

Biology

Principles of Inheritance and Variation

- Q.1 Mendel's last law is**
 (a) segregation (b) dominance
 (c) independent assortment (d) polygenic inheritance
- Q.2 The contrasting pairs of factors in Mendelian crosses are called**
 (a) multiple alleles (b) alleles
 (c) alloloci (d) paramorphs
- Q.3 Statement I :** Down's syndrome is due to polyploidy.
Statement II : It occurs due to changes in whole set of chromosomes.
 (a) Both statements are correct
 (b) Statement I is correct & II is incorrect
 (c) Statement I is incorrect & II is correct
 (d) Both statements are incorrect
- Q.4 Which of the following crosses will give tall and dwarf pea plants in same proportions?**
 (a) $TT \times tt$ (b) $Tt \times tt$
 (c) $TT \times Tt$ (d) $tt \times tt$
- Q.5 A pure tall pea was crossed with a pure dwarf pea. All the plants of F_1 were found to be tall. This is due to**
 (a) law of dominance.
 (b) disappearance of factor for dwarfness in F_1 generation.
 (c) segregation of factors.
 (d) co-ordination.
- Q.6 The F_2 generation of a cross produced identical phenotypic and genotypic ratio. It is not an expected Mendelian result, and can be attributed to**
 (a) independent assortment
 (b) linkage
 (c) incomplete dominance
 (d) none of the above
- Q.7 Statement I :** In Turner's syndrome, one X-chromosome is missing and in Klinefelter's syndrome, the condition is XXY.
Statement II : These can be easily studied by analysis of karyotypes.
 (a) Both statements are correct
 (b) Statement I is correct & II is incorrect
 (c) Statement I is incorrect & II is correct
 (d) Both statements are incorrect
- Q.8 Mendel selected pea as material for his experiments because**
 (a) it is an annual plant with comparatively short life cycle.
 (b) the flowers are self-pollinated.
 (c) the number of seeds produced is quite large.
 (d) all of the above.
- Q.9 Which of the following crosses would produce a genotypic ratio of 1 : 2 : 1 in F_2 ?**
 (a) $AB \times AB$ (b) $Ab \times ab$
 (c) $Ab \times Ab$ (d) $ab \times ab$
- Q.10 Punnett square is used to know the**
 (a) outcome of a cross
 (b) probable result of a cross
 (c) types of gametes
 (d) result of meiosis
- Q.11 Statement I :** Person with blood group AB can take blood from any other person.
Statement II : Blood group incompatibility is due to antigen antibody reaction. Blood group AB has no antibody and thus the antigen of other group is not affected.
 (a) Both statements are correct
 (b) Statement I is correct & II is incorrect
 (c) Statement I is incorrect & II is correct
 (d) Both statements are incorrect
- Q.12 Mutations can be induced with**
 (a) infrared radiations (b) I AA
 (c) ethylene (d) gamma radiations
- Q.13 Statement I :** Haemophilia shows transmission from carrier female to male progeny.
Statement II : The trait linked to the X-sex chromosome.
 (a) Both statements are correct
 (b) Statement I is correct & II is incorrect
 (c) Statement I is incorrect & II is correct
 (d) Both statements are incorrect
- Q.14 In XO type of sex determination**
 (a) females produce two different types of gametes.
 (b) males produce two different types of gametes.
 (c) females produce gametes with Y chromosomes.
 (d) males produce single type of gametes.

Q.15 Which one of the following cannot be explained on the basis of Mendel's law of dominance?

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

Q.16 Select the correct statement from the ones given below with respect to dihybrid cross.

- (a) Tightly linked genes on 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 chromosome show similar recombinations as the tightly linked ones.
- (d) Tightly linked genes on the same chromosome show very few recombinations.

Q.17 Which one of the following conditions correctly describes the manner of determining the sex in the given example?

- (a) Homozygous sex chromosomes (ZZ) determine female sex in birds.
- (b) XO type of sex chromosomes determine male sex in grasshopper.
- (c) XO condition in human as found in Turner's syndrome, determines female sex.
- (d) Homozygous sex chromosomes (XX) produce male in Drosophila.

Q.18 Which one of the following is an incorrect statement regarding mutations?

- (a) Deletion and insertion of base pairs cause frameshift 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.

Q.19 Match column-I with column-II and select the correct answer using the codes given below.

Column-I	Column-II
A. ABO blood groups	I. Dihybrid cross
B. Law of segregation	II. Monohybrid cross
C. Law of Independent assortment	III. Base pairs substitution
D. Gene mutation	IV. Multiple allelism
(a) A – II; B – I; C – IV; D – III	
(b) A – IV; B – I; C – II; D – III	
(c) A – IV; B – II; C – I; D – III	
(d) A – II; B – III; C – IV; D – I	

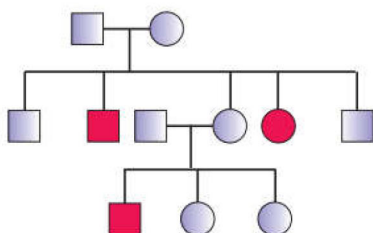
Q.20 Match column-I with column-II and select the correct answer using the codes given below.

Column-I	Column-II
A. Turner syndrome	I. Trisomy
B. Linkage	II. AA + XO
C. Y-chromosome	III. Morgan
D. Down's syndrome	IV. Testis determining factor
(a) A – II; B – I; C – IV; D – III	
(b) A – II; B – I; C – III; D – IV	
(c) A – IV; B – II; C – I; D – III	
(d) A – II; B – III; C – IV; D – I	

Q.21 Match column-I with column-II and find the correct answer.

Column -I	Column -II
A. Monoploidy	I. $2n - 1$
B. Monosomy	II. $2n + 1$
C. Nullisomy	III. $2n + 2$
D. Trisomy	IV. $2n - 2$
E. Tetrasomy	V. n
	VI. $3n$
(a) A – V, B – I, C – IV, D – II, E – III	
(b) A – V, B – II, C – IV, D – I, E – III	
(c) A – VI, B – V, C – III, D – IV, E – II	
(d) A – II, B – I, C – III, D – VI, E – V	

Q.22 Study the pedigree chart given below and choose its correct representation.

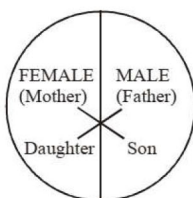


- (a) Inheritance of a condition like phenylketonuria as an autosomal recessive trait.
- (b) The pedigree chart is wrong as this is not possible.
- (c) Inheritance of a recessive sex-linked disease like haemophilia.
- (d) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria.

Q.23 Which one of the following symbols and its representation, used in human pedigree analysis is correct?

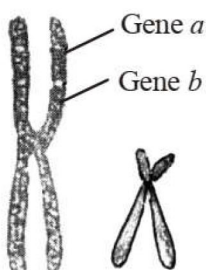
- (a) = mating between relatives
- (b) = unaffected male
- (c) = unaffected female
- (d) = male affected

Q.24 The given figure represents the inheritance pattern of a certain type of traits in humans. Which one of the following conditions could be an example of this pattern?



