Principle of Inheritance and Variation Important Questions With Answers

NEET Biology 2023

1. In a cross between negro and albino skin colour of humans showing polygenic inheritance, the phenotypic ratio in F_2 generation will be
   a) 9:3:3:1 **b) 1:6: 15:20: 15:6: 1** c) 1:4:6:4:1 d) 1:2:2:4: 1:2: 1:2:1

2. A mutation at one base of the first codon of a gene produces a non-functional protein. Such a mutation is referred as _____ .
   a) frameshift mutation **b) mis-sense mutation** c) non-sense mutation d) reverse mutation

   Solution : -
   If mutation at one base of the first codon of a gene takes place then all the subsequent codons will be out of register (genetic code). This results into the formation of mis-sense protein which is fonned due to the mutation in the first base of first codon and thus called missense mutation.

3. In a test cross involving Fl dihybrid flies, more parental type offspring were produced than the recombinant type offspring. This indicates:
   a) Chromosomes failed to separate during meiosis
   b) The two genes are linked and present on the same chromosome
   c) Both of the characters are controlled by more than one gene
   d) The two genes are located in two different chromosomes

   Solution : -
   When two genes in a dihybrid cross are situated on the same chromosomes, the ratio of parental gene combination is much higher than the non-parental combination

4. How many different kinds of gametes will be produced by a plant having the genotype AaBbCc?
   a) 4 b) 9 **c) 2** d) 8

   Solution : -
   it would make only two kinds of gametes these are ABC & AbC.

5. Select the disease which is caused by recessive autosomal genes when present in homozygous condition.
   a) Alkaptonuria b) Albinism c) Cystic fibrosis **d) All of these**

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

7. A child has blood group 'O'. If father has blood group 'A' and mother has blood group 'B', work out the genotypes of the parents.
   a) I^AI^A and I^Bi **b) I^Ai and I^Bi** c) I^Ai and ii d) ii and I^BI^B

   Solution : -
   If father has blood group 'A', mother has blood group 'B', and the child with blood group 'O' appears in progeny, this means that the parents are heterozygous.

8. The contrasting pairs of factors in Mendelian crosses are called____

a) multiple alleles **b) allelomorphs** c) alloloci d) paramorphs

Solution : -

Two allelomorphs are the different forms of a gene which are responsible for different expression of same characters, e.g. for colour offlower is R and r.

9. **Assertion:** When yellow bodied, white eyed **Drosophila** females were hybridised with brown-bodied, red eyed males; and F_1 progeny was intercrossed, F_2 ratio deviated from 9:3:3:1
Reason: When two genes in a dihybrid are on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental type.
a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false

Solution : -

In **Drosophila**, the genes for body and eye colour are located on X chromosome. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combination are higher than non-parental type. This occurs due to physical association or linkage of the two genes while non-parental gene combinations due to recombination between two genes. Thus, linkage and recombination deviates the ratio from Mendelian ratio of a dihybrid cross,(9 : 3 : 3: 1).

10. How many types of gametes can be produced by a diploid organism who is heterozygous for 4 loci?
a) 4 b) 8 **c) 16** d) 32

Solution : -

Types of gametes = 2^n where n is number of heterozygous loci. Thus, gametes produced by a diploid organism could be $2^4 = 16$.

11. Which is the most common mechanism of genetic variation in the population of sexually reproducing organism?
a) Chromosomal aberrations b) Genetic drift **c) Recombination** d) Transduction

Solution : -

In the population of sexually reproducing organisms, the most common mechanism of genetic variation is Recombination. In this process, there is exchange of genetic material between non-sister chromatid of homologous chromosomes during meiosis. This happens during gamete formation.

