CHAPTER 5

PRINCIPLE OF INHERITANCE AND VARIATION

MULTIPLE-CHOICE QUESTIONS

1. All genes located on the same chromosome:
   a. Form different groups depending upon their relative distance
   b. Form one linkage group
   c. Will not from any linkage groups
   d. Form interactive groups that affect the phenotype

2. Conditions of a karyotype 2n +1, 2n –1 and 2n + 2, 2n – 2 are called:
   a. Aneuploidy
   b. Polyploidy
   c. Allopolyploidy
   d. Monosomy

3. Distance between the genes and percentage of recombination shows:
   a. a direct relationship
   b. an inverse relationship
   c. a parallel relationship
   d. no relationship

4. If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is:
   a. Autosomal dominant
   b. Autosomal recessive
   c. Sex-linked dominant
   d. Sex-linked recessive

5. In sickle cell anaemia glutamic acid is replaced by valine. Which one of the following triplets codes for valine?
   a. G G G
   b. A A G
   c. G A A
   d. G U G

6. Person having genotype $I^A I^B$ would show the blood group as AB. This is because of:
   a. Pleiotropy
   b. Co-dominance
   c. Segregation
   d. Incomplete dominance

7. Z Z / ZW type of sex determination is seen in:
   a. Platypus
   b. Snails
   c. Cockroach
   d. Peacock

8. A cross between two tall plants resulted in offspring having few dwarf plants. What would be the genotypes of both the parents?
   a. TT and Tt
   b. Tt and Tt
   c. TT and TT
   d. Tt and tt

9. In a dihybrid cross, if you get 9:3:3:1 ratio it denotes that:
   a. The alleles of two genes are interacting with each other
   b. It is a multigenic inheritance
   c. It is a case of multiple allelism
   d. The alleles of two genes are segregating independently.

10. Which of the following will not result in variations among siblings?
   a. Independent assortment of genes
   b. Crossing over
   c. Linkage
   d. Mutation

11. Mendel's Law of independent assortment holds good for genes situated on the:
    a. non-homologous chromosomes
    b. homologous chromosomes
    c. extra nuclear genetic element
    d. same chromosome

12. Occasionally, a single gene may express more than one effect. The phenomenon is called:
    a. multiple allelism
    b. mosaicism
    c. pleiotropy
    d. polygeny

13. In a certain taxon of insects some have 17 chromosomes and the others have 18 chromosomes. The 17 and 18 chromosome-bearing organisms are:
    a. males and females, respectively
    b. females and males, respectively
    c. all males
    d. all females

14. The inheritance pattern of a gene over generations among humans is studied by the pedigree analysis. Character studied in the pedigree analysis is equivalent to:
    a. quantitative trait
    b. Mendelian trait
    c. polygenic trait
    d. maternal trait

15. It is said that Mendel proposed that the factor controlling any character is discrete and independent. His proposition was based on the
    a. results of F_3 generation of a cross.
    b. observations that the offspring of a cross made between the plants having two contrasting characters shows only one character without any blending.
    c. self pollination of F_1 offsprings
    d. cross pollination of F_1 generation with recessive parent

16. Two genes 'A' and 'B' are linked. In a dihybrid cross involving these two genes, the F_1 heterozygote is crossed with homozygous recessive parental type (aa bb). What would be the ratio of offspring in the next generation?
    a. 1 : 1 : 1: 1
    b. 9 : 3 : 3 : 1
    c. 3 : 1
    d. 1 : 1

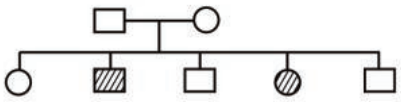
17. In the F_2 generation of a Mendelian dihybrid cross the number of phenotypes and genotypes are:
    a. phenotypes - 4; genotypes - 16
    b. phenotypes - 9; genotypes - 4
    c. phenotypes - 4; genotypes - 8
    d. phenotypes - 4; genotypes - 9

18. Mother and father of a person with 'O' blood group have 'A' and 'B' blood group, respectively. What would be the genotype of both mother and father?
    a. Mother is homozygous for 'A' blood group and father is heterozygous for 'B'
    b. Mother is heterozygous for 'A' blood group and father is homozygous for 'B'
    c. Both mother and father are heterozygous for 'A' and 'B' blood group, respectively
    d. Both mother and father are homozygous for 'A' and 'B' blood group, respectively

VERY SHORT ANSWER TYPE QUESTIONS

1. What is the cross between the progeny of F_1 and the homozygous recessive parent called? How is it useful?
2. Do you think Mendel's laws of inheritance would have been different if the characters that he chose were located on the same chromosome.
3. Enlist the steps of controlled cross pollination. Would emasculation be needed in a cucurbit plant? Give reasons for your answer.
4. A person has to perform crosses for the purpose of studying inheritance of a few traits / characters. What should be the criteria for selecting the organisms?

