

Principles of Inheritance and Variation — NEET Biology PYQ (2005-2021)

Class 12 Biology · 84 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. The production of gametes by the parents, formation of zygotes, the F_1 and F_2 plants, can be understood from a diagram called :

- (A) Bullet square
- (B) Punch square
- (C) Punnett square
- (D) Net square

NEET 2021

2. In a cross between a male and female, both heterozygous for sickle cell anaemia gene, what percentage of the progeny will be diseased ?

- (A) 50%
- (B) 75%
- (C) 25%
- (D) 100%

NEET 2020 · Q6

3. Identify the wrong statement with reference to the gene 'I' that controls ABO blood groups.

- (A) The gene (I) has three alleles.
- (B) A person will have only two of the three alleles.
- (C) When I^A and I^B are present together, they express same type of sugar.
- (D) Allele 'i' does not produce any sugar.

NEET 2020 · Q8

4. Select the correct match.

- (A) Haemophilia - Y linked
- (B) Phenylketonuria - Autosomal dominant trait
- (C) Sickle cell anaemia - Autosomal recessive trait, chromosome-11
- (D) Thalassaemia - X linked

NEET 2020 · Q61

5. How many true breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits?

- (A) 4
- (B) 2
- (C) 14
- (D) 8

NEET 2020 · Q83

6. Experimental verification of the chromosomal theory of inheritance was done by:

- (A) Mendel
- (B) Sutton
- (C) Boveri
- (D) Morgan

NEET 2019 · Q121

7. Select the incorrect statement.

- (A) Male fruit fly is heterogametic.
- (B) In male grasshoppers, 50% of sperms have no sex-chromosome.
- (C) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
- (D) Human males have one of their sex-chromosome much shorter than the other.

NEET 2019 · Q129

8. What map unit (Centimorgan) is adopted in the construction of genetic maps ?

- (A) A unit of distance between two expressed genes, representing 10% cross over.
- (B) A unit of distance between two expressed genes, representing 100% cross over.
- (C) A unit of distance between genes on chromosomes, representing 1% cross over.
- (D) A unit of distance between genes on chromosomes, representing 50% cross over.

NEET 2019 · Q147

9. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation, pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statement from the following :

- (A) This experiment does not follow the Principle of Dominance.
- (B) Pink colour in F_1 is due to incomplete dominance.
- (C) Ratio of F_2 is 1/4 (Red) : 2/4 (Pink) : 1/4 (White)
- (D) Law of Segregation does not apply in this experiment.

NEET 2019 · Q165

10. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by :

- (A) T.H. Morgan
- (B) Gregor J. Mendel
- (C) Alfred Sturtevant
- (D) Sutton Boveri

NEET 2019 · Q176

11. What is the genetic disorder in which an individual has an overall masculine development, gynaecomastia, and is sterile ?

- (A) Turner's syndrome
- (B) Klinefelter's syndrome
- (C) Edward syndrome
- (D) Down's syndrome

NEET 2018 · Q104

12. Which of the following pairs is wrongly matched?

- (A) XO type sex determination : Grasshopper
- (B) ABO blood grouping : Co-dominance
- (C) Starch synthesis in pea : Multiple alleles
- (D) T.H. Morgan : Linkage

NEET 2018 · Q105

13. Select the correct statement:

- (A) Spliceosomes take part in translation.
- (B) Punnett square was developed by a British scientist.
- (C) Franklin Stahl coined the term "linkage".
- (D) Transduction was discovered by S. Altman.

NEET 2018 · Q159

14. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by

- (A) Only grandchildren
- (B) Only sons
- (C) Only daughters
- (D) Both sons and daughters

NEET 2018 · Q180

15. Which of the following characteristics represent 'Inheritance of blood groups' in humans?

- a. Dominance
- b. Co-dominance
- c. Multiple allele
- d. Incomplete dominance
- e. Polygenic inheritance

- (A) Co-dominance, Incomplete dominance and Polygenic inheritance
- (B) Dominance, Co-dominance and Multiple allele
- (C) Co-dominance, Multiple allele and Polygenic inheritance
- (D) Dominance, Multiple allele and Polygenic inheritance

NEET 2017 · Q93

16. Thalassaemia and sickle cell anemia are caused due to a problem in globin molecule synthesis. Select the correct statement.

- (A) Both are due to a qualitative defect in globin chain synthesis.
- (B) Both are due to a quantitative defect in globin chain synthesis.
- (C) Thalassaemia is due to less synthesis of globin molecules.
- (D) Sickle cell anemia is due to a quantitative problem of globin molecules.

NEET 2017 · Q104

17. Which one from those given below is the period for Mendel's hybridization experiments?

- (A) 1856 - 1863
- (B) 1840 - 1850
- (C) 1857 - 1869
- (D) 1870 - 1877

NEET 2017 · Q118

18. The genotypes of a Husband and Wife are $I^A I^B$ and $I^A i$.

Among the blood types of their children, how many different genotypes and phenotypes are possible?

- (A) 3 genotypes ; 3 phenotypes
- (B) 3 genotypes ; 4 phenotypes
- (C) 4 genotypes ; 3 phenotypes
- (D) 4 genotypes ; 4 phenotypes

NEET 2017 (Gujarati paper) · Q58

19. The recessive genes located on X-chromosome in humans are always:

- (A) expressed in females
- (B) expressed in males
- (C) lethal
- (D) sub-lethal

NEET 2017 (Gujarati paper) · Q64

20. Select the correct option:

- (A) Phenylketonuria is X linked disease and results in accumulation of phenylpyruvic acid.
- (B) Down's syndrome is due to triploidy and results in mental retardation.
- (C) Turner's syndrome is due to trisomy and results in sterile female.
- (D) Klinefelter's syndrome is due to extra X chromosome and results in sterile male.

