevents it from burning easily when held in a flame. Why?
- (A) The metal rod cools the flame down.
  - (B) The paper becomes non-combustible when wrapped.
  - (C) The metal rod conducts heat away from the paper rapidly, keeping it below ignition temperature.
  - (D) The tight wrapping cuts off the oxygen supply.

Ans :

(C) The metal rod conducts heat away from the paper rapidly, keeping it below ignition temperature. Metal is a very good conductor of heat. It quickly draws heat away from the part of the paper in contact with the flame, preventing that section from reaching its ignition temperature.

55. Why does a paper spiral suspended above a burning candle rotate?
- (A) The flame pushes the paper directly.
  - (B) The heat causes the paper to shrink and twist.
  - (C) Hot air rising from the candle (convection current) pushes against the spiral, causing rotation.
  - (D) The paper absorbs moisture from the flame, making it heavy.

Ans :

(C) Hot air rising from the candle (convection current) pushes against the spiral, causing rotation. The candle heats the air above it. This hot air rises (convection) and impinges on the surfaces of the paper spiral, exerting a force that causes it to rotate, similar to how a turbine works.

56. Which statement correctly compares conduction and convection?
- (A) Both occur primarily in solids.
  - (B) Conduction involves particle movement; convection does not.
  - (C) Both transfer heat through electromagnetic waves.
  - (D) Conduction relies on particle interaction without bulk flow; convection involves bulk fluid movement.

Ans :

(D) Conduction relies on particle interaction without bulk flow; convection involves bulk fluid movement. This accurately contrasts the mechanisms : conduction passes energy particle-to-particle, while convection moves energy via the flow of the heated fluid itself.

57. How is heat transfer by radiation different from conduction and convection?
- (A) Radiation transfers coldness, not heat.
  - (B) Radiation requires a dense medium like metal.
  - (C) Radiation does not require a material medium to travel.
  - (D) Radiation only occurs at very high temperatures.

Ans :

(C) Radiation does not require a material medium to travel. A key distinction is that radiation can transmit heat energy through a vacuum (like space) via



electromagnetic waves, whereas conduction and convection rely on particles within a medium.

58. Which of the following is NOT primarily an example of convection?
- (A) Sea breeze and land breeze formation.  
 (B) Heating water in a pot from the bottom.  
 (C) Warmth felt directly from sunlight.  
 (D) Smoke rising from a chimney.

Ans :

(C) Warmth felt directly from sunlight.  
 Warmth from the sun reaching Earth through space is the primary example of heat transfer by radiation. The other options involve the movement of fluids (air or water) due to heating.

## MATCHING TYPE QUESTION

59. Match the mode of heat transfer in Column A with its primary characteristic in Column B :

	Column A		Column B
1.	Conduction	A.	Heat transfer through electromagnetic waves, no medium needed
2.	Convection	B.	Heat transfer by the actual movement of fluid particles
3.	Radiation	C.	Heat transfer mainly in solids, particle to particle
4.	Insulator	D.	Material that does not allow easy heat transfer by conduction

- (a) 1-C, 2-B, 3-A, 4-D  
 (b) 1-B, 2-C, 3-D, 4-A  
 (c) 1-C, 2-A, 3-B, 4-D  
 (d) 1-D, 2-B, 3-A, 4-C

Ans :

(a) 1-C, 2-B, 3-A, 4-D  
 Conduction involves particle-to-particle heat transfer in solids. Convection is heat transfer via fluid movement. Radiation doesn't need a medium. Insulators resist heat conduction.

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60. Match the natural phenomenon in Column A with the primary heat transfer process responsible in Column B :

	Column A		Column B
1.	Sea Breeze	A.	Radiation
2.	Heat from Sun	B.	Conduction
3.	Metal pan heating on a stove	C.	Convection
4.	Air trapped in woollen clothes keeping us warm	D.	Insulation (Poor Conduction)

- (a) 1-D, 2-A, 3-C, 4-B  
 (b) 1-A, 2-C, 3-B, 4-D  
 (c) 1-C, 2-A, 3-B, 4-D  
 (d) 1-C, 2-B, 3-D, 4-A

Ans :

- (c) 1-C, 2-A, 3-B, 4-D

Sea breeze is caused by convection currents in the air. Heat from the Sun reaches Earth by radiation. A metal pan heats up primarily by conduction. Trapped air in wool acts as an insulator.

61. Match the term related to water in nature in Column A with its correct description in Column B :

	Column A		Column B
1.	Evaporation	A.	Underground layer storing water
2.	Condensation	B.	Water seeping into the ground
3.	Aquifer	C.	Process of liquid water changing to water vapour due to heat
4.	Infiltration	D.	Process of water vapour changing to liquid water, forming clouds

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-B, 2-A, 3-D, 4-C  
 (c) 1-C, 2-B, 3-A, 4-D  
 (d) 1-D, 2-C, 3-B, 4-A

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

Evaporation is liquid to vapour. Condensation is vapour to liquid, forming clouds. An aquifer is an underground water storage layer. Infiltration is water seeping into the ground.

62. Match the material or clothing choice in Column A with the scientific reason based on heat transfer in Column B :

	Column A		Column B
1.	Dark-coloured clothes in winter	A.	Reflect most of the Sun's radiation
2.	Light-coloured clothes in summer	B.	Good conductor of heat for efficient cooking
3.	Metal cooking utensils	C.	Poor conductor of heat, prevents heat loss from body
4.	Wooden handles on saucepans	D.	Absorb more heat radiation from the Sun

- (a) 1-A, 2-D, 3-C, 4-B
- (b) 1-D, 2-A, 3-B, 4-C
- (c) 1-D, 2-C, 3-A, 4-B
- (d) 1-B, 2-A, 3-D, 4-C

Ans :

- (b) 1-D, 2-A, 3-B, 4-C

Dark clothes absorb more heat. Light clothes reflect heat. Metals are good heat conductors for cooking. Wood is a poor conductor, suitable for handles to prevent burns.

63. Match the observation from an experiment in Column A with the heat transfer principle it demonstrates in Column B :

	Column A		Column B
1.	Pins falling sequentially from a heated metal strip	A.	Hot air expands, becomes lighter and rises
2.	Coloured potassium permanganate rising in heated water	B.	Land heats up faster than water
3.	An inverted paper cup rising above a candle	C.	Heat transfer by movement of heated water (convection)
4.	Soil temperature increasing faster than water in sunlight	D.	Heat transfer through the metal (conduction)

- (a) 1-B, 2-C, 3-D, 4-A
- (b) 1-D, 2-A, 3-C, 4-B

- (c) 1-A, 2-B, 3-D, 4-C
- (d) 1-D, 2-C, 3-A, 4-B

Ans :

- (d) 1-D, 2-C, 3-A, 4-B

Pins falling demonstrates conduction along the metal. Coloured water movement shows convection. The paper cup rises due to hot air rising (convection). Differential heating of soil and water is a key observation.

### VERY SHORT QUESTION

64. Name one material that is a good conductor of heat.

Ans :

Metal (or Aluminium, Iron, Steel)

65. Name one material that is a poor conductor (insulator) of heat.

Ans :

Wood (or Glass, Clay, Porcelain, Air)

66. What is the process of heat transfer from a hotter part to a colder part of an object called, where particles pass heat to neighbours without moving?

Ans :

Conduction

67. Through which process does heat transfer mainly occur in solids?

Ans :

Conduction

68. Is air a good or poor conductor of heat?

Ans :

Poor conductor

69. What happens to air when it is heated?

Ans :

It expands (and becomes lighter/rises)

70. What is the process of heat transfer called where heat moves due to the actual movement of particles, typically in liquids and gases?

Ans :

Convection



71. Does land or water heat up faster during the day?

Ans :

Land

72. What is the movement of cooler air from the sea towards the land during the day called?

Ans :

Sea breeze

73. What is the movement of cooler air from the land towards the sea during the night called?

Ans :

Land breeze

74. By which process does heat from the Sun reach the Earth?

Ans :

Radiation

75. Does heat transfer by radiation require a medium?

Ans :

No

76. Which colour clothes reflect more heat – light-coloured or dark-coloured?

Ans :

Light-coloured

77. Name the traditional room heater used in the Himalayas mentioned in the text.

Ans :

Bukhari

78. What is the primary source of heat for the Earth?

Ans :

The Sun

79. What process causes water from oceans and lakes to turn into water vapour due to the Sun's heat?

Ans :

Evaporation

80. What process involves water vapour rising, cooling, and forming clouds?

Ans :

Condensation

81. What is the process called when water falls from clouds as rain, snow, or hail?

Ans :

Precipitation

82. What is the process called where surface water seeps through soil and rocks?

Ans :

Infiltration

83. What are the underground layers of sediments and rocks that store water called?

Ans :

Aquifers

## SHORT ANSWER QUESTION

84. Describe how heat is transferred by conduction along a metal strip when one end is heated.

Ans :

When one end is heated, particles at that end gain heat and vibrate more, passing energy to neighbouring particles. This continues along the strip, transferring heat without particles moving position.

85. Differentiate between good conductors and poor conductors (insulators) of heat, giving one example of each.

Ans :

Good conductors (e.g., metals like copper) allow heat to pass through them easily. Poor conductors or insulators (e.g., wood) do not allow heat to pass easily.

86. Explain why wearing woollen clothes keeps us warm in winter.

Ans :

Woollen fabric traps air in its pores. Since air is a poor conductor of heat, it reduces heat loss from our body to the colder surroundings, making us feel warm.

87. Why is it often warmer to use two thin blankets instead of one thick blanket?

Ans :

The layer of air trapped between the two thin blankets acts as an excellent insulator (poor conductor), preventing body heat loss more effectively than a single thick blanket might.

**88.** Explain why smoke from a fire rises upwards.

**Ans :**

Smoke consists of hot gases and particles. Being hotter than the surrounding air, the smoke expands, becomes lighter (less dense), and rises due to convection.

**89.** Describe how heat is transferred through water in a beaker when heated from below, using the term convection.

**Ans :**

Water at the bottom heats up, expands, becomes lighter, and rises. Cooler, denser water from the sides moves down to replace it, gets heated, and also rises. This circulation is convection.

**90.** Why does soil heat up and cool down faster than water?

**Ans :**

Soil and water have different specific heat capacities. Soil requires less heat to raise its temperature and loses heat more quickly compared to water.

**91.** Explain the formation of a sea breeze during the daytime.

**Ans :**

During the day, land heats faster than the sea. Warm air above land rises, creating low pressure. Cooler, denser air from above the sea blows towards the land to fill this space, creating a sea breeze.

**92.** Explain the formation of a land breeze during the night.

**Ans :**

At night, land cools faster than the sea. Air above the cooler land is denser than the warmer air above the sea. This cooler land air blows towards the sea, creating a land breeze.

**93.** Define radiation as a mode of heat transfer and give an example.

**Ans :**

Radiation is heat transfer through electromagnetic waves that does not require a medium. An example is heat travelling from the Sun to the Earth through the vacuum of space.

**94.** Why is it more comfortable to wear light-coloured clothes in summer?

**Ans :**

Light-coloured clothes reflect most of the Sun's heat (radiation) that falls on them, absorbing less heat compared to dark clothes, thus keeping us cooler.

**95.** Identify the primary modes of heat transfer involved when heating water in a metal pan on a stove.

**Ans :**

Heat transfers from the flame to the metal pan primarily by conduction. Heat transfers through the water inside the pan by convection. Heat radiates from the flame and hot pan to the surroundings.

**96.** Briefly describe the main stages of the water cycle.

**Ans :**

The water cycle involves : Evaporation (water turns to vapour), Transpiration (water vapour from plants), Condensation (vapour forms clouds), and Precipitation (water falls back as rain/snow).

**97.** How does the water cycle help redistribute water on Earth?

**Ans :**

Water evaporates mainly from large bodies (oceans), forms clouds that move with winds, and precipitation falls over land and sea, replenishing rivers, lakes, and groundwater globally.

**98.** What is infiltration, and what factors affect how easily it occurs?

**Ans :**

Infiltration is the process of surface water seeping into the ground through soil and rocks. It occurs more easily if the spaces between soil/rock particles are wider and interconnected.

**99.** What is groundwater, and how is it stored?

**Ans :**



Groundwater is water that has infiltrated the ground and is stored in the pore spaces within underground layers of sediments and rocks known as aquifers.

100. Why is groundwater conservation important? Mention one reason for its depletion.

Ans :

Groundwater is a vital resource but not unlimited. Conservation is important because excessive extraction for growing populations and reduced infiltration (due to concrete surfaces/less vegetation) are depleting it.

101. Explain the purpose of 'ice stupas' in Ladakh.

Ans :

Ice stupas are artificial glaciers created in winter by freezing stream water. They melt slowly in spring/summer, providing a crucial water source for farming when natural streams might be low.

102. How do hollow bricks help in keeping houses cool in summer and warm in winter?

Ans :

The air trapped within the hollow spaces of the bricks acts as a poor conductor of heat (insulator). This reduces heat transfer from outside in summer and heat loss from inside in winter.

103. Compare conduction and convection in terms of particle movement and requirement of a medium.

Ans :

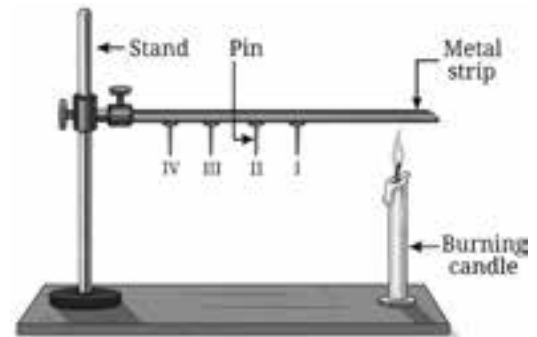
Conduction transfers heat through particle vibrations without overall particle movement, requiring a medium (mostly solids). Convection transfers heat via actual movement of particles, occurring in fluids (liquids/gases).

## LONG ANSWER QUESTION

104. Describe the experiment using a metal strip, wax, and pins to demonstrate heat transfer by conduction. Explain the observations and the conclusion drawn.

Ans :

A metal strip has pins attached with wax at intervals. One end is heated.



Observation : The pin closest to the heat source falls first, followed by the next, and so on.

Explanation : Heat conducts along the metal strip from the hot end to the cold end. As heat reaches each pin, the wax melts, causing the pin to fall. The sequential falling shows heat travelling progressively along the strip.

Conclusion : Heat is transferred through solids like metal by conduction, moving from hotter to colder regions without the particles themselves moving position.

105. Explain the process of convection using the experiment with potassium permanganate in water. Why is this method of heat transfer significant in liquids and gases?

Ans :

A potassium permanganate crystal is placed at the bottom of a beaker of water, which is then heated from below.



Figure : (a) Initial set-up for demonstration

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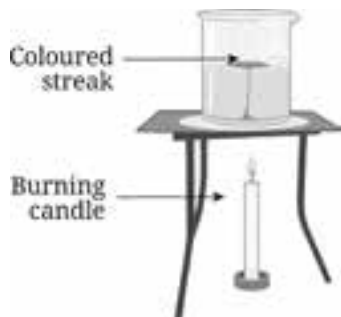


Figure : (b) Demonstration of convection in heated water

Observation : Coloured streaks of water rise from the bottom centre, move across the top and descend along the sides, creating a circulation pattern.

Explanation : Water at the bottom heats, expands, becomes less dense, and rises. Cooler, denser water from the sides sinks to take its place, gets heated, and rises too. This continuous movement of the fluid particles transfers heat throughout the water.

Significance : Convection is the primary way heat is distributed through liquids and gases because their particles are free to move, enabling these heat-driven currents.

106. Compare and contrast the formation of sea breeze and land breeze. Explain the role of differential heating of land and water in this phenomenon.

Ans :

Both breezes result from convection currents driven by the differential heating/cooling rates of land and water.

- (1) Sea Breeze (Day) : Land heats faster than the sea. Air over land warms, expands, rises (low pressure). Cooler, denser air over the sea flows inland to replace it. Wind : Sea to Land.
- (2) Land Breeze (Night) : Land cools faster than the sea. Air over land becomes cooler, denser (high pressure). Warmer, less dense air over the sea rises. Cooler air from land flows towards the sea. Wind : Land to Sea. The key is land's lower specific heat capacity compared to water, causing faster temperature changes.

107. Explain the three modes of heat transfer : conduction, convection, and radiation. Give one clear example where each process is dominant and state whether a medium is required.

Ans :

- (1) Conduction : Heat transfer through direct contact, via particle collisions/vibrations, without overall particle movement. Dominant in solids. Medium required. Example : Handle of a metal spoon getting hot when the spoon is in hot soup.
- (2) Convection : Heat transfer through the actual movement of heated fluid (liquid or gas) particles, creating currents. Dominant in fluids. Medium required. Example : Boiling water circulating in a pot.
- (3) Radiation : Heat transfer via electromagnetic waves, capable of travelling through vacuum. No medium required. Example : Heat from the Sun reaching Earth, or warmth felt from a distant fire.

108. Describe the water cycle in detail, explaining the role of the Sun's heat and the processes of evaporation, transpiration, condensation, and precipitation. Why is this cycle vital?

Ans :

The Sun's heat (radiation) drives the water cycle. Heat causes evaporation from water bodies (oceans, lakes) turning liquid water into water vapour. Plants release water vapour through transpiration. This warm, moist air rises. As it rises higher, it cools, causing condensation – water vapour turns back into tiny liquid water droplets or ice crystals, forming clouds. When these droplets/crystals become large enough, they fall back to Earth as precipitation (rain, snow, hail). Water collects on land, flows into rivers/lakes, or infiltrates the ground, eventually returning to oceans, completing the cycle. Vitality : It distributes fresh water globally, replenishes water sources, and influences weather/climate.

109. Explain how groundwater is formed and stored. What is an aquifer? Discuss two reasons for groundwater depletion and suggest one method for replenishment.

Ans :

Groundwater forms when precipitation or surface water infiltrates the ground, seeping through soil and porous rock layers. This water gets stored in the tiny spaces (pores) between sediment particles and within fractures in rocks. An aquifer is an underground layer of such water-bearing permeable rock, rock fractures, or unconsolidated materials (gravel, sand) from which groundwater can be extracted.



**Depletion Reasons :**

1. Over-extraction, often for agriculture or growing populations, removing water faster than it's naturally recharged.
2. Reduced infiltration due to increased urbanization (concrete surfaces prevent seepage) and deforestation.

**Replenishment Method :**

Rainwater harvesting collects rainwater and directs it into the ground (e.g., via recharge pits) to recharge aquifers.

110. Why do we wear different types of clothes in summer and winter? Explain the scientific principles of heat transfer involved.

**Ans :**

Clothing choices relate to regulating body temperature via heat transfer.

- (1) Summer : We wear light-coloured, often cotton clothes. Light colours reflect more solar radiation, absorbing less heat, keeping us cooler. Cotton allows sweat evaporation, which cools the body. Principle : Reflection/absorption of radiation, Evaporation.
- (2) Winter : We wear dark-coloured, often woollen clothes, sometimes in layers. Dark colours absorb more solar radiation, providing some warmth. Wool traps air, which is an insulator (poor conductor), reducing heat loss from the body by conduction and convection. Layers trap more air, enhancing insulation.

Principle : Absorption of radiation, Insulation (reducing conduction/convection).

111. Comparing the heating and cooling rates of soil and water. How do the results explain why coastal areas generally have more moderate climates than inland areas?

**Ans :**

Soil heats up significantly faster than water under sunlight and also cools down faster when removed from heat. Water heats and cools more slowly due to its higher specific heat capacity.

Application to climate : Coastal areas are near large water bodies (oceans/seas). During the day, the water absorbs heat slowly, keeping coastal areas cooler than inland areas (often aided by sea breeze). At night, the water releases heat slowly, keeping coastal areas warmer than inland areas

(often aided by land breeze). This moderating effect of water prevents extreme temperature fluctuations experienced far inland.

112. Think about the 'bukhari' room heater described. Identify where conduction, convection, and radiation are likely involved in heating the room and cooking food on it.

**Ans :**

- (1) Conduction : Heat conducts from the burning fuel (wood/charcoal) through the metal stove body to its flat top. If a utensil is placed on top, heat conducts from the stove top to the utensil base.
- (2) Convection : Air near the hot stove body heats up, becomes less dense, and rises. Cooler air sinks to replace it, gets heated, and rises, creating convection currents that circulate warm air throughout the room. If cooking, convection currents heat the contents of the utensil. Smoke rises up the chimney pipe due to convection.
- (3) Radiation : The hot stove body radiates heat outwards in all directions, directly warming people, furniture, and walls in the room without needing air movement.

113. Water conservation methods like 'ice stupas' are becoming important. Explain the concept behind ice stupas and discuss why such innovative methods are necessary in regions like Ladakh, linking it to the water cycle and climate.

**Ans :**

Ice stupas are artificial glaciers built in winter by spraying water (piped from streams) into freezing air. The ice accumulates layer by layer.

Concept : Store winter water (when streams flow but farming need is low) as ice, which melts slowly in spring/summer, releasing water when natural meltwater from high glaciers is scarce due to insufficient heat. Necessity in Ladakh : Ladakh is a cold desert with low precipitation. Farming relies on glacial meltwater. Climate change might affect glacier melt patterns. Spring season can have water scarcity before high-altitude snow melts significantly. Ice stupas provide a crucial, localized water source during this critical period, adapting water management to specific climate challenges and water cycle variations in the region.

## CASE BASED QUESTION

**114.** You need to boil water quickly for making tea. You have two pans of the same size, one made of thick ceramic (like clay) and one made of thin stainless steel. Both have plastic handles.

1. Which pan should you choose to boil the water fastest? Why?
2. Why are the handles made of plastic? Which heat transfer process does this primarily prevent?
3. If you leave the hot tea in the ceramic pan versus the steel pan after removing from heat, in which pan would it likely stay hot longer? Why?

**Ans :**

- (1) Choose the stainless steel pan because steel is a metal and a good conductor of heat, transferring heat from the stove to the water much faster than ceramic (a poor conductor).
- (2) Handles are plastic because plastic is a poor conductor of heat (insulator). This prevents heat from conducting from the hot pan to the user's hand.
- (3) The tea would likely stay hot longer in the ceramic pan because ceramic is a poor conductor/good insulator, slowing down the rate of heat loss to the surroundings compared to the steel pan.

**115.** On a sunny day at the beach, the sand feels very hot under your feet, but the ocean water feels cool. Later that evening, after sunset, the sand feels cool, while the water feels comparatively warmer.

1. Which heats up faster under the sun : sand or water?
2. Which cools down faster after sunset : sand or water?
3. What phenomenon, caused by this difference in heating/cooling, results in wind blowing from the sea to the land during the day?
4. Explain briefly why the water feels relatively warmer than the sand at night.

**Ans :**

- (1) Sand heats up faster.
- (2) Sand cools down faster.
- (3) Sea breeze.

(4) Water loses heat much more slowly than sand. So, while both cool down after sunset, the sand's temperature drops faster, making the water feel warmer in comparison during the night.

**116.** A person sits near a campfire on a cool, still night. They feel warmth on their face and hands, even though there is no wind blowing the hot air towards them. They also notice that the metal poker left in the fire becomes too hot to touch.

1. By which primary process does the warmth from the fire travel directly to the person's face and hands without air movement?
2. By which primary process does the handle of the metal poker get hot?
3. If the person moved further away from the fire, would the warmth felt via radiation increase or decrease? Why?

**Ans :**

- (1) Radiation.
- (2) Conduction (heat travels along the metal poker from the end in the fire).
- (3) Decrease, The intensity of heat radiation decreases with distance from the source.

**117.** Houses in cold climates sometimes have double-glazed windows (two panes of glass with a gap between them). Woolen sweaters are worn to keep warm. Both methods utilize a similar principle involving a specific material.

1. What material is trapped in the gap between the glass panes and within the wool fibers?
2. Is this material a good or poor conductor of heat?
3. Explain how trapping this material helps keep the house/person warm. Which heat transfer process is mainly reduced?

**Ans :**

- (1) Air.
- (2) Poor conductor (insulator).
- (3) The trapped air acts as an insulating layer, significantly reducing heat loss from the warm inside (house/body) to the cold outside. It primarily reduces heat transfer by conduction and convection across the gap/through the fabric.

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- 118.** After heavy rainfall in a city with lots of paved roads and concrete areas, water quickly flows into drains, often causing localized flooding. In a nearby forest area with similar rainfall, there is much less surface runoff and no flooding.
1. What process allows rainwater to soak into the ground in the forest?
  2. Why does less infiltration occur in the city compared to the forest?
  3. How does reduced infiltration in cities affect groundwater levels?

**Ans :**

- (1) Infiltration.
- (2) Paved roads and concrete surfaces are largely impermeable, preventing water from seeping into the ground, unlike the porous soil in the forest.
- (3) Reduced infiltration means less rainwater reaches and recharges the underground aquifers, contributing to the depletion of groundwater levels in urban areas.

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# CHAPTER 8

## MEASUREMENT OF TIME AND MOTION

### SUMMARY

#### 1. UNDERSTANDING TIME AND ITS MEASUREMENT

Timekeeping has fascinated humans since ancient times. Early time was tracked using natural events like the rising and setting of the Sun, phases of the Moon, and seasonal changes. To measure shorter intervals, devices like sundials, water clocks, hourglasses, and candle clocks were used. These tools relied on consistent natural changes to estimate the passage of time.



Figure : A sundial



Figure : A water clock (a) Water flowing out-type, (b) Floating bowl-type



Figure : An hourglass and A candle clock

#### 2. EVOLUTION OF TIMEKEEPING DEVICES

Ancient Indian texts like the Arthashastra and the work of scientists such as Aryabhata mentioned Ghatika-yantra, a bowl-shaped water clock. With the advancement of mechanical systems, pendulum clocks were invented. Galileo observed that pendulums take the same time for each swing, and this idea was developed further by Christiaan Huygens, who built the first pendulum clock in 1656

##### 2.1 The Simple Pendulum

A simple pendulum consists of a small weight (bob) suspended from a fixed point. When displaced and released, it oscillates. One oscillation includes a complete to-and-fro movement. The time taken for one oscillation is called the time period. This time period depends on the length of the string but not on the mass of the bob. This regularity allows pendulums to be used in timekeeping.

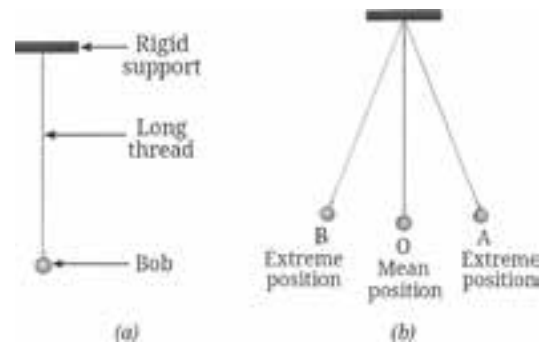


Figure : A simple pendulum

##### 2.2 Units of Time

The SI unit of time is the second (s). Other common units are minute (min) and hour (h). Modern digital devices use precise time intervals, even measuring milliseconds or microseconds, which is crucial in fields like sports, medicine (e.g., ECG), and technology (e.g., smartphones)

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### 3. MEASURING MOTION WITH SPEED

Speed is the rate at which an object covers distance. It is calculated as :

$$\text{Speed} = \frac{\text{Total Distance}}{\text{Total time taken}}$$

The SI unit of speed is metres per second (m/s), but kilometres per hour (km/h) is also commonly used. When distances differ but times are equal, the object covering more distance has higher speed. In real life, we often talk about average speed, since speed usually varies during travel

### 4. RELATIONSHIP BETWEEN SPEED, DISTANCE, AND TIME

These quantities are mathematically related :

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time} = \text{Distance} / \text{Speed}$$

This relationship helps in solving problems related to travel and motion.

### 5. UNIFORM AND NON-UNIFORM MOTION

If an object moves in a straight line with a constant speed, it is said to be in uniform linear motion (e.g., a train moving steadily). If the speed varies during motion, it is non-uniform motion (e.g., a car in city traffic). Real-life motions are generally non-uniform, so average speed is used for comparison.

### 6. DEVICES TO MEASURE SPEED AND DISTANCE

Vehicles use speedometers to display speed and odometers to measure the distance travelled. These instruments help monitor uniform and non-uniform motion in everyday life.



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## NCERT ACTIVITY

### Activity 8.1 : Let us construct

1. Take a used transparent plastic bottle (1/2 litre or larger) with its cap.
2. Cut it into two, roughly in the middle as shown in Figure (a).
3. Using a drawing pin, make a small hole in the cap of the bottle (Figure (b)).
4. Place the upper part of the bottle in an inverted position over the lower half (Figure (c)).
5. Fill the upper part of the bottle with water. You may add a few drops of ink or colour to make the water level easily visible (Figure (d)).

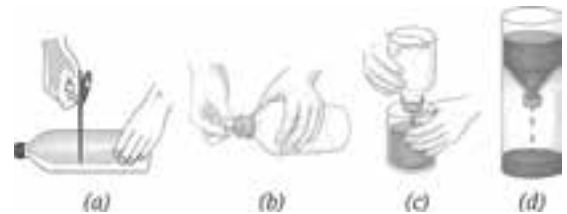


Figure : Making a simple water clock

6. The water will start dripping into the lower part of the bottle. Using a watch, mark the level of water after every one minute till all the water drips down.

#### Question :

1. Your water clock is ready. Can you now guess how to use it?
2. Pour the water from the lower part back into the top part and watch the level of water dripping into the lower part. Every time it touches a mark made by you, one more minute has passed.

#### Ans :

This activity describes the construction and calibration of a simple water clock.

1. After calibrating and marking the water levels in the lower part of the bottle corresponding to one-minute intervals (or other chosen intervals), the water clock can be used to measure time.
2. To start measuring time, fill the upper part of the bottle with water (preferably up to a consistent starting level if not using the full volume each time).

3. As the water drips from the upper part into the lower part, observe the water level in the lower part rising.
4. When the water level in the lower part reaches the first mark you made, one minute (or your calibrated unit of time) has passed. When it reaches the second mark, two minutes have passed, and so on.
5. Alternatively, if calibrated based on the upper container emptying, the time taken for the upper container to empty to certain marked levels, or completely, can be used to measure a fixed duration.

The principle is that water flows out through the small hole at a relatively constant rate (though this rate can change as the water level in the upper container decreases, which is a limitation of simple water clocks).

**Activity 8.2 : Let us experiment**

1. Collect a piece of string around 150 cm long, a heavy metal ball with hook/ a stone (bob), a stopwatch/ watch, and a ruler.
2. Tie the bob at one end of the string.
3. Fix the other end of the string to a rigid support such that the length of the string in between support and bob is around 100 cm.
4. Wait for the bob to come to rest. Your pendulum is now ready.
5. Gently hold the bob, move it slightly to one side and release it. Take care not to push the bob while releasing it and that the string is taut. Is your pendulum now oscillating?
6. Using a watch, measure the time it takes for the pendulum to complete 10 oscillations. Record the time in Table.
7. Repeat this activity 3-4 times.
8. Divide the time taken for 10 oscillations by 10 to calculate the time period of your pendulum. Note it down in Table .

**Table : Time period of a simple pendulum**

Length of the string = 100 cm

S. No.	Time taken for 10 oscillations (seconds)	Time period (seconds)
1		
2		
3		

Is the time period of your pendulum almost the same every time? What do you conclude from this

observation? The time period of the pendulum is almost the same every time.

Ans :

Yes, the pendulum will be oscillating after being released.

**Table : Time period of a simple pendulum**

Length of the string = 100 cm

S. No.	Time taken for 10 oscillations (seconds)	Time period (seconds)
1	20.2	2.02
2	19.9	1.99
3	20.1	2.01

Yes, if the experiment is conducted carefully (small amplitude of swing, consistent length, no pushing), the time period of the pendulum for a fixed length should be almost the same in each trial.

The conclusion is that the time period of a simple pendulum of a given length is constant (or nearly constant) at a particular location. This regularity is why pendulums were used in clocks for accurate timekeeping. Small variations in measurements can be due to human reaction time in starting/ stopping the watch, air resistance, or slight inconsistencies in releasing the bob or counting oscillations.

**Activity 8.3 : Let us identify**

1. Look at the wall clock shown in Figure carefully. What is the smallest interval of time you can measure with it?



Figure : A wall clock

Ans :

The smallest interval of time that can typically be measured with a standard analog wall clock (like the one usually depicted in Figure, which has an hour hand, a minute hand, and a seconds hand that moves in discrete steps or continuously) is



one second. This is indicated by the markings for seconds and the movement of the seconds hand. Some clocks may have finer markings, but one second is the common smallest marked interval.

### Activity 8.4 : Let us calculate

1. Look up at the railway timetable on the internet.
2. Identify a train stopping at the railway station nearest to your place of stay.
3. Find out the name of the next station where this train stops. Also, find the distance to that station as given in the timetable.
4. Note the time at which the train departs from your station and arrives at the next station. Find the difference to calculate the time taken by the train to cover the distance till the next station.
5. Calculate the speed of the train between the two stations and record it in Table.
6. Repeat for 4-5 different types of trains (Passenger/ Express/ Superfast).

#### Table : Finding the speed of trains

Name of the railway station nearest to your place of stay : [To be filled by student]

S. No.	Name of the Train	Name of the Next Station	Distance till the Next Station (km)	Time Taken till the Next Station (h)	Speed of the Train (km/h)
1					
2					
3					
4					
5					

Compare the speeds of the trains. Which is the fastest train?

Ans :

Name of the railway station nearest to your place of stay : Nagpur Junction

#### Table : Finding the speed of trains

S. No.	Name of the Train	Name of the Next Station	Distance (km)	Time Taken (h)	Speed (km/h)
1	Vidarbha Express	Wardha Junction	80	1.0	80 km/h
2	Sewagram Express	Wardha Junction	80	1.2	66.7 km/h

3	Maharashtra Express	Bhandara Road	60	1.5	40 km/h
4	Azad Hind Express	Gondia Junction	130	1.5	86.7 km/h
5	Nagpur Pune Superfast	Akola Junction	250	3.0	83.3 km/h

## NCERT EXERCISE

1. Calculate the speed of a car that travels 150 metres in 10 seconds. Express your answer in km/h.

Ans :

Given,

$$\text{Distance} = 150 \text{ metres (m)}$$

$$\text{Time} = 10 \text{ seconds (s)}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{150\text{m}}{10\text{s}} = 15\text{m/s}$$

Convert meter /second to Kilometer /Hour

$$1\text{m/s} = 3.6\text{Km/h}$$

$$15 \text{ m/s} \times 3.6 = 54 \text{ km/h}$$

The speed of the car is 54 km/h.

2. A runner completes 400 metres in 50 seconds. Another runner completes the same distance in 45 seconds. Who has a greater speed and by how much?

Ans :

Runner 1 :

$$\text{Distance} = 400 \text{ m}$$

$$\text{Time} = 50 \text{ s}$$

$$\begin{aligned} \text{Speed 1} &= \text{Distance} / \text{Time} \\ &= 400\text{m}/50\text{s} = 8\text{m/s} \end{aligned}$$

Runner 2 :

$$\text{Distance} = 400 \text{ m}$$

$$\text{Time} = 45 \text{ s}$$

$$\begin{aligned} \text{Speed 2} &= \text{Distance} / \text{Time} \\ &= 400\text{m}/45\text{s} \approx 8.89\text{m/s} \end{aligned}$$

Comparison :

Runner 2 has a speed of approximately 8.89 m/s, and Runner 1 has a speed of 8 m/s.

Since  $8.89 \text{ m/s} > 8 \text{ m/s}$ , Runner 2 has a greater speed.

By how much :

Difference in speed = Speed 2 - Speed 1

Difference in speed =  $8.89 \text{ m/s} - 8 \text{ m/s} = 0.89 \text{ m/s}$   
(approximately)

3. A train travels at a speed of  $25 \text{ m/s}$  and covers a distance of  $360 \text{ km}$ . How much time does it take?

Ans :

Given :

$$\text{Speed} = 25 \text{ m/s}$$

$$\text{Distance} = 360 \text{ km}$$

First, ensure units are consistent. Let's convert distance to metres :

$$\begin{aligned} \text{Distance} &= 360 \text{ km} \times 1000 \text{ m/km} \\ &= 360000 \text{ m} \end{aligned}$$

Now, use the formula :

$$\text{Time} = \text{Distance} / \text{Speed}$$

$$\text{Time} = 360000 \text{ m} / 25 \text{ m/s}$$

$$\text{Time} = 14400 \text{ seconds}$$

To convert time to hours :

$$1 \text{ hour} = 3600 \text{ seconds}$$

$$\text{Time in hours} = 14400 \text{ s} / 3600 \text{ s/h}$$

$$\text{Time} = 4 \text{ hours}$$

The train takes 4 hours.

Alternatively, convert speed to  $\text{km/h}$  first :

$$\begin{aligned} \text{Speed} &= 25 \text{ m/s} \times (18/5) \text{ km/h} \\ &= 5 \times 18 \text{ km/h} \\ &= 90 \text{ km/h} \end{aligned}$$

$$\text{Distance} = 360 \text{ km}$$

$$\text{Time} = \text{Distance} / \text{Speed}$$

$$\text{Time} = 360 \text{ km} / 90 \text{ km/h}$$

$$\text{Time} = 4 \text{ hours}$$

4. A train travels  $180 \text{ km}$  in  $3 \text{ h}$ . Find its speed in :
1.  $\text{km/h}$
  2.  $\text{m/s}$
  3. What distance will it travel in  $4 \text{ h}$  if it maintains the same speed throughout the journey?

Ans :

Given :

$$\text{Distance} = 180 \text{ km}$$

$$\text{Time} = 3 \text{ h}$$

- (i) Speed in  $\text{km/h}$  :

$$\text{Speed} = \text{Distance} / \text{Time}$$

$$\text{Speed} = 180 \text{ km/h}$$

$$\text{Speed} = 60 \text{ km/h}$$

- (ii) Speed in  $\text{m/s}$  :

To convert  $\text{km/h}$  to  $\text{m/s}$ , multiply by  $5/18$

$$\text{Speed} = 60 \text{ km/h} (5/18)$$

$$\text{Speed} = (60 \times 5) / 18 \text{ m/s}$$

$$\text{Speed} = 300 / 18 \text{ m/s}$$

$$\text{Speed} = 50 / 3 \text{ m/s} \approx 16.67 \text{ m/s}$$

- (iii) Distance traveled in  $4 \text{ h}$  at the same speed :

$$\text{Speed} = 60 \text{ km/h} \text{ (from part i)}$$

$$\text{New Time} = 4 \text{ h}$$

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Distance} = 60 \text{ km/h} \times 4 \text{ h}$$

$$\text{Distance} = 240 \text{ km}$$

The train will travel  $240 \text{ km}$  in  $4 \text{ hours}$ .

5. The fastest galloping horse can reach the speed of approximately  $18 \text{ m/s}$ . How does this compare to the speed of a train moving at  $72 \text{ km/h}$ ?

Ans :

$$\text{Speed of horse} = 18 \text{ m/s}$$

$$\text{Speed of train} = 72 \text{ km/h}$$

To compare, we need to have both speeds in the same unit. Let's convert the train's speed to  $\text{m/s}$ .

$$1 \text{ km/h} = 5/18 \text{ m/s}$$

$$\text{Speed of train in m/s} = 72 \times (5/18) \text{ m/s}$$

$$\text{Speed of train in m/s} = (72/18) \times 5 \text{ m/s}$$

$$\text{Speed of train in m/s} = 45 \text{ m/s}$$

$$\text{Speed of train in m/s} = 20 \text{ m/s}$$

Now compare :

$$\text{Speed of horse} = 18 \text{ m/s}$$

$$\text{Speed of train} = 20 \text{ m/s}$$

Since  $20 \text{ m/s} > 18 \text{ m/s}$  the train is faster than the galloping horse.

The train's speed is  $v$  greater than the horse's speed.

6. Distinguish between uniform and non-uniform motion using the example of a car moving on a straight highway with no traffic and a car moving in city traffic.

Ans :

**Uniform Motion :**



**Definition :** An object is said to be in uniform linear motion if it travels along a straight line and covers equal distances in equal intervals of time. This means its speed remains constant.

**Example :** Car on a straight highway with no traffic : If a car travels on a long, straight highway with no traffic or obstacles, and the driver maintains a constant speed (e.g., using cruise control at 80 km/h), its motion can be considered uniform linear motion. In every equal time interval (say, every 1 minute), the car would cover the same distance.

**Non-uniform Motion :**

**Definition :** An object is said to be in non-uniform linear motion if it travels along a straight line but its speed keeps changing, meaning it covers unequal distances in equal intervals of time.

**Example :** Car moving in city traffic : A car moving in city traffic typically undergoes non-uniform motion. It has to frequently speed up when the road is clear, slow down for other vehicles or traffic signals, stop at red lights, and then accelerate again. Its speed is constantly changing. In equal intervals of time (say, every 1 minute), the distance covered by the car will likely be different.

Distinction Summary :

Feature	Uniform Linear Motion	Non-uniform Linear Motion
Speed	Constant	Changing (variable)
Distance in equal time intervals	Equal	Unequal

Example : Car on a clear, straight highway at constant speed. Car navigating through city traffic.

- Data for an object covering distances in different intervals of time are given in the following table. If the object is in uniform motion, fill in the gaps in the table.

Time (s)	0	10	20	30	40	50	60	70
Distance (m)	0	8	16	24	32	40	48	56

**Ans :**

For uniform motion, the object covers equal distances in equal intervals of time.

From the table :

In the first 10 s (from 0 s to 10 s), distance covered  $8\text{ m} - 0\text{ m} = 8\text{ m}$

This means the speed is  $8\text{ m}/10\text{ s} = 0.8\text{ m/s}$

Alternatively, in every 10 s interval, the object covers 8 m.

Let's fill the gaps based on this :

At Time = 20 s : Distance covered in the interval 10 s to 20 s should be 8 m. So, Distance at 20 s = Distance at 10s + 8m = 8m + 8m = 16m

At Time = 40 s (Gap in Time) : The distances given are 0, 8, (gap1), 24, 32, 40, (gap2), 56.

The pattern of distance is increasing by 8 m every 10 s.

Distance at 0 s = 0

Distance at 10 s = 8

Distance at 20 s = 8+8 = 16 (So the first gap under Distance at 20s is 16)

Distance at 30 s = 16+8 = 24 (Matches table)

Distance at 40 s = 24+8 = 32 (Matches table)

The time interval for this 32 m distance is 40s. (The gap under Time for 32m is 40)

At Distance = 48 m (Gap in Distance) : The distance increases by 8 for every 10s.

Distance at 50 s = 40 m (Matches table)

Time for the next 8 m (to reach 48 m) would be 10 s more. So, Time for 48 m = 50 s + 10 s = 60 s

The distance would be 40 m + 8 m = 48 m

So the gap under Time is 60s and the gap under Distance is 48m.

Distance at 70 s = 48+8 = 56 (Matches table)

Filled Table :

Time (s)	0	10	20	30	40	50	60	70
Distance (m)	0	8	16	24	32	40	48	56

- A car covers 60 km in the first hour, 70 km in the second hour, and 50 km in the third hour. Is the motion uniform? Justify your answer. Find the average speed of the car.

**Ans :**

No, the motion is not uniform.

**Justification :** For motion to be uniform, the car must cover equal distances in equal intervals of time. Here, the time intervals are equal (1 hour each), but the distances covered are unequal (60 km, 70 km, 50 km). Since it covers unequal distances in equal intervals of time, its speed is changing, and thus the motion is non-uniform.

Find the average speed of the car :

Average speed = Total distance covered / Total time taken

$$\begin{aligned} \text{Total distance covered} &= 60 \text{ km} + 70 \text{ km} + 50 \text{ km} \\ &= 180 \text{ km} \end{aligned}$$

$$\begin{aligned} \text{Total time taken} &= 1 \text{ hour} + 1 \text{ hour} + 1 \text{ hour} \\ &= 3 \text{ hours} \end{aligned}$$

$$\text{Average speed} = 180 \text{ km} / 3 \text{ hours}$$

$$\text{Average speed} = 60 \text{ km/h}$$

The average speed of the car is 60 km/h.

9. Which type of motion is more common in daily life- uniform or non-uniform? Provide three examples from your experience to support your answer.

Ans :

Non-uniform motion is far more common in daily life.

Examples from experience :

1. Walking or running to school/market : My speed changes constantly. I might walk fast when I'm getting late, slow down to cross a road, stop to talk to a friend, and then speed up again. The distance I cover in each minute is rarely the same.
2. A bus or car journey in a city : The vehicle frequently starts, stops (at traffic lights, bus stops, due to traffic), accelerates, and decelerates. Its speed is almost never constant for any significant period.
3. A bird flying : A bird rarely flies in a perfectly straight line at a constant speed. It changes direction, flaps its wings at different rates to gain or lose altitude, glides, and then might accelerate to catch prey or avoid an obstacle. Its speed and direction are constantly varying. Uniform motion is an idealization that is rarely achieved perfectly in everyday situations for extended periods, though objects can approximate it for short durations or under specific controlled conditions (like a car on cruise control on an empty highway).
4. Data for the motion of an object are given in the following table. State whether the speed of the object is uniform or non-uniform. Find the average speed.

Time (s)	0	10	20	30	40	50	60	70	80	90	100
Distance (m)	0	6	10	16	21	29	35	42	45	55	60

Ans :

To determine if the motion is uniform or non-uniform, we need to check if the object covers equal distances in equal intervals of time. The time intervals are equal (10 s each). Let's calculate the distance covered in each 10 s interval :

$$0 - 10 \text{ s} : 6 - 0 = 6 \text{ m}$$

$$10 - 20 \text{ s} : 10 - 6 = 4 \text{ m}$$

$$20 - 30 \text{ s} : 16 - 10 = 6 \text{ m}$$

$$30 - 40 \text{ s} : 21 - 16 = 5 \text{ m}$$

$$40 - 50 \text{ s} : 29 - 21 = 8 \text{ m}$$

$$50 - 60 \text{ s} : 35 - 29 = 6 \text{ m}$$

$$60 - 70 \text{ s} : 42 - 35 = 7 \text{ m}$$

$$70 - 80 \text{ s} : 45 - 42 = 3 \text{ m}$$

$$80 - 90 \text{ s} : 55 - 45 = 10 \text{ m}$$

$$90 - 100 \text{ s} : 60 - 55 = 5 \text{ m}$$

Since the distances covered in equal 10-second intervals are unequal (6m, 4m, 6m, 5m, 8m, etc.), the speed of the object is non-uniform.

Find the average speed :

Average speed

$$= \text{Total distance covered} / \text{Total time taken}$$

Total distance covered

$$= 60 \text{ m (from the table at Time} = 100 \text{ s)}$$

$$\text{Total time taken} = 100 \text{ s}$$

$$\text{Average speed} = 60 \text{ m} / 100 \text{ s}$$

$$\text{Average speed} = 0.6 \text{ m/s}$$

The speed of the object is non-uniform, and its average speed is 0.6 m/s.

10. A vehicle moves along a straight line and covers a distance of 2 km. In the first 500 m, it moves with a speed of 10 m/s and in the next 500 m, it moves with a speed of 5 m/s. With what speed should it move the remaining distance so that the journey is complete in 200 s? What is the average speed of the vehicle for the entire journey?

Ans :

Given            Total distance = 2 km = 2000 m

Total time for the journey = 200 s

Part 1 of the journey :

Distance  $d_1 = 500 \text{ m}$

Speed  $s_1 = 10 \text{ m/s}$

Time  $t_1 = d_1 / s_1 = 500 \text{ m} / 10 \text{ m/s} = 50 \text{ s}$

Part 2 of the journey :



Distance  $d_2 = 500$  m

Speed  $s_2 = 5$  m/s

Time  $t_2 = d_2/s_2 = 500 \text{ m}/5 \text{ m/s} = 100$  s

Part 3 of the journey :

Remaining distance  $d_3$  Total distance =  $d_1 + d_2$

Time taken for the first two parts

$$= t_1 + t_2 = 50 \text{ s} + 100 \text{ s} = 150 \text{ s}$$

Remaining time for the third part  $t_3 =$  Total time  $t_1 + t_2$

Speed required for the remaining distance  $s_3$  :

$$s_3 = \frac{d_3}{t_3}$$

$$s_3 = 1000 \text{ m}/50 \text{ s}$$

$$s_3 = 20 \text{ m/s}$$

The vehicle should move the remaining distance with a speed of 20 m/s.