12. **Assertion:** The pink coloured flowers appear in F_2 generation of plant **Mirabilis jalapa**
Reason: This is observed due epistatic suppression of white colour alleles in one of parental flowers by red colour alleles.
a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion

c) If assertion is true but reason is false d) If both assertion and reason are false

Solution : -

In **Mirabilis jalapa** (four o'clock) there are two types of flower colour in pure state: red and white. When the two types of plants are crossed, the hybrid or plants of F_1 generation have pink flowers, If the latter are selfed, the plants of F_2 generation are of three types-red, pink and white flowered in the ratio of 1: 2 : 1. The pink colour apparently appears due to incomplete dominance of red (dominant) over white (recessive). Thus, pink is differentiated from red and white.

13. A colourblind girl is rare because she will be born only when____
a) her mother and matemal grandfather were colourblind
b) her father and maternal grandfather were colourblind
c) her mother is colour blind and father has normal vision
d) parents have normal vision but grand parents were colourblind

Solution : -

For a girl to be colourblind, the genotype of her father should be X^cY and of her mother either X^cX or $X^c X^c$, where X^c represents colour blind gene. In the given options this is only possible when her father and maternal grandfather were colour blind.

14. Two dominant non-allelic genes are 50 map units apart.The linkage is_____ .
a) cis type b) trans type c) complete **d) absent/incomplete**

Solution : -

Chromosome mapping is based on two genetic principles

(a) The frequency of crossing over between two genes is directly proportional to the distance between them in the chromosome.

(b) Genes are arranged in a linear order in the chromosome. 50 map unit distance between the genes is quite enough to change the cis arrangement of dominant genes into trans. So, there is no fixed linkage present.

15. Sickle cell anaemia has not been climinated from the African population because____
a) it is not a fatal disease **b) it provides immunity against malaria** c) it is controlled by dominant genes
d) it is controlled by recessive genes

Solution : -

In sickle cell anaemia RBC become sickle shaped which are not supportive for the growth of malarial parasite Plasmodium so it provides immunity against malaria disease.

16. Number of autosomes present in liver cells of a human female is
a) 22 autosomes **b) 22 pairs** c) 23 autosomes d) 23 pairs

Solution : -

In humans, number of autosomes are 2n = 44 or 22 pairs regardless of the sex.

17. A cow with red coat is crossed with a bull having white coat. Their offspring produced in F_1 generation showed roan coat. This effect is produced due to juxtaposition of small patches of red and white colour. What can be assumed about the gene controlling coat colour in cattle?
a) The alleles of gene controlling coat colour show a perfect dominant recessive relationship.

b) The alleles of gene controlling coat colour are incompletely dominant.

c) The alleles of gene controlling coat colour are codominant d) None of these

18. Select the corect statement:
a) Spliceosomes take part in translation **b) Punnet square was developed by a British scientist.**
c) Franklin Stahl coined the term "linkage". d) Transduction was discovered by S. Altman.

Solution : -

Punnet square was developed by a British geneticist Reginald C. Punnet. Franklin Stahl and Meselson proved semiconservative mode of DNA replication. Morgan coined the term linkage. Transduction was discovered by Zinder and Lederberg.

19. Segregation of Mendelian factors (no linkage, no crossing over) occurs during____
a) anaphase-I b) anaphase-II c) diplotene d) metaphase-I

Solution : -

At the end of anaphase-I, two groups of chromosomes (one at each pole) are produced. Each such group is having half the original number of chromosomes present in the parent nucleus. So, anaphase-I results in the reduction of chromosome number to half and segregation of Mendelian factors.

20. Which one from those given below is the period for Mendel's hybridisation experiments?
a) 1856-1863 b) 1840-1850 c) 1857-1869 d) 1870-1877

Solution : -

Mendel conducted hybridisation experiments on pea plant for 7 years between 1856 to 1863 and his research data was published in 1865.

