UNIQUE STUDY POINT

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Class: X	**Subject:** Science	**Session:** 2025-26
Chapter: 08 - Heredity	**Time:** 1½ Hours	**Max. Marks:** 40

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

SECTION A - Multiple Choice Questions (1 mark each)

1. The alternate forms of a gene are called:
(a) Chromosomes
(b) Alleles
(c) Genes
(d) Locus

2. A zygote which has an X chromosome inherited from the father will develop into a:
(a) Boy
(b) Girl
(c) Either boy or girl
(d) Cannot be determined

3. Which of the following is NOT a Mendelian trait in pea plants?
(a) Plant height
(b) Seed shape
(c) Number of seeds in a pod
(d) Flower color

4. In a heterozygous organism, the allele which is not expressed is known as:
(a) Dominant allele
(b) Recessive allele
(c) Codominant allele
(d) Supplementary allele

5. The genotypic ratio of a monohybrid cross in F2 generation is:
(a) 3:1
(b) 1:2:1

(c) 9:3:3:1
(d) 1:1

6. Which of the following statements is correct regarding DNA copying?
(a) DNA copying is always perfect
(b) DNA copying can have errors leading to variations
(c) DNA copying occurs only in gametes
(d) DNA copying is not important for reproduction

7. The inheritance pattern where both alleles express themselves equally is called:
(a) Complete dominance
(b) Incomplete dominance
(c) Codominance
(d) Over dominance

8. Mendel's work remained unrecognized for:
(a) 10 years
(b) 20 years
(c) 34 years
(d) 50 years

9. The process by which new species develop from existing species is called:
(a) Variation
(b) Heredity
(c) Evolution
(d) Reproduction

10. During reproduction, the chromosome number in gametes is:
(a) Same as parent cell
(b) Double of parent cell
(c) Half of parent cell
(d) Random

SECTION B - Short Answer Questions (2 marks each)

11. What is meant by the term 'allele'? How many alleles does a diploid organism have for a trait?

12. List two reasons why sexual reproduction is considered more beneficial than asexual reproduction.

13. What happens when a pure tall plant is crossed with a pure dwarf plant in F1 and F2 generations?

14. Can a trait that is not visible in an organism still be passed on to its offspring? Explain with an example.

SECTION C - Short Answer Questions (3 marks each)

15. Explain how the sex of a newborn child is determined in humans. Draw a schematic diagram to illustrate your answer.

16. What are the different ways in which individuals with a particular trait may increase in a population? Explain.

17. A violet flowered pea plant (VV) is crossed with a white flowered pea plant (vv). What is the

phenotype and genotype of F1 and F2 generations?

SECTION D - Long Answer Question (5 marks)

18. What is heredity? Explain Mendel's experiments that led to the formulation of the Law of Dominance and Law of Segregation. How do these laws explain the pattern of inheritance?

SECTION E - Case Study Based Questions (4 marks each)

19. Case Study 1:

A farmer wants to develop a variety of pea plant that produces round yellow seeds. He has plants with round green seeds (RRyy), wrinkled yellow seeds (rrYY), round yellow seeds (RrYy), and wrinkled green seeds (rryy). The traits for round seeds (R) and yellow color (Y) are dominant over wrinkled seeds (r) and green color (y) respectively. The farmer knows that to get pure breeding round yellow plants, he needs plants with RRYY genotype.

Based on the above information, answer the following questions:

(a) Which plants should the farmer cross to get the maximum number of round yellow seeds in F1 generation? (1 mark)

(b) If he crosses RRyy with rrYY plants, what will be the genotype and phenotype of F1 generation? (2 marks)

(c) Can he get pure breeding RRYY plants in F1 generation? Why or why not? (1 mark)

20. Case Study 2:

In humans, free earlobes (F) are dominant over attached earlobes (f). A man with free earlobes marries a woman with attached earlobes. They have eight children, six with free earlobes and two with attached earlobes. The man's father had attached earlobes while his mother had free earlobes. The woman's parents both had attached earlobes.

Based on the above information, answer the following questions:

(a) What is the genotype of the man and the woman? (1 mark)

(b) What is the expected ratio of children with free earlobes to attached earlobes? (1 mark)

(c) What can you conclude about the genotype of the man's mother? (2 marks)

DETAILED ANSWER KEY - PAPER 04

SECTION A - Answers to MCQs

1. (b) Alleles

Alleles are alternate forms of a gene. For example, T and t are alleles for height in pea plants.

2. (b) Girl

X from mother + X from father = XX (girl). If the father contributes Y chromosome, the child would be a boy (XY).

3. (c) Number of seeds in a pod

Number of seeds in a pod is a continuous variable and was not one of the seven traits studied by Mendel.