- (a) Thalassemia
- (b) Haemophilia
- (c) Phenylketonuria
- (d) Sickle cell anaemia

Q.25 The given figure is a highly simplified representation of the human sex chromosomes from a karyotype. The gene a and b could be of



- (a) colour blindness and body height.
- (b) attached ear lobe and Rhesus blood group.
- (c) haemophilia and red-green colour blindness.
- (d) phenylketonuria and haemophilia.

Q.26 **Statement I :** Phenylketonuria affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine.

Statement II : Accumulation of urea in brain results in mental retardation.

- (a) Both statements are correct
- (b) Statement I is correct & II is incorrect
- (c) Statement I is incorrect & II is correct
- (d) Both statements are incorrect

Q.27 According to the law of independent assortment in a dihybrid cross

- (a) there are four genotypes in F_2 .
- (b) F_2 contains 16 phenotypes.
- (c) there is a single individual which is homozygous recessive for both the characters.
- (d) it is not possible to forecast the different phenotypes.

Q.28 In case of codominance, the offsprings of F_1 generation have the trait

- (a) of either of two parents.
- (b) of both the parents.
- (c) of none of the parents.
- (d) in between the traits of two parents.

Q.29 **Statement I :** Cytoplasmic inheritance occurs only due to plasmagenes.

Statement II : Plasmagenes are restricted to only cell organelles, i.e., mitochondria and chloroplast.

- (a) Both statements are correct
- (b) Statement I is correct & II is incorrect
- (c) Statement I is incorrect & II is correct
- (d) Both statements are incorrect

Q.30 **Statement I :** Complementary genes are non-allelic genes.

Statement II : Complementary genes interact to produce a completely new traits.

- (a) Both statements are correct
- (b) Statement I is correct & II is incorrect
- (c) Statement I is incorrect & II is correct
- (d) Both statements are incorrect

- Q.31 Which one of the following correctly represents the nature of blood in the ABO system of blood groups pertaining to the presence of antigens and antibodies?**
 (a) Blood group A –Antibody A and antigen B
 (b) Blood group B–Antigen B and antibody A
 (c) Blood group AB–Both antibodies A and B
 (d) Blood group O–No antigens and no antibodies
- Q.32 In Down's syndrome, karyotyping has shown that the disorder is associated with trisomy of chromosome number 21 usually due to**
 (a) non-disjunction during gamete formation.
 (b) disjunction during sperm cell formation.
 (c) addition of extrachromosome during cleavage of zygote.
 (d) disjunction during egg cells production and sperm production.
- Q.33 Two organisms that are true-breeding for a certain genetic characteristic are mated and their offspring were analysed. Which of the following statements are correct for all possible cross.**
 (a) Both parents are homozygotes.
 (b) The offspring are either all homozygotes or all heterozygotes.
 (c) The offspring represent the F_1 generation and the gametes produced by the offspring will carry only one allele for this gene.
 (d) All of the above
- Q.34 Why is the allele for wrinkled seed shape in garden peas considered recessive ?**
 (a) It "recedes" in the F_2 generation when homozygous parents are crossed.
 (b) The trait associated with the allele is not expressed in heterozygotes.
 (c) Individuals with the allele have lower fitness than that of individuals with the dominant allele.
 (d) The allele is less common than the dominant allele. (The wrinkled allele is a rare mutant).
- Q.35 The crossing of F_1 to homozygous recessive parent is called**
 (a) back cross (b) test cross
 (c) F_1 cross (d) all of these
- Q.36 The test cross is used to determine the**
 (a) genotype of the plant (b) phenotype of the plant
 (c) both (a) and (b) (d) None of the above
- Q.37 ABO blood group system is due to**
 (a) multifactor inheritance
 (b) incomplete dominance
 (c) multiple allelism
 (d) epistasis
- Q.38 In humans, the dominance relationship between the A and B alleles of the ABO blood group gene is an example of**
 (a) complete dominance
 (b) incomplete dominance
 (c) codominance
 (d) epistasis
- Q.39 The distance between the genes is measured by**
 (a) angstrom (b) map unit
 (c) Dobson unit (d) millimetre
- Q.40 Linkage reduces the frequency of**
 (a) hybrids.
 (b) all parental types.
 (c) homozygous recessive parents.
 (d) heterozygous recessive parents.
- Q.41 Distance between the genes and percentage of recombination shows**
 (a) a direct relationship
 (b) an inverse relationship
 (c) a parallel relationship
 (d) no relationship
- Q.42 Statement I : The strength of linkage will be more when the distance between two genes is lesser. Statement II : In such case crossing over will be relatively less frequent.**
 (a) Both statements are correct
 (b) Statement I is correct & II is incorrect
 (c) Statement I is incorrect & II is correct
 (d) Both statements are incorrect
- Q.43 Sex is determined in human beings**
 (a) by ovum.
 (b) at time of fertilization.
 (c) 40 days after fertilization.
 (d) seventh to eight week when genitals differentiate in foetus.

- Q.44** The 'X' body of Henking was observed in
 (a) all sperms during spermatogenesis.
 (b) all eggs during oogenesis.
 (c) half of the sperms during spermatogenesis.
 (d) half of the eggs during oogenesis.
- Q.45** Which of the following statement is not correct of two genes that show 50% recombination frequency?
 (a) The genes are tightly linked.
 (b) The genes show independent assortment.
 (c) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis.
 (d) The genes may be on different chromosomes.
- Q.46** Refer the given statements and select the correct option.
 (i) Percentage of homozygous dominant individuals obtained by selfing Aa individuals is 25%.
 (ii) Types of genetically different gametes produced by genotype AABbcc are 2.
 (iii) Phenotypic ratio of monohybrid F_2 progeny in case *Mirabilis jalapa* is 3 : 1.
 (a) All the statements are true.
 (b) Statements (i) and (ii) are true, but statement (iii) is false.
 (c) Statements (i) and (iii) are true, but statement (ii) is false.
 (d) Statements (ii) and (iii) are true, but statement (i) is false.
- Q.47** **Assertion :** 'Factors' regulating the characters are found in pairs.
Reason : The dominant characters are even expressed when factors are in heterozygous condition
 (a) Assertion and reason both are true and the reason is correct explanation of assertion.
 (b) Assertion and reason both are true but reason is not correct explanation of assertion.
 (c) Assertion is true but reason is wrong.
 (d) Assertion and reason both are wrong.
- Q.48** Identify the incorrect statement.
 (a) In male grasshoppers, 50% of the sperms have no sex chromosome.
 (b) Usually female birds produce two types of gametes based on sex chromosomes.
 (c) The human males have one of their sex chromosomes much shorter than the other.
 (d) In domesticated fowls, the sex of the progeny depends on the type of sperm that fertilizes the egg.
- Q.49** Which of the following statements are correct ?
 (i) Incomplete or mosaic inheritance is an example of pre-Mendelian concept of blending inheritance.
 (ii) Test cross is a special type of back cross.
 (iii) Chromosomal aberrations are commonly observed in cancer cells.
 (iv) Thalassaemia is a Mendelian disorder.
 (a) (i) and (ii)
 (b) (ii), (iii) and (iv)
 (c) (ii) and (iv)
 (d) (i) and (iv) only
- Q.50** Match the column-I with column-II and choose the correct option.

