

CHAPTER 9

HEREDITY AND EVOLUTION

Syllabus

Heredity, Mendel's contribution, Laws for inheritance of traits, sex determination - brief introduction, basic concepts of evolution.

Trend Analysis

List of Concepts	2018	2019	2020
Heredity, Mendel's contribution, Acquired and Inherited traits	1 Q (1 M)		1 Q (3 M)
Basic concept of Evolution		1 Q (5 M)	1 Q (3 M)



TOPIC - 1

Heredity and Mendel's Contribution



Revision Notes

Introduction

- Variations arise usually during the process of sexual reproduction. They may be few in asexual reproduction, but many in case of sexual reproduction.
- The minor variations arising during sexual reproduction are caused by slight inaccuracies in DNA copying. In sexual reproduction, variations are also caused by crossing over process during meiosis.
- Beneficial variations help the species to survive better in the environment.
- Nature selects the beneficial variations thereby leading to evolution.
- Sexual reproduction produces offspring with similar body design of the parents. However, the offsprings are not identical and show a great deal of variation from the parents.
- **Importance of Variation:**
 - (i) Depending upon the nature of variations, different individuals would have different kinds of advantages.
e.g., Bacteria that can withstand heat will survive better in a heat wave.
 - (ii) Main advantage of variation to species is that it increases the chances of its survival in a changing environment.

Mendel and His Work on Inheritance

- **Gregor Johann Mendel (1833 & 1884):** Started his experiments on plant breeding and hybridization. He proposed the laws of inheritance in living organisms.

TOPIC - 1

Heredity and Mendel's Contribution

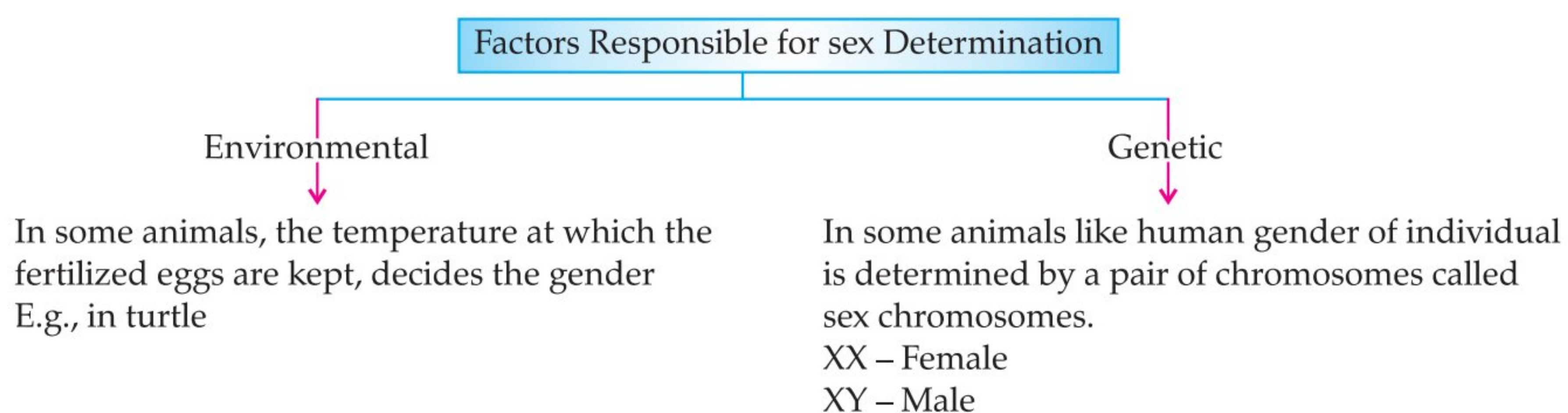
TOPIC - 2

Basic Concepts of Evolution

- Mendel was known as the **Father of Genetics**.
- Plant selected by Mendel was *Pisum sativum* (garden pea). Mendel used a number of varieties of garden pea to study the inheritance of seven pairs of contrasting characters.
- **Seven pairs of contrasting characters** in garden pea, selected by Mendel were:

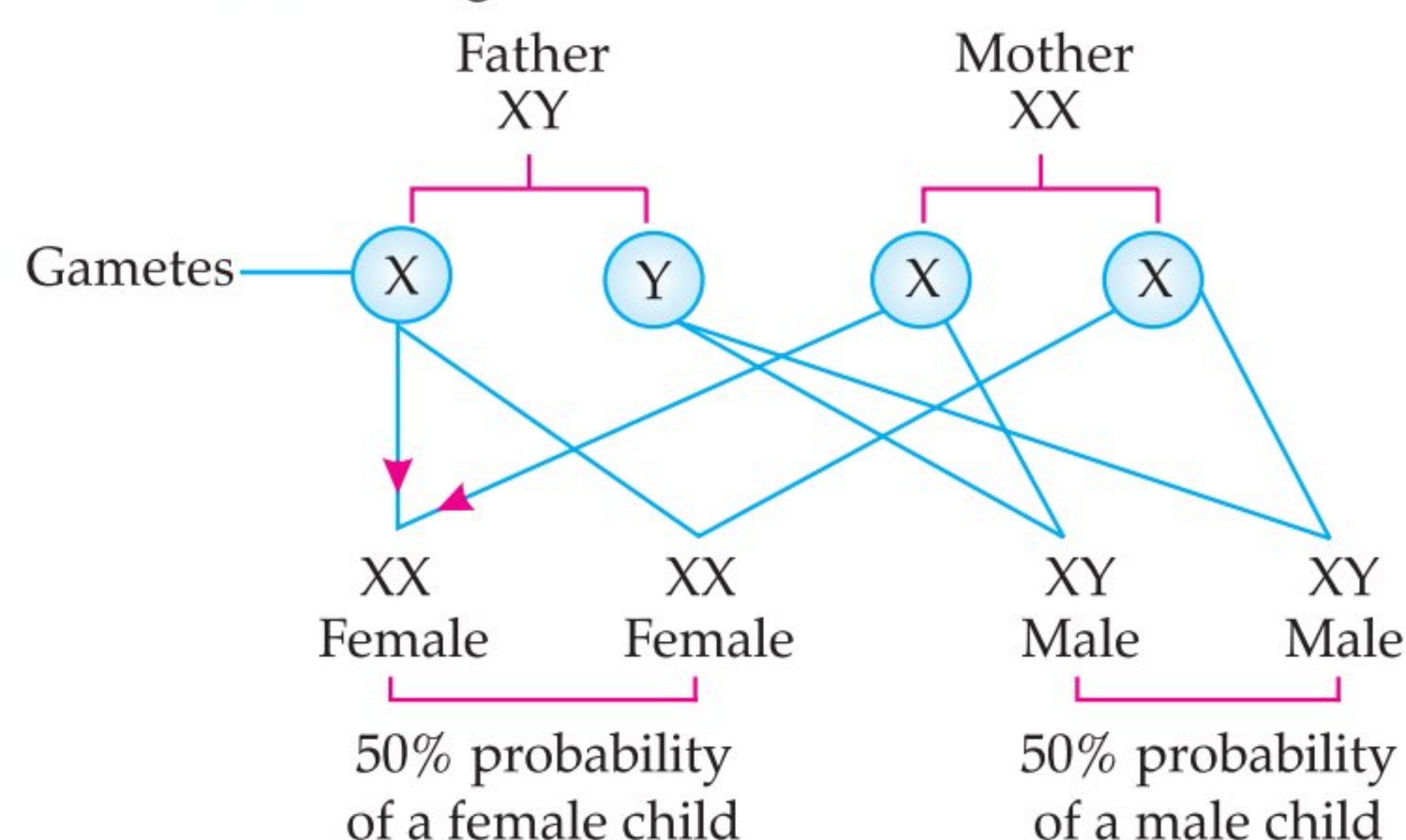
Character	Dominant Trait	Recessive Trait
Flower colour	Violet	White
Flower position	Axillary	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf/Short

- Mendel conducted a series of experiments in which he crossed the pollinated plants to study one character (at a time).
- In case of monohybrid cross with pure line breeding varieties of plants, the phenotypic ratio obtained in F_2 generation was 3: 1.
- In case of dihybrid cross *i.e.*, involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation was 9: 3: 3: 1.
- Mendel concluded that out of any pair of contrasting characters, one is dominant *i.e.*, it makes its appearance in the hybrid while the other is recessive *i.e.*, the manifestation of the other is masked.
- The homozygous dominant trait is denoted by two capital letters whereas the homozygous recessive trait is denoted by two small letters.
- The factors or genes controlling a particular trait separate from each other during gamete formation. Hence, gamete is always pure as far as contrasting characters are considered. Each gamete will possess only one gene set.
- In crossing, if two or more traits are involved, their genes assort independently, irrespective of the combinations present in the parents.
- Genes carry information for producing proteins, which in turn control the various body characteristics.
- For a particular trait, the offspring receives one allele from the father and one allele from the mother.
- The combination of the male and female germ cells gives a diploid zygote. Thus, the normal diploid number of chromosomes in the offspring is restored.
- Different mechanisms are used for sex determination in different species.



- **Sex Chromosomes:** In human beings, there are 23 pairs of chromosomes. Out of these, 22 chromosomes pairs are called **autosomes** and the last pair of chromosome which helps in deciding sex of the individual is called **sex chromosome**.

➤ Sex determination in human beings:



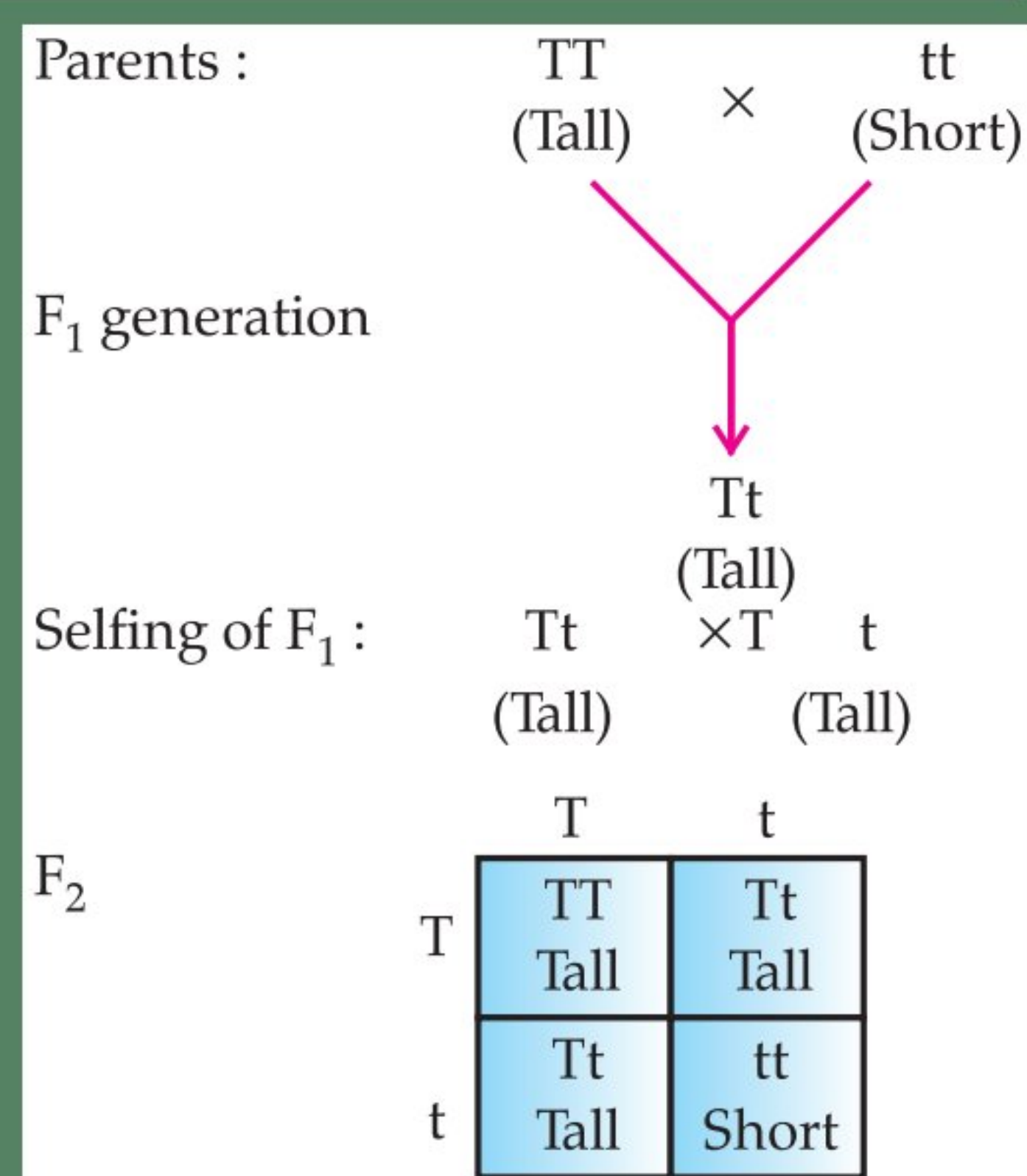
How is it done on the GREENBOARD?

Q. Name the plant Mendel used for his experiment. What type of progeny was obtained by Mendel in F_1 and F_2 generations when he crossed the tall and short plants? Write the ratio he obtained in F_2 generation plants. 3

Ans.:

Step I: Mendel used *Pisum sativum* (Pea plant) for his experiment.