21. Foetal sex can be determined by examining cells from the amniotic fluid by looking for ____
a) Barr bodies b) autosomes c) chiasmata d) kinetochore

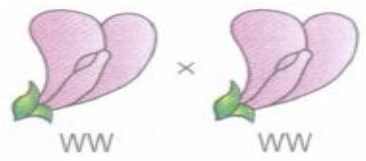
Solution : -
Females have XX-chromosome, presence of Barr body indicates female child while absence indicates male. Amniotic fluid contains living cells flaked off from the skin of baby or amnion (derived from zygote and identical to foetus cells). The non-dividing cells are examined. One X-chromosome always appears in the active state. If another is present, it is seen in a resting state as tightly coiled dark staining body (Barr body).

22. Conditions of a karyotype 2n ± 1 and 2n ± 2 are called
a) aneuploidy b) polyploidy c) allopolyploidy d) monosomy

Solution : -
The chromosomal disorders are caused due to lack or additions or abnormal arrangement of one or more chromosomes. Failure of segregation of chromatids during cell division cycle results in the gain or loss of chromosome(s), is called aneuploidy. For example, Down's syndrome results due to gain of extra copy of chromosome 21. Similarly, Turner's syndrome results due to loss of an X chromosome in human females.

23. In monohybrid cross, number of pure line plants in F_2 will be
a) One **b) Two** c) Three d) Four

24. Which of the following is a test cross?

a) 

b) 

c) 

d) 

Solution : -
To determine the genotype of a tall plant of F_2 generation, Mendel crossed the tall plant from F_2 generation with a dwarf plant. He called this a test cross. In a typical test cross an organism (pea plants) showing a dominant phenotype whose genotype is to be determined is crossedwith the recessive parent instead of self-crossing. The progenies of such a cross can easily be analysed to predict the genotype of the test organism. Normal test cross ratio for a monohybrid cross is 1 : 1 and for a dihybrid cross is 1 : 1 : 1 : 1.

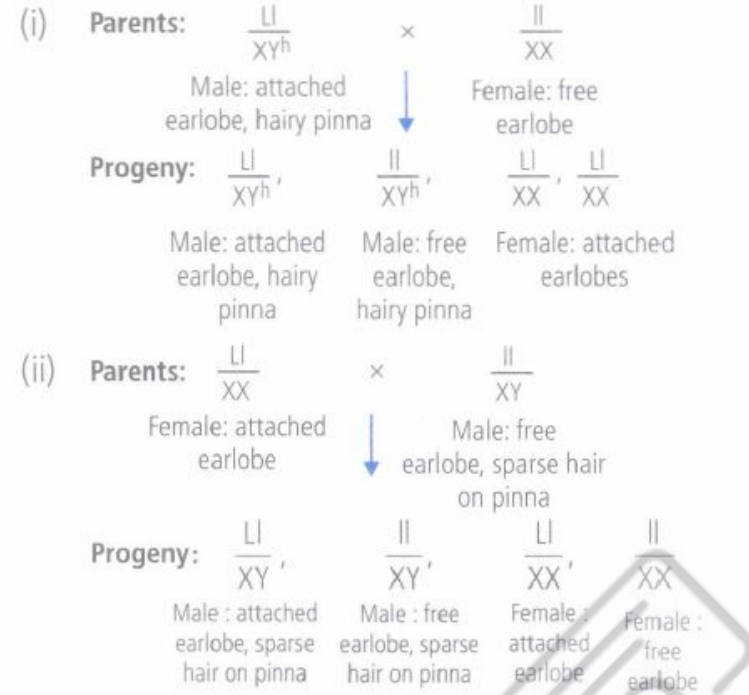
25. The maximum height of a plant is 18 feet and minimum average height 6 feet. If plant height is controlled by 3 pairs of polygenes, then the height of a plant with genotype AabbCc will be
a) 8 feet **b) 10 feet** c) 12 feet d) 14 feet

26. In humans, attached earlobes are a dominant feature over free earlobes while hypertrichosis of the ear is a holandric (Y-linked) feature. A man with attached earlobes and extensive hair on pinna married a woman having free earlobes. The couple had one son with attached earlobes and hairy pinna, another son with free earlobes and hairy pinna and two daughters with attached earlobes. One of the daughters married a man with free earlobes and sparse hair on pinna. They had two sons. What would be the characteristics of their pinnae?
a) Both will have attached earlobes and sparse hair on pinna.
b) There would be equal chances for both having free or attached earlobes and sparse hair on pinnae.

c) They would have hairy pinnae and there would be 1 in 8 chance that both will have attached earlobes.
d) Both will have free earlobes and extensive hair on pinnae.