Column -I	Column -II
A. Incomplete dominance	I. <i>Drosophila</i>
B. Mendelian disorder	II. <i>Antirrhinum</i> sp.
C. Transforming principle	III. Griffith
D. Dihybrid cross	IV. Haemophilia

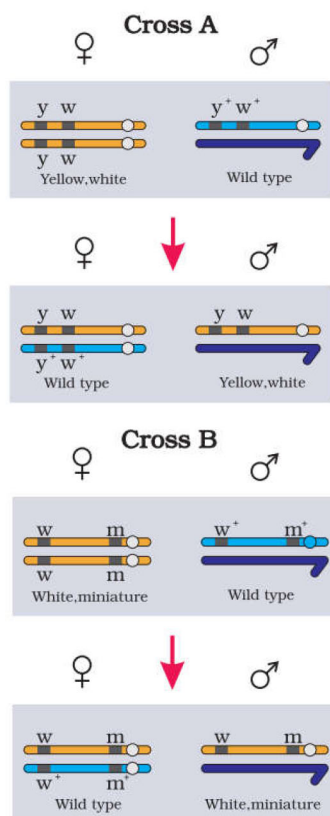
 (a) A – I; B – IV; C – III; D – II
 (b) A – IV; B – II; C – III; D – I
 (c) A – II; B – III; C – IV; D – I
 (d) A – II; B – IV; C – III; D – I
- Q.51** Match column-I with their name given in column-II and choose the correct answer.

Column -I	Column -II
A. Alfred Sturtevant	I. Mapped position of genes
B. Henking	II. X-body
C. Meischer	III. Nuclein
D. Morgan	IV. Dihybrid crosses in <i>Drosophila</i>

 (a) A – I, B – III, C – IV, D – II
 (b) A – I, B – II, C – III, D – IV
 (c) A – IV, B – I, C – II, D – III
 (d) A – III, B – II, C – IV, D – I
- Q.52** **Assertion :** A recessive character that was not expressed in heterozygous condition may be expressed again when it becomes homozygous.
Reason : The characters never blend in heterozygous condition.

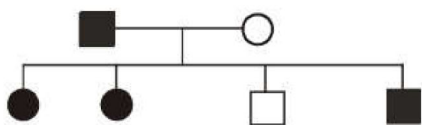
- (a) Assertion and reason both are true and the reason is correct explanation of assertion.
(b) Assertion and reason both are true but reason is not correct explanation of assertion.
(c) Assertion is true but reason is wrong.
(d) Assertion and reason both are wrong.

Q.53 The experiment shown in the given figure has been carried out by Morgan to show the phenomenon of linkage and recombination. If in cross A, genes are tightly linked and in cross B, genes are loosely linked then what will be the percentage of recombinants produced in cross A and cross B respectively?



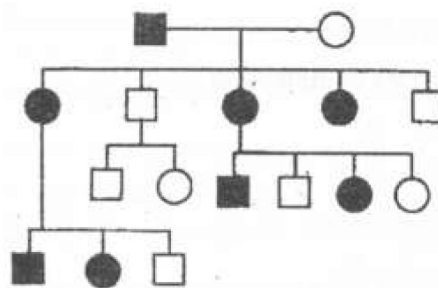
- (a) 98.7% and 62.8% (b) 1.3% and 37.2%
(c) 37.2 and 1.3% (d) 62.8% and 98.7%

Q.54 Study the pedigree chart of a certain family given below and select the correct conclusion which can be drawn for the character.



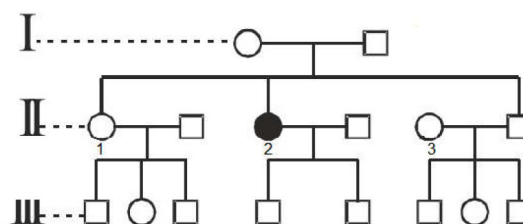
- (a) The female parent is heterozygous.
(b) The parents could not have had a normal daughter for this character.
(c) The trait under study could not be colourblindness.
(d) The male parent is homozygous dominant.

Q.55 Identify the type of inheritance shown in the diagram.



- (a) dominant X-linked (b) recessive X-linked
(c) dominant Y-linked (d) recessive Y-linked

Q.56 Following is a pedigree for albinism (aa). What is the probability of II -1 to be a heterozygous ?



- (a) $\frac{1}{3}$ (b) $\frac{1}{2}$
(c) $\frac{2}{3}$ (d) $\frac{1}{4}$

Q.57 In Mendelian dihybrid cross when heterozygous round yellow are self crossed, round green offsprings are represented by genotype

- (a) RrYy, RrYY, RRYy (b) RrYY, RRyy, rryy
(c) rrYy, rrYY (d) Rryy, RRYy

Q.58 In Drosophila, XXY represents a female but in human it is an abnormal male. It shows that

- (a) Y-chromosome is essential for male sex in human.
(b) Y-chromosome is essential for female sex determination in Drosophila.
(c) Y-chromosome is not essential for male sex determination in human.
(d) All of the above

Q.59 A tobacco plant heterozygous for albinism (a recessive character) is self-pollinated and 1200 seeds are subsequently germinated. How many seedlings would have the parental genotype?

- (a) 1250 (b) 600
(c) 300 (d) 2250

- Q.60 Multiple alleles are present**
 (a) at different loci in the same chromosome.
 (b) in different chromosomes.
 (c) at the same locus in one type of chromosomes.
 (d) None of the above
- Q.61 Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father?**
 (a) 50% (b) 25%
 (c) 100% (d) 75%
- Q.62 Assertion :** Characters segregate while formation of gametes.
Reason : The recessive characters are only expressed in homozygous conditions.
 (a) Assertion and reason both are true and the reason is correct explanation of assertion.
 (b) Assertion and reason both are true but reason is not correct explanation of assertion.
 (c) Assertion is true but reason is wrong.
 (d) Assertion and reason both are wrong.
- Q.63 The law of segregation of characters postulated by Mendel can be related to**
 (a) the presence of two genes for each character in a somatic cell.
 (b) a gamete receiving only one of the two homologous chromosomes during meiosis.
 (c) presence of both genes on the same chromosome.
 (d) None of the above
- Q.64 Assertion :** The Mendel's laws were extended in the form of 'Chromosomal Theory of Inheritance'.
Reason : Mendel's law of independent assortment does not hold true for the genes that were located on the same chromosomes.
 (a) Assertion and reason both are true and the reason is correct explanation of assertion.
 (b) Assertion and reason both are true but reason is not correct explanation of assertion.
 (c) Assertion is true but reason is wrong.
 (d) Assertion and reason both are wrong.
- Q.65 In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross $RR YY \times rryy$?**
 (a) Only wrinkled seeds with green cotyledons.
 (b) Only wrinkled seeds with both yellow cotyledons.
 (c) Only round seeds with yellow cotyledons.
 (d) Round seeds with yellow cotyledons and wrinkled seeds with green cotyledons.
- Q.66 A man has enlarged breasts, sparse hairs on the body and sex chromosomal formula XXY. He then suffers from**
 (a) Down's syndrome
 (b) Edward's syndrome
 (c) Turner's syndrome
 (d) Klinefelter's syndrome
- Q.67 Assertion :** 'Linked genes' located on the same chromosomes.
Reason : Closely located genes assorted together, and distantly located genes, due to recombination, assorted independently.
 (a) Assertion and reason both are true and the reason is correct explanation of assertion.
 (b) Assertion and reason both are true but reason is not correct explanation of assertion.
 (c) Assertion is true but reason is wrong.
 (d) Assertion and reason both are wrong.
- Q.68 Assertion :** In humans, a normal female has sex chromosomes (XX) and male has sex chromosomes as (XY).
Reason : In chicken, sex chromosomes in male are ZZ and in females are ZW.
 (a) Assertion and reason both are true and the reason is correct explanation of assertion.
 (b) Assertion and reason both are true but reason is not correct explanation of assertion.
 (c) Assertion is true but reason is wrong.
 (d) Assertion and reason both are wrong.
- Q.69 In sickle-cell anaemia, shape of RBCs under oxygen tension becomes**
 (a) biconcave disc like (b) elongated and curved
 (c) circular (d) spherical
- Q.70 Sickle cell anaemia 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.