Step II:



Step III: F_1 – All tall

Step IV: F_2 - Tall and short

Step V: Phenotypic ratio - 3 Tall: 1 Short

Step VI: Genotypic ratio - 1 Tall (TT): 2 Hybrid (Tt) : 1 Short (tt)



Objective Type Questions

1 mark each

A Multiple Choice Questions

Q. 1. Which of the following statement is incorrect?

- For every hormone there is a gene.
- For every protein there is a gene.
- For production of every enzyme there is a gene.
- For every molecule of fat there is a gene.

[NCERT Exemp.]

Ans. Correct option : (d)

Explanation: Hormone and enzymes are proteins and formation of any particular protein is controlled

by a particular gene. Hence, all other options are correct.

Q. 2. If a round, green seeded pea plant (RRyy) is crossed with wrinkled, yellow seeded pea plant, (rrYY) the seeds produced in F_1 generation are

- round and yellow.
- round and green.
- wrinkled and green.
- wrinkled and yellow.

[NCERT Exemp.]

Ans. Correct option : (a)

Explanation: As roundness and yellow colour are shown by capital letters in the genotype, so they are dominant traits. In F_1 generation, only dominant traits are expressed.

Q. 3. The maleness of a child is determined by

- (a) the X chromosome in the zygote.
- (b) the Y chromosome in zygote.
- (c) the cytoplasm of germ cell which determines the sex.
- (d) sex is determined by chance.

[NCERT Exemp.]

Ans. Correct option : (b)

Explanation: Y-chromosome in zygote means that the zygote would develop into a male child.

Q. 4. A zygote which has an X-chromosome inherited from the father will develop into a

- (a) boy.
- (b) girl.
- (c) X- chromosome does not determine the sex of a child.
- (d) either boy or girl.

[NCERT Exemp.]

Ans. Correct option : (b)

Explanation: A zygote with XX chromosomes in the 23rd pair would develop into a girl child.

Q. 5. From the list given below, select the character which can be acquired but not inherited.

- (a) colour of eye.
- (b) colour of skin.
- (c) size of body.
- (d) nature of hair.

[NCERT Exemp.]

Ans. Correct option : (c)

Explanation: Traits in other options are always inheritable traits.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion: A geneticist crossed a pea plant having violet flowers with a pea plant having white flowers, he got all violet flowers in first generation.

Reason: White colour gene is not passed on to next generation. A [CBSE SQP, 2021]

Ans. Correct option : (c)

Explanation: The gene for violet flowers is dominant over the gene for white flowers so that

only the violet gene is expressed as violet flowers in the first generation. 1

Q. 2. Assertion (A): Mendel chose a number of varieties of garden pea as plant material for his experiments.

Reason (R): Garden pea has well defined characters and is bisexual.

Ans. Correct option : (a)

Explanation: Mendel chose garden pea as plant material for his experiment because garden pea plants were easily available / they grow in one season / fertilization was easy. 1

Q. 3. Assertion (A): In humans, males play an important role in determining the sex of the child.

Reason (R): Males have two X chromosomes.

Ans. Correct option : (c)

Explanation: Sex of a child is dependent on the type of the male gamete that fuses with the female gamete. Human beings possess 23 pairs of chromosomes. Out of these, 22 pairs are known as **autosomes**, while the remaining one pair comprises sex chromosomes (XX in females and XY in males). At the time of fertilisation, the egg cell fuses with the sperm cell, resulting in the formation of the zygote. If the egg cell carrying an X chromosome fuses with the sperm carrying an X chromosome, the resulting child would be a girl. If the egg cell carrying an X chromosome fuses with the sperm carrying a Y chromosome, the resulting child would be a boy. 1

Q. 4. Assertion (A): Learning a skill such as dance and music is an acquired trait.

Reason (R): Acquired traits develop in the life time of an individual and do not pass to the progeny.

Ans. Correct option : (a)

Explanation: Traits which develop in the life time of an individual and do not pass to the progeny are called **acquired traits**. Learning a skill such as dance/music/loss of body parts/weight etc are example of acquired traits.

Q. 5. Assertion (A): Traits like eye colour or height are inherited traits.

Reason (R): Inherited traits are not transferred from parents to young ones.

Ans. Correct option : (c)

Explanation: Eye colour and height are genetically inherited traits, as these are expressed by genes. Inherited traits are the traits which are transferred from parents to young ones. Acquired traits are the characters that are acquired by the individual during its lifetime. These traits cannot be inherited. For example, if a wrestler develops large muscles due to his training program that does not mean it will be passed on to his offspring. 1

C Very Short Answer Type Questions

Q. 1. Mendel took tall pea plants and short pea plants and produced F_1 progeny through cross-

fertilisation. What did Mendel observe in the F_1 progeny? [AE] [CBSE, Comptt. Set. I, II & III, 2018]

Ans. All pea plant were tall in F_1 generation. 1
[CBSE Marking Scheme, 2018]

[AI] Q. 2. A Mendelian experiment consisted of breeding pea plants bearing violet flowers with pea plants bearing white flowers. What will be the result in F_1 progeny? [AE] [CBSE, Delhi & O.D. Set, 2018]

Ans. Violet flowers. 1
[CBSE Marking Scheme, 2018]



Topper Answer, 2018

Ans. As violet colour of flowers is dominant,
Genotype of white flowers :- 'vv'
Genotype of violet flowers :- 'V'
Genotype of F_1 progeny :- 'Vv'
According to law of dominance, colour of
flowers in F_1 progeny will be violet.

Q. 3. What is DNA?

[R] [Board Term II, Foreign Set II, 2016]

Ans. DNA is the carrier of hereditary information from parents to the next generation. 1
[CBSE Marking Scheme, 2016]

Q. 4. How many pairs of chromosomes are present in human beings? [R] [Board Term II, 2015]

Ans. 23 pairs. 1

Q. 5. Where is DNA found in a cell? [R] [O.D. Set II, 2015]

Ans. DNA is found in the cell nucleus. 1

Q. 6. What is a gene? [R] [Outside Delhi Set I, 2014]

Ans. Gene is a part of DNA that encodes the instructions that allow a cell to produce a specific protein or enzyme. 1

[AI] Q. 7. What is heredity?

[R] [Outside Delhi Set II, 2014]

Ans. The transmission of characteristics from one generation to another is known as heredity. 1

Q. 8. Name the information source for making proteins in the cells. [R] [Delhi Set-II, 2014]

Ans. Cellular DNA is the information source for making proteins in cells. 1

Short Answer Type Questions-I

2 marks each

Q. 1. "The chromosome number of the sexually reproducing parents and their offspring is the same." Justify this statement. [A]

Ans. Male individual have 46 chromosomes but because the gametes are always haploid i.e., they have half the number of chromosomes; sperms will be haploid (23 chromosomes). Female individual also contains only 23 chromosomes in egg. It is the fusion of the sperm and egg which leads to an offsprings with 46 chromosomes. 2

Q. 2. Give the respective scientific terms used for studying:

(i) the mechanism by which variations are created and inherited and

(ii) the development of new type of organisms form from the existing ones. [R]

Ans. (i) Genetics is the study of mechanism by which variations are created and inherited.

(ii) Evolution is used for studying the development of new type of organisms from the existing ones. 1+1

[AI] Q. 3. Differentiate between dominant and recessive traits. [U]

Ans. (a) The character which gets expressed in the presence of its contrasting form is termed as dominant trait.

(b) The trait which remains unexpressed in the presence of its contrasting form is called recessive trait. 1+1

Q. 4. 'Gene control traits'? Explain this statement with an example. [A]

Ans. Gene controls the trait by synthesizing the specific enzyme. Consider tallness as a trait. Plant height depends upon particular plant hormone which in turn will depend on the efficiency of the process for making it. If the enzyme responsible for the

production of this hormone is efficient, plant will be tall. If the gene for that enzyme has an alteration

that makes enzyme less efficient, the amount of hormone will be less and plant will be short. 2



Short Answer Type Questions-II

3 marks each

Q. 1. After self-pollination in pea plants with round, yellow seeds, following types of seeds were obtained by Mendel:

Seeds	Number
Round, yellow	630
Round, green	216
Wrinkled, yellow	202
Wrinkled, green	64

Analyse the result and describe the mechanism of inheritance which explains these results.

[A] [CBSE SQP, 2021]

Ans. The ratio obtained is 9:3:3:1 in which parental as well as new combinations are observed. This indicates that progeny plants have not inherited the whole set of genes from each parent.

Every germ cell takes on chromosome from the pair of maternal and paternal chromosomes. When two germ cells combine, segregation of one pair of characters is independent of other pair of characters. 3

[CBSE Marking Scheme, 2021]

[AI] Q. 2. In humans, there is a 50% probability of the birth of a boy and 50% probability that a girl will be born. Justify the statement on the basis of the mechanism of sex-determination in human beings.

[A] [CBSE SQP, 2021]

Ans. In human beings, the genes inherited from our parents decide whether it will be a boy or girl. Women have a perfect pair of sex chromosomes (XX). But, men have a mismatched pair (XY).

All children will inherit an X chromosome from their mother regardless of whether they are boys or girls. Thus, the sex of the children will be determined by what they inherit from their father. A child who inherits an X chromosome from her father will be a girl, and one who inherits a Y chromosome from him will be a boy. 3

[CBSE Marking Scheme, 2021]

Q. 3. A green stemmed rose plant denoted by GG and a brown stemmed rose plant denoted by gg are allowed to undergo a cross with each other.

(a) List your observations regarding:

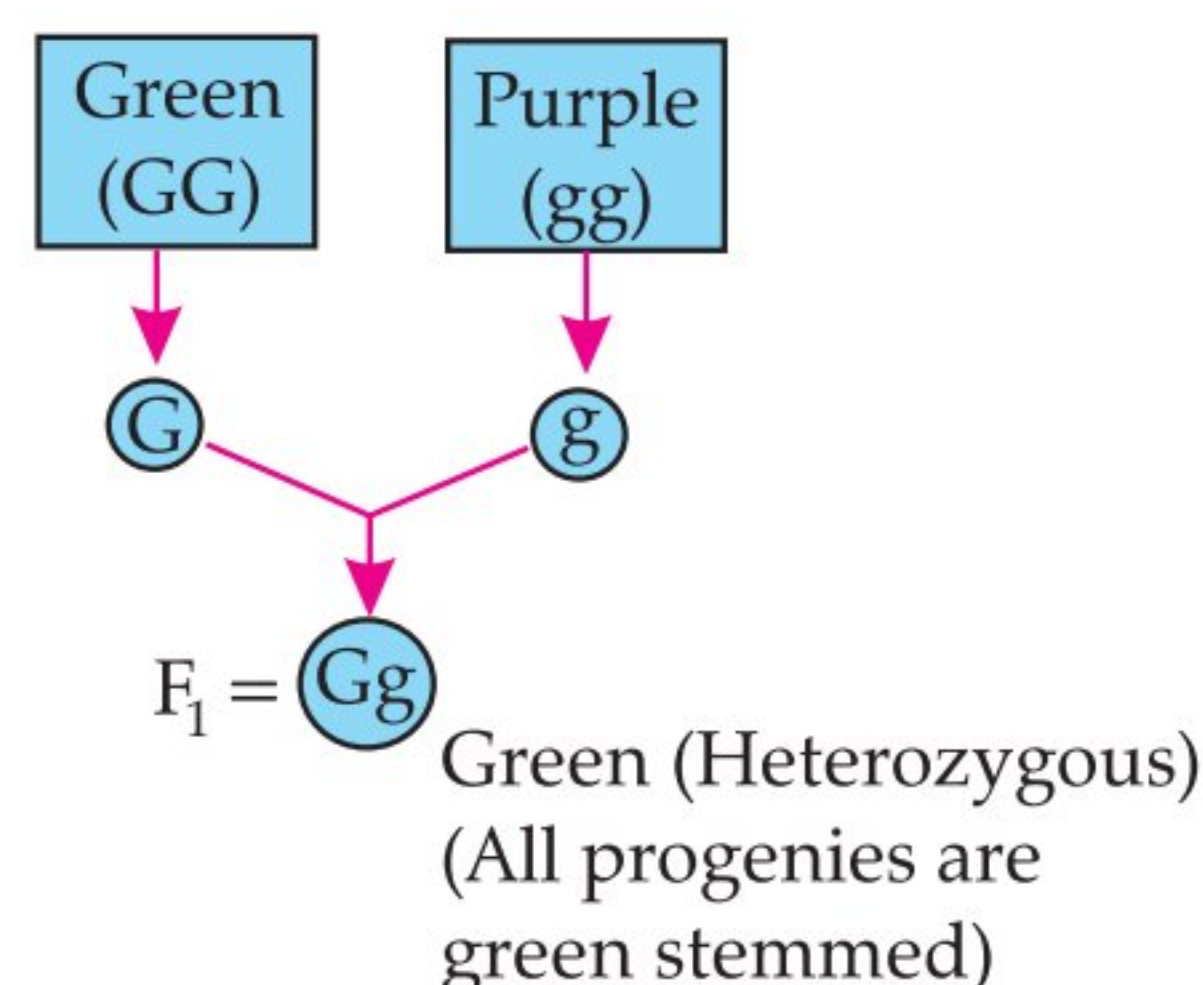
(i) Colour of stem in their F_1 progeny

(ii) Percentage of brown stemmed plants in F_2 progeny if F_1 plants are self pollinated.

