Principles of Inheritance and Variation

Assertion & Reason Type Questions

consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c. Assertion is true but Reason is false.

d. Assertion is false but Reason is true.

Q 1. Assertion (A): In a monohybrid cross, F_1 generations indicate dominant characters.
Reason (R): Dominance occurs only in heterozygous state.

Answer : (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. Monohybrid cross is a cross between two organisms of a species which is made to study the inheritance of a single pair of alleles or factors of a character. Dominant character is one of a pair of alleles which can express itself whether present in homozygous or heterozygous state. In F, generation (the generation of hybrids produced from a cross between the genetically different homozygous individuals called parents) the progenies are heterozygous dominant.

Q 2. Assertion (A): In thalassemia an abnormal myoglobin chain is synthesised due to a gene defect.
Reason (R): α-thalassemia is controlled by genes HBA-1 and HBA-2 on chromosome 16.

Answer : (d) Assertion is false but Reason is true.

Q 3. Assertion (A): Pure lines are called true breed.
Reason (R): True breeds are used for cross breeding.

Answer : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. Pure line is a strain of genetically pure true breeding individuals. Members of pure line are homozygous for one or more characters. In homozygous form both the factors express the same effect. These organisms are said to

breed true. They are used for cross breeding in order to get the desired improvement in crops.

Q 4. Assertion (A): The principle of segregation given by Mendel is the principle of purity of gametes.
Reason (R): Gametes are pure for a character.

Answer : (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. According to principle of segregation (first law of Mendelism), the two factors of a character which remain together in an individual to not get mixed up but keep their identity distinct, separate at the time of gametogenesis or sporogenesis, get randomly distributed to different offspring as per the principle of probability. Gametes carry a single factor or allele for a trait. The two Mendelian factors present in the F, plants segregate during gamete formation. The principle of segregation is called the principle of purity of gametes because segregation of the two Mendelian factors of a trait results in gametes receiving only one factor out of a pair. As a result gametes are always pure for a character.

Q 5. Assertion (A): Co-dominant alleles lack dominant recessive relationship.
Reason (R): Co-dominant alleles show incomplete dominance.

Answer : (c) Assertion is true but Reason is false. Such alleles which are able to express themselves in the presence of each other are called co-dominant. They do not show dominant recessive relationship and are able to express themselves independently when present together. For example, Blood group A and B shows codominance as when present together. They show AB blood group. In incomplete dominance, one of the alleles is more pronounced for example in Mirabilis jalapa when red (dominant) and white (recessive) flowers crossed the progeny is pink. Therefore, co-dominance is different from incomplete dominance.

Q 6. Assertion (A): Complementary genes are non- allelic genes.
Reason (R): Complementary genes interact to produce a completely new trait.

Answer : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Q 7. Assertion (A): Quantitative inheritance is called polygenic inheritance.
Reason (R): Several genes control the expression of a trait.

Answer : (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. Quantitative inheritance is a type of inheritance controlled by one or more genes in which the dominant alleles have cumulative effect with each dominant allele expressing a part or unit of the trait. the full trait being shown only when all the dominant alleles are present. The genes involved in quantitative inheritance are called polygenes. A polygene is defined as a gene where a dominant allele controls only a unit or partial quantitative expression of a trait.

Q 8. Assertion (A): When the two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations is much higher than non-parental type.
Reason (R): Higher parental gene combinations can be attributed to crossing over between two genes.

Answer : (c) Assertion is true but Reason is false. When the genes are linked, the proportion of parental gene combinations are much higher than non- parental types. When the genes for certain features (like black eyes and short wings of Drosophila) are located very close to each other on a chromosome, there are little chances of crossing over, giving higher parental combination. When the genes are on different locii on a chromosomes, the distance between them being considerable, there are higher chances of recombination, giving rise to mixed or non-parental features.

Q 9. Assertion (A): Accumulation of phenylalanine in the brain results in mental retardation in phenylketonuria.
Reason (R): The affected person lacks phenylalanine which is therefore not converted to tyrosine.

Answer : (c) Assertion is true but Reason is false.

Q10. Assertion: Mendel was successful in his hybridization.

Reason: Garden pea proved ideal experimental material.

Q11. Assertion: Mendel used true-breeding pea lines for artificial pollination experiments for his genetic studies.

Reason: For several generations, a true-breeding line shows the stable trait inheritance and expression.

Q12. Assertion: On true breeding lines, Mendel conducted cross pollination experiments.
Reason: For several generations, true breed line have stable trait inheritance.

Q13. Assertion: Cross of F1 individual with recessive homozygous parent is test cross.
Reason: No recessive individual are obtained in the monohybrid test cross progeny.

Q14. Assertion: The progeny produced have both the characters of parents.
Reason: The process by which characters pass from parent to progeny is known as inheritance.

Q15. Assertion: The progeny in F_2-generation traits were identical to their parental type.
Reason: The progeny show no blending of traits.

Q16. Assertion: Genes pass from one generation to another.
Reason: The unit of inheritance are genes.