- Q.71** 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
- Q.72** It is well known that Queen Victoria of England was a carrier for haemophilia. Since this is an X-linked disease, it can be predicted that
- (a) all of her sons would have had disease.
(b) all her daughters would have been carriers.
(c) her father must definitely have had haemophilia.
(d) haemophilia would have occurred in more of her male than her female descendents.
- Q.73** The number of phenotypes in ABO blood groups is
- (a) 1 (b) 4
(c) 6 (d) 8
- Q.74** 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.
- Q.75** The person with Turner's syndrome has
- (a) 45 autosomes and X sex chromosome
(b) 44 autosomes and XYY sex chromosomes
(c) 45 autosomes and XYY sex chromosomes
(d) 44 autosomes and X sex chromosome
- Q.76** In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation all pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statements from the following.
- (a) Law of segregation does not apply in this experiment.
(b) This experiment does not follow the Principle of Dominance.
(c) Pink colour in F_1 is due to incomplete dominance.
(d) Ratio of F_2 is $\frac{1}{4}$ (red) : $\frac{2}{4}$ (pink) : $\frac{1}{4}$ (white).
- Q.77** Three children in a family have blood types O, AB and B respectively. What are the genotypes of their parents?
- (a) $I^A i$ and $I^B i$ (b) $I^A I^B$ and $i i$
(c) $I^B I^B$ and $I^A I^A$ (d) $I^A I^A$ and $I^B i$
- Q.78** Which of the following statements are correct?
- (i) Haemophilia is a sex-linked recessive disease.
(ii) Down's syndrome is due to aneuploidy.
(iii) Phenylketonuria is an autosomal dominant gene disorder.
(iv) Phenylketonuria is an autosomal recessive gene disorder.
(v) Sickle-cell anaemia is an X-linked recessive gene disorder.
- (a) (i), (iii) and (v) (b) (i) and (iii)
(c) (ii) and (v) (d) (i), (ii) and (iv)
- Q.79** Choose the correct statements given below regarding Mendelian inheritance.
- (i) Mendel's experiments had small sample size which gave greater credibility to the data.
(ii) A true breeding line shows a stable trait inheritance and expression for several generations.
(iii) In a dissimilar pair of factors, one member of the pair dominates over the other.
(iv) A recessive parental trait is expressed only in its heterozygous condition.
(v) Two alleles of a gene are located on homologous sites on homologous.
- (a) (ii) only (b) (ii), (iii) and (v)
(c) (i), (iii) and (v) (d) (i) and (v)
- Q.80** Which of the following statements are the correct?
- (i) Failure of segregation of chromatids during cell division results in aneuploidy.
(ii) Chromosomal disorders are mainly determined by alteration or mutation in a single gene.
(iii) Thalassaemia and cystic fibrosis are Mendelian disorders.
(iv) Sickle cell anemia is an X-linked trait.
(v) Haemophilia is an autosome linked recessive disease.
- (a) (i) and (iii) (b) (i), (iii) and (iv)
(c) (iii) and (iv) (d) (ii) and (iii)

Q.81 Match column-I with column-II and select the correct option from the codes given below.

Column-I	Column-II
A. Autosomal recessive trait	I. Down's syndrome
B. Sex-linked recessive trait	II. Phenylketonuria
C. Metabolic error linked to autosomal recessive	III. Haemophilia
D. Additional 21 st chromosome	IV. Sickle cell anaemia

- (a) A – II; B – I; C – IV; D – III
(b) A – IV; B – I; C – II; D – III
(c) A – IV; B – III; C – II; D – I
(d) A – III; B – IV; C – I; D – II

Q.82 Match column-I (Definition) with column-II (Terms) and select the correct option from the codes given below.

Column-I (Definition)	Column-II (Terms)
A. A single trait controlled by three or more than three alleles	I. Pleiotropy
B. A single trait controlled by three or more than three genes	II. Multiple alleles
C. A single gene exhibits multiple phenotypic expression	III. Polygenic inheritance

- (a) A – II; B – III; C – I
(b) A – III; B – II; C – I
(c) A – I; B – II; C – III
(d) A – II; B – I; C – III

Q.83 A mutation is a

- (a) sudden temporary change in an organism's genetic material.
(b) change in phenotype followed by a change in genotype.
(c) change in hereditary material directed by a changing environment.
(d) change in genotype which may result in a new expression of a characteristic.

Q.84 Harmful mutations does not get eliminated from gene pool because

- (a) they are recessive and carried by homozygous individuals.
(b) they are recessive and carried by heterozygous individuals.
(c) they are formed repeatedly.
(d) they show genetic drift.

Q.85 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) 3 : 1 :: Tall : Dwarf
(b) 3 : 1 :: Dwarf : Tall
(c) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf
(d) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf.

Q.86 In a normal couple, half the sons are haemophilic while half the daughters are carriers. The gene responsible for it is located on

- (a) X-chromosome of father.
(b) Y-chromosome of father.
(c) one X-chromosome of mother.
(d) both the X-chromosomes of mother.

Q.87 What proportion of the offsprings obtained from cross AABbCc × AaBbCc will be completely heterozygous for all genes segregated independently?

- (a) 1/8 (b) 1/4
(c) 1/2 (d) 1/16

Q.88 How would you test a pea plant whether it is a pure or hybrid for tallness ?

- (a) Cross the pea plant with another tall pea plant of unknown genotype.
(b) Cross the pea plant with a pure tall pea plant.
(c) Cross the pea plant with a homozygous dwarf pea.
(d) Cross the pea plant with any pea plant.