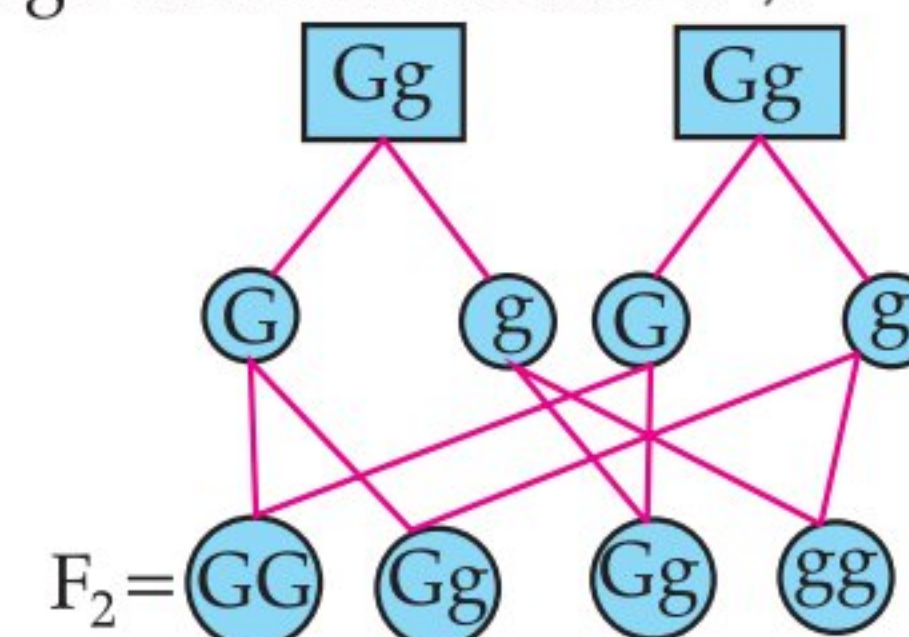
(iii) Ratio of GG and Gg in the F_2 progeny.

(b) Based on the finding of this cross, what conclusion can be drawn? [CBSE OD SET I, 2020]

Ans. (a) (i) Colour of the stem in F_1 progeny: All green



(ii) Percentage of brown stem: 25%



(iii) GG: Gg is 1: 2

(b) Based on the above cross, it can be concluded that green colour is dominant and get expressed in F_1 generation. The brown stem, which does not get express itself in the F_1 generation, is the recessive character. This is the law of dominance. 2+1=3

Q. 4. In a pea plant, the trait of flowers bearing purple colour (PP) is dominant over white colour (pp). Explain the inheritance pattern of F_1 and F_2 generations with the help of a cross following the rules of inheritance of traits. State the visible characters of F_1 and F_2 progenies.

[A] [Board SQP, 2020]

Ans. Let purple trait be represented by: PP and White trait be: pp

Parental	PP	×	pp	1/2
				↓
F_1 generation	Pp	×	Pp (Selfing)	1
				↓
Gametes of F_2	P		p	
	P	PP	Pp	
	p	Pp	pp	
				1/2 + 1/2

Visible characters of F_1 progeny all flowers are purple coloured and in F_2 progenies 3 are purple coloured and 1 is white coloured flower 3

[CBSE Marking Scheme, 2020]

COMMONLY MADE ERROR

→ Students often get confused between phenotype and genotype and between F_1 and F_2 generation.

ANSWERING TIP

- Practice concept of phenotype along with F_1 and F_2 generation and genotype with the help of examples.

Q. 5. Name the plant Mendel used for his experiment. What type of progeny was obtained by Mendel in F_1 and F_2 generations when he crossed the tall and short plants? Write the ratio he obtained in F_2 generation plants. [Board Delhi, Set- I, 2019]

Ans. Pea Plant / Garden pea / *Pisum sativum*

F_1 – All tall; F_2 - Tall and short

Ratio – Tall: Short

3: 1 / 1: 2: 1

1+ 1 +1

[CBSE Marking Scheme, 2019]

Detailed Answer:

Mendel used *Pisum sativum* (Pea plant) for his experiment.

Mendel took a tall pea (TT) plant and a short pea (tt) plant. When he crossed both, the first filial generation (F_1) obtained were tall. When F_1 progeny was self-pollinated, all plants obtained in F_2 generation were not tall. Instead, three tall pea (dominant) plants and one short pea (recessive) plant was obtained.

Parents : TT (Tall) × tt (Short)

F_1 generation

Tt
(Tall)

Selfing of F_1 :

Tt × Tt
(Tall) (Tall)

F_2

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Short

Phenotypic ratio and genotypic ratio should be in same horizontal line.

Phenotypic ratio

3 Tall: 1 short

Genotypic ratio

1 Pure Tall (TT): 2 Hybrid (Tt):

1 Pure short (tt)

3

COMMONLY MADE ERROR

- Mostly students explain this answer incorrectly.

ANSWERING TIP

- Practice a number of examples for Monohybrid and Dihybrid cross.

Q. 6. List two differences between acquired traits and inherited traits by giving an example of each.

[Board Delhi, Set- I, 2019]

Ans.

Acquired Trait	Inherited Trait
1. These traits are not transferred from one generation to the next generation.	These traits are transferred from one generation to the next.
2. They do not bring about change in DNA. Example: Acquiring any skill.	They bring about changes in DNA. Example: Eye colour.

(or any other relevant point and example) 1+1+1

[CBSE Marking Scheme, 2019]

COMMONLY MADE ERROR

- Students often write the differences in paragraph form rather than in tabular form.

ANSWERING TIP

- Differences between acquired and inherited traits must be written in tabular form and the points should be compatible. Don't forget to write the examples as asked.

AI Q. 7. What are acquired traits? Why are these traits generally not inherited over generations? Explain.

[CBSE, Comptt. Set I, II & III, 2018]

OR

With the help of suitable examples, explain why certain traits cannot be passed on to the next generation. What are such traits called?

[Board Term II 2014; Outside Delhi Set I, 2015]

Ans. Characters that a person acquires during one's life time are known as **acquired characters/traits**. 1

Such changes do not occur in the reproductive tissues. 1

Changes in the non-reproductive tissues are not passed on to the DNA of the germ cells and therefore not inherited by the next generation. 1

[CBSE Marking Scheme, 2018]

AI Q. 8. If we cross-bred tall (dominant) pea plant with pure-bred dwarf (recessive) pea plant, we will get plants of F_1 generation. If we now self-cross the pea plant of F_1 generation, we obtain pea plants of F_2 generation.

(i) What do the plants of F_1 generation look like?

(ii) State the ratio of tall plant to dwarf plants in F_2 generation.

(iii) State the type of plants not found in F_1 generation but appeared in F_2 generation. Write the reason for the same. [AE] [OD Comptt. 31/1 2017]

Ans. (i) Tall 1
(ii) 3:1 $\frac{1}{2}$

(iii) Dwarf $\frac{1}{2}$
Reason: Being a recessive trait, dwarfness can only be expressed in the recessive homozygous condition or in the absence of dominant trait. 1

AI Q. 9. How do Mendel's experiment show that traits are inherited independently?

[O.D. Set I, 2016, Delhi 31/1/3 2017]

Ans. (i) When a cross was made between a tall pea plant with round seeds and a short pea plant with wrinkled seeds, the F_1 progeny plants are all tall with round seeds. This indicates that tallness and round seeds are the dominant traits. 1

(ii) When the F_1 plants are self-pollinated, the F_2 progeny consist of some tall plants with round seeds and some short plants with wrinkled seeds which are the parental traits. 1

(iii) There were also some new combinations like tall plants with wrinkled seeds and short plants with round seeds. $\frac{1}{2}$

(iv) Thus, it may be concluded that tall and short traits and round and wrinkled seed traits have been inherited independently. $\frac{1}{2}$

OR

A flow chart depicting the same.

Note: Any other contrasting characters can also be taken

[CBSE Marking Scheme, 2016]



Topper Answer, 2016

Ans.

Mendel's dihybrid cross helps to know that traits are inherited independently. Various alleles remain together in hybrid union and at the time of progeny formation they assort independently. This was proved by the new mixtures of plants that were produced during cross.

$RRyy$ (round green) \times $rrYY$ (wrinkled yellow)
 gametes Ry ry
 $RrYy$ (Round yellow) - F_1
 $F_1 \times F_1$ \Rightarrow F_2
 $RrYy \times RrYy \Rightarrow 9:3:3:1$ (Phenotype ratio)

Round yellow	→	9	} Phenotype.
Round green	→	3	
Wrinkled yellow	→	3	
Wrinkled green	→	1	

9 combination of Genotype were produced.
New mixtures such as round yellow, wrinkled green etc... showed that in case of Ry , R and y are not linked and are independently inherited.

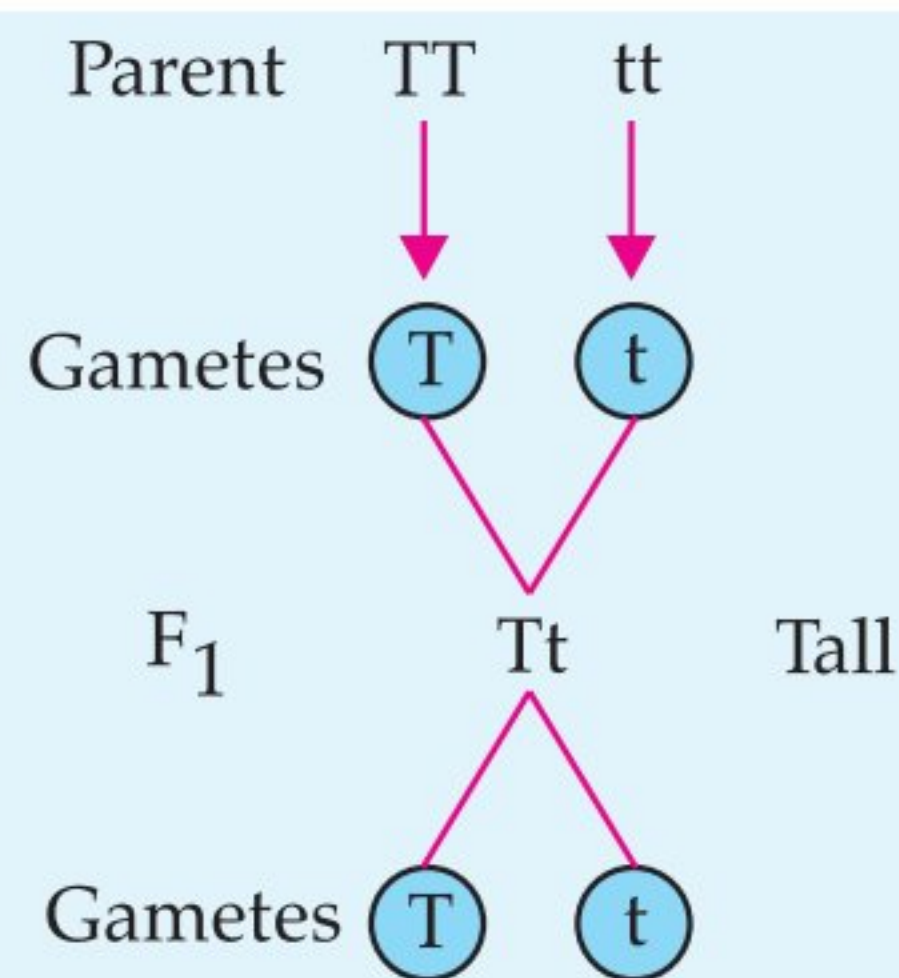
Q. 10. In one of his experiments with pea plants Mendel observed that when a pure tall pea plant is crossed with a pure dwarf pea plants, in the first generation, F_1 only tall plants appear.

(i) What happens to the traits of the dwarf plants in this case?

(ii) When the F_1 generation plants were self-fertilised, he observed that in the plants of second generation, F_2 , both tall plants and dwarf plants were present. Why it happened? Explain briefly.

[AE] [Board Term II, Delhi Set I, 2016]

Ans. (i)



1

The dwarf traits of the plants is not expressed due to the presence of the dominant tall trait.

F₂ TT Tt Tt tt
Tall Tall Tall Dwarf

Tall: Dwarf = 3: 1 ratio

1

- (ii) In the F₂ generation, both the tall and dwarf traits are present in the ratio of 3: 1. This showed that the traits for tallness and dwarfness are present in the F₁ generation, but the dwarfness, being the recessive trait, does not express itself in the presence of tallness, the dominant trait.

1

[CBSE Marking Scheme, 2016]

COMMONLY MADE ERROR

- ➔ Mostly students make error while drawing the cross. Some of them forget to label the stages.

ANSWERING TIP

- ➔ Practice cross with the help of different characteristic features in three stages:
(a) Parents
(b) F₁ generation
(c) F₂ generation

Q. 11. How did Mendel interpret his result to show that traits may be dominant or recessive? Describe briefly. [Board Term II, Delhi Set II, 2016]

Ans. Mendel conducted breeding experiments on Pea plants.

- (i) He selected pure breed tall and dwarf plants. ½
(ii) He cross-pollinated these plants. ½
(iii) In the F₁ generation, he obtained only tall plants. Tallness is the dominant trait. ½
(iv) Then, he produced F₂ generation by self cross of hybrids / F₁. ½
(v) He found that 3/4th of the plants were tall and 1/4th were dwarf. ½
(vi) The trait which remains hidden in F₁ generation plants is the recessive traits. ½

[CBSE Marking Scheme, 2016]

Q. 12. In a monohybrid cross between tall pea plants (TT) and short pea plants (tt) a scientist obtained only tall pea plants (Tt) in the F₁ generation. However, on self cross of the F₁ generation pea plants, he obtained both tall and short plants in F₂ generation. On the basis of above observations with other angiosperms also, can the scientist arrive at a law? If yes, explain the law. If not, give justification for your answer.