Solution : -

It is given that attached earlobes are a dominant feature hence, we can represent it as LL or Ll. Also, hypertrichosis of the ear is a Y-linked feature and thus we can represent is as yh. Now, according to the given information following crosses can be made:



Thus, there would be equal chances for both daughters and sons to have free earlobe (ll) or attached (Ll) earlobe and sparse hair on pinna.

27. In this disease, there occurs a failure of chloride ion transport mechanism in cell surface membrane of epithelial cells; sweat of the patient contains very high level of Na^+ and Cl^- ions. The disease is
a) thalassaemia b) Alzheimer's disease c) Gaucher's disease **d) cystic fibrosis.**

Solution : -

Cystic fibrosis (CF) is an abnormal recessive disorder of infants, children and young adults that is due to a recessive autosomal allele present on chromosome 7. The disease gets its name from the fibrous cysts that appear in the pancreas. It produces a defective glycoprotein. The defective glycoprotein causes formation of thick mucus in skin, lungs, pancreas, liver and other secretory organs. Sweat of the patient contains very high level of Na+ and Cl-. There is failure of chloride ion transport mechanism in cell surface membrane of epithelial cell. Accumulation of thick mucus in lungs results in obstruction of airways. There is recurrent pulmonary infection, mucus deposition in pancreas, maldigestion of food with high fat content in stools. Liver may undergo cirrhosis. The sweat of the sufferer is saltier.

28. Diploid chromosome number in humans is____
a) 46 b) 44 c) 48 d) 42

Solution : -

There are 23 pairs of chromosomes in humans in which 22 pairs of autosome and one pair of sex chromosome is present thus, total number of diploid chromosome is 23 pairs =46 chromosomes

29. Both the allels are independently expressed in
a) Eye colour in Drosophila b) Fruit colour in Cucurbita **c) Sickle cell haemoglobin**
d) Height in tobacco

30. The allele which is unable to express its effect in the presence of another is called _____

a) codominant b) supplementary c) complementary **d) recessive**

Solution : -

In heterozygous condition where both the contrasting alleles are present only one allele is able to express, called dominant, while other which remain suppressed is called recessive.

31. The incorrect statement with regard to Haemophilia is _____

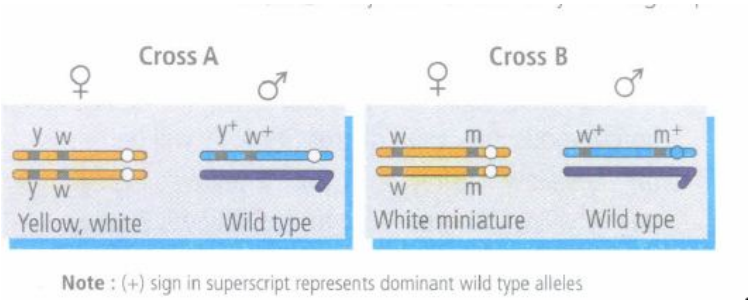
a) It is a recessive disease **b) It is a dominant disease**

c) A single protein involved in the clotting of blood is affected d) It is a sex-linked disease

Solution : -

It is a dominant disease. This statement is incorrect with regard to haemophilia. Because haemophilia is a sexlinked recessive disease. A single protein involved in the clotting of blood is affected.

32. Refer to the given figure of cross A and cross B and select the correct statement regarding them.



a) In cross A, the strength of linkage between genes y and w is higher than the cross B genes wand m.

b) In cross A, the strength of linkage between genes y and w is lesser than the cross B genes wand m.

c) Both cross A genes y and wand cross B have the same strength of linkage.

d) The percentage of recombinants produced in cross A is higher than cross B.