Average speed of the vehicle for the entire journey:

Average speed = Total distance / Total time

Average speed = 2000 m/200 s

Average speed = 10 m/s

The average speed of the vehicle for the entire journey is 10 m/s.

(D) Sundial

Ans :

(D) Sundial

A sundial operates by tracking the movement of a shadow cast by a fixed object (gnomon) as the Sun moves across the sky during the day.

3. What substance's flow is used to measure time in an hourglass?

(A) Water

(B) Oil

(C) Sand

(D) Mercury

Ans :

(C) Sand

An hourglass measures a specific time interval based on the regulated flow of fine sand from an upper bulb to a lower bulb through a narrow neck.

4. The Ghatika-yantra, mentioned by Aryabhata, was a type of which ancient timekeeping device common in India?

(A) Sundial

(B) Sinking bowl water clock

(C) Pendulum clock

(D) Candle clock

Ans :

(B) Sinking bowl water clock

The Ghatika-yantra is described as a specific type of water clock where a bowl with a small hole gradually fills with water and sinks after a fixed time interval (ghati).

5. What was a potential inaccuracy of early water clocks that used water flowing out of a marked vessel?

(A) The water evaporated too quickly.

(B) The markings on the vessel were often wrong.

(C) The flow rate decreased as the water level dropped.

(D) Sunlight affected the water temperature and flow.

Ans :

(C) The flow rate decreased as the water level dropped.

As the water level in the outflow-type water clock lowers, the pressure decreases, causing the water to flow out more slowly, leading to inaccuracies in time measurement.

## MULTIPLE CHOICE QUESTION

1. What natural events did early humans observe that repeat after definite intervals, leading to the concept of timekeeping?

(A) Earthquakes and volcanic eruptions

(B) Formation of rocks and mountains

(C) Rising/setting of the Sun, phases of the Moon, changing seasons

(D) Growth of trees and movement of animals

Ans :

(C) Rising/setting of the Sun, phases of the Moon, changing seasons

Ancient people observed regular natural cycles—such as the daily movement of the sun, phases of the moon, and changing seasons—which became the foundation for early timekeeping and calendar systems.

2. Which ancient timekeeping device uses the changing position of a shadow cast by sunlight?

(A) Water clock

(B) Hourglass

(C) Candle clock

6. The Samrat Yantra at Jantar Mantar, Jaipur, is the world's largest example of which type of time measuring instrument?

(A) Water clock  
 (B) Pendulum clock  
 (C) Stone sundial  
 (D) Atomic clock

Ans :

(C) Stone sundial

The Samrat Yantra is recognized as the world's largest stone sundial, an ancient astronomical instrument designed centuries ago to measure time accurately using the position of shadows.

7. In the water clock made in Activity 8.1 using a cut plastic bottle, how is time measured?

(A) By the time taken for water to evaporate.  
 (B) By observing the shadow cast by the bottle.  
 (C) By marking the water level in the lower part at regular intervals (e.g., every minute).  
 (D) By weighing the amount of water collected.

Ans :

(C) By marking the water level in the lower part at regular intervals (e.g., every minute).

The activity involves calibrating the clock by marking the water level in the receiving (lower) part at known time intervals as water drips from the top part.

8. Galileo Galilei's observation of a swinging lamp in a church led to the understanding of which principle important for clocks?

(A) The effect of gravity on time.  
 (B) The periodic motion of a pendulum (constant time period for a given length).  
 (C) The relationship between light and time.  
 (D) The use of springs and gears in timekeeping.

Ans :

(B) The periodic motion of a pendulum (constant time period for a given length).

Galileo discovered that a pendulum of a specific length takes a consistent amount of time to complete each swing (oscillation), regardless of the swing's amplitude (within limits).

9. Who is credited with inventing the first pendulum clock, inspired by Galileo's work?

(A) Isaac Newton  
 (B) Kautilya  
 (C) Christiaan Huygens  
 (D) Varahamihira

Ans :

(C) Christiaan Huygens

Christiaan Huygens invented and patented the pendulum clock in the mid-17th century, utilizing the regular C period of a pendulum discovered by Galileo to improve timekeeping accuracy significantly.

10. What is the small metallic ball suspended by a thread in a simple pendulum called?

(A) Pivot  
 (B) Bob  
 (C) Fulcrum  
 (D) Weight

Ans :

(B) Bob

The term 'bob' specifically refers to the mass (often a metallic ball) attached to the end of the string or rod in a pendulum.

11. What type of motion does a simple pendulum exhibit when it swings back and forth?

(A) Linear motion  
 (B) Circular motion  
 (C) Oscillatory motion (Periodic motion)  
 (D) Random motion

Ans :

(C) Oscillatory motion (Periodic motion)

The repetitive back-and-forth movement of a pendulum around its rest position is defined as oscillatory motion. Since it repeats in regular time intervals, it's also periodic.

12. What constitutes one complete oscillation of a simple pendulum starting from its mean position O?

(A) Movement from O to extreme position A only.  
 (B) Movement from A to extreme position B only.  
 (C) Movement from O to A, then to B, and back to O.  
 (D) Movement from A to B and back to A twice.

Ans :

(C) Movement from O to A, then to B, and back to O.

One full oscillation (or cycle) involves the bob moving through its entire range of motion and returning to its starting point and state of motion (e.g.,  $O \rightarrow A \rightarrow B \rightarrow O$ ).

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13. What is the time taken by a pendulum to complete one full oscillation called?

(A) Frequency  
 (B) Amplitude  
 (C) Time period  
 (D) Wavelength

Ans :

(C) Time period

The time period (symbol T) of a pendulum (or any oscillating system) is specifically defined as the duration required to complete one full cycle or oscillation.

14. If a pendulum takes 20 seconds to complete 10 oscillations, what is its time period?

(A) 200 seconds  
 (B) 10 seconds  
 (C) 2 seconds  
 (D) 0.5 seconds

Ans :

(C) 2 seconds

The time period is the time per oscillation.

Time Period = Total Time / Number of Oscillations

$$= 20 \text{ s} / 10 = 2 \text{ s.}$$

15. According to the experiments discussed, the time period of a simple pendulum primarily depends on which factor?

(A) The mass of the bob  
 (B) The material of the thread  
 (C) The length of the pendulum (string)  
 (D) The amplitude (width) of the swing

Ans :

(C) The length of the pendulum (string)

Experiments show that the time period of a simple pendulum is mainly determined by its length; longer pendulums have longer periods. It's largely independent of the bob's mass and amplitude (for small swings).

16. If you have two pendulums of the same length but with bobs of different masses at the same location, how will their time periods compare?

(A) The heavier bob will have a shorter time period.  
 (B) The heavier bob will have a longer time period.  
 (C) Both pendulums will have approximately the same time period.  
 (D) The time period will depend on the color of the bob.

Ans :

(C) Both pendulums will have approximately the same time period.

The time period of a simple pendulum is independent of the mass of the bob (provided air resistance is negligible). Therefore, pendulums of the same length will oscillate with the same period.

17. Modern quartz clocks utilize the vibrations of what component for accurate timekeeping?

(A) A pendulum  
 (B) A balance wheel and spring  
 (C) A tiny quartz crystal  
 (D) Flowing water

Ans :

(C) A tiny quartz crystal

Quartz clocks rely on the property of quartz crystals to vibrate at a very precise and stable frequency when an electric voltage is applied, using these vibrations to measure time.

18. What is the SI (International System) unit of time?

(A) Minute (min)  
 (B) Hour (h)  
 (C) Second (s)  
 (D) Day (d)

Ans :

(C) Second (s)

The internationally agreed-upon base unit for measuring time in the SI system is the second, symbolized by 's'.

19. How many seconds are there in one minute?

(A) 30 s  
 (B) 60 s  
 (C) 100 s  
 (D) 3600 s

Ans :

(B) 60 s

By definition, one minute is equal to exactly 60 seconds. 1 min = 60 s.

20. How many minutes are there in one hour?

(A) 30 min  
 (B) 60 min  
 (C) 100 min  
 (D) 24 min

Ans :

(B) 60 min

By definition, one hour is equal to exactly 60 minutes.  $1 \text{ h} = 60 \text{ min}$ .

21. According to the writing conventions mentioned, which is the correct way to write 5 hours?  
 (A) 5 Hrs.  
 (B) 5 hr  
 (C) 5 hrs  
 (D) 5 h

Ans :

(D) 5 h

The unit symbol for hour is 'h' (lowercase, singular, no period unless at sentence end). A space should be left between the number and the unit.

22. What is the smallest time interval typically measurable by a standard analogue wall clock with a second hand?  
 (A) 1 minute  
 (B) 1 second  
 (C) 1 millisecond  
 (D) 1 hour

Ans :

(B) 1 second

The second hand on a typical wall clock allows measurement of time intervals down to one second, indicated by the markings around the clock face.

23. What does the term 'millisecond' represent?  
 (A) One millionth of a second  $1/1,000,000 \text{ s}$   
 (B) One thousandth of a second  $1/1,000 \text{ s}$   
 (C) One hundredth of a second  $1/100 \text{ s}$   
 (D) One thousand seconds  $1000 \text{ s}$

Ans :

(B) One thousandth of a second  $1/1000 \text{ s}$

The prefix 'milli-' means one-thousandth. Therefore, a millisecond (ms) is equal to 0.001 seconds.

24. In sports like sprinting, time is often measured to the hundredth or thousandth of a second. Why is such precision necessary?  
 (A) To make the races seem more exciting.  
 (B) To accurately determine winners when finishes are very close.  
 (C) To comply with international time standards.  
 (D) To test the limits of the timing equipment.

Ans :

(B) To accurately determine winners when finishes are very close.

In short races, competitors often finish extremely close together. High-precision timing (milliseconds) is needed to reliably distinguish finishing order and declare the correct winner.

25. If two runners cover the same distance (e.g., 100m), how can we determine who ran faster?  
 (A) By measuring who is taller.  
 (B) By comparing the time taken; the one taking less time is faster.  
 (C) By measuring their stride length.  
 (D) By checking who finished less tired.

Ans :

(B) By comparing the time taken; the one taking less time is faster.

For a fixed distance, speed is inversely related to time. The runner who completes the distance in the shortest time interval has the highest speed and is therefore faster.

26. What is the 'speed' of an object defined as?  
 (A) The total distance covered by the object.  
 (B) The total time taken to cover a distance.  
 (C) The distance covered by the object in a unit time.  
 (D) How quickly the object accelerates.

Ans :

(C) The distance covered by the object in a unit time.

Speed quantifies how fast an object is moving and is defined as the rate at which it covers distance, specifically the distance traveled per unit of time.

27. What is the formula used to calculate the speed of an object?  
 (A) Speed = Total distance covered  $\times$  Total time taken  
 (B) Speed = Total time taken / Total distance covered  
 (C) Speed = Total distance covered / Total time taken  
 (D) Speed = (Total distance covered + Total time taken) / 2

Ans :

(C) Speed = Total distance covered / Total time taken

The fundamental formula for calculating speed is obtained by dividing the total distance traveled by the total time elapsed during the travel.



28. What is the SI unit of speed?

- (A) kilometre/hour (km/h)
- (B) metre/minute (m/min)
- (C) kilometre/second (km/s)
- (D) metre/second (m/s)

Ans :

(D) metre/second (m/s)

Since the SI unit for distance (length) is the metre (m) and the SI unit for time is the second (s), the derived SI unit for speed (distance/time) is metre per second (m/s).

29. A bicycle travels 3.6 km in 15 minutes. Calculate its speed in m/s.

- (A) 240 m/s
- (B) 14.4 m/s
- (C) 4 m/s
- (D) 0.24 m/s

Ans :

(C) 4 m/s

First convert distance to meters (3.6 km = 3600 m) and time to seconds (15 min = 15 × 60 s = 900 s). Speed = Distance / Time = 3600 m / 900 s = 4 m/s.

30. To compare the speeds of different trains between two stations using a timetable (Activity 8.4), what information do you need?

- (A) Only the departure times.
- (B) Only the distance between stations.
- (C) The distance between stations and the time taken to travel that distance.
- (D) The type of engine used by each train.

Ans :

(C) The distance between stations and the time taken to travel that distance.

To calculate speed (Distance/Time), you need both the distance covered (distance between the stations) and the time taken (difference between arrival and departure times).

31. How can you calculate the total distance covered by an object if you know its speed and the total time taken?

- (A) Distance = Speed / Time
- (B) Distance = Time / Speed
- (C) Distance = Speed × Time
- (D) Distance = Speed + Time

Ans :

(C) Distance = Speed × Time

By rearranging the speed formula (Speed = Distance / Time), we find that Distance = Speed multiplied by Time.

32. A car travels at a constant speed of 50 km/h for 2 hours. What is the total distance covered?

- (A) 25 km
- (B) 52 km
- (C) 100 km
- (D) 150 km

Ans :

(C) 100 km

Distance = Speed × Time

$$= 50 \text{ km/h} \times 2 \text{ h} = 100 \text{ km.}$$

33. How can you calculate the total time taken for a journey if you know the total distance covered and the speed?

- (A) Time = Speed × Distance
- (B) Time = Speed / Distance
- (C) Time = Distance / Speed
- (D) Time = Distance - Speed

Ans :

(C) Time = Distance / Speed

Rearranging the speed formula (Speed = Distance / Time) gives Time = Distance divided by Speed.

34. A train needs to cover a distance of 360 km. If its average speed is 90 km/h, how much time will the journey take?

- (A) 4 hours
- (B) 0.25 hours
- (C) 450 hours
- (D) 270 hours

Ans :

(A) 4 hours

Time = Distance / Speed = 360 km / 90 km/h = 4 h.

35. When we calculate speed using the formula Speed = Total Distance / Total Time, what kind of speed are we usually calculating, especially for real-world journeys?

- (A) Instantaneous speed
- (B) Maximum speed
- (C) Minimum speed
- (D) Average speed

Ans :

(D) Average speed

Objects rarely travel at a perfectly constant speed. The formula gives the average speed over the entire journey, accounting for periods of moving faster or slower.

36. What is the instrument in a vehicle that measures and displays the vehicle's instantaneous speed, usually in km/h?  
 (A) Odometer  
 (B) Tachometer  
 (C) Speedometer  
 (D) Chronometer

Ans :

(C) Speedometer

A speedometer is specifically designed to indicate the speed at which a vehicle is currently moving.

37. What is the instrument in a vehicle that measures the total distance travelled?  
 (A) Speedometer  
 (B) Odometer  
 (C) Trip meter  
 (D) Pedometer

Ans :

(B) Odometer

An odometer records and displays the cumulative distance covered by the vehicle since its manufacture or last reset.

38. What is linear motion?  
 (A) Motion in a circle  
 (B) Motion along a straight line  
 (C) Motion that repeats periodically  
 (D) Motion that changes speed constantly

Ans :

(B) Motion along a straight line

Linear motion (or rectilinear motion) is defined as movement occurring along a straight path or line.

39. What is uniform linear motion?  
 (A) Motion along a curved path with constant speed.  
 (B) Motion along a straight line with changing speed.  
 (C) Motion along a straight line with constant speed.  
 (D) Motion that stops and starts frequently.

Ans :

(C) Motion along a straight line with constant speed.

Uniform linear motion combines two conditions : the path must be straight (linear) and the speed must remain constant (uniform) throughout the motion.

40. An object in uniform linear motion covers \_\_\_\_\_ distances in \_\_\_\_\_ intervals of time.  
 (A) unequal, equal  
 (B) equal, unequal  
 (C) equal, equal  
 (D) unequal, unequal

Ans :

(C) equal, equal

The defining characteristic of uniform motion (constant speed) is that the object travels exactly the same distance during any equal intervals of time, no matter how short or long the intervals are.

41. What is non-uniform linear motion?  
 (A) Motion along a straight line with constant speed.  
 (B) Motion along a straight line where the speed keeps changing.  
 (C) Motion in a circle with constant speed.  
 (D) Motion that is always slowing down.

Ans :

(B) Motion along a straight line where the speed keeps changing.

Non-uniform linear motion occurs when an object moves along a straight path, but its speed varies (increases, decreases, or changes irregularly) during the motion.

42. An object in non-uniform linear motion covers \_\_\_\_\_ distances in equal intervals of time.  
 (A) equal  
 (B) zero  
 (C) unequal  
 (D) constant

Ans :

(C) unequal

Because the speed is changing in non-uniform motion, the distance covered during successive equal time intervals will generally be different (more distance if speeding up, less if slowing down).

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43. Consider Train X and Train Y in Table. Train X travels 20 km every 10 minutes. Train Y travels varying distances (20, 15, 15, 25, 20, 25 km) in consecutive 10-minute intervals. Which train exhibits uniform linear motion?

**Distances travelled by two trains in equal time intervals of 10 minutes**

Time (AM)	Train X		Train Y	
	Position (km)	Distance (km)	Position (km)	Distance (km)
10:00	0	0	0	0
10:10	20	20	20	20
10:20	40	20	35	15
10:30	60	20	50	15
10:40	80	20	75	25
10:50	100	20	95	20
11:00	120	20	120	25

- (A) Train Y  
 (B) Train X  
 (C) Both Train X and Train Y  
 (D) Neither Train X nor Train Y

**Ans :**

(B) Train X

Train X covers equal distances (20 km) in equal time intervals (10 min), indicating constant speed and thus uniform linear motion. Train Y covers unequal distances, showing non-uniform motion.

44. Why is uniform linear motion described as an 'idealisation' and seldom found in everyday life over long durations?
- (A) Because measuring constant speed is impossible.  
 (B) Because forces like friction and air resistance, or varying conditions, often cause speeds to change.  
 (C) Because objects naturally prefer to move in curves.  
 (D) Because constant speed requires zero acceleration, which is rare.

**Ans :**

(B) Because forces like friction and air resistance, or varying conditions, often cause speeds to change.

In the real world, factors like friction, air resistance, changes in terrain, traffic, or engine power variations make it very difficult for objects

to maintain a perfectly constant speed for extended periods.

45. A car moving on a straight highway with no traffic and cruise control set is an example closer to which type of motion?
- (A) Non-uniform linear motion  
 (B) Uniform linear motion  
 (C) Circular motion  
 (D) Oscillatory motion

**Ans :**

(B) Uniform linear motion

Under ideal conditions like an empty straight highway with cruise control maintaining speed, the car's motion approximates uniform linear motion (constant speed, straight path).

46. A car moving in busy city traffic, frequently stopping, starting, speeding up, and slowing down, exemplifies which type of motion?
- (A) Uniform linear motion  
 (B) Non-uniform linear motion  
 (C) Uniform circular motion  
 (D) Periodic motion

**Ans :**

(B) Non-uniform linear motion

City traffic forces constant changes in speed (accelerating, decelerating, stopping), making the car's motion highly non-uniform, even if the overall path is roughly linear.

47. A car travels 150 metres in 10 seconds. What is its speed in m/s?
- (A) 1.5 m/s  
 (B) 15 m/s  
 (C) 150 m/s  
 (D) 1500 m/s

**Ans :**

(B) 15 m/s

Speed = Distance / Time = 150 m / 10 s = 15 m/s.

48. Convert the speed of 15 m/s to km/h.
- (A) 4.17 km/h  
 (B) 15 km/h  
 (C) 54 km/h  
 (D) 90 km/h

**Ans :**

(C) 54 km/h

To convert m/s to km/h, multiply by (3600/1000) or 3.6. So, 15 m/s  $\times$  3.6 = 54 km/h.

49. Runner A completes 400 m in 50 s. Runner B completes 400 m in 45 s. Who has the greater speed?  
 (A) Runner A  
 (B) Runner B  
 (C) Both have the same speed.  
 (D) Cannot be determined.

Ans :

(B) Runner B  
 Both cover the same distance. Runner B takes less time ( $45\text{ s} < 50\text{ s}$ ), therefore Runner B has a greater speed.

50. A train travels at a speed of 25 m/s. It covers a distance of 360 km. How much time does it take in hours?  
 (A) 4 hours  
 (B) 14.4 hours  
 (C) 0.069 hours  
 (D) 9000 hours

Ans :

(A) 4 hours  
 First, convert speed to km/h :  $25\text{ m/s} \times 3.6 = 90\text{ km/h}$ . Then,  $\text{Time} = \text{Distance} / \text{Speed} = 360\text{ km} / 90\text{ km/h} = 4\text{ h}$ .

51. A train travels 180 km in 3 h. What is its speed in km/h?  
 (A) 3 km/h  
 (B) 60 km/h  
 (C) 180 km/h  
 (D) 540 km/h

Ans :

(B) 60 km/h  
 $\text{Speed} = \text{Distance} / \text{Time} = 180\text{ km} / 3\text{ h} = 60\text{ km/h}$ .

52. A horse gallops at 18 m/s. A train moves at 72 km/h. Compare their speeds.  
 (A) Horse is faster.  
 (B) Train is faster.  
 (C) Both have the same speed.  
 (D) Comparison is not possible.

Ans :

(B) Train is faster.  
 Convert train speed to m/s :  $72\text{ km/h} / 3.6 = 20\text{ m/s}$ . Since  $20\text{ m/s}$  (train)  $> 18\text{ m/s}$  (horse), the train is faster.

53. If data shows an object travels 8 m in the first 10 s, then another 8 m in the next 10 s (total 16 m in 20 s), and so on, what type of motion is indicated? (implied)  
 (A) Non-uniform motion  
 (B) Uniform motion  
 (C) Circular motion  
 (D) At rest

Ans :

(B) Uniform motion  
 Covering equal distances (8 m) in equal time intervals (10 s) is the definition of uniform motion (constant speed).

54. A car covers 60 km, 70 km, and 50 km in three successive one-hour intervals. Is its motion uniform? What is its average speed?  
 (A) Uniform; Average speed = 60 km/h  
 (B) Non-uniform; Average speed = 60 km/h  
 (C) Uniform; Average speed = 70 km/h  
 (D) Non-uniform; Average speed = 50 km/h

Ans :

(B) Non-uniform; Average speed = 60 km/h  
 The car covers unequal distances in equal time intervals (1 hour), so the motion is non-uniform.  
 $\text{Average speed} = \text{Total Distance} / \text{Total Time}$   
 $= (60+70+50)\text{ km} / 3\text{ h}$   
 $= 180\text{ km} / 3\text{ h} = 60\text{ km/h}$ .

55. Which type of motion (uniform or non-uniform) is more common in daily life?  
 (A) Uniform motion  
 (B) Non-uniform motion  
 (C) Both are equally common  
 (D) Neither occurs in daily life

Ans :

(B) Non-uniform motion  
 Most everyday movements involve starting, stopping, speeding up, slowing down, or changing direction, making non-uniform motion far more prevalent than perfectly uniform motion.

56. Consider a simple pendulum.  
 (1) Its time period depends significantly on the bob's mass.  
 (2) Its time period depends on its length.  
 (3) Its motion is an example of periodic oscillatory motion.  
 Which statements are correct?  
 (A) 1 and 2 only      (B) 2 and 3 only  
 (C) 1 and 3 only      (D) 1, 2, and 3



Ans :

(B) 2 and 3 only

The time period depends on length (Statement 2) but not significantly on mass (Statement 1 is incorrect). The motion is periodic and oscillatory (Statement 3).

57. What ancient Indian time unit was measured by the sinking of a Ghatika-yantra bowl, equal to  $1/60$ th of a 24-hour day?
- (A) Pala  
(B) Vighati  
(C) Muhurta  
(D) Ghati (or Ghatika)

Ans :

(D) Ghati (or Ghatika)

The text explicitly states the time unit measured by the Ghatika-yantra was the ghati (or ghatika), and that a day was divided into 60 ghatis.

58. Designing an activity to measure pulse rate involves counting beats over a period of time. What instrument is essential for measuring that time accurately?
- (A) Ruler  
(B) Thermometer  
(C) Watch or stopwatch  
(D) Weighing scale

Ans :

(C) Watch or stopwatch

To calculate a rate (beats per minute), one needs to count the number of beats and accurately measure the time interval (e.g., 15 s, 30 s, or 60 s) during which they occur, requiring a timing device.

59. Why might slight differences occur in repeated measurements of a pendulum's time period in Activity 8.2?
- (A) The length of the string changes slightly.  
(B) Human reaction time errors in starting/stopping the watch; slight variations in releasing the bob.  
(C) The mass of the bob decreases due to air friction.  
(D) The gravitational pull changes during the experiment.

Ans :

(B) Human reaction time errors in starting/stopping the watch; slight variations in releasing the bob.

Small inconsistencies in starting/stopping the timer relative to the pendulum's swing and ensuring the bob is released consistently without pushing are common sources of experimental error.

60. Is a playground swing executing simple harmonic motion similar to a pendulum? Does its time period depend on the weight of the child swinging?
- (A) Yes, it's like a pendulum; period depends heavily on weight.  
(B) No, it's not like a pendulum; period depends on length.  
(C) Yes, it's like a pendulum; period depends mainly on length, not significantly on weight.  
(D) No, it's circular motion; period depends on pushing force.

Ans :

(C) Yes, it's like a pendulum; period depends mainly on length, not significantly on weight.

A swing behaves much like a pendulum. Its time period (time for one back-and-forth swing) is primarily determined by its length (from support to seat) and is largely independent of the rider's weight, just like a simple pendulum's period is independent of the bob's mass.

## MATCHING TYPE QUESTION

61. Match the ancient time-measuring device in Column A with its working principle in Column B :

	Column A		Column B
1.	Sundial	A.	Controlled flow of sand
2.	Water Clock	B.	Burning of a calibrated candle
3.	Hourglass	C.	Changing position of a shadow cast by the Sun
4.	Candle Clock	D.	Regulated flow of water into or out of a vessel

- (a) 1-C, 2-D, 3-A, 4-B  
(b) 1-D, 2-C, 3-B, 4-A  
(c) 1-C, 2-A, 3-D, 4-B  
(d) 1-B, 2-D, 3-A, 4-C

Ans :

(a) 1-C, 2-D, 3-A, 4-B

Sundials use shadows. Water clocks use water flow. Hourglasses use sand flow. Candle clocks use the rate of burning of a marked candle to indicate time passage.

62. Match the term related to a simple pendulum in Column A with its correct definition in Column B :

	Column A		Column B
1.	Bob	A.	Time taken to complete one full swing (to and fro)
2.	Oscillation	B.	The metallic ball suspended at the end of the thread
3.	Time Period	C.	Depends on the length of the pendulum, not mass of the bob
4.	Key property of Time Period	D.	One complete to-and-fro movement of the pendulum

(a) 1-A, 2-D, 3-C, 4-B

(b) 1-B, 2-A, 3-D, 4-C

(c) 1-D, 2-B, 3-A, 4-C

(d) 1-B, 2-D, 3-A, 4-C

Ans :

(d) 1-B, 2-D, 3-A, 4-C

The bob is the pendulum's mass. An oscillation is one complete swing. Time period is the duration of one oscillation and it primarily depends on the pendulum's length.

63. Match the quantity related to motion in Column A with its SI unit or formula in Column B :

	Column A		Column B
1.	Time	A.	m/s
2.	Distance	B.	ss (second)
3.	Speed	C.	m (metre)
4.	Formula for Time Taken	D.	$\frac{\text{Total distance}}{\text{Speed}}$

(a) 1-C, 2-B, 3-A, 4-D

(b) 1-B, 2-C, 3-D, 4-A

(c) 1-B, 2-C, 3-A, 4-D

(d) 1-A, 2-C, 3-B, 4-D

Ans :

(c) 1-B, 2-C, 3-A, 4-D

The SI unit of time is the second. The SI unit for distance (length) is the metre. The SI unit for speed is metre/second. Time taken is distance divided by speed.

64. Match the type of motion in Column A with its defining characteristic in Column B :

	Column A		Column B
1.	Uniform Linear Motion	A.	Instrument that measures the distance travelled by a vehicle
2.	Non-uniform Linear Motion	B.	Motion along a straight line with constant speed
3.	Speedometer	C.	Motion along a straight line where speed keeps changing
4.	Odometer	D.	Instrument that displays the vehicle's speed

(a) 1-D, 2-A, 3-C, 4-B

(b) 1-B, 2-C, 3-D, 4-A

(c) 1-B, 2-A, 3-D, 4-C

(d) 1-C, 2-B, 3-A, 4-D

Ans :

(b) 1-B, 2-C, 3-D, 4-A

Uniform linear motion involves constant speed in a straight line. Non-uniform linear motion has changing speed in a straight line. A speedometer shows speed. An odometer shows distance travelled.

65. Match the time-keeping technology or concept in Column A with its associated feature in Column B :

	Column A		Column B
1.	Quartz Clock	A.	Ancient Indian sinking bowl water clock
2.	Atomic Clock	B.	Uses vibrations of a crystal for timekeeping
3.	Ghatika-yantra	C.	Extremely precise, loses one second in millions of years
4.	Pendulum Clock	D.	Time period depends on its length (Huygens' invention)



- (a) 1-C, 2-B, 3-D, 4-A  
 (b) 1-B, 2-A, 3-C, 4-D  
 (c) 1-D, 2-C, 3-A, 4-B  
 (d) 1-B, 2-C, 3-A, 4-D

Ans :

- (d) 1-B, 2-C, 3-A, 4-D

Quartz clocks use crystal vibrations. Atomic clocks are highly precise. Ghatika-yantra was an ancient Indian water clock. Pendulum clock's time period is determined by its length.

## VERY SHORT QUESTION

66. Name one natural event that ancient humans used for timekeeping.

Ans :

Rising/setting of the Sun (or phases of the Moon, changing seasons)

67. What ancient device measures time using the changing position of a shadow?

Ans :

Sundial

68. Name one type of ancient clock that used the flow of a substance other than water.

Ans :

Hourglass (sand) (or Candle clock)

69. What is the small metallic ball in a simple pendulum called?

Ans :

Bob

70. What is the resting position of a pendulum called?

Ans :

Mean position

71. What type of motion does a simple pendulum exhibit?

Ans :

Oscillatory motion (or Periodic motion)

72. What is the time taken by a pendulum to complete one oscillation called?

Ans :

Time period

73. Does the time period of a simple pendulum depend on the mass of its bob?

Ans :

No

74. What physical property of a simple pendulum primarily determines its time period?

Ans :

Its length

75. What is the SI unit of time?

Ans :

Second (s)

76. How many seconds are there in one minute?

Ans :

60 s

77. How many minutes are there in one hour?

Ans :

60 min

78. What is the distance covered by an object in a unit time called?

Ans :

Speed

79. What is the formula to calculate speed?

Ans :

Speed = Total distance covered / Total time taken

80. What is the SI unit of speed?

Ans :

Metre per second (m/s)

81. What instrument in a vehicle measures and displays its speed?

Ans :

Speedometer

82. What instrument in a vehicle measures the distance travelled?

Ans :

Odometer

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83. What is the motion of an object moving along a straight line called?

Ans :

Linear motion

84. What term describes linear motion where the speed remains constant?

Ans :

Uniform linear motion

85. What term describes linear motion where the speed keeps changing?

Ans :

Non-uniform linear motion

## SHORT ANSWER QUESTION

86. Briefly explain how a sundial works.

Ans :

A sundial uses the shadow cast by a specific part (gnomon) onto a marked dial. As the sun moves across the sky, the shadow's position changes, indicating the time.

87. Describe one type of ancient water clock mentioned in the text.

Ans :

One type had water flowing out of a marked vessel; the water level indicated time. Another used a bowl with a hole that slowly filled and sank in a fixed time.

88. What constitutes one complete oscillation of a simple pendulum starting from its mean position?

Ans :

One oscillation is completed when the bob moves from the mean position (O) to one extreme (A), then to the other extreme (B), and finally back to the mean position (O).

89. Why is the motion of a pendulum considered periodic?

Ans :

The pendulum's motion is periodic because it repeats its path (swinging back and forth) after a fixed interval of time (its time period).

90. How is the time period of a pendulum calculated from the time taken for multiple oscillations?

Ans :

Measure the total time taken for a specific number of oscillations (e.g., 10 or 20) and divide this total time by the number of oscillations performed.

91. State the relationship between the length of a simple pendulum and its time period.

Ans :

The time period of a simple pendulum depends on its length. Longer pendulums generally have longer time periods.

92. What basic principle underlies the working of all clocks, ancient or modern?

Ans :

All clocks rely on some process that repeats continuously at regular, predictable intervals, allowing these intervals to be counted or marked to measure the passage of time.

93. Write the symbols for second, minute, and hour according to SI conventions.

Ans :

The symbol for second is 's', for minute is 'min', and for hour is 'h'. They are written in lowercase without a full stop (unless at end of sentence).

94. How can you determine which of two runners is faster in a race of the same distance?

Ans :

The runner who takes less time to cover the same distance is faster. Their speed is higher.

95. If a car travels 120 km in 2 hours, what is its speed in km/h?

Ans :

Speed = Distance / Time = 120 km / 2 h = 60 km/h.

96. Write the formula that relates distance, speed, and time.

Ans :

Total distance covered = Speed × Total time taken (or Speed = Distance/Time, or Time = Distance/Speed).

97. A cyclist travels at a speed of 5 m/s for 20 seconds. What distance does the cyclist cover?



Ans :

$$\begin{aligned} \text{Distance} &= \text{Speed} \times \text{Time} \\ &= 5 \text{ m/s} \times 20 \text{ s} = 100 \text{ m.} \end{aligned}$$

98. What is meant by 'average speed'? Why is it often used instead of just 'speed'?

Ans :

Average speed is the total distance covered divided by the total time taken. It's used because objects rarely move at a perfectly constant speed; their speed often varies (non-uniform motion).

99. Explain the difference between uniform and non-uniform linear motion.

Ans :

Uniform linear motion is movement along a straight line at a constant, unchanging speed. Non-uniform linear motion is movement along a straight line where the speed changes over time.

100. Give an example of uniform linear motion and non-uniform linear motion from daily life.

Ans :

Uniform (approximate) : A car on a straight, empty highway at a steady speed.  
Non-uniform : A car moving in city traffic, constantly speeding up and slowing down.

101. How can you tell if an object is in uniform linear motion by observing the distances it covers in equal time intervals?

Ans :

If an object covers equal distances in equal intervals of time while moving in a straight line, its motion is uniform linear motion.

102. What information does a speedometer provide? What are its typical units?

Ans :

A speedometer measures and displays the instantaneous speed of a vehicle. Its typical units are kilometres per hour (km/h).

103. What information does an odometer provide? What are its typical units?

Ans :

An odometer measures and displays the total distance travelled by a vehicle. Its typical units are kilometres (km).

104. Why was the invention of the pendulum clock a major breakthrough in timekeeping?

Ans :

The pendulum clock was much more accurate than previous mechanical clocks because the time period of a pendulum of a given length is nearly constant, providing a reliable basis for time measurement.

105. How is time measured very accurately in modern clocks like atomic clocks?

Ans :

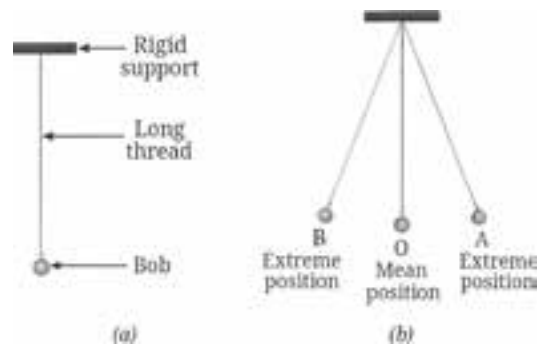
Modern clocks use tiny, extremely rapid, and highly stable periodic vibrations, such as those from quartz crystals or specific atoms, allowing for incredibly precise time measurement.

## LONG ANSWER QUESTION

106. Describe how you would set up a simple pendulum and experimentally determine its time period. What precautions should be taken?

Ans :

Setup : Suspend a heavy bob (metal ball/stone) from a rigid support using a long thread (e.g., 100 cm). Ensure the bob hangs freely.



Procedure : Gently displace the bob slightly to one side and release it to start oscillations. Using a stopwatch, measure the time taken for a specific number of complete oscillations (e.g., 10 or 20). Repeat this measurement 3-4 times. Calculate the average time for the chosen number of oscillations. Finally, divide this average time by the number of oscillations to find the time period (Time period = Total time / Number of oscillations). Precautions : Ensure the support is rigid, the string is taut,

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avoid pushing the bob (release gently), measure time for multiple oscillations (e.g., 10 or 20) for better accuracy, avoid large swings.

107. Differentiate clearly between uniform linear motion and non-uniform linear motion. Analyse the data in Table for Train X and Train Y to determine which train exhibits which type of motion between 10:00 AM and 11:00 AM. Justify your answer.

Time (AM)	Train X		Train Y	
	Position (km)	Distance (km)	Position (km)	Distance (km)
10:00	0	0	0	0
10:10	20	20	20	20
10:20	40	20	35	15
10:30	60	20	50	15
10:40	80	20	75	25
10:50	100	20	95	20
11:00	120	20	120	25

Ans :

Uniform linear motion occurs when an object moves along a straight line at a constant, unchanging speed, covering equal distances in equal time intervals. Non-uniform linear motion occurs when an object moves along a straight line, but its speed changes over time, covering unequal distances in equal time intervals.

Analysis of Table :

Train X : In each 10-minute interval (10:00 - 10:10, 10:10 - 10:20, etc.), Train X covers exactly 20 km. Since it covers equal distances in equal time intervals, Train X is in uniform linear motion.

Train Y : In the 10-minute intervals, Train Y covers varying distances (20 km, 15 km, 15 km, 25 km, 20 km, 25 km). Since it covers unequal distances in equal time intervals, Train Y is in non-uniform linear motion.

108. Imagine you are travelling in a car equipped with a speedometer and an odometer. Describe what each instrument tells you at different points during a journey involving city traffic and highway driving. How would you calculate the average speed for the entire trip?

Ans :

The speedometer shows the car's instantaneous speed. In city traffic, its reading would frequently

change (e.g., 0 km/h at stops, 20 km/h, 40 km/h, then down again), indicating non-uniform motion. On the highway, the driver might maintain a steadier speed (e.g., 80 km/h), where the speedometer reading stays relatively constant, indicating more uniform motion for stretches. The odometer continuously adds up the total distance travelled since it was last reset. To calculate average speed for the entire trip, note the total distance shown on the odometer at the end of the trip and divide it by the total time taken for the journey (measured separately).

109. Discuss the evolution of timekeeping devices from ancient methods (like sundials or water clocks) to modern atomic clocks. What was the driving need for more accurate time measurement, and what scientific principles enabled these advancements?

Ans :

Ancient devices like sundials (using shadows) and water clocks (using water flow) relied on natural cycles or simple physical processes but had limited accuracy (affected by weather, non-constant flow rates). The driving need for accuracy increased with advancements in science, navigation (determining longitude), and eventually technology. A major breakthrough was the pendulum clock (Huygens, inspired by Galileo), using the principle that a pendulum's period is nearly constant for a given length. Later, quartz clocks utilized the precise, high-frequency vibrations of quartz crystals under electric current. Atomic clocks achieve supreme accuracy by using the incredibly stable frequencies associated with electron transitions in specific atoms as their 'ticks'.

110. Prerna runs a 100 m sprint in 12.5 seconds. Calculate her average speed in m/s and km/h. If she maintained this average speed, how long would it take her to run 1 km (1000 m)?

Ans :

Given,

$$\text{Distance} = 100 \text{ m,}$$

$$\text{Time} = 12.5 \text{ s.}$$

$$\text{Average speed (m/s)} = \text{Distance} / \text{Time}$$

$$= 100 \text{ m} / 12.5 \text{ s} = 8 \text{ m/s.}$$

To convert m/s to km/h, multiply by (3600/1000) or 3.6 :

$$\text{Average speed (km/h)} = 8 \text{ m/s} \times 3.6$$

$$= 28.8 \text{ km/h.}$$



Time to run 1 km (1000 m) :

$$\begin{aligned}\text{Time} &= \text{Distance} / \text{Speed} \\ &= 1000 \text{ m} / 8 \text{ m/s} = 125 \text{ s}.\end{aligned}$$

Converting to minutes :  $125 \text{ s} = 2 \text{ minutes and } 5 \text{ seconds}$ .

111. Explain why simply knowing the total distance and total time is sufficient to calculate average speed, even if the object moved at varying speeds during the journey. Use an example.

**Ans :**

Average speed considers the overall outcome of the motion – the total displacement achieved over the total duration. It smooths out any variations in instantaneous speed. For example, if a car travels 100 km in 2 hours, its average speed is 50 km/h. It doesn't matter if it travelled at 60 km/h for the first hour and 40 km/h for the second, or stopped for coffee and then sped up. The average speed only depends on the starting point, ending point (total distance), and the total time elapsed, providing a single measure for the overall rate of travel.

112. Consider the data in Is the motion uniform or non-uniform? Calculate the average speed of the object for the entire 100 seconds.

**Ans :**

The distances covered in equal 10-second intervals are : 6m, 4m, 6m, 5m, 8m, 6m, 7m, 3m, 10m, 5m. Since the object covers unequal distances in equal time intervals, the motion is non-uniform.

To find the average speed :

Total distance covered = 60 m (from the table at time = 100 s).

Total time taken = 100 s.

Average speed = Total distance / Total time =  $60 \text{ m} / 100 \text{ s} = 0.6 \text{ m/s}$ .

113. Galileo observed that the time period of a pendulum seemed independent of the amplitude (how far it swings, provided it's small) and the bob's mass, but dependent on its length. Why was this discovery crucial for developing accurate clocks?

**Ans :**

Galileo's discovery was crucial because it identified a reliable, predictable periodic motion. If the time period depended heavily on the swing amplitude (which naturally decreases due to air resistance) or the bob's mass (which might vary slightly), it

would be hard to maintain a consistent 'tick'. By finding that the period mainly depends on length (which can be fixed), it provided a stable physical phenomenon that could be harnessed to regulate the mechanism of a clock, leading to significantly improved accuracy over previous timekeeping methods which were often less consistent.

114. Discuss the importance of standardized units like the second (s) for time and metre per second (m/s) for speed in science and everyday life.

**Ans :**

Standardized units (like SI units) are essential for clear communication and consistency in science, engineering, trade, and daily life. Using 'second' as the standard unit of time ensures that measurements are universally understood and comparable, regardless of location or context. Similarly, using 'metre per second' for speed provides an unambiguous measure of motion that facilitates scientific calculations, engineering designs (e.g., vehicle safety), and comparisons (e.g., speed limits, performance data). Without standards, confusion, errors, and incompatibility would arise, hindering progress and potentially causing safety issues.

## CASE BASED QUESTION

115. An ancient water clock uses a bowl with a tiny hole that sinks completely in exactly 24 minutes (one 'ghati'). Monks use this to time their meditation sessions. One day, a monk notices the bowl seems to be sinking slightly faster than usual. (Approx. 50 words)
1. What physical principle does this type of water clock rely on?
  2. Suggest one possible reason why the bowl might be sinking faster.
  3. Is this water clock likely to be as accurate as a modern quartz watch? Why or why not?

**Ans :**

- (1) It relies on a relatively constant rate of water flowing into the bowl through the hole, causing it to gradually fill and sink.
- (2) Possible reasons : The hole might have accidentally become slightly larger, allowing water to enter faster; or perhaps the water

level outside the bowl is higher than usual, increasing pressure and flow rate.

- (3) No, it's much less accurate. The flow rate can be affected by factors like water temperature (viscosity), impurities slightly clogging the hole, or variations in the external water level, unlike the highly stable electronic oscillations in a quartz watch.

**116.** A family drives from City A to City B. The car's odometer reads 15,250 km at the start and 15,500 km at the end. The journey takes exactly 4 hours, including a 30-minute stop for lunch.

1. What was the total distance covered by the car?
2. What was the total time taken for the journey?
3. Calculate the average speed of the car for the entire journey in km/h.
4. Does this average speed reflect the car's speed while it was actually moving? Explain briefly.

**Ans :**

- (1) Total distance = 15,500 km - 15,250 km = 250 km.
- (2) Total time taken = 4 hours.
- (3) Average speed = Total distance / Total time = 250 km / 4 h = 62.5 km/h.
- (4) No, the average speed includes the 30-minute stop. The car's actual speed while moving would have been higher than 62.5 km/h to cover 250 km in the 3.5 hours of driving time.

**117.** A student builds two simple pendulums. Pendulum 1 has a 50 cm string and a heavy metal bob. Pendulum 2 has a 100 cm string and an identical heavy metal bob. They measure the time for 10 oscillations for both.

1. Which pendulum would the student expect to complete 10 oscillations in a shorter time?
2. What is the property called that describes the time for one complete oscillation?
3. If the student replaced the metal bob on Pendulum 2 with a lighter wooden bob of the same size, would they expect the time for 10 oscillations to change significantly? Why?

**Ans :**

- (1) Pendulum 1 (with the shorter 50 cm string).
- (2) Time period.
- (3) No, the time period of a simple pendulum depends primarily on its length, not significantly on the mass of the bob (for reasonably heavy bobs).

**118.** An athlete runs on a straight track. Their coach records the time taken to pass markers placed every 50 metres. The times are : 50m in 6s, 100m in 11s, 150m in 15s, 200m in 18s. (Approx. 40 words)

1. Calculate the time taken for each 50m interval.
2. Was the athlete's motion uniform or non-uniform during this run? Explain.
3. Calculate the athlete's average speed for the entire 200m run in m/s.

**Ans :**

- (1) 0-50m : 6s; 50-100m : 5s (11-6); 100-150m : 4s (15-11); 150-200m : 3s (18-15).
- (2) Non-uniform. The time taken to cover equal distances (50m) decreased, meaning the speed was increasing (accelerating).
- (3) Average speed = Total distance / Total time = 200 m / 18 s = 11.11 m/s.

**119.** A bus travels along a straight highway. The driver tries to maintain a constant speed of 80 km/h, as shown on the speedometer. However, they occasionally have to slow down slightly for slower vehicles before accelerating back to 80 km/h.

1. What type of motion is the driver trying to achieve?
2. Due to the occasional slowing down and speeding up, what type of motion does the bus actually exhibit over the whole journey?
3. If the bus travels for 3 hours, can we confidently say it covered exactly 240 km (80 km/h × 3 h)? Why or why not?

**Ans :**

- (1) Uniform linear motion (constant speed in a straight line).
- (2) Non-uniform linear motion (because the speed is not perfectly constant).
- (3) No, we cannot be confident. Because the bus occasionally slowed down, its average speed over the 3 hours would be slightly less than 80 km/h, so the total distance covered would likely be slightly less than 240 km.

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# CHAPTER 9

## LIFE PROCESSES IN ANIMALS

### SUMMARY

#### 1. WHAT ARE LIFE PROCESSES?

Animals, including humans, perform vital life processes like nutrition, respiration, excretion, and reproduction to survive. This chapter focuses on nutrition and respiration, which involve the intake of food, breaking it down, and using it to release energy necessary for other functions.

#### 2. NUTRITION IN HUMANS

Food provides energy and must be broken into simpler forms like sugars, amino acids, and fatty acids to be absorbed. This breakdown happens in the alimentary canal, a long tube from the mouth to the anus.

- (1) Mouth : Digestion begins here with mechanical chewing and saliva, which chemically breaks down starch into sugar.
- (2) Oesophagus : Pushes food to the stomach through wave-like muscle contractions called peristalsis.
- (3) Stomach : Uses digestive juices, acid, and mucus to churn and digest food, especially proteins.
- (4) Small Intestine : Receives bile from the liver (to break fats) and pancreatic juice (to digest all nutrients). Its inner walls have villi for absorbing digested nutrients into the blood.
- (5) Large Intestine : Absorbs water and salts. Waste is stored in the rectum and removed via the anus (egestion).

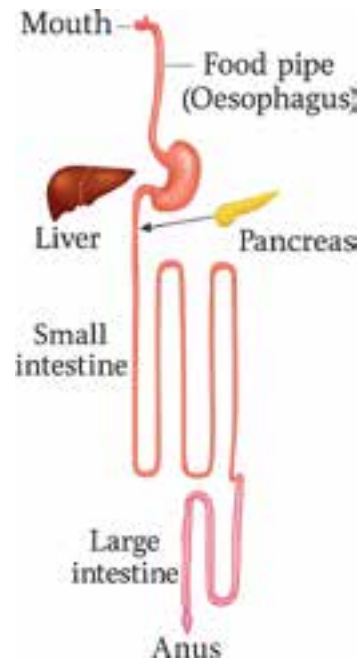


Figure : Alimentary canal if it is stretched out

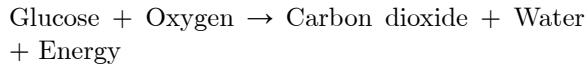
#### 3. NUTRITION IN OTHER ANIMALS

Not all animals digest food like humans. Ruminants like cows chew partially and swallow it. Later, they bring it back to the mouth for further chewing (rumination). Birds, lacking teeth, use a muscular organ called the gizzard, which grinds food with the help of swallowed stones.

