UNIQUE STUDY POINT

By Sumeet Sahu

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Unique Study Point, Amitesh Nagar, Indore, MP | Contact: 8103405051

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. Which of the following represents a genotype?
(a) Tall plant
(b) Round seed
(c) Tt
(d) Yellow flower

2. In humans, how many pairs of chromosomes are sex chromosomes?
(a) 22 pairs
(b) 1 pair
(c) 23 pairs
(d) 2 pairs

3. Which blood group is known as the universal donor?
(a) A
(b) B
(c) AB
(d) O

4. Variations that are useful for the survival of an organism in a changing environment are retained through:
(a) Artificial selection
(b) Natural selection
(c) Genetic drift
(d) Mutation

5. The phenomenon where a single gene controls multiple characteristics is known as:
(a) Dominance

(b) Pleiotropy
(c) Polygenic inheritance
(d) Codominance

6. Which of the following is an example of acquired trait?
(a) Eye color
(b) Body weight gained by overeating
(c) Blood group
(d) Height

7. The law of independent assortment was proposed during the study of:
(a) Monohybrid cross
(b) Dihybrid cross
(c) Test cross
(d) Back cross

8. In a dihybrid cross, what is the phenotypic ratio in F2 generation?
(a) 3:1
(b) 1:2:1
(c) 9:3:3:1
(d) 1:1

9. DNA copying is necessary during reproduction because:
(a) DNA is easily damaged
(b) It provides variations for evolution
(c) It ensures genetic continuity
(d) Both (b) and (c)

10. A woman has two X chromosomes. She will produce gametes with:
(a) Only X chromosome
(b) Only Y chromosome
(c) Both X and Y chromosomes
(d) No sex chromosome

SECTION B - Short Answer Questions (2 marks each)

11. What are genes? Where are they located in the cell?

12. Explain the term 'variation'. Why is it important for a species?

13. A child has blood group O. If the father has blood group A and mother has blood group B, what will be the genotypes of parents?

14. What is the difference between inherited and acquired traits? Give one example of each.

SECTION C - Short Answer Questions (3 marks each)

15. Explain Mendel's Law of Independent Assortment with a suitable example.

16. How does DNA control the synthesis of proteins? Explain briefly.

17. What is a test cross? Why is it performed? Explain with an example.

SECTION D - Long Answer Question (5 marks)

18. Explain how variations occur during sexual reproduction. How does this process differ from asexual reproduction? What is the significance of variations for evolution?

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

19. Case Study 1:

Blood groups in humans are controlled by three alleles A, B, and O. The alleles A and B are dominant over O, but A and B show codominance when present together. This means a person with alleles A and O will have blood group A, a person with B and O will have blood group B, a person with A and B will have blood group AB, and a person with O and O will have blood group O.

Based on the above information, answer the following questions:

(a) What is codominance? (1 mark)

(b) A man with blood group A marries a woman with blood group B. Their first child has blood group O. What are the genotypes of the parents? (2 marks)

(c) What other blood groups can their children have? (1 mark)

20. Case Study 2:

Variations are differences in characteristics among individuals of the same species. These variations arise during reproduction both in asexual and sexual modes. In asexual reproduction, variations are limited and occur due to small inaccuracies in DNA copying. However, in sexual reproduction, greater variations occur due to genetic recombination during meiosis and random fusion of gametes. Some variations are beneficial, some are harmful, and some are neutral. Natural selection acts on these variations.

Based on the above information, answer the following questions:

(a) Which type of reproduction produces more variations and why? (1 mark)

(b) How does natural selection promote evolution? (2 marks)

(c) Why are variations essential for species survival? (1 mark)

DETAILED ANSWER KEY - PAPER 02

SECTION A - Answers to MCQs

1. (c) Tt

Tt represents the genetic constitution (genotype), while tall plant, round seed, and yellow flower are phenotypes.

2. (b) 1 pair

Humans have 1 pair of sex chromosomes (XX in females, XY in males) out of 23 pairs of chromosomes.

3. (d) O

Blood group O is the universal donor as it has no antigens on RBCs and can be given to any blood group.

4. (b) Natural selection

Natural selection is the process by which useful variations are retained and harmful variations are eliminated.

5. (b) Pleiotropy

Pleiotropy is when a single gene affects multiple characteristics. For example, phenylketonuria affects multiple body systems.

6. (b) Body weight gained by overeating

Acquired traits are not inherited and develop during an individual's lifetime due to environmental factors.

7. (b) Dihybrid cross

The law of independent assortment was proposed based on observations from dihybrid cross experiments.

8. (c) 9:3:3:1

In a dihybrid cross, F2 generation shows a phenotypic ratio of 9:3:3:1.

9. (d) Both (b) and (c)

DNA copying ensures genetic continuity across generations and provides variations for evolution.

10. (a) Only X chromosome

A woman with XX chromosomes can only produce gametes (eggs) with X chromosome.

SECTION B - Answers to Short Answer Questions

11.

Genes: Genes are functional units of heredity that carry information from parents to offspring. They control the expression of specific traits.

Location: Genes are located on chromosomes in the nucleus of cells. Each gene occupies a specific

position (locus) on a chromosome. They are made up of DNA.

12.

Variation: Variations are differences in characteristics among individuals of the same species. These can be in physical appearance, physiological functions, or behavior.