[Board Term II, Delhi Set III, 2016]

Ans. Yes, the scientist may arrive at the law of dominance according to which the trait that is expressed in the F₁ generation is the dominant trait, although both the dominant and recessive traits are present in the F₁ generation. In the F₂ generation the recessive traits is also expressed along with the dominant traits. 1 + 1 + 1

[CBSE Marking Scheme, 2016]

Q. 13. 'Different species use different strategies to determine sex of a newborn individual. It can be environmental cues or genetically determined.' Explain the statement by giving example for each strategy. [Board Term II, SQP, 2016]

Ans. **Environmental Cue:** (i) In some animals, the temperature at which fertilised eggs are kept determines whether the developing animal in egg is male or female.

(ii) In some animals like snail, individual can change sex.

Genetical Cue: A child who inherits an X-chromosome from her father will be a girl and one who inherits a Y-chromosome from the father will be boy. 1 + 1 + 1

[CBSE Marking Scheme, 2016]

Q. 14. What is DNA copying? State its importance.

[Board Term II, Delhi Set II, 2015]

Ans. DNA replication or DNA copying is the process of producing two identical replicas from one original DNA molecule during cell division.

Importance of DNA Copying:

- (i) DNA replication needs to occur so that during cell division, new cells will also have a copy of organism's DNA.
(ii) DNA is necessary to make all the RNA and proteins needed for cells to carry out necessary reactions and cellular processes in order to survive. 1 + 1 + 1



Long Answer Type Questions

5 marks each

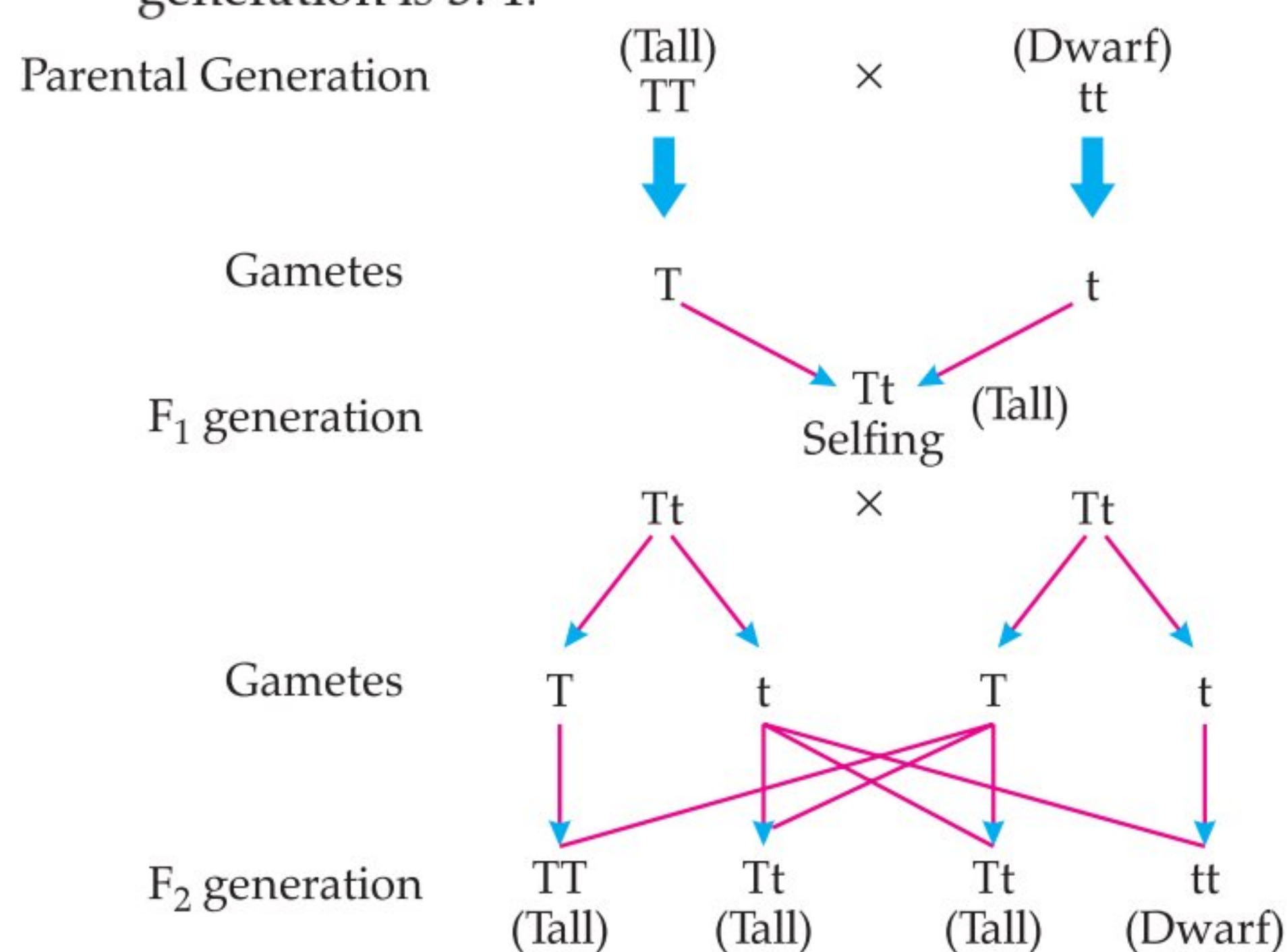
Q.1. (a) What is the law of dominance of traits? Explain with an example.

(b) Why are the traits acquired during the life time of an individual not inherited? Explain.

[C] [Delhi Set I, 2020]

Ans. (a) **Law of dominance of traits:** It states that "When parents having pure contrasting characters are crossed then only one character expresses itself in F_1 generation. This character is the dominant character and the character which cannot express itself is called recessive character".

Let us take an example of tall and dwarf in pea plant. When pure line tall (TT) plants were crossed with pure line dwarf (tt) plants, offspring were all heterozygous tall (Tt). The appearance of all Tall plants in the F_1 generation shows that tallness is the dominant character while dwarfness is the recessive character. The ratio of Tall to Dwarf in F_2 generation is 3:1.



(b) Characters that a person acquires during one's life time are known as acquired characters/traits. Such changes do not occur in the reproductive tissues. Changes in the non-reproductive tissues are not passed on to the DNA of the germ cells and therefore not inherited by the next generation. 3+2

Q.2. (a) What are dominant and recessive traits?

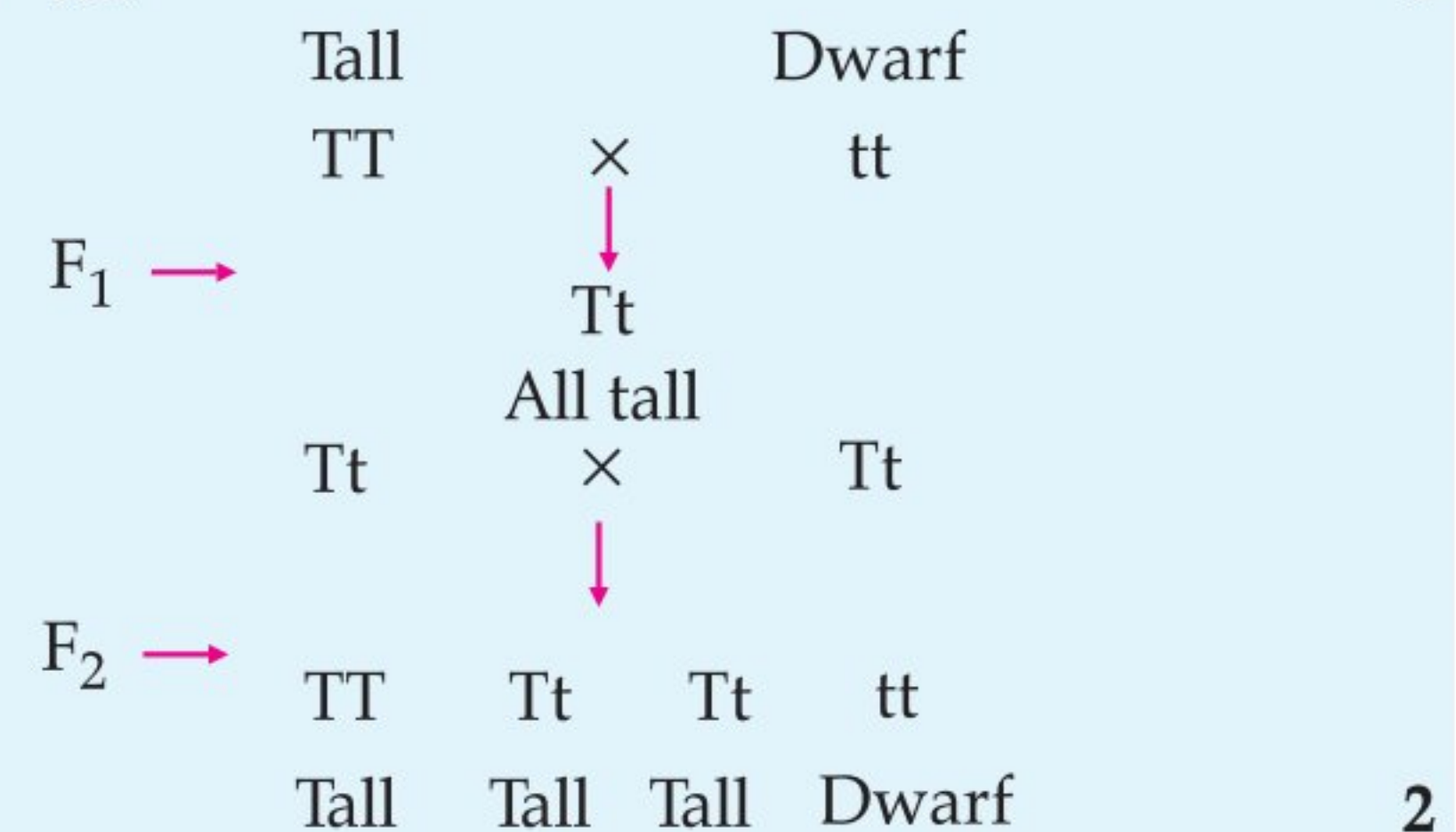
(b) "Is it possible that a trait is inherited but may not be expressed in the next generation?" Give a suitable example to justify this statement.

[R] [Board Outside Delhi, Set- II, 2019]

Ans. (a) **Dominant Trait:** The trait which expresses itself in F_1 (first) generation after crossing contrasting (opposite) trait is known as **dominant character** (trait). 1

Recessive Trait: The trait which is not expressed itself in F_1 (first) generation after crossing contrasting (opposite) trait. 1

(b) Yes 1



(Or can be explained in words also)

[CBSE Marking Scheme, 2019]

Q.3. (a) Why did Mendel choose garden pea for his experiments? Write two reasons.

(b) List two contrasting visible characters of garden pea Mendel used for his experiment.

(c) Explain in brief how Mendel interpreted his results to show that the traits may be dominant or recessive. [R] [Board Term II, Foreign I, 2016]

Ans. (a) **Reasons:**

- Pea plant is small and easy to grow.
- A large number of true breeding varieties of pea plant are available.
- Short life cycle.
- Both self and cross-pollination can be made possible. (Any two reasons) $2 \times \frac{1}{2} = 1$

(b) **Contrasting characters:**

- Round / Wrinkled seeds
- Tall / Short plants
- White / Purple flowers
- Green / Yellow seeds (Or any other)

(Any two) $2 \times \frac{1}{2}$

(c) When Mendel crossed two pea plants with a pair of contrasting characters, only one character appeared in all the members of F_1 progeny and the others remain hidden.

On selfing F_1 , the hidden characters reappeared in just 25% of the offsprings and the other 75% shared the characters expressed in F_1 .

Mendel concluded that the character which expresses itself in F_1 and in 75% of the individuals of F_2 is dominating while the other is recessive. (Or same thing can be explained by using an example) 1 + 1 + 1

[CBSE Marking Scheme, 2016]

Q.4. How do Mendel's experiments show that

(a) Traits may be dominant or recessive?

(b) Inheritance of two traits is independent of each other? [U] [Delhi 31/1/2017]

Ans. (a) Mendel conducted a Monohybrid cross/ (crossed pure tall pea plants with pure dwarf pea plants) he observed only tall pea plants in the F_1 generation, but on self crossing of the F_1 progeny, both tall and dwarf pea plants were observed in F_2 generation in the ratio 3: 1. Appearance of tall character in F_1 and F_2 generations shows tallness to be a dominant character. But absence of dwarf character in F_1 and its reappearance in F_2 confirms that dwarfness is recessive character. 2½

(b) Mendel conducted a dihybrid cross and observed that though he started with two types of parents, he obtained four types of individuals in F_2 . The appearance of new recombination in F_2 generations along with parental type characters showed that traits are inherited independently of each other. 2½

[CBSE Marking Scheme, 2017]

A Q. 5. With the help of one example for each, distinguish between the acquired traits and the inherited traits., Why are the traits/experiences acquired during the entire lifetime of an individual not inherited in the next generation? Explain the reason of this fact with an example. [AE] [OD 31/1 2017]

Ans. Acquired traits: Traits which develop in the life time of an individual and do not pass to the progeny. 1
Example: Learning a skill such as dance/music/loss of body parts/weight/any other example. ½
Inherited traits: Traits present in the gamete/germ cells which can be seen in the progeny. 1
Example: Skin colour/eyebrows/any other example. ½
Reason: Traits/characteristics acquired during one's life time do not bring any change in the DNA of the reproducing cells/germ cells. 1
Example: Decrease in body weight of beetles due to starvation do not pass on to the next generation because there is no change in the germ cells of beetles. 1

[CBSE Marking Scheme, 2017]

OR



Topper Answer, 2017

Ans.