#### 4. RESPIRATION IN HUMANS

Breathing is the process of inhaling oxygen and exhaling carbon dioxide. Oxygen enters the lungs via nostrils, passes through the windpipe, and reaches small sacs called alveoli, where gas exchange happens. Oxygen is absorbed into the blood, while carbon dioxide is expelled. Respiration is the process where oxygen helps break down glucose (from food) to release energy for the body. The equation is :

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Breathing is a physical process, while respiration is a chemical reaction inside cells

**5. BREATHING IN OTHER ANIMALS**

Breathing differs across species :

- (1) Lungs are used by mammals, reptiles, and birds.
- (2) Gills in fish extract oxygen from water.
- (3) Skin is used by earthworms and amphibians like frogs, especially when underwater.
- (4) Tadpoles use gills, while adult frogs use both lungs and skin.

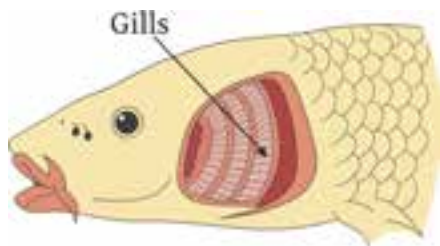


Figure : Breathing body parts in a fish

**6. TRANSPORT OF NUTRIENTS AND GASES**

The circulatory system, including the heart, blood and blood vessels, carries oxygen and nutrients to every cell and removes waste. This ensures efficient delivery of energy and essential materials across the body.

**NCERT ACTIVITY**

**Activity 9.1 : Let us investigate**

- 1. Take two test tubes and label them as 'A' and 'B'.
- 2. Take one teaspoonful of boiled rice in test tube A, and take a teaspoonful of boiled rice after chewing it for 30-60 seconds in test tube B.
- 3. Add 3-4 mL of water in both the test tubes.
- 4. Note the initial colour of the rice-water mixture in Table.
- 5. Add 3-4 drops of iodine solution into each test tube with the help of a dropper. Mix

the content of each test tube separately and observe.

Record your observations in Table.

**Table : Action of saliva on starch**

Test tube	Initial colour before adding iodine	Final colour after adding iodine	Possible reason for the change in colour, if any
A :	Boiled rice		
B :	Chewed boiled rice		

Ans :

**Table : Action of saliva on starch**

	Test tube	Initial colour before adding iodine	Final colour after adding iodine	Possible reason for the change in colour, if any
A	Boiled rice	White/ Cloudy white	Blue-black	Boiled rice contains starch. Iodine solution turns blue-black in the presence of starch.
B	Chewed boiled rice	White/ Cloudy white	No colour change (or very light blue/brownish, or much less intense blue-black than A)	Saliva contains an enzyme (amylase) that breaks down starch into simpler sugars. If starch is broken down, iodine will not give a blue-black colour. If some starch remains, a faint colour might appear.



**Activity 9.2 : Let us make a model**

1. Take a wide transparent plastic bottle with a lid. Remove its bottom.
2. Make a hole in the lid of the bottle.
3. Take a Y-shaped hollow tube, as shown in Figure.

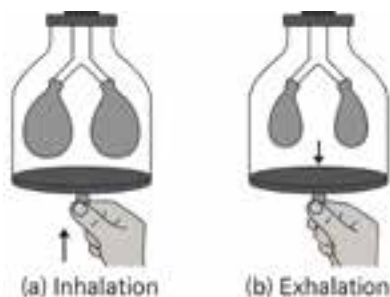


Figure : Model to show mechanisms of breathing

4. Fix two deflated balloons to the forked end of the tube. Secure them with rubber bands to make them airtight.
5. Insert the straight end of the tube tightly through the lid from the open base of the bottle and seal the lid with clay to make it airtight.
6. To the open base of the bottle, attach a thin rubber sheet tightly using a large rubber band.
7. Pull the rubber sheet from the centre of the base downwards and watch the balloons Figure (a). What do you observe?
8. Now, release the rubber sheet upwards and observe the balloons Figure (b). What changes do you see in the balloons?
9. When you pull the rubber sheet downwards, the balloons inflate. Conversely, when you release the rubber sheet upwards, the balloons deflate.
10. What do the balloons in the model mentioned in Figure represent? What does the rubber sheet represent?

Ans :

When the rubber sheet is pulled downwards Figure (a) :

Observation : The balloons inside the bottle will inflate (fill with air).

When the rubber sheet is released/pushed upwards Figure (b) :

Observation : The balloons inside the bottle will deflate (air will come out).

What do the balloons in the model represent?  
The balloons represent the lungs.

What does the rubber sheet represent? The rubber sheet at the base of the bottle represents the diaphragm.

**Explanation of the model :**

**Pulling the rubber sheet down (Inhalation) :** This action increases the volume inside the plastic bottle (representing the chest cavity). The increase in volume leads to a decrease in air pressure inside the bottle compared to the atmospheric pressure outside. As a result, air from the outside rushes in through the Y-shaped tube and inflates the balloons (lungs).

**Releasing/Pushing the rubber sheet up (Exhalation) :** This action decreases the volume inside the plastic bottle. The decrease in volume leads to an increase in air pressure inside the bottle compared to the atmospheric pressure outside. As a result, air is forced out of the balloons (lungs) through the Y-shaped tube, causing them to deflate.

This model effectively demonstrates the basic mechanical principle of how the diaphragm and changes in chest cavity volume contribute to breathing (inhalation and exhalation).

**Activity 9.3 : Let us explore**

1. To be demonstrated by the teacher
2. Take an equal amount of freshly prepared lime water in two test tubes, A and B, as given in Figure.
3. In test tube A, pass the air using a syringe/pichkari Figure (a). This is the same air that you inhale.
4. In test tube B, repeatedly blow air through your mouth into the lime water using a straw Figure (b).



(a) Air is passed to lime water (b) Air exhaled into lime water

5. Do you observe any changes in the colour of the lime water?

Ans :

Test tube A (passing atmospheric air with syringe/pichkari) : The lime water will show no significant change, or it might turn very slightly cloudy only

after passing a very large volume of air for a prolonged time. Atmospheric air contains a very small percentage of carbon dioxide (around 0.04%). Test tube B (blowing exhaled air through a straw) : The lime water will turn milky or cloudy relatively quickly.

What does this indicate?

This indicates that the exhaled air (from our breath) contains a significantly higher concentration of carbon dioxide than the atmospheric air we inhale. Lime water turns milky in the presence of carbon dioxide due to the formation of insoluble calcium carbonate. The more pronounced and quicker change in test tube B shows that our bodies produce carbon dioxide as a waste product of respiration, which is then expelled during exhalation.

### NCERT EXERCISE

- Complete the journey of food through the alimentary canal by filling up the boxes with appropriate parts-  
 Food → Mouth → \_\_\_\_\_ → Stomach → \_\_\_\_\_ → \_\_\_\_\_ Anus

Ans :

Food → Mouth → Oesophagus (or Food pipe) → Stomach → Small intestine → Large intestine (then Rectum) → Anus

- Sahil placed some pieces of chapati in test tube A. Neha placed chewed chapati in test tube B, and Santushti took boiled and mashed potato in test tube C. All of them added a few drops of iodine solution to their test tubes-A, B, and C, respectively. What would be their observations? Give reasons.

Ans :

**Test tube A** (Sahil - pieces of chapati + iodine) :  
 Observation : The chapati pieces will turn blue-black.

**Reason** : Chapati is made from wheat flour, which contains starch. Iodine solution gives a blue-black colour in the presence of starch.

**Test tube B** (Neha - chewed chapati + iodine) :  
 Observation : The chewed chapati will likely show no blue-black colour or a very faint blue-black/ brownish colour, or at least a much less intense blue-black colour compared to test tube A.

**Reason** : Chewing mixes the chapati with saliva. Saliva contains an enzyme called salivary amylase, which begins the digestion of starch, breaking it down into simpler sugars. If the starch is partially or fully digested, the iodine test will be negative or show a reduced positive result.

**Test tube C** (Santushti - boiled and mashed potato + iodine) :

Observation : The boiled and mashed potato will turn blue-black.

**Reason** : Potato is rich in starch. Boiling and mashing are physical changes that do not remove or chemically alter the starch. Therefore, iodine will react with the starch to give a blue-black colour.

- What is the role of the diaphragm in breathing?
  - To filter the air
  - To produce sound
  - To help in inhalation and exhalation
  - To absorb oxygen

Ans :

To help in inhalation and exhalation

Justification : The diaphragm is a large, dome-shaped muscle located at the base of the chest cavity.

During inhalation, the diaphragm contracts and flattens (moves downwards), increasing the volume of the chest cavity. This reduces the pressure inside the lungs, causing air to be drawn in.

During exhalation, the diaphragm relaxes and returns to its dome shape (moves upwards), decreasing the volume of the chest cavity. This increases the pressure inside the lungs, forcing air out.

- Match the following

	Name of the part		Functions
(i)	Nostrils	(a)	fresh air from outside enters
(ii)	Nasal passages	(b)	exchange of gases occurs
(iii)	Windpipe	(c)	protects lungs
(iv)	Alveoli	(d)	tiny hair and mucus help to trap dust and dirt from the air we breathe



(v)	Ribcage	(e)	air reaches our lungs through this part
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**Ans :**

- (i) Nostrils → (a) fresh air from outside enters
- (ii) Nasal passages → (d) tiny hair and mucus help to trap dust and dirt from the air we breathe
- (iii) Windpipe → (e) air reaches our lungs through this part
- (iv) Alveoli → (b) exchange of gases occurs
- (v) Ribcage → (c) protects lungs

5. Anil claims to his friend Sanvi that respiration and breathing are the same process. What question(s) can Sanvi ask him to make him understand that he is not correct?

**Ans :**

Sanvi can ask Anil the following questions :

1. "Anil, if breathing is just taking air in and out, where and how does our body get energy from the food we eat using the air we breathe in?"
2. "Is breathing a physical process of moving air, or a chemical process that happens inside our body's cells to release energy?"
3. "We know we breathe in oxygen and breathe out carbon dioxide. What happens to the oxygen inside our body, and where does the extra carbon dioxide we exhale come from?"
4. "Can you explain the difference between the mechanical act of getting air into our lungs and the process that uses the oxygen from that air to produce energy for our body to function?"
5. "Do all living cells in our body 'breathe' in the same way our lungs do, or do they undergo a different process to get energy?"
6. "What is the actual chemical reaction involved when our body uses food and oxygen, and is that reaction just the act of moving air?"

These questions aim to highlight that breathing is the mechanical process of gas exchange with the environment, while respiration is a cellular chemical process that uses oxygen to break down glucose and release energy.

6. Which of the following statements is correct and why?

1. Anu : We inhale air.
2. Shanu : We inhale oxygen.

3. Tanu : We inhale air rich in oxygen.

**Ans :**

The most correct and comprehensive statement is from Tanu : We inhale air rich in oxygen.

**Why :**

- (i) **Anu** : We inhale air. This statement is true. Air is a mixture of gases (mainly nitrogen, oxygen, argon, carbon dioxide, and trace other gases) that we take into our lungs.
- (ii) **Shanu** : We inhale oxygen. This statement is incomplete and somewhat misleading. While oxygen is the vital component of air that our body uses, we don't selectively inhale only oxygen from the atmosphere. We inhale the entire mixture of gases present in the air.
- (iii) **Tanu** : We inhale air rich in oxygen. This statement is the most accurate. We inhale atmospheric air, which is a mixture of gases. Oxygen constitutes about 21% of this air, making it "rich in oxygen" compared to other gases like carbon dioxide (approx. 0.04%) that are also present. Our respiratory system is designed to extract this oxygen from the inhaled air.

Therefore, Tanu's statement correctly describes that we take in the mixture called air, and that this air is valuable to us primarily because of its oxygen content.

7. We often sneeze when we inhale a lot of dust-laden air. What can be possible explanations for this?

**Ans :**

Sneezing is a reflex action that helps to clear the nasal passages of irritants. Possible explanations for sneezing when inhaling dust-laden air include :

1. Irritation of Nasal Mucosa : Dust particles, pollen, or other foreign particles in the air can irritate the sensitive mucous membranes lining the nasal passages.
2. Triggering of Nerve Endings : This irritation stimulates nerve endings in the nose.
3. Reflex Action : These nerve signals are sent to the brain, which then triggers a sneeze. A sneeze is a sudden, forceful expulsion of air through the nose and mouth.
4. Expulsion of Irritants : The primary purpose of this forceful expulsion is to remove the irritating particles (dust, in this case) from the nasal passages and prevent them from entering the lower respiratory tract (lungs),

where they could cause more significant problems or infection.

5. Role of Nasal Hairs and Mucus : While nasal hairs and mucus trap many larger particles, a large influx of dust can overwhelm this first line of defense, leading to irritation and sneezing.

Sneezing is essentially a protective mechanism of the respiratory system.

8. Paridhi and Anusha of Grade 7 started running for their morning workout. After they completed their running, they counted their breaths per minute. Anusha was breathing faster than Paridhi. Provide at least two possible explanations for why Anusha was breathing faster than Paridhi.

**Ans :**

Possible explanations for why Anusha was breathing faster than Paridhi after running :

1. Different Fitness Levels : Anusha might have a lower level of cardiovascular fitness compared to Paridhi. Less fit individuals often have a higher breathing rate (and heart rate) during and after exercise because their bodies are less efficient at delivering oxygen to the muscles and removing carbon dioxide. Paridhi, if fitter, might recover more quickly and her breathing rate might return to normal faster or not have increased as much.
2. Different Intensity of Effort : Anusha might have run at a higher intensity or speed than Paridhi, or pushed herself harder during the workout. A more strenuous effort demands more oxygen and produces more carbon dioxide, leading to a faster breathing rate to meet these demands.
3. Different Body Sizes/Metabolism : Though less likely to be the primary factor for a significant difference if they are of similar age and build, differences in body mass or metabolic rate could slightly influence oxygen demand and thus breathing rate.
4. Different Running Techniques or Efficiency : Less efficient running mechanics could lead to greater energy expenditure for the same distance/speed, thus increasing oxygen demand and breathing rate for Anusha.
5. Underlying Health or Respiratory Conditions (Less common but possible) : If Anusha has a mild, undiagnosed respiratory issue (like exercise-induced asthma, though this is speculative without more information),

it could cause her to breathe faster to get sufficient oxygen.

6. Emotional State/Anxiety : If Anusha was more anxious or stressed during the run, this could also influence her breathing rate.

The most likely explanations are differences in fitness levels or the intensity with which they ran.

9. Yadu conducted an experiment to test his idea. He took two test tubes, A and B, and added a pinch of rice flour to the test tubes, half-filled with water and stirred them properly. To test tube B, he added a few drops of saliva. He left the two test tubes for 35-45 min. After that, he added iodine solution into both the test tubes. Experimental results are as shown in Figure.



Figure : Experimental results

(Figure shows : Test tube A (Rice flour + Water + Iodine) turns blue-black. Test tube B (Rice flour + Water + Saliva + Iodine) shows no blue-black colour or a much lighter colour.)

What do you think he wants to test?

**Ans :**

Yadu wants to test the action of saliva on starch present in the rice flour.

More specifically, he is investigating :

Whether saliva can break down (digest) starch.

He is using iodine solution as an indicator for the presence of starch (iodine turns blue-black in the presence of starch).

By comparing the colour change in test tube A (control, without saliva) and test tube B (with saliva), he can determine if saliva has altered the starch in the rice flour. The expected result (as shown in typical representations of this experiment) is that test tube A will turn blue-black (starch present), while test tube B will show little or no blue-black colour, indicating that the saliva has broken down the starch into sugars.

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10. Rakshita designed an experiment taking two clean test tubes, A and B and filled them with lime water as shown in the figure. In test tube A, the surrounding air that we inhale was passed on by sucking air from the pipe, and in test tube B, the exhaled air was blown through the pipe (Figure). What do you think she is trying to investigate? How can she confirm her findings?

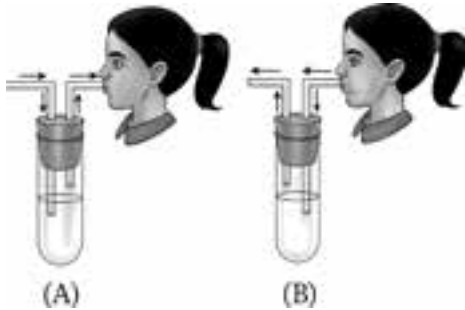


Figure : Experimental set-up

Ans :

Rakshita is trying to investigate the presence of carbon dioxide ( $\text{CO}_2$ ) in exhaled air.

**In her experiment:**

- Test tube A receives inhaled or atmospheric air, which has a lower concentration of carbon dioxide.
- Test tube B receives exhaled air, which contains a higher concentration of carbon dioxide.

**Observation and Confirmation:**

- Lime water turns milky in the presence of carbon dioxide due to the formation of calcium carbonate.
- If test tube B turns milky faster than test tube A, it confirms that exhaled air has more carbon dioxide than inhaled air.

Thus, Rakshita can confirm that we exhale carbon dioxide, a byproduct of respiration.

## MULTIPLE CHOICE QUESTION

1. What are processes like nutrition, respiration, excretion, and reproduction, which are essential for the survival of living beings, collectively called?
- (A) Biological functions  
(B) Daily activities

- (C) Life processes  
(D) Environmental adaptations

Ans :

- (C) Life processes

Nutrition, respiration, excretion, and reproduction are essential functions required for survival and are collectively referred to as life processes.

2. Which of the following is an example of how animals obtain food?

- (A) Plants performing photosynthesis.  
(B) Bees sucking nectar from flowers.  
(C) Fungi decomposing dead matter.  
(D) Humans cooking food.

Ans :

- (B) Bees sucking nectar from flowers.

The text provides examples of diverse feeding methods in animals, including bees and sunbirds consuming nectar, infants feeding on milk, snakes swallowing prey, and filter-feeding.

3. Why do animals, including humans, need to break down complex food components like carbohydrates, proteins, and fats?

- (A) To make the food taste better.  
(B) Because complex components cannot provide energy.  
(C) To convert them into simpler forms that the body can absorb and utilize.  
(D) To remove harmful substances from the food.

Ans :

- (C) To convert them into simpler forms that the body can absorb and utilize.

The body cannot directly use large, complex food molecules. Digestion breaks them down into smaller, simpler units that can be absorbed into the bloodstream and used by cells.

4. What is the long tube, starting from the mouth and ending at the anus, through which food passes during digestion called?

- (A) Respiratory tract  
(B) Circulatory system  
(C) Alimentary canal  
(D) Nervous system

Ans :

- (C) Alimentary canal

The alimentary canal, also known as the digestive tract or gut, is the continuous pathway through which food is ingested, digested, absorbed, and waste eliminated.

5. Where does the process of digestion begin in the human body?  
 (A) Stomach  
 (B) Small intestine  
 (C) Oesophagus  
 (D) Mouth

**Ans :**

(D) Mouth

The journey of food and the process of digestion commence in the mouth with the mechanical breakdown by teeth (chewing) and initial chemical breakdown by saliva.

6. What is the initial breakdown of food into smaller pieces by crushing and chewing in the mouth called?  
 (A) Chemical digestion  
 (B) Absorption  
 (C) Mechanical digestion  
 (D) Egestion

**Ans :**

(C) Mechanical digestion

Mechanical digestion refers to the physical processes that break down food into smaller pieces without chemical change, such as chewing in the mouth and churning in the stomach.

7. What substance in the mouth starts the chemical digestion of starch into sugars?  
 (A) Mucus (B) Acid  
 (C) Saliva (D) Bile

**Ans :**

(C) Saliva

Saliva contains digestive enzymes (like amylase) that begin the chemical breakdown of complex carbohydrates (starch) into simpler sugars, which is why starchy foods taste sweeter after prolonged chewing.

8. Imagine why does boiled rice turn blue-black with iodine, while thoroughly chewed rice shows little or no color change?  
 (A) Chewing removes the starch from the rice.  
 (B) Saliva breaks down the starch in the chewed rice into sugars.  
 (C) Iodine only reacts with uncooked starch.  
 (D) Boiled rice contains a blue-black dye.

**Ans :**

(B) Saliva breaks down the starch in the chewed rice into sugars.

Iodine tests for starch. Saliva digests the starch in the chewed rice, converting it to sugars, hence iodine doesn't produce a strong blue-black color in test tube B.

9. What is the general process of breaking down complex food components into simpler forms within the body called?  
 (A) Respiration  
 (B) Circulation  
 (C) Digestion  
 (D) Excretion

**Ans :**

(C) Digestion

Digestion is the overall biological process responsible for breaking down large, complex food molecules into smaller, simpler molecules that can be absorbed and used by the body.

10. What is the name of the muscular tube that connects the mouth to the stomach?  
 (A) Windpipe (Trachea)  
 (B) Small intestine  
 (C) Food pipe (Oesophagus)  
 (D) Large intestine

**Ans :**

(C) Food pipe (Oesophagus)

The oesophagus, or food pipe, is the tube through which chewed food travels from the mouth down to the stomach, propelled by muscular contractions.

11. How does food move down the oesophagus and along the alimentary canal?  
 (A) By gravity alone.  
 (B) By wave-like muscular contractions and relaxations (peristalsis).  
 (C) By being pushed by air pressure.  
 (D) By dissolving into a liquid form.

**Ans :**

(B) By wave-like muscular contractions and relaxations (peristalsis).

The walls of the alimentary canal contract and relax rhythmically in waves (peristalsis) behind the food, pushing it forward through the digestive tract.

12. What actions occur in the stomach to help digest food?  
 (A) Only absorption of water.  
 (B) Production of bile and insulin.  
 (C) Chewing and saliva production.  
 (D) Churning and mixing with digestive juice, acid, and mucus.



**Ans :**

(D) Churning and mixing with digestive juice, acid, and mucus.

The stomach walls contract to churn food, mixing it thoroughly with secretions containing digestive enzymes (for protein), acid (to kill bacteria and aid digestion), and mucus (for protection).

- 13.** What is the primary role of the acid secreted in the stomach?
- (A) To digest carbohydrates.  
 (B) To protect the stomach lining.  
 (C) To help break down proteins and kill harmful bacteria.  
 (D) To neutralize the food entering from the mouth.

**Ans :**

(C) To help break down proteins and kill harmful bacteria.

Stomach acid (hydrochloric acid) creates an acidic environment optimal for protein-digesting enzymes and also helps sterilize the food by killing ingested bacteria.

- 14.** What substance protects the inner lining of the stomach from damage by acid?
- (A) Bile  
 (B) Saliva  
 (C) Pancreatic juice  
 (D) Mucus

**Ans :**

(D) Mucus

The stomach secretes a thick layer of mucus that coats its inner walls, forming a protective barrier against the corrosive effects of the stomach acid.

- 15.** The story of Alexis St. Martin and Dr. William Beaumont provided early insights into what aspect of digestion?
- (A) How the small intestine absorbs nutrients.  
 (B) The role of saliva in starch digestion.  
 (C) The process of digestion occurring within the stomach.  
 (D) The function of the large intestine.

**Ans :**

(C) The process of digestion occurring within the stomach.

Due to St. Martin's unhealed stomach wound, Dr. Beaumont could directly observe food being broken down inside the stomach and study the effects of gastric juice.

- 16.** Which part of the alimentary canal is the longest, where most chemical digestion and absorption of nutrients occur?
- (A) Stomach  
 (B) Oesophagus  
 (C) Large intestine  
 (D) Small intestine

**Ans :**

(D) Small intestine

Despite its name, the small intestine is the longest section (about 6 meters) and is the primary site for the final breakdown of food and absorption of the resulting nutrients.

- 17.** Which two organs, associated with the alimentary canal, secrete digestive juices into the small intestine?
- (A) Kidneys and Bladder  
 (B) Lungs and Heart  
 (C) Liver and Pancreas  
 (D) Spleen and Gallbladder

**Ans :**

(C) Liver and Pancreas

The liver produces bile, and the pancreas produces pancreatic juice, both of which are released into the small intestine to aid digestion. The small intestine wall also secretes juices.

- 18.** What is the function of bile, secreted by the liver, in digestion?
- (A) To digest starch into sugars.  
 (B) To break down proteins into amino acids.  
 (C) To neutralize stomach acid and break down fats into smaller droplets.  
 (D) To absorb water from undigested food.

**Ans :**

(C) To neutralize stomach acid and break down fats into smaller droplets.

Bile is alkaline, neutralizing acid from the stomach. It also emulsifies fats, breaking large fat globules into smaller droplets, increasing the surface area for fat-digesting enzymes to work.

- 19.** What substances are broken down by pancreatic juice, secreted by the pancreas?
- (A) Only carbohydrates  
 (B) Only proteins  
 (C) Only fats  
 (D) Carbohydrates, proteins, and fats

**Ans :**

(D) Carbohydrates, proteins, and fats

Pancreatic juice contains a mixture of enzymes capable of digesting all three major food components : carbohydrates, proteins, and fats.

- 20.** What is the process by which digested nutrients pass from the small intestine into the bloodstream called?  
 (A) Egestion  
 (B) Digestion  
 (C) Absorption  
 (D) Respiration

**Ans :**

(C) Absorption  
 Absorption is the process where the final products of digestion (simple sugars, amino acids, fatty acids) move across the wall of the small intestine and enter the blood or lymph.

- 21.** How does the inner lining of the small intestine facilitate efficient absorption of nutrients?  
 (A) It is very thick and muscular.  
 (B) It secretes acid to break down nutrients further.  
 (C) It has thousands of finger-like projections (villi) that increase surface area.  
 (D) It moves food rapidly to prevent absorption.

**Ans :**

(C) It has thousands of finger-like projections (villi) that increase surface area.  
 The presence of numerous villi dramatically increases the internal surface area of the small intestine, maximizing the contact between digested food and the absorbing surface.

- 22.** What is Celiac disease?  
 (A) An infection of the stomach lining.  
 (B) A condition where the body reacts negatively to gluten, damaging the small intestine.  
 (C) A blockage in the oesophagus.  
 (D) An inability to digest lactose (milk sugar).

**Ans :**

(B) A condition where the body reacts negatively to gluten, damaging the small intestine.  
 Celiac disease is an autoimmune disorder triggered by gluten (a protein in wheat, barley, rye), leading to damage to the small intestinal lining and impaired nutrient absorption.

- 23.** After the small intestine, undigested food material moves into which part of the alimentary canal?

- (A) Stomach  
 (B) Rectum  
 (C) Large intestine  
 (D) Oesophagus

**Ans :**

(C) Large intestine  
 Material that is not digested or absorbed in the small intestine passes into the large intestine for further processing (water absorption) and waste formation.

- 24.** What is the primary function of the large intestine?  
 (A) To digest proteins and fats.  
 (B) To absorb most of the nutrients from food.  
 (C) To absorb water and some salts from undigested food material.  
 (D) To secrete bile and pancreatic juice.

**Ans :**

(C) To absorb water and some salts from undigested food material.  
 The main role of the large intestine is to reabsorb water and electrolytes (salts) from the remaining indigestible food matter, consolidating it into feces (stool).

- 25.** What is the semi-solid waste material formed in the large intestine called?  
 (A) Chyme  
 (B) Bile  
 (C) Stool (or feces)  
 (D) Mucus

**Ans :**

(C) Stool (or feces)  
 Stool, or feces, is the term for the waste product of digestion, consisting primarily of undigested food material (especially fiber), bacteria, and sloughed-off cells, formed in the large intestine.

- 26.** Where is the stool temporarily stored before elimination from the body?  
 (A) Small intestine  
 (B) Stomach  
 (C) Rectum  
 (D) Appendix

**Ans :**

(C) Rectum  
 The rectum is the final section of the large intestine, terminating at the anus. It serves as a temporary storage site for feces before defecation.



27. What is the process of eliminating stool (feces) from the body through the anus called?  
 (A) Digestion  
 (B) Absorption  
 (C) Ingestion  
 (D) Egestion (or defecation)

Ans :

(D) Egestion (or defecation)  
 Egestion (or defecation) is the act or process by which undigested waste material (feces) is discharged from the body via the anus.

28. What role do bacteria in the large intestine play?  
 (A) They cause diseases and infections.  
 (B) They absorb water and salts.  
 (C) They help break down undigested material (like fiber) and produce some nutrients.  
 (D) They have no significant function.

Ans :

(C) They help break down undigested material (like fiber) and produce some nutrients.  
 The gut microbiome, including bacteria in the large intestine, plays a beneficial role by fermenting undigested fiber and synthesizing certain vitamins.

29. What is the process called where grass-eating animals like cows bring partially digested food back from the stomach to the mouth for further chewing?  
 (A) Digestion  
 (B) Egestion  
 (C) Rumination  
 (D) Respiration

Ans :

(C) Rumination  
 Rumination, or “chewing the cud,” is the process characteristic of ruminant animals where partially digested food (cud) is regurgitated from the rumen (a stomach compartment) back to the mouth for more thorough chewing.

30. Animals like cows and buffaloes that perform rumination are called what?  
 (A) Carnivores  
 (B) Omnivores  
 (C) Herbivores  
 (D) Ruminants

Ans :

(D) Ruminants

Ruminants are a specific group of herbivorous mammals characterized by their specialized digestive system involving a multi-compartment stomach and the process of rumination.

31. Instead of teeth, what structure do birds possess in their digestive system to help break down food, often using swallowed grit?  
 (A) Rumen  
 (B) Crop  
 (C) Gizzard  
 (D) Cloaca

Ans :

(C) Gizzard  
 Birds have a muscular part of the stomach called the gizzard, which grinds food, often aided by small stones (grit) they intentionally swallow.

32. What is the process called by which digested nutrients, like sugar (glucose), are broken down inside the body using oxygen to release energy?  
 (A) Digestion  
 (B) Circulation  
 (C) Respiration  
 (D) Breathing

Ans :

(C) Respiration  
 Cellular respiration is the metabolic process where cells break down glucose (from food) in the presence of oxygen to produce ATP (energy), carbon dioxide, and water.

33. What is the physical process of inhaling and exhaling air called?  
 (A) Respiration  
 (B) Circulation  
 (C) Breathing  
 (D) Digestion

Ans :

(C) Breathing  
 Breathing specifically refers to the mechanical act of taking air into the lungs (inhalation) and expelling air from the lungs (exhalation). It facilitates gas exchange for respiration.

34. What is a key difference between breathing and respiration?  
 (A) Breathing is chemical; respiration is physical.  
 (B) Breathing occurs in the lungs; respiration occurs in the stomach.  
 (C) Breathing is the intake/outtake of air; respiration is the release of energy from food

using oxygen.

- (D) Breathing uses carbon dioxide; respiration uses oxygen.

Ans :

(C) Breathing is the intake/outtake of air; respiration is the release of energy from food using oxygen.

Breathing is the mechanical process of gas exchange with the environment, while respiration is the chemical process within cells that uses the oxygen obtained via breathing to release energy from nutrients.

35. Through which structures does air normally enter the human respiratory system?

- (A) Mouth
- (B) Ears
- (C) Nostrils
- (D) Oesophagus

Ans :

- (C) Nostrils

The respiratory pathway begins with the nostrils, the external openings of the nasal cavity, through which air is typically inhaled.

36. What is the function of the tiny hairs and mucus in the nasal passages?

- (A) To detect smells.
- (B) To warm the inhaled air.
- (C) To trap dust, dirt, and other particles from the inhaled air.
- (D) To produce sound during speech.

Ans :

- (C) To trap dust, dirt, and other particles from the inhaled air.

The hairs and mucus lining the nasal passages act as a filter, trapping particulate matter from the inhaled air, thus cleaning it before it reaches the lungs.

37. After passing through the nasal passages, air travels down which tube to reach the lungs?

- (A) Oesophagus (Food pipe)
- (B) Aorta
- (C) Windpipe (Trachea)
- (D) Ureter

Ans :

- (C) Windpipe (Trachea)

The windpipe, or trachea, is the airway that connects the larynx (voice box) to the bronchi, conducting inhaled air towards the lungs.

38. What are the tiny, balloon-like air sacs at the end of the smallest branches within the lungs called, where gas exchange takes place?

- (A) Bronchioles
- (B) Capillaries
- (C) Alveoli
- (D) Villi

Ans :

- (C) Alveoli

The alveoli are microscopic air sacs in the lungs. Their thin walls, surrounded by capillaries, provide a large surface area for the efficient exchange of oxygen and carbon dioxide with the blood.

39. What bony structure protects the lungs in the chest cavity?

- (A) Skull
- (B) Spine (Vertebral column)
- (C) Pelvis
- (D) Rib cage

Ans :

- (D) Rib cage

The rib cage forms a protective enclosure around the vital organs in the chest, including the lungs and the heart.

40. During inhalation (breathing in), what happens to the ribs and diaphragm?

- (A) Ribs move down and inwards; diaphragm moves upwards.
- (B) Ribs move up and outwards; diaphragm moves downwards.
- (C) Ribs remain stationary; diaphragm moves downwards.
- (D) Ribs move up and outwards; diaphragm remains stationary.

Ans :

- (B) Ribs move up and outwards; diaphragm moves downwards.

Inhalation involves the contraction of the diaphragm (pulling it down) and intercostal muscles (lifting ribs up and out), increasing the volume of the chest cavity.

41. What is the effect of the movements of the ribs and diaphragm during inhalation on the chest cavity volume and air flow?

- (A) Volume decreases, air flows out.
- (B) Volume increases, air flows in.
- (C) Volume remains constant, no air flow.
- (D) Volume increases, air flows out.



Ans :

(B) Volume increases, air flows in.

The expansion of the chest cavity during inhalation lowers the pressure inside the lungs relative to the outside air, causing air to rush into the lungs.

42. During exhalation (breathing out), what happens to the ribs and diaphragm?
- (A) Ribs move down and inwards; diaphragm moves upwards (relaxes).  
 (B) Ribs move up and outwards; diaphragm moves downwards.  
 (C) Ribs remain stationary; diaphragm moves upwards.  
 (D) Ribs move down and inwards; diaphragm remains stationary.

Ans :

(A) Ribs move down and inwards; diaphragm moves upwards (relaxes).

Exhalation is typically passive; the diaphragm relaxes (moves up), and the ribs move down and in due to muscle relaxation and elastic recoil, decreasing the chest cavity volume.

43. In the model showing the mechanism of breathing (Activity 9.2), what do the balloons represent?
- (A) Diaphragm  
 (B) Rib cage  
 (C) Lungs  
 (D) Windpipe

Ans :

(C) Lungs

The balloons inside the bottle inflate and deflate as the rubber sheet is moved, mimicking the way the lungs fill with air and empty during breathing.

44. What does the rubber sheet at the base of the bottle in the breathing model (Activity 9.2) represent?
- (A) Lungs  
 (B) Rib cage  
 (C) Windpipe  
 (D) Diaphragm

Ans :

(D) Diaphragm

Pulling and releasing the rubber sheet simulates the contraction and relaxation of the diaphragm muscle, which changes the volume inside the bottle (chest cavity).

45. Imagine lime water in test tube B (with exhaled air blown through it) turns milky, while test tube

A (with surrounding air passed through) does not. What does this demonstrate?

- (A) Inhaled air contains more carbon dioxide than exhaled air.  
 (B) Exhaled air contains significantly more carbon dioxide than inhaled air.  
 (C) Exhaled air contains only carbon dioxide.  
 (D) Lime water reacts with oxygen, not carbon dioxide.

Ans :

(B) Exhaled air contains significantly more carbon dioxide than inhaled air.

The milky result with exhaled air shows a higher concentration of  $\text{CO}_2$  compared to the surrounding air passed through test tube A, indicating  $\text{CO}_2$  is a waste product of respiration.

46. Where does the exchange of oxygen and carbon dioxide between the air in the lungs and the blood occur?

- (A) In the windpipe  
 (B) In the nasal passages  
 (C) Across the walls of the alveoli  
 (D) Within the diaphragm muscle

Ans :

(C) Across the walls of the alveoli

Gas exchange happens by diffusion across the very thin walls of the numerous alveoli and the surrounding capillaries (tiny blood vessels).

47. What is the approximate percentage of oxygen in the air we inhale?

- (A) 4-5%  
 (B) 16-17%  
 (C) 21%  
 (D) 78%

Ans :

(C) 21%

Atmospheric air is composed of approximately 21% oxygen, which is the amount present in the air we normally inhale.

48. What is the approximate percentage of carbon dioxide in the air we inhale?

- (A) 0.04%  
 (B) 4-5%  
 (C) 16-17%  
 (D) 21%

Ans :

(A) 0.04%

The air we breathe in contains only a very small fraction of carbon dioxide, typically around 0.04%.

49. Compared to inhaled air, does exhaled air contain more or less oxygen, and more or less carbon dioxide?
- (A) More oxygen, less carbon dioxide
  - (B) Less oxygen, more carbon dioxide
  - (C) Same oxygen, more carbon dioxide
  - (D) Less oxygen, same carbon dioxide

Ans :

(B) Less oxygen, more carbon dioxide  
 During respiration, the body uses up some oxygen (reducing its percentage in exhaled air to about 16-17%) and produces carbon dioxide as waste (increasing its percentage to about 4-5%).

50. What body system is responsible for transporting nutrients, oxygen, and waste products throughout the body?
- (A) Respiratory system
  - (B) Digestive system
  - (C) Nervous system
  - (D) Circulatory system

Ans :

(D) Circulatory system  
 The circulatory system, consisting of the heart, blood, and blood vessels, acts as the body's transport network, carrying essential substances to cells and removing waste materials.

51. Why is smoking harmful to the respiratory system?
- (A) It increases the oxygen levels in the blood.
  - (B) It damages the lungs and increases the risk of respiratory diseases like cancer.
  - (C) It cleans the alveoli and improves breathing.
  - (D) It only affects the smoker's sense of smell.

Ans :

(B) It damages the lungs and increases the risk of respiratory diseases like cancer.  
 Smoking introduces toxic chemicals that damage lung tissue, impair gas exchange, and significantly increase the likelihood of developing serious respiratory illnesses and lung cancer.

52. Besides mammals, which other groups of animals mentioned typically breathe using lungs?
- (A) Fish and insects
  - (B) Birds, lizards, snakes, adult frogs (on land)
  - (C) Earthworms and tadpoles
  - (D) Spiders and crabs

Ans :

(B) Birds, lizards, snakes, adult frogs (on land)  
 Animals such as birds, elephants, lions, cows, goats, lizards, and snakes use lungs to breathe air. Adult amphibians like frogs also rely on lungs for breathing while on land.

53. What specialized structures do most aquatic animals like fish use for gas exchange in water?
- (A) Lungs
  - (B) Skin
  - (C) Gills
  - (D) Alveoli

Ans :

(C) Gills  
 Gills are respiratory organs adapted for extracting dissolved oxygen from water and releasing carbon dioxide back into the water, common in fish and other aquatic organisms.

54. How do adult frogs breathe differently on land versus in water?
- (A) Lungs on land, Gills in water
  - (B) Gills on land, Lungs in water
  - (C) Lungs on land, Skin in water
  - (D) Skin on land, Lungs in water

Ans :

(C) Lungs on land, Skin in water  
 Adult frogs exhibit adaptability; they use lungs for breathing when on land but can also exchange gases through their moist skin when submerged in water.

55. How do earthworms exchange gases with their environment?
- (A) Through lungs
  - (B) Through gills
  - (C) Through their moist skin
  - (D) Through small holes called spiracles

Ans :

(C) Through their moist skin  
 Earthworms lack specialized respiratory organs like lungs or gills; gas exchange (oxygen in, carbon dioxide out) occurs directly across their thin, moist body surface (skin).

56. Fill in the blanks for the journey of food :
- Mouth → Oesophagus → Stomach → \_\_\_\_\_ → Large intestine → Anus.
- (A) Liver
  - (B) Pancreas
  - (C) Small intestine
  - (D) Gallbladder

Ans :

(C) Small intestine

Following the stomach, the partially digested food enters the small intestine for further digestion and absorption, before undigested material moves to the large intestine.

57. What is the role of the diaphragm in breathing?
- (A) It filters dust from the air.  
 (B) It produces the voice.  
 (C) It contracts and relaxes to help change the volume of the chest cavity for inhalation/exhalation.  
 (D) It exchanges gases directly with the blood.

Ans :

(C) It contracts and relaxes to help change the volume of the chest cavity for inhalation/exhalation.

The diaphragm is a primary muscle of respiration. Its contraction (moving down) increases chest volume for inhalation, and its relaxation (moving up) decreases volume for exhalation.

58. Match the respiratory part with its function :
- Alveoli.
- (A) Air reaches lungs through this part (Windpipe).  
 (B) Where exchange of gases occurs.  
 (C) Protects the lungs (Rib cage).  
 (D) Filters air with hair and mucus (Nasal passages).

Ans :

(B) Where exchange of gases occurs.

Alveoli are the tiny air sacs within the lungs specifically adapted for the exchange of oxygen and carbon dioxide between the inhaled air and the bloodstream.

59. Why is it more accurate to say “We inhale air rich in oxygen” rather than just “We inhale oxygen”?
- (A) Because air contains only oxygen.  
 (B) Because we selectively inhale only the oxygen molecules from the air.  
 (C) Because air is a mixture of gases, including nitrogen, oxygen (~21%), CO<sub>2</sub>, etc.  
 (D) Because inhaled air has less oxygen than exhaled air.

Ans :

(C) Because air is a mixture of gases, including nitrogen, oxygen (~21%), CO<sub>2</sub>, etc.

We inhale the surrounding air, which is a mixture. While oxygen is the component crucial for

respiration, we inhale the entire mixture, not just pure oxygen.

60. Why might someone breathe faster after running compared to resting?
- (A) To cool down the body temperature.  
 (B) Because running damages the lungs temporarily.  
 (C) To inhale more oxygen and exhale more carbon dioxide to meet increased energy demands.  
 (D) Because the heart rate decreases during running.

Ans :

(C) To inhale more oxygen and exhale more carbon dioxide to meet increased energy demands. Strenuous activity like running requires muscles to produce much more energy via respiration. This increases the demand for oxygen intake and the need to eliminate the extra carbon dioxide produced, leading to faster breathing.

## MATCHING TYPE QUESTION

61. Match the part of the human digestive system in Column A with its primary function in Column B:

	Column A		Column B
1.	Mouth	A.	Absorption of water and some salts from undigested food
2.	Stomach	B.	Complete digestion and absorption of nutrients
3.	Small Intestine	C.	Initial breakdown of starch by saliva
4.	Large Intestine	D.	Churns food and starts protein digestion with acid and enzymes

- (a) 1-C, 2-D, 3-B, 4-A  
 (b) 1-D, 2-C, 3-A, 4-B  
 (c) 1-C, 2-A, 3-D, 4-B  
 (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (a) 1-C, 2-D, 3-B, 4-A

The mouth starts starch digestion. The stomach begins protein digestion. The small intestine completes digestion and absorbs nutrients. The large intestine absorbs water and salts from remaining undigested material.

62. Match the digestive secretion or structure in Column A with the organ that produces it or its role in Column B:

	Column A		Column B
1.	Saliva	A.	Pancreas; breaks down carbohydrates, proteins, fats
2.	Bile	B.	Stomach lining; protects stomach from acid
3.	Pancreatic Juice	C.	Mouth (salivary glands); breaks down starch
4.	Mucus (in stomach)	D.	Liver; neutralizes stomach acid, breaks down fats

- (a) 1-D, 2-C, 3-B, 4-A  
 (b) 1-C, 2-D, 3-A, 4-B  
 (c) 1-C, 2-A, 3-D, 4-B  
 (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (b) 1-C, 2-D, 3-A, 4-B

Saliva from salivary glands digests starch. Bile from the liver aids fat digestion. Pancreatic juice from the pancreas digests major nutrients. Mucus protects the stomach lining from acid.

63. Match the animal or group in Column A with its characteristic digestive or respiratory feature in Column B:

	Column A		Column B
1.	Ruminants	A.	Breathe through moist skin
2.	Birds	B.	Have gills for breathing in water
3.	Earthworms	C.	Have a gizzard for grinding food
4.	Fish	D.	Chew cud (partially digested food)

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-D, 2-A, 3-C, 4-B  
 (c) 1-D, 2-C, 3-A, 4-B

- (d) 1-A, 2-C, 3-D, 4-B

Ans :

- (c) 1-D, 2-C, 3-A, 4-B

Ruminants like cows chew cud. Birds use a gizzard to grind food. Earthworms breathe through their moist skin. Fish use gills to extract oxygen from water.

64. Match the part of the human respiratory system in Column A with its main function in Column B:

	Column A		Column B
1.	Nostrils	A.	Dome-shaped muscle that helps in breathing movements
2.	Windpipe	B.	Tiny air sacs where gas exchange takes place
3.	Alveoli	C.	Entry point for air, filters dust with hair and mucus
4.	Diaphragm	D.	Passage connecting nasal cavity/mouth to the lungs

- (a) 1-D, 2-C, 3-A, 4-B  
 (b) 1-C, 2-B, 3-D, 4-A  
 (c) 1-C, 2-D, 3-B, 4-A  
 (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (c) 1-C, 2-D, 3-B, 4-A

Nostrils filter inhaled air. The windpipe is an air passage to the lungs. Alveoli are sites of gas exchange. The diaphragm is a muscle crucial for breathing mechanics.

65. Match the respiratory process or concept in Column A with its correct description in Column B:

	Column A		Column B
1.	Inhalation	A.	Chemical process releasing energy from glucose using oxygen
2.	Exhalation	B.	Ribs move up/out, diaphragm moves down, air enters lungs
3.	Respiration	C.	Gas exchange structure in fish
4.	Gills	D.	Ribs move down/in, diaphragm moves up, air leaves lungs



- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-B, 2-D, 3-A, 4-C  
 (c) 1-B, 2-A, 3-D, 4-C  
 (d) 1-D, 2-B, 3-A, 4-C

Ans :

- (b) 1-B, 2-D, 3-A, 4-C

Inhalation involves chest expansion and diaphragm lowering. Exhalation is the reverse. Respiration is the chemical energy release. Gills are respiratory organs in fish for aquatic breathing.

## VERY SHORT QUESTION

66. Name one life process essential for the survival of living beings.

Ans :

Nutrition (or Respiration, Excretion, Reproduction)

67. What is the long tube in the digestive system through which food passes called?

Ans :

Alimentary canal

68. Where does the process of digestion begin in humans?

Ans :

Mouth

69. What substance in the mouth helps break down starch?

Ans :

Saliva

70. What type of nutrient does saliva begin to digest?

Ans :

Starch (Carbohydrate)

71. What is the tube connecting the mouth to the stomach called?

Ans :

Food pipe (or Oesophagus)

72. Name one substance secreted by the stomach lining that helps kill bacteria.

Ans :

Acid

73. What substance protects the stomach lining from acid?

Ans :

Mucus

74. Which organ secretes bile?

Ans :

Liver

75. What is the main function of bile in digestion?

Ans :

Breaks down fats(or Neutralises acid)

76. Which organ secretes pancreatic juice?

Ans :

Pancreas

77. In which part of the alimentary canal does most nutrient absorption occur?

Ans :

Small intestine

78. What are the finger-like projections in the small intestine that increase surface area called?

Ans :

Villi

79. What is the main function of the large intestine?

Ans :

Absorbs water and some salts

80. What is the process of expelling undigested waste (stool) from the body called?

Ans :

Egestion

81. What are grass-eating animals like cows called, which chew partially digested food?

Ans :

Ruminants

82. What is the process where ruminants bring back partially digested food to chew again?

Ans :

Rumination

83. What is the process of taking in air called?

Ans :

Inhalation

84. What are the tiny air sacs in the lungs where gas exchange occurs called?

Ans :

Alveoli

85. What is the large, dome-shaped muscle below the lungs that helps in breathing called?

Ans :

Diaphragm

## SHORT ANSWER QUESTION

86. What is digestion ? Why is it necessary for animals?

Ans :

Digestion is the breakdown of complex food components into simpler forms. It's necessary because the body can only absorb and use these simpler forms for energy, growth, and repair.

87. How do teeth help in digestion? What is this initial breakdown called?

Ans :

Teeth break down food into smaller pieces by crushing and chewing. This initial physical breakdown increases the surface area for digestive juices to act upon and is called mechanical digestion.

88. Explain how saliva contributes to the digestion of food in the mouth.

Ans :

Saliva moistens food, making it easier to swallow. It also contains digestive juice (enzyme) that starts breaking down complex starch into simpler sugars.