NEET 2017 (Gujarati paper) · Q118

21. Select the wrong statement:

- (A) Law of Dominance and Law of Independent Assortment were proposed by Mendel
- (B) Linkage and recombination were discovered by Sutton
- (C) Three scientists independently rediscovered the Mendel's laws in 1900
- (D) Chromosomal Theory of Inheritance was proposed by Sutton

22. Which one of the following is not true for the experiments of Mendel on pea?

- (A) He chose characters of two contrasting states
- (B) He used true-breeding lines
- (C) His observations were based on natural, open pollination
- (D) His experiments had large sampling size

23. The mechanism that causes a gene to move from one linkage group to another is called

- (A) inversion
- (B) duplication
- (C) translocation
- (D) crossing-over

24. A true breeding plant is

- (A) one that is able to breed on its own
- (B) produced due to cross-pollination among unrelated plants
- (C) near homozygous and produces offspring of its own kind
- (D) always homozygous recessive in its genetic constitution

25. If a colour-blind man marries a woman who is homozygous for normal colour vision, the probability of their son being colour-blind is

- (A) 0
- (B) 0.5
- (C) 0.75
- (D) 1

26. Which of the following most appropriately describes haemophilia?

- (A) Recessive gene disorder
- (B) X - linked recessive gene disorder
- (C) Chromosomal disorder
- (D) Dominant gene disorder

27. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F₁ plants were selfed the resulting genotypes were in the ratio of:

- (A) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf
- (B) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf
- (C) 3 : 1 :: Tall : Dwarf
- (D) 3 : 1 :: Dwarf : Tall

28. Match the terms in Column I with their description in Column II and choose the correct option:

Column I: (a) Dominance (b) Codominance (c) Pleiotropy (d) Polygenic inheritance

Column II: (i) Many genes govern a single character (ii) In a heterozygous organism only one allele expresses itself (iii) In a heterozygous organism both alleles express themselves fully (iv) A single gene influences many characters

- (A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
- (B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
- (C) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
- (D) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

NEET 2016 Phase 1 · Q128

29. Pick out the correct statements:

- (a) Haemophilia is a sex-linked recessive disease.**
- (b) Down's syndrome is due to aneuploidy.**
- (c) Phenylketonuria is an autosomal recessive gene disorder.**
- (d) Sickle cell anaemia is an X - linked recessive gene disorder.**

- (A) (a) and (d) are correct.
- (B) (b) and (d) are correct.
- (C) (a), (c) and (d) are correct.
- (D) (a), (b) and (c) are correct.

NEET 2016 Phase 1 · Q170

30. In a testcross involving F₁ dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates:

- (A) The two genes are located on two different chromosomes.
- (B) Chromosomes failed to separate during meiosis.
- (C) The two genes are linked and present on the same chromosome.
- (D) Both of the characters are controlled by more than one gene.

NEET 2016 Phase 1 · Q179

31. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in:

- (A) Aneuploidy
- (B) Polyploidy
- (C) Somaclonal variation
- (D) Polyteny

AIPMT 2015

32. Alleles are:

- (A) heterozygotes
- (B) different phenotype
- (C) true breeding homozygotes
- (D) different molecular forms of a gene

AIPMT 2015

33. The movement of a gene from one linkage group to another is called:

- (A) Crossing over
- (B) Inversion
- (C) Duplication
- (D) Translocation

AIPMT 2015

34. Multiple alleles are present:

- (A) On non-sister chromatids
- (B) On different chromosomes
- (C) At different loci on the same chromosome
- (D) At the same locus of the chromosome

AIPMT 2015

35. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offsprings?

- (A) O only
- (B) A and B only
- (C) A, B and AB only
- (D) A, B, AB and O

AIPMT 2015

36. How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments?

- (A) Seven
- (B) Five
- (C) Six
- (D) Eight

AIPMT 2014

37. Fruit colour in squash is an example of:

- (A) Dominant epistasis
- (B) Complementary genes
- (C) Inhibitory genes
- (D) Recessive epistasis

AIPMT 2014

38. A man whose father was colour blind marries a woman who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind?

- (A) 0%
- (B) 50%
- (C) 75%
- (D) 25%

AIPMT 2014

39. A human female with Turner's syndrome:

- (A) has one additional X chromosome
- (B) exhibits male characters
- (C) is able to produce children with normal husband
- (D) has 45 chromosomes with XO

NEET 2013

40. Which of the following statements is not true of two genes that show 50% recombination frequency?

- (A) The genes may be on different chromosomes
- (B) The genes are tightly linked
- (C) The genes show independent assortment
- (D) If the genes are present on the same chromosome, they undergo more than one crossover in every meiosis

NEET 2013

41. If two persons with 'AB' blood group marry and have sufficiently large number of children, these children could be classified as 'A' blood group : 'AB' blood group : 'B' blood group in 1 : 2 : 1 ratio. Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This is an example of

- (A) Codominance
- (B) Incomplete dominance
- (C) Partial dominance
- (D) Complete dominance

NEET 2013

42. The incorrect statement with regard to haemophilia is

- (A) It is a sex-linked disease
- (B) It is a recessive disease
- (C) It is a dominant disease
- (D) A single protein involved in the clotting of blood is affected