Solution : -

The physical distance between two genes determines both the strength of the linkage and the frequency of the crossing over between two genes. The strength of the linkage increases with the closeness of the two genes. On the other hand the frequency of crossing over increaseswith the increase in the physical distance between the two genes.

33. Phenotype of an organism is the result of_____

a) cytoplasmic effects and nutrition b) environmental changes and sexual dimorphism

c) genotype and environment interactions d) mutations and linkages

Solution : -

Phenotype is the appearance of one organism while genotype is the gene complement it has from its ancestors. These gees only show their effect in phenotype but environment also plays significance role in this. Thus phenotypes is a result of genotype and environmental interaction.

34. Genotypically and phenotypically same ratio is obtained from

a) Incomplete dominance b) Multiple alleles c) Out cross d) Reciprocal cross

35. A fruit fly heterozygous for sex-linked genes, is mated with normal female fruit fly. Male specific chromosome will enter egg cell in the proportion_____ .

a) 1: 1 b) 2: 1 c) 3: 1 d) 7: 1

Solution : -

Genes which are present on sex chromosomes are called sex linked genes. Male Drosophila contains XY sex chromosome. while female contains XX-chromosomes, During gamete formation male produces 50% male specific gametes and 50% female specific gametes while female

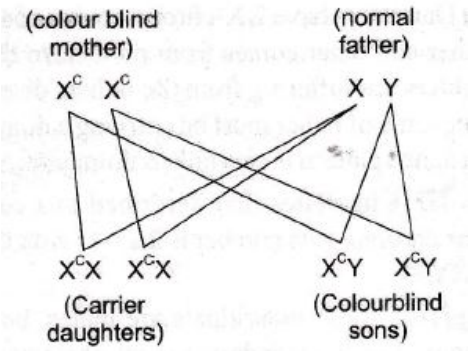
produces only one tlpe of gametes, i.e. female specific, As male produces two types of gametes in equal proportion, There is an equal opportunity to getting a male or female offspring.

36. A colourblind mother and normal father would have_____

a) colour blind sons and normal/carrier daughters b) colour blind sons and daughters c) all colour blind d) all normal

Solution : -

A colourblind mother and normal father would have colour blind sons and carrier daughters. Daughters will be normal phenotypically but they will be carrier genotypically.



37. In maize, coloured endosperm (C) is dominant over colourless (c); and full endosperm (R) is dominant over shrunken (r). When a dihybrid of F_1 generation was test crossed, it produced four phenotypes in the following percentage:

Coloured full - 48%

Coloured shrunken - 5%

Colourless full - 7%

Colourless shrunken - 40%

From this data, what will be the distance between two non-allelic genes?

a) 48 units b) 5 units c) 7 units **d) 12 units**

Solution : -

Given that recombinant percentage is 7% and 5% therefore, total recombinants would be 7 + 5 = 12%. It is known that one map unit is the distance that yields 1% recombinant chromosomes. Hence distance between two nonallelic genes is 12 map units.

38. Among the following characters, which one was not considered by Mendel in his experiments of pea?

a) Stem - Tall or Dwarf **b) Trichomes - Glandular or non-glandur** c) Seed - Green or Yellow d) Pod - Inflated or constricted

Solution : -

Mendel studied seven constricted characters during his experiments. The nature of trichomes were not studied by him.

39. A test cross is carried out to:

a) Predict whether two trails are linked b) Assess the number of alleles of a gene

c) Determine the genotype of F2 plant d) Determine whether two species or verities will breed successfully

Solution : -

In order to find genotype, test cross is followed i.e., crossing the F1 progeny with recessive parent.