↳ ACQUIRED TRAITS	INHERITED TRAITS
<p>1) These traits are acquired by a person during his lifetime.</p> <p>2) They don't pass to next generations.</p> <p>3) They don't direct evolution.</p> <p>4) eg → Body weight, Knowledge.</p>	<p>1) These traits are inherited by the individual from his/her parents.</p> <p>2) They pass to next generations.</p> <p>3) They direct evolution.</p> <p>4) eg → eye colour, skin colour, height etc.</p>
<p>The traits which are acquired by individual during his lifetime can't be passed to future generations as they don't bring any change in the DNA of germ cells. Any change in non-reproductive tissue cannot lead to change in DNA of germ cells. for eg → there were red beetles living in green bushes and the bushes were hit by plant disease. This caused reduction in the available food to red beetles and made them poorly nourished. But if the bushes will become free from any plant disease, the new generation will be healthy & of normal weight as low weight don't caused any change in the DNA of germ cells of red beetles.</p>	



TOPIC - 2

Basic Concepts of Evolution



Revision Notes

Evolution:

- Evolution is the sequence of gradual changes which takes place in the primitive organisms, over millions of years, in which new species are produced.
- Genetic drift can alter gene frequencies in small population and provide diversity without any survival benefits.
- Several factors such as environment, mutations, reproduction, etc., can cause alterations in gene frequencies in a population over generations, leading to evolution.
- Changes occurring in the DNA of germ cells are heritable whereas changes taking place in the non-reproductive tissues are not inherited.
- Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.
- Natural selection, genetic drift, variations and geographical isolation can lead to speciation in sexually reproducing organisms.
- Gene flow between the members of a population prevents speciation.
- **The fundamental characteristics used to classify organisms are:**
 - (i) Presence of prokaryotic or eukaryotic cells.
 - (ii) Whether the organism is unicellular or multicellular.
 - (iii) Ability to perform photosynthesis.
 - (iv) Presence of endoskeleton or exoskeleton in heterotrophic organisms.
- Classification of living organisms is closely related to their evolution.
- Both evolution and classification are interlinked.
 1. Classification of species is reflection of their evolutionary relationship.
 2. The more characteristics two species have in common, the more closely they are related.
 3. The more closely they are related, the more recently they have a common ancestor.
 4. Similarities among organisms allow us to group them together and to study their characteristics.
- **Evidences of Evolution:**
 - (a) **Homologous Organs:** These are the organs that have same structural plan and origin but different functions.
 - (b) **Analogous Organs:** These are the organs that have different origin and structural plan but same function. Analogous organs provide mechanism for evolution. E.g., wings of bird and wings of insects.
 - (c) **Fossils:** Fossils help in tracing evolutionary pathways. The age of fossils can be determined by using the relative method or the isotope dating method.
- Evolution is not a one-step process, but a continuous process occurring in several stages.
- Complex organs are formed slowly over many generations, sometimes with intermediate forms playing an important role.
- Sometimes the use of certain features gets modified with time. For example: Feathers may have provided insulation initially, but later became associated with flight.
- Evolutionary studies have shown that birds are closely related to reptiles.
- Humans have carried out artificial selection for various features of cabbage and produced different vegetables.

Vegetable produced	Selected feature
Broccoli	Arrested flower development
Cauliflower	Sterile flowers
Kohlrabi	Swollen parts
Kale	Larger leaves

- Molecular phylogeny can also be used to trace evolutionary relationships. Here, the DNA of different species is compared. Greater the differences in DNA, more distantly related are the species.
- Disappearance of the existing species is not a requirement for formation of new species.
- The new species formed are better adapted to the environment but they need not be superior to the existing species.
- The common ancestor of humans and chimpanzees evolved in different ways to produce the present forms.
- Evolution produces more diverse and complex body forms over a period of time, but the newly formed species are not more progressive than the already existing ones. So, it is wrong to say that evolution produces progressive higher forms from lower ones.
- All human beings, whether fair skinned or dark skinned, belong to the same species *i.e.*, *Homo sapiens* that originated in Africa.
- The human ancestors gradually migrated from Africa to various parts of the world such as Asia, Europe, Australia and America. Thus they spread to different parts of the earth and adapted as best as they could to their environmental conditions.



Mnemonics

Concept: Homologous organs	Concept: Analogous Organs
Mnemonics: Hi Virate How is the Bat & Ball for Test Cricket Today Lets Win the Match by Taking Catch	Mnemonics: All the People of Delhi & Faridabad are Sweet & Peaceful Who give Best Breads & Many Options of Egg-dishes
Interpretation: homologous Vertebrate Heart Brain Bougainvillea Thorn Cucurbita Tendrils Limbs Whale Man Bat Cheetah	Interpretation: Analogous Penguins Dolphins Flippers Sweet-Potato Wings Birds Butterfly Mammals Octopus Eyes

How is it done on the GREENBOARD?

- Q. (a) What is genetics ?
 (b) What are genes? Where are the genes located?
 (c) State and define three factors responsible for the rise of a new species. 5

Ans.

Step I: Genetics is the branch of biology that deals with the study of genes and heredity in organisms.

Step II: Genes are basic unit of heredity. They are linear segments of DNA which codes for a gene product.

Step III: Genes are located on chromosomes.

Factors responsible for the rise of a new species (speciation) are :

Step IV: Geographic isolation wherein geographic barrier prevents interaction between species. Over a period of time, the sub-populations become more and more diversified from one another and finally form two different species.

Step V: Genetic drift : The accidental change in frequency of genes in a small population is called genetic drift.

Step VI: Natural selection : It is the process that results in the increased survival and reproductive success of individuals that are well suited to their environment.



Objective Type Questions

1 mark each

A Multiple Choice Questions

Q. 1. An example of homologous organs is

- (a) our arm and a dog's fore-leg.
- (b) our teeth and an elephant's tusks.
- (c) potato and runners of grass.
- (d) all of the above. [NCERT Exemp.]

Ans. Correct option : (b)

Explanation: An example of homologous organs is our teeth and an elephant's tusks.

Q. 2. In evolutionary terms, we have more in common with

- (a) a Chinese school-boy. (b) a chimpanzee.
- (c) a spider. (d) a bacterium.

[NCERT Exemp.]

Ans. Correct option : (a)

Explanation: In evolutionary terms, we have more in common with a Chinese school boy as both are humans and belong to same species.

Q. 3. The theory of evolution of species by natural selection was given by

- (a) Mendel (b) Darwin
- (c) Morgan (d) Lamarck

[NCERT Exemp.]

Ans. Correct option : (b)

Explanation: The theory of evolution of species by natural selection was given by Charles Darwin.

Q. 4. A basket of vegetables contains carrot, potato, radish and tomato. Which of them represent the correct homologous structures?

- (a) Carrot and potato (b) Carrot and tomato
- (c) Radish and carrot (d) Radish and potato

[NCERT Exemp.]

Ans. Correct option : (c)

Explanation: Radish and carrot are modified tap roots. Organs with similar origin are called homologous organs.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion (A): Fossils are remains of dead organisms.

Reason (R): It is helpful in study of evolution.

Ans. Correct option : (b)

Explanation: Fossils are remains of hard parts of the dead organisms in the strata of earth. It help in tracing evolutionary pathways. 1

Q. 2. Assertion (A): Wings of butterfly and wings of bat are analogous organs.

Reason (R): Analogous organs have different origin and structural plan but same function.

Ans. Correct option : (a)

Explanation: Wings of butterfly and wings of bat though they perform similar function, they have different origin/basic structure. Hence, they are known as **analogous organs**. 1

Q. 3. Assertion (A): Speciation is the process of formation of a new species from a pre-existing one.

Reason (R): Mutation plays a role in speciation.

Ans. Correct option : (a)

Explanation: Speciation is an evolutionary process by which new species arise. One of the factors that lead to speciation is mutation. 1

C Very Short Answer Type Questions

AI Q. 1. What is speciation?

[KVS-2014]

R [Board Term II, Delhi Set II, 2015]

Ans. Speciation is the evolution of reproductive isolation among once interbreeding populations *i.e.*, the development of one or more species from an existing species.

[CBSE Marking Scheme, 2015] 1

Q. 2. List any two factors that could lead to speciation?

U

Ans. Two factors that could lead to speciation are—

- (i) Genetic drift, (ii) Reproductive isolation. ½ + ½

Q. 3. Write the contribution of Charles Darwin in the field of evolution. R

Ans. Charles Darwin proposed that evolution of species occurred by natural selection. 1

AI Q. 4. (i) Which of the following fossil is invertebrate and which one is vertebrate?

- (a) Dinosaur, (b) Ammonite. R

Ans. (a) Vertebrate, (b) Invertebrate. ½+½



Short Answer Type Questions-I

2 marks each

AI Q. 1. What are analogous organs? Why cannot the wing of a butterfly and the wing of a bat be considered homologous organs? State one reason.

R [OD Comptt. 2017]

Ans. Analogous organs: Organs with dissimilar basic structure or origin, but performing same function. 1
Because though they perform similar function, they have different origin/basic structure. 1

COMMONLY MADE ERROR

- Students often get confused between analogous and homologous organs and write opposite answer.

ANSWERING TIP

- Learn the differences between the two in tabular form for easy understanding and retention.

Q. 2. In an area A, the leaf material available to beetles

was very less. What are the two consequences seen in the beetles? **A**

Ans. The consequences are as follows:

- They switched to new type of food and entered new niches.
- This led to arise of diverse variety of beetles as some changes in beetles will take place to make them adaptable to new niches. 1+1

AI Q. 3. State two methods of determining the age of fossils.

Ans. (i) If we dig into the earth and start finding fossils, it can be assumed that the fossils closer to the surface are more recent to those found in the deeper layers.

(ii) By detecting the ratios of different isotopes of the same element in the fossil material.

Q. 4. "Geographical isolation is not a major factor in the speciation of a self pollinating plant species." Justify this statement with the help of an example. **A**

Ans. Geographical isolation will not be a major factor in the speciation of a self-pollinating plant species. It involves the same flower / plant in which male and female gametes are formed. 2



Short Answer Type Questions-II

3 marks each

Q. 1. What are homologous structures? Give an example. Is it necessary that homologous structures always have a common ancestor? Justify your answer.

A [Delhi, Set- I, 2020]

Ans. Homologous Structures: Structures that are similar in origin but perform different functions. For e.g. forelimbs of humans and the wings of birds perform different functions but their skeletal structures are similar.

Yes, homology indicates common ancestry. Homologous organs follow the same basic plan of organization during their development but in the adult condition, these organs are modified to perform different functions as an adaptation to different environments. 1+1+1=3

AI Q. 2. (a) Classify the following as homologous or analogous pairs:

- Broccoli and Cabbage
- Ginger and Raddish
- Fore limbs of birds and lizard
- Wings of a bat and Wings of a bird

(b) State the main feature that categorises a given pair of organs as homologous or analogous.

A [Outside Delhi, Set- I, 2020]

Ans. (a) (i) Analogous structure

(ii) Analogous structures

(iii) Homologous structures

(iv) Analogous structures

(b) Homologous organs are defined as the organs which have same structure but different functions while analogous organs are defined as the organs which have same functions but different structure.

2+1=3

Q. 3. List three factors that could lead to speciation. Which of these cannot be a major factor in the speciation of a self-pollinating plant species and why? **R** [Outside Delhi, Set- II, 2020]

Ans. Factors which can lead to speciation are:

- Genetic drift
- Mutation / Drastic change in the genes or DNA
- Natural selection
- Geographical isolation

Geographical isolation cannot be a major factor in the speciation of a self-pollinating plant species.

Reason: Physical barrier cannot be created in self pollinating plants. 2+1=3

Q. 4. How does the creation of variations in a species promote survival? Explain with the help of an example.



Topper's Answer, 2019

- Ans. 13.
- ① Populations of organisms live in well defined places or niches.
 - ② They are native to that area. ~~The way~~
 - ③ Reproduction involves DNA replication which can generate errors that is the main source of variations.
 - ④ This consistency of DNA is responsible for maintenance of body design.
 - ⑤ Suppose the temperature in that region increases or decreases, water level changes or there is a meteorite hit, the population may get wiped out.
 - ⑥ But if there are some organisms that can tolerate the heat, they would survive.
 - ⑦ They would further reproduce and survive in nature.
 - ⑧ For e.g. Bacteria are one of the oldest surviving organisms.
Due to variations in their body designs, they adapt most of the inhospitable climates like deserts, ice etc.

AI Q. 5. (a) What is variation? How is variation created in a population? How does the creation of variation in a species promote survival?

(b) Explain how, offspring and parents of organisms reproducing sexually have the same number of chromosomes. **[CBSE, Comptt. Set, I, II, III, 2018]**

Ans. (a) Occurrence of differences between organisms is called **variation**.

New variation may arise during the process of DNA copying that already has variations accumulated from previous generations.

Combining variations from two or more individuals would thus create new combinations of variations.