4. (b) Recessive allele

In a heterozygous organism (Tt), the recessive allele (t) is present but not expressed in the phenotype.

5. (b) 1:2:1

Genotypic ratio in F2 generation of a monohybrid cross is 1 TT : 2 Tt : 1 tt (1:2:1).

6. (b) DNA copying can have errors leading to variations

DNA copying is generally accurate but small errors can occur, leading to variations which are important for evolution.

7. (c) Codominance

In codominance, both alleles express themselves equally. Example: AB blood group where both A and B antigens are present.

8. (c) 34 years

Mendel's work was published in 1866 but remained unrecognized until 1900 (34 years).

9. (c) Evolution

Evolution is the process by which new species develop from existing species over long periods of time.

10. (c) Half of parent cell

Gametes are produced by meiosis which reduces the chromosome number to half (haploid).

SECTION B - Answers to Short Answer Questions

11.

Allele: An allele is one of two or more alternative forms of a gene that arise by mutation and are found at the same position (locus) on a chromosome. Different alleles produce variations in inherited characteristics.

Number of alleles in diploid organism: A diploid organism has TWO alleles for each trait - one

inherited from each parent. These may be identical (homozygous) or different (heterozygous).

12.

Two reasons why sexual reproduction is more beneficial:

1. **Greater genetic variation:** Sexual reproduction involves fusion of gametes from two parents, creating offspring with new combinations of genes. This produces much greater variation than asexual reproduction.

2. **Better adaptation and survival:** The variations produced through sexual reproduction increase the chances that some individuals will survive environmental changes. This genetic diversity helps species adapt to changing conditions and evolve over time.

13.

Cross: Pure tall (TT) × Pure dwarf (tt)

F1 Generation:
• Genotype: All Tt (heterozygous)
• Phenotype: All tall (100%)

F2 Generation (F1 self-cross: Tt × Tt):
• Genotype: 1 TT : 2 Tt : 1 tt
• Phenotype: 3 Tall : 1 Dwarf (75% tall, 25% dwarf)

The dwarf trait which was not visible in F1 reappears in F2 generation.

14.

Yes, a trait that is not visible in an organism can still be passed on to its offspring.

Explanation: This happens when an organism is heterozygous for a trait. The recessive allele is present in the genotype but is masked by the dominant allele, so it is not visible in the phenotype. However, this recessive allele can be passed to offspring.

Example: A tall pea plant with genotype Tt carries both tall (T) and dwarf (t) alleles. Only tallness is visible (phenotype), but the plant can pass the dwarf allele (t) to its offspring. When this offspring receives another t allele from the other parent, it will be dwarf (tt).

SECTION C - Answers to Short Answer Questions

15.

Sex Determination in Humans:

Sex in human beings is determined genetically by sex chromosomes.

Process:
• Humans have 23 pairs of chromosomes
• 22 pairs are autosomes (body chromosomes)
• 1 pair is sex chromosomes (X and Y)
• Females: XX (homogametic)
• Males: XY (heterogametic)

Mechanism:

• All eggs produced by mother contain X chromosome
• Sperms from father can carry either X or Y chromosome
• 50% sperms carry X, 50% carry Y

Schematic Diagram:
Parents: Mother (XX) × Father (XY)
↓
Gametes: Eggs (X, X) × Sperms (X, Y)
↓
Fertilization:
X (egg) + X (sperm) = XX (Girl) - 50%
X (egg) + Y (sperm) = XY (Boy) - 50%

Therefore, there is a 50% chance of having a boy or girl. The sex of the child depends on which type of sperm fertilizes the egg.

16.

Different ways individuals with a particular trait may increase in a population:

1. Natural Selection:
• If a trait provides survival advantage in a particular environment, individuals with that trait survive better and reproduce more
• Over time, this trait becomes more common in the population
• Example: Bacteria that are resistant to antibiotics survive treatment and multiply

2. Genetic Drift:
• Random changes in gene frequency in small populations
• Some traits may become more common by chance, not because they provide advantage
• Especially important in small or isolated populations

3. Artificial Selection:
• Humans deliberately breed organisms with desired traits
• Example: Breeding dogs for specific characteristics, crop plants for higher yield
• The selected trait increases rapidly in the population

17.

Cross: VV (Violet) × vv (White)

F1 Generation:
Gametes from VV: All V
Gametes from vv: All v
Offspring: All Vv

Genotype of F1: All Vv (heterozygous)
Phenotype of F1: All Violet flowers (100%)

F2 Generation (F1 self-cross: Vv × Vv):
Gametes: V and v from each parent

Punnett Square:
V v
V VV Vv
v Vv vv

Genotype of F2: 1 VV : 2 Vv : 1 vv (ratio 1:2:1)
Phenotype of F2: 3 Violet : 1 White (ratio 3:1)
• Violet flowers: 75% (VV and Vv)
• White flowers: 25% (vv)

SECTION D - Answer to Long Answer Question

18.