40. A disease caused by an autosomal primary nondisjunction is ____

a) Klinefelter's syndrome b) Tumer's syndrome c) Sickel Cell anemia **d) Down's syndrome**

Solution : -

A disease caused by an autosomal primary nondisjunction is Down's syndrome. Non-disjunction is the failure of homologous chromosomes or chromatids to separate properly during cell division. Non-disjunction of 21^{st} chromosomes during oogenesis is the is the main cause of down syndrome. It occurs due to presence of an extra copy of chromosome no. 21 in human. It is also called trisomy of 21^{st} chromosomes.

41. If both parents are carriers for thalassaemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?
a) 25% b) 100% c) No chance d) 50%

42. Both sickle cell anemia and Huntington's chorea are _____ .
a) congenital disorders b) pollulant-induced disorders c) virus-related diseases
d) bacteria - related diseases

Solution : -
It is a group of disorder that causes RBCs to become misshapen and break down. Haemoglobin becomes useless for oxygen transport. Huntington Chorea is a condition in which nerve cells in the brain break down over time. It leads to irregular limbs movement, thinking disorders. They both are genetic disease present in any person since birth hence congenital disease.

43. Select the correct statement from the ones given below with respect to dihybrid cross_____
a) Tightly linked genes un the same chromosome show higher recombinations.
b) Genes far apart on the same chromosome show very few recombinations.
c) Genes loosely linked on the same chrosome show similar recombinations as the tightly linked ones
d) Tightly linked genes on the same chromosome show very few recombinations

Solution : -
Tightly linked genes on the same chromosome show very few recombinations. Recombination is the formation of new combination of gene during meiosis. Meiosis is a type of cell division which results haploid gametes. According to Morgon and his co-workers genes located on the same chromosome are called linked genes. These genes may be very tightly linked (showed very low recombination) or may be very loosely linked (showed higher recombination).

44. A normal women, whose: father was colour-blind is married to a normal man. The sons would be_____ .
a) 75% colour-blind **b) 50% color-blind** c) all normal d) all colour-blind

Solution : -
Normal woman with colour blind father would be a carrier
Woman (X^cX) Normal man (XY)
Progeny (X^cX) XX
XY X^cY
Normal Colour Blind son $\rightarrow X^cY$
Normal Son $\rightarrow XY$
But carrier daughter $\rightarrow X^cX$
Normal daughter $\rightarrow XX$
50% of the sons would be colour blind.

45. Which one of the following blood groups is not possible in children from parents with combination B x AB?
a) A b) B c) AB **d) O**

46. Select the incorrect statement from the following _____ .
a) Galactosemia is an inbom etror of metabolism.
b) Small population size results in random genetic drift in a population **c) Baldness is a sex -limited trait**
d) Linkage is an exception to the principle of independent assortment in heredity

Solution : -
Baldness is a sex limited trait. This is incorrect trait. The phenomenon of linkage is an exception to the principle of independent assortment in heredity. Galactosemia is a hereditary disease in which galactose digesting enzyme synthesised by liver is absent. Small population size results in random genetic drift in population.

47. Find odd one out (W,r,t.pea traits).

a) Yellow ootyledon b) Yellow pod c) Terminal flower d) Constricted pod

48. The grain colour of wheat is determined by the additive effect of two pairs genes. Accordingly the F_2 inheritance appears in the ratio of 15 red:1 white. The fifteen red appear in different shades in the ratio of
a) 9:3:3 b) 6:6:3 c) 1:4:7:3 **d) 1:4:6:4**

49. A polygenic inheritance in human beings is _____ .
a) skin colour b) phenylketonuria c) colour blindness d) sickle-cell anaemia

Solution : -
Human skin colour is controlled by polygenic effect atleast by three separate genes. Skin colour is determined by cumulative genes and this hypothesis was designed by Devenport and Devenport in 1910.

50. 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.

Solution : -
Mendel performed crosses involving two characters called as dihybrid cross. Results of the dihybrid cross where the two parents different in two pairs of contrasting traits i.e. seed colour and seed shape are as follows: