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. Mendel's experiments were conducted on which plant?
(a) Wheat
(b) Garden pea
(c) Rice
(d) Maize

2. In a monohybrid cross, the F2 generation shows a phenotypic ratio of:
(a) 1:2:1
(b) 3:1
(c) 9:3:3:1
(d) 2:1

3. The trait that expresses itself in the F1 generation is called:
(a) Recessive trait
(b) Dominant trait
(c) Neutral trait
(d) Intermediate trait

4. The genotype of a tall plant showing dominant character is:
(a) TT only
(b) Tt only
(c) Both TT and Tt
(d) tt only

5. The chromosomal composition of a normal human male is:
(a) 44 + XX
(b) 44 + XY

(c) 22 + X
(d) 22 + Y

6. The sex of a child is determined by:
(a) The mother's chromosome only
(b) The father's chromosome only
(c) Both parents equally
(d) Environmental factors

7. A cross between F1 progeny and the homozygous recessive parent is called:
(a) Monohybrid cross
(b) Test cross
(c) Back cross
(d) Dihybrid cross

8. The number of pairs of contrasting characters studied by Mendel in pea plants was:
(a) 5
(b) 6
(c) 7
(d) 8

9. In pea plants, the gene for tallness (T) is dominant over the gene for dwarfness (t). A homozygous tall plant is crossed with a dwarf plant. The genotype of F1 offspring will be:
(a) TT
(b) Tt
(c) tt
(d) TT and Tt

10. The basic unit of heredity is:
(a) Cell
(b) Chromosome
(c) Gene
(d) DNA

SECTION B - Short Answer Questions (2 marks each)

11. What is the difference between dominant and recessive traits? Give one example of each in pea plants.

12. Why did Mendel choose pea plants for his experiments? Give any two reasons.

13. A cross is made between pure tall pea plants (TT) and pure dwarf pea plants (tt). What would be the phenotype and genotype of the F1 generation?

14. Differentiate between genotype and phenotype with examples.

SECTION C - Short Answer Questions (3 marks each)

15. Explain how sex is determined in human beings with the help of a diagram.

16. What is a monohybrid cross? Explain with an example showing the phenotypic ratio in F2 generation.

17. State Mendel's Law of Segregation. How does this law explain the inheritance of traits?

SECTION D - Long Answer Question (5 marks)

18. Describe Mendel's experiment on inheritance of two traits (dihybrid cross) in pea plants. Draw a Punnett square to show the inheritance pattern and explain the phenotypic ratio obtained in F2 generation.

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

19. Case Study 1:

Gregor Mendel conducted experiments on garden peas for seven years (1856-1863) and proposed the laws of inheritance in living organisms. Mendel selected 14 true-breeding pea plant varieties, which were similar except in one character with contrasting traits. He used a number of contrasting visible characters of garden peas – round/wrinkled seeds, tall/short plants, white/violet flowers and so on.

Based on the above information, answer the following questions:

(a) What is meant by true-breeding plants? (1 mark)

(b) Why did Mendel select pea plants for his experiments? Give two reasons. (1 mark)

(c) If a heterozygous tall plant (Tt) is crossed with a homozygous dwarf plant (tt), what will be the ratio of tall to dwarf plants in the offspring? (2 marks)

20. Case Study 2:

Sex determination in human beings is a genetic process. Human beings have 23 pairs of chromosomes out of which 22 pairs are autosomes and one pair is sex chromosome. Females have two X chromosomes (XX) while males have one X and one Y chromosome (XY). During gamete formation, each gamete receives one chromosome from each pair. All eggs formed will have X chromosome, but sperms can have either X or Y chromosome.

Based on the above information, answer the following questions:

(a) What are autosomes? (1 mark)

(b) What percentage of human sperms carry X chromosome? (1 mark)

(c) If a couple has four daughters, what is the possibility of their fifth child being a son? Justify your answer. (2 marks)

DETAILED ANSWER KEY - PAPER 01

SECTION A - Answers to MCQs

1. (b) Garden pea

Mendel conducted his experiments on garden pea plants (Pisum sativum).

2. (b) 3:1

In a monohybrid cross, the F2 generation shows a phenotypic ratio of 3:1 (3 dominant : 1 recessive).

3. (b) Dominant trait

The trait that expresses itself in the F1 generation is called the dominant trait.

4. (c) Both TT and Tt

A tall plant can have either TT (homozygous) or Tt (heterozygous) genotype.

5. (b) 44 + XY

A normal human male has 44 autosomes and XY sex chromosomes.

6. (b) The father's chromosome only

The sex of a child is determined by the type of chromosome (X or Y) contributed by the father.

7. (b) Test cross

A test cross is performed to determine whether an individual is homozygous or heterozygous for a dominant trait.

8. (c) 7

Mendel studied 7 pairs of contrasting characters in pea plants.

9. (b) Tt

TT × tt = All Tt (heterozygous tall) offspring.

10. (c) Gene

A gene is the basic unit of heredity that controls the expression of a trait.