Q17. Assertion: In a monohybrid cross, F1 generation indicate dominant characters.
Reason: Dominance occurs only in heterozygous state.

Q18. Assertion: In monohybrid cross, at F2 stage, both parental traits are expressed in 3: 1 proportion.
Reason: At F2 stage, the contrasting parental traits show blending.

Q19. Assertion: The cross between the F1 progeny and either of the parent types is a test cross.
Reason: The cross between F1 progeny and the double recessive genotype is back cross.

Q20. Assertion: A pair of contrasting characters is termed as allele.
Reason: Only one gene of an allele is expressed in an individual.

Q21. Assertion: In Mirabilis, selfing of F1 pink flower plants produces same phenotypic & genotypic ratio.
Reason: Flower colour gene shows incomplete dominance.

Q22. Assertion: Gametes receives only one allele of a gene.
Reason: During gamete formation, mitosis takes place leads to formation of haploid cells.

Q23. Assertion: In F_2 generation of plant Mirabilis jalapa, the pink coloured flowers appear.
Reason: This is observed due epistatic suppression of white colour alleles in one of parental flowers by red colour alleles.

Q24. Assertion: A good example of multiple alleles is ABO blood group system.
Reason: When IA and IB alleles are present together in ABO blood group system, they both express their own types.

ANSWER KEY 10 to 24

Q10 : (b) Mendel chose garden pea as plant material for his experiments, since it had the following advantages:
(i) Well defined characters.
(ii) Bisexual flowers.
(iii) Predominantly self-fertilization.
(iv) Easy hybridization.
Besides these features, garden pea, being self-fertilized, had pure lines due to natural self-fertilization for a number of years. Therefore, any variety used was pure for the characters it carried. Mendel's success was mainly based on the fact that he considered a single character at one time.

Q11 : (a) On garden pea for many years mendel carried out hybridization experiments. He performed various types of cross breeding and then allowed the offspring for self breeding. He selected varieties and used pure lines of ture breeding lines, i.e., they produce offspring resembling the parents. these lines show the stable trait inheritance and expression for several generations making them suitable for genetic studies.

Q12 : (a) True breeding lines have inheritance of pure characters for several generations.

13 : (c) In the monohybrid test cross progeny both heterozygous and recessive individuals are obtained in 1 : 1 ratio.

Q14 **:** (b) According to Mendelian inheritance, genes come in different varieties called alleles. Somatic cells contain 2 alleles with one allele provided by each parent of an organism.

Q15 : (a) Both the characters appear during the formation of F2-generation, so no blending occurs.

Q16 : (b) Chromosomes carry gene that passes on the traits of parents to the off springs during genetic recombination.

Q17 : (c) Monohybrid cross is a cross between two organisms of a species which is made to study the inheritance of a single pair of alleles or factors of a character. Dominant character is one of a pair of alleles which can express itself whether present in homozygous or heterozygous state. In F1, generation, the generation of hybrids produced from a cross between the genetically different homozygous individuals called parents the progenies are heterozygous dominant.

Q18 : (c) Both the parental traits of a character in F2 generation are expressed in the ratio of three dominant to one recessive. Whereas, in F1 generation only one of the parental traits is expressed and the other lies hidden or unexpressed. However, in the hybrid there is no mixing of two characters. At the time formation of gamete, two factors separate or segregate and passes into different gametes, that hence have one factor of a pair. During fertilization, gametes fuse randomly so that factors come together in new generation and freely express themselves.

Q19 : (d) Back cross is a cross of F1 hybrid with either of the two parents. When F1 off springs are crossed with the dominant parents, all the F2 generation off springs develop dominant character. On the other hand, when F1 hybrids are crossed with recessive parent, individuals with both the phenotypes appear in equal proportions. Crossing of F1 individual with dominant phenotype with its homozygous recessive parent is called test cross. It is used to determine whether the individuals exhibiting dominant characters are homozygous or heterozygous.

Q20 : (c) An allele is an alternative form of a gene one member of a pair that is located at a specific position on a specific chromosome. Diploid organisms, for example, humans, have paired homologous chromosomes in their somatic cells, and these contain two copies of each gene.

Q21 : (a)

Q22 : (c) Meiosis is the process by which gametes are formed and during this process only one variant of gene pass to the gamete.

Q23 : (c) In Mirabilis jalapa (four o'clock) have two types, of flower colour in pure state: red and white. When the two types of plants are crossed, the hybrid or plants of F1 generation produce pink flowers. If the latter are selfed, the plants of F2 generation are of three types-red, pink and white flowered in the ratio of 1 : 2 : 1. Due to incomplete dominance of red (dominant) over white (recessive), the pink colour apparently appears. Thus, pink is differentiated from red and white.

Q24 : (b) In the ABO system, consists four blood groups A, B, AB and O. ABO blood groups are controlled by gene I. The gene has three alleles I^A, I^B and i. This phenomenon is known as multiple allelism. IA and IB are completely dominant over i. When I^A and I^B are present together, they both express themselves and produce AB blood group. This phenomenon is known as codominance.