89. How is food moved down the oesophagus into the stomach?

Ans :

Food moves down through wave-like contractions and relaxations of the oesophagus walls. This

muscular movement, called peristalsis (though term not used in text), pushes the food forward.

90. Describe the role of acid and mucus secreted in the stomach.

Ans :

Acid helps break down proteins and kills many harmful bacteria present in the food. Mucus protects the stomach's inner lining from being damaged by the strong acid.

91. What is the function of the liver and pancreas in digestion?

Ans :

The liver secretes bile, which neutralizes stomach acid and helps break down fats. The pancreas secretes pancreatic juice, which helps digest carbohydrates, proteins, and fats.

92. How is the small intestine adapted for efficient absorption of nutrients?

Ans :

The inner lining of the long small intestine has thousands of finger-like projections (villi) which vastly increase the surface area available for absorbing digested nutrients into the bloodstream.

93. What happens to the undigested food material in the large intestine?

Ans :

The large intestine absorbs most of the remaining water and some salts from the undigested food. This process makes the waste material semi-solid (stool).

94. Explain the process of rumination in animals like cows.

Ans :

Ruminants like cows partially chew grass, swallow it into a part of the stomach (rumen), where it's partially digested. Later, this food (cud) is brought back to the mouth for thorough re-chewing before further digestion.

95. What is the difference between breathing and respiration?

Ans :

Breathing is the physical process of inhaling air (oxygen) into the lungs and exhaling air (carbon dioxide) out. Respiration is the chemical



process inside body cells where oxygen is used to break down glucose (from food) to release energy, producing carbon dioxide and water as byproducts.

96. Describe the path air takes from the nostrils to the alveoli in the lungs.

**Ans :**

Air enters through the nostrils, passes through the nasal passages (where dust is filtered), goes down the windpipe, which branches into the two lungs, and further divides into smaller tubes ending in the alveoli.

97. How do the ribs and diaphragm work together during inhalation?

**Ans :**

During inhalation, the ribs move up and outwards, and the diaphragm contracts and moves downwards. This increases the volume of the chest cavity, drawing air into the lungs.

98. How do the ribs and diaphragm work together during exhalation?

**Ans :**

During exhalation, the ribs move down and inwards, and the diaphragm relaxes and moves upwards. This decreases the volume of the chest cavity, pushing air out of the lungs.

99. Explain how the exchange of oxygen and carbon dioxide occurs in the alveoli.

**Ans :**

Alveoli have thin walls surrounded by blood vessels. Oxygen from inhaled air passes from the alveoli into the blood, while carbon dioxide passes from the blood into the alveoli to be exhaled.

100. Why does lime water turn milky when we exhale into it, but not when normal air is passed through it?

**Ans :**

Exhaled air contains a significantly higher concentration of carbon dioxide (about 4-5%) compared to inhaled air (about 0.04%). Carbon dioxide reacts with lime water to make it milky.

101. Briefly describe how fish breathe using gills.

**Ans :**

Fish use gills, which are richly supplied with blood vessels. Water flows over the gills, and dissolved oxygen from the water passes into the blood, while carbon dioxide from the blood passes into the water.

102. How do adult frogs breathe on land and in water?

**Ans :**

Adult frogs use lungs for breathing when on land. When in water, they can also exchange gases (oxygen and carbon dioxide) directly through their moist skin.

103. How do earthworms exchange gases?

**Ans :**

Earthworms breathe through their skin. Their skin is moist and allows for the direct exchange of oxygen from the air/soil into their body and carbon dioxide out.

104. What is the role of the circulatory system in relation to digestion and respiration?

**Ans :**

The circulatory system (heart, blood, vessels) transports absorbed nutrients from the small intestine and oxygen from the lungs to all body cells. It also carries waste products like carbon dioxide away from cells.

105. Why is maintaining good oral hygiene important? Mention one practice.

**Ans :**

Good oral hygiene prevents tooth decay and bad breath caused by bacteria acting on food particles. One practice is brushing teeth twice a day.

## LONG ANSWER QUESTION

106. Describe the complete journey of food through the human alimentary canal, mentioning the key organs involved and the main digestive processes occurring in each major part (mouth, stomach, small intestine, large intestine).

**Ans :**

Food enters the Mouth, where mechanical digestion (chewing by teeth) and initial chemical digestion (saliva breaks down starch) occur. It's

then swallowed and pushed down the Oesophagus (food pipe) by muscular contractions. In the Stomach, food is churned and mixed with acid (kills bacteria, aids protein digestion) and digestive juices (break down proteins); mucus protects the lining. The partially digested food moves to the Small Intestine. Here, bile from the liver (breaks down fats) and pancreatic juice from the pancreas (digests carbs, proteins, fats), plus intestinal juices, complete digestion. Nutrients are absorbed through the villi into the blood. Undigested material enters the Large Intestine, where water and salts are absorbed. The remaining waste (stool) is stored in the rectum and expelled via the anus (egestion).

107. Explain the digestion of the main food components – carbohydrates, proteins, and fats – indicating where each process primarily occurs in the human digestive system.

Ans :

- (1) Carbohydrates : Digestion starts in the mouth, where saliva begins breaking down starch into sugars. Further breakdown of remaining carbohydrates occurs in the small intestine by pancreatic juice and intestinal enzymes into simple sugars (like glucose) for absorption.
  - (2) Proteins : Digestion starts in the stomach, where acid and digestive juices begin breaking down proteins. This continues in the small intestine, where pancreatic and intestinal juices further break proteins into amino acids for absorption.
  - (3) Fats : Minimal digestion occurs before the small intestine. Here, bile from the liver emulsifies fats (breaks large droplets into smaller ones). Pancreatic and intestinal juices then break down these smaller fat droplets into fatty acids and glycerol for absorption.
108. Describe the structure and function of the human respiratory system, including the pathway of air and the mechanism of breathing (inhalation and exhalation).

Ans :

The respiratory system facilitates gas exchange. Air enters through the Nostrils into Nasal Passages (filtering dust), then down the Windpipe.



Figure : Human respiratory system

The windpipe branches into two tubes entering the Lungs. Inside the lungs, these tubes divide repeatedly, ending in tiny air sacs called Alveoli. Lungs are protected by the Rib cage.

Breathing mechanism : Inhalation occurs when the diaphragm contracts (moves down) and ribs move up/out, expanding the chest cavity and drawing air in. Exhalation occurs when the diaphragm relaxes (moves up) and ribs move down/in, reducing chest cavity volume and forcing air out. Gas exchange occurs in the alveoli.

109. Compare and contrast the processes of breathing and cellular respiration in humans. Include the purpose, location, inputs, and outputs of each.

Ans :

- (1) Breathing:
  - (a) Purpose : To take in oxygen from the air and remove carbon dioxide from the body.
  - (b) Location : Respiratory system (lungs, airways).
  - (c) Inputs : Air (containing approx. 21% oxygen).
  - (d) Outputs : Air (containing approx. 16-17% oxygen and 4-5% carbon dioxide).
  - (e) Nature : Physical process (mechanical movement of air).
- (2) Cellular Respiration:
  - (a) Purpose : To break down glucose (from food) using oxygen to release energy usable by cells.
  - (b) Location : Inside body cells (mitochondria).
  - (c) Inputs : Glucose (from digested food) and Oxygen (delivered by blood from lungs).
  - (d) Outputs : Carbon dioxide, Water, and Energy (ATP).

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- (e) Nature : Chemical process. While distinct, they are linked : breathing supplies the oxygen needed for respiration and removes its waste product, carbon dioxide.

**110.** Explain the process of gas exchange in the alveoli of the lungs and how oxygen and carbon dioxide are transported in the body.

**Ans :**

The alveoli are tiny air sacs with very thin walls, surrounded by a dense network of tiny blood vessels (capillaries). When air is inhaled, the alveoli fill with oxygen-rich air. Oxygen diffuses across the thin walls of the alveoli and capillaries into the blood, binding to hemoglobin in red blood cells. Simultaneously, carbon dioxide, a waste product from cellular respiration carried by the blood from body tissues, diffuses from the blood across the capillary and alveolar walls into the air inside the alveoli to be exhaled. The circulatory system (blood) then transports the oxygen to all body cells for respiration and carries carbon dioxide back to the lungs.

**111.** Compare the digestive systems and processes of humans and ruminants (like cows). Highlight key differences, especially regarding the digestion of plant material.

**Ans :**

Humans have a single stomach and primarily digest food sequentially through the mouth, stomach, small intestine, and large intestine. Ruminants (like cows) have a complex stomach with multiple compartments, including the rumen. Key difference : Ruminants eat grass/plants rich in cellulose. They partially chew, swallow into the rumen where microbes help break down cellulose, then regurgitate the partially digested food (cud) to re-chew thoroughly (rumination). Humans lack the necessary enzymes and stomach structure to digest cellulose efficiently. The overall path (oesophagus, intestines, anus) exists in both, but the stomach structure and the rumination process are unique to ruminants, adapted for digesting fibrous plant matter.

**112.** Different animals have different respiratory organs adapted to their habitats. Describe the respiratory mechanisms of a fish (aquatic) and an earthworm (terrestrial, burrowing), contrasting them with human lung respiration.

**Ans :**

- (1) Fish (Gills) : Live underwater. Use gills, specialized structures with large surface area and rich blood supply, to extract dissolved oxygen directly from water flowing over them and release carbon dioxide into the water. This is different from humans using lungs to extract oxygen from air.
- (2) Earthworm (Skin) : Live in moist soil. Respire through their entire moist skin surface. Oxygen from air/moisture in soil diffuses directly through the skin into their blood, and carbon dioxide diffuses out. Humans cannot breathe through skin; gas exchange is localized in lungs.
- (3) Humans (Lungs) : Use internal lungs with millions of alveoli to maximize surface area for gas exchange with inhaled air. Air is actively moved in/out via breathing mechanism involving diaphragm/ribs.

**113.** Discuss the importance of fibre in the human diet, referencing its role in the digestive system, particularly the large intestine. Mention foods rich in fibre.

**Ans :**

Fibre, primarily undigestible plant material, is crucial for digestive health although not absorbed as a nutrient. In the large intestine, fibre adds bulk to the undigested waste, helping it move smoothly and preventing constipation. Certain fibres are also fermented by beneficial gut bacteria, producing useful substances. Maintaining regular bowel movements facilitated by fibre helps eliminate waste efficiently. Fibre-rich foods include fruits, vegetables, and whole grains. Fermented foods also support gut health.

## CASE BASED QUESTION

- 114.** A person eats a meal consisting of roti (mainly starch), dal (mainly protein), and a small amount of ghee (fat). Trace the main sites of digestion for each of these components as they pass through the alimentary canal.
1. Where does the digestion of starch in the roti begin?
  2. Where does the digestion of protein in the dal primarily begin?
  3. Where are all three components (remaining carbohydrates, proteins, and fats) fully

broken down and absorbed?

**Ans :**

- (1) Starch digestion begins in the mouth due to saliva.
- (2) Protein digestion primarily begins in the stomach due to stomach acid and digestive juices.
- (3) Digestion is completed and absorption primarily occurs in the small intestine, with the help of secretions from the liver, pancreas, and intestinal wall.

**115.** After a vigorous exercise session, a person finds themselves breathing much faster and deeper than when they were resting. Their muscles also feel tired.

1. Why does the breathing rate increase during vigorous exercise?
2. What process in the muscle cells uses the extra oxygen to release energy?
3. What waste product of this energy-releasing process is removed by faster breathing?

**Ans :**

- (1) Muscles need more energy during exercise. Faster breathing increases oxygen intake, needed for cellular respiration to release that energy.
- (2) Cellular respiration.
- (3) Carbon dioxide.

**116.** A student sets up the lung model (bottle, Y-tube, balloons, rubber sheet). When they pull the rubber sheet down, the balloons inflate. When they push it up, the balloons deflate.

1. In this model, what does the rubber sheet represent in the human respiratory system?
2. What do the balloons represent?
3. Does pulling the rubber sheet down simulate inhalation or exhalation? Explain why the balloons inflate.

**Ans :**

- (1) The diaphragm.
- (2) The lungs.
- (3) Simulates inhalation. Pulling the sheet down increases the volume inside the bottle (chest cavity), reducing pressure and drawing air into the balloons (lungs).

**117.** A farmer notices their cow spends a lot of time chewing even when it's resting in the barn and not eating fresh grass. The cow seems healthy otherwise.

1. What is the process called when the cow chews previously swallowed food?
2. Is this behaviour a sign of illness or a normal process for this type of animal?
3. Why do cows need to perform this action?

**Ans :**

- (1) Rumination.
- (2) It is a normal and essential digestive process for ruminants like cows.
- (3) Cows eat fibrous plant matter (grass) that needs thorough mechanical breakdown (chewing) and microbial action (in the rumen) for proper digestion. Rumination allows them to re-chew the partially digested food (cud) extensively.

**118.** Someone suffering from acidity takes an antacid containing a basic substance. The antacid provides relief from the burning sensation in the stomach.

1. What secretion in the stomach is responsible for the acidity?
2. What type of chemical reaction likely occurs between the basic antacid and the stomach acid?
3. How does this reaction provide relief?

**Ans :**

- (1) Stomach acid.
- (2) Neutralisation reaction.
- (3) The basic antacid neutralizes the excess stomach acid, reducing the overall acidity and thereby relieving the burning sensation or discomfort caused by it.

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# CHAPTER 10

## LIFE PROCESSES IN PLANTS

### SUMMARY

#### 1. GROWTH IN PLANTS

Plants grow by developing new leaves, branches, and height, and thickening of the stem. Experiments show that both sunlight and water are essential for healthy plant growth. Without water, plants dry out, and without sunlight, their growth becomes stunted and leaves may turn yellow.

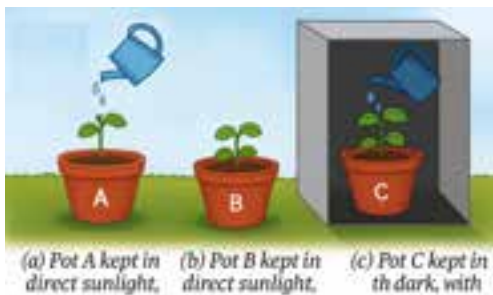


Figure : Experimental set-up to understand the role of sunlight and water in plant growth

#### 2. HOW PLANTS MAKE THEIR FOOD

Unlike animals, plants do not eat food. Instead, they produce it themselves through a process called photosynthesis. This happens mainly in the leaves, which contain a green pigment called chlorophyll. Chlorophyll captures sunlight and in the presence of water and carbon dioxide, produces glucose (a simple sugar) and oxygen. The glucose is stored as starch, which can be detected using an iodine test

Photosynthesis equation:

Carbon dioxide + Water  $\rightarrow$  Glucose + Oxygen  
(in the presence of sunlight and chlorophyll)

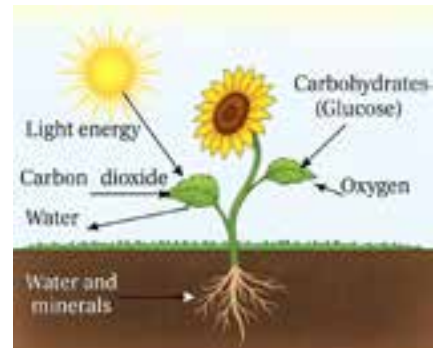


Figure : A diagram showing photosynthesis

#### 2.1 Factors Required for Photosynthesis

From experiments:

- (1) Chlorophyll is needed because only green parts of the leaf produce starch.
- (2) Sunlight is essential; no starch forms in dark conditions.
- (3) Carbon dioxide is required; its absence prevents starch formation.

This proves that photosynthesis requires sunlight, water, chlorophyll, and carbon dioxide

#### 2.2 Oxygen Release

Photosynthesis not only makes food but also releases oxygen, as shown through the appearance of air bubbles in experiments with aquatic plants placed under sunlight. The oxygen helps maintain the balance of gases in the environment.

#### 2.3 Exchange of Gases

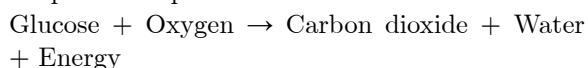
Plants exchange gases through tiny pores on the leaves called stomata, which open and close to allow the intake of carbon dioxide and the release of oxygen during photosynthesis and respiration. Water and minerals are absorbed by the roots and transported through xylem, a type of tube inside the plant. The food made in leaves is sent to other parts of the plant using another set of tubes called the phloem. These transport systems ensure that

all plant parts get the necessary water, nutrients, and energy.

### 3. RESPIRATION IN PLANTS

Like animals, plants also respire. They break down the glucose made during photosynthesis using oxygen to release carbon dioxide, water, and energy, which is used for growth and development. The process occurs in all parts of the plant, both green and non-green

Respiration equation:



- Place pot A in direct sunlight. Keep the soil in this pot slightly moist by adding an adequate amount of water every day (Figure (a)).
- Place pot B in direct sunlight, without adding water to the soil (Figure (b)).
- Place pot C in the dark. Keep the soil in this pot slightly moist by adding an adequate amount of water every day (Figure (c)).

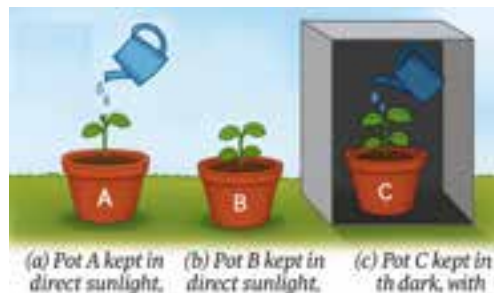


Figure : Experimental set-up to understand the role of sunlight and water in plant growth

#### Activity 10.1 : Let us test some explanations

- Take three earthen pots (or used bottles/containers) of the same size filled with garden soil. Plant saplings of similar sizes of a fast-growing plant like chilli or tomato in each pot Figure.
- Label the pots A, B, and C.
- Count the number of leaves on each sapling and record your observations.

- Observe the plants for two weeks<sup>1</sup> and record changes in their height, number of leaves, colour of leaves and any other changes that may appear. Record your observations in Table.
- This experiment will need two weeks. Teachers can plan this activity accordingly.

**Table : Effect of sunlight and water on plant growth**

Pots kept under different conditions	Availability of Sunlight	Availability of Water	Height of plant (cm) Day 1	Height of plant (cm) After 2 weeks	Number of leaves Day 1	Number of leaves After 2 weeks	Colour of leaves (Green/Yellow) After 2 weeks
Pot A : In direct sunlight, with water	Yes	Yes	e.g., 10	e.g., 18	e.g., 6	e.g., 12	Green
Pot B : In direct sunlight, without water	Yes	No	e.g., 10	e.g., 9 (or wilting/dead)	e.g., 6	e.g., 4 (or dropped/wilted)	Yellowish/Brown/Wilted
Pot C : In the dark, with water	No	Yes	e.g., 10	e.g., 12 (may be elongated/spindly)	e.g., 6	e.g., 7 (may be pale)	Yellowish/Pale Green

#### Question

- What differences did you observe between the plants in the three pots?
- Which pot has the plant with the maximum growth?
- Which pot has the plant with the least growth?

#### Ans :

- (a) Pot A (Sunlight, Water) : The plant likely showed healthy growth, an increase in height, an increase in the number of green leaves, and appeared vigorous.
- (b) Pot B (Sunlight, No Water) : The plant likely wilted, its growth stunted, leaves may have turned yellow or brown and



dropped, and it might have died or shown very poor health by the end of two weeks.

- (c) Pot C (Dark, Water) : The plant may have grown taller (elongated or etiolated as it searches for light) but would likely have fewer new leaves, and its leaves would be pale green or yellowish due to lack of sunlight for chlorophyll production and photosynthesis. It would not appear as healthy as the plant in Pot A.
- (2) Pot A (with direct sunlight and water) would have the plant with the maximum healthy growth.
- (3) Pot B (with direct sunlight but no water) would likely have the plant with the least growth, and it may even die. If Pot B's plant dies quickly, then Pot C (dark with water) would show more growth than B but less healthy growth than A.

**Activity 10.2 : Let us check (demonstration activity)**

The teacher may demonstrate this activity.

1. Keep a leaf in boiling water for five minutes to soften it.
2. Dip this leaf in a test tube containing alcohol.
3. Place the test tube in a beaker containing boiling water. Wait until the leaf becomes colourless Figure (a).

**Caution :** *Caution-Alcohol should never be placed near a heat source directly, as it is highly flammable and can easily lead to fire and burns.*

4. Take out the leaf and place it on a plate.
5. Now, put a few drops of diluted iodine solution with the help of a dropper on the decolorized leaf Figure (b). Wait for a few minutes and observe.



Figure : Starch test in a leaf

6. If the colour of the leaf changes to blue-black, it indicates the presence of starch.

Ans :

This activity describes the procedure for testing a leaf for the presence of starch.

**Observation :** If the leaf has been photosynthesizing (i.e., it was exposed to light and had other necessary conditions before being picked), then after performing the steps:







- (1) Boiling in water softens the leaf and kills the cells, breaking down cell walls to allow iodine to penetrate.
- (2) Boiling in alcohol (in a water bath for safety) removes the chlorophyll (decolorizes the leaf), making it easier to see the colour change with iodine.
- (3) Adding iodine solution to the decolorized leaf : The parts of the leaf containing starch will turn blue-black . If no starch is present, the leaf will take on the brownish-yellow colour of the iodine solution.

**Conclusion :** A blue-black colour indicates the presence of starch, which is a product of photosynthesis.

**Activity 10.3 : Let us check**

Bhaskar took a leaf having both green and non-green patches from each of two similar potted plants-one kept in sunlight and the other kept in the dark for 36 hours. He wanted to compare the leaves before and after the starch test. He made a sketch of the leaves to record the location of the green and the non-green patches on them with the help of a tracing paper. After that, he performed an iodine test (as shown in Activity 10.2) on the leaves. Bhaskar recorded his observations in Table.

**Table : Presence of starch in green and non-green parts of the leaves of plants**

S. No.	Light conditions for potted plant	Initial colours before iodine test	Final colours after iodine test
1.	Plant kept in sunlight 	Green and non-green patches on the leaf 	Green patches of leaf turned blue-black 
2.	Plant kept in the dark 	Green and non-green patches on the leaf 	No change in colour 

**Question**

1. Plant in sunlight, variegated leaf (green and non-green patches). Initial : Green and non-green patches. Final after iodine : Green patches turn blue-black, non-green patches do not.
2. Plant in dark, variegated leaf. Initial : Green and non-green patches. Final after iodine : No change in colour in either patch.)

Ans :

Inferences from the observations in Table :

1. Sunlight is necessary for starch production (photosynthesis) :  
The leaf from the plant kept in sunlight showed starch (turned blue-black) only in its green patches.  
The leaf from the plant kept in the dark for 36 hours did not show the presence of starch in any part (neither green nor non-green patches), even though it had green patches. This indicates that without sunlight, photosynthesis and subsequent starch production did not occur, or any stored starch was used up.
2. Chlorophyll (present in green patches) is necessary for starch production :  
In the leaf from the plant kept in sunlight, only the green patches (which contain chlorophyll) turned blue-black.  
The non-green patches of the same leaf (which lack sufficient chlorophyll) did not turn blue-black, indicating no starch was produced there, even though they were exposed to sunlight.

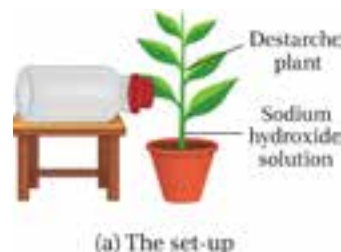
**Overall Conclusion :** The experiment demonstrates that both sunlight and chlorophyll are essential for a plant to produce starch (food) through photosynthesis. Photosynthesis occurs in the green parts of the leaves when exposed to light.

**Activity 10.4 : Let us experiment (demonstration activity)**

- The teacher may demonstrate this activity.
1. Take a potted green plant and keep it in the dark for two to three days to allow it to destarch (i.e., lose any stored starch). Then, locate one leaf of this plant for this experiment.
  2. Take a wide-mouthed bottle and pour some caustic soda (sodium hydroxide) into it (caustic soda absorbs carbon dioxide from the air).

**Caution :** *Caution-Caustic soda is a strong chemical that can cause skin burns; only teachers should handle it.*

3. Insert half of the destarched leaf into the bottle through a split cork, leaving the other half of the leaf outside, and place the bottle as shown in Figure (a).



4. Place the set-up in sunlight for a few hours.
5. Observe and record the availability of water, sunlight, chlorophyll, and carbon dioxide in Table .
6. Remove the leaf and test it for starch using the iodine test, as was done in Activity 10.2.
7. Record your observations in Table .

**Table : Role of air in the preparation of starch by plants**

Availability of Chlorophyll	Availability of Carbon dioxide	Starch present (Yes/No) After iodine test
-----	-----	-----
-----	-----	-----
Part of the leaf inside the bottle	-----	-----
Part of the leaf outside the bottle	-----	-----

What does this experiment show?

Ans :

Part of the leaf	Availability of Water (Assumed available to whole plant)	Availability of Sunlight (For whole setup)	Availability of Chlorophyll (In green leaf parts)	Availability of Carbon dioxide	Starch present (Yes/No) After iodine test
-----	-----	-----	-----	-----	No
Part of the leaf inside the bottle	Yes	Yes	Yes	No (or very little, absorbed by caustic soda solution)	No (does not turn blue-black)
Part of the leaf outside the bottle	Yes	Yes	Yes	Yes (from atmospheric air)	Yes (turns blue-black)

This experiment shows that carbon dioxide (present in the air) is essential for plants to prepare starch through the process of photosynthesis.

The part of the leaf outside the bottle had access to all necessary factors : water (from the soil through the stem), sunlight, chlorophyll (as it's a green leaf), and carbon dioxide from the atmosphere. This part produced starch.

The part of the leaf inside the bottle had access to water, sunlight, and chlorophyll, but the carbon dioxide inside the bottle was absorbed by the caustic soda (sodium hydroxide) solution. Without carbon dioxide, this part of the leaf could not perform photosynthesis and therefore did not produce starch.

### Activity 10.5 : Let us explore

1. Look at Figure. Compare the two set-ups labelled as A and B, and analyse.

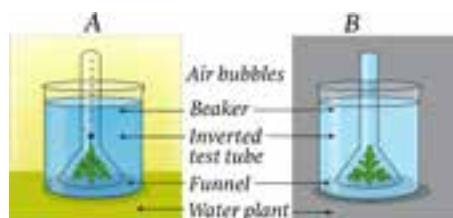


Figure : Activity showing the release of oxygen during photosynthesis

2. In Figure, set-up A is placed in sunlight, and set-up B is placed in the dark. What difference do you observe in the two set-ups? Do you observe air bubbles emerging in the inverted test tube in set-up A? The gas produced in this set-up caused bubbles to emerge and get accumulated in the inverted test tube. Which gas is this? (Dialogue follows where Barkha didi tests the gas with a lit matchstick, and it

produces an intense flame, inferring the gas is rich in oxygen).

**Ans :**

Figure shows an aquatic plant like Hydrilla under an inverted funnel and test tube, submerged in water. Set-up A is in sunlight, Set-up B is in dark.

Difference observed in the two set-ups : In set-up A (placed in sunlight), you would observe air bubbles emerging from the aquatic plant and collecting at the top of the inverted test tube. In set-up B (placed in the dark), you would observe very few or no air bubbles emerging from the plant.

### Activity 10.6 : Let us examine (demonstration activity)

The teacher may demonstrate this activity.

1. Collect a leaf from a plant such as rhoeo, money plant, onion, hibiscus, coleus, or any grass.
2. Put it in a beaker filled with water.
3. Carefully peel a thin layer from the lower surface of the leaf.
4. Place the peel in a watch glass with water.
5. Now, take a microscope slide and carefully put a drop of water on it.
6. Using forceps, transfer the peel of the leaf from the watch glass to the slide with the help of forceps.
7. Put a drop of ink on the leaf peel with the help of a dropper.
8. Cover the peel with a coverslip and observe it under a microscope.

#### Question

1. What do you observe? Do you notice tiny pores on the peel, as shown in Figure? These pores are called stomata.

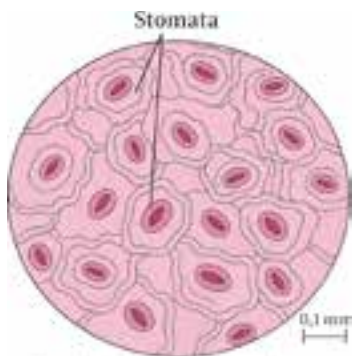


Figure : Stomata on the lower surface of a rhoeo leaf

Ans :

**Observation under the microscope :** Yes, when observing the peel from the lower surface of the leaf under a microscope, one would notice numerous tiny pores. Each pore (stoma) is typically surrounded by two bean-shaped cells called guard cells. These structures are the stomata (singular : stoma). The ink helps to stain the cells, making the structures more visible.

**Conclusion :** The activity demonstrates the presence of stomata, which are small pores usually found on the surface of leaves (more abundantly on the lower surface in many plants). These stomata play a crucial role in the exchange of gases (carbon dioxide uptake and oxygen release) during photosynthesis and also in transpiration (release of water vapour).

**Activity 10.7 : Let us experiment**

1. Take two tumblers and label them A and B.
2. Fill one-third of each tumbler with water.
3. Add a few drops of red ink to tumbler B.
4. Obliquely cut the stems of both plants at their base while keeping them inside the water and immediately place one plant in each tumbler, as shown in Figure (a) and (b).
5. Observe these plants the next day.

What do you notice? Compare the plant stems placed in the tumblers. Do you observe red colour in the stem, leaves, and flowers of the plant from Tumbler B? Figure (c) and (d) show the plants after one day. Compare the plant in Figure (c) with that in Figure (d).

A red colour is visible in the stem, leaves, and flowers of the plant in Figure (d). How did different parts of the plant acquire this red colour?

Cut the stem from the upper part of the plant that is not immersed in the red-coloured water. Observe the cut stem using a magnifying glass.

Do you spot the red colour in the stem (Figure (e))?

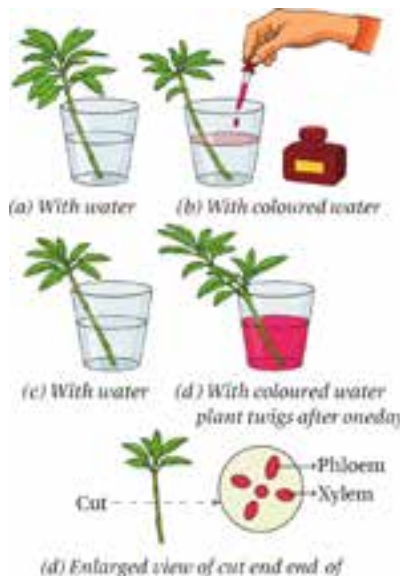


Figure : Experiment to check for water transportation in plants

Ans :

**Observations :** Plant in Tumbler A (plain water) : The stem, leaves, and flowers will remain their natural colour.

1. Plant in Tumbler B (red-coloured water) :
2. Yes, after one day, red colour will be observed in the stem.
3. The veins of the leaves will appear red.
4. If the plant has white flowers, the petals of the flowers will show streaks of red or turn pinkish/reddish.

Cut stem from Tumbler B Figure (e) : Yes, when the cut end of the stem (from the upper part) is observed with a magnifying glass, tiny red-coloured dots or channels will be visible within the stem. These are the xylem vessels that have transported the red-coloured water.

**Activity 10.8 : Let us find out (demonstration activity)**

1. Soak some moong bean seeds in water overnight.
2. Put a layer of cotton in a conical flask (Figure) and moisten the cotton with water to keep it wet.
3. Place the soaked seeds over the wet cotton in the conical flask.
4. Cover the mouth of the conical flask with a cork having two holes.

- Fit two tubes A and B through the two holes on the cork, as shown in Figure.
- Leave it undisturbed for 24 hours in the dark.
- Take two test tubes and fill them with lime water.
- Cover the mouth of one test tube with a cork having one hole in it.
- Dip one glass tube in the test tube through a hole in the cork.
- Connect the flask and test tube with a rubber pipe as shown in Figure.

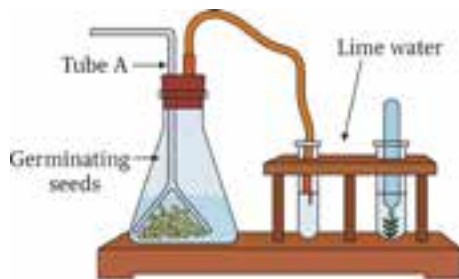


Figure : Set-up to test respiration in plants

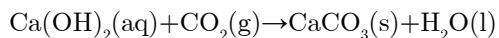
Compare both the test tubes for any change in colour. Does the lime water turn milky in both the test tubes?

Why does the lime water turn milky in the test tube connected to the flask?

Ans :

- No, the lime water only turns distinctly milky in the test tube connected to the flask with germinating seeds.
- The lime water in the test tube connected to the flask turns milky because the germinating moong bean seeds are actively respiring. During respiration, living organisms (including germinating seeds, which are highly metabolically active) take in oxygen (from the air trapped within the flask) and release carbon dioxide as a waste product. This carbon dioxide gas produced by the respiring seeds is drawn through Tube B and bubbles into the lime water (calcium hydroxide,  $\text{Ca}(\text{OH})_2$ ). Carbon dioxide reacts with lime water to form insoluble calcium carbonate ( $\text{CaCO}_3$ ), which precipitates out and causes the characteristic milky appearance.

The reaction is:



This experiment demonstrates that germinating seeds undergo respiration and release carbon dioxide as a byproduct. The control test tube,

exposed only to the low concentration of carbon dioxide in atmospheric air, helps to confirm that the milky appearance is specifically due to the activity of the germinating seeds.

## NCERT EXERCISE

- Complete the following table

S.No.	Feature	Photosynthesis	Respiration
1.	Raw materials		
2.	Products		
3.	Word equation		
4.	Importance		

Ans :

S. No.	Feature	Photosynthesis	Respiration
1.	Raw materials	Carbon dioxide, Water, Light energy	Glucose (food), Oxygen
2.	Products	Glucose (food/ carbohydrates), Oxygen	Carbon dioxide, Water, Energy (ATP)
3.	Word equation	Carbon dioxide + Water Chlorophyll Sunlight Glucose + Oxygen	Glucose + Oxygen → Carbon dioxide + Water + Energy
4.	Importance	Produces food for plants (and subsequently for animals); Releases oxygen into the atmosphere, essential for respiration by most living organisms.	Releases energy from food for the plant's life processes (growth, repair, maintenance, etc.). Essential for the survival of the plant.

- Imagine a situation where all the organisms that carry out photosynthesis on the earth have disappeared. What would be the impact of this on living organisms?

Ans :

If all organisms that carry out photosynthesis disappeared, there would be no production of oxygen and food for other living organisms. This would disrupt the food chain, as plants provide food for herbivores and oxygen for respiration. Without plants, life on Earth would not be sustained..

3. A potato slice shows the presence of starch with iodine solution. Where does the starch in potatoes come from? Where is the food synthesized in the plant, and how does it reach the potato?

Ans :

The starch in potatoes comes from the glucose produced in the leaves during photosynthesis. Photosynthesis occurs in the leaves, where food is synthesised in the form of glucose. This glucose is then transported through the plant to the potato, where it is stored in the form of starch..

4. Does the broad and flat structure of leaves make plants more efficient for photosynthesis? Justify your answer.

Ans :

Yes, the broad and flat structure of leaves makes plants more efficient for photosynthesis. This shape increases the surface area, allowing more sunlight to be absorbed by the chlorophyll present in the leaves. It also helps in the exchange of gases through the stomata, thus enhancing the process of photosynthesis.

5. X is broken down using Y to release carbon dioxide, Z, and energy.  $X + Y \rightarrow \text{Carbon dioxide} + Z + \text{Energy}$  X, Y, and Z are three different components of the process. What do X, Y, and Z stand for?

Ans :

This word equation represents the process of aerobic respiration.

X : Stands for Glucose (or other organic food molecules like fats or proteins that are ultimately broken down to or enter the glucose breakdown pathway). Glucose is the primary fuel source that is broken down.

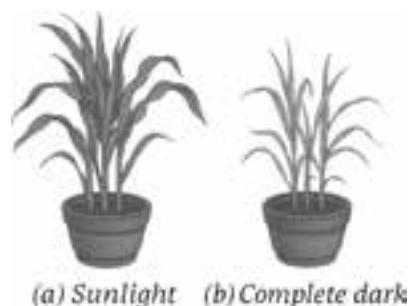
Y : Stands for Oxygen. Oxygen is required for the complete breakdown of glucose in aerobic respiration.

Z : Stands for Water. Water is another product of aerobic respiration along with carbon dioxide and energy.

So the equation is:

Glucose + Oxygen  $\rightarrow$  Carbon dioxide + Water + Energy

6. Krishna set-up an experiment with two potted plants of same size and placed one of them in sunlight and the other in a dark room, as shown in Figure.



Answer the following questions

1. What idea might she be testing through this experiment?
2. What are the visible differences in plants in both the conditions?
3. According to you, leaves of which plants confirm the iodine test for the presence of starch?

Ans :

- (i) Krishna might be testing the idea that sunlight is necessary for normal plant growth and for photosynthesis (production of starch). She is investigating the effect of the presence or absence of sunlight on plants, assuming other conditions like water and soil are similar.
- (ii) The plant kept in sunlight looks healthy and green as it performs photosynthesis while the plant kept in the dark room looks weak, pale, and yellowish because it cannot perform photosynthesis properly.
- (iii) The leaves of the plant kept in sunlight will confirm the iodine test for starch.

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7. Vani believes that 'carbon dioxide is essential for photosynthesis'. She puts an experimental set-up, as shown in Figure, to collect evidence to support or reject her idea. (Figure shows four potted plants with sufficient water under prescribed conditions:



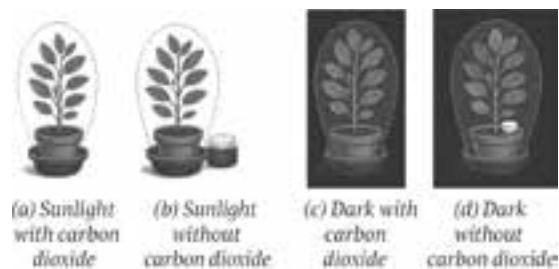


Figure : A potted plant with sufficient water is placed under the prescribed conditions

1. Sunlight with carbon dioxide
2. Sunlight without carbon dioxide
3. Dark with carbon dioxide
4. Dark without carbon dioxide.)

Answer the following questions-

- (1) In which plant(s) in the above set-up(s) will starch be formed?
- (2) In which plant(s) in the above set-up(s) will starch not be formed?
- (3) In which plant(s) in the above set-up(s) will oxygen be generated?
- (4) In which plant(s) in the above set-up(s) will oxygen not be generated?

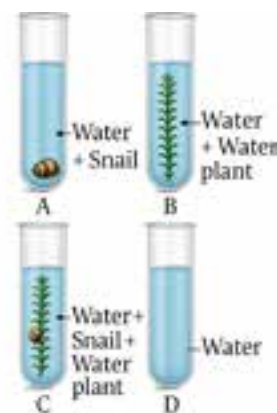
Ans :

For starch formation (photosynthesis) and oxygen generation, a plant needs sunlight, carbon dioxide, water (given as sufficient), and chlorophyll (assuming green potted plants).

- (i) Starch will be formed in plant (a) Sunlight with carbon dioxide.  
This is the only setup where all necessary conditions for photosynthesis (sunlight, carbon dioxide, water, chlorophyll) are met.
- (ii) Starch will not be formed (or will be negligibly formed if previously destarched) in plants:
  - (a) Sunlight without carbon dioxide : Lacks carbon dioxide.
  - (b) Dark with carbon dioxide : Lacks sunlight.
  - (c) Dark without carbon dioxide : Lacks both sunlight and carbon dioxide.
- (iii) Oxygen will be generated in plant (a) Sunlight with carbon dioxide. Oxygen is a byproduct of photosynthesis.
- (iv) Oxygen will not be generated (or negligibly generated) in plants:
  - (a) Sunlight without carbon dioxide : Photosynthesis cannot occur without  $\text{CO}_2$ .
  - (b) Dark with carbon dioxide : Photosynthesis cannot occur without light.

- (c) Dark without carbon dioxide : Photosynthesis cannot occur without light and  $\text{CO}_2$ .

8. Ananya took four test tubes and filled three-fourth of each test tube with water. She labelled them A, B, C, and D (Figure). In test tube A, she kept a snail; in test tube B, she kept a water plant; in test tube C, she kept both a snail and a plant. In test tube D, she kept only water. Ananya added a carbon dioxide indicator to all the test tubes. She recorded the initial colour of water and observed if there are any colour changes in the test tubes after 2-3 hours.



(Figure shows : A : Water + Snail; B : Water + Water plant; C : Water + Snail + Water plant; D : Water only.)

What do you think she wants to find out? How will she know if she is correct?

Ans :

Ananya wants to find out how plants and animals affect the amount of carbon dioxide in water. She is testing the role of respiration and photosynthesis. The carbon dioxide indicator changes colour depending on how much carbon dioxide is present in the water. Ananya will know she is correct by observing the colour changes in the carbon dioxide indicator in each test tube:

1. Test Tube A (Snail only): The indicator will turn yellow/orange, showing increased carbon dioxide due to the snail's respiration.
2. Test Tube B (Plant only): The indicator will turn blue/purple, showing decreased carbon dioxide because the plant uses it during photosynthesis.
3. Test Tube C (Snail + Plant): The colour may stay neutral or slightly blue, showing a balance as the snail gives out carbon dioxide

and the plant uses it.

4. Test Tube D (Only water): No colour change, as there is no living organism to add or remove carbon dioxide.
9. Design an experiment to observe if water transportation in plants is quicker in warm or cold conditions.

**Ans :**

To test whether water transportation in plants is quicker in warm or cold conditions, take two identical potted plants. Place one plant in a warm location (near a heater or sunny spot) and the other plant in a cool place (like in the shade). Add a few drops of food colouring to the water and water both plants. After a few hours, observe the movement of the coloured water up the stem and into the leaves. The plant in the warm conditions will show faster movement of the coloured water, as higher temperatures increase the rate of evaporation and water transportation.

10. Photosynthesis and respiration are essential to maintain balance in nature. Discuss.

**Ans :**

Photosynthesis removes carbon dioxide from the air, uses sunlight to turn it into glucose, and releases oxygen. Respiration—done by plants and animals—uses that oxygen to break down glucose, releasing energy, water and carbon dioxide. Each process supplies the gas the other needs, recycling carbon and keeping oxygen and carbon dioxide levels stable. This continuous give-and-take sustains food production, energy release and the overall balance of life on Earth.

## MULTIPLE CHOICE QUESTION

1. Unlike animals that eat food, how do most plants obtain the nutrients and energy they need for growth?
  - (A) By absorbing ready-made food from the soil through roots.
  - (B) By producing their own food using simple substances from the environment.
  - (C) By capturing and digesting small insects.
  - (D) By absorbing nutrients directly from the air through leaves.

**Ans :**

(B) By producing their own food using simple substances from the environment.

Plants are generally autotrophs, meaning they produce their own food through processes like photosynthesis, whereas animals are heterotrophs that rely on consuming other organisms for energy.

2. What are some visible changes mentioned that occur in plants as they grow?
  - (A) Change in color from green to brown.
  - (B) Movement from one place to another.
  - (C) Emergence of new leaves/branches, increase in height, thickening of stem.
  - (D) Production of sound and light.

**Ans :**

(C) Emergence of new leaves/branches, increase in height, thickening of stem.

The text lists observable signs of plant growth, including the development of new parts (leaves, branches), an increase in overall size (height), and thickening of supportive structures (stem).

3. What does the poor growth or death of the plant in Pot B (sunlight, no water) in Activity 10.1 indicate?
  - (A) Sunlight is harmful to plant growth.
  - (B) Water is essential for plant survival and growth.
  - (C) Soil quality was poor in Pot B.
  - (D) Plants do not need sunlight if they have soil.

**Ans :**

(B) Water is essential for plant survival and growth.

Comparing Pot A (with water) and Pot B (without water), both in sunlight, highlights the necessity of water for the plant to survive and grow.

4. What does the limited growth and potential yellowing of leaves in Pot C (dark, water) compared to Pot A (sunlight, water) in Activity 10.1 suggest?
  - (A) Water is not important if there is no sunlight.
  - (B) Darkness promotes faster growth.
  - (C) Sunlight is essential for healthy plant growth and maintaining green leaves.
  - (D) The soil in Pot C lacked nutrients.

**Ans :**

(C) Sunlight is essential for healthy plant growth and maintaining green leaves.

Comparing Pot A and Pot C, both receiving water, demonstrates the critical role of sunlight.



Without it, growth is stunted, and leaves may lose their green color due to lack of photosynthesis.

5. Which ancient Indian text, mentioned in the “Fascinating Facts” box, records observations about plant growth, soil, and agricultural practices like manure preparation?
- (A) Arthashastra  
(B) Charaka Samhita  
(C) Vrikshayurveda  
(D) Brihatsamhita

Ans :

(C) Vrikshayurveda

The text specifically names Vrikshayurveda as an ancient work containing knowledge about plant care, soil management, and agricultural techniques aimed at improving crop health and yield.

6. In what form do plants primarily store the food they produce?
- (A) Proteins  
(B) Fats  
(C) Starch (a type of carbohydrate)  
(D) Vitamins

Ans :

(C) Starch (a type of carbohydrate)

The food produced by plants, primarily in the form of glucose, is often converted into starch and stored in parts such as leaves, roots, or seeds.

7. Where does the production of food (photosynthesis) mainly occur in most plants?
- (A) Roots  
(B) Stem  
(C) Flowers  
(D) Leaves

Ans :

(D) Leaves

Leaves are referred to as the ‘food factories’ of plants because they are the primary sites where photosynthesis takes place, optimized by their structure and chlorophyll content.

8. What is the name of the green pigment present in leaves that helps capture sunlight energy?
- (A) Hemoglobin  
(B) Chlorophyll  
(C) Melanin  
(D) Carotene

Ans :

(B) Chlorophyll

Chlorophyll is the pigment responsible for the green color of leaves and plays the crucial role of absorbing light energy required for photosynthesis.

9. A leaf is boiled in water and then in alcohol before testing with iodine. What is the purpose of boiling the leaf in alcohol?
- (A) To add starch to the leaf.  
(B) To remove the chlorophyll (decolorize the leaf).  
(C) To soften the leaf cell walls.  
(D) To kill any bacteria on the leaf.

Ans :

(B) To remove the chlorophyll (decolorize the leaf).

Alcohol dissolves chlorophyll. Removing the green pigment makes it easier to observe the blue-black color change if starch is present when iodine is added.

10. What does a blue-black color change indicate when iodine solution is added to a decolorized leaf?
- (A) Presence of protein  
(B) Presence of chlorophyll  
(C) Absence of starch  
(D) Presence of starch

Ans :

(D) Presence of starch

The iodine test is a standard chemical test where iodine solution turns blue-black or dark violet in the presence of starch.

11. A leaf with green and non-green patches. After exposure to sunlight, only the green patches turn blue-black with iodine. What does this demonstrate?
- (A) Non-green patches store more starch.  
(B) Starch is produced only in the parts containing chlorophyll, using sunlight.  
(C) Sunlight destroys starch in non-green patches.  
(D) Iodine only works on green-colored tissues.

Ans :

(B) Starch is produced only in the parts containing chlorophyll, using sunlight.

This experiment links starch production directly to the presence of chlorophyll (in the green patches) and the availability of sunlight, as the non-green parts (lacking sufficient chlorophyll) do not produce detectable starch.

12. If the plant was kept in the dark before testing, why would even the green patches NOT show the presence of starch?  
 (A) Chlorophyll is destroyed in the dark.  
 (B) Starch turns into sugar in the dark.  
 (C) Sunlight is essential for photosynthesis (starch production) to occur.  
 (D) The plant uses up all stored starch for respiration in the dark.

Ans :

(C) Sunlight is essential for photosynthesis (starch production) to occur.

Keeping the plant in the dark prevents photosynthesis. Even with chlorophyll present, starch cannot be produced without light energy. Any previously stored starch might also be used up.

13. Why might some leaves appear red, violet, or brown instead of green?  
 (A) They lack chlorophyll entirely.  
 (B) They contain other pigments that mask the green chlorophyll.  
 (C) They perform a different type of photosynthesis.  
 (D) They absorb different colors of sunlight.

Ans :

(B) They contain other pigments that mask the green chlorophyll.

These leaves still contain chlorophyll, but the presence of larger amounts of other pigments (like anthocyanins or carotenoids) hides the green color. Photosynthesis often still occurs.

14. A part of a destarched leaf is enclosed in a bottle containing caustic soda (sodium hydroxide), and the plant is placed in sunlight. What is the purpose of the caustic soda?  
 (A) To provide nutrients to the leaf.  
 (B) To absorb carbon dioxide from the air inside the bottle.  
 (C) To keep the air inside the bottle moist.  
 (D) To react with chlorophyll.

Ans :

(B) To absorb carbon dioxide from the air inside the bottle.

Caustic soda (sodium hydroxide) is a chemical that readily absorbs carbon dioxide. Its use ensures that the part of the leaf inside the bottle is deprived of CO<sub>2</sub>.

15. The part of the leaf outside the bottle turns blue-black with iodine, but the part inside does not. What essential requirement for photosynthesis does this demonstrate?  
 (A) Water  
 (B) Chlorophyll  
 (C) Sunlight  
 (D) Carbon dioxide

Ans :

(D) Carbon dioxide

The only difference between the two parts of the leaf is access to carbon dioxide (removed inside the bottle by caustic soda). Since only the outside part produces starch, CO<sub>2</sub> must be essential.

16. What is the overall process called by which plants use sunlight, water, carbon dioxide, and chlorophyll to prepare their own food (glucose)?  
 (A) Respiration  
 (B) Transpiration  
 (C) Photosynthesis  
 (D) Germination

Ans :

(C) Photosynthesis

Photosynthesis is the specific term for the process where green plants synthesize food (glucose) using light energy, water, carbon dioxide, and chlorophyll.

17. Besides glucose (food), what important gas is released as a byproduct during photosynthesis?  
 (A) Carbon dioxide  
 (B) Nitrogen  
 (C) Oxygen  
 (D) Hydrogen

Ans :

(C) Oxygen

The experiment with the aquatic plant shows gas bubbles accumulating in sunlight. Testing this gas with a glowing splint (which relights or burns brighter) confirms it is oxygen, a by product of photosynthesis.

18. What is the word equation representing photosynthesis?  
 (A) Glucose + Oxygen → Carbon dioxide + Water + Energy  
 (B) Carbon dioxide + Water → (Sunlight, Chlorophyll) → Glucose + Oxygen  
 (C) Water + Sunlight → Oxygen + Hydrogen  
 (D) Glucose + Carbon dioxide → Starch + Water



Ans :

(B) Carbon dioxide + Water → (Sunlight, Chlorophyll) → Glucose + Oxygen

This equation correctly shows the inputs (CO<sub>2</sub>, water), necessary conditions (sunlight, chlorophyll), and outputs (glucose, oxygen) of the photosynthesis process.

19. Which Indian plant scientist studied the effects of water, temperature, and light color on photosynthesis?
- (A) C.V. Raman  
(B) Jagadish Chandra Bose  
(C) Kamala Sohonie  
(D) Rustom Hormusji Dastur

Ans :

(D) Rustom Hormusji Dastur

R.H. Dastur is mentioned in the "Know a Scientist" section specifically for his research on various factors affecting the process of photosynthesis in plants.

20. What are the tiny pores, usually found on the surface of leaves, that help in the exchange of gases (carbon dioxide and oxygen) with the atmosphere called?
- (A) Xylem  
(B) Phloem  
(C) Chloroplasts  
(D) Stomata

Ans :

(D) Stomata

Stomata are microscopic pores on the leaf epidermis, surrounded by guard cells, that regulate the intake of CO<sub>2</sub> and release of O<sub>2</sub> (and water vapor) during photosynthesis and respiration.

21. How do plants primarily take up water and dissolved minerals from the soil?
- (A) Through the leaves (stomata)  
(B) Through the stem  
(C) Through the roots  
(D) Through the flowers

Ans :

(C) Through the roots

The root system is specialized for absorbing water and essential mineral nutrients dissolved in the soil water, anchoring the plant as well.

22. What are the thin, tube-like structures within the plant that transport water and dissolved minerals from the roots up to the leaves and other parts?

- (A) Phloem  
(B) Stomata  
(C) Xylem  
(D) Epidermis

Ans :

(C) Xylem

Xylem is the vascular tissue in plants specifically responsible for the upward transport (conduction) of water and minerals absorbed by the roots.

23. A plant twig is placed in red-colored water. The red color appears in the stem, leaves, and flowers the next day. Which tissue is responsible for this upward transport?
- (A) Phloem  
(B) Stomata  
(C) Chlorophyll  
(D) Xylem

Ans :

(D) Xylem

The experiment demonstrates the function of the xylem. The red ink, dissolved in the water, is drawn up through the xylem vessels, making the transport pathway visible.

24. What are the thin, tube-like structures that transport the food (sugars produced during photosynthesis) from the leaves to other parts of the plant, like roots and fruits?
- (A) Xylem  
(B) Stomata  
(C) Phloem  
(D) Root hairs

Ans :

(C) Phloem

Phloem is the vascular tissue responsible for the translocation (transport) of sugars (food produced in the leaves) to parts of the plant where they are needed for growth or storage.

25. What is the main difference in the function of xylem and phloem?
- (A) Xylem transports food; phloem transports water.  
(B) Xylem transports water/minerals upwards; phloem transports food (sugars) usually downwards or to storage areas.  
(C) Xylem is for gas exchange; phloem is for water absorption.  
(D) Xylem provides support; phloem produces chlorophyll.

Ans :

(B) Xylem transports water/minerals upwards; phloem transports food (sugars) usually downwards or to storage areas.

Xylem's primary role is upward water and mineral transport from roots. Phloem's primary role is the transport of sugars produced during photosynthesis from leaves to other plant parts.

26. Do plants respire, similar to animals?
- (A) No, plants only perform photosynthesis.
  - (B) Yes, all living parts of a plant respire continuously.
  - (C) Only the roots of plants respire.
  - (D) Only the non-green parts of plants respire.

Ans :

(B) Yes, all living parts of a plant respire continuously.

Respiration is a fundamental life process occurring in all living cells, including plant cells, to release energy from food. Plants respire both day and night.

27. What gas do plants take in, and what gas do they release during respiration?
- (A) Take in carbon dioxide, release oxygen.
  - (B) Take in oxygen, release carbon dioxide.
  - (C) Take in nitrogen, release oxygen.
  - (D) Take in oxygen, release nitrogen.

Ans :

(B) Take in oxygen, release carbon dioxide.  
Plant respiration, like animal respiration, uses oxygen to break down glucose and releases carbon dioxide, water and energy as products.

28. What is the primary purpose of respiration in both plants and animals?
- (A) To produce food (glucose).
  - (B) To exchange gases with the environment.
  - (C) To transport water and minerals.
  - (D) To break down glucose and release usable energy for life processes.

Ans :

(D) To break down glucose and release usable energy for life processes.

Respiration is the essential process that converts the chemical energy stored in glucose into a form (like ATP) that cells can use to power their activities, growth, and maintenance.

29. The germinating seeds in a flask connected to lime water. Why does the lime water turn milky?

- (A) The seeds release oxygen during germination.
- (B) The seeds release carbon dioxide during respiration.
- (C) The seeds absorb carbon dioxide from the lime water.
- (D) The cotton wool reacts with the lime water.

Ans :

(B) The seeds release carbon dioxide during respiration.

Germinating seeds are actively respiring. They consume oxygen and release carbon dioxide as a waste product. This CO<sub>2</sub> travels through the tube and reacts with the lime water, turning it milky.

30. What is the word equation for respiration in plants (and animals)?

- (A) Carbon dioxide + Water → Glucose + Oxygen
- (B) Glucose + Oxygen → Carbon dioxide + Water + Energy
- (C) Glucose + Carbon dioxide → Oxygen + Water
- (D) Water + Energy → Glucose + Oxygen

Ans :

(B) Glucose + Oxygen → Carbon dioxide + Water + Energy

This equation correctly shows the inputs (glucose, oxygen) and outputs (carbon dioxide, water, energy) of the cellular respiration process.

31. How do photosynthesis and respiration differ in terms of gas exchange in plants?

- (A) Both use CO<sub>2</sub> and release O<sub>2</sub>.
- (B) Both use O<sub>2</sub> and release CO<sub>2</sub>.
- (C) Photosynthesis uses CO<sub>2</sub> and releases O<sub>2</sub>; Respiration uses O<sub>2</sub> and releases CO<sub>2</sub>.
- (D) Photosynthesis uses O<sub>2</sub> and releases CO<sub>2</sub>; Respiration uses CO<sub>2</sub> and releases O<sub>2</sub>.

Ans :

(C) Photosynthesis uses CO<sub>2</sub> and releases O<sub>2</sub>; Respiration uses O<sub>2</sub> and releases CO<sub>2</sub>.

The gas exchange is opposite : Photosynthesis consumes carbon dioxide and produces oxygen, while respiration consumes oxygen and produces carbon dioxide.

32. During the daytime, a green plant is performing both photosynthesis and respiration. What is the net gas exchange typically observed?

- (A) Net release of CO<sub>2</sub>, net uptake of O<sub>2</sub>.
- (B) Net uptake of CO<sub>2</sub>, net release of O<sub>2</sub>.
- (C) No net gas exchange.
- (D) Net release of both CO<sub>2</sub> and O<sub>2</sub>.



Ans :

(B) Net uptake of  $\text{CO}_2$ , net release of  $\text{O}_2$ .

In sufficient light, the rate of photosynthesis usually exceeds the rate of respiration. Therefore, the plant takes in more  $\text{CO}_2$  than it releases, and releases more  $\text{O}_2$  than it consumes.

33. Which Indian woman scientist received a Ph.D. for contributions to the understanding of respiration in plants?

(A) Janaki Ammal  
(B) Asima Chatterjee  
(C) Kamala Sohanie  
(D) Tessy Thomas

Ans :

(C) Kamala Sohanie

The "Know a Scientist" box features Kamala Sohanie and mentions her Ph.D. was awarded for her work in the area of plant respiration.

34. Complete the table comparing Photosynthesis and Respiration regarding 'Products'.

(A) Photo : Carbon dioxide, Water, Energy; Resp : Glucose, Oxygen  
(B) Photo : Glucose, Oxygen; Resp : Carbon dioxide, Water, Energy  
(C) Photo : Water, Energy; Resp : Sunlight, Chlorophyll  
(D) Photo : Carbon dioxide, Water; Resp : Starch, Oxygen

Ans :

(B) Photo : Glucose, Oxygen; Resp : Carbon dioxide, Water, Energy

Photosynthesis produces glucose (food) and oxygen. Respiration produces carbon dioxide, water and releases energy.

35. If all photosynthesizing organisms disappeared, what major impact would it have on other living organisms?

(A) Increase in atmospheric oxygen levels.  
(B) Decrease in global temperatures.  
(C) Lack of food source for most food chains and depletion of atmospheric oxygen.  
(D) Increase in available water resources.

Ans :

(C) Lack of food source for most food chains and depletion of atmospheric oxygen.

Photosynthesis produces the food that forms the base of almost all food chains and replenishes the atmospheric oxygen essential for the respiration of most animals, including humans.

36. A potato slice tests positive for starch. Where was this food originally synthesized in the potato plant, and how did it reach the potato tuber?

(A) Synthesized in roots, transported by xylem.  
(B) Synthesized in leaves (photosynthesis), transported to the tuber (storage organ) via phloem.  
(C) Synthesized in the tuber itself.  
(D) Absorbed directly from the soil as starch.

Ans :

(B) Synthesized in leaves (photosynthesis), transported to the tuber (storage organ) via phloem.

Food (glucose, then starch) is made in the leaves. It is then transported through the phloem tissue to storage organs like the potato tuber (a modified stem).

37. How does the broad, flat structure of most leaves benefit photosynthesis?

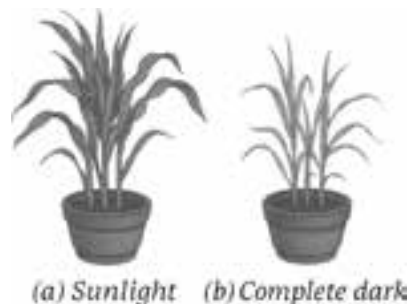
(A) It reduces water loss.  
(B) It provides a large surface area for capturing sunlight and absorbing carbon dioxide.  
(C) It helps the plant stay cool.  
(D) It makes the leaves stronger against wind.

Ans :

(B) It provides a large surface area for capturing sunlight and absorbing carbon dioxide.

A large, flat surface maximizes the exposure to sunlight and allows for numerous stomata, facilitating efficient absorption of the necessary ingredients for photosynthesis.

38. In Krishna's experiment (Figure), what idea is likely being tested by comparing a plant in sunlight with one in the dark?



(A) The effect of water on plant growth.  
(B) The role of soil type in photosynthesis.  
(C) The necessity of sunlight for photosynthesis/ healthy growth.  
(D) The effect of temperature on leaf color.

Ans :

(C) The necessity of sunlight for photosynthesis/ healthy growth.

By keeping all other conditions (water, soil, plant type) similar and varying only the light availability, the experiment aims to demonstrate the importance of sunlight.

39. In Vani's experiment (Figure), which setup(s) will likely show the presence of starch after a period of exposure?



- (A) Only (a) Sunlight with CO<sub>2</sub>
- (B) Only (b) Sunlight without CO<sub>2</sub>
- (C) Both (a) and (c)
- (D) Both (a) and (b)

Ans :

(A) Only (a) Sunlight with CO<sub>2</sub>  
Starch production (photosynthesis) requires sunlight AND carbon dioxide (along with water and chlorophyll). Only setup (a) provides both sunlight and assumes normal CO<sub>2</sub> availability. Setup (b) lacks CO<sub>2</sub>, (c) lacks sunlight, (d) lacks both.

40. In Vani's experiment (Figure), in which setup(s) will oxygen be generated?



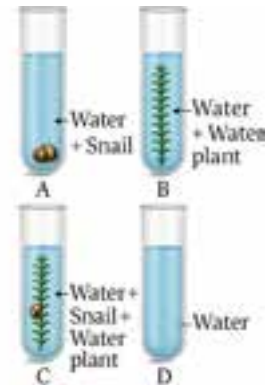
- (A) Only (a) Sunlight with CO<sub>2</sub>
- (B) Only (b) Sunlight without CO<sub>2</sub>
- (C) Both (a) and (c)
- (D) Both (a) and (b)

Ans :

(A) Only (a) Sunlight with CO<sub>2</sub>  
Oxygen is produced as a byproduct of photosynthesis. Since photosynthesis requires

both sunlight and CO<sub>2</sub> (and water/chlorophyll), oxygen will only be generated in significant amounts in setup (a).

41. In Ananya's experiment (Figure) with snails, plants, and CO<sub>2</sub> indicator, what process is the snail primarily carrying out that would affect the indicator?

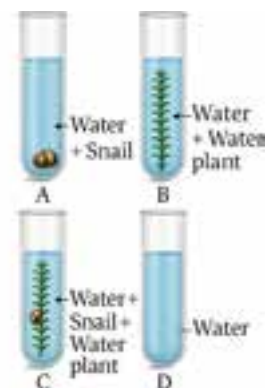


- (A) Photosynthesis
- (B) Respiration (releasing CO<sub>2</sub>)
- (C) Water absorption
- (D) Growth

Ans :

(B) Respiration (releasing CO<sub>2</sub>)  
Animals like snails respire, consuming oxygen and releasing carbon dioxide. This released CO<sub>2</sub> would react with the indicator.

42. In Ananya's experiment (Figure), what process is the water plant primarily carrying out in the light that would affect the CO<sub>2</sub> indicator?



- (A) Respiration (releasing CO<sub>2</sub>)
- (B) Water absorption
- (C) Photosynthesis (using CO<sub>2</sub>)
- (D) Decay



Ans :

(C) Photosynthesis (using  $\text{CO}_2$ )

In the presence of light, the water plant will perform photosynthesis, consuming carbon dioxide from the water, which would affect the indicator. (It also respire, but photosynthesis usually dominates in light).

43. Identify X, Y, and Z in the respiration equation :  
 $X + Y \rightarrow \text{Carbon dioxide} + Z + \text{Energy}$ .

- (A) X=Water, Y=Carbon dioxide, Z=Glucose  
 (B) X=Oxygen, Y=Glucose, Z=Sunlight  
 (C) X=Glucose, Y=Oxygen, Z=Water  
 (D) X=Carbon dioxide, Y=Sunlight, Z=Oxygen

Ans :

(C) X=Glucose, Y=Oxygen, Z=Water

The equation represents cellular respiration where glucose (X) is broken down using oxygen (Y), producing carbon dioxide, water (Z), and energy.

44. How are photosynthesis and respiration essential for maintaining balance in nature, particularly regarding atmospheric gases?

- (A) Both processes produce oxygen.  
 (B) Photosynthesis uses  $\text{CO}_2$  and releases  $\text{O}_2$ , while respiration uses  $\text{O}_2$  and releases  $\text{CO}_2$ , creating a cycle.  
 (C) Both processes consume carbon dioxide.  
 (D) Respiration purifies the air by removing pollutants.

Ans :

(B) Photosynthesis uses  $\text{CO}_2$  and releases  $\text{O}_2$ , while respiration uses  $\text{O}_2$  and releases  $\text{CO}_2$ , creating a cycle.

These two processes are complementary. Photosynthesis removes  $\text{CO}_2$  and adds  $\text{O}_2$  to the atmosphere, while respiration does the opposite, helping to maintain relatively stable levels of these gases.

45. A sealed bottle garden with a plant inside continues to thrive. Why doesn't the plant run out of oxygen or carbon dioxide if the bottle is sealed?

- (A) The plant stops needing gases once sealed.  
 (B) Gases can pass through the glass bottle.  
 (C) The plant recycles gases :  $\text{CO}_2$  from respiration is used for photosynthesis, and  $\text{O}_2$  from photosynthesis is used for respiration.  
 (D) The soil provides all necessary gases.

Ans :

(C) The plant recycles gases :  $\text{CO}_2$  from respiration is used for photosynthesis, and  $\text{O}_2$  from photosynthesis is used for respiration.

Inside the sealed environment, the plant creates a mini-ecosystem. It performs both photosynthesis (using  $\text{CO}_2$ , releasing  $\text{O}_2$ ) and respiration (using  $\text{O}_2$ , releasing  $\text{CO}_2$ ), effectively recycling the essential gases needed for its survival.

46. Which statement correctly compares the inputs and outputs of photosynthesis and respiration?

- (A) Photosynthesis inputs  $\text{CO}_2/\text{H}_2\text{O}$ , outputs Glucose/ $\text{O}_2$ ; Respiration inputs Glucose/ $\text{O}_2$ , outputs  $\text{CO}_2/\text{H}_2\text{O}/\text{Energy}$ .  
 (B) Photosynthesis inputs Glucose/ $\text{O}_2$ , outputs  $\text{CO}_2/\text{H}_2\text{O}$ ; Respiration inputs  $\text{CO}_2/\text{H}_2\text{O}$ , outputs Glucose/ $\text{O}_2/\text{Energy}$ .  
 (C) Both use Glucose/ $\text{O}_2$  and produce  $\text{CO}_2/\text{H}_2\text{O}$ .  
 (D) Both use  $\text{CO}_2/\text{H}_2\text{O}$  and produce Glucose/ $\text{O}_2$ .

Ans :

(A) Photosynthesis inputs  $\text{CO}_2/\text{H}_2\text{O}$ , outputs Glucose/ $\text{O}_2$ ; Respiration inputs Glucose/ $\text{O}_2$ , outputs  $\text{CO}_2/\text{H}_2\text{O}/\text{Energy}$ .

This accurately summarizes the key reactants (inputs) and products (outputs) for both fundamental processes, highlighting their complementary nature regarding gases and glucose.

47. Water and minerals are absorbed by roots. How do they reach the leaves where photosynthesis occurs?

- (A) Through phloem tissue  
 (B) By diffusing through the air spaces in the stem  
 (C) Through xylem tissue  
 (D) By evaporating and condensing in the leaves

Ans :

(C) Through xylem tissue

Xylem vessels form a continuous network from roots through the stem to the leaves, providing the pathway for the upward transport of water and dissolved minerals.

48. Where does the energy required for photosynthesis come from?

- (A) Chemical energy stored in water  
 (B) Heat energy from the soil  
 (C) Light energy from the sun  
 (D) Energy released during respiration

Ans :

(C) Light energy from the sun

Photosynthesis is the process of converting light energy, primarily from sunlight captured by chlorophyll, into chemical energy stored in glucose molecules.

49. Which of the following is NOT essential for photosynthesis to occur?  
 (A) Carbon dioxide  
 (B) Water  
 (C) Oxygen  
 (D) Sunlight (or suitable light source)

Ans :

(C) Oxygen  
 Carbon dioxide, water, light energy, and chlorophyll are all necessary inputs or conditions for photosynthesis. Oxygen is a product released during the process, not a requirement.

50. If a plant leaf is coated with petroleum jelly (vaseline) on both surfaces, what process would be most significantly hindered?  
 (A) Absorption of water by roots.  
 (B) Transport of food through phloem.  
 (C) Gas exchange through stomata (CO<sub>2</sub> intake, O<sub>2</sub> release).  
 (D) Absorption of sunlight by chlorophyll.

Ans :

(C) Gas exchange through stomata (CO<sub>2</sub> intake, O<sub>2</sub> release).  
 Petroleum jelly would block the stomata (pores) on the leaf surfaces, preventing the necessary exchange of carbon dioxide and oxygen required for photosynthesis and respiration.

51. Plants store food as starch. When needed, this starch can be broken down back into glucose. Why is glucose important for the plant?  
 (A) It provides green color to the leaves.  
 (B) It absorbs water from the soil.  
 (C) It is used during respiration to release energy for the plant's life activities.  
 (D) It helps in the transport of minerals.

Ans :

(C) It is used during respiration to release energy for the plant's life activities.  
 Glucose is the primary fuel source for cellular respiration. Plants break down glucose (obtained directly from photosynthesis or from stored starch) to generate the energy required for growth, repair, and other metabolic processes.

52. Besides leaves, can other green parts of a plant, like some stems, perform photosynthesis?  
 (A) No, only leaves can photosynthesize.  
 (B) Yes, any plant part containing chlorophyll can potentially photosynthesize if exposed to light.  
 (C) No, stems are only for transport and support.  
 (D) Yes, but they produce different sugars than leaves.

Ans :

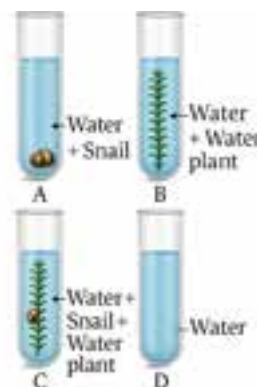
(B) Yes, any plant part containing chlorophyll can potentially photosynthesize if exposed to light. While leaves are the primary site, it is also noted that other green parts (containing chlorophyll), such as young stems in some plants, can also carry out photosynthesis..

53. **Assertion (A) :** Plants release oxygen during the day.  
**Reason (R) :** Oxygen is a product of photosynthesis, which occurs in the presence of sunlight.  
 (A) Both A and R are true, and R is the correct explanation of A.  
 (B) Both A and R are true, but R is not the correct explanation of A.  
 (C) A is true, but R is false.  
 (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.  
 Plants do release oxygen during daylight hours (Assertion A). This happens because oxygen is generated during photosynthesis, a process that requires sunlight (Reason R). Thus, R correctly explains A.

54. In Ananya's experiment (Figure), what might happen in test tube C containing both a snail and a plant, placed in light?



- (A) CO<sub>2</sub> levels will definitely increase due to the snail.  
 (B) CO<sub>2</sub> levels will definitely decrease due to the plant.  
 (C) CO<sub>2</sub> levels might remain relatively stable or change depending on the balance between snail respiration and plant photosynthesis/respiration.  
 (D) The water will evaporate quickly.

Ans :

(C) CO<sub>2</sub> levels might remain relatively stable or change depending on the balance between snail respiration and plant photosynthesis/respiration. The snail produces CO<sub>2</sub> (respiration), while the plant uses CO<sub>2</sub> (photosynthesis) and produces CO<sub>2</sub> (respiration). The net change in CO<sub>2</sub> depends on the relative rates of these processes.

55. **Assertion (A)** : Transport of water from roots to leaves occurs through phloem.

**Reason (R)** : Transport of food from leaves to other parts occurs through xylem.

- (A) Both A and R are true.  
 (B) Both A and R are false.  
 (C) A is true, but R is false.  
 (D) A is false, but R is true.

Ans :

(B) Both A and R are false.  
 Assertion A is false; water/minerals move via xylem. Reason R is false; food moves via phloem. The functions are reversed in the statements.

56. Why is it important for gardeners or farmers to ensure plants have adequate water, sunlight, and nutrients (minerals)?

- (A) To make the plants look decorative.  
 (B) To support the essential life processes of photosynthesis and respiration, leading to healthy growth and yield.  
 (C) To prevent insects from attacking the plants.  
 (D) To encourage plants to grow faster than normal.

Ans :

(B) To support the essential life processes of photosynthesis and respiration, leading to healthy growth and yield.

Water, sunlight, CO<sub>2</sub>, and minerals are crucial inputs for photosynthesis (food production) and overall plant metabolism (including respiration for energy), which directly impact the plant's

health, growth, and productivity (e.g., fruit/crop yield).

## MATCHING TYPE QUESTION

57. Match the plant process in Column A with its primary requirement or product in Column B:

	Column A		Column B
1.	Photosynthesis	A.	Release of energy from glucose
2.	Respiration	B.	Uptake of water and minerals from soil
3.	Starch Test (Iodine)	C.	Production of glucose and oxygen using sunlight
4.	Root Absorption	D.	Indicates presence of stored food in leaves

- (a) 1-C, 2-A, 3-D, 4-B  
 (b) 1-A, 2-C, 3-B, 4-D  
 (c) 1-C, 2-D, 3-A, 4-B  
 (d) 1-D, 2-A, 3-B, 4-C

Ans :

(a) 1-C, 2-A, 3-D, 4-B  
 Photosynthesis produces glucose and oxygen using sunlight. Respiration releases energy from glucose. The iodine test checks for starch. Roots absorb water and minerals from the soil.

58. Match the plant structure in Column A with its main function in Column B:

	Column A		Column B
1.	Stomata	A.	Transports food from leaves to other parts
2.	Xylem	B.	Green pigment that absorbs sunlight for photosynthesis
3.	Phloem	C.	Tiny pores on leaves for gas exchange
4.	Chlorophyll	D.	Transports water and minerals from roots to leaves

- (a) 1-D, 2-C, 3-B, 4-A  
 (b) 1-C, 2-A, 3-D, 4-B  
 (c) 1-A, 2-D, 3-C, 4-B  
 (d) 1-C, 2-D, 3-A, 4-B

Ans :

(d) 1-C, 2-D, 3-A, 4-B

Stomata are pores for gas exchange. Xylem transports water and minerals upwards. Phloem transports food. Chlorophyll is the pigment that captures sunlight for photosynthesis.

59. Match the reactant or condition for photosynthesis in Column A with its source or role in Column B:

	Column A		Column B
1.	Carbon Dioxide	A.	Absorbed by roots from the soil
2.	Water	B.	Trapped by chlorophyll in leaves
3.	Sunlight	C.	Gas taken from the atmosphere through stomata
4.	Glucose	D.	Simple carbohydrate produced as food

- (a) 1-B, 2-A, 3-D, 4-C
- (b) 1-C, 2-D, 3-A, 4-B
- (c) 1-C, 2-A, 3-B, 4-D
- (d) 1-A, 2-C, 3-B, 4-D

Ans :

(c) 1-C, 2-A, 3-B, 4-D

Carbon dioxide is taken from air via stomata. Water is absorbed by roots. Sunlight energy is trapped by chlorophyll. Glucose is the food produced during photosynthesis.

60. Match the experimental observation in Column A with the conclusion it supports in Column B:

	Column A		Column B
1.	Leaf from a plant in dark shows no starch	A.	Oxygen is released during photosynthesis
2.	Part of leaf inside bottle with caustic soda shows no starch	B.	Chlorophyll is necessary for photosynthesis
3.	Bubbles from an aquatic plant in sunlight	C.	Sunlight is necessary for photosynthesis
4.	Only green parts of a variegated leaf show starch	D.	Carbon dioxide is necessary for photosynthesis

- (a) 1-C, 2-D, 3-A, 4-B
- (b) 1-D, 2-A, 3-C, 4-B

(c) 1-C, 2-B, 3-D, 4-A

(d) 1-A, 2-D, 3-B, 4-C

Ans :

(a) 1-C, 2-D, 3-A, 4-B

No starch in dark shows sunlight is needed. No starch with caustic soda (absorbs CO<sub>2</sub>) shows CO<sub>2</sub> is needed. Bubbles in sunlight indicate oxygen release. Starch only in green parts shows chlorophyll is needed.

61. Match the term related to plant life processes in Column A with its correct association in Column B:

	Column A		Column B
1.	'Food Factories'	A.	Process releasing CO <sub>2</sub> in plants (e.g., germinating seeds)
2.	Respiration in plants	B.	Primary sites for photosynthesis (leaves)
3.	Photosynthesis equation output	C.	Transport tissue for water and minerals
4.	Xylem	D.	Glucose and Oxygen

- (a) 1-D, 2-A, 3-C, 4-B
- (b) 1-B, 2-C, 3-D, 4-A
- (c) 1-B, 2-A, 3-D, 4-C
- (d) 1-A, 2-D, 3-B, 4-C

Ans :

(c) 1-B, 2-A, 3-D, 4-C

Leaves are called 'food factories' due to photosynthesis. Plant respiration releases carbon dioxide. Photosynthesis produces glucose and oxygen. Xylem transports water and minerals

### VERY SHORT QUESTION

62. Besides water, what environmental factor is shown to be essential for plant growth ?

Ans :

Sunlight

63. In what form do plants primarily store food?

Ans :

Starch



64. What is the green pigment in leaves called that captures sunlight?

Ans :

Chlorophyll

65. What colour change indicates the presence of starch when iodine solution is added to a leaf?

Ans :

Blue-black

66. What process must be done to a leaf before the iodine test to make colour changes easily visible?

Ans :

Decolorization (usually using alcohol)

67. Which part of a leaf (green or non-green patches) produces starch in the presence of sunlight?

Ans :

Green patches

68. What chemical is used to absorb carbon dioxide?

Ans :

Caustic soda (Sodium hydroxide)

69. What gas from the air is essential for plants to make food (starch)?

Ans :

Carbon dioxide

70. What is the process called by which plants prepare their own food using sunlight, water, carbon dioxide, and chlorophyll?

Ans :

Photosynthesis

71. What are the primary 'food factories' of most plants?

Ans :

Leaves

72. What gas is released by plants during photosynthesis?

Ans :

Oxygen

73. What test can be used to show that the gas released during photosynthesis is oxygen?

Ans :

Inserting a glowing/lit matchstick (relights/burns brighter)

74. What simple carbohydrate is actually produced first during photosynthesis?

Ans :

Glucose

75. What tiny pores on the leaf surface help in the exchange of gases?

Ans :

Stomata

76. Which plant tissue transports water and minerals from the roots to the leaves?

Ans :

Xylem

77. Which plant tissue transports food prepared in the leaves to other parts of the plant?

Ans :

Phloem

78. Do plants respire (break down food for energy)?

Ans :

Yes

79. What gas do plants primarily take in during respiration?

Ans :

Oxygen

80. What gas do plants primarily release during respiration?

Ans :

Carbon dioxide

81. In the respiration equation (Glucose + Oxygen → ? + ? + Energy), what are the two chemical products besides energy?

Ans :

Carbon dioxide and Water

82. Write the word equation for photosynthesis.

Ans :

Carbon dioxide + Water  $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$  Glucose + Oxygen

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## SHORT ANSWER QUESTION

83. Explain the roles of sunlight and water in plant growth.

**Ans :**

The activity shows plants need both sunlight and water for healthy growth. Plants deprived of either sunlight (Pot C) or water (Pot B) did not grow well compared to the plant with both (Pot A).

84. Why are leaves generally green and broad? How does this help the plant?

**Ans :**

Leaves are green due to chlorophyll, which absorbs sunlight for photosynthesis. Their broad, flat shape maximizes the surface area exposed to sunlight for efficient energy capture.

85. Describe the steps involved in testing a leaf for the presence of starch using iodine.

**Ans :**

Boil the leaf in water to soften it. Then, boil it in alcohol (in a water bath) to remove chlorophyll (decolourise). Wash the leaf, spread it out, and add iodine solution. A blue-black colour indicates starch.

86. How does demonstrate that carbon dioxide is essential for photosynthesis?

**Ans :**

The part of the leaf inside the bottle (with caustic soda absorbing  $\text{CO}_2$ ) did not produce starch (no blue-black colour), while the part outside (with access to atmospheric  $\text{CO}_2$ ) did. This shows  $\text{CO}_2$  is required.

87. What happens to the glucose produced during photosynthesis?

**Ans :**

Glucose provides immediate energy for the plant. Excess glucose is converted into starch, a complex carbohydrate, which is stored in various parts of the plant for later use.

88. What are stomata and what is their function in photosynthesis?

**Ans :**

Stomata are tiny pores, usually on the leaf surface. They allow the plant to take in carbon dioxide from the air and release oxygen produced during photosynthesis.

89. Explain the function of xylem tissue in plants

**Ans :**

Xylem consists of tube-like structures that transport water and dissolved minerals from the roots upwards to the stem, leaves, and flowers. Red-coloured water moving up through these tubes (xylem).

90. What is the function of phloem tissue in plants?

**Ans :**

Phloem tissue consists of tubes that transport the food (sugars like glucose produced during photosynthesis) from the leaves to all other parts of the plant where it is needed for growth or storage.

91. Do plants respire only at night, or all the time? Explain briefly.

**Ans :**

Plants respire all the time (day and night). Respiration is the process of breaking down food (glucose) to release energy, which is constantly needed for life processes.

92. Compare the gases taken in and released during photosynthesis and respiration in plants.

**Ans :**

Photosynthesis takes in carbon dioxide and releases oxygen. Respiration takes in oxygen and releases carbon dioxide.

93. Why is respiration necessary for plants, even though they produce their own food?

**Ans :**

Photosynthesis produces food (glucose), but respiration is needed to break down that glucose to release the stored chemical energy in a form the plant can use for growth, repair, and other life functions.

94. Can non-green parts of a plant perform photosynthesis? Why or why not?

**Ans :**

Generally, no. Photosynthesis requires the green pigment chlorophyll to capture sunlight



energy. Non-green parts typically lack sufficient chlorophyll to carry out the process effectively.

95. Can non-green parts of a plant respire? Explain.

Ans :

Yes, all living parts of a plant, whether green or non-green (like roots, stems, flowers), respire continuously to release energy needed for their survival and function.

96. What are the raw materials needed by plants for photosynthesis?

Ans :

The raw materials are carbon dioxide (from air) and water (from soil). Sunlight (energy source) and chlorophyll (pigment) are also essential conditions.

97. What are the products of photosynthesis?

Ans :

The main products are glucose (a simple sugar/carbohydrate, used as food) and oxygen (released as a gas).

98. How do plants obtain water and minerals for their life processes?

Ans :

Plants absorb water and dissolved minerals from the soil through their roots. This water and mineral solution is then transported upwards to the rest of the plant via the xylem tissue.

99. Why is chlorophyll essential for photosynthesis?

Ans :

Chlorophyll is the pigment that absorbs light energy from the sun. This captured energy is used to power the chemical reaction that converts carbon dioxide and water into glucose.

## LONG ANSWER QUESTION

100. Describe two experiments that demonstrate the essential requirements for photosynthesis, other than water. Explain the setup, procedure, observations, and conclusions for each.

Ans :

**Sunlight Requirement:**

- (1) Setup : Use a potted plant with variegated (green and non-green) leaves. Keep one such plant in sunlight and another identical one in complete darkness for 36 hours.
- (2) Procedure : Pluck a leaf from each plant. Test both leaves for starch using the iodine test (boil in water, decolourise in alcohol, add iodine).
- (3) Observation : For the sunlit leaf, only the green parts turn blue-black. For the dark-kept leaf, no part turns blue-black.
- (4) Conclusion : Sunlight and chlorophyll are necessary for starch production (photosynthesis).

**Carbon Dioxide Requirement:**

- (1) Setup : Use a destarched potted plant. Enclose half of one leaf inside a bottle containing caustic soda (absorbs  $\text{CO}_2$ ), sealing it with a split cork. Leave the other half exposed to air. Place the setup in sunlight.
  - (2) Procedure : After several hours, remove the leaf and test the entire leaf for starch using the iodine test.
  - (3) Observation : The part of the leaf outside the bottle turns blue-black, while the part inside does not.
  - (4) Conclusion : Carbon dioxide from the air is necessary for photosynthesis.
101. Explain the overall process of photosynthesis. Include the site where it occurs, the necessary inputs, the energy source, the catalyst (pigment), the products formed, and the word equation.

Ans :

Photosynthesis is the process by which green plants synthesize their own food. It primarily occurs in the leaves, specifically within chloroplasts containing the green pigment chlorophyll. The necessary inputs (raw materials) are carbon dioxide (taken from the air through stomata) and water (absorbed by roots and transported via xylem). The energy source is sunlight, captured by chlorophyll. Chlorophyll acts as a catalyst, facilitating the reaction. During the process, light energy converts carbon dioxide and water into glucose (a simple sugar used as food) and oxygen (released into the atmosphere through stomata).

Carbon dioxide + Water  $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$  Glucose + Oxygen

102. Compare and contrast the processes of photosynthesis and respiration in plants. Discuss when each occurs, the primary site, the inputs, the outputs, and the overall purpose.

Ans :

Feature	Photosynthesis	Respiration
Purpose	To produce food (glucose)	To release energy from food (glucose)
Timing	Only occurs in the presence of light	Occurs continuously (day and night)
Site	Primarily in chloroplasts (leaves)	In all living cells
Inputs	Carbon dioxide, Water, Light energy	Glucose, Oxygen
Outputs	Glucose, Oxygen	Carbon dioxide, Water, Energy (ATP)
Energy Flow	Stores light energy as chemical energy	Releases chemical energy for use

103. Describe the transport system in plants. Explain the functions of xylem and phloem tissues and how they facilitate the movement of essential substances throughout the plant.

Ans :

Plants have a vascular system for transport, composed mainly of xylem and phloem tissues.

- (1) Xylem : Consists of tube-like cells forming continuous vessels from roots to leaves. Its function is the transport of water and dissolved minerals absorbed by the roots upwards to the stem, leaves, and other parts. This movement is primarily driven by transpiration pull (evaporation from leaves).
- (2) Phloem : Consists of another set of tube-like cells. Its function is the transport of food (sugars like glucose/sucrose) produced during photosynthesis in the leaves (source) to all other parts of the plant where it's needed for energy, growth, or storage (sink), such as roots, fruits, and growing tips. This transport can occur both upwards and downwards.

104. Explain the significance of stomata in the life processes of a plant. Describe their structure briefly and mention the two main processes they facilitate.

Ans :

Stomata are tiny pores, usually located on the underside of leaves, flanked by guard cells that control their opening and closing. Their significance lies in facilitating crucial gas exchange.

- (1) Photosynthesis : Stomata allow the intake of carbon dioxide (CO<sub>2</sub>) from the atmosphere, which is essential raw material for photosynthesis. They also allow the release of oxygen (O<sub>2</sub>), a byproduct of photosynthesis.
- (2) Transpiration : They also allow water vapour to escape from the leaf into the atmosphere. While this leads to water loss, it also creates the transpiration pull necessary for water absorption and transport through the xylem. Thus, stomata play a vital role in both food production and water transport regulation.

105. What is meant by 'destarching' a plant? Why is this step necessary before conducting experiments (testing for CO<sub>2</sub> requirement)?

Ans :

Destarching means removing any previously stored starch from the leaves of a plant. This is usually done by keeping the plant in complete darkness for 2-3 days. During this time, the plant uses up its stored starch for respiration, but cannot produce new starch via photosynthesis due to lack of light. This step is necessary before experiments testing requirements for photosynthesis (like CO<sub>2</sub>) to ensure that any starch detected at the end of the experiment was actually produced during the experiment under the test conditions, and is not just leftover stored starch from before.

106. How do plants obtain the raw materials (carbon dioxide and water) needed for photosynthesis? Trace the path of each from the environment into the leaf cells where photosynthesis occurs.

Ans :

- (1) Carbon Dioxide (CO<sub>2</sub>) : Obtained from the atmosphere. CO<sub>2</sub> gas enters the leaf through tiny pores called stomata, usually located on the underside. From there, it diffuses through air spaces within the leaf to reach the photosynthetic cells (mainly mesophyll cells containing chloroplasts).
- (2) Water (H<sub>2</sub>O) : Absorbed from the soil by the roots. It travels upwards through the stem and into the leaves via the xylem tissue. Water then moves from the xylem vessels into the surrounding leaf cells, reaching the chloroplasts where photosynthesis takes place.



## CASE BASED QUESTION

- 107.** Although plants release oxygen during photosynthesis, they also need oxygen for respiration. Explain how plants manage this gas exchange and why both processes are vital for the plant's survival.

**Ans :**

Plants manage gas exchange primarily through stomata. During the day, photosynthesis is usually much more active than respiration. So, while plants are taking in  $\text{CO}_2$  and releasing  $\text{O}_2$  for photosynthesis, they are simultaneously taking in some  $\text{O}_2$  and releasing some  $\text{CO}_2$  for respiration. The net effect during the day is usually  $\text{CO}_2$  uptake and  $\text{O}_2$  release. At night, photosynthesis stops (no light), but respiration continues, so plants take in  $\text{O}_2$  and release  $\text{CO}_2$ . Both processes are vital : Photosynthesis produces the food (glucose) needed for energy and building blocks. Respiration releases the energy stored in that glucose, powering all life functions.

- 108.** Discuss the statement "Leaves are the 'food factories' of plants". Explain why this analogy is used and what processes and structures within the leaf support this function.

**Ans :**

This analogy is used because leaves are the primary site where plants produce their own food (glucose) through photosynthesis, much like a factory produces goods. Supporting Structures/ Processes:

Broad, flat shape : Maximizes sunlight absorption.

- (1) Chlorophyll : Green pigment within chloroplasts captures light energy.
- (2) Stomata : Pores allow intake of  $\text{CO}_2$  and release of  $\text{O}_2$ .
- (3) Xylem : Transports water from roots to the leaf cells.
- (4) Phloem : Transports the manufactured food (sugars) away from the leaf to other parts. These features work together efficiently within the leaf to carry out the complex process of synthesizing food using simple raw materials and light energy.

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- 109.** A gardener grows tomato plants. Plant X is kept in a sunny spot and watered regularly. Plant Y is kept in the same sunny spot but is not watered for two weeks. Plant Z is kept indoors in a dark cupboard but watered regularly.

1. Which plant (X, Y, or Z) would likely show the healthiest growth? Why?
2. What essential process for food production cannot occur properly in Plant Z? Why?
3. What is the likely condition of Plant Y after two weeks? What essential substance is it lacking?

**Ans :**

- (1) Plant X, because it receives both sunlight and water, which are essential for photosynthesis and growth.
- (2) Photosynthesis cannot occur properly because Plant Z is kept in the dark, lacking the necessary sunlight energy.
- (3) Plant Y is likely wilted or dead. It is lacking water, which is essential for plant survival and photosynthesis.

- 110.** A student takes a leaf from a plant that has been growing in sunlight and performs the starch test. They observe that the entire leaf turns blue-black. They take another leaf from the same plant, cover a small portion of it with black paper for two days while it's still on the plant in sunlight, then test this leaf for starch.

1. What does the blue-black colour on the first leaf indicate?
2. What result would the student expect for the part of the second leaf that was covered with black paper? Why?
3. What result would be expected for the uncovered parts of the second leaf? What does this experiment demonstrate?

**Ans :**

- (1) It indicates the presence of starch, meaning photosynthesis occurred throughout the leaf.
- (2) The covered part would likely not turn blue-black (or show much less colour) because the black paper blocked sunlight, preventing photosynthesis and starch production in that area.
- (3) The uncovered parts should turn blue-black. This experiment demonstrates that sunlight

is necessary for photosynthesis (starch production) to occur in the leaf.

**111.** A student cuts the stem of a white carnation flower obliquely and places it in a beaker containing water mixed with blue ink. After a few hours, they observe blue streaks appearing in the white petals of the flower.

1. Through which tissue in the stem and petals did the blue ink travel?
2. What process does this experiment demonstrate in plants?
3. If the student had used phloem tissue instead, would they observe the same result? Why or why not?

**Ans :**

- (1) Xylem tissue.
- (2) It demonstrates the transport of water (carrying the ink) upwards through the plant's vascular system (xylem).
- (3) No. Phloem transports food (sugars) primarily from the leaves downwards or to other parts, not water upwards from the stem base to the petals in this manner.

**112.** In a sealed, transparent container with moist soil, a healthy green plant is placed. The container is kept in sunlight. After several days, the plant appears healthy, and moisture droplets are visible inside the container.

1. Which process produces the oxygen inside the sealed container, allowing the plant to survive?
2. Which process produces the carbon dioxide inside the container, needed for the process in Q1?
3. What does the presence of moisture droplets suggest about gas exchange and the water cycle within the container?

**Ans :**

- (1) Photosynthesis.
- (2) Respiration (by the plant itself and soil microbes).
- (3) It suggests transpiration (water release from leaves) is occurring. The container acts like a mini-ecosystem where water cycles through evaporation/transpiration and condensation, and gases ( $O_2$  /  $CO_2$ ) are exchanged between photosynthesis and respiration.

**113.** A gardener notices that the leaves of their plants are turning yellow, especially the older ones. They suspect a nutrient deficiency. They know that

plants absorb nutrients along with water through their roots.

1. Which plant tissue is responsible for transporting absorbed water and nutrients (minerals) from the roots to the leaves?
2. If the yellowing is due to a lack of nutrients needed for chlorophyll production, which essential process in the leaves will be negatively affected?
3. Besides nutrient deficiency, what other factor essential for photosynthesis might cause leaves to turn yellow if it is lacking?

**Ans :**

- (1) Xylem.
- (2) Photosynthesis (as chlorophyll is needed to capture light energy).
- (3) Lack of sufficient sunlight (as seen in Pot C kept in the dark) can also cause leaves to turn yellow as chlorophyll degrades or isn't synthesized properly without light.

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# CHAPTER 11

## LIGHT – SHADOWS AND REFLECTIONS

### 1. SOURCES OF LIGHT

Light enables us to see things. Luminous objects like the Sun, stars, lightning, and electric bulbs emit their own light. In contrast, non-luminous objects such as the Moon reflect light from luminous sources. Early humans used fire as the first artificial light, and now electric lighting, especially LEDs, meets most of our needs due to their energy efficiency and long life.



Figure : Some sources of electric light

### 2. LIGHT TRAVELS IN A STRAIGHT LINE

Activities using matchboxes or pipes show that light always travels in a straight line. You can see a light beam only if there's no obstacle in its path. Bending a pipe blocks the light, proving that light does not bend around corners easily under normal conditions

### 3. TRANSPARENT, TRANSLUCENT AND OPAQUE MATERIALS

Materials are classified based on how much light they allow:

- (1) Transparent : Light passes through completely (e.g., glass).
- (2) Translucent : Light passes partially (e.g., tracing paper).
- (3) Opaque : Light doesn't pass at all (e.g., wood or cardboard)

### 4. FORMATION OF SHADOWS

When an opaque object blocks light, it casts a shadow. The shape, size, and sharpness of the shadow depend on the object's distance from the light source and screen. Shadows can be sharp

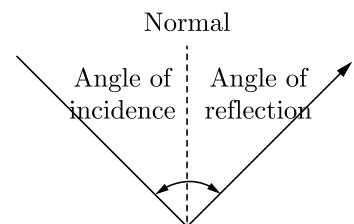
or blurry, depending on whether the object is opaque, translucent, or transparent.



Figure : Shadows around us

### 5. REFLECTION OF LIGHT

Reflection is the change in direction of light when it hits a shiny surface, such as a mirror. Light reflects off flat mirrors, allowing us to redirect beams. This principle is used in devices like periscopes.



### 6. IMAGES IN A PLANE MIRROR

Plane mirrors form:

- (1) Erect and same-sized images
- (2) Laterally inverted images (left appears right)
- (3) Virtual images (not captured on a screen)

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This is why “AMBULANCE” is written in reverse on the front of ambulances—it appears correctly in rear-view mirrors.