Q.89 Experimental verification of the chromosomal theory of inheritance was done by

- (a) Mendel (b) Sutton
(c) Boveri (d) Morgan

Q.90 Mendel was successful in formulating the laws of inheritance whereas his predecessors were not because

- (a) he studied one clear-cut character at a time.
(b) the characters studied by him were present on separate chromosomes.
(c) of the right choice of material.
(d) he kept accurate records of his experiments.
- Q.91** A human male produces sperms with the genotypes AB, Ab, aB and ab pertaining to two di-allelic characters in equal proportions. What is the corresponding genotype of this person?
(a) AaBB (b) AABb
(c) AABb (d) AaBb
- Q.92** The F_2 generation offspring in a plant showing incomplete dominance, exhibit
(a) variable genotypic and phenotypic ratios.
(b) a genotypic ratio of 1 : 1.
(c) a phenotypic ratio of 3 : 1.
(d) similar phenotypic and genotypic ratios of 1 : 2 : 1.
- Q.93** Sex determination in grasshoppers, humans, and Drosophila is similar because
(a) females are hemizygous.
(b) males have one X-chromosome and females have two X-chromosomes.
(c) all males always have one Y-chromosome in all three species.
(d) the ratio of autosomes to sex chromosomes is the same in all three organisms.
- Q.94** Mendel's rules do not correctly predict patterns of inheritance for tightly linked genes or the inheritance of alleles that show incomplete dominance or epistasis. Does this mean that his hypothesis are incorrect ?
(a) Yes, because they are relevant to only a small number of organisms and traits.
(b) Yes, because not all data support his hypothesis.
(c) No, because he was not aware of meiosis or the chromosome theory of inheritance.
(d) No, it just means that his hypothesis are limited to certain conditions.
- Q.95** Assertion : The genetic component of an organism is called genotype.
Reason : Genotype is the type of hereditary properties of an organism.
(a) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
(b) If both Assertion and Reason are true but the Reason is not the correction explanation of the Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.
- Q.96** Which of the following characteristics represent 'inheritance of blood groups' in humans?
(i) Dominance
(ii) Co-dominance
(iii) Multiple allele
(iv) Incomplete dominance
(v) Polygenic inheritance
(a) (ii), (iii) and (v) (b) (i), (ii) and (iii)
(c) (ii), (iv) and (v) (d) (i), (iii) and (v)
- Q.97** Probability of four sons to a couple is
(a) 1/4 (b) 1/8
(c) 1/16 (d) 1/32
- Q.98** Assertion : In humans, the gamete contributed by the male determines whether the child produced will be male or female.
Reason : Sex in humans is a polygenic trait depending upon a cumulative effect of some genes on X-chromosome and some on Y-chromosome.
(a) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
(b) If both Assertion and Reason are true but the Reason is not the correction explanation of the Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.
- Q.99** A male human is heterozygous for autosomal genes A and B and is also hemizygous for haemophilic gene h. What proportion of his sperms will be abh?
(a) 1/8 (b) 1/32
(c) 1/16 (d) 1/4
- Q.100** Assertion : Test cross is used to determine an unknown genotype within one breeding generation.
Reason : Test cross is a cross between F_1 hybrid and dominant parent.
(a) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.
(b) If both Assertion and Reason are true but the Reason is not the correction explanation of the Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

Solution

1. (c)
Mendel's second or last law was "law of independent Assortment". It states that genes of different characters located in different pairs of chromosomes are independent of one another in this segregation during gamete formation.
2. (b)
Allele or allelomorph is a pair of contrasting characters in Mendelian crosses. Alleles are slightly different forms of the same gene.
3. (d)
(I) Down's syndrome is due to **aneuploidy**.
(II) It occurs due to changes in **number** of chromosomes.
4. (b)
5. (a)
According to law of dominance, only one character or factor expresses itself in F_1 generation and this character is called dominant. Therefore in this cross, character of tallness, which is observed in all the plants of F_1 generation, is the dominant character.
6. (c)
Incomplete dominance is the phenomenon where dominant allele does not completely express itself. This phenomenon was first studied in flower colour of *Mirabilis jalapa* or four O' clock plant. The phenotypic as well as genotypic monohybrid ratio in F_2 generation in incomplete dominance is 1 : 2 : 1 i.e., pure dominant : hybrid : pure recessive. F_1 generation expresses a phenotype which is intermediate between those of the parent, e.g., pink flowers are obtained when red and white flowered plants are crossed.
7. (a)
Both statements are correct.
8. (d)
Mendel selected Garden pea as material for his hybridization experiments because of the following reasons:
(i) Hybridization or crossing in pea is easy.
(ii) It has bisexual flowers.
(iii) It has a number of well defined contrasting characters.
(iv) It shows predominantly self - fertilization.
(v) It has a short life span.
9. (c)
Selfing $Ab \times Ab$
 F_2 generation:

	A	b
A	AA	Ab
b	Ab	bb

Phenotypic ratio: 3 : 1
Genotypic ratio: AA : Ab : bb
1 : 2 : 1
Ab $\times$ Ab would produce a genotypic ratio of 1:2:1 in F_2 generation.
10. (b)
Punnett square is a checker-board used to show the result of a cross between two organisms. It was devised by geneticist, R.C. Punnett (1927). It depicts both genotype and phenotype of the progeny
11. (a)
Both statements are correct.
12. (d)
Mutation is the process by which genetic variations are created through changes in the base sequence within genes. It is possible to induce mutations artificially through use of chemicals or radiations (like gamma radiations).
13. (a)
Both statements are correct.
14. (b)
In 'XO' type of sex determination, males produce two different types of gametes, e.g., grasshopper where half of the sperms contain X-chromosomes while the other half lacking 'X' chromosomes or possessing 'O'.
15. (c)
According to Mendel's law of Dominance, out of two contrasting allelomorphous factors only one expresses itself in an individual. The factor that expresses itself is called dominant while the other which has not shown its effect in the heterozygous individual is termed as recessive. The option (c) in the given question cannot be explained on the basis of law of dominance. It can only be explained on the basis of Mendel's Law of independent assortment, according to which in a dihybrid cross, the two alleles of each character assort independently of the alleles of other character and separate at the time of gamete formation.