Importance:
1. Variations provide raw material for evolution
2. They help species adapt to changing environmental conditions
3. Beneficial variations increase chances of survival

13.

Since the child has blood group O (genotype: OO), the child must have received one O allele from each parent.

Father's genotype: AO (because he has blood group A but can pass O to offspring)
Mother's genotype: BO (because she has blood group B but can pass O to offspring)

Cross: AO × BO
Possible offspring: AB, AO, BO, OO
The child with blood group O has genotype OO.

14.

Inherited traits: Traits that are passed from parents to offspring through genes. These are present in DNA and are heritable.
Example: Eye color, blood group

Acquired traits: Traits that develop during an individual's lifetime due to environmental factors or use/disuse of organs. These are not passed to offspring.
Example: Muscular body due to exercise, scar from injury

SECTION C - Answers to Short Answer Questions

15.

Law of Independent Assortment: When two pairs of contrasting characters are considered together in a cross, the inheritance of one pair of characters is independent of the other pair.

Example: In pea plants, the inheritance of seed shape (round/wrinkled) is independent of seed color (yellow/green).

When a plant with round, yellow seeds (RRYY) is crossed with wrinkled, green seeds (rryy):
• F1 generation: All round, yellow (RrYy)
• F2 generation shows four phenotypes: Round Yellow (9), Round Green (3), Wrinkled Yellow (3), Wrinkled Green (1)

This 9:3:3:1 ratio proves that shape and color are inherited independently.

16.

DNA control of protein synthesis:

1. **Information storage:** DNA contains genetic information in the form of sequences of nitrogenous bases.

2. **Transcription:** A specific segment of DNA (gene) acts as a template to form messenger RNA (mRNA) in the nucleus.

3. **Translation:** mRNA moves to ribosomes in the cytoplasm where it directs the synthesis of specific proteins by arranging amino acids in a particular sequence.

4. **Function:** These proteins act as enzymes or structural components that determine the traits and characteristics of an organism.

17.

Test Cross: A cross between an organism showing dominant phenotype (but unknown genotype) with a homozygous recessive organism.

Purpose: To determine whether the organism showing dominant trait is homozygous (TT) or heterozygous (Tt).

Example:
A tall pea plant can be TT or Tt. To find out:
• Cross it with a dwarf plant (tt)
• If all offspring are tall → the plant is TT
• If offspring show 1:1 ratio of tall:dwarf → the plant is Tt

Results:
TT × tt = All Tt (all tall)
Tt × tt = Tt and tt (1 tall : 1 dwarf)

SECTION D - Answer to Long Answer Question

18.

Variations during Sexual Reproduction:

1. Sources of variations in sexual reproduction:
• **Crossing over:** Exchange of genetic material between homologous chromosomes during meiosis
• **Independent assortment:** Random distribution of maternal and paternal chromosomes during gamete formation
• **Random fertilization:** Any male gamete can fuse with any female gamete
• **Gene recombination:** New combinations of genes from both parents

2. Difference from Asexual Reproduction:
Sexual Reproduction:
• Involves two parents
• Involves meiosis and fusion of gametes
• Produces large variations
• Offspring are genetically different from parents

Asexual Reproduction:
• Involves single parent
• Involves mitosis only
• Produces minimal variations (only due to DNA copying errors)
• Offspring are genetically identical to parent (clones)

3. Significance of Variations for Evolution:

• Variations provide raw material for natural selection
• Beneficial variations help organisms adapt to changing environments
• Organisms with advantageous variations survive and reproduce more successfully
• Over many generations, accumulation of favorable variations leads to evolution of new species
• Without variations, species cannot adapt and may become extinct

SECTION E - Answers to Case Study Based Questions

19.

(a) Codominance: A condition where both alleles of a gene express themselves equally in the heterozygous condition, without any blending. Neither allele is dominant or recessive. Example: In blood group AB, both A and B antigens are expressed.

(b) Since the child has blood group O:
Child's genotype: OO
This means both parents must have passed O allele to the child.

Father's genotype: AO (phenotype: Blood group A)
Mother's genotype: BO (phenotype: Blood group B)

(c) Other possible blood groups in their children:
Cross: AO × BO
Possible offspring genotypes:
• AB (blood group AB)
• AO (blood group A)
• BO (blood group B)
• OO (blood group O)

Therefore, their children can have blood groups: A, B, AB, or O

20.

(a) Sexual reproduction produces more variations because:
In sexual reproduction, variations arise from:
• Crossing over during meiosis
• Independent assortment of chromosomes
• Random fusion of gametes from two different parents
• Combination of genetic material from two individuals

In asexual reproduction, variations are minimal as they occur only due to small errors in DNA copying.

(b) Natural selection promotes evolution:
• Natural selection favors individuals with beneficial variations that increase survival and reproduction
• Organisms with advantageous traits are more likely to survive and pass their genes to offspring
• Over many generations, beneficial variations accumulate in the population
• Harmful variations are eliminated as organisms with these traits are less likely to survive
• This gradual change in genetic composition of a population over time leads to evolution

(c) Variations are essential for species survival because:
When environments change, variations enable some individuals to adapt and survive. Without variations, entire species could become extinct if unable to cope with environmental changes. Variations provide the flexibility needed for long-term species survival.

Made with ❤ by Sumeet Sahu

Unique Study Point, Amitesh Nagar, Indore, MP

Website: uniquestudyonline.com