Heredity: Heredity is the transmission of genetic characteristics from parents to offspring through genes. It is the reason why offspring resemble their parents in their characteristics.

Mendel's Experiments:

Mendel conducted experiments on pea plants using contrasting traits. He selected pure-breeding plants and performed controlled crosses.

1. Law of Dominance:

Experiment:
• Mendel crossed pure tall plants (TT) with pure dwarf plants (tt)
• F1 generation: All plants were tall
• No intermediate height plants were observed

Observation:
Only one trait (tallness) was expressed in F1 generation, even though both parents contributed genes.

Law of Dominance states:
• When two contrasting traits are brought together in a hybrid, only one trait expresses itself (dominant trait)
• The other trait (recessive) remains hidden
• In a heterozygous condition (Tt), dominant trait (T) masks the recessive trait (t)

2. Law of Segregation:

Experiment:
• Mendel allowed F1 tall plants (Tt) to self-pollinate
• F2 generation showed both tall and dwarf plants in 3:1 ratio
• The dwarf trait reappeared in F2

Observation:
The hidden recessive trait reappeared in F2 generation, indicating that both alleles were present in F1 but separated during gamete formation.

Law of Segregation states:
• Each individual has two alleles for each trait (one from each parent)
• During gamete formation, these allele pairs segregate (separate) so that each gamete receives only one allele
• During fertilization, alleles from both parents randomly combine to form offspring

Explanation of Inheritance Pattern:

F1 Cross: Tt × Tt
Gametes formed: Each parent produces 50% T gametes and 50% t gametes (segregation)

F2 combinations:
• T + T = TT (Tall) - 25%
• T + t = Tt (Tall) - 50%
• t + t = tt (Dwarf) - 25%

Genotypic ratio: 1:2:1 (TT:Tt:tt)
Phenotypic ratio: 3:1 (Tall:Dwarf) - because both TT and Tt appear tall (dominance)

These laws explain how traits are inherited in a predictable pattern and why offspring show both similarities and variations from parents.

SECTION E - Answers to Case Study Based Questions

19.

(a) Plants to cross for maximum round yellow seeds in F1:
The farmer should cross RRyy (round green) with rrYY (wrinkled yellow).

This cross will produce:
RRyy × rrYY → All F1: RrYy (100% round yellow seeds)

(b) Cross: RRyy × rrYY

Gametes:
RRyy produces: Ry only
rrYY produces: rY only

F1 offspring: All RrYy

Genotype of F1: All RrYy (100%)
Phenotype of F1: All Round Yellow seeds (100%)

(c) Can he get RRYY in F1?
No, he cannot get pure breeding RRYY plants in F1 generation from this cross.

Reason: To get RRYY genotype, both parents must contribute R and Y alleles. But RRyy parent can only contribute y (not Y), and rrYY parent can only contribute r (not R). Therefore, all F1 offspring will be RrYy (heterozygous for both traits), not RRYY (homozygous dominant for both traits).

To get RRYY plants, he would need to self-cross the F1 (RrYy × RrYy) and select the RRYY plants from F2 generation.

20.

(a) Genotypes:

Man's genotype: Ff (heterozygous)
Reason: He has free earlobes (shows dominant trait) but his father had attached earlobes (ff). So the man must have inherited 'f' from his father and 'F' from his mother.

Woman's genotype: ff (homozygous recessive)
Reason: She has attached earlobes (recessive trait), and both her parents had attached earlobes (ff).

So she must have inherited 'f' from both parents.

(b) Expected ratio:
Cross: Ff × ff

Gametes:
Man (Ff): 50% F, 50% f
Woman (ff): 100% f

Offspring:
• F + f = Ff (free earlobes) - 50%
• f + f = ff (attached earlobes) - 50%

Expected ratio: 1:1 (Free earlobes : Attached earlobes)

(c) Man's mother's genotype:
The man's mother had free earlobes and her son (the man) has genotype Ff.

Since the man inherited 'f' from his father (who had attached earlobes, genotype ff), he must have inherited 'F' from his mother.

The man's mother could be either:
• **FF (homozygous dominant)** - if she always showed free earlobes
• **Ff (heterozygous)** - if she showed free earlobes but carried recessive allele

Conclusion: Man's mother is either FF or Ff. We cannot determine her exact genotype from the given information alone, but we know for certain she has at least one F allele since the man inherited F from her.