16. (d)
When two allelic pair are used for crossing, it is called dihybrid cross. Linkage is the inheritance of genes of same chromosome together and capacity of these genes to retain their parental combination in subsequent generation. The strength of linkage between two genes is inversely proportional to the distance between the two. This means, two linked genes show higher frequency of recombination if the distance between them is higher and lower frequency if the distance is smaller.
17. (b)
XO type of sex chromosomes determine male sex in grasshoppers. This type of sex-determination comes under XX-XO type. Its common examples are cockroaches, grasshoppers and bugs. The female has two homomorphic sex chromosomes XX and is homogametic. It produces similar eggs, each with one X-chromosome. The male has one chromosome only and is heterogametic. It produces 2 types of sperms : gynosperms with X and androsperms without X. In grasshopper, the males lack Y-sex chromosome and have only an X-chromosome besides autosomes whereas females have a pair of X-chromosomes. Male produce sperm cells that contain either an X-chromosome or no sex chromosome, which is designated as O.
18. (d)
Change in single base pair of DNA is also a type of mutations called point mutations. It is a type of mutation that causes the replacement of a single base nucleotide with another nucleotide of the genetic material, DNA or RNA. For example, a point mutation is the cause of sickle cell disease.
19. (c)
ABO blood group is an example of multiple allelisms because of presence of more than two alleles (I^A , I^B and i) of a gene. They are produced due to repeated mutation of the same gene but in different directions. Law of segregation can be explained with the help of monohybrid cross.. Law of independent assortment can be explained with the help of dihybrid cross. Law of independent assortment states that allele pairs, which are independent of one another, separate independently during the formation of gametes. Gene mutation is a permanent alteration in the DNA sequence. Mutations range in size; they can affect anywhere from a single DNA building block (base pair) to a large segment of a chromosome that includes multiple genes.
20. (d)
Turner's syndrome is a genetic defect in which affected women have only one X chromosome (XO), and causes developmental abnormalities and infertility. Linkage is the tendency of alleles that are located close together on a chromosome to be inherited together during meiosis. Morgan coined the term linkage to describe the physical association of genes on chromosomes. Y chromosomes are referred to as the testis determining factor (also known as sex determining factor). Down's syndrome arises due to trisomy of chromosome 21. It is usually caused by an error in cell division called "nondisjunction" which results in an embryo with three copies of chromosome 21 instead of the usual two.
21. (a)
A-V, B-I, C-IV, D-II, E-III
Monoploidy – n
Monosomy – $2n - 1$
Nullisomy – $2n - 2$
Trisomy – $2n + 1$
Tetrasomy – $2n + 2$
22. (a)
The pedigree chart shows the inheritance of a condition like phenylketonuria as an autosomal recessive trait. Parents need to be heterozygous as two of their children are known to be sufferer of the disease. It cannot be recessive sex linked inheritance because then the male parent would also be a sufferer.
23. (a)
Pedigree analysis is a record of the occurrence of a trait in several generations of a human family. In this male members are shown by squares and female by circles. Sibs are represented horizontally on a line in order of birth. It helps us in giving information about genotype of an individual for trait under investigation.
24. (b)
The inheritance pattern of a particular trait shown in the given picture results in haemophilia. Haemophilia is a group of inherited blood disorders in which the blood does not clot properly. It is caused by a fault in one of the genes that determine how the body makes blood clotting factor VIII or IX. These genes are located on the X-chromosome. Haemophilia appears only in human male which can be transferred to their grandson through their carrier daughter (Criss-cross inheritance).

25. (c)
In the given figure of sex chromosomes, gene a and b present on X chromosomes represent disordershaemophilia and red green colour blindness. Both these disorders occur due to recessive sex linked genes present on sex chromosomes. Red green colour blindness is more common in males than females due to presence of only one X chromosomes.
The sufferers are not able to distinguish red and green colour.
26. (b)
(II) Accumulation of **phenylpyruvic acid** in brain results in mental retardation.
27. (c)
28. (b)
In co-dominance, both the genes are expressed for a particular character in F₁ hybrid progeny. There is no blending of characters, whereas both the characters are expressed equally. Examples : Codominance is seen in animals for coat colour. When a black parent is crossed with white parent, a roan colour in F₁ progeny is produced.
29. (b)
(II) Plasmagones are restricted to only **female organelle which is present in ovum/egg cell**.
30. (a)
Both statements are correct.
31. (b)
ABO system is one of the most important human "blood group systems". The system is based on the presence or absence of antigens A and B on the surface of red blood cells and antibodies against these in blood serum. A person whose blood contains either or both of these antibodies cannot receive a transfusion of blood containing the corresponding antigens as this would cause the red blood cells to clump.
- | Type of blood group | Antigen | Antibody |
|---------------------|---------|---------------|
| A | A | Anti-B or 'b' |
| B | B | Anti-A or 'a' |
| AB | A, B | Absent |
| O | None | 'a' and 'b' |
32. (a)
Down's syndrome is also known as Mongolian idiocy or mongolism. In Langdon Down of England (1866) studied the Mongolian idiocy and described the trisomic condition of their chromosomes. Down's syndrome, a very common congenital abnormality arises due to the failure of separation of 21st pair of autosomes during meiosis. Thus, an egg is produced with 24 chromosomes instead of 23. A Down's syndrome has 3 autosomes in 21st pair instead of 2. Total number of chromosome in this case is $2n + 1$ (21^{st}) = 47.
33. (d)
Given that both parents are true-breeding, the cross must be either $AA \times AA$, $AA \times aa$, or $aa \times aa$. If you work out these crosses, you will see that all of the possible answers are true for each possible situation.
34. (b)
Allele for wrinkled shape of seed in garden pea plant is considered to be recessive because the trait (character) associated with the allele is not expressed in heterozygotes.
35. (b)
The crossing of F₁ to homozygous recessive parent is called test cross. Test cross is a cross between two individuals in which one individual shows the dominant phenotype of a characteristic and the other individual who is homozygous recessive for that trait in order to determine the genotype of the dominant individual.
36. (a)
The test cross is used to determine the genotype of the offsprings, to know whether the offspring is homozygous or heterozygous.
37. (c)
The mode of inheritance in case of multiple alleles is called multiple allelism. A well known and simplest example of multiple allelism is the inheritance of ABO blood groups in human beings. In human population, 3 different alleles for this characters are found – I^A, I^B and I^O. A person is having only two of these three alleles and blood type can be determined.

38. (c)
Codominance is the phenomenon of two alleles lacking dominant recessive relationship and both express themselves in the organisms. The codominant alleles are able to express themselves independently when present together. ABO blood groups are controlled by the gene I. Gene I has three alleles I^A , I^B and i .
39. (b)
40. (a)
Linkage is the tendency for alleles of different genes to be passed together from one generation to the next. It reduces the frequency of hybrids.
41. (a)
Distance between the genes $\propto$ to the percentage of recombination.
42. (a)
Both statements are correct.
43. (b)
A pair of X chromosomes is present in the female whereas X and Y chromosomes are present in the male. There is an equal possibility of fertilization of the ovum (female gamete containing pair of X chromosomes) with the sperm (male gamete) carrying either X or Y chromosomes. If ovum fertilizes with a sperm carrying X chromosome the zygote develops into the female offspring and the fertilization of ovum with sperm (carrying Y chromosome) results into the male offspring. On this basis, it is evident that only sperm plays an important role to determine the sex of a child.
44. (c)
The X body of Henking was observed in half of the sperms during spermatogenesis. During his experiments on insects, Henking found the traces of a nuclear structure all through the process of spermatogenesis which he named it as X body. He also observed that, after spermatogenesis, exact half of the sperms received this X body, while the remaining half did not. Later, scientists found out that this X body of Henking was actually a chromosome and hence, named it X-chromosome.
45. (a)
Tightly linked genes show more linkage than crossing over.
46. (b)
Mirabilis jalapa shows incomplete dominance with a phenotype of 1 : 2 : 1.
47. (b)
According to Mendel's law of dominance, factors (heterozygous condition) occur in pair and in a dissimilar pair of factors one member of the pair dominates (dominant) the other (recessive).
48. (d)
In many birds, female has a pair of dissimilar chromosomes ZW and male has two similar ZZ chromosomes unlike mammals, the sex in birds is decided by the Ova/eggs of the female and not by the sperms of the male.
49. (b)
Statement (ii), (iii) and (iv) are correct.
(i) Incomplete or mosaic inheritance is not an example of pre - Mendelian concept of blending inheritance because the parental types reappear in the F_2 generation. However, it is considered to be an example of quantitative inheritance where only a single gene pair is involved and F_2 phenotypic ratio is 1 : 2 : 1, similar to genotypic ratio.
50. (d)
Incomplete dominance (discovered by Correns) is the phenomenon where dominant allele does not completely express itself. The inheritance of flower colour in *Antirrhinum sp.* is a good example of incomplete dominance. Haemophilia is a sex linked recessive disease. It is a type of Mendelian disorder since its inheritance follows the principles of Mendelian genetics and can be traced in a family by pedigree analysis. Transforming principle was given by Griffith. Dihybrid cross is a cross when two allelic pair are used for crossing. Several dihybrid crosses were carried out in *Drosophila* to study genes that were sex linked.
51. (b)
52. (a)
Recessive characters are the ones which cannot express themselves in the presence of dominant characters. These are expressed only in homozygous condition. On the other hand, dominant characters are expressed in both homozygous and heterozygous conditions. This is because characters never blend with each other.