Figure : Image of a pen in a plane mirror

### 7. PINHOLE CAMERA

A pinhole camera forms an inverted image on a screen using a small opening to allow light rays in a straight line. Unlike mirrors, this device shows upside-down images, useful for understanding image formation

### 8. SIMPLE OPTICAL DEVICES

**Periscope** : Uses two plane mirrors placed at an angle to see over obstacles (e.g., in submarines or bunkers).

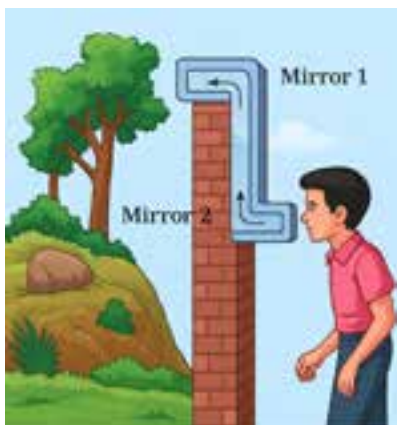


Figure : A periscope

**Kaleidoscope** : Uses mirrors and colored objects to form beautiful patterns through multiple reflections, often used in design inspiration.



(c) (d)  
Figure : A kaleidoscope

## NCERT ACTIVITY

### Activity 11.1 : Let us investigate

1. Take three matchboxes and make a hole in the inner tray of each matchbox, exactly at the same position.
2. Arrange these three matchboxes in a straight line. Make sure that all three holes are exactly at the same height and are in a line as shown in Figure.

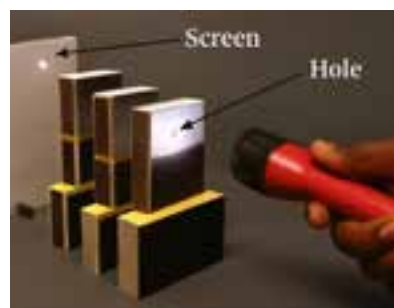


Figure : Matchbox activity–light through holes

3. Place a torch light on one side of the matchboxes, ensuring that its lamp is at the height of the holes.
4. Place a cardboard (screen) on the other side of the matchboxes and obtain a bright spot on it. (You may need to slightly adjust the heights of boxes.)
5. Move one of the matchboxes slightly to a side or up and down. Are you able to obtain the light spot on the screen now?

Ans :

When all three holes are aligned : Yes, you are able to obtain a bright spot of light on the screen.  
When one of the matchboxes is moved slightly (so the holes are no longer aligned) : No, you will not be able to obtain the light spot on the screen. The light from the torch will be blocked by the misaligned matchbox tray.



**Activity 11.2 : Let us explore**

**Caution :** Use a lighted candle under adult supervision only.

1. Take a long hollow pipe of some flexible material and align it so that you can see the candle flame as shown in Figure (a).



Figure : Viewing candle flame through (a) a straight pipe, (b) a bent pipe

2. Now, bend the pipe and try to see the candle flame again (Figure (b)). Can you still see it?

**Ans :**

1. Viewing through a straight pipe (Figure (a)) : Yes, you can see the candle flame.
2. Viewing through a bent pipe (Figure (b)) : No, you cannot see the candle flame.

**Activity 11.3 : Let us experiment**

1. Collect objects made of different materials. Also, you will need a torch.

**Table : Light through different materials**

Material	Transparent/ Translucent/ Opaque	Light will pass fully/ partially/not at all	
		My prediction	My prediction
Cardboard			
Paper			
Glass			
Tracing paper			
Thick cloth			
.....			
.....			

(Add others like clear plastic, frosted glass, metal sheet, clean water in a clear container)

2. List the materials of the objects in Table and classify them into transparent, translucent, and opaque (In the chapter ‘Materials Around Us’ in the Grade 6 Science textbook Curiosity you learnt to classify materials

into transparent, translucent, and opaque, depending on how you could see through them).

3. Go to a dark room, turn on the torch, and place it at such a position that you get a spot of light from the torch on a wall. Or you may place a cardboard screen as shown in Figure and get the spot of light on it.



Figure : Passing light through different materials

4. We will now conduct this activity in two parts-prediction and observation.

- (a) Predict what will happen if you hold an object in front of the light coming out of the torch. Would you continue to see the spot of light on the screen? Note your prediction in Table.
- (b) Now, actually place the object between the torch and the screen. Does light pass through the object? Note your observation in Table.

5. Repeat this for all the objects. Was your observation the same as your prediction? What conclusions could you draw? Light passes almost completely through transparent materials. Light passes partially through translucent materials. Light does not pass through opaque materials.

**Ans :**

**Table : Light through different materials**

Material	Transparent/ Translucent/ Opaque	Light will pass fully/ partially/not at all	
		My prediction	Light will pass fully/ partially/ not at all - My observation
Card board	Opaque	Not at all	Not at all (a shadow is formed)
Paper (thin)	Translucent	Partially	Partially (some light passes, a faint shadow might be seen)

Glass (clear)	Transparent	Fully	Fully (or almost fully, a very faint shadow or none)
Tracing paper	Translucent	Partially	Partially (light is scattered, a diffuse shadow)
Thick cloth	Opaque (or nearly opaque)	Not at all (or very little)	Not at all (or very little, a dark shadow)
Clear plastic	Transparent	Fully	Fully
Frosted glass	Translucent	Partially	Partially
Metal sheet	Opaque	Not at all	Not at all
Clean water (in clear container)	Transparent	Fully	Fully

Transparent materials allow light to pass through them almost completely, so you can see clearly through them, and they cast very faint or no shadows.

Translucent materials allow some light to pass through them, but they scatter the light, so you cannot see clearly through them. They cast faint or diffuse shadows.

Opaque materials do not allow any light to pass through them. You cannot see through them at all, and they cast dark, well-defined shadows.

**Activity 11.4 : Let us explore**

1. Collect some opaque objects of different shapes and sizes.
2. Repeat Activity 11.3, but this time, carry out the actions mentioned in the first column of Table.
3. Observe the shape and size of the shadow on the screen for each of the actions.
4. Did the shadow form in all cases? Was the shape and size of the shadow the same as the object?
5. Record your observations in the second column of Table.

**Table : Observation of shadows**

Action	Observations regarding shadow
The screen is removed.	
The object is removed.	
The torch is switched off.	

The object is moved closer to the screen, keeping the torch and the screen fixed.	
The object is moved closer to the torch, keeping the torch and the screen fixed.	
The object is tilted, keeping the torch and the screen fixed.	
The colour of the object is changed.	

**Questions :**

1. What conclusions do you draw from this activity? What do we need to observe a shadow? Does the colour of the shadow change when the colour of the object is changed?

**Ans :**

Action	Observations regarding shadow
The screen is removed.	No shadow is observed (or it might be seen faintly on a distant surface if available, but a clear shadow requires a screen).
The object is removed.	No shadow is observed (only the spot of light from the torch is seen on the screen, assuming the torch is on)
The torch is switched off.	No shadow is observed (no light, so no shadow).
The object is moved closer to the screen, keeping the torch and the screen fixed.	The shadow becomes smaller and sharper.
The object is moved closer to the torch, keeping the torch and the screen fixed.	The shadow becomes larger and possibly more blurred at the edges (penumbra might be more noticeable depending on the light source size).

The object is tilted, keeping the torch and the screen fixed.	The shape of the shadow changes. The shadow is the 2D projection of the object's outline as seen from the perspective of the light source. Tilting changes this outline.
The colour of the object is changed.	The colour of the shadow does not change. Shadows are regions where light is blocked, so they are always dark (black or grey), regardless of the object's colour.

No, a shadow did not form if the screen was removed, the object was removed, or the torch was switched off.

The shape of the shadow is related to the outline of the object blocking the light, but it can be distorted depending on the angle of the light and the screen. The size of the shadow changes depending on the relative positions of the light source, object, and screen. It is not always the same size as the object.

2. What conclusions do you draw from this activity?

**Ans :**

- (1) Shadows are formed when an opaque object blocks the path of light.
- (2) To observe a shadow, we need a source of light, an opaque object, and a screen.
- (3) The size of the shadow depends on the distance between the light source and the object, and the distance between the object and the screen.
- (4) Moving the object closer to the light source makes the shadow larger. Moving the object closer to the screen makes the shadow smaller.
- (5) The shape of the shadow depends on the shape of the object and its orientation relative to the light source.
- (6) The colour of an opaque object does not affect the colour of its shadow; shadows are always dark.

3. What do we need to observe a shadow?

**Ans :**

We need:

- (1) A source of light.
  - (2) An opaque (or translucent) object to block the light.
  - (3) A screen (a surface) on which the shadow can be formed.
4. Does the colour of the shadow change when the colour of the object is changed?

**Ans :**

No, the colour of the shadow does not change when the colour of the opaque object is changed. Shadows are always dark (black or shades of grey) because they are areas where light is absent or significantly reduced.

### Activity 11.5 : Let us investigate

1. Find a shiny flat steel plate or a plane mirror, that is, a mirror that is flat and not curved.
2. Take it outside and let the sunlight fall on the shiny surface. What can you do to redirect light on the wall on which the sunlight is not falling directly?
3. Turn the shiny plate or mirror in different directions to redirect the light onto a wall or a nearby surface (Figure).



Figure : Using mirror to redirect sunlight on a wall

Do you see a spot of light on the wall? Does it mean that the shiny plate or mirror has changed the direction of light?

4. Now, tilt the shiny plate or mirror in different ways and observe the light spot on the wall. Does it change position? Notice how light always travels in straight lines and changes direction when it falls on the shiny plate or mirror.

**Questions :**

1. What conclusion do you draw from your observations?

**Ans :**

What can you do to redirect light on the wall on which the sunlight is not falling directly? You can hold the shiny plate or plane mirror in the path of the sunlight and angle it in such a way that the sunlight bounces off its surface and is directed towards the wall.

2. Do you see a spot of light on the wall?

Ans :

Yes, a bright spot of light will be seen on the wall. Does it mean that the shiny plate or mirror has changed the direction of light? Yes, this observation means that the shiny plate or mirror has changed the direction of the light that fell on it.

Does it change position when the shiny plate or mirror is tilted? Yes, when the shiny plate or mirror is tilted in different ways, the position of the light spot on the wall changes.

3. What conclusion do you draw from your observations?

Ans :

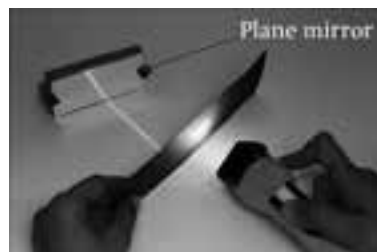
The conclusion is that shiny surfaces, like a polished steel plate or a plane mirror, can change the direction of light that falls on them. This phenomenon of light bouncing off a surface is called reflection. The direction of the reflected light depends on the angle at which the light strikes the shiny surface and the orientation of the surface itself.

**Activity 11.6 : Let us experiment**

1. Take a plane mirror with stand, a torch, a comb, a sheet of white paper, and a strip of black paper.
2. Using the black paper, close all openings of the comb, except for one to make a thin slit.
3. Spread a white paper on a table, hold the comb perpendicular to the sheet of paper and shine the torch light on the slit. Adjust the comb and torch slightly till you see a thin beam of light along the paper which has passed through the slit (Figure (a)).



(a) A light beam



(b) Reflection of light in a plane mirror

4. Now, place the mirror in the path of the light beam while keeping the comb steady (Figure (b)). What do you observe?

Ans :

**Observation :**

Without the mirror (Figure (a)) : A thin beam of light is seen traveling in a straight line along the white paper after passing through the slit in the comb.

With the mirror (Figure (b)) : When the plane mirror is placed in the path of this light beam, the light beam will be seen to strike the mirror and then bounce off it, changing its direction. A new beam of light (the reflected beam) will be seen traveling away from the mirror at an angle. The original beam striking the mirror is the incident beam.

**Conclusion :** The path of the light beam is changed after falling on the mirror. The mirror reflects the light, causing it to travel in a new direction. This further demonstrates the reflection of light by a mirror.

**Activity 11.7 : Let us experiment**

1. Take a plane mirror and a pen or some other object.
2. Place the pen in front of the mirror as shown in Figure.



Figure : Image of a pen in a plane mirror

3. Now, move the pen to different positions in front of the mirror and compare the sizes of the images of the pen at each position.
4. Again, move the pen to different positions in front of the mirror and observe if the image is upright at each position.



5. Now, place a screen vertically behind the mirror. Move it around.

**Questions :**

1. What do you see in the mirror?

**Ans :**

You see an image of the pen that appears to be located behind the mirror.

2. Are the two sizes (object and image) the same?

**Ans :**

Yes, when the pen is moved to different positions, the size of the image of the pen in the plane mirror appears to be the same size as the actual pen.

3. Does the tip of the pen appear on top at each position?

**Ans :**

Yes, the image of the pen in the plane mirror is upright (erect). The tip of the pen in the image appears on top, just like the actual pen.

4. Do you get the image on the screen (either behind or in front of the mirror)?

**Ans :**

No, you cannot get the image formed by a plane mirror on a screen. The image is virtual; it appears to be behind the mirror, where light rays do not actually converge.

Conclusions about the image formed by a plane mirror from this activity :

- (i) The image is the same size as the object.
- (ii) The image is upright (erect).
- (iii) The image is virtual (cannot be formed on a screen).

**Activity 11.8 : Let us experiment**

1. Stand in front of a plane mirror and look at your image (Figure). Notice how far it appears to be from the mirror.



Figure : Observing one's own image in a mirror

2. Now, stand close to the mirror. Is the image also closer to the mirror?
3. Stand at different distances from the mirror and notice how far the image appears to be from the mirror in each case. Do you find any relation between your distance from the mirror and the distance of your image from the mirror?
4. Raise your left arm. Which arm does your image raise?
5. Touch your right ear. Which ear does your image touch?

**Question :**

1. Is the image also closer to the mirror when you stand close?

**Ans :**

Yes, when you stand closer to the mirror, your image also appears to be closer to the mirror.

Relation between your distance from the mirror and the distance of your image from the mirror : The image appears to be located as far behind the mirror as the object (you) is in front of it. The distance of the image from the mirror is equal to the distance of the object from the mirror.

Raise your left arm. Which arm does your image raise? Your image appears to raise its right arm.

Touch your right ear. Which ear does your image touch? Your image appears to touch its left ear.

**Conclusions from this activity:**

1. The image formed by a plane mirror is located as far behind the mirror as the object is in front of it.
2. The image formed by a plane mirror is laterally inverted (left appears right, and right appears left).

**Activity 11.9 : Let us explore**

1. Caution-Use a lighted candle under adult supervision only.
2. Take a piece of cardboard and a candle. Make a small hole in the cardboard.
3. In a dimly lit room, position the cardboard at a short distance from a screen.
4. Place a lighted candle in front of it as shown in Figure (a).

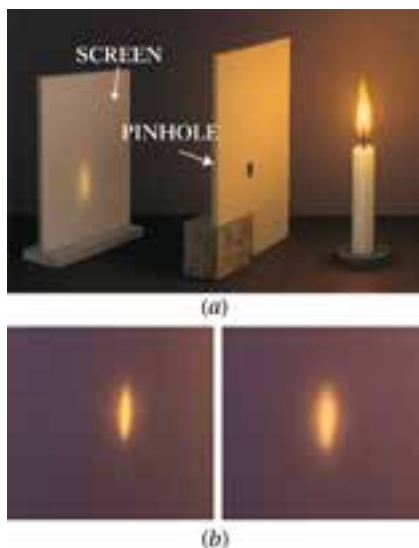


Figure : (a) A simple pinhole camera, (b) Image of a candle flame on screen

**Question :**

1. What do you see on the screen?

**Ans :**

You will see an inverted (upside-down) image of the candle flame formed on the screen. If the hole is small enough, the image will be relatively sharp. Light rays from the top of the flame pass through the pinhole and travel in a straight line to the bottom of the image on the screen, and rays from the bottom of the flame pass through the pinhole to the top of the image on the screen, thus creating an inverted image.

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**Activity 11.10 : Let us construct**

1. Take two boxes of cardboard such that one can slide into another with very little gap in between them. Cut open one side of each box.
2. On the opposite face of the larger box, make a small hole in the middle (Figure (a)).
3. On the opposite face of the smaller box, cut out a square from the middle with a side of about 5-6 cm. Cover this opening with a thin translucent paper (like a tracing paper) to form a screen (Figure (b)).
4. Slide the smaller box inside the larger one in such a way that the side with the tracing paper is inside (Figure (c)).

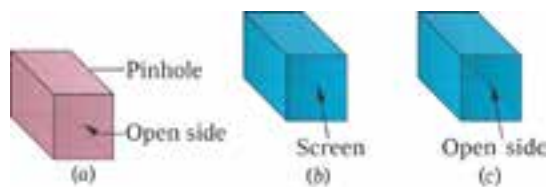


Figure : A sliding pinhole camera

Hold the pinhole camera with the pinhole facing the object and look through the open side of the smaller box. Cover your head and the camera with a dark cloth. Look at a distant object, like a tree or building, in bright sunlight and move the smaller box forward or backward until an image appears on the tracing paper.

This activity describes the construction of a sliding pinhole camera.

**Question :**

1. Do the images seen in the camera show the colours of the objects on the other side?
2. Are the images erect or upside down?

**Ans :**

- (1) Yes, the images formed by a pinhole camera are coloured. They show the colours of the actual objects being viewed.
- (2) The images formed by a pinhole camera are upside down (inverted). They are also usually laterally inverted, though this is less obvious for objects like trees.

**NCERT EXERCISE**

1. Which of the following are luminous objects?  
Mars, Moon, Pole Star, Sun, Venus, Mirror

**Ans :**

Luminous objects are those that emit their own light.

1. Pole Star : Is a star, and stars produce their own light. So, it is luminous.
2. Sun : Is a star and produces its own light. So, it is luminous.  
Non-luminous objects do not produce their own light; they shine by reflecting light from a luminous source.
3. Mars : Is a planet, reflects sunlight. Non-luminous.
4. Moon : Is a natural satellite, reflects sunlight. Non-luminous.

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5. Venus : Is a planet, reflects sunlight. Non-luminous.
  6. Mirror : Reflects light. Non-luminous.
- Therefore, the luminous objects are : Pole Star, Sun.

2. Match the items in Column A with those in Column B.

Column A	Column B
Pinhole camera	Blocks light completely
Opaque object	The dark region formed behind the object
Transparent object	Forms an inverted image
Shadow	Light passes almost completely through it

Ans :

Pinhole camera → Forms an inverted image  
 Opaque object → Blocks light completely  
 Transparent object → Light passes almost completely through it  
 Shadow → The dark region formed behind the object

3. Sahil, Rekha, Patrick and Qasima are trying to observe the candle flame through the pipe as shown in Figure.

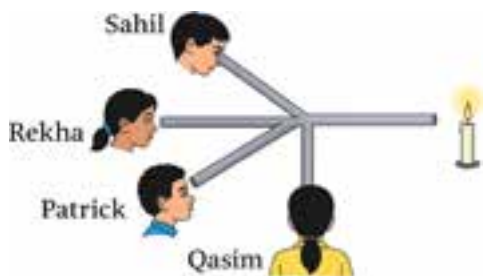


Figure shows four children:

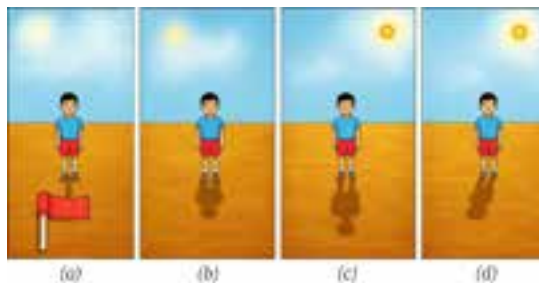
1. Rekha looking through a straight pipe at a candle.
2. Patrick looking through a bent pipe at a candle.
3. Sahil looking through a straight pipe but it is aimed above the candle.
4. Qasima looking through a straight pipe but it is aimed below the candle.)
5. Who can see the flame?

Ans :

Only Rekha (i) can see the flame.

Reasoning :

1. Rekha (i) : Is looking through a straight pipe that is correctly aligned with the candle flame. Light travels in straight lines, so she can see it.
  2. Patrick (ii) : Is looking through a bent pipe. Light travels in straight lines and will be blocked by the bend in the pipe.
  3. Sahil (iii) : Is looking through a straight pipe, but it is aimed above the candle flame. Since light travels in straight lines, the light from the flame will not enter the pipe in a way that reaches his eye.
  4. Qasima (iv) : Is looking through a straight pipe, but it is aimed below the candle flame. Similar to Sahil, the light from the flame will not align with the pipe to reach her eye.
4. Look at the images shown in Figure and select the correct image showing the shadow formation of the boy.



(Figure typically shows a boy standing and a light source (e.g., the sun) in a particular position. The options (a), (b), (c), (d) would show the boy with a shadow cast in different directions/lengths.)

Ans :

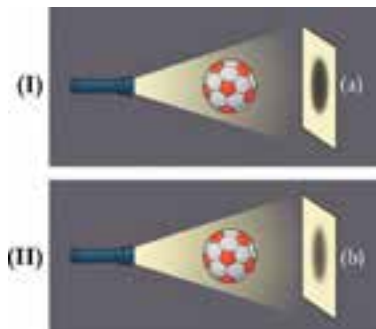
To select the correct image, one needs to understand that:

1. A shadow is formed on the side opposite to the light source.
2. The length and direction of the shadow depend on the position of the light source.  
 If the light source is high (like the sun at noon), the shadow will be short.  
 If the light source is low on the horizon (like the sun in the morning or evening), the shadow will be long.  
 The shadow will extend away from the object in a straight line from the light source.

(Without seeing the specific Figure and options, a precise answer cannot be given. The student needs to apply these principles to the provided image.) For example, if the sun is to the boy's

right and slightly high, his shadow will be to his left and moderately long.

5. The shadow of a ball is formed on a wall by placing the ball in front of a fixed torch as shown in Figure. In scenario (i) the ball is closer to the torch, while in scenario (ii) the ball is closer to the wall. Choose the most accurate representation of the shadows formed in both scenarios from the options provided (a and b).



(Figure typically depicts these two scenarios. Options (a) and (b) would show different sized shadows.)

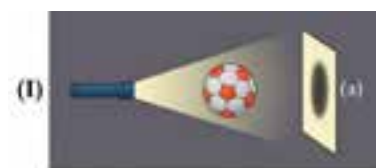
Ans :

- Scenario - Ball closer to the torch : When the object (ball) is closer to the light source (torch), the shadow formed on the distant screen (wall) will be larger.
- Scenario - Ball closer to the wall (screen) : When the object (ball) is further from the light source and closer to the screen, the shadow formed on the screen will be smaller (closer to the actual size of the object).

Therefore, the student needs to choose the option that shows:

- A larger shadow for scenario (i).
  - A smaller shadow for scenario (ii).
- (Without seeing options (a) and (b), a specific choice cannot be made.)

6. Based on Figure, match the position of the torch in Column A with the characteristics of the ball's shadow in Column B.



(Figure is the same as in Q.5, showing a torch, a ball, and a screen/wall.)

Column A	Column B
If the torch is close to the ball	The shadow would be smaller
If the torch is far away (from the ball)	The shadow would be larger
If the ball is removed from the set-up	Two shadows would appear on the screen
If two torches are present in the set-up on the left side of the ball	A bright spot would appear on the screen

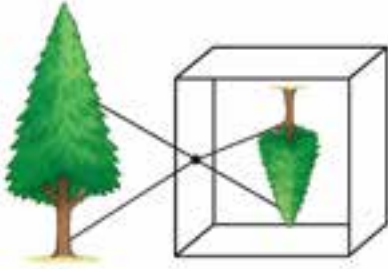
Ans :

- When the torch is close, the light spreads more and the ball blocks more light — so the shadow is larger.
  - When the torch is far, the light rays are more parallel and the ball blocks less — so the shadow is smaller.
  - If the ball is removed, nothing blocks the light — the screen just shows light, no shadow.
  - With two torches, each torch casts a shadow in a slightly different direction — this causes two overlapping shadows.
7. Suppose you view the tree shown in Figure through a pinhole camera. Sketch the outline of the image of the tree formed in the pinhole camera.



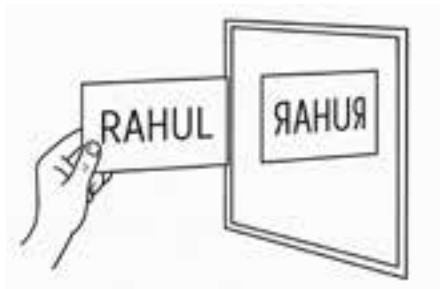
Ans :





8. Write your name on a piece of paper and hold it in front of a plane mirror such that the paper is parallel to the mirror. Sketch the image. What difference do you notice? Explain the reason for the difference.

Ans :



**Difference Noticed :**

The image in the mirror appears reversed from left to right. This is called lateral inversion. For example, the letter "R" in your name appears flipped, and the entire word is mirrored.

**Reason for the Difference :**

A plane mirror reflects light back in such a way that the left side of the object appears on the right in the image, and the right side appears on the left. This happens because the mirror doesn't reverse up-down or front-back positions, but only interchanges left and right, causing lateral inversion.

9. Measure the length of your shadow at 9 AM, 12 PM, and 4 PM with the help of your friend. Write down your observations:
1. At which of the given times is your shadow the shortest?
  2. Why do you think this happens?

Ans :

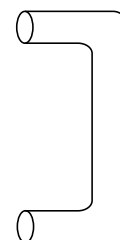
A typical set of measurements shows that your shadow is longest at 9 AM, grows shortest around 12 PM (local noon), and becomes longer again by 4 PM. The shadow is shortest at 12 PM because,

at that time, the Sun is highest in the sky for the day. When the Sun's rays strike the ground more nearly vertically, the line joining the top of your head to the tip of the shadow meets the ground at a steeper angle, reducing the shadow's length. As the Sun's apparent position lowers toward the eastern or western horizon in the morning or afternoon, the rays strike the ground at a shallower angle, so the same height casts a longer shadow.

10. On the basis of following statements, choose the correct option.
1. **Statement A** : Image formed by a plane mirror is laterally inverted.
  2. **Statement B** : Images of alphabets T and O appear identical to themselves in a plane mirror.
- (a) Both statements are true  
 (b) Both statements are false  
 (c) Statement A is true, but statement B is false  
 (d) Statement A is false, but statement B is true

Ans :

- (a) Both statements are true  
 (i) **Statement A** : Image formed by a plane mirror is laterally inverted. This is true. Left appears as right and right as left in the image.  
 (ii) **Statement B** : Images of alphabets T and O appear identical to themselves in a plane mirror. This is also true. The letters 'T' and 'O' (when written symmetrically) are vertically symmetrical. Even though lateral inversion occurs, their mirror images look identical to the original letters because of this symmetry. For example, the left side of an 'O' is a mirror image of its right side, so when laterally inverted, it still looks like an 'O'. The same applies to a symmetrically written 'T'.
11. Suppose you are given a tube of the shape shown in the Figure and two plane mirrors smaller than the diameter of the tube. Can this tube be used to make a periscope? If yes, mark where you will fix the plane mirrors.

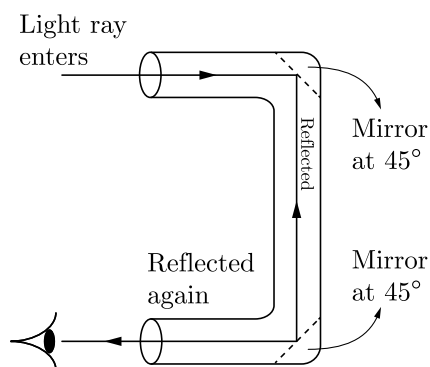


Ans :

Yes, a Z-shaped tube (or any tube with two parallel but offset sections connected by bends) can be used to make a simple periscope.

If yes, mark where you will fix the plane mirrors:  
You need to fix the two plane mirrors as follows:

- Place one mirror at the top bend of the tube. It should be positioned at a 45-degree angle to the vertical axis of the top part of the tube, facing downwards into the tube and towards the viewing opening at the bottom.
- Place the second mirror at the bottom bend of the tube. It should also be positioned at a 45-degree angle to the vertical axis of the bottom part of the tube, facing upwards into the tube, and parallel to the first mirror.



12. We do not see the shadow on the ground of a bird flying high in the sky. However, the shadow is seen on the ground when the bird swoops near the ground. Think and explain why it is so.

Ans :

We do not see the shadow of a bird flying high in the sky because the bird is too far from the ground and blocks only a small amount of sunlight. The light rays spread out and the shadow becomes faint or scattered, making it invisible to our eyes. However, when the bird swoops close to the ground, it blocks more light directly and the shadow becomes sharp and visible. Thus, the shadow is seen only when the bird is near the ground.

## MULTIPLE CHOICE QUESTION

1. What is the primary purpose for which fireflies use the light they produce?

- (A) To see in the dark
- (B) To generate heat
- (C) To communicate with each other
- (D) To scare away predators

Ans :

(C) To communicate with each other  
Jatin's grandparents explain to Keshav that fireflies, which are seasonal insects, utilize the light they emit as a means of communication.

2. Is the Moon considered a source of light? Why or why not?
- (A) Yes, it produces its own faint light.
  - (B) No, it only reflects light from the Sun.
  - (C) Yes, because moonlight allows us to see at night.
  - (D) No, it absorbs all light that falls on it.

Ans :

(B) No, it only reflects light from the Sun.  
The Moon is non-luminous; it does not produce its own light but shines because its surface reflects sunlight falling on it.

3. What are objects called that emit their own light?
- (A) Reflective objects
  - (B) Opaque objects
  - (C) Luminous objects
  - (D) Translucent objects

Ans :

(C) Luminous objects  
The text defines luminous objects as those that give out or emit light generated by themselves, such as the Sun, stars, a burning candle, or an electric lamp.

4. What are objects called that do not emit their own light but can be seen when light falls on them?
- (A) Luminous objects
  - (B) Transparent objects
  - (C) Light sources
  - (D) Non-luminous objects

Ans :

(D) Non-luminous objects  
Non-luminous objects are those that do not produce their own light. We see them because they reflect light from a luminous source (like the Sun or a lamp) to our eyes.

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5. Which of the following is listed as a natural source of light?  
 (A) LED lamp  
 (B) Candle  
 (C) Lightning  
 (D) Torch

Ans :

(C) Lightning

The Sun, stars, lightning, natural fire, and certain animals (like fireflies) are examples of natural sources that emit their own light.

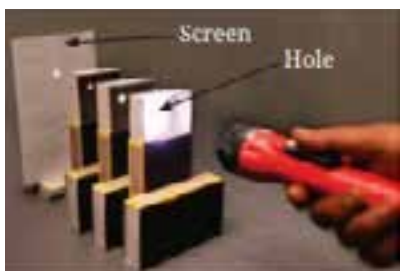
6. Why are LED lamps promoted by the government and considered environmentally better than traditional lamps?  
 (A) They produce different colors of light.  
 (B) They are made from natural materials.  
 (C) They consume much less power and last longer.  
 (D) They do not require electricity to operate.

Ans :

(C) They consume much less power and last longer.

LEDs are energy-efficient, consuming less electricity for the same amount of light, and have a longer lifespan, reducing waste and energy consumption compared to older technologies.

7. Imagine three matchboxes with aligned holes as shown in the figure. Light from a torch passes through all three holes to form a spot on a screen. What does this demonstrate?



- (A) Light can bend around corners.  
 (B) Light travels in a straight line.  
 (C) Light is blocked by cardboard.  
 (D) Light gets brighter as it passes through holes.

Ans :

(B) Light travels in a straight line.

The light spot is only seen when the holes are perfectly aligned, indicating that light travels along a straight path and cannot pass if the path is blocked or bent.

8. Why can a candle flame be seen through a straight pipe but not through a bent pipe?  
 (A) The bent pipe absorbs the light.  
 (B) The straight pipe magnifies the flame.  
 (C) Light travels in straight lines and cannot follow the curve of the bent pipe.  
 (D) The bent pipe filters out the light from the flame.

Ans :

(C) Light travels in straight lines and cannot follow the curve of the bent pipe.

The light propagates rectilinearly (in straight lines). The bend in the pipe obstructs the straight path from the flame to the observer's eye.

9. The property that light travels in a straight line path is often referred to as:  
 (A) Reflection of light  
 (B) Refraction of light  
 (C) Rectilinear propagation of light  
 (D) Dispersion of light

Ans :

(C) Rectilinear propagation of light

Rectilinear propagation is the scientific term describing the tendency of light waves to travel in straight lines in a uniform medium.

10. Materials that allow light to pass through them almost completely, allowing clear visibility, are called what?  
 (A) Opaque  
 (B) Translucent  
 (C) Luminous  
 (D) Transparent

Ans :

(D) Transparent

Transparent materials, like clear glass or clean water, permit most light to pass through without significant scattering, enabling objects behind them to be seen clearly.

11. What are materials called that allow only some light to pass through, making objects behind them appear blurry or indistinct?  
 (A) Opaque  
 (B) Transparent  
 (C) Translucent  
 (D) Reflective

Ans :

(C) Translucent

Translucent materials, such as tracing paper or frosted glass, scatter light as it passes through, allowing partial visibility but not clear images.

12. Materials that do not allow any light to pass through them are known as what?  
 (A) Transparent  
 (B) Translucent  
 (C) Opaque  
 (D) Luminous

Ans :

(C) Opaque  
 Opaque materials, like wood, metal, or cardboard, completely block the passage of light; you cannot see through them at all.

13. If you shine a torch through a piece of cardboard onto a screen, what will you observe on the screen?  
 (A) A bright, clear spot of light.  
 (B) A dim, blurry spot of light.  
 (C) No light spot, as cardboard is opaque.  
 (D) A magnified image of the torch bulb.

Ans :

(C) No light spot, as cardboard is opaque.  
 Cardboard is an opaque material. It will block the light from the torch, preventing it from reaching the screen, resulting in darkness where the light would have been.

14. How is a shadow formed?  
 (A) When light passes through a transparent object.  
 (B) When a luminous object emits light in all directions.  
 (C) When an opaque or translucent object blocks the path of light.  
 (D) When light reflects off a shiny surface.

Ans :

(C) When an opaque or translucent object blocks the path of light.  
 A shadow is created in the region behind an object where light from a source is obstructed by that object, preventing the light from reaching a surface (screen).

15. What three things are generally needed to observe a shadow?  
 (A) A transparent object, darkness, and eyes.  
 (B) A mirror, an object, and water.  
 (C) A source of light, an opaque/translucent object, and a screen.  
 (D) A luminous object, a lens, and a camera.

Ans :

(C) A source of light, an opaque/translucent object, and a screen.

To form and see a shadow, you need light coming from a source, an object to block that light, and a surface (screen) onto which the shadow can be cast.

16. How do shadows formed by opaque objects typically compare to those formed by translucent objects?  
 (A) Opaque objects form lighter shadows; translucent form darker shadows.  
 (B) Opaque objects form darker shadows; translucent form lighter shadows.  
 (C) Both form equally dark shadows.  
 (D) Only opaque objects form shadows.

Ans :

(B) Opaque objects form darker shadows; translucent form lighter shadows.  
 Opaque objects block light completely, creating dark shadows. Translucent objects allow some light through, resulting in fainter, less dark shadows.

17. If you move an opaque object closer to the light source (keeping the screen fixed), what happens to the size of its shadow on the screen?  
 (A) The shadow becomes smaller.  
 (B) The shadow becomes larger.  
 (C) The shadow size remains unchanged.  
 (D) The shadow disappears.

Ans :

(B) The shadow becomes larger.  
 Moving the object closer to the light source causes it to block a wider angle of light rays heading towards the screen, resulting in a larger shadow.

18. If you move an opaque object closer to the screen (keeping the light source fixed), what happens to the size of its shadow?  
 (A) The shadow becomes smaller.  
 (B) The shadow becomes larger.  
 (C) The shadow size remains unchanged.  
 (D) The shadow becomes sharper.

Ans :

(A) The shadow becomes smaller.  
 Moving the object closer to the screen reduces the distance over which the shadow diverges, making the resulting shadow on the screen smaller.



19. Does changing the color of an opaque object change the color of its shadow?  
 (A) Yes, the shadow takes the color of the object.  
 (B) Yes, the shadow becomes the complementary color.  
 (C) No, the shadow is always dark (absence of light), regardless of object color.  
 (D) It depends on the color of the light source.

Ans :

(C) No, the shadow is always dark (absence of light), regardless of object color.

A shadow is simply an area where light is blocked. Its appearance is dark because less light reaches that area, irrespective of the color of the object casting the shadow.

20. Shadow puppetry, like Tholu Bommalata or Ravana Chhaya, utilizes which property of light and objects?  
 (A) Reflection from mirrors.  
 (B) Light passing through transparent figures.  
 (C) Formation of shadows when opaque cut-out figures block light.  
 (D) The bending of light around puppets.

Ans :

(C) Formation of shadows when opaque cut-out figures block light.

Shadow puppetry works by placing opaque figures between a light source and a screen, casting shadows that create the characters and scenes for storytelling.

21. When sunlight falls on a shiny surface like a polished steel plate or a mirror, what happens to the direction of the light?  
 (A) The light is completely absorbed.  
 (B) The light passes straight through.  
 (C) The direction of the light is changed (reflected).  
 (D) The light is converted into heat.

Ans :

(C) The direction of the light is changed (reflected).

Shiny surfaces are good reflectors. They bounce the light rays off, changing their direction of travel according to the law of reflection.

22. What is the change in direction of light when it bounces off a mirror or a shiny surface called?  
 (A) Refraction  
 (B) Absorption

- (C) Reflection  
 (D) Dispersion

Ans :

(C) Reflection

Reflection is the specific term for the phenomenon where light strikes a surface and bounces back, changing its direction.

23. A narrow beam of light is directed at a plane mirror using a slit. When a plane mirror is placed in the path of this beam, what is observed?  
 (A) The light beam stops at the mirror.  
 (B) The light beam passes through the mirror.  
 (C) The path of the light beam changes direction after hitting the mirror.  
 (D) The light beam spreads out into multiple colors.

Ans :

(C) The path of the light beam changes direction after hitting the mirror.

The experiment demonstrates reflection; the mirror causes the incident light beam to bounce off at an angle, changing its path.

24. What do you see when you look at your face in a plane mirror?  
 (A) A shadow of your face.  
 (B) A magnified view of your face.  
 (C) A reflection (image) of your face.  
 (D) A distorted version of your face.

Ans :

(C) A reflection (image) of your face.

The likeness of yourself seen in a mirror is called an image, formed by the light rays from your face reflecting off the mirror surface and entering your eyes.

25. In the context of mirrors, what is the actual physical item placed in front of the mirror called?  
 (A) Image  
 (B) Reflection  
 (C) Object  
 (D) Screen

Ans :

(C) Object

The term 'object' refers to the real thing whose reflection or image is being viewed in the mirror or formed by a lens/pinhole.

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- 26.** How does the size of the image formed by a plane mirror compare to the size of the object?  
 (A) The image is always larger.  
 (B) The image is always smaller.  
 (C) The image is the same size as the object.  
 (D) The size depends on the distance from the mirror.

**Ans :**

(C) The image is the same size as the object.  
 A key characteristic of images formed by plane (flat) mirrors is that they are always the same size as the original object.

- 27.** Is the image formed by a plane mirror typically upright or upside down?  
 (A) Always upside down (inverted).  
 (B) Always upright (erect).  
 (C) Sometimes upright, sometimes inverted.  
 (D) Neither upright nor inverted.

**Ans :**

(B) Always upright (erect).  
 Plane mirrors consistently produce images that are oriented the same way up as the object; this is described as an erect image.

- 28.** Can the image formed by a plane mirror be projected onto a screen placed behind or in front of the mirror?  
 (A) Yes, easily on a screen behind the mirror.  
 (B) Yes, easily on a screen in front of the mirror.  
 (C) No, the image cannot be obtained on a screen (it is virtual).  
 (D) Only if the object is very close to the mirror.

**Ans :**

(C) No, the image cannot be obtained on a screen (it is virtual).  
 The image in a plane mirror appears to be located behind the mirror where light rays do not actually converge. Such images, which cannot be captured on a screen, are called virtual images.

- 29.** How does the apparent distance of the image behind a plane mirror relate to the distance of the object in front of the mirror?  
 (A) The image appears twice as far behind the mirror.  
 (B) The image appears half as far behind the mirror.  
 (C) The image appears at the same distance behind the mirror as the object is in front.  
 (D) The image distance is unrelated to the object distance.

**Ans :**

(C) The image appears at the same distance behind the mirror as the object is in front.  
 For a plane mirror, the virtual image is always located at a distance behind the mirror equal to the object's distance in front of the mirror.

- 30.** When you raise your left hand in front of a plane mirror, your image appears to raise its right hand. What is this left-right reversal called?  
 (A) Inversion  
 (B) Magnification  
 (C) Lateral inversion  
 (D) Reflection reversal

**Ans :**

(C) Lateral inversion  
 Lateral inversion is the specific term describing the apparent sideways reversal of an image formed by a plane mirror, where left and right seem interchanged.

- 31.** Why is the word 'AMBULANCE' often written in a laterally inverted manner on the front of emergency vehicles?  
 (A) It is a secret code.  
 (B) To make it readable correctly in the rear-view mirrors of vehicles ahead.  
 (C) It looks more stylish that way.  
 (D) To save space on the vehicle.

**Ans :**

(B) To make it readable correctly in the rear-view mirrors of vehicles ahead.  
 Drivers looking in their rear-view mirrors see the laterally inverted writing reversed back to normal, allowing them to quickly identify the ambulance and give way.

- 32.** What is Aranmula Kannadi, mentioned as a surviving craft in Kerala?  
 (A) A type of stained glass window.  
 (B) A unique metal surface mirror.  
 (C) A special kind of lens.  
 (D) A traditional shadow puppet.

**Ans :**

(B) A unique metal surface mirror.  
 The text mentions Aranmula Kannadi as an example of traditional metal mirror making that still exists, producing highly reflective mirrors from a specific metal alloy.



- 33.** What is a pinhole camera?  
 (A) A camera that uses a large lens to form images.  
 (B) A device that uses mirrors to reflect light.  
 (C) A device where light from an object passes through a tiny hole to form an image on a screen.  
 (D) A type of digital camera without a lens.

**Ans :**

(C) A device where light from an object passes through a tiny hole to form an image on a screen. A pinhole camera operates on the principle of rectilinear propagation, allowing light rays from different points on an object to pass through a small aperture (pinhole) and form an inverted image on an internal screen.

- 34.** What is a key characteristic of the image formed by a pinhole camera?  
 (A) It is always upright (erect).  
 (B) It is always larger than the object.  
 (C) It is always upside down (inverted).  
 (D) It is always virtual (cannot be formed on a screen).

**Ans :**

(C) It is always upside down (inverted). Because light travels in straight lines, rays from the top of the object pass through the pinhole and land on the bottom of the screen, and vice versa, resulting in an inverted image.

- 35.** How does the image formed by a pinhole camera differ from the image formed by a plane mirror in terms of orientation?  
 (A) Both are inverted.  
 (B) Both are erect.  
 (C) Pinhole image is inverted; plane mirror image is erect.  
 (D) Pinhole image is erect; plane mirror image is inverted.

**Ans :**

(C) Pinhole image is inverted; plane mirror image is erect.

A pinhole camera produces an upside-down (inverted) image. A plane mirror produces an upright (erect) image, although it is laterally inverted.

- 36.** Can a pinhole camera capture the colors of the object being viewed?  
 (A) No, it only forms black and white images.  
 (B) Yes, the image formed shows the colors of the

object.

- (C) Only if the pinhole is large enough.  
 (D) Only if the screen is colored.

**Ans :**

(B) Yes, the image formed shows the colors of the object.

The light rays passing through the pinhole carry the color information from the object, so the image formed on the screen will display the object's colors (though it might be dim).

- 37.** In the sliding pinhole camera constructed in Activity 11.10, what is the purpose of sliding the inner box?  
 (A) To change the size of the pinhole.  
 (B) To adjust the focus and sharpness of the image on the tracing paper screen.  
 (C) To change the color of the image.  
 (D) To invert the image back to upright.

**Ans :**

(B) To adjust the focus and sharpness of the image on the tracing paper screen.

Sliding the inner box changes the distance between the pinhole and the screen. Adjusting this distance allows for focusing the image, making it sharper for objects at different distances.

- 38.** What is a periscope?  
 (A) A device used to magnify distant objects.  
 (B) An instrument using two plane mirrors, typically in a Z-shape, to see over obstacles.  
 (C) A type of camera that uses a large lens.  
 (D) A device that creates colorful patterns using mirrors.

**Ans :**

(B) An instrument using two plane mirrors, typically in a Z-shape, to see over obstacles.

A simple periscope uses two parallel plane mirrors, angled usually at 45 degrees, to reflect light down and then across, allowing viewing around corners or over obstructions.

- 39.** Periscopes are commonly used in which applications mentioned?  
 (A) Telescopes and microscopes  
 (B) Cameras and projectors  
 (C) Submarines, tanks, and by soldiers in bunkers  
 (D) Kaleidoscopes and binoculars

**Ans :**

(C) Submarines, tanks, and by soldiers in bunkers

The text lists submarines (to see above water), tanks, and soldiers in trenches or bunkers as common users of periscopes for safe observation.

40. What is a kaleidoscope?  
 (A) A device for measuring light intensity.  
 (B) A tube containing mirrors (usually three) and loose colored objects that creates changing symmetrical patterns.  
 (C) An instrument for viewing distant stars.  
 (D) A type of simple camera.

Ans :

(B) A tube containing mirrors (usually three) and loose colored objects that creates changing symmetrical patterns.

A kaleidoscope uses multiple reflections between angled mirrors to generate intricate, colorful, and symmetrical patterns from objects placed at one end.

41. How are the beautiful, changing patterns created in a kaleidoscope?  
 (A) By bending light through a lens.  
 (B) By mixing different colored lights.  
 (C) By multiple reflections of colored objects between the angled mirrors.  
 (D) By projecting images onto a screen.

Ans :

(C) By multiple reflections of colored objects between the angled mirrors.

The mirrors reflect the images of the colored beads/bangles multiple times, creating complex, symmetrical patterns that change as the objects shift position when the tube is rotated.

42. Which of the following objects listed in are luminous? Mars, Moon, Pole Star, Sun, Venus, Mirror.  
 (A) Mars, Moon, Venus  
 (B) Pole Star, Sun  
 (C) Moon, Mirror  
 (D) Sun, Mars, Venus

Ans :

(B) Pole Star, Sun

Luminous objects emit their own light. The Sun is a star and emits light. The Pole Star is also a star. Mars, Moon, Venus are planets/moon reflecting sunlight. A mirror reflects light.

43. Match the item with its description : Pinhole camera.

- (A) Blocks light completely (Opaque object)  
 (B) Light passes almost completely through it (Transparent object)  
 (C) Forms an inverted image  
 (D) The dark region formed behind the object (Shadow)

Ans :

(C) Forms an inverted image

A key characteristic of the image formed by a pinhole camera is that it is upside down, or inverted.

44. Match the item with its description : Opaque object.

- (A) Light passes almost completely through it  
 (B) Forms an inverted image  
 (C) Blocks light completely  
 (D) The dark region formed behind the object

Ans :

(C) Blocks light completely

By definition, opaque objects are those that do not allow light to pass through them, thus blocking it completely.

45. Match the item with its description : Shadow.

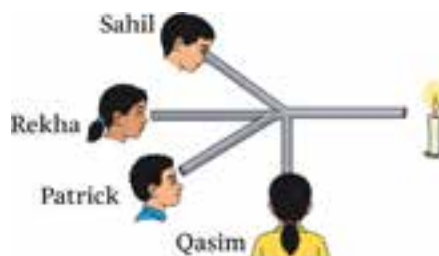
- (A) Light passes almost completely through it  
 (B) Forms an inverted image  
 (C) Blocks light completely  
 (D) The dark region formed behind the object

Ans :

(D) The dark region formed behind the object

A shadow is the dark area created behind an object where light from a source has been blocked by that object.

46. In Figure, four children try to see a candle flame through pipes. Who will be able to see the flame?



- (A) Only Sahil (straight pipe)  
 (B) Only Rekha (bent pipe)  
 (C) Both Patrick and Qasima (bent pipes)  
 (D) Only Qasima (clear bent pipe)

Ans :



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(B) Only Rekha (straight pipe)

Light travels in straight lines. Only Rekha, looking through the straight pipe, has an unobstructed straight-line path from the candle flame to his eye.

47. If you view a tree through a pinhole camera, what will the image look like on the screen?
- (A) Upright and larger  
 (B) Upright and smaller  
 (C) Inverted (upside down) and smaller  
 (D) Inverted and laterally inverted

Ans :

(C) Inverted (upside down) and smaller  
 A pinhole camera forms an inverted image. For distant objects like trees, the image formed is typically much smaller than the actual object.

48. If you write your name and hold it in front of a plane mirror, what characteristic will the image exhibit?
- (A) It will be inverted (upside down).  
 (B) It will be magnified.  
 (C) It will be laterally inverted (left-right reversed).  
 (D) It will be blurry.

Ans :

(C) It will be laterally inverted (left-right reversed).  
 Plane mirrors produce laterally inverted images, so the letters of your name will appear reversed from left to right in the reflection.

49. At what time of day is your shadow likely to be the shortest?
- (A) Early morning (e.g., 9 AM)  
 (B) Around noon (e.g., 12 PM)  
 (C) Late afternoon (e.g., 4 PM)  
 (D) Midnight

Ans :

(B) Around noon (e.g., 12 PM)  
 Your shadow is shortest when the Sun is highest in the sky, which occurs around local noon. At sunrise and sunset, the Sun is low, casting long shadows.

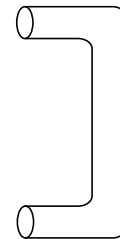
50. Statement A : Image formed by a plane mirror is laterally inverted.  
 Statement B : Images of alphabets T and O appear identical to themselves in a plane mirror.  
 Choose the correct option.

- (A) Both statements are true.  
 (B) Both statements are false.  
 (C) Statement A is true, but statement B is false.  
 (D) Statement A is false, but statement B is true.

Ans :

(A) Both statements are true.  
 Statement A is a known property of plane mirrors. Statement B is also true because letters like T and O (and others like A, H, I, M, U, V, W, X, Y) are vertically symmetrical, so their laterally inverted image looks identical to the object.

51. Can a Z-shaped tube (Figure) be used to make a periscope with two plane mirrors? If yes, how should the mirrors be placed?



- (A) No, the tube must be straight.  
 (B) Yes, place mirrors flat against the top and bottom ends.  
 (C) Yes, place mirrors at 45-degree angles at the corners, parallel to each other.  
 (D) Yes, place mirrors perpendicular to the tube walls.

Ans :

(C) Yes, place mirrors at 45-degree angles at the corners, parallel to each other.  
 A periscope works by reflecting light between two parallel mirrors. In a Z-shaped tube, mirrors placed at 45° at the bends will reflect light along the tube's path, allowing viewing around the corners.

52. Why might the shadow of a bird flying high in the sky not be visible on the ground, but becomes visible when it flies low?
- (A) High-flying birds are transparent.  
 (B) The shadow becomes too large and faint (diffuse) when the bird is far from the ground (screen).  
 (C) Birds only cast shadows when near the ground.  
 (D) Sunlight doesn't reach birds flying high up.

Ans :

(B) The shadow becomes too large and faint (diffuse) when the bird is far from the ground (screen).

Shadows become less sharp and fainter (more diffuse) as the distance between the object and the screen increases. When the bird is high, its shadow spreads out and becomes too indistinct to see on the ground.

53. If you cover a torch with colored transparent paper (e.g., red cellophane), what color will the shadow of an opaque object cast by this light be?
- (A) Red
  - (B) The color of the object
  - (C) Black or dark gray
  - (D) Complementary color to red (cyan/green)

Ans :

(C) Black or dark gray

A shadow is the absence of light. While the surrounding illuminated area will be colored (red), the shadow itself will still be dark because the colored light is blocked by the opaque object.

54. What happens to the number of images seen when two plane mirrors are placed at an angle to each other, compared to a single mirror?
- (A) Fewer images are seen.
  - (B) Only one image is seen, but it's brighter.
  - (C) Multiple images are formed due to reflections between the mirrors.
  - (D) The image becomes inverted.

Ans :

(C) Multiple images are formed due to reflections between the mirrors.

When mirrors are angled, light reflects back and forth between them, creating multiple virtual images. The number of images depends on the angle between the mirrors.

55. Can a small piece of plane mirror form an image of a very large object like a tree?
- (A) No, the mirror must be larger than the object.
  - (B) No, only curved mirrors can image large objects.
  - (C) Yes, but the image will be very small and blurry.
  - (D) Yes, you can see a portion of the large object's reflection in the small mirror.

Ans :

(D) Yes, you can see a portion of the large object's reflection in the small mirror.

While the mirror won't show the entire large tree at once unless you are far away, it can reflect light rays coming from parts of the tree, allowing you to see an image of those parts. The field of view is limited by the mirror size.

56. Approximately how long does it take for light emitted by the Sun to reach the Earth?
- (A) 8 seconds
  - (B) 8 minutes 20 seconds
  - (C) 8 hours
  - (D) Instantly

Ans :

(B) 8 minutes 20 seconds

The "Fascinating Facts" box states that light takes about 8 minutes and 20 seconds to travel the distance from the Sun to the Earth.

57. **Assertion (A)** : Light travels in a straight line.  
**Reason (R)** : Shadows are formed when an opaque object blocks the path of light.
- (A) Both A and R are true, and R is the correct explanation of A.
  - (B) Both A and R are true, but R is not the correct explanation of A.
  - (C) A is true, but R is false.
  - (D) A is false, but R is true.

Ans :

(A) Both A and R are true, and R is the correct explanation of A.

The formation of a distinct shadow (Reason R) occurs precisely because light travels in straight lines (Assertion A) and cannot bend around the opaque object blocking its path.

58. **Assertion (A)** : The image formed in a plane mirror is laterally inverted.  
**Reason (R)** : The image formed in a plane mirror is always upside down.
- (A) Both A and R are true, and R is the correct explanation of A.
  - (B) Both A and R are true, but R is not the correct explanation of A.
  - (C) A is true, but R is false.
  - (D) A is false, but R is true.

Ans :

(C) A is true, but R is false.

Assertion A correctly states that plane mirror images are laterally inverted. Reason R is false; plane mirror images are always erect (upright), not upside down.



59. Which of the following is NOT a characteristic of the image formed by a plane mirror?  
 (A) Same size as the object  
 (B) Erect (upright)  
 (C) Laterally inverted  
 (D) Can be formed on a screen (real)

Ans :

(D) Can be formed on a screen (real)

Images formed by plane mirrors are virtual; they appear behind the mirror and cannot be projected onto a screen. Real images can be formed on a screen.

## MATCHING TYPE QUESTION

60. Match the term related to light sources and materials in Column A with its correct description in Column B:

	Column A		Column B
1.	Luminous Object	A.	Allows light to pass through partially
2.	Non-luminous Object	B.	Emits its own light
3.	Transparent Material	C.	Does not emit its own light; reflects light
4.	Translucent Material	D.	Allows light to pass through almost completely

- (a) 1-B, 2-C, 3-D, 4-A  
 (b) 1-C, 2-B, 3-A, 4-D  
 (c) 1-B, 2-A, 3-D, 4-C  
 (d) 1-D, 2-C, 3-B, 4-A

Ans :

(a) 1-B, 2-C, 3-D, 4-A

Luminous objects produce their own light. Non-luminous objects reflect light. Transparent materials let light pass fully. Translucent materials allow partial light passage.

61. Match the phenomenon of light in Column A with its key characteristic or requirement in Column B:

	Column A		Column B
--	----------	--	----------

1.	Rectilinear Propagation of Light	A.	Formed when an opaque object blocks light
2.	Shadow Formation	B.	Change in direction of light by a mirror
3.	Reflection of Light	C.	Image is same size, erect, and laterally inverted
4.	Image by Plane Mirror	D.	Light travels in a straight line

- (a) 1-A, 2-D, 3-C, 4-B  
 (b) 1-D, 2-C, 3-B, 4-A  
 (c) 1-D, 2-A, 3-B, 4-C  
 (d) 1-B, 2-A, 3-D, 4-C

Ans :

(c) 1-D, 2-A, 3-B, 4-C

Rectilinear propagation means light travels straight. Shadows form when light is blocked. Reflection is light bouncing off a mirror. Plane mirror images are same size, erect, and laterally inverted.

62. Match the optical device in Column A with its working principle or image characteristic in Column B:

	Column A		Column B
1.	Pinhole Camera	A.	Uses two plane mirrors to see over obstacles
2.	Periscope	B.	Forms an inverted image on a screen
3.	Kaleidoscope	C.	Opaque object that blocks light completely
4.	Cardboard	D.	Uses multiple reflections to create patterns

- (a) 1-C, 2-D, 3-A, 4-B  
 (b) 1-B, 2-A, 3-D, 4-C  
 (c) 1-B, 2-D, 3-A, 4-C  
 (d) 1-D, 2-A, 3-C, 4-B

Ans :

(b) 1-B, 2-A, 3-D, 4-C

A pinhole camera forms an inverted image. A periscope uses two mirrors for indirect viewing. A kaleidoscope creates patterns using multiple reflections. Cardboard is an opaque material.

**VERY SHORT QUESTION**

63. Match the characteristic of a shadow or image in Column A with the condition or object that produces it in Column B:

	Column A		Column B
1.	Darker Shadow	A.	Formed by a plane mirror
2.	Lighter Shadow	B.	Formed by an opaque object
3.	Laterally Inverted Image	C.	Object is moved closer to the light source (screen fixed)
4.	Larger Shadow	D.	Formed by a translucent object

- (a) 1-D, 2-B, 3-A, 4-C
- (b) 1-B, 2-A, 3-D, 4-C
- (c) 1-A, 2-D, 3-C, 4-B
- (d) 1-B, 2-D, 3-A, 4-C

Ans :

- (d) 1-B, 2-D, 3-A, 4-C

Opaque objects cast darker shadows. Translucent objects cast lighter shadows. Plane mirrors produce laterally inverted images. Shadows enlarge when the object is nearer the light source.

64. Match the term related to light and its interaction in Column A with a relevant example or property in Column B:

	Column A		Column B
1.	Sun	A.	Does not allow light to pass through
2.	Moon	B.	Its image cannot be formed on a screen
3.	Opaque	C.	A natural luminous object
4.	Plane Mirror Image	D.	A non-luminous object reflecting sunlight

- (a) 1-C, 2-D, 3-A, 4-B
- (b) 1-B, 2-A, 3-D, 4-C
- (c) 1-C, 2-A, 3-D, 4-B
- (d) 1-D, 2-C, 3-B, 4-A

Ans :

- (a) 1-C, 2-D, 3-A, 4-B

The Sun is a luminous object. The Moon is non-luminous, reflecting sunlight. Opaque materials block light. Plane mirror images are virtual (cannot be caught on screen).

65. Name the main source of natural light on Earth.

Ans :

The Sun

66. What are objects called that emit their own light?

Ans :

Luminous objects

67. What are objects called that do not emit their own light?

Ans :

Non-luminous objects

68. Is the Moon a luminous or non-luminous object?

Ans :

Non-luminous object

69. What modern light sources are known for consuming less power and lasting longer?

Ans :

Light Emitting Diode (LED) lamps

70. Does light generally travel in a straight line or a curved path?

Ans :

Straight line

71. What type of material allows light to pass through it almost completely?

Ans :

Transparent material

72. What type of material allows light to pass through it only partially?

Ans :

Translucent material

73. What type of material does not allow light to pass through it at all?

Ans :

Opaque material

74. What is the dark patch formed when an opaque object blocks the path of light called?

Ans :

Shadow



**SHORT ANSWER QUESTION**

75. What three things are needed to observe a shadow?

**Ans :**

A source of light, an opaque object, and a screen

76. Does the colour of an opaque object affect the colour of its shadow?

**Ans :**

No

77. What is the change in the direction of light by a mirror called?

**Ans :**

Reflection of light

78. What type of mirror is flat and not curved?

**Ans :**

Plane mirror

79. What you see of yourself in a mirror is called an \_\_\_\_\_.

**Ans :**

Image (or reflection)

80. Is the image formed by a plane mirror the same size as, larger than, or smaller than the object?

**Ans :**

Same size as the object

81. Is the image formed by a plane mirror upright (erect) or upside down (inverted)?

**Ans :**

Upright (erect)

82. Can the image formed by a plane mirror be obtained on a screen?

**Ans :**

No

83. What is the perceived left-right reversal in a plane mirror image called?

**Ans :**

Lateral inversion

84. What simple device uses a tiny hole to form an image on a screen?

**Ans :**

Pinhole camera

85. Differentiate between luminous and non-luminous objects with one example each.

**Ans :**

Luminous objects emit their own light (e.g., the Sun, a lit candle). Non-luminous objects do not emit their own light but reflect light (e.g., the Moon, a book).

86. How does the Moon shine if it is a non-luminous object?

**Ans :**

The Moon shines because it reflects the light emitted by the Sun that falls on its surface.

87. Describe a simple activity to show that light travels in straight lines.

**Ans :**

Look at a candle flame through a straight pipe; the flame is visible. Then, bend the pipe and try to look again; the flame is not visible, showing light travels straight.

88. How would you classify glass, tracing paper, and cardboard based on how light interacts with them?

**Ans :**

Glass is transparent (light passes fully). Tracing paper is translucent (light passes partially). Cardboard is opaque (light does not pass).

89. Explain how a shadow is formed.

**Ans :**

Light travels in straight lines. When an opaque object blocks the path of light, light cannot reach the area behind the object. This dark area where light is blocked is the shadow.

90. Do translucent objects form shadows? If so, how do they compare to shadows of opaque objects?

**Ans :**

Yes, translucent objects form shadows, but they are generally lighter or fainter than the dark shadows formed by opaque objects because some light passes through them.

91. List three factors required to form and observe a shadow.

**Ans :**

To observe a shadow, we need :

1. A source of light,
2. An opaque (or translucent) object to block the light, and
3. A screen (surface) on which the shadow can be cast.

- 92.** How does the distance between the object and the light source affect the size of the shadow cast on a fixed screen?

**Ans :**

Moving the object closer to the light source (while keeping the screen fixed) makes the shadow larger. Moving it further away makes the shadow smaller.

- 93.** What is reflection of light? Use the example of a mirror redirecting sunlight.

**Ans :**

Reflection is the change in direction of light when it bounces off a surface, like a mirror. A mirror can redirect sunlight falling on it to a different spot.

- 94.** State two characteristics of the image formed by a plane mirror.

**Ans :**

The image formed by a plane mirror is :

1. The same size as the object
2. Upright (erect)

- 95.** Explain lateral inversion with an example using your reflection in a plane mirror.

**Ans :**

Lateral inversion is the apparent left-right reversal in a mirror image. If you raise your left hand, your image appears to raise its right hand.

- 96.** Why is the word 'AMBULANCE' often written laterally inverted on the front of ambulance vehicles?

**Ans :**

It is written inverted so that drivers viewing it in their rear-view mirrors can read the word correctly ('AMBULANCE') due to the lateral inversion caused by the mirror.

- 97.** Describe the image formed by a pinhole camera. Is it erect or inverted?

**Ans :**

A pinhole camera forms an image on a screen by allowing light rays from an object to pass through a tiny hole. The image formed is inverted (upside down).

- 98.** How does a simple periscope allow you to see objects that are not directly visible?

**Ans :**

A periscope uses two plane mirrors placed parallel to each other but offset, usually at 45-degree angles in a Z-shaped tube. Light from the object reflects off the top mirror, down the tube, reflects off the bottom mirror, and into the viewer's eye.

- 99.** Briefly describe how a kaleidoscope creates beautiful patterns.

**Ans :**

A kaleidoscope uses three rectangular mirrors joined in a triangular shape inside a tube. Loose coloured objects (beads, bangles) at one end are reflected multiple times by the mirrors, creating complex, symmetrical patterns when viewed from the other end.

- 100.** How does the straight-line travel of light explain shadow formation?

**Ans :**

Because light travels straight, it cannot bend around an opaque object placed in its path. The region directly behind the object, where the straight light rays are blocked, forms the shadow.

- 101.** How does the straight-line travel of light explain image formation in a pinhole camera?

**Ans :**

Light rays from different points on an object travel in straight lines through the tiny pinhole. Rays from the top of the object travel straight to the bottom of the screen, and rays from the bottom travel straight to the top, forming an inverted image.

- 102.** Give one example of a natural source of light and one example of an artificial source of light.

**Ans :**

Natural source : The Sun (or stars, lightning, fireflies). Artificial source : An electric bulb (or candle, torch, fire).

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- 103.** Why should one be careful when using lasers or pointing them at anyone's eyes?

**Ans :**

Laser light is concentrated. Pointing even a low-power laser beam directly into eyes can cause serious and permanent eye damage.

- 104.** Why are LED lamps considered environmentally friendly compared to traditional lamps?

**Ans :**

LED lamps consume much less electricity (power) for the same amount of light and last longer, reducing energy consumption and waste generation.

## LONG ANSWER QUESTION

- 105.** Describe an experiment to conclusively demonstrate that light travels in straight lines. Explain the setup, procedure, observations and conclusion.

**Ans :**

### Experiment :

- (1) Setup : A lighted candle and a long, flexible hollow pipe.

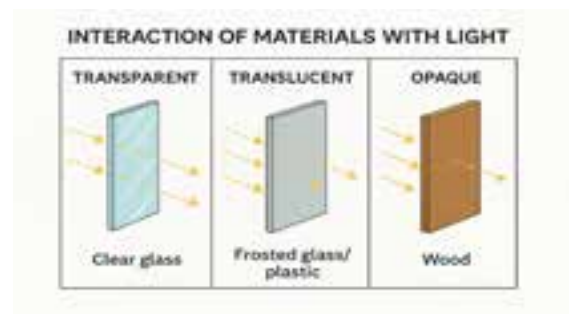


- (2) Procedure : First, keep the pipe straight and look through it at the candle flame. Then, bend the pipe and try to look at the flame through it again.
- (3) Observation : The candle flame is clearly visible through the straight pipe but cannot be seen at all through the bent pipe.
- (4) Conclusion : Since the light from the flame could only travel along the straight path of the pipe to reach the eye, and was blocked when the path was bent, this demonstrates that light travels in straight lines. (Rectilinear propagation).

- 106.** Explain how you would classify materials as transparent, translucent, and opaque based on their interaction with light. Give an example of each type of material.

**Ans :**

- (1) Basis of Classification : How much light passes through the material.
- (2) Procedure : Shine a torchlight on different materials placed between the torch and a screen/wall in a dark room. Observe the light on the screen.
- (3) Transparent : Light passes through almost completely, allowing clear vision through them and casting almost no shadow (e.g., clear glass, air, clean water). A bright spot is seen on the screen.
- (4) Translucent : Light passes through partially, scattering it. Vision through them is blurry, and they cast faint shadows (e.g., tracing paper, frosted glass, thin cloth). A dim or diffused spot is seen.
- (5) Opaque : Light does not pass through at all. Vision through them is blocked, and they cast dark shadows (e.g., cardboard, wood, metal, thick cloth). No light spot is seen, only a shadow.



- 107.** Explain the phenomenon of reflection of light using . Draw a simple diagram to illustrate the incident ray and the reflected ray.

**Ans :**

When a ray of light hits a polished surface, and the ray bounces back, it is known as the reflection of light. The incident light ray that falls on the surface is reflected off the polished surface. The light ray that bounces back is known as the reflected ray. A perpendicular drawn on a reflecting surface is called normal.



108. List and explain four key characteristics of the image formed by a plane mirror.

Ans :

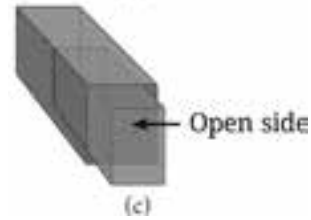
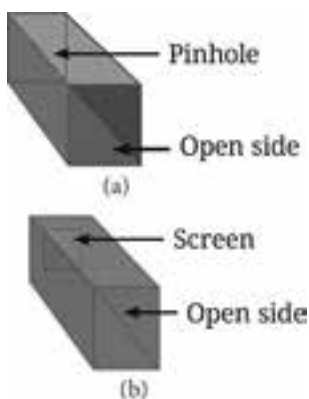
Characteristics of a plane mirror image:

- (1) Same Size : The image appears to be the exact same size as the object itself.
- (2) Erect : The image is upright, oriented the same way vertically as the object (not upside down).
- (3) Virtual (Cannot be formed on screen) : The image appears behind the mirror but cannot be projected onto a screen placed there.
- (4) Laterally Inverted : The image shows a left-right reversal compared to the object (e.g., left hand appears as right hand in the image). (Also acceptable : Same distance behind the mirror as the object is in front).

109. Describe the construction and working of a simple pinhole camera. Explain why the image formed is inverted.

Ans :

- (1) **Construction** : Two cardboard boxes, one sliding inside the other. The outer box has a tiny pinhole on one face. The inner box has one face replaced with a translucent screen (tracing paper). **Assembly** : Slide the inner box into the outer one with the screen facing inwards, opposite the pinhole.



- (2) **Working** : Place the pinhole facing a bright object. Light rays from the object travel in straight lines. Rays from the top of the object pass straight through the pinhole and land on the bottom part of the screen. Rays from the bottom of the object pass straight through the pinhole and land on the top part of the screen. This crossing of rays results in an inverted (upside down) image forming on the screen. Adjusting the inner box focuses the image.

110. Compare the image formed by a pinhole camera with the image formed by a plane mirror in terms of orientation (erect/inverted) and whether it can be formed on a screen (real/virtual).

Ans :

- (1) Pinhole Camera Image:
  - (a) Orientation : Inverted (upside down).
  - (b) Formation on Screen : Yes, it is formed on the translucent screen (Real image).
- (2) Plane Mirror Image:
  - (a) Orientation : Erect (upright).
  - (b) Formation on Screen : No, it appears behind the mirror and cannot be formed on a screen (Virtual image). The key differences are orientation (inverted vs. erect) and nature (real vs. virtual).

111. Explain the principle and construction of a simple periscope using two plane mirrors. How does it allow viewing over obstacles?

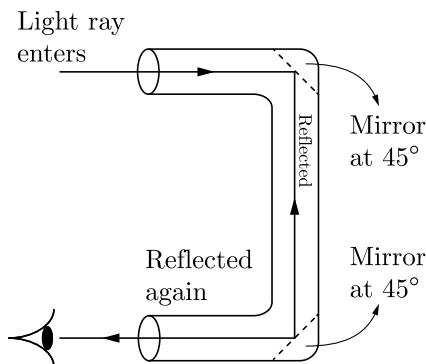
Ans :

- (1) Principle : Reflection of light by plane mirrors. Light travels in straight lines but its direction can be changed by reflection.
- (2) Construction : Typically a Z-shaped tube or box. Two plane mirrors are fixed inside, parallel to each other, and usually at a 45° angle to the axis of the tube sections they are in. One mirror is near the top opening, the other near the bottom viewing opening.

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- (3) **Working :** Light from a distant object above enters the top opening, hits the top mirror, reflects downwards (at  $90^\circ$ ), travels down the tube, hits the bottom mirror, reflects horizontally (another  $90^\circ$ ) into the observer's eye. This allows the observer to see over obstacles.

112. Why are shadows sometimes sharp and sometimes blurry? Consider the size of the light source relative to the object. (Information not explicitly in text, requires inference).

**Ans :**

The sharpness of a shadow depends on the nature of the light source. A very small point source of light produces sharp-edged shadows because light rays are blocked cleanly. However, most real-life light sources (like the Sun, a frosted bulb) have a definite size (they are extended sources). Light from different parts of the source can reach the edges of the shadow region, causing partial illumination and making the shadow edges blurry or fuzzy (this blurry region is called the penumbra, though the term isn't used here). The closer the object is to the screen, or the smaller/more distant the light source, the sharper the shadow tends to be.

113. While luminous objects produce light, we see non-luminous objects because they reflect light. Explain this using the example of seeing a book in a room lit by an electric lamp.

**Ans :**

The electric lamp is a luminous object, emitting its own light. This light travels outwards in straight lines. Some of this light falls on the book. The book is a non-luminous object; it does not produce its own light. However, the surface of the book reflects the lamp light that falls on it. Some of this reflected light travels in straight lines

to our eyes. When our eyes detect this reflected light, our brain interprets it as seeing the book. Without the lamp (light source) or the reflection from the book's surface, we wouldn't be able to see the non-luminous book.

## CASE BASED QUESTION

114. Keshav sees fireflies emitting light at night and the Moon shining brightly. His grandfather explains fireflies produce their own light, but the Moon reflects sunlight.
1. Classify the fireflies and the Moon as luminous or non-luminous.
  2. What is the ultimate source of the light we see as moonlight?
  3. Why can Keshav see the trees at night under the moonlight? Are the trees luminous or non-luminous?

**Ans :**

- (1) Fireflies are luminous. The Moon is non-luminous.
- (2) The Sun.
- (3) Keshav sees the trees because they reflect the moonlight (which is reflected sunlight) towards his eyes. The trees are non-luminous.

115. A student shines a torchlight through three different materials onto a wall : Material A lets a clear, bright spot pass through. Material B blocks the light completely, forming a dark shadow. Material C lets some light pass, forming a dim, fuzzy spot.

1. Classify Material A based on its interaction with light.
2. Classify Material B based on its interaction with light.
3. Classify Material C based on its interaction with light.
4. Which material would be best suited for making a windowpane? Why?

**Ans :**

- (1) Transparent.
- (2) Opaque.
- (3) Translucent.
- (4) Material A (transparent), because it allows clear vision and maximum light to pass through.

**116.** In a shadow puppet show, the puppeteer holds a flat cut-out figure between a bright lamp and a white screen. By moving the puppet closer to the lamp, the shadow on the screen becomes larger and slightly blurrier.

1. What property of light causes the shadow to form?
2. Why does moving the puppet closer to the lamp make the shadow larger?
3. Why might the shadow become blurrier when the puppet is closer to the lamp (an extended source)?

**Ans :**

- (1) Light travels in straight lines and is blocked by the opaque puppet.
- (2) When closer to the light source, the puppet blocks light rays that diverge more widely, casting a larger shadow on the distant screen.
- (3) When closer to an extended light source (like a lamp bulb, not a point source), light from different parts of the source can pass around the edges of the puppet, creating a larger fuzzy edge (penumbra) around the main dark shadow (umbra).

**117.** A girl stands 2 metres in front of a large plane mirror in a shop. She sees her reflection. She holds up her right hand.

1. How far behind the mirror surface does her image appear to be?
2. Which hand does her image in the mirror appear to hold up? What is this effect called?
3. Is the image she sees real or virtual? Can it be projected onto a wall behind the mirror?

**Ans :**

- (1) 2 metres (Image distance equals object distance for a plane mirror).
- (2) Her image appears to hold up its left hand. This effect is called lateral inversion.
- (3) The image is virtual. It cannot be projected onto a wall or screen.

**118.** Using a pinhole camera made from boxes, a student views a tall tree outside on a sunny day. They see a clear but upside-down image of the tree on the tracing paper screen inside the camera.

1. Why is the image formed inside the pinhole camera upside down (inverted)?
2. Is the image seen on the tracing paper real or virtual?
3. If the student made the pinhole larger, how would the image likely change?

**Ans :**

- (1) Light rays from the top of the tree travel straight through the pinhole to the bottom of the screen, and rays from the bottom of the tree travel to the top of the screen.
- (2) Real (because it is formed on a screen).
- (3) The image would become brighter but also much blurrier and less sharp, as overlapping rays from different parts of the object would pass through the larger hole.

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# CHAPTER 12

## EARTH, MOON AND THE SUN

### SUMMARY

#### 1. EARTH'S ROTATION

The Earth rotates on its own axis from West to East once every 24 hours, which causes day and night. We see the Sun rise in the East and set in the West due to this rotation. This movement is similar to sitting on a merry-go-round and watching the surroundings appear to move in the opposite direction. During rotation, the half of the Earth facing the Sun experiences daytime, while the other half experiences night.

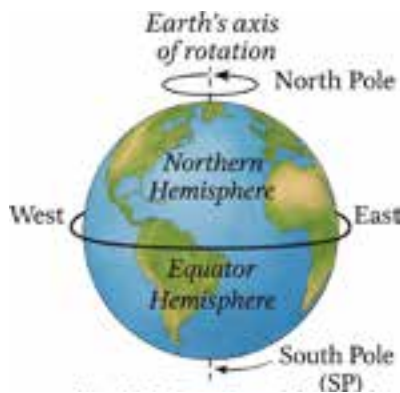


Figure : Rotation of the Earth

#### 2. EARTH'S REVOLUTION

Apart from rotation, the Earth also revolves around the Sun in a nearly circular orbit, taking about 365 days and 6 hours to complete one revolution. This revolution leads to the apparent change in positions of stars and constellations throughout the year. Different constellations become visible in the night sky at different times due to Earth's changing position in its orbit.



Figure : Revolution of the Earth around the Sun leads to changing view of the night sky throughout the year

#### 3. SEASONS ON EARTH

The Earth's tilted axis (about  $23.5^\circ$ ) and its spherical shape cause the seasons. In June, the Northern Hemisphere is tilted towards the Sun, receiving more direct and longer sunlight—this causes summer there. Conversely, in December, it's tilted away, resulting in winter. The Southern Hemisphere experiences opposite seasons at the same time. On the equinoxes (March 21 and September 23), both hemispheres receive equal sunlight, making the day and night almost equal

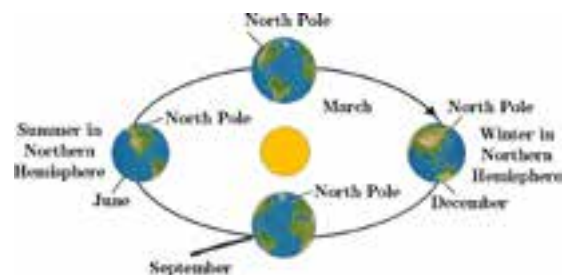


Figure : Different positions of the Earth while revolving around the Sun (The Earth's orbit appears elongated because this is a side view and not the top view.)

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#### 4. SOLAR ECLIPSES

A solar eclipse occurs when the Moon comes between the Earth and the Sun and blocks sunlight. Despite being smaller, the Moon can cover the Sun due to its proximity to the Earth. A total solar eclipse happens when the Sun is fully covered by the Moon, while a partial eclipse occurs when only part of the Sun is blocked. These eclipses are short-lived and visible only from specific regions. Never look directly at a solar eclipse without proper protection, as it can damage the eyes.

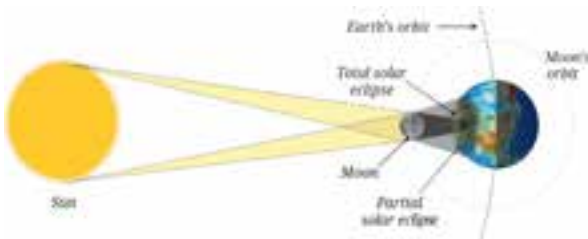


Figure : Geometry of solar eclipse

#### 5. LUNAR ECLIPSES

A lunar eclipse happens when the Earth comes between the Sun and the Moon, casting a shadow on the Moon. A total lunar eclipse occurs when the full Moon enters Earth's shadow, often turning red. A partial lunar eclipse is when only part of the Moon is covered. Unlike solar eclipses, lunar eclipses are safe to view with the naked eye and visible over larger areas.

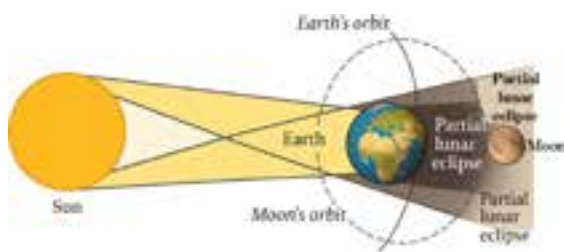


Figure : Geometry of lunar eclipse

#### 6. DAY-NIGHT AND YEARLY CYCLE

Due to Earth's rotation, different parts of the globe experience day and night. Due to its revolution, we experience seasonal variations and changes in the visible night sky across months. These predictable movements help in understanding eclipses, solstices, and equinoxes, and have been observed since ancient times by astronomers like Aryabhata, who accurately estimated Earth's rotation period.

### NCERT ACTIVITY

#### Activity 12.1 : Let us explore

1. Ask someone to turn the merry-go-round slowly in the anti-clockwise direction as shown in Figure.



Figure : A girl observing objects around her while riding a merry-go-round

While you are sitting on the moving merry-go-round, look around you. Do the objects around you appear to be moving?

In which direction do they appear to be moving?

While you turn in the anti-clockwise direction, the objects appear to turn around you in the opposite direction, that is, in the clockwise direction.

2. Now fix your gaze at a particular tree (or a building) ahead of you while sitting on the merry-go-round turning around in anti-clockwise direction.

In which direction do you find the tree turning around you? Is it in your view all the time?

Ans :

Do the objects around you appear to be moving? Yes, the stationary objects around the merry-go-round (like trees, benches, other people not on the merry-go-round) will appear to be moving.

In which direction do they appear to be moving? If you are turning anti-clockwise on the merry-go-round, the stationary objects around you will appear to be moving in the opposite direction, which is clockwise, relative to you.

In which direction do you find the tree turning around you? The tree will appear to turn around you in the clockwise direction (opposite to your anti-clockwise motion).

Is it in your view all the time? No, the tree will not be in your view all the time. As you rotate, the tree will appear to enter your field of view



from one side (from your left, if you are moving anti-clockwise and the tree is initially ahead) and then move out of your field of view on the other side (to your right).

### Activity 12.2 : Let us explore

1. Use a globe to represent the Earth and place a small sticker to mark your location on it Figure (a).



Figure : (a) Using a globe to understand rotation of the Earth

2. While viewing from above the North Pole, slowly rotate the globe on its axis in anti-clockwise direction.
3. Observe how your location turns around and finally comes back to its original position completing one rotation.

Let us now further explore to understand how day and night occur on the Earth due to its rotation.

4. Use a torch to represent the Sun. Go to a relatively dark room to carry out the further steps of the activity.
5. Now, shine light from the torch placed at some distance, say 1.5 metres, on the globe as shown in Figure (b). Do you notice how half of the globe receives the light from the torch, while the other half stays dark?



Figure : Using a globe and a torchlight to understand day and night

It is day time in that half of the globe which receives light, and night time in the other half.

6. In India, sunrise first occurs in the eastern part and then in other parts. While looking at the eastern part of India on the globe, rotate the globe in one direction and then in the opposite direction. What is the direction of rotation when light falls on the eastern part of India first?

The light falls on the eastern part of India first when the globe rotates from West to East with respect to the North-South axis of the globe.

7. Now while rotating the globe from West to East, observe your location on the Earth. Does it go through a cycle of day and night?

Ans :

Observing location on rotating globe : As the globe is rotated anti-clockwise (when viewed from above the North Pole), the sticker marking your location will move in a circle around the globe's axis and return to its starting point after one full rotation.

Illuminating the globe with a torch : Yes, when the torch (representing the Sun) shines on the globe, half of the globe is illuminated (experiencing "day") and the other half remains dark (experiencing "night").

Direction of rotation for sunrise in eastern India first : The light from the torch will fall on the eastern part of India first if the globe is rotated from West to East (which is an anti-clockwise rotation when viewed from above the North Pole).

Observing your location during rotation from West to East : Yes, as the globe rotates from West to East, the sticker representing your location will move from the dark half (night) into the illuminated half (day, experiencing "sunrise"), then across the illuminated half (daytime) and then into the dark half again (experiencing "sunset" and then night). This demonstrates the cycle of day and night due to the Earth's rotation.

### Activity 12.3 : Let us explore

1. On an early evening between March and May, identify the Big Dipper (Saptarishi), and the Pole Star (Dhruva Tara), if visible, as you did in the chapter 'Beyond Earth' in the Grade 6 Science textbook Curiosity.

- Note down your location and date of your night sky observations. The activity must be carried out on the same night.
- Draw the orientation of the Big Dipper in the sky with respect to the Pole Star (or a fixed tree/building on the ground in a direction towards the Big Dipper if you cannot see the Pole Star). Mark the time of your observation along with your sketch as shown in Figure.

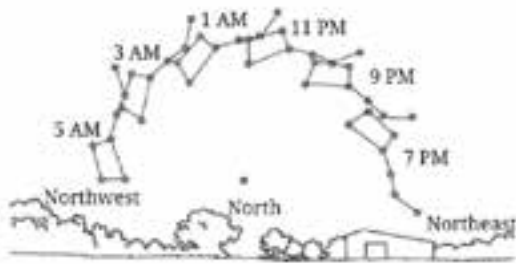


Figure : Illustrative sketch of Big Dipper (for activity 12.3) by a student located in Pune on the night of 1-2 April

- After two hours, observe the Big Dipper again. Has it moved? Again, draw its orientation and note down the time.
- Repeat the above step after two hours. Do you observe that the Big Dipper appears to move around the Pole Star (notice just the movement even if you cannot see the Pole Star)?

Ans :

Has the Big Dipper moved after two hours? Yes, after two hours, the Big Dipper will appear to have moved its position in the sky relative to the horizon or any fixed terrestrial landmarks.

Does the Big Dipper appear to move around the Pole Star? Yes, if the Pole Star is visible, the Big Dipper will appear to be slowly rotating (circling) around the Pole Star in an anti-clockwise direction (when facing North). If the Pole Star is not visible but a fixed reference point on the ground is used, the Big Dipper's position relative to this point will change over time, consistent with an apparent circular motion around the point where the Pole Star would be.

This apparent movement of the Big Dipper (and other stars) is due to the Earth's rotation on its axis. Since the Earth's axis of rotation points very close to the Pole Star (in the Northern Hemisphere), the Pole Star appears nearly stationary, while other celestial objects seem to revolve around it.

### Activity 12.4 : Let us explore

- Ask your friend to stand in front of you at a distance of about 5 metres. Consider his head to be the Sun.
- Now close one eye and show a thumbs up with your outstretched hand towards your friend as shown in Figure. Are you able to cover the entire head of your friend with your thumb?



Figure : Trying to cover a friend's head with the thumb

Ans :

Yes, you are able to cover the entire head of your friend with your thumb, even though your thumb is much smaller than your friend's head.

This happens because the apparent size of an object depends on both its actual physical size and its distance from the observer. Since your thumb is much closer to your eye than your friend's head, its apparent size can be large enough to cover the apparent size of the more distant (and actually larger) head. This principle helps explain how the relatively small Moon can appear to cover the much larger Sun during a solar eclipse, as the Moon is much closer to Earth than the Sun.

### NCERT EXERCISE

- In Figure, how many hours of sunlight do the North Pole and the South Pole receive during one rotation of the Earth?



**Ans :**

In the given figure, the North Pole is in darkness, which means it is winter in the Northern Hemisphere. During this time, the North Pole receives 0 hours of sunlight, while the South Pole, experiencing summer, receives 24 hours of sunlight during one rotation of the Earth. This occurs due to the tilt of the Earth's axis.

**2. Fill in the blanks**

1. Stars rise in the \_\_\_\_\_ and set in the \_\_\_\_\_.
2. Day and night are caused by the Earth's \_\_\_\_\_.
3. When the Moon fully covers the Sun from our view, it is called a \_\_\_\_\_ solar eclipse.

**Ans :**

- (i) Stars rise in the East and set in the West.
- (ii) Day and night are caused by the Earth's rotation.
- (iii) When the Moon fully covers the Sun from our view, it is called a total solar eclipse.

**3. State whether True or False**

1. Lunar eclipse occurs when the Sun comes between the Earth and the Moon.
2. Sunrise happens earlier in Gujarat than in Jharkhand.
3. In Chennai, the longest day occurs on the summer solstice.
4. We should watch the solar eclipse directly with our naked eye.
5. Seasons occur due to the tilt of Earth's axis of rotation and its spherical shape.
6. The Earth's revolution around the Sun causes day and night.

**Ans :**

- (i) False : A lunar eclipse occurs when the Earth comes between the Sun and the Moon, casting a shadow on the Moon.
- (ii) False : Jharkhand is to the east of Gujarat. Since the Earth rotates from West to East, locations further east experience sunrise earlier. So, sunrise happens earlier in Jharkhand than in Gujarat.
- (iii) True : Chennai is in the Northern Hemisphere. The summer solstice (around June 21st) marks the longest day of the year for the Northern Hemisphere.
- (iv) False : Viewing a solar eclipse directly with the naked eye can cause serious eye damage

and even blindness. Specialised eye protection or indirect viewing methods must be used.

- (v) True : The tilt of the Earth's axis (23.5 degrees) relative to its orbital plane, combined with its revolution around the Sun, causes different parts of the Earth to receive more direct sunlight at different times of the year, leading to seasons. The spherical shape also influences how sunlight is spread over areas.
- (vi) False : The Earth's rotation on its axis causes day and night. The Earth's revolution around the Sun causes the year and contributes to the seasons.

**4. Padmashree saw the Orion constellation nearly overhead at 8 pm yesterday. When will she see Orion overhead today?**

**Ans :**

Padmashree will see the Orion constellation overhead about 4 minutes earlier each day due to Earth's revolution. If she saw it at 8:00 pm yesterday, she will see it at 7:56 pm today.

**5. Nandhini saw a group of stars rising at midnight on 21 June. When will she see the same group of stars rising at midnight next year?**

**Ans :**

Stars rise about 4 minutes earlier each day because of Earth's orbit around the Sun. Over a year, this adds up to a 24-hour shift. This means Nandhini will see the same stars rising at midnight on 20 June next year, as they rise one day earlier on the calendar each year.

**6. Abhay noticed that when it was daytime in India, his uncle who was in the USA was generally sleeping as it was night-time there. What is the reason behind this difference?**

**Ans :**

The reason behind this difference is the Earth's rotation on its axis.

The Earth is a sphere, and as it rotates, only one half of it can face the Sun at any given time. The half facing the Sun experiences daytime, while the opposite half experiences night-time.

India and the USA are located on different parts of the Earth's surface, separated by a significant difference in longitude. When India is facing the Sun and experiencing daytime, the USA, being on the other side of the Earth (or a part of it significantly away from the sunlit side), is in darkness and experiencing night-time.

As the Earth continues to rotate, the positions will change, and the USA will move into daylight while India moves into night.

7. Four friends used the following ways to see the solar eclipse. Who among them was being careless?
1. Ravikiran used a solar eclipse goggle.
  2. Jyothi used a mirror to project the Sun's image.
  3. Adithya saw the Sun directly with his eyes.
  4. Aruna attended a programme arranged by a planetarium.

Ans :

Adithya saw the Sun directly with his eyes was being careless.

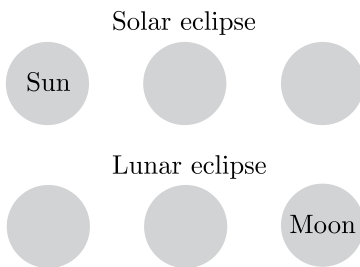
**Reason :** It is extremely dangerous to look directly at the Sun, even during a partial solar eclipse, without proper, specialised eye protection. Doing so can cause severe and permanent eye damage, including blindness.

Ravikiran using solar eclipse goggles is safe if they are certified and meet safety standards.

Jyothi using a mirror to project the Sun's image onto a surface (indirect viewing) is a safe method.

Aruna attending a programme arranged by a planetarium is also safe, as they would provide proper viewing equipment or methods.

8. Fill in the circles in Figure appropriately with one of the following : Sun, Moon, Earth.



Ans :

- (1) For Solar Eclipse:
- (2) Circle 1 (Light Source) : Sun
- (3) Circle 2 (Object in Middle) : Moon
- (4) Circle 3 (Object experiencing eclipse/shadow) : Earth
- (5) (Arrangement : Sun → Moon → Earth)
- (6) For Lunar Eclipse:
- (7) Circle 1 (Light Source) : Sun
- (8) Circle 2 (Object in Middle) : Earth
- (9) Circle 3 (Object being eclipsed/in shadow) : Moon

(10)(Arrangement : Sun → Earth → Moon)

9. The Moon is much smaller than the Sun, yet it can block the Sun completely from our view during a total solar eclipse. Why is it possible?

Ans :

This is possible because of the relative apparent sizes of the Moon and the Sun as viewed from Earth. Although the Sun is vastly larger than the Moon in actual physical size (about 400 times wider), it is also about 400 times farther away from the Earth than the Moon is. This specific ratio of size and distance results in the Sun and the Moon having nearly the same apparent angular size in our sky (about 0.5 degrees).

Because their apparent sizes are so similar, the Moon, when it passes directly between the Earth and the Sun during a new moon phase and its orbit aligns perfectly, can appear to cover the entire disk of the Sun, resulting in a total solar eclipse for observers in the Moon's umbral shadow.

10. The Indian cricket team matches in Australia are often held in December. Should they pack winter or summer clothes for their trip?

Ans :

They should pack summer clothes. Australia lies in the Southern Hemisphere, where the seasons are opposite to those in India. December falls in the middle of the Australian summer, so the weather will be warm to hot when the cricket team arrives..

11. Why do you think lunar eclipses can be seen from a large part of the Earth when they happen, but total solar eclipse can be seen by only a small part of the Earth?

Ans :

During a lunar eclipse the Earth comes between the Sun and the Moon. The Earth's shadow at the Moon's distance is wide enough to cover the whole Moon, and anyone who is on the night-side of Earth can look up and watch the Moon pass through that shadow. Because half of the Earth (the entire night hemisphere) can see the Moon at the same time, the eclipse is visible from a very large area.

In a total solar eclipse the Moon comes between the Sun and the Earth. The Moon is much smaller than the Earth, so its darkest



shadow (called the umbra) forms only a narrow cone that touches the Earth in a small strip a few tens of kilometres wide. Only people who are positioned inside that moving strip see the Sun completely covered; observers just outside it see only a partial eclipse or nothing at all. Hence a total solar eclipse is visible from only a small part of the Earth's surface, whereas a lunar eclipse can be seen from almost an entire hemisphere.

12. If the Earth's axis were not tilted with respect to the axis of revolution, explain what would be the effect on seasons?

Ans :

The Earth's seasons result from the  $23.5^\circ$  tilt of its axis: as our planet orbits the Sun, each hemisphere leans toward the Sun for part of the year (summer) and away for the opposite part (winter). If the axis were not tilted—that is, if it stood straight up relative to its path around the Sun—the Sun's rays would strike the equator directly all year long. Every place on Earth would then have almost exactly 12 hours of daylight and 12 hours of darkness each day, and the angle of the Sun's rays at any given latitude would never change. Consequently, no region would experience the shifting patterns of heating and cooling that create spring, summer, autumn, and winter. Equatorial zones would stay consistently hot, the poles consistently cold, and the intermediate latitudes would have a steady, unchanging climate throughout the year—essentially a world without seasons.

## MULTIPLE CHOICE QUESTION

1. Rashmika observes coconut tree shadows getting shorter from morning to afternoon. She initially thinks the Sun moves across the sky. What is the actual reason for this apparent movement?
- (A) The Sun actually moves across the sky daily.  
 (B) The coconut trees bend during the day.  
 (C) The Earth rotates on its axis.  
 (D) The Moon's gravity pulls the Sun across the sky.

Ans :

(C) The Earth rotates on its axis.

The apparent movement of the Sun across the sky, causing changes in shadow length and position, is a result of the Earth spinning on its own axis.

2. If you are sitting on a merry-go-round turning anti-clockwise, in which direction do stationary objects outside the ride, like trees, appear to move?
- (A) Anti-clockwise, same as the ride.  
 (B) Clockwise, opposite to the ride's direction.  
 (C) Towards the center of the ride.  
 (D) Away from the center of the ride.

Ans :

(B) Clockwise, opposite to the ride's direction. Due to relative motion, when you rotate anti-clockwise, the stationary surroundings appear to rotate around you in the opposite (clockwise) direction. This helps understand Earth's rotation effect.

3. The Sun appears to rise in the East and set in the West. This apparent motion is analogous to the merry-go-round experience and is caused by what?
- (A) The Sun revolving around the Earth from East to West.  
 (B) The Earth rotating on its axis from West to East.  
 (C) The stars pushing the Sun across the sky.  
 (D) The Earth rotating on its axis from East to West.

Ans :

(B) The Earth rotating on its axis from West to East.

Just as stationary objects appear to move opposite to the merry-go-round's rotation, the Sun (which is relatively stationary) appears to move Westward because the Earth rotates Eastward (West to East).

4. What is the spinning motion of an object, like the Earth, around an imaginary line passing through it called?
- (A) Revolution  
 (B) Orbit  
 (C) Rotation  
 (D) Eclipse

Ans :

(C) Rotation

Rotation specifically refers to the act of an object turning or spinning around its own internal axis.