Species having suitable variations have more chances of survival in case of change in environment conditions.

(b) In sexually reproducing organisms, male and female gametes/reproductive cells with only half the number of chromosomes (as in the parent cell) are produced. During fertilization, when male and female gametes fuse to give rise to a zygote, original number of chromosomes are restored.

[CBSE Marking Scheme, 2018]

Q. 6. 'Natural Selection and Speciation leads to evolution'. Justify this statement. **[Delhi 31/1/2 2017]**

Ans. (a) Natural selection is defined as the change in frequency of some genes in a population, which gives survival advantage to a species.

(b) Whereas speciation is the development of a new species from pre-existing ones.

(c) This leads to a sequence of gradual change in the primitive organisms over millions of years, to form newer species which are very different from older ones. This is called **evolution**. **1 + 1 + 1**

[CBSE Marking Scheme, 2017]

Detailed Answer:

Natural selection is the phenomenon by which the nature selects those species which possess survival advantage over the other species. According to theory of natural selection, there is struggle of existence within the species of a population for the environmental resources and their struggle leads to survival of certain organisms and elimination of the less competent species. The better adapted organisms would, thus, survive and pass on their traits to next generation, gradually leading to evolution.

Speciation is a process of formation of new species from the existing one due to reproductive isolation of a part of its population. This reproductive isolation can occur due to geographical isolation of a part of population. With time, the genetic drift will accumulate different variations in each of the geographically separated sub-population. Ultimately all the individuals of these two groups will isolate reproductively, thus, leading to formation and evolution of new species. Thus, we can say that both natural selection and speciation lead to the evolution of species on earth.

Q. 7. Explain with an example for each, how the following provides evidences in favour of evolution in organisms:

(i) Homologous organs

(ii) Analogous organs [Delhi 31/1/1 2017]

(iii) Fossils. [Board Term II, Delhi Set II, 2015]

Ans. (i) Homologous organs: Forelimb of human and bird are homologous organs. They have same structural design and developmental origin, but they have different functions and appearance. Homologous organs help us to understand that the organisms have evolved from a common ancestor.

The more common characteristics the two species have, the more closely they are related.

(ii) **Analogous organs:** Analogous organs are those organs which have different basic structural design and development origin but have similar appearance and perform similar functions.

Example: The wings of birds and bats look similar but have different design in their structure. They have a common function of flying, but their origins are not common. So, birds and bats are not closely related.

(iii) **Fossils** and their study is useful in knowing about the species which are no longer alive.

They provide evidence and missing links between two classes. They are helpful in forming a sequence of organisms in the pathway of evolution.

Thus, fossils have an importance in deciding evolutionary relationship. *Archaeopteryx* is a fossil bird. It had feathers, fused bones and beak which are exclusively bird structures. It also had some features which are found in reptiles e.g., teeth in jaw, claws on free fingers and a long tail. This fossil provides a clue that birds have evolved from reptiles. 1+1+1 [CBSE Marking Scheme 2015]

Q. 8. 'Evolution and Classification of organisms are interlinked.' Give reasons to justify this statement.

[OD 31/1 2017]

OR

'Two areas of study namely 'evolution' and 'classification' are interlinked'. Justify this statement.

[Board Term II, O.D. Set I, 2016]

[Board Term II, 2015]



Topper Answer, 2017

Ans.

1) classification is the reflection of evolutionary relationships between organisms.

2) More the two organisms are related to each other, more characteristics they have in common.

3) More characteristics they have in common, more recently they have common ancestor like a girl & her real brother.

4) Similarities between organisms allow us to group (classify) them & study these groups to determine how these organisms are evolutionary related.

Detailed Answer:

"Every organism has an inbuilt tendency for genetic variation which plays an important role in the origin of new species and forms the basis for evolution. The more characteristics two species have in common, the more closely they are related. Classification of organisms involves organising them in different groups, based on the similarities and dissimilarities of characteristics. Therefore, classification of species is a reflection on their evolutionary relationship. Thus, we can say that evolution and classification of organisms are interlinked.

Q. 9. Define evolution. How does it occur? Explain how fossils provide evidences in support of evolution?

[U] [OD Comptt. 2017]

Ans. (a) Evolution: Gradual accumulation of variations and its selection by nature leading to formation of new species. 1

(b) Variations may arise in a population due to mutations or sexual reproduction. Sub-populations are formed due to genetic drift and geographical isolation. When natural selection acts on them, most suitable variation survives leading to evolution of a new species. 2

(c) Fossils provide missing link between the species/phylogenetic relationships who has evolved from whom. They provide information about prehistoric organisms. 1, 1

[CBSE Marking Scheme, 2017]

Q. 10. What is organic evolution? It cannot be equated with progress. Explain with the help of a suitable example.

[AE] [OD 31/3 2017]

Ans. Organic evolution is the process or event of change in an organism by which descendants differ from their ancestors. 1

Evolution cannot be equated to progress. From lower forms to higher forms, it gives rise to more complex body designs even while the simpler body designs continue to flourish. For example, human beings have not evolved from chimpanzees but both have common ancestor. 2

Q. 11. What are homologous organs? Give one example. Can the wings of a butterfly and the wings of bat be regarded as homologous? Give reason in support of your answers.

[U] [OD Comptt. 31/1 2017]

Ans. Homologous Organs: Organs with similar basic structure/origin but modified to perform different functions. (or any other) 1

Example: Forelimbs of various vertebrates. ½

Wings of butterfly and the wings of a bat cannot be regarded as homologous organs. ½

Reasons: Though, they perform the similar function, they have different origin/basic structure. [CBSE Marking Scheme, 2017] 1

[AI] Q. 12. How are fossils formed? State any one role of fossils in the study of organic evolution?

[A] [OD Comptt. 31/2 2017]

Ans. Formation: On certain occasions, a dead body or at least some parts may be in an environment that does not let it decompose completely and gets preserved, subsequently either the part or its impression becomes a fossil. 2

Role of Fossil: Provides missing link between the species. 1

They tell us about prehistoric organisms.

[CBSE Marking Scheme, 2017]

Q. 13. Give an example of the characteristics being used to determine how close two species are in evolutionary terms. [R] [Foreign 31/2/1, 2017]

Ans. Study of homologous organs as forelimbs of mammals, birds, reptiles and amphibian; show that though they perform different functions have similar basic / internal structure; this is because they have evolved from common ancestor and help us in determining the closeness between two species in evolutionary terms. 1 + 1 + 1

[CBSE Marking Scheme, 2017]

Q. 14. List three factors that provide evidences in favour of evolution in organisms and state the role of each in brief. [Foreign Set II, 2017]

[R] [Board Term II, Foreign Set I, 2016]

Ans. Evidences of evolution are:

(i) Analogous organs: Organisms with similar looking organs may have different origin.

(ii) Homologous organs: Organisms with apparently different looking organs may have similar origin.

(iii) Fossils: Allow us to make estimates of how far back evolutionary relationships goes. Fossils when chronologically arranged help in tracing the evolutionary history of an organism. 3 × 1 = 3

[CBSE Marking Scheme, 2016]

Q. 15. What is speciation? Explain in brief the role of natural selection and genetic drift in this process.

[R] [Board Term II, Foreign Set II, 2016]

Ans. (i) Speciation: Origin of new species from pre-existing ones. 1

Role of Genetic drift and natural selection:

Genetic drift is flow of genes from one population to another by chance factor or randomly. Over generation, it will accumulate different changes in different population. 1

In addition, natural selection operates differently in different population selecting the fittest / favourable feature in both the population.

Over a long period of time, the differences in the two population may become so drastic that they no longer reproduce with each other and thus, give rise to new species. 1

[CBSE Marking Scheme, 2016]

Q. 16. What is speciation? List four factors responsible for speciation. [R] [Board Term II, Delhi Set I, 2015]

Ans. Speciation is the evolution of reproductive isolation among once interbreeding population.

Factors which can lead to speciation are:

(i) Over generation, **genetic drift** may accumulate which lead to speciation.

(ii) **Natural selection** may work differently in different location which may give rise to speciation.

(iii) Severe **DNA change**.

(iv) A **variation** may occur which does not allow sexual act between two groups. 1 + 2

[CBSE Marking Scheme, 2015]

AI Q. 17. Explain the following:

- (a) Speciation
- (b) Natural Selection

R [Board Term II, Delhi Set II, 2015]

Ans. (a) **Speciation:** Refer SAQ-II, Q. 16.

- (b) **Natural Selection:** (i) There is natural variation within any population and some individuals have more favourable variations than others.
- (ii) Population remains fairly constant even though all species produce a large number of offsprings.
- (iii) This is due to 'competition' or 'struggle' for existence between same and different species.
- (iv) The struggle for survival within population eliminates the unfit individuals and those with 'favourable variations' survive and pass on these variations to their progeny to continue. This is called **natural selection**. The favourable variations are accumulated over a long time period leading to the origin of a new species. $1\frac{1}{2} + 1\frac{1}{2}$

[CBSE Marking Scheme, 2015]

Q. 18. Homologous organs are different from analogous organs.

- (i) Mention the two basic characteristics that decide about analogy and homology between the two organs.
- (ii) On what basis is the classification of organisms into prokaryotic and eukaryotic done?

U [Board Term II, 2015]

Ans. (i) The two basic characteristics that decide about analogy and homology are origin, structures and function.

- (ii) In prokaryotic organism, no true nucleus is found. Therefore, nucleus is absent.
- In eukaryotic organisms, true nucleus is found.

$1 + 1 + 1$

[CBSE Marking Scheme 2015]

Q. 19. There are two different types of organs, homologous and analogous. Differentiate between them by giving three points.

U [Board Term II, 2015]

Ans.

S. No.	Homologous Organs	Analogous Organs
(i)	They have same basic structural design.	They have different basic structural design.
(ii)	They perform different functions.	They perform similar functions.
(iii)	Their appearances are different.	They have similar appearances.

[CBSE Marking Scheme, 2015] 3

COMMONLY MADE ERROR

- Students often write differences in paragraph form.

ANSWERING TIP

- Learn the differences between analogous and homologous organs in tabular form for easy retention and understanding. Writing answers in tabular form are easy to understand than paragraph form.

Q. 20. (a) Cite the evidence on the basis of which it is concluded that birds have evolved from reptiles.

- (b) Insects, *Octopus*, *Planaria* and Vertebrates also possess eyes. Can these animals be grouped together on the basis of the eyes they possess. Why or why not? Give reason to justify your answer. [Board Term II, Delhi Set I, II, III, 2014]

AE [Board Term II, Foreign Set I, 2015]

Ans. (a) (i) Fossils showing imprints of feathers along with the bones in dinosaurs/reptiles found.

- (ii) They could not fly and presumably use the feathers for insulation.

(iii) Later they developed/evolved and adapted feathers for flight.

(iv) Thus, they give evidence that birds have evolved from reptiles. $\frac{1}{2} \times 4 = 2$

- (b) Yes, eyes can be grouped together, which have evolved over generation from imperfect eyes in *Planaria* to perfect eyes in vertebrates. $\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2015]



Long Answer Type Questions

5 marks each

Q. 1. (a) What is genetics?

- (b) What are genes? Where are the genes located?
- (c) State and define three factors responsible for the rise of a new species. **R** [Delhi, Set- II, 2020]

Ans. (a) **Genetics:** Branch of biology that deals with the study of genes and heredity in organisms.

- (b) Genes are basic unit of heredity. They are linear segments of DNA which codes for a gene product. Genes are located on chromosomes.

(c) **Factors responsible for the rise of a new species (speciation) are:**

- (i) **Geographic isolation:** wherein geographic barrier prevents interaction between species. Over a

period of time, the sub-populations become more and more diversified from one another and finally form two different species.

- (ii) **Genetic drift:** The accidental change in frequency of genes in a small population is called genetic drift.
- (iii) **Natural selection:** It is the process that results in the increased survival and reproductive success of individuals that are well suited to their environment.