53. (b)
The percentage of recombinants produced in cross I and cross II are respectively 1.3% and 37.2%.
54. (a)
On the basis of the given pedigree chart of a certain family, it can be concluded that the female parent (shown by blank circle) is heterozygous where one gene is dominant and other gene is recessive.
55. (a)
The type of inheritance shown in the given diagram is dominant X linked
56. (c)
Parents are heterozygous normal otherwise II-2 could not be albino. Now cross between 2-heterozygous
(Aa) produces AA (1) : Aa (2) : aa (1). Since II-1 is normal, the chances of a heterozygous (normal) child will be 2 out of three, i.e., 2/3.
57. (d)
58. (a)
In *Drosophila*, XXY represents a female but in human it is an abnormal male, because Y chromosomes are essential for determining the sex of the individual. Normally male individual possess X and Y chromosomes and female have XX chromosomes. Therefore individual having XXY genotype is an abnormal male.
59. (b)
60. (c)
More than two alternative forms (alleles) of a gene in a population occupying the same locus on a chromosome or its homologue are known as multiple alleles.
61. (a)
Down's syndrome is the example of autosomal aneuploidy. Here, an extra copy of chromosome 21 occurs. During gametogenesis, 50% gametes of the affected parent will have extra chromosome. Thus, the percentage of affected offsprings produced from affected mother and normal father should be 50%.
62. (b)
Reason : According to principle of segregation (second law of Mendelism), the two factors of a character which remain together in an individual do not get mixed up but keep their identity distinct, separate at the time of gametogenesis or sporogenesis, get randomly distributed to different offspring. Gametes carry a single factor or allele for a trait.

63. (b)
The law of segregation of characters postulated by Mendel can be related to a gamete receiving only one of the two homologous chromosomes during meiosis.

64. (b)
Reason : The Mendel's laws were extended in the form of Chromosomal Theory of Inheritance because during Mendel's experimentation, the society was not acceptable to such drastic changes in their scientific ideas. They could not believe the existence of such discrete factors such as genes which would segregate without mixing as this did not support their idea of the constant changes leading to evolution. Moreover, the means of communication was poor at that time as a result of which, the information could not be conveyed to the masses. Also, Mendel's mathematical approach to prove biological laws was unacceptable.

65. (d)
Since round seed shape is dominant over wrinkled seed shape and yellow cotyledon is dominant over green cotyledon so *RRYY* individuals is round yellow and *rryy* is wrinkled green.

Round yellow seeds X Wrinkled green seeds
RRYY *rryy*



F_1 generation *RrYy*

F_2 generation is obtained by selfing F_1 .

♀ \ ♂	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Expected phenotypes in F_2 generation are round yellow seed 9, wrinkled yellow seed 3, round green seed 3, wrinkled green seed 1.

66. (d)
Klinefelter's syndrome occurs due to trisomy of sex chromosomes which results in (XXY) sex chromosomes. Total chromosomes in such persons are $2n + 1 = 47$ in place of 46. Klinefelter (1942) found that testes in such male remain underdeveloped in adulthood. They develop secondary sex characters of female like large breasts and loss of facial hair. Characters of male develop due to Y-chromosome and those like female due to XX chromosomes. About one male child out of every 5,000 born, develops Klinefelter's

syndrome. Such children are born as a result of fertilization of abnormal eggs (XX) with normal sperm with Y-chromosome or by fertilization of normal eggs with (X) chromosomes by abnormal sperms with (XY) chromosome. They are sterile males, mentally retarded and are eunuchs.

67. (a)

When two genes are close together on the same chromosome, they do not assort independently and are said to be linked. The linked genes tend to get inherited together as the link between them fails to break. Genes whose loci are nearer to each other are less likely to be separated onto different chromatids during chromosomal crossover, and are therefore said to be genetically linked. In other words, the nearer two genes are on a chromosome, the lower is the chance of a swap occurring between them, and the more likely they are to be inherited together.

68. (b)

Both in humans and in *Drosophila*, the female has a pair of XX chromosomes (homogametic) and the male XY (heterogametic) composition. In many birds, female has a pair of dissimilar chromosomes ZW and male two similar ZZ chromosomes.

69. (b)

70. (b)

Sickle cell anaemia is an autosomal linked recessive trait that can be transmitted from parents to the offsprings when both the partners are carrier for gene (or heterozygous). It is caused by a change in a single base pair of DNA. Sickle-cell anaemia is the name of a specific form of sickle-cell disease in which there is homozygosity for the mutation that causes HbS. Sickle-cell disease, or sickle-cell anaemia, is a lifelong blood disorder characterized by red blood cells that assume an abnormal, rigid, sickle shape. Sickling decreases the cells flexibility and results in a risk of various complications.

71. (c)

Mendel conducted artificial pollination or cross pollination experiments using several true-breeding pea lines. He selected 14 true-breeding pea plant varieties, as pairs which were similar except for one character with contrasting traits. Some of the contrasting traits selected were smooth or wrinkled seeds, yellow or green seeds, inflated (full) or constricted green or yellow pods and tall or dwarf plants.

72. (d)

Since haemophilia is an X linked disease it can be predicted that haemophilia would have occurred in more of her male than her female descendants due to criss cross inheritance. Haemophilia (also known as bleeder disorder) is a sex linked recessive disease which occurs due to deficiency of plasma thromboplastin or antihemophilia globulin during which the exposed blood does not clot. It transfers from unaffected carrier female to some of the male progeny. The possibility of female becoming a haemophilic is extremely rare because mother of such female has to be at least carrier and the father should be haemophilic.

73. (b)

The three alleles I^A , I^B and i of gene I in ABO blood group system can produce six different genotypes and four different phenotypes as shown below :

Genotype	Phenotype
A^1A^1	Blood group A
A^1i	
B^1B^1	Blood group B
B^1i	
A^1B^1	Blood group AB
ii	Blood group O

74. (c)

ABO blood groups are controlled by the gene I. The gene (I) has three alleles I^A , I^B and i . The alleles I^A and I^B produce a slightly different form of the sugar while allele i does not produce any sugar. Because humans are diploid organisms, each person possesses any two of the three I gene alleles. When I^A and I^B are present together they both express their own types of sugars, because of co-dominance.