5. Through which points does the Earth's axis of rotation pass?  
 (A) Equator and Prime Meridian  
 (B) Tropic of Cancer and Tropic of Capricorn  
 (C) Geographic North Pole and Geographic South Pole  
 (D) Magnetic North Pole and Magnetic South Pole

**Ans :**

(C) Geographic North Pole and Geographic South Pole

The imaginary line around which the Earth spins connects the geographic North Pole to the geographic South Pole.

6. Approximately how long does it take for the Earth to complete one full rotation on its axis?  
 (A) 365 days  
 (B) 29.5 days  
 (C) 12 hours  
 (D) 24 hours

**Ans :**

(D) 24 hours

The Earth completes one spin on its axis roughly every 24 hours, which defines the length of a solar day.

7. When viewed from above the North Pole, in which direction does the Earth rotate?  
 (A) Clockwise (East to West)  
 (B) Anti-clockwise (West to East)  
 (C) North to South  
 (D) South to North

**Ans :**

(B) Anti-clockwise (West to East)

The standard convention is that Earth rotates counter-clockwise when observed from a point above the North Pole. This direction corresponds to West to East rotation on the surface.

8. What phenomenon is directly caused by the Earth's rotation on its axis?  
 (A) The changing seasons  
 (B) The cycle of day and night  
 (C) The phases of the Moon  
 (D) Solar and lunar eclipses

**Ans :**

(B) The cycle of day and night

As the Earth spins, different parts of its surface turn towards and away from the Sun, causing the regular alternation between daylight and darkness.

9. A globe and a torch (representing the Sun), what does the illuminated half of the globe represent?  
 (A) Winter season  
 (B) Night time  
 (C) Summer season  
 (D) Day time

**Ans :**

(D) Day time

The torchlight simulates sunlight. The portion of the globe receiving direct light represents the part of the Earth experiencing day.

10. Why does sunrise occur earlier in the eastern parts of India compared to the western parts?  
 (A) Because the Sun moves faster over eastern India.  
 (B) Because eastern India is closer to the Sun.  
 (C) Because the Earth rotates from West to East, bringing eastern regions into sunlight first.  
 (D) Because of differences in time zones only.

**Ans :**

(C) Because the Earth rotates from West to East, bringing eastern regions into sunlight first.

As the Earth spins towards the East, locations further east encounter the sunrise boundary earlier than locations further west during each rotation.

11. Which scientist used a long pendulum (now known as a Foucault pendulum) to demonstrate the Earth's rotation?  
 (A) Galileo Galilei  
 (B) Christiaan Huygens  
 (C) Leon Foucault  
 (D) Aryabhata

**Ans :**

(C) Leon Foucault

Leon Foucault devised the experiment using a very long pendulum whose swing plane appears to rotate relative to the Earth's surface, providing direct evidence of Earth's rotation.

12. Why do stars, like the Sun, appear to move across the night sky?  
 (A) Because stars revolve around the Earth daily.  
 (B) Because the Earth's atmosphere magnifies their movement.  
 (C) Because the Earth is rotating on its axis.  
 (D) Because stars are constantly moving away from Earth.

**Ans :**



(C) Because the Earth is rotating on its axis. Similar to the Sun's apparent motion, the rotation of the Earth causes the stars to appear to trace arcs across the night sky from East to West.

13. Which star appears nearly stationary in the Northern Hemisphere sky because the Earth's axis points almost directly towards it?
- (A) Sirius  
(B) Betelgeuse  
(C) The Pole Star (Polaris/Dhruva Tara)  
(D) Vega

Ans :

(C) The Pole Star (Polaris/Dhruva Tara)  
The Earth's axis of rotation happens to align closely with the Pole Star (Polaris). Therefore, as the Earth spins, Polaris appears to remain fixed in the northern sky while other stars circle around it.

14. The apparent rising in the east and setting in the west of the Moon is caused by what?
- (A) The Moon's revolution around the Earth.  
(B) The Earth's revolution around the Sun.  
(C) The Earth's rotation on its axis.  
(D) The Moon's own rotation.

Ans :

(C) The Earth's rotation on its axis.  
Just like the Sun and stars, the Moon's apparent daily motion across the sky is primarily due to the Earth spinning on its axis.

15. Which ancient Indian astronomer, in his work Aryabhatiya, explained the apparent motion of stars as being due to the Earth's rotation?
- (A) Varahamihira  
(B) Brahmagupta  
(C) Bhaskara II  
(D) Aryabhata

Ans :

(D) Aryabhata  
Aryabhata's analogy of a person in a moving boat seeing stationary objects move backward is applied to explain that the Earth's rotation makes the fixed stars appear to move westward.

16. What is the movement of one object around another object, such as the Earth moving around the Sun, called?
- (A) Rotation  
(B) Eclipse  
(C) Revolution

(D) Oscillation

Ans :

(C) Revolution  
Revolution describes the motion of a celestial body traveling in a path (orbit) around another celestial body.

17. What is the path taken by an object revolving around another object called?
- (A) Axis  
(B) Orbit  
(C) Trajectory  
(D) Equator

Ans :

(B) Orbit  
The term orbit refers to the specific curved path that a planet, moon, or satellite follows as it revolves around a larger central body due to gravity.

18. Approximately how long does it take for the Earth to complete one revolution around the Sun?
- (A) 24 hours  
(B) 29.5 days  
(C) 365 days and 6 hours (one year)  
(D) 12 months exactly

Ans :

(C) 365 days and 6 hours (one year)  
The period of Earth's revolution around the Sun defines our year and takes approximately 365.25 days to complete one full orbit.

19. Why do we see different constellations in the night sky at different times of the year?
- (A) Because the constellations themselves move significantly.  
(B) Because the Earth rotates on its axis.  
(C) Because as the Earth revolves around the Sun, our night-time view points towards different parts of space.  
(D) Because the Earth's tilt changes throughout the year.

Ans :

(C) Because as the Earth revolves around the Sun, our night-time view points towards different parts of space.  
As Earth orbits the Sun, the side facing away from the Sun at night (our view of the distant stars) gradually changes direction over the months, revealing different constellations.

20. What is the primary reason for the occurrence of seasons on Earth?
- (A) The changing distance between the Earth and the Sun.
  - (B) The tilt of the Earth's axis of rotation relative to its orbital plane.
  - (C) The periodic variation in the Sun's energy output.
  - (D) The effect of the Moon's gravitational pull.

Ans :

(B) The tilt of the Earth's axis of rotation relative to its orbital plane.

The ~23.5-degree tilt of Earth's axis is the main cause of seasons. As Earth revolves, this tilt causes different hemispheres to receive more direct sunlight and longer daylight hours at different times of the year.

21. When the Northern Hemisphere is tilted towards the Sun (around June), what season does it experience?
- (A) Winter
  - (B) Autumn
  - (C) Spring
  - (D) Summer

Ans :

(D) Summer

The tilt towards the Sun means sunlight hits the Northern Hemisphere more directly (more intense heating) and for longer durations each day, resulting in summer.

22. Why is sunlight generally more intense in the hemisphere tilted towards the Sun?
- (A) Because that hemisphere is significantly closer to the Sun.
  - (B) Because the Sun produces more heat during that time.
  - (C) Because the sunrays are spread over a smaller area due to the angle of incidence.
  - (D) Because the atmosphere is thinner over that hemisphere.

Ans :

(C) Because the sunrays are spread over a smaller area due to the angle of incidence.

When tilted towards the Sun, sunlight strikes the surface more directly (closer to perpendicular), concentrating the energy over a smaller area, leading to more intense heating compared to when light hits at a glancing angle.

23. During summer in the Northern Hemisphere (around June), what season is experienced in the Southern Hemisphere?
- (A) Summer
  - (B) Winter
  - (C) Spring
  - (D) Autumn

Ans :

(B) Winter

Because of the Earth's tilt, when the Northern Hemisphere is tilted towards the Sun, the Southern Hemisphere is tilted away, receiving less direct sunlight and experiencing shorter days, resulting in winter.

24. Around which date does the summer solstice (longest day) occur in the Northern Hemisphere?
- (A) March 21
  - (B) June 21
  - (C) September 23
  - (D) December 22

Ans :

(B) June 21

The summer solstice marks the day with the maximum duration of daylight in the Northern Hemisphere, occurring typically around June 21st, when the North Pole's tilt towards the Sun is greatest.

25. Around which date does the winter solstice (shortest day) occur in the Northern Hemisphere?
- (A) March 21
  - (B) June 21
  - (C) September 23
  - (D) December 22

Ans :

(D) December 22

The winter solstice is the day with the minimum duration of daylight in the Northern Hemisphere, occurring typically around December 22nd, when the North Pole is tilted furthest away from the Sun.

26. What are the days called when the length of daytime and nighttime are approximately equal all over the Earth (around March 21 and September 23)?
- (A) Solstices
  - (B) Eclipses
  - (C) Equinoxes
  - (D) Transits



Ans :

(C) Equinoxes

Equinoxes occur twice a year when the Earth's tilt is such that neither hemisphere is tilted significantly towards or away from the Sun, resulting in nearly equal day and night durations globally.

27. Why do regions near the Equator experience less prominent seasonal changes compared to regions at higher latitudes?

- (A) The Equator is always tilted towards the Sun.  
 (B) The Equator receives roughly the same intensity and duration of sunlight throughout the year.  
 (C) The Equator rotates faster than the poles.  
 (D) The Equator has no atmosphere to trap heat.

Ans :

(B) The Equator receives roughly the same intensity and duration of sunlight throughout the year.

Due to Earth's shape and tilt, the equatorial regions receive relatively direct sunlight and experience about 12 hours of daylight year-round, leading to minimal variations in temperature and thus less distinct seasons.

28. How long does the period of continuous daylight or continuous darkness last at the North and South Poles?

- (A) 24 hours  
 (B) One month  
 (C) Six months  
 (D) One year

Ans :

(C) Six months

Due to the Earth's axial tilt, each pole experiences approximately six months of continuous daylight (when tilted towards the Sun) followed by six months of continuous darkness (when tilted away).

29. Why can the Moon, which is much smaller than the Sun, appear to cover the Sun completely during a solar eclipse?

- (A) The Moon expands when it passes near the Sun.  
 (B) The Sun shrinks during an eclipse.  
 (C) The Moon is much closer to Earth than the Sun, making their apparent sizes similar from Earth.  
 (D) Earth's atmosphere magnifies the Moon's

size.

Ans :

(C) The Moon is much closer to Earth than the Sun, making their apparent sizes similar from Earth.

Although the Sun is vastly larger than the Moon, its immense distance makes it appear about the same size in the sky as the much closer Moon. This coincidence allows the Moon to block the Sun's disk.

30. What type of event occurs when the Moon passes directly between the Sun and the Earth, casting a shadow on Earth?

- (A) Lunar eclipse  
 (B) Solar eclipse  
 (C) Transit of Venus  
 (D) Equinox

Ans :

(B) Solar eclipse

A solar eclipse happens when the Moon aligns between the Sun and Earth, blocking sunlight and casting the Moon's shadow onto a part of the Earth's surface.

31. What is it called when the Moon completely blocks the Sun's disk as seen from a specific location on Earth?

- (A) Partial solar eclipse  
 (B) Annular solar eclipse  
 (C) Total solar eclipse  
 (D) Lunar eclipse

Ans :

(C) Total solar eclipse

A total solar eclipse occurs in the region where the Moon's darkest shadow (umbra) falls, completely obscuring the Sun's bright face for a brief period.

32. What is observed when the Moon only partially covers the Sun's disk?

- (A) Total solar eclipse  
 (B) Partial solar eclipse  
 (C) Total lunar eclipse  
 (D) Partial lunar eclipse

Ans :

(B) Partial solar eclipse

A partial solar eclipse is seen from areas where the Moon's lighter shadow (penumbra) falls, or during the phases before and after totality, where only a portion of the Sun is blocked.

- 33.** Why is it extremely dangerous to look directly at the Sun, even during a partial solar eclipse, without proper eye protection?
- (A) The Moon emits harmful radiation during an eclipse.
  - (B) The Sun's intense radiation can cause permanent eye damage or blindness.
  - (C) Looking at the eclipse can cause bad luck according to superstition.
  - (D) It is safe to look if you squint your eyes.

**Ans :**

(B) The Sun's intense radiation can cause permanent eye damage or blindness. Even when partially covered, the Sun's remaining visible surface emits intense ultraviolet and visible radiation powerful enough to severely damage the retina, leading to permanent vision loss.

- 34.** Which method is considered safe for viewing a solar eclipse?
- (A) Using standard sunglasses.
  - (B) Looking through binoculars or a telescope directly.
  - (C) Using specialized solar viewing glasses or projecting the Sun's image onto a screen.
  - (D) Looking directly for only a few seconds.

**Ans :**

(C) Using specialized solar viewing glasses or projecting the Sun's image onto a screen. Safe viewing requires filters specifically designed for solar observation that block harmful radiation, or indirect methods like pinhole projection or telescope/binocular projection onto a surface.

- 35.** What type of event occurs when the Earth passes directly between the Sun and the Moon, casting Earth's shadow on the Moon?
- (A) Solar eclipse
  - (B) Lunar eclipse
  - (C) Transit of Earth
  - (D) Full Moon

**Ans :**

(B) Lunar eclipse  
A lunar eclipse happens when the Earth aligns between the Sun and the Moon, causing the Earth's shadow to fall upon the Moon's surface, dimming or obscuring it. This can only happen during the Full Moon phase.

- 36.** What is it called when the Moon passes completely into the Earth's darkest shadow (umbra)?

- (A) Partial lunar eclipse
- (B) Total lunar eclipse
- (C) New Moon
- (D) Total solar eclipse

**Ans :**

(B) Total lunar eclipse  
During a total lunar eclipse, the entire Moon enters the Earth's umbra. The Moon doesn't usually disappear completely but often takes on a reddish hue.

- 37.** Why can a lunar eclipse be safely viewed with the naked eye, unlike a solar eclipse?
- (A) The Moon reflects less harmful light than the Sun.
  - (B) During a lunar eclipse, you are looking at the Moon being shadowed, not the intensely bright Sun.
  - (C) Lunar eclipses only happen at night when it's dark anyway.
  - (D) Earth's atmosphere filters the light during a lunar eclipse.

**Ans :**

(B) During a lunar eclipse, you are looking at the Moon being shadowed, not the intensely bright Sun. A lunar eclipse involves observing the relatively dim Moon as it passes through Earth's shadow. There is no danger from looking at the Moon, eclipsed or otherwise.

- 38.** What is the name of the ancient Indian astronomical text mentioned that provides calculations for predicting eclipses?
- (A) Aryabhatiya
  - (B) Vrikshayurveda
  - (C) Charaka Samhita
  - (D) Surya Siddhanta

**Ans :**

(D) Surya Siddhanta  
The Surya Siddhanta is specifically cited as a well-known ancient text containing methods and calculations for predicting solar and lunar eclipses.

- 39.** Which Indian observatory, operated by the Indian Institute of Astrophysics (IIA), has provided solar data for over 100 years?
- (A) Jantar Mantar, Jaipur
  - (B) Kavalur Observatory
  - (C) Kodaikanal Solar Observatory
  - (D) Girawali Observatory, Pune



Ans :

(C) Kodaikanal Solar Observatory  
The Kodaikanal Solar Observatory is highlighted for its long history (established 1899) of solar observations and data collection.

40. Who is known as the father of modern Indian astronomy and was instrumental in setting up telescopes at Nainital and Kavalur?
- (A) Aryabhata  
(B) C.V. Raman  
(C) M.K. Vainu Bappu  
(D) Vikram Sarabhai

Ans :

(C) M.K. Vainu Bappu  
M.K. Vainu Bappu is recognized for his significant contributions to establishing modern astronomical facilities in India and his research on stars and comets.

41. The Earth tilted with the North Pole (NP) in sunlight and the South Pole (SP) in darkness. How many hours of sunlight does the NP receive in one rotation?
- (A) 0 hours  
(B) 12 hours  
(C) 24 hours  
(D) 6 hours

Ans :

(C) 24 hours  
The diagram depicts the situation around the June solstice where the North Pole experiences 24 hours of continuous daylight due to the Earth's tilt towards the Sun.

42. Fill in the blank : Stars appear to rise in the \_\_\_\_\_ and set in the \_\_\_\_\_.
- (A) West, East  
(B) North, South  
(C) East, West  
(D) South, North

Ans :

(C) East, West  
Due to the Earth's West-to-East rotation, celestial objects like stars (and the Sun/Moon) appear to follow a path rising in the eastern part of the sky and setting in the western part.

43. **Assertion (A)** : A lunar eclipse occurs when the Sun comes between the Earth and the Moon.  
**Reason (R)** : During a lunar eclipse, the Earth's shadow falls on the Moon.

- (A) Both A and R are true, and R explains A.  
(B) Both A and R are true, but R does not explain A.  
(C) A is false, but R is true.  
(D) Both A and R are false.

Ans :

(C) A is false, but R is true.  
Assertion A is false; the Earth comes between the Sun and Moon during a lunar eclipse. Reason R correctly describes what happens during a lunar eclipse (Earth's shadow on Moon).

44. **Assertion (A)** : Seasons occur due to the tilt of Earth's axis of rotation and its spherical shape.  
**Reason (R)** : The Earth's distance from the Sun changes significantly throughout the year, causing seasons.
- (A) Both A and R are true, and R explains A.  
(B) Both A and R are true, but R does not explain A.  
(C) A is true, but R is false.  
(D) A is false, but R is true.

Ans :

(C) A is true, but R is false.  
Assertion A correctly identifies the primary causes of seasons (tilt and shape). Reason R states an incorrect explanation; while Earth's distance varies slightly, this is not the main cause of seasons.

45. Padmashree saw Orion overhead at 8 pm yesterday. Due to Earth's rotation, when will she likely see Orion nearly overhead today?
- (A) Exactly 8 pm  
(B) Slightly earlier than 8 pm (approx. 4 minutes earlier)  
(C) Significantly later, around midnight  
(D) At sunrise the next morning

Ans :

(B) Slightly earlier than 8 pm (approx. 4 minutes earlier)  
Earth takes about 23 hours 56 minutes (sidereal day) to rotate relative to the stars, not exactly 24 hours (solar day). So, a star pattern returns to the same position about 4 minutes earlier each night.

46. Nandhini saw stars rising at midnight on June 21st. When will she see the same stars rising at midnight again?
- (A) The next night (June 22nd)  
(B) One month later (July 21st)  
(C) Six months later (December 21st)  
(D) One year later (next June 21st)

Ans :

(D) One year later (next June 21st)

Due to Earth's revolution around the Sun, the stars visible at a specific time shift throughout the year. The same star pattern will be visible at the same time of night approximately one year later.

47. Why is it daytime in India when it is night time in the USA?
- (A) Because the USA is much farther from the Sun.
  - (B) Because India and the USA are on opposite sides of the rotating Earth.
  - (C) Because of different seasonal conditions.
  - (D) Because time zones are set arbitrarily.

Ans :

(B) Because India and the USA are on opposite sides of the rotating Earth.

India and the USA are located roughly on opposite sides of the globe. Due to Earth's rotation, when one side faces the Sun (day), the opposite side faces away (night).

48. Who among the four friends viewing a solar eclipse was being careless and risking eye damage?
- (A) Ravikiran (used solar eclipse goggles)
  - (B) Jyothi (used mirror projection)
  - (C) Adithya (saw directly with eyes)
  - (D) Aruna (attended planetarium program)

Ans :

(C) Adithya (saw directly with eyes)

Looking directly at the Sun during any phase of a solar eclipse without proper, certified eye protection is extremely dangerous and can cause permanent blindness. The other methods mentioned are safe.

49. Fill in the arrangement for a SOLAR eclipse : [Source] → [Blocker] → [Observer's Planet].
- (A) Sun → Earth → Moon
  - (B) Earth → Sun → Moon
  - (C) Sun → Moon → Earth
  - (D) Moon → Sun → Earth

Ans :

(C) Sun → Moon → Earth

In a solar eclipse, the Moon comes between the Sun and the Earth, blocking the Sun's light from reaching Earth.

50. Fill in the arrangement for a LUNAR eclipse : [Source] → [Blocker] → [Object Eclipsed].

- (A) Sun → Moon → Earth
- (B) Earth → Sun → Moon
- (C) Moon → Earth → Sun
- (D) Sun → Earth → Moon

Ans :

(D) Sun → Earth → Moon

In a lunar eclipse, the Earth moves between the Sun and the Moon, casting its shadow onto the Moon.

51. Why can a total solar eclipse only be seen from a very small part of the Earth, while a lunar eclipse is visible from a much larger area (nearly half the Earth)?
- (A) The Moon's shadow on Earth is much smaller than Earth's shadow on the Moon.
  - (B) Solar eclipses happen less frequently than lunar eclipses.
  - (C) The Moon moves faster than the Earth's shadow.
  - (D) People are less interested in watching solar eclipses.

Ans :

(A) The Moon's shadow on Earth is much smaller than Earth's shadow on the Moon.

The Moon casts a relatively small shadow (umbra and penumbra) on the Earth's surface during a solar eclipse. In contrast, the Earth casts a much larger shadow that the entire Moon passes through during a lunar eclipse, making it visible to anyone on the night side of Earth.

52. If the Earth's axis were not tilted, what would be the effect on seasons?
- (A) Seasons would be much more extreme.
  - (B) There would essentially be no distinct seasons; climate would mainly depend on latitude.
  - (C) Only two seasons would occur : hot and cold.
  - (D) The length of the year would change.

Ans :

(B) There would essentially be no distinct seasons; climate would mainly depend on latitude.

Without the axial tilt, the amount and intensity of sunlight received by any given latitude would remain relatively constant throughout the year's revolution, eliminating the primary cause of seasonal variation.

53. The Australian cricket summer season occurs during December-January. If the Indian team tours Australia in December, should they pack mainly summer or winter clothes?



- (A) Winter clothes, as it's December globally.
- (B) Summer clothes, as December is summer in the Southern Hemisphere (Australia).
- (C) Both, as weather is unpredictable.
- (D) Rain gear only.

**Ans :**

(B) Summer clothes, as December is summer in the Southern Hemisphere (Australia).

Seasons are opposite in the Northern and Southern Hemispheres due to the Earth's tilt. When it is winter in the Northern Hemisphere (like India) around December, it is summer in the Southern Hemisphere (like Australia).

- 54.** The apparent size of an object depends on what two factors?
- (A) Its color and brightness.
  - (B) Its actual physical size and its mass.
  - (C) Its actual physical size and its distance from the observer.
  - (D) Its temperature and its speed.

**Ans :**

(C) Its actual physical size and its distance from the observer.

How large an object appears (apparent size) is determined by both how big it truly is (actual size) and how far away it is. Closer objects appear larger.

- 55.** Why does a Foucault pendulum appear to change its plane of swing over time?
- (A) Air currents push the pendulum around.
  - (B) The pendulum's string twists gradually.
  - (C) The Earth is rotating beneath the freely swinging pendulum.
  - (D) The ceiling support point moves slightly.

**Ans :**

(C) The Earth is rotating beneath the freely swinging pendulum.

The pendulum's swing plane remains fixed relative to the stars, but the Earth rotates underneath it, creating the illusion that the swing plane itself is rotating relative to the room/ground.

- 56.** The planet Uranus has a much greater axial tilt than Earth. What effect might this have on its seasons?
- (A) No seasons at all.
  - (B) Very mild and short seasons.
  - (C) Extremely long and extreme seasons.
  - (D) Four seasons occurring simultaneously.

**Ans :**

(C) Extremely long and extreme seasons.

A large axial tilt (Uranus is tilted almost on its side) leads to very dramatic seasonal changes, with each pole facing the Sun for many years, resulting in extremely long, harsh summers and winters.

- 57.** What is a 'transit' in astronomy, such as the Transit of Venus?
- (A) When a planet explodes.
  - (B) When a smaller celestial body passes directly between a larger body and the observer, appearing as a small dot against the larger body.
  - (C) When two planets collide.
  - (D) When a planet completes one orbit.

**Ans :**

(B) When a smaller celestial body passes directly between a larger body and the observer, appearing as a small dot against the larger body.

A transit occurs when a closer, smaller body (like Venus or Mercury) passes across the face of a much larger, more distant body (like the Sun) as seen from Earth.

- 58.** The fact that scientists use tiny 'wobbles' in a star's movement to detect explanets implies what?
- (A) Stars are not perfectly stationary.
  - (B) Planets exert a gravitational pull on their host stars, causing them to move slightly.
  - (C) Explanets emit strong radio signals.
  - (D) Telescopes can directly see the planets wobbling.

**Ans :**

(B) Planets exert a gravitational pull on their host stars, causing them to move slightly.

A planet orbiting a star pulls gravitationally on the star, causing the star to 'wobble' slightly around their common center of mass. Detecting this wobble is an indirect method for finding explanets.

- 59.** Which of the following is NOT directly caused by the Earth's rotation?
- (A) The cycle of day and night.
  - (B) The apparent movement of the Sun across the sky.
  - (C) The occurrence of seasons.
  - (D) The apparent movement of stars across the night sky.

**Ans :**

(C) The occurrence of seasons.

Seasons are caused by the tilt of Earth's axis combined with its revolution around the Sun, not primarily by its daily rotation. Rotation causes day/night and apparent celestial motion.

### MATCHING TYPE QUESTION

60. Match the Earth's motion in Column A with its primary effect in Column B:

	Column A		Column B
1.	Earth's Rotation	A.	Causes the cycle of seasons
2.	Earth's Revolution	B.	Causes the Sun to appear to rise and set daily
3.	Tilt of Earth's Axis	C.	Blocks sunlight from reaching the Moon
4.	Earth during Lunar Eclipse	D.	Leads to different constellations visible at night throughout the year

- (a) 1-B, 2-D, 3-A, 4-C
- (b) 1-A, 2-B, 3-D, 4-C
- (c) 1-B, 2-A, 3-D, 4-C
- (d) 1-D, 2-C, 3-A, 4-B

Ans :

- (a) 1-B, 2-D, 3-A, 4-C

Earth's rotation causes daily sunrise and sunset. Its revolution causes the changing view of night sky constellations. The axis tilt is key to seasons. During a lunar eclipse, Earth blocks sunlight to the Moon.

61. Match the astronomical event in Column A with its correct description in Column B:

	Column A		Column B
1.	Solar Eclipse	A.	Earth's shadow falls on the Moon
2.	Lunar Eclipse	B.	Moon's shadow falls on the Earth
3.	Summer Solstice (N. Hemisphere)	C.	Apparent daily motion of stars around the Pole Star

4.	Apparent Stellar Motion	D.	Longest day of the year in the Northern Hemisphere
----	-------------------------	----	--

- (a) 1-C, 2-A, 3-D, 4-B
- (b) 1-B, 2-D, 3-A, 4-C
- (c) 1-D, 2-A, 3-B, 4-C
- (d) 1-B, 2-A, 3-D, 4-C

Ans :

- (d) 1-B, 2-A, 3-D, 4-C

A solar eclipse occurs when the Moon's shadow falls on Earth. A lunar eclipse is when Earth's shadow is on the Moon. Summer solstice marks the longest day. Earth's rotation causes apparent stellar motion.

62. Match the term related to Earth's position or time in Column A with its definition in Column B:

	Column A		Column B
1.	Orbit	A.	Approximately 24 hours for Earth
2.	Axis of Rotation	B.	The path an object takes while revolving around another
3.	Rotation Period	C.	Day when daytime and nighttime are of equal length
4.	Equinox	D.	Imaginary line through North and South poles around which Earth spins

- (a) 1-B, 2-D, 3-A, 4-C
- (b) 1-D, 2-B, 3-C, 4-A
- (c) 1-B, 2-A, 3-D, 4-C
- (d) 1-C, 2-D, 3-A, 4-B

Ans :

- (a) 1-B, 2-D, 3-A, 4-C

Orbit is the path of revolution. The axis of rotation is the line Earth spins around. Rotation period is time for one spin. Equinoxes have equal day and night.

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63. Match the celestial body or phenomenon in Column A with its characteristic observed from Earth in Column B:



	Column A		Column B
1.	The Sun	A.	Appears nearly stationary in the Northern night sky
2.	The Moon	B.	Can completely cover the Sun during a total solar eclipse
3.	Pole Star	C.	Its apparent size is similar to the Moon's from Earth
4.	Apparent Size of Moon	D.	Appears to rise in the East and set in the West daily

64. Match the celestial body or phenomenon in Column A with its characteristic observed from Earth in Column B:

	Column A		Column B
1.	The Sun	A.	Appears nearly stationary in the Northern night sky
2.	The Moon	B.	Its shadow causes a solar eclipse on Earth
3.	Pole Star	C.	Primary source of light for the Earth
4.	Apparent Daily Motion	D.	Caused by Earth's rotation, affecting Sun, Moon, and stars

- (a) 1-A, 2-D, 3-C, 4-B    (b) 1-C, 2-B, 3-A, 4-D  
 (c) 1-C, 2-A, 3-D, 4-B    (d) 1-B, 2-C, 3-A, 4-D

Ans :

(b) 1-C, 2-B, 3-A, 4-D

The Sun is Earth's primary light source. The Moon's shadow causes solar eclipses. The Pole Star appears stationary. Earth's rotation causes the apparent daily motion of celestial bodies.

65. Match the reason for a phenomenon in Column A with the phenomenon it causes in Column B:

	Column A		Column B
1.	Earth rotating from West to East	A.	Different constellations visible at different times of year

2.	Earth revolving around the Sun	B.	Day and night cycle
3.	Tilt of Earth's axis during revolution	C.	Moon appearing dark red during a total lunar eclipse
4.	Earth passing between Sun and Moon (Full Moon)	D.	Occurrence of seasons (summer/winter)

- (a) 1-D, 2-A, 3-B, 4-C  
 (b) 1-B, 2-C, 3-D, 4-A  
 (c) 1-A, 2-B, 3-D, 4-C  
 (d) 1-B, 2-A, 3-D, 4-C

Ans :

(d) 1-B, 2-A, 3-D, 4-C

Earth's West-to-East rotation causes the day-night cycle. Earth's revolution causes the changing view of constellations. The axial tilt during revolution causes seasons.

### VERY SHORT QUESTION

66. What motion of the Earth causes the Sun to appear to rise in the East and set in the West?

Ans :

Earth's rotation

67. What is the imaginary line passing through the North and South poles around which the Earth spins called?

Ans :

Axis of rotation

68. In which direction does the Earth rotate when viewed from above the North Pole?

Ans :

Anti-clockwise (or West to East)

69. Approximately how long does the Earth take to complete one rotation on its axis?

Ans :

24 hours

70. What phenomenon is caused by the Earth's rotation, resulting in half the globe being lit and the other half dark?

**Ans :**

Day and night

- 71.** Which star appears nearly stationary in the night sky when viewed from the Northern Hemisphere?

**Ans :**

Pole Star (Dhruva Tara)

- 72.** What is the motion of the Earth around the Sun called?

**Ans :**

Revolution

- 73.** What is the path the Earth takes while revolving around the Sun called?

**Ans :**

Orbit

- 74.** Approximately how long does the Earth take to complete one revolution around the Sun?

**Ans :**

365 days and 6 hours (or about 1 year)

- 75.** What feature of the Earth's axis, combined with its revolution, causes seasons?

**Ans :**

The tilt of the Earth's axis

- 76.** In which month is the Northern Hemisphere tilted towards the Sun, experiencing summer?

**Ans :**

June

- 77.** In which month is the Northern Hemisphere tilted away from the Sun, experiencing winter?

**Ans :**

December

- 78.** What term describes the time when the day is longest in the Northern Hemisphere (around June 21)?

**Ans :**

Summer solstice

- 79.** What term describes the time when the day is shortest in the Northern Hemisphere (around December 22)?

**Ans :**

Winter solstice

- 80.** What term describes the times (around March 21 and September 23) when day and night are approximately equal in length?

**Ans :**

Equinox (Spring/Autumn Equinox)

- 81.** What event occurs when the Moon comes between the Sun and the Earth, blocking sunlight?

**Ans :**

Solar eclipse

- 82.** Why can the Moon, which is much smaller than the Sun, appear to cover the Sun during an eclipse?

**Ans :**

Because the Moon is much closer to the Earth than the Sun is.

- 83.** What type of solar eclipse occurs when the Moon completely blocks the Sun?

**Ans :**

Total solar eclipse

- 84.** What event occurs when the Earth comes between the Sun and the Moon, casting a shadow on the Moon?

**Ans :**

Lunar eclipse

- 85.** Is it safe to view a solar eclipse directly with the naked eye?

**Ans :**

No

### SHORT ANSWER QUESTION

- 86.** If the Earth rotates from West to East, why does the Sun appear to move from East to West?

**Ans :**

Because we observe the Sun from the rotating Earth, the Sun appears to move in the opposite direction to the Earth's rotation, similar to how stationary objects appear to move backward when you are on a moving merry-go-round.

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87. Explain how the rotation of the Earth causes the cycle of day and night.

**Ans :**

As the Earth rotates on its axis, only the half facing the Sun receives light (daytime). The other half faces away from the Sun and is in darkness (night-time). Rotation continuously brings different parts into sunlight and darkness.

88. Why does the Pole Star appear fixed in the sky while other stars seem to move around it (in the Northern Hemisphere)?

**Ans :**

The Earth's axis of rotation points almost directly towards the Pole Star. As the Earth spins, the Pole Star remains aligned with the axis, appearing stationary, while other stars trace circles around it due to the Earth's rotation.

89. Differentiate between Earth's rotation and revolution.

**Ans :**

Rotation is the spinning of the Earth on its own axis (causing day/night, takes 24 hrs). Revolution is the movement of the Earth in its orbit around the Sun (causing changing views of stars/seasons, takes approx. 365 days).

90. Why do we see different constellations in the night sky at different times of the year?

**Ans :**

As the Earth revolves around the Sun, our viewpoint from the night side of Earth faces different directions in space throughout the year, bringing different constellations into view after sunset.

91. Explain the main reason why the Earth experiences seasons.

**Ans :**

Seasons are caused mainly by the tilt of the Earth's axis (23.5 degrees) relative to its orbital plane. As Earth revolves around the Sun, this tilt causes different hemispheres to receive more direct sunlight (summer) or less direct sunlight (winter) at different times of the year.

92. Why is summer in the Northern Hemisphere warmer than winter? Mention two reasons related to sunlight.

**Ans :**

In Northern Hemisphere summer (around June), it is tilted towards the Sun, so : 1) Sunlight hits more directly (concentrated over a smaller area), making it more intense. 2) Daytime lasts longer than 12 hours, allowing more heating.

93. What is a solar eclipse? Briefly describe the alignment of the Sun, Moon, and Earth.

**Ans :**

A solar eclipse occurs when the Moon passes directly between the Sun and Earth, casting a shadow on Earth and blocking the Sun's light. Alignment : Sun - Moon - Earth.

94. Explain the difference between a total solar eclipse and a partial solar eclipse.

**Ans :**

In a total solar eclipse, the Moon completely covers the Sun's disc as seen from a specific area (umbra) on Earth. In a partial solar eclipse, the Moon only covers part of the Sun's disc.

95. Why is it dangerous to look directly at the Sun during a solar eclipse?

**Ans :**

Even when partially eclipsed, the Sun's remaining visible part emits intense radiation that can severely damage the eyes, potentially causing permanent blindness, even if it doesn't feel painful at the time.

96. Describe one safe method for viewing a solar eclipse mentioned in the text.

**Ans :**

Participating in viewing events organized by planetaria or astronomy clubs using specialized eye protection, or projecting the Sun's image onto a wall using a mirror setup.

97. What is a lunar eclipse? Briefly describe the alignment of the Sun, Earth, and Moon.

**Ans :**

A lunar eclipse occurs when the Earth passes directly between the Sun and the Moon, casting Earth's shadow onto the Moon and blocking sunlight from reaching it. Alignment : Sun - Earth - Moon.

98. Is it safe to view a lunar eclipse directly? Why or why not?

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**Ans :**

Yes, it is safe to watch a lunar eclipse directly with the naked eye because you are looking at the Moon, which is only reflecting sunlight and is not intensely bright like the Sun itself.

99. Explain the concept of ‘apparent size’ using the example of the Sun and Moon.

**Ans :**

Apparent size is how large an object looks to our eye, depending on both its actual size and its distance. Although the Sun is vastly larger than the Moon, it is much farther away, making their apparent sizes look similar from Earth.

100. What is the difference between solstice and equinox?

**Ans :**

Solstices (Summer/Winter) mark the times when the Earth’s tilt causes one hemisphere to receive the most direct sunlight (longest day) or least direct sunlight (shortest day). Equinoxes (Spring/Autumn) mark the times when sunlight is most direct at the equator, resulting in nearly equal day and night length globally.

101. Why are seasons generally less prominent near the equator?

**Ans :**

Near the equator, sunlight strikes relatively directly throughout the year due to Earth’s shape and tilt. There isn’t a significant change in the angle or duration of sunlight, leading to less variation in temperature and thus less prominent seasons.

102. How long does sunlight take to reach Earth? What does this imply?

**Ans :**

Sunlight takes about 8 minutes and 20 seconds to reach Earth. This implies that we always see the Sun as it was over 8 minutes ago, not as it is instantaneously.

103. What is a Foucault pendulum used to demonstrate?

**Ans :**

A Foucault pendulum, a long pendulum with a heavy bob, is used to provide a simple, visual demonstration of the Earth’s rotation.

104. Why do stars appear to move in arcs in long-exposure photographs (star trails)?

**Ans :**

Long-exposure photos capture the apparent movement of stars across the night sky over time. This apparent movement is caused by the continuous rotation of the Earth on its axis.

105. According to Aryabhata, how did people in Lanka perceive the motion of stationary stars? Why?

**Ans :**

Aryabhata explained that people perceived stationary stars as moving towards the west, just as someone on a moving boat sees stationary objects on the bank moving backward. This apparent motion is due to the Earth’s eastward rotation.

## LONG ANSWER QUESTION

106. Explain in detail how the rotation of the Earth on its axis causes the cycle of day and night, and the apparent movement of the Sun across the sky. Use diagrams if helpful.

**Ans :**

The Earth rotates on its axis approximately every 24 hours. As it spins, different parts of the planet face towards or away from the Sun. The half facing the Sun receives sunlight and experiences daytime. The half facing away is in shadow and experiences night-time. Earth rotates from West to East. From our perspective on the rotating Earth, the stationary Sun appears to move across the sky in the opposite direction. It appears to rise in the East (as our location rotates into sunlight), travel across the sky, and set in the West (as our location rotates out of sunlight). (Diagram could show Earth half-lit by Sun, with arrows indicating rotation and apparent solar path).

107. Describe the revolution of the Earth around the Sun. Explain how this movement, combined with the tilt of the Earth’s axis, leads to the occurrence of seasons in the Northern and Southern Hemispheres.

**Ans :**

The Earth revolves around the Sun in a nearly circular orbit, taking about 365.25 days (one



year). The Earth's axis of rotation is tilted at about 23.5 degrees relative to its orbital plane and maintains this tilt throughout the revolution. Because of this tilt:

- (1) Around June : The Northern Hemisphere (NH) is tilted towards the Sun, receiving more direct sunlight over longer days (Summer in NH). The Southern Hemisphere (SH) is tilted away, receiving less direct sunlight over shorter days (Winter in SH).
- (2) Around December : The NH is tilted away from the Sun (Winter in NH), while the SH is tilted towards the Sun (Summer in SH).
- (3) Around March and September (Equinoxes) : Neither hemisphere tilts significantly towards the Sun, resulting in more equal day/night lengths and transitional seasons (Spring/Autumn).

- 108.** Explain the phenomenon of a solar eclipse. Describe the alignment needed, the difference between total and partial eclipses, and why it's crucial to observe it safely. Draw a simple diagram.

**Ans :**

A solar eclipse occurs when the Moon passes directly between the Sun and Earth (Sun-Moon-Earth alignment). The Moon casts a shadow on Earth. If an observer is within the darkest part of the shadow (umbra), they see the Moon completely blocking the Sun – a total solar eclipse. If they are in the lighter part of the shadow (penumbra), they see only part of the Sun blocked – a partial solar eclipse. It's crucial to observe safely using special eclipse glasses or projection methods because looking directly at the Sun, even when partially eclipsed, can cause severe eye damage or blindness due to intense radiation. (Diagram should show Sun, Moon blocking light, Earth with umbra and penumbra shadow regions).

- 109.** Explain the phenomenon of a lunar eclipse. Describe the alignment needed, the difference between total and partial eclipses, and why it is safe to view directly. Draw a simple diagram.

**Ans :**

A lunar eclipse occurs when the Earth passes directly between the Sun and the Moon (Sun-Earth-Moon alignment), casting Earth's shadow on the Moon. For this to happen, the Moon must be in its full phase. If the Moon passes completely into Earth's darkest shadow (umbra), it's a total lunar eclipse, often appearing dim red. If only

part of the Moon enters the umbra, it's a partial lunar eclipse. It's safe to view directly because we are looking at the Moon, which only reflects sunlight and is never bright enough to harm our eyes, unlike the Sun itself. (Diagram should show Sun, Earth casting shadow, Moon passing through umbra/penumbra).

- 110.** Rashmika observed that tree shadows were long in the morning and shorter in the afternoon. Explain this observation based on the apparent movement of the Sun caused by Earth's rotation.

**Ans :**

The apparent movement of the Sun across the sky (caused by Earth's rotation) changes the angle at which sunlight hits objects. In the morning, the Sun appears low in the eastern sky. Sunlight strikes the tree at a low angle, casting a long shadow pointing westwards. As the Earth rotates, the Sun appears to move higher in the sky. Around noon, the Sun is at its highest point, shining down more vertically. This causes the shadow to become much shorter and fall closer to the base of the tree. In the afternoon, the Sun moves lower in the western sky, casting increasingly longer shadows towards the east.

- 111.** Compare the apparent daily motion of the Sun and the stars as seen from Earth. What causes these apparent motions, and why does the Pole Star appear almost fixed?

**Ans :**

Both the Sun and the stars (except the Pole Star) appear to rise in the east, move across the sky, and set in the west over a 24-hour period. This apparent daily motion is caused by the Earth's rotation on its axis from West to East. We see them move in the opposite direction. The Pole Star appears almost fixed because the Earth's axis of rotation points nearly directly at it. As the Earth spins, the Pole Star remains aligned with the axis and thus doesn't appear to move significantly in the sky for observers in the Northern Hemisphere.

- 112.** How does the concept of 'apparent size' explain why the Moon can cause a total solar eclipse, but the larger planets Mercury and Venus cannot?

**Ans :**

Apparent size depends on both an object's actual size and its distance from the observer. The Sun is vastly larger than the Moon, but it is also about 400 times farther away from Earth than the

Moon is. This specific ratio of size and distance makes the Sun and Moon appear almost exactly the same size in our sky. Therefore, the Moon can perfectly block the Sun during a total solar eclipse. Mercury and Venus, although larger than the Moon, are much farther away than the Moon, making their apparent sizes much smaller than the Sun's. Thus, they only appear as tiny dots crossing the Sun (transits) and cannot block it.

113. Explain why different parts of the Earth receive sunlight at different intensities, particularly comparing the equator and the polar regions, considering Earth's tilt and spherical shape.

Ans :

Due to the Earth's spherical shape, sunlight arriving in parallel rays strikes the surface at different angles. Near the equator, sunlight hits almost perpendicularly, concentrating the energy over a smaller area, resulting in higher intensity and warmer temperatures. Near the poles, the same amount of sunlight strikes the curved surface at a glancing angle, spreading the energy over a much larger area. This results in lower intensity sunlight and colder temperatures. Earth's tilt further influences this, causing seasonal variations in intensity for regions away from the equator.

114. Consider Activity 12.1 (merry-go-round). How does this activity help in understanding why stationary objects like the Sun or stars appear to move when observed from the rotating Earth?

Ans :

When sitting on the merry-go-round rotating anti-clockwise, stationary objects outside (like trees) appear to move around the observer in the opposite (clockwise) direction. They enter the field of view from one side and exit from the other. This simulates our experience on Earth. Earth rotates West to East (anti-clockwise view from North Pole). Stationary celestial objects like the Sun and stars appear to move across our sky in the opposite direction, East to West, entering our view (rising) and exiting (setting) as the Earth turns. The activity provides an analogy for relative motion due to the observer's own movement.

115. If the Earth's axis were not tilted, how would this affect the seasons and the length of day and night throughout the year?

Ans :

If the Earth's axis were not tilted (i.e., perpendicular to its orbital plane), sunlight would always strike the Earth most directly at the equator and less directly towards the poles consistently throughout the year. There would be no significant shift in the directness or duration of sunlight received by the Northern and Southern Hemispheres as the Earth revolves. Consequently, there would be no distinct seasons (like summer and winter); the climate at any given latitude would remain relatively constant year-round. Additionally, the length of day and night would be approximately 12 hours each everywhere on Earth, every day of the year (except possibly right at the poles). (Analysing/Evaluating)

### CASE BASED QUESTION

116. An observer in Delhi, India notices the Sun high in the sky at noon in June, and the days are long and hot. An observer in Sydney, Australia at the same time (June) notices the Sun lower in the sky at noon, and the days are shorter and cooler.
1. Which hemisphere is tilted towards the Sun in June?
  2. Which season is it likely experiencing in Delhi (Northern Hemisphere) in June?
  3. Which season is it likely experiencing in Sydney (Southern Hemisphere) in June? Explain why based on Earth's tilt.

Ans :

- (1) The Northern Hemisphere.
- (2) Summer.
- (3) Winter. Because the Northern Hemisphere is tilted towards the Sun, the Southern Hemisphere is tilted away, receiving less direct sunlight and experiencing shorter days.

117. During a full moon night, observers notice the Moon gradually becoming dimmer and turning reddish before becoming bright again over a few hours. They are told this is a lunar eclipse.
1. What is passing between the Sun and the Moon to cause this eclipse?
  2. Why does the Moon appear dim or reddish during the total phase of the eclipse? (Information not explicitly in text, requires inference)
  3. Is it safe for the observers to watch this event without special eye protection?



Ans :

- (1) The Earth (casting its shadow on the Moon).
  - (2) Earth's atmosphere refracts (bends) some sunlight into the shadow. The atmosphere scatters blue light more, allowing mostly red light to pass through and illuminate the Moon dimly, giving it a reddish hue.
  - (3) Yes, observing a lunar eclipse is safe for the naked eye.
- 118.** A group plans to watch a solar eclipse predicted for their city. They know looking directly is unsafe. Person A suggests using regular sunglasses. Person B suggests making a pinhole projector. Person C suggests buying certified solar eclipse glasses. (Approx. 45 words)
1. Why is Person A's suggestion unsafe?
  2. Which person suggests the safest method for direct viewing?
  3. Describe briefly how Person B's pinhole projector method works for indirect viewing.

Ans :

- (1) Regular sunglasses do not block enough of the intense solar radiation and are unsafe for viewing the Sun directly, even during an eclipse.
  - (2) Person C (using certified solar eclipse glasses designed for safe solar viewing).
  - (3) A pinhole projector involves making a small hole in a piece of card. Sunlight passing through this hole projects a small, inverted image of the Sun onto another surface (like a second card or wall) held behind it. One observes the projected image, not the Sun itself.
- 119.** Rashmika places a stick vertically in the ground on a sunny day. At 8 AM, the shadow is long. At 12 noon, the shadow is very short. At 4 PM, the shadow is long again, but pointing in a different direction than the morning shadow. (Approx. 45 words)
1. What causes the length of the shadow to change throughout the day?
  2. Why is the shadow shortest around noon?
  3. Why does the shadow point in different directions in the morning and afternoon?

Ans :

- (1) The changing apparent position (angle) of the Sun in the sky due to the Earth's rotation.

- (2) Around noon, the Sun is highest in the sky, shining down most directly, resulting in the shortest shadow.
- (3) Because the Sun appears to move across the sky from East (morning) to West (afternoon), the shadow, which points away from the Sun, moves from West (morning) to East (afternoon).

- 120.** An astronomer uses a telescope to observe Jupiter. They notice that Jupiter appears to move across the night sky from East to West over several hours, similar to the stars. (Approx. 28 words)
1. What causes this apparent East-to-West motion of Jupiter across the night sky?
  2. Is Jupiter moving around the Earth daily?
  3. Over many weeks or months, the astronomer would notice Jupiter's position changing relative to the background stars. What causes this slower, long-term change in position?

Ans :

- (1) The rotation of the Earth on its axis (from West to East).
- (2) No, Jupiter orbits the Sun. Its apparent daily motion is due to Earth's rotation.
- (3) This is caused by both Jupiter's own revolution around the Sun and Earth's revolution around the Sun.

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