NEET 2013

43. If both parents are carriers for thalassemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?

- (A) no chance
- (B) 50%
- (C) 25%
- (D) 100%

AIPMT 2012 Mains

44. Which one of the following is a wrong statement regarding mutations ?

- (A) Deletion and insertion of base pairs cause frame-shift mutations
- (B) Cancer cells commonly show chromosomal aberrations
- (C) UV and Gamma rays are mutagens
- (D) Change in a single base pair of DNA does not cause mutation

AIPMT 2012 Mains

45. A test cross is carried out to

- (A) determine the genotype of a plant at F_2
- (B) predict whether two traits are linked
- (C) assess the number of alleles of a gene
- (D) determine whether two species or varieties will breed successfully

AIPMT 2012 Prelims

46. A normal-visioned man whose father was colour-blind, marries a woman whose father was also colour-blind. They have their first child as a daughter. What are the chances that this child would be colour-blind ?

- (A) 50%
- (B) 100%
- (C) Zero percent
- (D) 25%

AIPMT 2011 Mains

47. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child?

- (A) Only one X chromosome
- (B) One X and one Y chromosome
- (C) Two X chromosomes
- (D) Only one Y chromosome

AIPMT 2011 Mains

48. Test cross in plants or in *Drosophila* involves crossing

- (A) The F_1 hybrid with a double recessive genotype
- (B) Between two genotypes with dominant trait
- (C) Between two genotypes with recessive trait
- (D) Between two F_1 hybrids

AIPMT 2011 Prelims

49. Which one of the following conditions correctly describes the manner of determining the sex in the given example?

- (A) Homozygous sex chromosomes (XX) produce male in *Drosophila*
- (B) Homozygous sex chromosomes (ZZ) determine female sex in birds
- (C) XO type of sex chromosomes determine male sex in grasshopper
- (D) XO condition in humans as found in Turner Syndrome, determines female sex

AIPMT 2010 Mains · Q33

50. In *Antirrhinum* two plants with pink flowers were hybridized. The F_1 plants produced red, pink and white flowers in the proportion of 1 red, 2 pink and 1 white. What could be the genotype of the two plants used for hybridization? Red flower colour is determined by RR, and white by rr genes.

- (A) rrrr
- (B) RR
- (C) Rr
- (D) rr

AIPMT 2010 Mains · Q36

51. A cross in which an organism showing a dominant phenotype is crossed with the recessive parent in order to know its genotype is called :

- (A) Monohybrid cross
- (B) Back cross
- (C) Test cross
- (D) Dihybrid cross

AIPMT 2010 Mains · Q42

52. ABO blood grouping is controlled by gene I which has three alleles and show co-dominance. There are six genotypes. How many phenotypes in all are possible?

- (A) Six
- (B) Three
- (C) Four
- (D) Five

AIPMT 2010 Mains · Q51

53. The fruit fly *Drosophila melanogaster* was found to be very suitable for experimental verification of chromosomal theory of inheritance by Morgan and his colleagues because :

- (A) It reproduces parthenogenetically
- (B) A single mating produces two young flies
- (C) Smaller female is easily recognisable from larger male
- (D) It completes life cycle in about two weeks

AIPMT 2010 Prelims · Q119

54. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance?

- (A) Factors occur in pairs
- (B) The discrete unit controlling a particular character is called a factor
- (C) Out of one pair of factors one is dominant, and the other recessive
- (D) Alleles do not show any blending and both the characters recover as such in F_2 generation

AIPMT 2010 Prelims · Q120

55. The genotype of a plant showing the dominant phenotype can be determined by

- (A) Back cross
- (B) Test cross
- (C) Dihybrid cross
- (D) Pedigree analysis

AIPMT 2010 Prelims · Q124

56. ABO blood groups in humans are controlled by the gene I. It has three alleles- I^A , I^B and i. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur?

- (A) Two
- (B) Three
- (C) One
- (D) Four

57. Select the correct statement from the ones given below with respect to dihybrid cross

- (A) Tightly linked genes on the same chromosome show very few recombinations
- (B) Tightly linked genes on the same chromosome show higher recombinations
- (C) Genes far apart on the same chromosome show very few recombinations
- (D) Genes loosely linked on the same chromosome show similar recombinations as the tightly linked ones

58. Which one of the following symbols and its representation, used in human pedigree analysis is correct?

- (A) $\blacklozenge$ = male affected
- (B) $\square=\bigcirc$ = mating between relatives
- (C) $\bigcirc$ = unaffected male
- (D) $\square$ = unaffected female

59. Sickle cell anemia is:

- (A) caused by substitution of valine by glutamic acid in the beta globin chain of haemoglobin
- (B) caused by a change in a single base pair of DNA
- (C) characterized by elongated sickle like RBCs with a nucleus
- (D) an autosomal linked dominant trait

60. Select the incorrect statement from the following:

- (A) Galactosemia is an inborn error 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

61. Point mutation involves:

- (A) Change in single base pair
- (B) Duplication
- (C) Deletion
- (D) Insertion

62. Haploids are more suitable for mutation studies than the diploids. This is because

- (A) All mutations, whether dominant or recessive are expressed in haploids
- (B) Haploids are reproductively more stable than diploids
- (C) Mutagens penetrate in haploids more effectively than diploids
- (D) Haploids are more abundant in nature than diploids

63. Which one of the following conditions in humans is correctly matched with its chromosomal abnormality/ linkage?

- (A) Down syndrome - 44 autosomes + XO
- (B) Klinefelter syndrome - 44 autosomes + XXY
- (C) Colour blindness - Y-linked
- (D) Erythroblastosis foetalis - X-linked

