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 sequence of nucleotides in DNA determines:
(a) The structure of carbohydrates
(b) The structure of proteins
(c) The structure of lipids
(d) The structure of minerals

2. Which of the following statements about F1 generation is INCORRECT?
(a) All F1 plants are identical to each other
(b) F1 plants show only dominant traits
(c) F1 plants are heterozygous
(d) F1 plants have both recessive alleles

3. In snapdragons, when a red-flowered plant is crossed with a white-flowered plant, pink flowers are produced. This is an example of:
(a) Complete dominance
(b) Incomplete dominance
(c) Codominance
(d) Multiple allelism

4. The chromosomes that determine an individual's sex are called:
(a) Autosomes
(b) Allosomes
(c) Homologous chromosomes
(d) Sister chromatids

5. A trait that is not expressed in F1 generation but reappears in F2 generation is:
(a) Dominant

(b) Recessive
(c) Lethal
(d) Acquired

6. In human beings, the normal gene complement consists of:
(a) 22 autosomes + XX or XY
(b) 22 pairs of autosomes + XX or XY
(c) 23 autosomes + XX or XY
(d) 23 pairs of chromosomes including sex chromosomes

7. What determines the traits in offspring?
(a) Only cytoplasm of cells
(b) Only the nucleus of cells
(c) Both nucleus and cytoplasm
(d) Neither nucleus nor cytoplasm

8. If a normal human male cell has 46 chromosomes, how many chromosomes will be present in his sperm?
(a) 46
(b) 23
(c) 92
(d) 22

9. Evolution is mainly based on:
(a) Acquired characters
(b) Inherited variations
(c) Environmental changes
(d) All of these

10. When both parents contribute equal genetic material to offspring, it is called:
(a) Maternal inheritance
(b) Paternal inheritance
(c) Biparental inheritance
(d) Cytoplasmic inheritance

SECTION B - Short Answer Questions (2 marks each)

11. Define homozygous and heterozygous conditions with suitable examples.

12. How many chromosomes are present in human somatic cells and gametes? Why is there a difference?

13. What is incomplete dominance? Give one example from plants.

14. Why are variations important in species that reproduce sexually?

SECTION C - Short Answer Questions (3 marks each)

15. Explain why traits acquired during the lifetime of an individual are not inherited. Give suitable examples.

16. Two pea plants, one with round yellow seeds (RrYy) and another with round yellow seeds (RrYy), are crossed. Calculate the ratio of plants with wrinkled green seeds in the F1 generation.

17. What are chromosomes? Explain their role in heredity.

SECTION D - Long Answer Question (5 marks)

18. Describe the contribution of Gregor Mendel to the field of genetics. What were the seven contrasting traits he studied in pea plants? Why is he called the "Father of Genetics"?

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

19. Case Study 1:

In some animals like reptiles, the temperature at which fertilized eggs are kept determines whether the animals developing in the eggs will be male or female. In other animals such as snails, individuals can change sex. However, in human beings, the sex of the individual is largely genetically determined. In humans, most chromosomes have a maternal and a paternal copy. But one pair, called the sex chromosomes, is odd in not always being a perfect pair. Women have a perfect pair of sex chromosomes (XX), while men have a mismatched pair (XY).

Based on the above information, answer the following questions:

(a) Name two organisms where sex is not genetically determined. (1 mark)

(b) What is the probability that a human couple will have a baby girl? Show with a genetic cross. (2 marks)

(c) Can a mother be responsible for the sex of her child? Justify your answer. (1 mark)

20. Case Study 2:

Mendel used a number of contrasting visible characters of garden peas such as round/wrinkled seeds, tall/short plants, white/violet flowers, and so on. He took pea plants with different characteristics and produced progeny from them, and calculated the percentages of tall or short progeny. In his experiments on monohybrid cross, he found that the F1 generation showed only one of the parental traits (dominant), but in F2 generation, both traits appeared in the ratio 3:1. The recessive trait which seemed to have disappeared in F1 generation, reappeared in F2 generation.