1+1+3

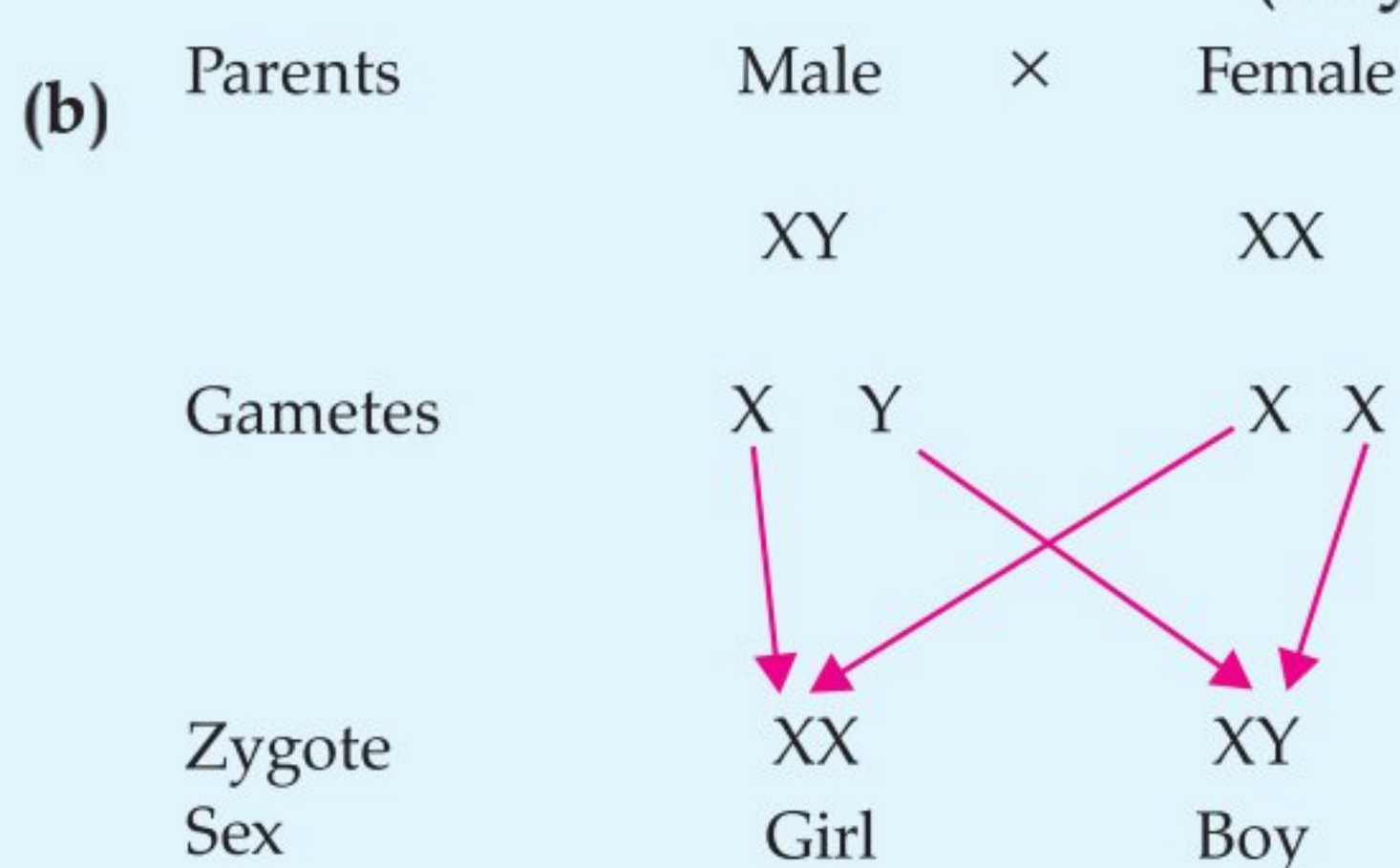
AI Q. 2. (a) What are homologous structures? Give an example.

- (b) "The sex of a newborn child is a matter of chance and none of the parents may be considered responsible for it." Justify this statement with the help of a flow chart showing sex-determination in human beings.

R [Board Outside Delhi, Set-I, 2019]

Ans. (a) The organs having similar origin / structures but performing different functions. 1

Example: limbs of frog, limbs of lizard, bird, human
(Any two) $\frac{1}{2} + \frac{1}{2}$



Hence, sex determination is purely a matter of chance. [CBSE Marking Scheme, 2019]

Detailed Answer:

- (a) Homologous structures are those structures which have a common basic structure but perform different functions. Example, forelimbs of reptiles, amphibians and mammals.
- (b) In human beings, the sex of the individual is determined by the genes inherited from the parents. Women have a perfect pair of sex chromosomes i.e, XX whereas men have a mismatched pair of normal sized X and short one Y making it XY. All children will inherit an X chromosome from their mother regardless of whether they are boys or girls. Thus, the

Q. 5. (a) How do the following provide evidences in favour of evolution in organisms ? Explain with an example for each.

(i) Homologous organs

(ii) Analogous organs

(iii) Fossils

(b) Explain two methods to determine the age of fossils.

U [CBSE Board, 2019]

sex of children is decided by what they inherit from their father. A child who inherits an X chromosome will be a girl and one who inherits a Y chromosome from him will be a boy. So, there is an equal chance of a girl child as well as a boy child.

Q. 3. Name the phenomenon that governs the following:

- (i) Green beetles living in green bushes are not eaten by the crows.
- (ii) Number of blue beetles in green bushes increases only because the red beetles, living there, were trampled by a herd of elephants.
- (iii) No 'medium height plants' are obtained in F_1 generation, upon crossing pure tall and dwarf pea plants.
- (iv) Tails of mice were surgically removed for several generations, still mice had tails in the following generations.
- (v) A migrant beetle reproduces with the local population; as a result genes of migrant beetle enter the new population. **C** [CBSE, SQP 2019]

Ans. (i) Natural selection

(ii) Genetic drift

(iii) Law of dominance

(iv) Acquired characters are not inherited

(v) Gene flow. [CBSE Marking Scheme, 2019]

Q. 4. (a) What are fossils and how is age of fossils determined?

- (b) During artificial selection, which features of wild cabbage were selected to give rise to (i) Cabbage and (ii) Cauliflower. **A** [CBSE, SQP 2019]

Ans. (a) Body or its parts that are not decomposed/preserved traces of organisms.

- Upon digging the earth, the fossils that are found closer to the surface are more recent than the fossils in deeper layers.
- By detecting the ratios of different isotopes of the same element in the fossil material.

(b) (i) By selecting very short distances between leaves.

(ii) By selecting sterile flowers. 5

[CBSE Marking Scheme, 2019]



Ans. 20. I Homologous organs

1. They are the organs that are similar in structure but have been modified to perform different functions.

20. a) For eg.

Forelimbs of humans, frog and lizard have similar structures. Frog uses it to hop and as a shock absorber, humans use it to write, hold etc. and lizards use it to creep on walls.

They explain that maybe the reptiles, mammals and amphibians had common ancestors and evolved to be in the present form.

Analogous Organs

- ① They have different ~~structures~~ structures and appearance but perform similar function.

- ② For eg. wings of a bat and a bird have different structure; but perform function of flying. [Birds have feathers and wings all over body. Bat - Thin flap like webbed wings.]
- ③ They do not show common ancestry but trace evolution due to which they inherited the became capable of flying.

(iii) Fossils

- ① They are the remains of plants and animals found under earth that lived in remote past.

- ② They tell us about the evolutionary relationships in the past.

- ③ For eg. Archaeopteryx has ^{round} cranium and wings similar to birds but claws and beak similar to reptiles.

- ④ This ~~also~~ shows relation between reptiles and aves or maybe aves evolving from reptiles.

- ⑥ Fossils can be determined by -

(i) Carbon-14 Dating

① All organisms have some percentage of carbon which decreases as we die.

② The % percentage of fossil is compared with the present percentage in living organisms to determine their age.

(ii) Relative method

① The earth is dug, the fossils found closer to earth are recent whereas the ones found in deeper layers are the older ones.

For eg. Dinosaurs are found in deeper layers.

AI Q. 6. What are fossils? How are they formed? List two methods of determining the age of fossils. Explain in brief the importance of fossils in deciding the evolutionary relationships.

R [Foreign 31/2/1, 2017]

Ans. (i) Fossils: The remains/impression of dead / decayed plants / animals of the part. $\frac{1}{2}$

(ii) Formation of fossils: Formed when dead organisms are compressed under high pressure deep under the soil. 1

(iii) Two methods of determining the age of fossils are:

(a) Relative method, $\frac{1}{2}$

(b) Carbon dating method. $\frac{1}{2}$

(iv) Importance of fossils: (a) The presence of fossilized remains of the organisms is the evidence of existence of the organisms millions of years ago, out of which some have become extinct. $\frac{1}{2}$

(b) Fossil also helps in the determination of the connecting links between various groups and their origin from the primitive ones. 1 + 1

AI Q. 7. Define evolution. How does it occur? Describe how fossils provide us evidences in support of evolution.

[Board Term II, O.D. Set III, 2016]



Topper Answer, 2016

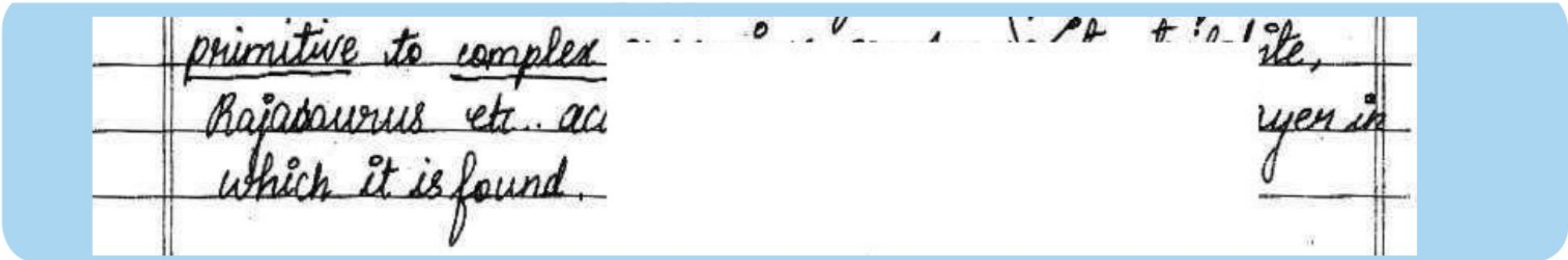
Ans.

Evolution the process of change from simple life forms to complex life forms by gradual change. It is generating diversity and shaping the diversity.

* It occurs over the course of time and generations by Variation, Speciation, Natural Selection, Genetic drift etc..

Fossils are the preserved traces of living organisms.

* It helps us to find the intermediate forms in between two classes etc.. For example fossil of Archeopteryx helps us



Q. 8. What is meant by speciation? List four factors that could lead to speciation. Which of these cannot be a major factor in the speciation of a self-pollinating plant species. Give reason to justify your answer.

[Board Term II, Delhi Set I 2016, Foreign II 2015]

- Ans. (i) **Speciation:** The process of formation of a new species from a pre-existing one. 1
- (ii) **Four factors that lead to speciation are:**
- (a) Genetic drift
 - (b) Mutation / Drastic change in the genes or DNA
 - (c) Natural selection
 - (d) Geographical isolation 4 × ½ = 2

- (iii) Geographical isolation cannot be a major factor in the speciation of a self-pollinating plant species. 1
- (iv) **Reason:** Physical barrier cannot be created in self-pollinating plants. 1

COMMONLY MADE ERROR

→ Students often write answers in paragraph form rather than in bullet form.

ANSWERING TIP

→ Write answers point-wise rather than in the form of an essay.

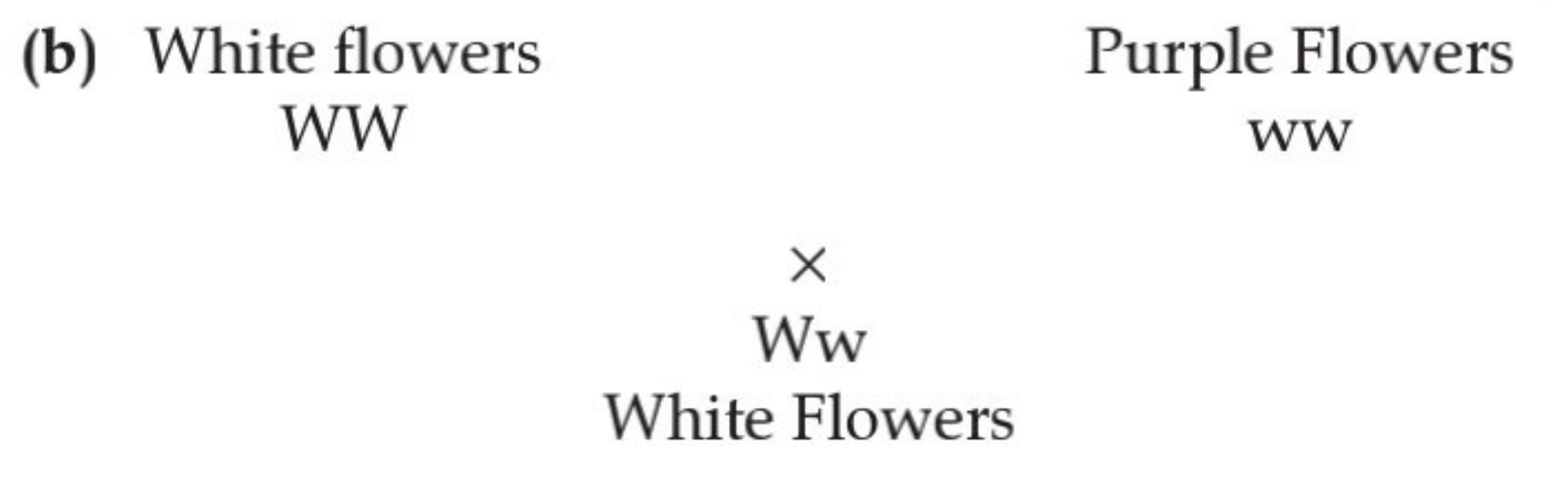
Visual Case-based Questions
4 marks each

Q. 1. Read the passage and answer any of the four questions from (a) to (e).

In a cross between plants with purple flowers and plants with white flowers, the offspring of F₁ generation all had white flowers. When the F₁ generation was self-crossed, it was observed in the F₂ generation that out of 100, 75 flowers were white. Make a cross and answer the following questions:

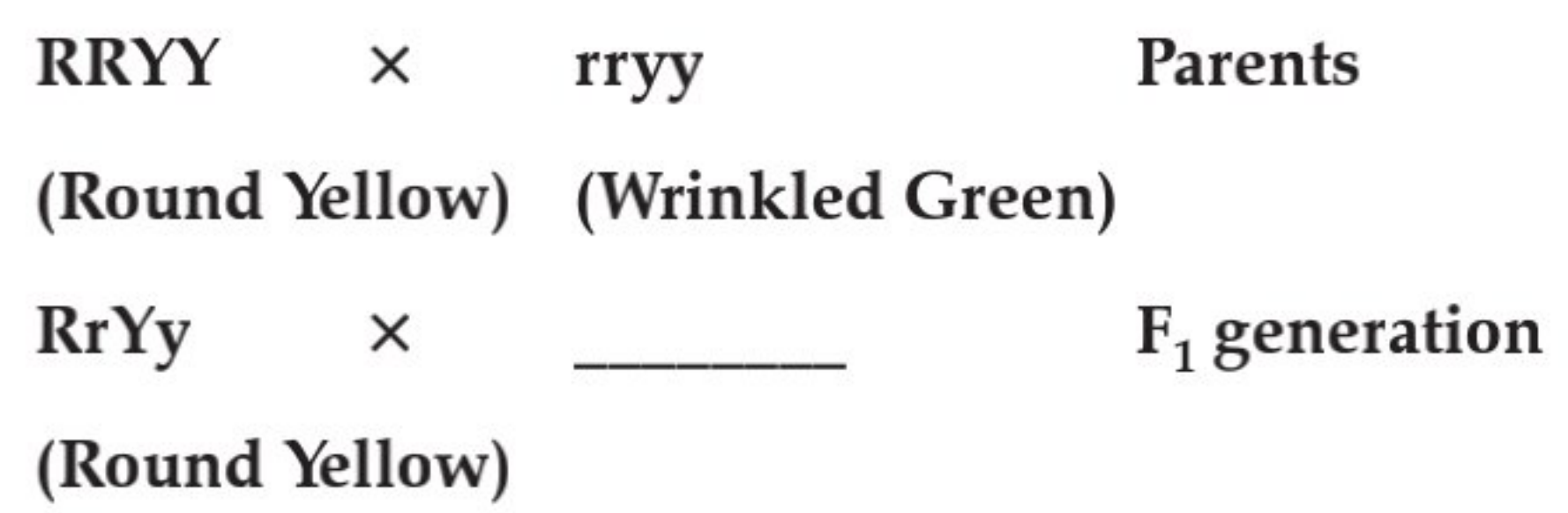
- (a) The above cross is known as:
- (i) Monohybrid cross (ii) Dihybrid cross
 - (iii) Test cross (iv) Back cross
- (b) Show the cross.
- (c) Which of these is not the genotype of F₂ progeny?
- (i) WW (ii) Ww
 - (iii) ww (iv) Wp
- (d) The ratio of 'White: Purple' flowers in the F₂ generation is
- (i) 3:1 (ii) 1:2
 - (iii) 1:3 (iv) 2:1

Ans. (a) (i) Monohybrid cross



- (c) (iv) Genotypes of F₂ progeny are WW, Ww, ww
- (d) Ratio between White: Purple flowers are 3: 1
- (e) (iii) Following combinations of genotype emerge in F₂ generation: TT (1), tt (1) and Tt (2).
- This shows that ratio of pure tall (TT) to pure short (tt) is 1: 1. (Any four) 1+1+1+1

Q. 2. Study the given cross showing self pollination in F₁ and answer any of the four questions from (a) to (e).



- (a) The missing black in the above cross is:
- (i) RrYy (ii) RRYy
 - (iii) RryY (iv) rryy

- (a) The animal C is
- Trilobite
 - Archaeopteryx*
 - Peripatus*
 - Lamprey
- (b) A belongs to _____ and B belongs to _____ group respectively.
- Birds, Reptile
 - Fish, Amphibian
 - Birds, Mammals
 - Fish, Reptile
- (c) _____ name is given to the forelimbs like those of A and B, which have the same basic design but different functions?
- Analogous organs
 - Homologous organs
 - Vestigial organs
 - None of these
- (d) Which is the correct evolutionary chain involving A, B and C.
- $C \rightarrow A \rightarrow B$
 - $B \rightarrow C \rightarrow A$
- (e) Select the correct statement.
- Tendrils of a pea plant and phylloclade of *Opuntia* are homologous
 - Tendrils of a pea plant and phylloclade of *Opuntia* are analogous
 - Wings of birds and limbs of lizards are analogous
 - Wings of bird and wings of bat are homologous

Ans. (a) (ii) Animal C is *Archaeopteryx*.

- (b) (i) A belongs to birds group while B belongs to reptile group.
- (c) (ii) Homologous organs.
- (d) (ii) $B \rightarrow C \rightarrow A$
- (e) (iv) Wings of birds and wings of bat are homologous. Since they have same basic design however their origin is different. (Any four) 1+1+1+1

Q. 5. Read the passage and answer any of the four questions from (a) to (e).

Fossils are formed layer by layer in a sequence. It is a slow process that is totally dependent on where the organism dies. In the ocean, fossils are

settled at the bottom in the soil or sand. In the course of time, these layers changed into rocks due to the presence of the water above and also due to chemical reactions. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks.

- (a) If the fossil of an organism is found in the deeper layers of earth, then we can predict that
- the extinction of organism has occurred recently
 - the extinction of organism has occurred thousands of years ago
 - the fossil position in the layers of earth is not related to its time of extinction
 - time of extinction cannot be determined
- (b) Which of these statements is correct about the importance of fossils in the study of organic evolution?
- It provides missing link between the species.
 - They tell us about the prehistoric organisms.
 - It help in establishing the time period in which organisms lived.
 - All of these
- (c) Which of these organisms is fossilized?
- Trilobite
 - Crab
 - Lamprey
 - Shark
- (d) Some dinosaurs had feathers although they could not fly but birds have feathers that help them to fly. In the context of evolution this means that
- reptiles have evolved from birds
 - there is no evolutionary connection between reptiles and birds
 - feathers are homologous structures in both the organisms
 - birds have evolved from reptiles
- (e) Which of the following constitutes a fossil?
- A mineralized burrow of an extinct animal
 - An unidentified animal found frozen in a glacier

- (iii) An ant found inside a block of amber, dating back to 110 million years
- (iv) All of the above

Ans. (a) (ii) Fossils refer to the petrified remains of organisms that lived in the past and get preserved in rocks. The fossil position in the layer of earth relates to the time of extinction of organisms, If the fossil of an organism is found in the deeper layers of earth, then it is predicted that extinction of organism has occurred thousands of years ago. Whereas the fossils found closer to the surface are more recent

(b) (iv) Role of Fossil: Provides missing link between the species/who has evolved from whom. They tell us about prehistoric organisms. Also, it help in establishing the time period in which organisms lived. **(Any one)**

(c) (i) Trilobite

(d) (iv) In the context of evolution, the use of feathers by birds for flying means that birds have evolved from reptiles. Dinosaurs had feathers but could not fly using them. Birds, later adapted the feathers for flight. Since, dinosaurs were reptiles, this means that birds have evolved from them.

(e) (iv) All the given options constitute a fossil.

(Any four) 1+1+1+1

Q. 6. Read the below passage and answer the following questions.

Meena studied forelimbs of three organisms and she found that organism X had long and short bones, covered with muscles, which are used for running. The organism Y had long and short bones, covered with feathers used for flying. The organism Z has a layer of a complex chemical with supporting framework which is not made of bones and which is used for flying.

(a) To which class does the organism X, Y and Z belongs to?

(b) The name given to the forelimbs of organisms X and Y?

- (i) Homologous organs
- (ii) Analogous organs
- (iii) Vestigial organs
- (iv) Fossils

(c) The name is given to the forelimbs of organisms Y and Z is:

- (i) Homologous organs
- (ii) Analogous organs
- (iii) Vestigial organs
- (iv) Fossils

(d) Differentiate between the above two types of organs.

(e) Analogous structures are

- (i) Structurally similar
- (ii) Functionally similar
- (iii) Structurally and functionally similar
- (iv) Normally non-functional

Ans. (a) Organisms X and Y are vertebrates. X is a mammal whereas Y is a bird. Z is an insect (invertebrate).

(b) (i) Forelimbs of vertebrates are homologous organs, i.e., organs having same fundamental structure but perform different functions.

(c) (ii) Wings of insects and wings of birds are analogous organs, i.e., organs having similar functions but different in their structural details and origin.

(d)

S. No.	Homologous Organs	Analogous Organs
(i)	They have same basic structural design.	They have different basic structural design.
(ii)	They perform different functions.	They perform similar functions.
(iii)	Their appearances are different.	They have similar appearances.

(e) (ii) Functionally similar

(Any four) 1+1+1+1

Know the Terms

- **F₁ generations:** The generations resulting immediately from a cross of the first set of parents (parental generation).
- **F₂ generations:** Offsprings resulting from a cross of the members of F₁ generation.
- **Dominant:** The gene which expresses itself if F₁ hybrid generation is known as **dominant gene**.

- **Recessive:** The gene which is unable to express itself in presence of the dominant gene.
- **Genotype:** It is the genetic constitution of an organism which determines the phenotypic characters.
- **Phenotype:** It is the outward appearance of an individual.
- **Progeny:** The offspring produced as a result of reproduction of the parents.
- **Dominant trait:** A genetic trait is considered dominant if it is expressed in a person who has only one copy of that gene *i.e.* a trait which phenotypically expressed in heterozygote.
- **Recessive trait:** A genetic trait is considered recessive if it is expressed only when two copies of the recessive gene are present.
- **Homozygous:** Having two identical alleles of the same gene.
- **Heterozygous:** Having dissimilar alleles at corresponding chromosomal loci.
- **Monohybrid cross:** A type of cross in which only one pair of contrasting characters are considered.
- **Dihybrid cross:** A type of cross in which the inheritance of two pairs of contrasted characters is considered.
- **Allele:** Either of a pair (or series) of alternative forms of a gene that can occupy the same locus on a particular homologous pair of chromosome and that control the same character.
- **Somatic cells:** All cells forming the body of an organism, except the reproductive cells.
- **Sex chromosomes:** Either of a pair of chromosomes, usually designated X or Y, in the germ cells of most animals, that combine to determine the sex and sex-linked characteristics of an individual.
- **Gene:** A segment of DNA that is involved in producing a polypeptide chain and forms the basic unit of heredity.
- **Trait:** A trait is a distinct variant of a phenotypic character of an organism that may be inherited or environmentally determined.
- **Haploid cell:** Cell that has only one complete set of chromosomes.
- **Diploid cell:** Cell that has two sets of chromosomes, one of paternal origin, the other of maternal origin.
- **Micro-evolution:** Evolution resulting from small specific genetic changes that can lead to a new sub-species.
- **Genetic drift:** It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations.
- **Speciation:** The process of formation of a new species.
- **Fossils:** Any naturally preserved remains of ancient life or traces of any organism that lived in geological age.
- **Molecular phylogeny:** The use of a gene's molecular characteristics to trace the evolutionary history of organisms.

SELF ASSESSMENT TEST - 2

Maximum Time: 1 hour

MM: 25

Q. 1. Choose the correct alternative from the given options.

- (i) If salivary amylase is lacking in the saliva, which of the following events in the mouth cavity will be affected?
(a) Proteins breaking down into amino acids
(b) Starch breaking down into sugars
(c) Fats breaking down into fatty acids and glycerol
(d) Absorption of vitamins 1
- (ii) What prevents back flow of blood inside the heart during contraction?
(a) Valves in heart (b) Thick muscular walls of ventricles
(c) Thin walls of atria (d) All of the above 1
- (iii) Factors responsible for the rapid spread of bread mould on slices of bread are
(i) large number of spores.
(ii) availability of moisture and nutrients in bread.
(iii) presence of tubular branched hyphae.
(iv) formation of round shaped sporangia.
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i) and (ii) (d) (iii) and (iv) 1
- (iv) If a round, green seeded pea plant (RRyy) is crossed with wrinkled, yellow seeded pea plant, (rrYY) the seeds produced in F_1 generation are
(a) round and yellow. (b) round and green.
(c) wrinkled and green. (d) wrinkled and yellow. 1

Q. 2. Assertion and Reason

Directions : In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

Mark the correct choice as :

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

(i) Assertion (A) : Valves are present in the arteries.

Reason (R) : Arteries carry oxygenated blood from heart to different body parts except pulmonary artery.

(ii) Assertion (A) : Speciation is the process of formation of a new species from a pre-existing one.

Reason (R) : Mutation plays a role in speciation. 1

Q. 3. Name the two components of peripheral nervous system.

Q. 4. Name the hormones in humans which regulate carbohydrate, protein and fat metabolism in the body. Mention the site where it is synthesized. 1

Q. 5. Give one example of following plants:

- (a) Which is (i) positively phototropic and (ii) negatively geotropic.
(b) Which is positively hydrotropic as well as positively geotropic ?
(c) Which synthesises auxin ? 3

- Q. 6.** Bile juice does not have any digestive enzyme but still plays a significant role in the process of digestion. Justify the statement. **3**
- Q. 7.** (a) Mention the role of the following organs of human male reproductive system:
(i) Testis; (ii) Scrotum; (iii) Vas deferens; (iv) Prostate glands. (b) What are the two roles of testosterone ? **3**
- Q. 8.** Explain with an example for each, how the following provides evidences in favour of evolution in organisms:
(i) Homologous organs
(ii) Analogous organs
(iii) Fossils. **3**
- Q. 9.** Give one example each of unisexual and bisexual flowers. Differentiate between the two types of pollination that occur in flowers. What happens when a pollen lands on a suitable stigma ? Write about the events that occur till the seed formation in the ovary. **5**