5. The pedigree chart given below shows a particular trait which is absent in parents but present in the next generatoin irrespective of sexes. Draw your conclusion on the basis of the pedigree.



6. In order to obtain the F_1 generation Mendel pollinated a pure-breeding tall plant with a pure breeding dwarf plant. But for getting the F_2 generation, he simply self-pollinated the tall F_1 plants. Why?

7. "Genes contain the information that is required to express a particular trait." Explain.

8. How are alleles of particular gene differ from each other? Explain its significance.

9. In a monohybrid cross of plants with red and white flowered plants, Mendel got only red flowered plants. On self-pollinating these F_1 plants got both red and white flowered plants in 3:1 ratio. Explain the basis of using RR and rr symbols to represent the genotype of plants of parental generation.

10. For the expression of traits genes provide only the potentiality and the environment provides the opportunity. Comment on the veracity of the statement.

11. A, B, D are three independently assorting genes with their recessive alleles a, b, d, respectively. A cross was made between individuals of Aa bb DD genotype with aa bb dd. Find out the type of genotypes of the offspring produced.

12. In our society a woman is often blamed for not bearing male child. Do you think it is right? Justify.

13. Discuss the genetic basis of wrinkled phenotype of pea seed.

14. Even if a character shows multiple allelism, an individual will only have two alleles for that character. Why?

15. How does a mutagen induce mutation? Explain with example.

SHORT ANSWER TYPE QUESTIONS

1. In a Mendelian monohybrid cross, the F_2 generation shows identical genotypic and phenotypic ratios. What does it tell us about the nature of alleles involved? Justify your answer.

2. Can a child have blood group O if his parents have blood group 'A' and 'B'. Explain.
3. What is Down's syndrome? Give its symptoms and cause. Why is it that the chances of having a child with Down's syndrome increases if the age of the mother exceeds forty years?
4. How was it concluded that genes are located on chromosomes?
5. A plant with red flowers was crossed with another plant with yellow flowers. If F_1 showed all flowers orange in colour, explain the inheritance.
6. What are the characteristic features of a true-breeding line?
7. In peas, tallness is dominant over dwarfness, and red colour of flowers is dominant over the white colour. When a tall plant bearing red flowers was pollinated with a dwarf plant bearing white flowers, the different phenotypic groups were obtained in the progeny in numbers mentioned against them:

   Tall, Red = 138
   Tall, White = 132
   Dwarf, Red = 136
   Dwarf, White = 128

   Mention the genotypes of the two parents and of the four offspring types.
8. Why is the frequency of red-green colour blindness is many times higher in males than that in the females?
9. If a father and son are both defective in red-green colour vision, is it likely that the son inherited the trait from his father? Comment.
10. Discuss why *Drosophila* has been used extensively for genetical studies.
11. How do genes and chromosomes share similarity from the point of view of genetical studies?
12. What is recombination? Discuss the applications of recombination from the point of view of genetic engineering.
13. What is artificial selection? Do you think it affects the process of natural selection? How?
14. With the help of an example differentiate between incomplete dominance and co-dominance.
15. It is said, that the harmful alleles get eliminated from population over a period of time, yet sickle cell anaemia is persisting in human population. Why?

LONG ANSWER TYPE QUESTIONS

1. In a plant tallness is dominant over dwarfness and red flower is dominant over white. Starting with the parents work out a dihybrid cross. What is standard dihybrid ratio? Do you think the values would deviate if the two genes in question are interacting with each other?

2. a. In humans, males are heterogametic and females are homogametic. Explain. Are there any examples where males are homogametic and females heterogametic?
   b. Also describe as to, who determines the sex of an unborn child? Mention whether temperature has a role in sex determination.

3. A normal visioned woman, whose father is colour blind, marries a normal visioned man. What would be probability of her sons and daughters to be colour blind? Explain with the help of a pedigree chart.

4. Discuss in detail the contributions of Morgan and Sturvant in the area of genetics.

5. Define aneuploidy. How is it different from polyploidy? Describe the individuals having following chromosomal abnormalities.
   a. Trisomy of 21st Chromosome
   b. XXY
   c. XO