Based on the above information, answer the following questions:

(a) What is a monohybrid cross? (1 mark)

(b) What conclusion can be drawn when a trait disappears in F1 but reappears in F2 generation? (2 marks)

(c) Why does the F1 generation show only the dominant trait? (1 mark)

DETAILED ANSWER KEY - PAPER 03

SECTION A - Answers to MCQs

1. (b) The structure of proteins

The sequence of nucleotides in DNA codes for the sequence of amino acids in proteins.

2. (d) F1 plants have both recessive alleles

F1 plants from a cross between pure dominant and pure recessive parents are heterozygous (having one dominant and one recessive allele), not both recessive alleles.

3. (b) Incomplete dominance

In incomplete dominance, neither allele is completely dominant, resulting in an intermediate phenotype (pink flowers).

4. (b) Allosomes

Sex chromosomes are also called allosomes. In humans, these are X and Y chromosomes.

5. (b) Recessive

A recessive trait is not expressed in the F1 generation but can reappear in F2 generation in homozygous recessive condition.

6. (d) 23 pairs of chromosomes including sex chromosomes

Humans have 23 pairs of chromosomes (22 pairs of autosomes + 1 pair of sex chromosomes).

7. (c) Both nucleus and cytoplasm

Traits are mainly determined by nuclear DNA, but some traits are also influenced by cytoplasmic organelles like mitochondria.

8. (b) 23

Gametes (sperm/egg) contain half the number of chromosomes as somatic cells due to meiosis (46÷2 = 23).

9. (b) Inherited variations

Evolution is based on inherited variations that can be passed to the next generation, not acquired characters.

10. (c) Biparental inheritance

In sexual reproduction, offspring receive equal genetic contribution from both parents (biparental inheritance).

SECTION B - Answers to Short Answer Questions

11.

Homozygous: When both alleles for a trait are identical (same).
Examples: TT (homozygous tall), tt (homozygous dwarf)
Produces only one type of gametes.

Heterozygous: When two different alleles for a trait are present.
Example: Tt (heterozygous tall)
Produces two types of gametes (T and t).

12.

Human somatic cells: 46 chromosomes (23 pairs)
Human gametes: 23 chromosomes (haploid)

Reason for difference:
During gamete formation (meiosis), the chromosome number is reduced to half. This is necessary so that when two gametes fuse during fertilization, the offspring receives the normal diploid number (23 + 23 = 46). This maintains a constant chromosome number across generations.

13.

Incomplete dominance: A type of inheritance where neither allele is completely dominant over the other. The heterozygous individual shows a phenotype intermediate between the two homozygous parents.

Example: In snapdragons (Antirrhinum):
• Red flowered plant (RR) × White flowered plant (rr)
• F1 generation: All pink flowered plants (Rr)
• Pink is intermediate between red and white

14.

Variations are important in sexually reproducing species because:
1. **Adaptation:** Variations help organisms adapt to changing environmental conditions
2. **Survival advantage:** Some variations provide survival advantages in specific environments
3. **Evolution:** Variations provide raw material for natural selection and evolution
4. **Species diversity:** Variations prevent extinction by creating genetic diversity in the population

SECTION C - Answers to Short Answer Questions

15.

Acquired traits are not inherited because:

1. **Not in DNA:** Acquired traits develop due to use, disuse, or environmental factors and are not encoded in the DNA of germ cells.

2. **Somatic changes only:** These changes occur in somatic (body) cells, not in germ cells (sex cells).

3. **Not transferred to offspring:** Only genetic information present in germ cells is passed to the next generation. Changes in body cells cannot alter the genetic information in germ cells.

Examples:
• A person who develops strong muscles through exercise will not have children born with strong muscles
• If a person loses a finger in an accident, their children will still be born with all fingers
• A person who learns to play piano will not have children born with piano-playing skills

16.

Cross: RrYy × RrYy

Gametes from each parent: RY, Ry, rY, ry

Using Punnett square for dihybrid cross:
Total offspring combinations = 16

Wrinkled green seeds = rryy

From the 16 combinations:
• Round Yellow (R_Y_) = 9
• Round Green (R_yy) = 3
• Wrinkled Yellow (rrY_) = 3
• Wrinkled Green (rryy) = 1

Ratio of wrinkled green seeds = 1/16
In ratio form = 1 out of 16 plants
Percentage = 6.25%

17.