SECTION B - Answers to Short Answer Questions

11.

Dominant trait: The trait that expresses itself in the presence of a contrasting trait. It masks the effect of the recessive trait.
Example: Tallness (T) in pea plants.

Recessive trait: The trait that remains suppressed in the presence of a dominant trait and expresses only in homozygous condition.
Example: Dwarfness (t) in pea plants.

12.

Mendel chose pea plants because:

1. **Easy to grow:** Pea plants have a short life span and are easy to grow in large numbers.
2. **Distinct contrasting traits:** Pea plants have several easily observable contrasting traits (tall/dwarf, round/wrinkled seeds, etc.).
3. **Self-pollinating:** Pea plants are naturally self-pollinating but can also be cross-pollinated manually.

13.

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

Genotype of F1: All Tt (heterozygous)
Phenotype of F1: All tall plants

Explanation: Since tallness (T) is dominant over dwarfness (t), all F1 offspring will be tall even though they carry one recessive gene.

14.

Genotype: The genetic makeup of an organism, represented by genes/alleles.
Example: TT, Tt, or tt for height in pea plants.

Phenotype: The physical appearance or observable characteristics of an organism.
Example: Tall or dwarf plant (TT and Tt both appear tall, while tt appears dwarf).

SECTION C - Answers to Short Answer Questions

15.

Sex determination in humans is genetically controlled by sex chromosomes.

Process:
• Females have XX sex chromosomes (homogametic)
• Males have XY sex chromosomes (heterogametic)
• All eggs contain X chromosome
• Sperms can carry either X or Y chromosome

Diagram:
Mother (XX) × Father (XY)
↓
Eggs: All X | Sperms: 50% X, 50% Y
↓
Offspring: 50% XX (girls), 50% XY (boys)

Thus, the sex of the child depends on the type of sperm that fertilizes the egg. If X-carrying sperm fertilizes the egg, the child will be a girl (XX). If Y-carrying sperm fertilizes the egg, the child will be a boy (XY).

16.

Monohybrid cross: A cross between two parents differing in only one pair of contrasting characters.

Example: Cross between tall (TT) and dwarf (tt) pea plants

P generation: TT × tt
F1 generation: All Tt (tall)

F1 self-cross: Tt × Tt

F2 generation:
Genotypic ratio: 1 TT : 2 Tt : 1 tt
Phenotypic ratio: 3 Tall : 1 Dwarf

This 3:1 ratio is the characteristic phenotypic ratio of a monohybrid cross in F2 generation.

17.

Law of Segregation: The two alleles of a gene pair segregate (separate) during gamete formation and each gamete receives only one allele.

Explanation:
1. Each organism has two alleles for each trait (one from each parent)
2. During gamete formation, these alleles separate so that each gamete carries only one allele
3. During fertilization, alleles from both parents combine randomly
4. This explains why offspring show variations and both parental traits can reappear in later generations

Example: In a Tt plant, the T and t alleles separate during gamete formation, producing 50% gametes with T and 50% with t.

SECTION D - Answer to Long Answer Question

18.

Dihybrid Cross - Mendel's Experiment:

Mendel crossed pea plants differing in two traits:
• Round, Yellow seeds (RRYY) × Wrinkled, Green seeds (rryy)
• R = Round (dominant), r = wrinkled (recessive)
• Y = Yellow (dominant), y = green (recessive)

F1 Generation:
All offspring were Round, Yellow (RrYy)

F2 Generation (F1 self-cross: RrYy × RrYy):

Punnett Square:

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Phenotypic Ratio in F2:
• Round, Yellow: 9
• Round, Green: 3
• Wrinkled, Yellow: 3
• Wrinkled, Green: 1

Ratio = 9:3:3:1

This experiment led Mendel to propose the Law of Independent Assortment, which states that the inheritance of one trait does not affect the inheritance of another trait.

SECTION E - Answers to Case Study Based Questions

19.

(a) True-breeding plants: Plants that produce offspring with the same traits when self-pollinated generation after generation. They are homozygous for the particular trait.

(b) Two reasons why Mendel selected pea plants:
1. Presence of distinct contrasting traits that are easily observable
2. Short life cycle allowing study of multiple generations in a short time

(c) Cross: Tt × tt
Gametes from Tt: T and t
Gametes from tt: t and t

Offspring:
• Tt (tall) - 50%
• tt (dwarf) - 50%

Ratio of tall : dwarf = 1:1

20.

(a) Autosomes: The chromosomes that do not determine the sex of an individual. In humans, there are 22 pairs (44) of autosomes that control body characteristics other than sex.

(b) Percentage of sperms carrying X chromosome: 50%
(Half of the sperms carry X chromosome and half carry Y chromosome)

(c) Possibility of fifth child being a son: 50% or 1:1

Justification: Each pregnancy is an independent event. The sex of previous children does not affect the sex of future children. Since the father produces 50% X-carrying sperms and 50% Y-carrying sperms, there is always a 50% chance of having a son and 50% chance of having a daughter, regardless of how many daughters they already have.