64. In the hexaploid wheat, the haploid (n) and basic (x) numbers of chromosomes are

- (A) $n = 21$ and $x = 21$
- (B) $n = 21$ and $x = 14$
- (C) $n = 21$ and $x = 7$
- (D) $n = 7$ and $x = 21$

65. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRY $\times$ rry genotypes are hybridized, the F $_2$ segregation will show

- (A) segregation in the expected 9 : 3 : 3 : 1 ratio
- (B) segregation in 3 : 1 ratio
- (C) higher number of the parental types
- (D) higher number of the recombinant types

66. Inheritance of skin colour in humans is an example of

- (A) point mutation
- (B) polygenic inheritance
- (C) codominance
- (D) chromosomal aberration

67. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F $_1$ generation?

- (A) 9 : 1
- (B) 1 : 3
- (C) 3 : 1
- (D) 50 : 50

68. A human male produces sperms with the genotypes AB, Ab, aB, and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person?

- (A) AaBB
- (B) AABb
- (C) AaBb
- (D) AaBb

69. Which one of the following is the most suitable, medium for culture of Drosophila melanogaster ?

- (A) Moist bread
- (B) Agar agar
- (C) Ripe banana
- (D) Cow dung

70. Phenotype of an organism is the result of :

- (A) mutations and linkages
- (B) cytoplasmic effects and nutrition
- (C) environmental changes and sexual dimorphism
- (D) genotype and environment interactions

AIPMT 2006 Prelims · Q132

71. How many different kinds of gametes will be produced by a plant having the genotype AABbCC ?

- (A) Three
- (B) Four
- (C) Nine
- (D) Two

AIPMT 2006 Prelims · Q162

72. Which one of the following is an example of polygenic inheritance ?

- (A) Flower colour in *Mirabilis jalapa*
- (B) Production of male honey bee
- (C) Pod shape in garden pea
- (D) Skin colour in humans

AIPMT 2006 Prelims · Q171

73. Test cross involves :

- (A) crossing between two genotypes with recessive trait
- (B) crossing between two F_1 hybrids
- (C) crossing the F_1 hybrid with a double recessive genotype
- (D) crossing between two genotypes with dominant trait

AIPMT 2006 Prelims · Q175

74. If a colourblind woman marries a normal visioned man, their sons will be :

- (A) all normal visioned
- (B) one-half colourblind and one-half normal
- (C) three-fourths colourblind and one-fourth normal
- (D) all colourblind

AIPMT 2006 Prelims · Q197

75. Sickle cell anaemia has not been eliminated from the African population because :

- (A) it is controlled by recessive genes
- (B) it is not a fatal disease
- (C) it provides immunity against malaria
- (D) it is controlled by dominant genes

AIPMT 2006 Prelims · Q199

76. Both sickle cell anaemia and Huntington's chorea are :

- (A) bacteria-related diseases
- (B) congenital disorders
- (C) pollutant-induced disorders
- (D) virus-related diseases

AIPMT 2005 Prelims · Q112

77. A man and a woman, who do not show any apparent signs of a certain inherited disease, have seven children (2 daughters and 5 sons). Three of the sons suffer from the given disease but none of the daughters are affected. Which of the following mode of inheritance do you suggest for this disease ?

- (A) Autosomal dominant
- (B) Sex-linked dominant
- (C) Sex-limited recessive
- (D) Sex-linked recessive

78. G-6-P dehydrogenase deficiency is associated with haemolysis of :

- (A) lymphocytes
- (B) RBCs
- (C) platelets
- (D) leucocytes

79. A woman with normal vision, but whose father was colour blind, marries a colourblind man. Suppose that the fourth child of this couple was a boy. This boy :

- (A) must have normal colour vision
- (B) will be partially colourblind since he is heterozygous for the colourblind mutant allele
- (C) must be colourblind
- (D) may be colourblind or may be of normal vision

80. Which of the following is not a hereditary disease ?

- (A) Cretinism
- (B) Cystic fibrosis
- (C) Thalassaemia
- (D) Haemophilia

81. Haemophilia is more commonly seen in human males than in human females because :

- (A) this disease is due to an X-linked dominant mutation
- (B) a greater proportion of girls die in infancy
- (C) this disease is due to an X-linked recessive mutation
- (D) this disease is due to a Y-linked recessive mutation

82. A woman with 47 chromosomes due to three copies of chromosome 21 is characterized by :

- (A) Down syndrome
- (B) triploidy
- (C) Turner syndrome
- (D) super femaleness

83. In order to find out the different types of gametes produced by a pea plant having the genotype AaBb, it should be crossed to a plant with the genotype

- (A) aaBB
- (B) AaBB
- (C) AABB
- (D) aabb

84. The salivary gland chromosomes in the dipteran larvae, are useful in gene mapping because :

- (A) these are much longer in size
- (B) these are easy to stain
- (C) these are fused
- (D) they have endoreduplicated chromosomes

Answer key and explanations

1. Answer: (C) Punnett square

The Punnett square, devised by Reginald C. Punnett, is the checkerboard diagram that shows gametes of both parents and the zygote combinations of the F_1 and F_2 generations. The other names are not real genetic terms.

2. Answer: (C) 25%

Sickle cell anaemia is autosomal recessive, so $Hb^A Hb^S \times Hb^A Hb^S$ gives $1 Hb^A Hb^A : 2 Hb^A Hb^S : 1 Hb^S Hb^S$. Only the $Hb^S Hb^S$ quarter is diseased, i.e. 25%; the 50% heterozygotes are carriers, not patients.