75. (d)

Turner's syndrome is caused by the absence of X-chromosomes in females. Persons suffering from Turner's syndrome are monosomic for sex chromosomes i.e., possess only one X and no Y chromosome (XO). In other words they have chromosome number $2n - 1 = 45$. They are phenotypic females but are sterile because they have under developed reproductive organs. They are dwarf about 4 feet 10 inches and are flat chested with wide spread nipples of mammary glands which never enlarge like those in normal woman. They develop as normal female in

- childhood but at adolescence their ovaries remain underdeveloped. They lack female hormone estrogen. About one out of every 5,000 female births results in Turner's syndrome.
76. (a)
Law of segregation applies in this case as when pink flowers obtained in F_1 are selfed then red and white flowers are obtained in F_2 which indicates that there is no mixing of gametes.
77. (a)
Parents having genotype $I^A i$ and $I^B i$ have children of the following blood group type – O, AB, and B.
78. (d)
Haemophilia is a sex-linked disease, which is marked in heterozygous condition. It is a recessive character. Down's syndrome is due to aneuploidy which arises because of non-disjunction of two chromosomes of homologous pair. Phenylketonuria is an autosomal recessive disorder in which the homozygous recessive individuals lacks the enzyme phenylalanine hydroxylase needed to change phenylalanine to tyrosine. Sickle cell anaemia is an autosome linked recessive trait that can be transmitted from parents to the offsprings when both the partners are carrier for the gene (or heterozygous).
79. (b)
Statements (ii), (iii) and (v) are correct. Gregor Mendel, conducted hybridization experiments on garden peas for seven years and proposed the laws of inheritance in living organisms. His experiments had a large sampling size, which have greater credibility to the data. A recessive parental trait is expressed only in its homozygous condition.
80. (a)
Statements (i) and (iii) are correct. Mendelian disorders are mainly determined by alternation or mutation in a single gene whereas chromosomal disorders are caused due to absence or excess or abnormal arrangement of one or more chromosomes. Sickle cell anaemia is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene. Haemophilia is sex-linked recessive disease which shows its transmission from unaffected carrier female to some of the male progeny.
81. (c)
Sickle cell anaemia is an autosomal recessive trait. Haemophilia is a Sex linked recessive trait. Metabolic error linked to autosomal recessive: Phenylketonuria. Phenylketonuria is an inherited disease due to faulty metabolism of phenylalanine. The affected individual lacks an enzyme that converts the amino acids phenylalanine into tyrosine. It is characterized by the presence of phenyl ketones in the urine and usually first noted by signs of mental retardation in infancy. Down's syndrome occurs due to presence of an Additional 21st chromosomes.
82. (a)
83. (d)
Mutation is the sudden inheritable discontinuous variation which appears in an organism due to permanent changes in their genotypes. The term mutation was coined by Hugo de Vries (1901).
84. (b)
Recessive mutation is carried by heterozygous carrier individuals. This is why they do not get eliminated from the gene pool.
85. (c)
When a tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant and the F_1 plants were selfed the resulting genotypes were in the ratio of 1 : 2 : 1, i.e., Tall homozygous : Tall heterozygous : Dwarf
- It can be illustrated as given below :
- | | | | |
|-------------------|------------|-------------|-------------------|
| Tall
TT | × | Dwarf
tt | Parent generation |
| (T) | | (t) | Gametes |
| Tt | | | F_1 generation |
| Tall heterozygous | | | |
| ↓ | | | |
| Tt × Tt | | | Selfing |
| ♂ \ ♀ | T | t | |
| T | TT
Tall | Tt
Tall | F_2 generation |
| t | Tt
Tall | tt
Dwarf | |
- Phenotypic ratio : 3 : 1 :: Tall : Dwarf
Genotypic ratio - 1 : 2 : 1 :: TT : Tt : tt

86. (c)
Haemophilia is a sex linked disease in which the patient continues to bleed even from a minor cut since he or she does not possess the natural phenomenon of blood clotting. Haemophilia is genetically due to the presence of recessive gene h , carried by X-chromosome. A female becomes haemophiliac only when both its X-chromosomes carry the gene (X^hX^h). However, such females generally die before birth because the combination of these two recessive alleles is lethal. A female having only one allele for haemophilia (XX^h) appears normal because the allele for normal blood clotting present on the other X-chromosome is dominant. Such females are known as carriers. In case of males, a single gene for the defect is able to express itself as the Y-chromosome is devoid of any corresponding allele (X^hY) in which an organism has three times ($3n$) the haploid number (n) of chromosomes.
87. (a)
88. (c)
Purity and hybrid nature of the pea plant can be tested by crossing the pea plant with a homozygous dwarf pea plant. This is known as test cross.
89. (d)
Sutton and Boveri proposed the chromosomal theory of inheritance but its experimental verification was done by Thomas Hunt Morgan.
90. (a)
Mendel was successful in formulating the laws of inheritance whereas his predecessors were not because he studied one clear cut character at one time for his breeding experiment and took those traits which do not show linkage, interaction or incomplete dominance.
91. (d)
As sperms produced are with genotypes AB, Ab, aB, ab (two diallelic character) the person must be heterozygous for both genes. So, his genotype will be AaBb.
92. (d)
The F_2 generation offsprings in a plant showing incomplete dominance exhibit similar phenotypic and genotypic ratios of 1 : 2 : 1 i.e. pure dominant: hybrid: pure recessive. In incomplete dominance, neither of the two alleles are completely dominant over the other and the dominant alleles do not completely express itself.
93. (b)
Sex determination in grasshoppers, humans, and Drosophila is similar because males have one X-chromosome & females have two X-chromosomes. In these three species, females have two X-chromosomes and males have one X-chromosome. The ratio of X-chromosomes to autosomes is important (and different in each organism) in Drosophila and grasshoppers, but not in humans. In all three species, males have one Y-chromosome, but the Y-chromosome is required for male fertility, not for Drosophila to be male (in Drosophila, male flies can be XO).
94. (d)
Mendel's rules do not correctly predict patterns of inheritance for tightly linked genes or the inheritance of alleles that show incomplete dominance or epistasis. This shows that these hypothesis are correct and limited to certain condition.
95. (a)
Genotype of the organism include all dominant and recessive characters.
96. (b)
ABO blood group system in human beings is an example of dominance, co-dominance and multiple allelism.
 $I^A I^O$, $I^B I^O$ or i - Alleles shows dominant-recessive relationship.
 $I^A I^B$ - Co-dominance is a phenomenon in which alleles of a gene do not show dominant recessive relationship and express themselves independently when present together.
 I^A , I^B I^O or i - More than two alternate forms of a gene present on the same locus are called as multiple alleles and the mode of inheritance in the alleles is called multiple allelism.
97. (c)
98. (c)
In human, the gamete contributed by the male determines whehter the child produced will be male and female. Sex in humans is a polygenic trait depending upon cumulative effect of some genes present on Y-chromosome. Only sex in human is monogenic trait.
99. (a)
The male human is heterozygous for autosomal gene A and B and also hemizygous for haemophilic gene h , then his genotype will be $AaBbX^hY$ because haemophilia is a sex linked trait that is present on X-chromosome. So, the total number of gametes will be abX^h , abY , ABX^h , ABY , AbX^h , AbY , aBX^h , aBY . So the proportion of abX^h sperm will be $1/8$.
100. (c)