Chromosomes: Thread-like structures present in the nucleus of cells, composed of DNA and proteins. They carry genetic information in the form of genes.

Role in heredity:
1. **Carriers of genes:** Chromosomes carry genes which determine hereditary characteristics

2. **Equal contribution:** Offspring receive equal number of chromosomes from both parents (half from mother, half from father)

3. **Maintain genetic information:** During cell division, chromosomes ensure accurate transmission of genetic information to daughter cells

4. **Sex determination:** Sex chromosomes (X and Y) determine the sex of offspring

5. **Basis of variation:** Recombination and independent assortment of chromosomes during meiosis create variations

SECTION D - Answer to Long Answer Question

18.

Gregor Mendel's Contributions to Genetics:

1. Key Contributions:
• Established the fundamental principles of inheritance
• Proposed the concept of genes (called "factors" by Mendel)
• Discovered dominant and recessive traits
• Formulated the Law of Segregation
• Formulated the Law of Independent Assortment
• Used mathematical approach to study heredity
• Proved that traits are inherited as discrete units, not through blending

2. Seven Contrasting Traits Studied by Mendel in Pea Plants:
1. **Seed shape:** Round vs. Wrinkled
2. **Seed color:** Yellow vs. Green
3. **Flower color:** Violet vs. White

4. **Pod shape:** Inflated vs. Constricted
5. **Pod color:** Green vs. Yellow
6. **Flower position:** Axial vs. Terminal
7. **Plant height:** Tall vs. Dwarf

3. Why Mendel is called the "Father of Genetics":
• First systematic study: He was the first to conduct systematic and scientific experiments on inheritance
• Mathematical approach: He used statistical methods to analyze his results
• Foundational laws: His laws of inheritance form the foundation of modern genetics
• Scientific method: He followed rigorous scientific methodology including controlled experiments and large sample sizes
• Predictive power: His principles can predict inheritance patterns accurately
• Universal application: His principles apply to all sexually reproducing organisms

Though his work was not recognized during his lifetime, it was rediscovered in 1900 and became the cornerstone of genetics.

SECTION E - Answers to Case Study Based Questions

19.

(a) Two organisms where sex is not genetically determined:
1. Reptiles (some species) - temperature-dependent
2. Snails - can change sex during lifetime

(b) Probability of having a baby girl:
Probability = 50% or 1:1

Genetic cross:
Parents: Mother (XX) × Father (XY)

Mother's gametes: All X
Father's gametes: 50% X, 50% Y

Offspring:
• X (from mother) × X (from father) = XX (girl) - 50%
• X (from mother) × Y (from father) = XY (boy) - 50%

Therefore, probability of baby girl = 50%

(c) Mother cannot be responsible for sex of child because:
The mother can only contribute X chromosome (as she has XX). The father contributes either X (resulting in girl) or Y (resulting in boy) chromosome. Therefore, it is the father's chromosome that determines the sex of the child, not the mother's.

20.

(a) Monohybrid cross: A genetic cross between two individuals that differ in only one characteristic (or one pair of contrasting traits). Example: Cross between tall (TT) and dwarf (tt) pea plants.

(b) Conclusion when trait disappears in F1 but reappears in F2:
When a trait disappears in F1 generation but reappears in F2 generation, we can conclude that:
• The trait that appears in F1 is dominant

• The trait that disappears in F1 is recessive
• F1 individuals are heterozygous (carrying both alleles)
• The recessive allele was present in F1 but was masked by the dominant allele
• When F1 individuals are self-crossed, recessive alleles can come together in F2, making the recessive trait visible again in approximately 25% of F2 offspring

(c) F1 generation shows only dominant trait because:
In F1 generation, each individual inherits one dominant allele from one parent and one recessive allele from the other parent, making them heterozygous. Since the dominant allele masks the expression of the recessive allele, only the dominant trait is visible in the phenotype. The recessive allele is present but not expressed.