3. Answer: (C) When I^A and I^B are present together, they express same type of sugar.

I^A and I^B are codominant: each adds a different sugar to the plasma membrane, so a person with both shows both A and B antigens (blood group AB). The other statements are correct: gene I has three alleles, a diploid person carries any two of them, and allele i adds no sugar.

4. Answer: (C) Sickle cell anaemia - Autosomal recessive trait, chromosome-11

Sickle cell anaemia is an autosomal recessive disorder due to a mutation in the beta-globin gene on chromosome 11. Haemophilia is X-linked recessive, phenylketonuria is autosomal recessive and thalassemia is autosomal recessive, so those pairs are wrong.

5. Answer: (C) 14

Mendel chose 14 true-breeding pea varieties as 7 pairs, each pair differing in one character with contrasting traits. The trap is to answer 7, the number of characters, or 2, the number of traits per character.

6. Answer: (D) Morgan

Thomas Hunt Morgan's work on *Drosophila* gave the experimental verification of the chromosomal theory of inheritance. Sutton and Boveri proposed the theory, and Mendel worked before chromosomes were linked to heredity.

7. Answer: (C) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.

Birds show ZW-ZZ sex determination: females (ZW) are heterogametic, so the sex of the chick depends on the egg, not the sperm. Male *Drosophila* are XY, male grasshoppers are XO (half the sperms lack an X), and the human Y is much shorter than the X.

8. Answer: (C) A unit of distance between genes on chromosomes, representing 1% cross over.

One centimorgan (map unit) is the distance between genes on a chromosome that gives 1% recombination (crossing over). 50% recombination is the maximum and indicates unlinked genes.

9. Answer: (D) Law of Segregation does not apply in this experiment.

In incomplete dominance the alleles still segregate during gamete formation, which is why the F_2 shows a 1 red : 2 pink : 1 white ratio; so saying the law of segregation does not apply is incorrect. Only the principle of dominance fails here, because the heterozygote is intermediate.

10. Answer: (C) Alfred Sturtevant

Alfred Sturtevant, Morgan's student, used the frequency of recombination between gene pairs on the same chromosome as a measure of distance and mapped genes. Morgan discovered linkage and coined the term recombination but did not build the map.

11. Answer: (B) Klinefelter's syndrome

Klinefelter's syndrome (47, XXY) gives overall masculine development with feminine features such as gynaecomastia, and the individuals are sterile. Turner's syndrome (45, XO) affects females.

12. Answer: (C) Starch synthesis in pea : Multiple alleles

Starch synthesis in pea is controlled by one gene with two alleles (B and b); it is NCERT's example of incomplete dominance at the level of starch grain size and of pleiotropy, not of multiple alleles.

Grasshopper has XO sex determination, the I^A and I^B alleles of ABO are co-dominant and Morgan worked out linkage.

13. Answer: (B) Punnett square was developed by a British scientist.

The Punnett square is named after Reginald C. Punnett, a British geneticist. Spliceosomes act in splicing of hnRNA, not translation; Morgan coined the term linkage; and transduction was discovered by Zinder and Lederberg, while Altman is known for ribozymes.

14. Answer: (D) Both sons and daughters

A mother passes one of her two X chromosomes to every child, sons and daughters alike, so either sex can receive the affected X. It is the father's X that goes only to daughters, which is the trap.

15. Answer: (B) Dominance, Co-dominance and Multiple allele

ABO blood groups are controlled by one gene I with three alleles (multiple alleles); I^A and I^B are each dominant over i (dominance), and when together both are expressed (co-dominance). Blood group is not a polygenic trait and shows no incomplete dominance.

16. Answer: (C) Thalassemia is due to less synthesis of globin molecules.

Thalassemia is a quantitative problem in which too few globin chains are made. Sickle cell anaemia is a qualitative problem, an abnormal β -globin with valine in place of glutamic acid, so calling it quantitative is wrong.

17. Answer: (A) 1856 - 1863

Mendel carried out his hybridisation experiments on garden pea for seven years, from 1856 to 1863, and published them in 1865. The other ranges do not match this period.

18. Answer: (C) 4 genotypes ; 3 phenotypes

Crossing $I^A I^B \times I^A i$ gives $I^A I^A$, $I^A i$, $I^B i$ and $I^i i$, which is 4 genotypes. $I^A I^A$ and $I^A i$ are both blood group A, so the phenotypes are A, AB and B, which is 3. Group O cannot appear because no child can be $i i$.

19. Answer: (B) expressed in males

Males are hemizygous (XY), so a single recessive allele on their only X chromosome is always expressed, as in haemophilia and colour blindness. Females express it only when homozygous, and most such genes are neither lethal nor sub-lethal.

20. Answer: (D) Klinefelter's syndrome is due to extra X chromosome and results in sterile male.

Klinefelter's syndrome (47, XXY) results from an extra X chromosome and gives a sterile male.

Phenylketonuria is autosomal recessive, Down's syndrome is trisomy of chromosome 21 (not triploidy), and Turner's syndrome is a monosomy (45, XO).

21. Answer: (B) Linkage and recombination were discovered by Sutton

Linkage and recombination were discovered by T.H. Morgan through his *Drosophila* experiments, not by Sutton. Sutton (with Boveri) proposed the chromosomal theory of inheritance, and de Vries, Correns and von Tschermak rediscovered Mendel's work in 1900.

22. Answer: (C) His observations were based on natural, open pollination

Mendel made his crosses by controlled artificial pollination (emasculatation and bagging), not by natural open pollination. He did choose seven characters with two contrasting forms, start from true-breeding lines and use large samples, which gave his data statistical reliability.

23. Answer: (C) translocation

In translocation a chromosome segment breaks off and joins a non-homologous chromosome, so its genes shift to a different linkage group. Crossing over exchanges segments between homologous chromosomes of the same linkage group, and inversion and duplication change order or copy number within a chromosome.

24. Answer: (C) near homozygous and produces offspring of its own kind

A true-breeding line has been self-pollinated for generations, making it nearly homozygous, so it gives offspring with the same trait. It may be homozygous dominant or recessive, and cross-pollination among unrelated plants increases heterozygosity instead.

25. Answer: (A) 0

Colour blindness is X-linked recessive, and a son gets his only X chromosome from his mother. Here the mother is XX with two normal alleles and the father passes only his Y to sons, so every son is normal and the probability is 0; the daughters will be carriers.

26. Answer: (B) X - linked recessive gene disorder

Haemophilia is caused by a recessive allele on the X chromosome, so it is a sex-linked (X-linked) recessive disorder, seen mostly in males. 'Recessive gene disorder' is true but less precise; it is not a chromosomal or dominant disorder.

27. Answer: (A) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf

$TT \times tt$ gives Tt in F_1 ; selfing Tt gives $TT : Tt : tt$ in a 1 : 2 : 1 ratio, i.e. tall homozygous : tall heterozygous : dwarf. 3 : 1 tall : dwarf is the phenotypic ratio, not the genotypic one asked for.

28. Answer: (B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Dominance means only one allele is expressed in the heterozygote; codominance means both alleles are fully expressed (e.g. ABO blood group); pleiotropy is one gene affecting several traits (e.g. phenylketonuria); polygenic inheritance is many genes controlling one trait (e.g. skin colour).

29. Answer: (D) (a), (b) and (c) are correct.

Haemophilia is X-linked recessive, Down's syndrome results from trisomy 21 (aneuploidy) and phenylketonuria is autosomal recessive. Sickle-cell anaemia is autosomal recessive (HbS gene on chromosome 11), not X-linked, so every combination containing it is wrong.

30. Answer: (C) The two genes are linked and present on the same chromosome.

Independent assortment would give equal parental and recombinant classes (1:1:1:1) in a dihybrid testcross. An excess of parental types means the genes tend to be inherited together, i.e. they are linked on the same chromosome, with recombinants coming only from crossing over.

31. Answer: (B) Polyploidy

If chromosomes separate but no cell plate forms (failure of cytokinesis), both sets stay in one cell and the chromosome number doubles, i.e. polyploidy. Aneuploidy is gain or loss of single chromosomes, and polyteny is repeated DNA replication without separation of chromatids.

32. Answer: (D) different molecular forms of a gene

Alleles are alternative forms of the same gene at one locus, differing slightly in their DNA sequence. Heterozygotes and true-breeding homozygotes are kinds of individuals, and a phenotype is the visible trait, not the gene form.

33. Answer: (D) Translocation

Translocation moves a chromosome segment, with its genes, to a non-homologous chromosome, which is a different linkage group. Crossing over only exchanges segments between homologous chromosomes of the same linkage group.

34. Answer: (D) At the same locus of the chromosome

Multiple alleles are more than two alternative forms of one gene, so they all occupy the same locus (e.g. I^A , I^B and i of the ABO gene). Genes at different loci or on different chromosomes are different genes, not alleles.

35. Answer: (D) A, B, AB and O

If both parents are heterozygous ($I^A i \times I^B i$), the children can be $I^A I^B$ (group AB), $I^A i$ (group A), $I^B i$ (group B) or ii (group O). So all four groups are possible; 'A, B and AB only' would apply only if one parent were homozygous.

36. Answer: (A) Seven

Mendel studied seven pairs of contrasting characters in pea, such as tall/dwarf stem, round/wrinkled seed and yellow/green seed.

37. Answer: (A) Dominant epistasis

In summer squash the dominant allele for white fruit colour masks the expression of the gene for yellow versus green, giving a 12 : 3 : 1 ratio in F_2 , which is dominant epistasis. Recessive epistasis gives 9 : 3 : 4 and complementary genes give 9 : 7, so those do not fit.

38. Answer: (B) 50%

The woman's colour-blind mother must give her X^c and her normal father gives a normal X, so she is a carrier (XX^c). Sons receive their X only from the mother, so half the sons get X^c and are colour blind: 50%. The man's father being colour blind does not matter, because a father never passes his X to his sons and the man himself is normal.

39. Answer: (D) has 45 chromosomes with XO

Turner's syndrome results from absence of one X chromosome, giving $44 + XO = 45$ chromosomes. Such females are sterile with rudimentary ovaries, so they cannot bear children, and they do not have an extra X (that is Klinefelter's XXY in males) or male characters.

40. Answer: (B) The genes are tightly linked

A recombination frequency of 50% is the maximum and is what unlinked genes show, so such genes behave as if assorting independently, whether on different chromosomes or far apart on one chromosome with multiple crossovers. Tightly linked genes show very low recombination, so calling them tightly linked is the untrue statement.

41. Answer: (A) Codominance

In AB individuals both the I^A and I^B alleles are fully expressed, producing both A and B proteins, which is codominance. In incomplete dominance the heterozygote would have an intermediate phenotype instead of showing both parental products.

42. Answer: (C) It is a dominant disease

Haemophilia is an X-linked recessive disorder in which a single clotting factor protein is affected. Calling it a dominant disease is the incorrect statement.

43. Answer: (C) 25%

Two carriers ($Tt \times Tt$) give $TT : Tt : tt$ in a 1 : 2 : 1 ratio, so the chance of an affected (tt) child is $1/4$, i.e. 25%. 50% is the chance of a carrier child.

44. Answer: (D) Change in a single base pair of DNA does not cause mutation

A change in a single base pair is itself a mutation (a point mutation, as in sickle-cell anaemia), so that statement is wrong. Insertions and deletions do shift the reading frame, cancer cells commonly show chromosomal aberrations, and UV and gamma rays are mutagens.

45. Answer: (A) determine the genotype of a plant at F₂

A test cross crosses a dominant-phenotype plant (such as one from the F₂) with the homozygous recessive parent; the offspring ratio reveals whether that plant is homozygous or heterozygous. It is not a tool for testing linkage or counting alleles.

46. Answer: (C) Zero percent

The man has normal vision, so his X chromosome carries the normal allele; every daughter receives this X from him. The woman, whose father was colour-blind, is a carrier, but the daughter can be at most a carrier, so her chance of being colour-blind is zero.

47. Answer: (C) Two X chromosomes

A normal human female has 44 autosomes plus two X chromosomes (44 + XX). A single X gives Turner's syndrome, X with Y gives a male, and a zygote with only a Y chromosome is not viable.

48. Answer: (A) The F₁ hybrid with a double recessive genotype

A test cross crosses an organism showing the dominant phenotype, typically the F₁ hybrid, with the recessive parent; for two genes that is the double recessive genotype. Crossing two F₁ hybrids is a selfing or F₂ cross, not a test cross.

49. Answer: (C) XO type of sex chromosomes determine male sex in grasshopper

In grasshoppers, males have only one X chromosome (XO) and females have XX, so the XO condition determines the male sex. In *Drosophila* XX is female, in birds ZZ is male, and in humans sex is decided by the presence or absence of the Y chromosome.

50. Answer: (C) Rr

Flower colour in *Antirrhinum* (dog flower) shows incomplete dominance, so the heterozygote Rr is pink. Crossing Rr × Rr gives RR : Rr : rr in a 1 : 2 : 1 ratio, i.e. red : pink : white. RR or rr parents would breed true for red or white.

51. Answer: (C) Test cross

Crossing a dominant-phenotype individual of unknown genotype with a homozygous recessive is a test cross: all dominant offspring means the individual was homozygous, and a 1 : 1 ratio means it was heterozygous. A back cross is any cross of F₁ with either parent, so only the cross with the recessive parent is the test cross.

52. Answer: (C) Four

The three alleles I^A, I^B and i give six genotypes, but I^A and I^B are dominant over i and co-dominant with each other, so only four phenotypes appear: A, B, AB and O. Six would be correct only if every genotype looked different.

53. Answer: (D) It completes life cycle in about two weeks

Drosophila is useful for genetics because it completes its life cycle in about two weeks, a single mating gives a large number of progeny, and the sexes are easy to tell apart. The female is larger than the male, not smaller, and flies reproduce sexually, not parthenogenetically.

54. Answer: (D) Alleles do not show any blending and both the characters recover as such in F₂ generation

The return of both parental traits unchanged in the F₂, without blending, is explained by the Law of Segregation (purity of gametes), not by the Law of Dominance. Paired factors and one dominant factor masking a recessive one are the ideas behind dominance.

55. Answer: (B) Test cross

In a test cross, the dominant-phenotype plant is crossed with a homozygous recessive. All dominant offspring mean it is homozygous, and a 1:1 ratio means it is heterozygous. A back cross can be made to either parent, so it does not necessarily reveal the genotype.

56. Answer: (D) Four

The six genotypes give four blood groups: A (I^AI^A, I^Ai), B (I^BI^B, I^Bi), AB (I^AI^B, codominance) and O (ii). The answer 'three' misses the AB group, where both alleles are expressed.

57. Answer: (A) Tightly linked genes on the same chromosome show very few recombinations

Morgan found that genes lying close together (tightly linked) rarely separate by crossing over, so they show few recombinants, as with the white-eye and yellow-body genes in *Drosophila*. Genes far apart or loosely linked show more recombination, not less.

58. Answer: (B) $\square=\bigcirc$ = mating between relatives

In pedigree charts, a double line joining a male (square) and a female (circle) shows a consanguineous mating, that is, mating between relatives. A shaded diamond is an affected person of unspecified sex, a plain circle is an unaffected female, and a plain square is an unaffected male.

59. Answer: (B) caused by a change in a single base pair of DNA

Sickle cell anaemia results from a single base substitution (GAG to GUG) in the β -globin gene, a point mutation, so glutamic acid at the sixth position is replaced by valine, not the other way round. The trait is autosomal recessive and mature RBCs have no nucleus.

60. Answer: (C) Baldness is a sex-limited trait

Baldness is a sex-influenced trait (expressed more often in males because of hormones), not a sex-limited trait, which is expressed in only one sex. The other statements are correct: galactosemia is an inborn error, genetic drift is strong in small populations, and linked genes do not assort independently.

61. Answer: (A) Change in single base pair

A point mutation is a change in a single base pair of DNA, as in sickle cell anaemia. Duplication and larger deletions or insertions alter segments of chromosomes or DNA rather than a single base.

62. Answer: (A) All mutations, whether dominant or recessive are expressed in haploids

A haploid has only one copy of each gene, so a recessive mutation cannot be masked by a dominant allele and shows up directly in the phenotype. Mutagen penetration does not depend on ploidy, so that option gives a wrong reason.

63. Answer: (B) Klinefelter syndrome - 44 autosomes + XXY

Klinefelter syndrome results from an extra X chromosome in a male, giving 44 autosomes + XXY (47 chromosomes). Down syndrome is trisomy 21 (44 + XO is Turner syndrome), colour blindness is X-linked, and erythroblastosis foetalis comes from Rh incompatibility, not sex linkage.

64. Answer: (C) $n = 21$ and $x = 7$

Bread wheat is hexaploid with $2n = 6x = 42$. Its gametes carry $n = 21$ chromosomes, and the basic set is $x = 42/6 = 7$. Options that equate n and x ignore that n here contains three basic sets.

65. Answer: (C) higher number of the parental types

Genes lying very close together are tightly linked and rarely separated by crossing over, so the F_2 shows many more parental combinations than recombinants. The 9:3:3:1 ratio holds only for independently assorting genes.

66. Answer: (B) polygenic inheritance

Human skin colour is controlled by several genes with additive effects, giving continuous variation; this is polygenic inheritance. Codominance involves two alleles of one gene both being expressed, as in ABO blood groups.

67. Answer: (D) 50 : 50

$Yy \times yy$ gives half Yy (yellow) and half yy (green), a 1:1 or 50:50 ratio. A 3:1 ratio would need both parents to be heterozygous.

68. Answer: (D) AaBb

Four gamete types in equal proportions are produced only by a double heterozygote (AaBb) with independent assortment. AaBB or AABb would give only two gamete types, and AABB only one.

69. Answer: (C) Ripe banana

Drosophila feeds on yeasts in fermenting fruit, so ripe (overripe) banana is the classic simple culture medium. Agar alone has no food value for the flies.

70. Answer: (D) genotype and environment interactions

The observable phenotype is produced by the genotype acting within a given environment. Mutations, nutrition or sexual dimorphism each affect only a part of it.

71. Answer: (D) Two

Only the B gene is heterozygous, so the plant makes $2^1 = 2$ kinds of gametes: ABC and AbC. AA and CC each give only one kind of allele.

72. Answer: (D) Skin colour in humans

Human skin colour is controlled by several genes with additive effects, giving continuous variation; this is polygenic inheritance. Flower colour in *Mirabilis jalapa* shows incomplete dominance of a single gene.

73. Answer: (C) crossing the F₁ hybrid with a double recessive genotype

In a test cross the F₁ (or any dominant-phenotype) plant is crossed with the homozygous recessive parent to find its genotype. Crossing two F₁ hybrids is selfing that gives the F₂.

74. Answer: (D) all colourblind

A colourblind woman is X^cX^c, so every son gets an X carrying the colourblind allele from her and a Y from the father; all sons are colourblind. The daughters would be carriers with normal vision.

75. Answer: (C) it provides immunity against malaria

Heterozygous carriers (HbA HbS) are more resistant to falciparum malaria, so the allele is kept in high frequency where malaria is common. Simply being recessive does not explain why the allele persists at such a high frequency.

76. Answer: (B) congenital disorders

Both sickle cell anaemia and Huntington's chorea are genetic (inherited) disorders, present from birth in the genotype. They are not caused by microbes or pollutants.

77. Answer: (D) Sex-linked recessive

Unaffected parents with affected sons only fits an X-linked recessive trait: the mother is a carrier and passes the mutant X to some sons, while daughters receive the father's normal X and are not affected. A dominant trait would show up in at least one of the parents.

78. Answer: (B) RBCs

Red blood cells rely on glucose-6-phosphate dehydrogenase to make NADPH, which protects them from oxidative damage. In the X-linked deficiency, oxidant drugs or fava beans cause RBCs to break down (haemolytic anaemia). White cells and platelets are not the cells that lyse.

79. Answer: (D) may be colourblind or may be of normal vision

The woman got her colour-blind father's X, so she is a carrier (X^cX). A son always gets his X from his mother, so each son has a 50% chance of colour blindness, whatever the birth order. Males carry only one X, so a son cannot be heterozygous.

80. Answer: (A) Cretinism

Cretinism is caused by thyroid hormone deficiency in childhood (often iodine deficiency), a hormonal disorder rather than an inherited gene defect. Cystic fibrosis, thalassaemia and haemophilia are all Mendelian genetic disorders.

81. Answer: (C) this disease is due to an X-linked recessive mutation

Haemophilia is X-linked recessive. Males have one X, so one mutant allele causes the disease, while females need two copies and are usually carriers. A Y-linked trait would never appear in females at all.

82. Answer: (A) Down syndrome

Trisomy 21 (47 chromosomes) is Down syndrome. Turner syndrome is 45,XO, super female is XXX (trisomy of the X), and triploidy would mean three full sets (69 chromosomes).

83. Answer: (D) aabb

A test cross with the double recessive aabb works because that parent gives only ab gametes, so each offspring's phenotype shows exactly which gamete came from the AaBb plant. Dominant alleles in the tester would hide the recessive gametes.

84. Answer: (D) they have endoreduplicated chromosomes

Polytene chromosomes form by repeated DNA replication without cell division (endoreduplication), so many chromatids lie side by side. This gives clear band patterns that can be linked to particular genes. Their large size is a result of endoreduplication, and the bands are what make mapping possible.

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