Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

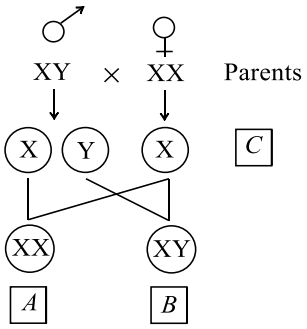
Single Correct Answer Type

1. A haemophilic woman marries a normal man, then
   a) All the children will be normal
   b) All the sons will be haemophilic
   c) All the girls will be haemophilic
   d) Half girls will be haemophilic
2. Disorder inherited as Mendel's law of inheritance called
   a) Mendelian disorder
   b) Chromosomal disorder
   c) Maternal inheritance
   d) Polygenic inheritance
3. The term 'gene' was coined by
   a) Avery
   b) Bateson
   c) Johanssen
   d) Mendel
4. The phenotypic ratio in the F_2 gereration of dihybrid cross, is
   a) 9 : 3 : 3 : 1
   b) 1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1
   c) 7 : 1 : 1 : 7
   d) 12 : 8 : 4
5. Chromosome is made up of
   a) DNA +pectin
   b) RNA +DNA
   c) DNA +histone
   d) Only histone
6. Select the incorrect statemant from the following.
   a) Linkage is an exception to the principle of independent assortment in heredity
   b) Galactosemia is an inborn error of metabolism
   c) Small population size result in random genetic drift in a population
   d) Baldness is a sex-limited trait
7. A pure tall and a pure dwarf plant were crossed to produced offsprings. Offsprings were self crossed, then find out the ratio between true breeding tall to true breeding dwarf?
   a) 1 : 1
   b) 3 : 1
   c) 2 : 1
   d) 1 : 2 : 1
8. Exposure of X-rays enhances the frequency of
   a) Linkage
   b) Crossing over
   c) Pairing of chromosome
   d) Segregation
9. A self-fertilizing trihybrid plant forms
   a) 8 different gametes and 64 different zygotes
   b) 4 different gametes and 16 different zygotes
   c) 8 different gametes and 16 different zygotes
   d) 8 different gametes and 32 different zygotes
10. Genotype is the
    a) Genetic constitution
    b) Genetic constitution of the phenotype
    c) Trait expressed
    d) Expressed genes
11. Failure of cytokinesis after …A… stage of cell division results in an increase in a whole set of chromosomes in an organism called …B…
    a) A-prophase, B-polyploidy
    b) A-metaphase, B-polyploidy
    c) A-anaphase, B-polyploidy
    d) A-telophase, B-polyploidy
12. In previous question find out total seeds (plants) having round seed texture
    a) 12
    b) 10
    c) 9
    d) 11
13. The ratio 1 : 1 : 1 : 1 is obtained from a cross between the parents
    a) RRYY × rryy
    b) RRYY × rryy
    c) RRYY × Rryy
    d) RrYy × rryy

14. Which of the following terms represent a pair of contrasting characters?
    a) Homozygous b) Heterozygous c) Allelomorphs d) Codominant genes
15. Harmful mutation does not get eliminated from the gene pool because they are mainly
    a) Dominant, which have beneficial effect on population and carried by heterozygous individuals
    b) Dominant, which have beneficial effect on population and carried by homozygous individuals
    c) Carried from one generation to another generation through autosomal chromosomes
    d) They show genetic drift
16. Incomplete linkage is …A… . Complete linkage is …B… . Choose correct option for A and B
    a) A-common, B-rare b) A-rare, B-common
    c) A-impracticle, B-practicle d) A-practicle, B-impracticle
17. Mendelism was rediscovered by
    I. Morgan
    II. De Vries
    III. Correns
    IV. Tschermark
    Choose the correct option
    a) I, III and IV b) I, II, III and IV c) II, III and IV d) I, II and III
18. In gynandromorphs,
    a) Some cells of body contain XX and some cells with genotype XY
    b) All cells have XX genotype
    c) All cells have XY genotype
    d) All cells with genotype XXY
19. Example of interagenic gene interaction is/are
    a) Incomplete dominance b) Codominant
    c) Multiple alleles d) All of the above
20. If a cross between two individuals produces offspringe with 50% dominant character (A) and 50% recessive character (a),then the genotypes of parents are
    a) Sex linked genes b) Pseudoallelic genes
    c) Intermediate inheritance d) Dominant and recessive genes
21. Which is correct about traits choosen by Mendel for his experiment on pea plant?
    a) Terminal pod was dominant b) Constricted pod was dominant
    c) Green coloured pod was dominant d) Tall plants were recessive
22. Codominance is found in
    a) Plants b) Animal c) Both (a) and (b) d) Prokaryote
23. During Mendel's investigation, it was first time that …A… and …B… were applied in biology. Here A and B refers to
    a) A-statistical analysis; B-mathematical logic
    b) A-statistical analysis; B-physical logic
    c) A-statistical analysis; B-chemistry logic
    d) A-statistical analysis; B-simple logic
24. The chromosomal denotation for heterogametic female and homogametic male are
    a) ZW and ZZ b) ZO-ZZ c) XX-XO d) Both (a) and (b)
25. Pure tall plants are crossed with pure dwarf plants. In the F_1-generation, all plants were tall. These tall plants of F_1-generation were selfed and the ratio of tall to dwarf plants obtained was 3: 1. This is called
    a) Dominance b) Inheritance c) Codominance d) heredity
26. The best method to determine the homozygosity and heterozygosity of an individual is
    a) Self-fertilisation b) Back cross c) Test cross d) Inbreeding
27. A medical technician, while observing a human blood smear under the microscope notes the presence of a Barr body close to the nuclear membrane in the WBC. This indicates that the person under investigation is a

a) Colourblind b) Haemophilic c) Normal female d) Normal male

28. Find out A, B and C in the diagram given below in



a) A-Male, B-Female, C-Gametes b) A-Male, B-Female, C-Sperm
c) A-Female, B-Male, C-Gametes d) A-Gametes, B-Male, C-Female

29. In Turner's syndrome
a) Female is fertile b) Male is fertile c) Female is sterile d) Male is sterile

30. The most likely reason for the development of resistance against pesticides in insect damaging a crop is
a) Random mutations b) Genetic recombination
c) Directed mutations d) Acquired heritable changes

31. Lampbrush chromosomes sre seen in
a) Interphase b) Zygotene c) Diplotene d) metaphase

32. In case of incomplete dominance, what will be the phenotypic ratio of F_2generation?
a) Histones b) Hydrocarbons c) Polynucleotides d) Lipoproteins

33. Examples of dissimilar sex chromosomes are given below
I. XX – XY ⇒ I
II. XX – XO ⇒ II
I and II in the above statement can be

	I	II
a)	Man and most insect	Cockroach and roundworms
c)	Butterfly	Fishes

	I	II
b)	Cockroach and roundworms	Man and most insect
d)	Bird	Reptiles

34. Mutations, which alter nucleotide sequence within a gene are
a) Frameshift mutation b) Base pair substitutions
c) Both (a) and (b) d) None of these

35. The F_1generation has all tall, and F_2ratio is 3 : 1, it proves
a) Law of dominance b) Independent assortment
c) Law of segregation d) linkage

36. Mendel's law were true for situation in which
a) Alleles are affected by their environment b) Alleles shows complete dominance
c) Alleles of a gene alter the affect of a different gene d) A given character is determined by more than one gene

37. Blood group-O has
a) No antibodies b) No antigens c) a or b antibodies d) A and B antigens

38. Wilson detected the colour blindness disease in
a) 1921 b) 1911 c) 1912 d) 1910

39. In a dihybrid cross between RRYY and rryy parents, the number of RrYy genotypes in F_2generation will be
a) 4 b) 3 c) 2 d) 1

40. If a cross between two individuals produces offspringe with 50% dominant character (A) and 50% recessive character (a),then the genotypes of parents are
a) Genic interactions controlling a character b) Multiple genes controlling a character
c) Expression of many characters by a single gene d) Alternative forms of a gene at a given locus

41. A women with albinic father marries an albinic man.the proportion of her progeny is

a) 2 normal : 1 albinic
b) All normal
c) All albinic
d) 1 normal : 1 albinic

42. When one sex chromosome is lacking in female and males are homogametic, in that condition, the sex chromosomal representation is
a) ZO-ZZ
b) XY-XX
c) XX-XO
d) ZW-ZZ

43. Some individuals with blood group –A may inherit the genes for blonde hair, while other individuals with blood group – A may the gene for brown hair. This can be best explained by the principle of
a) Dominance
b) Multiple alleles
c) Independent assortment
d) Incomplete dominance

44. In bugs and cockroaches, the sex determination takes place by
a) XX and XO chromosomes
b) XX and XY chromosomes
c) ZZ-ZW chromosomes
d) ZO-ZZ chromosomes

45. The two …A… separate and pass into two daughter nuclei and cells during mitosis. Similarly, each …B… replicates, with one pair passing into each daughter cell during mitosis. This maintains the similar …C… of all the cells.
Find out correct option for A, B and C
a) A-chromatid, B-allele pair, C-morphology
b) A-chromatid, B-allele pair, C-genetic composition
c) A-organ, B-organ pair, C-individuality
d) A-unlinked gene, B-linked gene, C-morphology

46. The shape of chromosome is determined by
a) Centrosome
b) Centromere
c) Chromomere
d) telomere

47. Mendel was a
a) Austrian biology teacher
b) Austrian monk
c) Austrian scientist
d) Austrian mathematician

48. Who clearly proved and define linkage?
a) Morgan
b) Castle
c) Bateson
d) Punnett

49. Improvement of human race through hereditary qualities is called
a) Euthenics
b) Human heredity
c) Human demography
d) Eugenics

50. 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

51. When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is
a) Tetraploidy
b) Pentaploidy
c) Diploidy
d) Triploidy

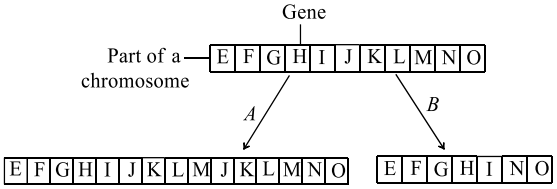
52. Colour blindness is
a) Sex-linked recessive disease
b) Sex-linked dominant disease
c) Autosomal dominant disease
d) Autosomal recessive disease

53. A condition, where a certain gene is present in only a single copy in a diploid cell, is called
a) Four different types of gametes produced by the F_1-dihybrid
b) Homozygous condition of the F_1-dihybrid
c) Four different types of F_1-dihybrids
d) Four different types of gametes produced by the P_1-parent

54. If the blood group of a child is A and of mother is B, then the genotype of mother and father may be
a) BB × AA
b) AB × AB
c) BO × OO
d) BO × AO

55.  symbol in pedigree analysis represents
a) Still birth
b) Still death
c) Still carrier
d) Still mating

56. Which amino acids are present in histones?
    a) Lysine and histidine
    b) Valine and histidine
    c) Arginine and lysine
    d) Arginine and histidine
57. Monosomic trisomy are represented as
    a) $2n-1+1$
    b) $2n-1-1$
    c) $2n-1$
    d) $2n+1+1$
58. Which is a sex-influenced disease?
    a) Baldness in male
    b) Haemophilia
    c) Xeroderma pigmentosa
    d) Down's syndrome
59. Thalassaemia is
    a) Autosomal recessive disease
    b) Autosomal dominant disease
    c) Sex-linked dominant disease
    d) Sex-linked recessive disease
60. Mutation is phenomena which results in alternation of
    a) Sequence
    b) Carbohydrates
    c) Proteins
    d) Fat
61. A man with normal vision whose father was colourblind marries with women whose father was also colourblind. Suppose their first child is daughter then what are the chances of this child to be colourblind?
    a) 100%
    b) 25%
    c) 50%
    d) 0%
62. Gamete mother cells of the chromosome 44 + XY suffers from non-disjunction at first meiotic division. Which of the following set of gametes would result?
    a) 22 + XX, 22 + XY, and 22, 22
    b) 22 + XY, 22 + XY, and 22, 22
    c) 22 + X, 22 + Y, and 22 + Y, 22
    d) 22 + X, 22 + XY, and 22 + Y, 22 + Y
63. Law of Mendel, which is not completely applicable is?
    a) Codominance
    b) Law of segregation
    c) Law of independent assortment
    d) Law of dominance
64. Low pitched voice, beared and moustaches, belong to the
    a) Sex limited traits
    b) Sex linked trait
    c) Nullisomic traits
    d) Sex influenced traits
65. Multiple allele can be manifested only when there is the study of
    a) Individual organism
    b) Genus
    c) Population
    d) Phylum
66. *Nicotiana sylvestris* flowers only during long days and *N. tabacum* flowers only during short days, if raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be cross fertilized to produce self-fertile offspring. What is the best reason for considering *N. sylvestris* and *N. tobaccum* to be separate species?
    a) They are physiologically distinct
    b) They are morphologically distinct
    c) They cannot interbreed in nature
    d) They are reproductively distinct
67. The following diagram shows two types of chromosomal mutations



    Give the name or type of mutation in respect to A and B
    a) A-Duplication, B-Substitution
    b) A-Duplication, B-Deletion
    c) A-Inversion, B-Deletion
    d) A-Inversion, B-Substitution
68. How many different kinds of gametes will be produced by a plant having the genotype AABbCC?
    a) Three
    b) Four
    c) Nine
    d) Two
69. Down's syndrome and Turner's syndrome occur in human beings due to
    a) Monosomic and nullisomic conditions respectively
    b) Monosomic and trisomic conditions respectively
    c) Trisomic and monosomic conditions respectively
    d) Trisomic and tetrasomic conditions respectively
70. What are all the chances of colourblind daughters of a normal man marrying normal women whose father was colourblind?

a) All sons are normal and all daughters are colourblind
b) Both the sons and daughters are phenotypically normal
c) All the sons are colourblind and all daughters are normal
d) 50% sons are colourblind and all daughters are phenotypically normal

71. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of
a) Oestrogen b) Growth hormone c) Testosterone d) Inhibits

72. Which of these is not a Mendelian disorder?
a) Cystic fibrosis b) Sickle-cell anaemia c) Colourblindness d) Turner's syndrome

73. Which of the following is not true of haemophilia?
a) Royal disease
b) Bleeder's disease
c) X-linked disorder
d) Y-linked disorder

74. If heterozygous dominant (tT) crossed with homozygous dwarf plant, then the percentage of progeny having dwarf character is
a) 60% b) 40% c) 50% d) 70%

75. Mutations are generally induced by means of
a) $\alpha - rays$ b) $\beta - rays$ c) $\gamma - rays$ d) UV radiations

76. Two crosses between the same pair of genotypes or phenotypes, in which the sources of the gametes are reversed in one cross, is known as
a) Dihybrid cross b) Reverse cross c) Test cross d) Reciprocal cross

77. A hereditary, disease, which is never passed on from father to son is
a) X-chromosomal linked disease
b) Autosomal linked disease
c) Y-chromosomal linked disease
d) None of the above

78. Bateson used the term coupling and repulsion for linkage and crossing over. Choice the correct coupling and repulsion combination

	Coupling	Repulsion
a)	AABB, aabb	AAbb, aaBB
b)	AABB, aabb	AABB, AAbb
c)	AAbb, aaBB	AaBb, aabb
d)	aaBB, aabb	AABB, aabb

79. In blood group typing in human, if an allele contributed by one parent is I^A and an allele contributed by the other parent is *i*, the resulting blood group of the offspring will be
a) A b) B c) AB d) O

80. A person having 45 chromosomes and Y-chromosome absent. Is suffering from
a) Down's syndrome
b) Klinefelter's syndrome
c) Turner's syndrome
d) gynandromorph

81. Linkage and crossing over are
a) Same phenomena
b) Different phenomena
c) Opposite phenomena
d) Identical phenomena

82. The modern concept of gene is
a) A segment of DNA, capable of crossing over
b) Functional unit of DNA
c) A segment of RNA
d) A segment of chromosome

83. Females in haplodiploidy sex determination are
a) N b) $2n$ c) $\frac{1}{2}n$ d) $3n$

84. Using imprints from a plate with complete medium and carrying bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. These imprints need to be used
a) Only on plates with streptomycin
b) On plates with minimal medium
c) Only on plates without streptomycin
d) On plates with and without streptomycin

85. Phenylketonuria, Huntington's disease and sickle cell anaemia are caused respectively due to disorders associated with
a) Chromosome-7, chromosome-11 and chromosome-12
b) Chromosome-11, Chromosome-4 chromosome-12

c) Chromosome-7, chromosome-12 and chromosome-11
d) Chromosome-12, chromosome-4 and chromosome-11

86. The arrangement of genes on chromosome is
a) Linear b) Oviod c) Diffused d) Spiral

87. When two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be
a) Pseudoalleles b) Multiple alleles
c) The part of same gene d) Different genes

88. Which of the following matches correctly?
a) Factor –II - Thromboplastin b) Factor –III - Prothrombin
c) Factor –VIII - Antihaemophilic globulin d) Factor –XII - Haemophilic

89. The longest chromosomes is seen in
a) *Allium* b) *Lilium* c) *Trillium* d) *Zea mays*

90. Mendel observed that ….. generation shows always phenotype of dominant parent
a) F_4 b) F_2 c) F_1 d) F_0

91. ...A… genes are those which occurs on the same chromosome and …B… genes are those, which are present on different chromosome.
Choose correct choice for A and B
a) A-linked; B-unlinked gene b) A-unlinked; B-linked
c) A-identical; B-non-identical d) A-non-identical; B-identical

92. Allelic sequence variations where more than one variant (allele) at a locus in a human population with a frequency greater than 0.01 is refered to as
a) Incomplete dominance b) Multiple allelism
c) SNP d) DNA polymorphism

93. The possibility of a female becoming a haemophilia is …A… rare because mother of such a female has to be at least …B… and the father should be …C…
Choose the correct option for A, B and C
a) A-extremely, B-carrier, C-haemophilic
b) A-extremely, B-carrier, C-carrier
c) A-extremely, B-haemophilic, C-carrier
d) A-extremely, B-haemophilic, C-haemophilic

94. If the foetus is Rh^+ and mother is Rh^-, then
a) Foetus will transmit antigen to mother blood
b) Foetus will transmit antibody to mother blood
c) Foetus is attacked by antibodies to mother blood
d) Foetus is attacked by antigen to mother blood

95. The most popularly known blood grouping is the ABO grouping. It is named ABO and not ABC, because 'O' in it refers to having
a) Other antigens besides A and B on RBCs b) Over dominance of this type on the genes for A and B types
c) One antibody only—either anti-a or anti–b on the RBCs d) No antigens A and B on RBCs

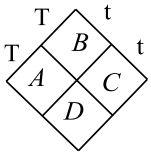
96. Alleles are
a) Alternate forms of a gene b) Homologous chromosome
c) Pair of sex chromosome d) None of the above

97. Telomere repetitive DNA sequences control the function of eukaryotic chromosomes because they
a) Act as replicons b) Are RNA transcription initiator
c) Help chromosome pairing d) Prevent chromosome loss

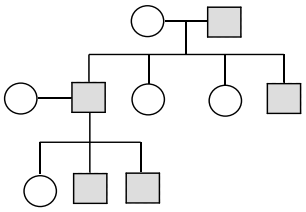
98. Genotypic and phenotypic ratios remains the same in
a) Sex-linked genes b) Pseudoallelic genes
c) Intermediate inheritance d) Dominance and recessive genes

99. Mendelian disorder may be of
    a) Recessive b) Dominant c) Both (a) and (b) d) Can't be determined
100. Sickle –cell anaemia has not been eliminated from the African population because it
    a) Is controlled by recessive genes b) Is not a fatal disease
    c) Provides immunity against malaria d) Is controlled by dominant genes
101. A condition characterized by not having an exact number of chromosomes in a multiple of haploid set is called
    a) Polyploidy b) Synploidy c) aneuploidy d) None of these
102. Choose correct option for A, B, C and D

TT × Tt



    a) A-tt, B-TT, C-TT, D-TT b) A-Tt, B-Tt, C-Tt, D-Tt
    c) A-TT, B-TT, C-Tt, D-TT d) A-Tt, B-Tt, C-Tt, D-TT
103. When a cross is conducted between black feathered hen and a white feathered cock, blue feathered fowls are formed. When these fowls are allowed for interbreeding, in F_2- generation, there are 20 blue fowls. What would be the number of black and white fowls?
    a) Black 20, white 10 b) Black 20, white 20 c) Black 10, white 10 d) Black 10, white 20
104. Chromosomes are made up of
    a) DNA are protein b) RNA and DNA c) DNA and histone d) Only histones
105. In pedigree analysis, the square, blackened and horizontal lines represents
    a) Female, healthy individual, parents b) Female, affected individual, parents
    c) Male, affected individual, parents d) Male, affected individual, progeny
106. Following pedigree chart shows



    a) Character is carried by Y-chromosome b) Character is sex-linked recessive
    c) Character is sex-linked dominant d) Character is recessive autosomal
107. Mr. Sidd is suffering from hypertrichosis and phenylketonuria. His father is heterozygous for phenylketonuria. The probability of Sidd's sperm having one recessive autosomal allele and holandric gene is
    a) $\frac{1}{2}$ b) $\frac{1}{8}$ c) $\frac{1}{10}$ d) $\frac{1}{4}$
108. F_3-generation is obtained by
    a) Selfing of F_1 b) Selfing of F_2 c) Crossing of F_1 and F_2 d) None of these
109. In which one of the following, complementary gene interaction rato of 9 : 7 is observed?
    a) Fruit shape in Shepherd's purse b) Coat colour in mouse
    c) Feather colour in fowl d) Flower colour in pea
110. Starch synthesis gene in pea plant is the example of
    a) Single gene produce more than one effects
    b) Multiple genes produce more than one effects
    c) Two genes produce more than one effects
    d) Multiple genes produce less than one effects
111. In *Drosophila* , the sex is determined by

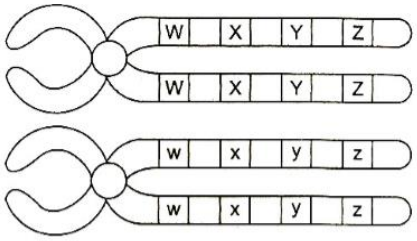
a) The ratio of pairs of X-chromosomes to the pairs of autosomes
b) Whether the egg is fertilized or develops parthenogenetically
c) The ratio of number of X-chromosomes to the set of autosomes
d) X and Y-chromosomes

112. The 1 : 2 : 1 ratio with the pink flower in the F_2-generation indicate the phenomenon of
a) Dominance
b) Codominance
c) Incomplete dominance
d) Segregation

113. Sexual reproducation leads to
a) Genetic recombination
b) Polyploidy
c) Aneuploidy
d) Euploidy

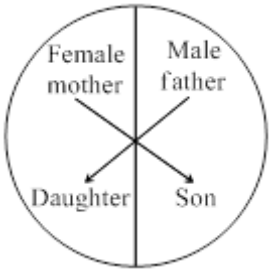
114. Husband has blood group-A and wife has blood group-B. What is the blood group of children?
a) A
b) B
c) AB
d) A, B, AB and O

115. Study the following figure and find out the most probable position at which the crossing over takes place



a) w and W
b) X and y
c) y and Z
d) w and z

116. Given diagram shows certain type of traits in human. Which one of the following option could be an example of this pattern?



a) Haemophilia
b) Anaemia
c) Phenylketonuria
d) Thalassaemia

117. In case of incomplete dominance, what will be the phenotypic ratio of F_2generation?
a) 3 : 1
b) 1 : 2 : 1
c) 1 : 1 : 1 : 1
d) 2 : 2

118. Haemophilia, a X-linked recessive disease is caused due to deficiency of
a) Blood plasma and vitamin–K
b) Blood platelets and haemoglobin
c) Lack of clotting material and vitamin-K
d) All of the above

119. All of this obeys Mendel's laws except
a) Codominance
b) Independent assortment
c) Dominance
d) Purity of gametes

120. in β-thalassaemia, the affected chromosome is
a) 16th
b) 14th
c) 13th
d) 19th

121. 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_1generation?
a) 50 : 50
b) 9 : 1
c) 1 : 3
d) 3 : 1

122. Who was fly men of genetics?
a) Sutton
b) Pasteur
c) Robert Hooke
d) TH Morgan

123. Mendel's contribution for genetic inheritance was
a) The idea that genes are found on chromosomes
b) Providing a mechanism that explains patterns of inheritance
c) Describing how genes are influenced by the environment

d) Determining that the information contained in DNA codes for proteins

124. The genotypic ratio of a monohybrid cross in F_2-generation is
a) 3 : 1 b) 1 : 2 : 1 c) 2 : 1 : 1 d) 9 : 3 : 3 : 1

125. Baldness is more common in men than in woman. It could be explained on the basis that
a) Genes of baldness are located on X-chromosomes only
b) Baldness genes are located on Y-chromosomes
c) Genes of baldness are autosomal but influenced by androgens
d) None of the above

126. How many pairs of contrasting characters in pea pod were chosen by Mendel?
a) 3 b) 5 c) 7 d) 9

127. A mutagen pollutant is
a) Organophosphates b) Resins
c) Chlorinated hydrocarbons d) Nitrogen oxides

128. Both chromosome and gene (Mendelian factors) whether dominant or recessive are transmitted from generation to generation in which form
a) Changed b) Unaltered form c) Altered form d) Disintegrated

129. Pedigree analysis is very important in human beings because
a) It helps genetic counselers to avoid disorders
b) It shows origin of traits
c) It shows the flow of traits in family
d) All of the above

130. Genes when present in homozygous condition results in non – viable progeny, the factor responsible for such conditions are
a) Polygenes b) Linked genes c) Lethal genes d) Epistatic genes

131. Turner's syndrome caused due to the absence of
a) One X-chromosome (44 with XO) b) One Y-chromosome
c) One X-and Y-chromosome d) Two X-chromosome

132. The recessive genes located on X-chromosome in humans are always
a) Lethal b) Sub-lethal c) Expressed in males d) Expressed in females

133. Strength of the linkage between the two genes is
a) Proportionate to the distance between them
b) Inversely proportionate to the distance between them
c) Depend on the chromosomes
d) Depend upon the size of chromosomes

134. Fruitfly is excellent model for genetics because of
I. Small life cycle (two week)
II. Can be feed on simple synthesis medium
III. Single mating produce large number of progeny
IV. Clear differentiation of sexes
V. Many heredity variation can be seen with low power microscopes
Choose the correct option
a) I, II and III b) III, IV and V c) I, IV and V d) All of these

135. In Guinea pigs, black short hair (BBSS) is dominant over white long hair (bbss). During a dihybrid cross, the F_2-generation individuals with genotypes BBSS, BbSS, BBSs and BbSs are in the ratio of
a) 9 : 3 : 3 : 1 b) 4 : 2 : 1 : 2 c) 1 : 2 : 1 : 2 d) 1 : 2 : 2 : 4

136. When both parents are of blood type AB, they can have children with
a) A, B, AB and O blood types b) A, B, and AB blood types
c) A and B blood types d) A, B and O blood types

137. Test cross is
a) Recessive F_1-plant crosses with dominant F_2-plant
b) Recessive F_2-plant crosses with dominant F_3-plant

c) Dominant F_2-plant crosses with recessive parent plants
d) Dominant F_2-plant crosses with heterozygous parent plants

138. The phenomenon of a single gene regulating several phenotypes is called
a) Multiple allelism b) epistasis
c) Incomplete dominance d) Pleiotropism

139. If two pea plants having red (dominant) coloured flowers with unknown genotypes are crossed, 75% of the flowers with unknown genotypes are crossed, 75% of the flowers are red and 25% are white. The genotypic constitution of the parents having red coloured flowers will be
a) Both homozygous b) One homozygous and other heterozygous
c) Both heterozygous d) Both hemizygous

140. A woman has a haemophilic son and three normal children. Her genotype and that of her husband with respect to this gene would be
a) XX and X^hY b) X^hX^h and X^hY c) X^hX^h and XY d) X^hX and XY

141. The proportion of plants that were dwarf and tall in F_2- generation ofo Mendel experiment
a) $\frac{1}{4}$ th and $\frac{3}{4}$th b) $\frac{3}{4}$ th and $\frac{1}{4}$th c) $\frac{2}{3}$ rd and $\frac{1}{3}$ rd d) $\frac{1}{3}$ rd and $\frac{4}{3}$rd

142. Night blindness is
a) Genetic disease b) Nutritional deficiency disease
c) Generally found in male d) Generally found in female

143. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridized, then F_2-segregation wii show
a) 1 : 2 : 1 b) 3 : 1 c) 9 : 3 : 3 : 1 d) 1 : 1 : 1

144. Who argued that pairing and separation of chromosomes would lead to the segregation of a pair of factor they carried?
a) Sutton b) Boveri c) Both (a) and (b) d) Morgan

145. Sex chromosomes of male are
a) Homozygous b) Heterozygous c) Hemizygous d) autosomes

146. Trisomy of which chromosome is involved in Down's syndrome?
a) 15^{th} b) 21^{st} c) 20^{th} d) 19^{th}

147. Which of the following symbols are used for representing chromosome of birds?
a) ZZ-ZW b) XX-XY c) XO-XX d) ZZ-WW

148. Sudden and heritable change in a character of an organism is called
a) Mutation b) Heterosis c) Inbreeding d) selection

149. Heterozygous purple flower is crossed with recessive white flower. The progeny has the ratio
a) All purple b) All white
c) 50% purple, 50% white d) 75% purple, 25% white

150. The Mendel crossed true breeding tall and dwarf plant varieties in his experiment. The tall character was dominant and recessive character was dwarf. The recessive character was appeared in
a) F_1 b) F_2 c) F_3 d) F_2 and F_3

151. Night blindness can be corrected by giving vitamin- …A… but colour blindness can't be cured because it is …B… disease.
Choose the correct option for A and B
a) A-A; B-genetic b) A-B; B-autosomal c) A-C; B-non-genetic d) A-D; B-genetic

152. Heredity is
a) Transmission of characters b) Mixing of characters
c) Blending of inheritance d) Deleting of characters

153. Which of these statements about Huntington's disease is true?
a) Genetic tests to detect the presence of the allele responsible for Huntington's disease do not exist at this time
b) The onset of Huntington's disease is typically between birth and three years of age

c) There is currently no effective treatment of Huntington's disease
d) Huntington's disease is caused by the expression of a recessive allele

154. Centromere is required for
a) Transcription
b) Crossing over
c) Cytoplasmic cleavage
d) Movement of chromosomes towards poles

155. Which of the following condition in humans is correctly matched with its chromosomal abnormality/linkage?
a) Klinefelter's syndrome –44 autosomes + XXY
b) Colour blindness –Y- linked
c) Erythroblastosis foetalis –X- linked
d) Down' s syndrome – 44 autosomes+ XO

156. Rrrr progeny : Red (dominant) flowered heterozygous crossed with white flower
a) 350 → red : 350 → white
b) 450 → red : 250 → white
c) 380 → red : 250 → white
d) None of these

157. A hereditary disease which is never passed on form father to son is
a) X- chromosomal linked disease
b) Autosomal linked disease
c) Y- chromosomal linked disease
d) None of the above

158. A man with blood group-B marries a woman with blood-A and their first child is having blood group-B. What is the genotype of child?
a) I^aI^b
b) I^aI^o
c) I^bI^o
d) I^bI^b

159. Linked gene are present on
a) Same chromosome
b) Different chromosome
c) Heterologous chromosome
d) Paired chromosome

160. The structure that become double in synthesis phase of cell division is/are
a) RNA
b) Centriole
c) DNA
d) None of these

161. Genetics is the branch of biology which deals with
a) Variation
b) Inheritance
c) Both (a) and (b)
d) Study of characters

162. Giant chromosomes are found inside
a) nucleus of man
b) oocytes of frog
c) salivary glands of silk moth
d) salivary glands of *Drosophila*

163. Who is known as father of physiological genetics or father of biochemical genetics?
a) Slatyer
b) Charles Elton
c) Taylor
d) Archibald Garrod

164. The graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross, is called
a) Pedigree analysis
b) Karyotype
c) Punnett square
d) Chromosome map

165. Rh factor can produce disease
a) AIDS
b) Turner's syndrome
c) Erythroblastosis foetalis
d) Sickle-cell anaemia

166. To determine heterozygousity of a cross, one has to perform
a) Back cross
b) Reciproacal cross
c) Test cross
d) Any of these

167. Which of the following type of mutation involves the reverse order of genes in a chromosome?
a) Deletion
b) Duplication
c) Inversion
d) Reciprocal translocation

168. The chromosomal number in the meiocytes of housefly is
a) 8
b) 12
c) 21
d) 23

169. The alternate forms of a gene is called
a) Recessive character
b) Dominant character
c) Alleles
d) Alternative gene

170. Haemophilia is related to
a) Albinism
b) Sickle-cell anaemia
c) Colour blindness
d) thalassemia

171. Identify a Mendelian disorder from the following.
a) Down's syndrome
b) Turner's syndrome
c) Phenylketonuria
d) Klinefelter's syndrome

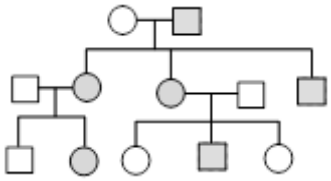
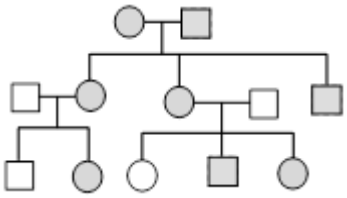
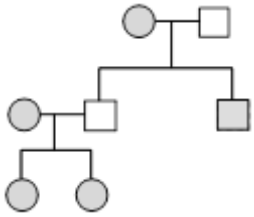
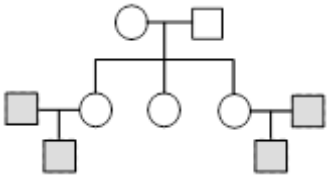
172. When a tall plant with round seeds (TTRR) crossed with a dwarf plant with wrinkled seeds (ttrr), the F_1-generation consists of tall plants with round seeds. What would be the proportion of dwarf plant with wrinkled seeds in F_1-generation?
a) $\frac{1}{4}$
b) $\frac{1}{16}$
c) 0
d) $\frac{1}{2}$

173. The term 'Genetics' was proposed by
a) Mendel
b) Bateson
c) Motgan
d) Johanssen

174. Sex chromosomes are also known as
a) Autosomes
b) Allosomes
c) Genome
d) karyotype

175. Mendel obtained recessive character in F_2 by …A… the …B… plants. Here *A* and *B* refers to
a) A-self-pollinating; $B-F_1$
b) A-self-pollinating; $B-F_2$
c) A-cross-pollinating; $B-F_1$
d) A-cross-pollinating; $B-F_2$

176. In a family father had a trait but mother did not. All their sons and daughter had this trait. The same trait was found in some grand daughters, through daughter were married to the normal persons.
Choose the correct pedigree chart for the condition

a) 
b) 
c) 
d) 

177. If genes of an allelic pair are not-same. This condition is called
a) Homozygous
b) Heterozygous
c) Diallelic
d) Polyallelic

178. Which type of pollination method was adopted by Mendel in his experiment?
a) Artificial
b) Cross pollination
c) Natural
d) Both (a) and (b)

179. 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

180. Grain colour in wheat is determined by three pairs of polygene. Following the cross AABBCC(dark colour) × aabbcc(light colour) , in F_2 generation. What proportion of the progeny is likely to resemble either parent?
a) Half
b) Less than 5 per cent
c) One –third
d) None of these

181. Chromosomal abbreviation commonly found in the
a) Cancer cells
b) Normal cells
c) Healthy cells
d) Autosomal cells

182. In short horned cattle, genes for red(R) and white(r) coat colour occur. Cross between red (RR) and white (rr) produced (Rr) roan. This is an example of
a) Incomplete dominance
b) Codominance
c) Complementary genes
d) Epistasis

183. Female is haemophilic definitely if

a) Mother is carrier
b) Father is carrier
c) Father is affected
d) Both mother and father affected

184. Polyploidy leads to rapid formation of new species because of
a) Isolation
b) Development of multiple sets of chromosomes
c) Mutation
d) Genetic recombination

185. Law of segregation is also called law of
a) Probability
b) Purity of gametes
c) Independence of gametes
d) Punnett hypothesis

186. Test cross is a cross between
a) Hybrid × Dominant parent
b) Hybrid × Recessive parent
c) Hybrid × Hybrid parent
d) Two distantly related species

187. XX and XY chromosomal sex determination, females are
a) Homogametic
b) Heterogametic
c) Can not determine
d) All of the above

188. Heterogametic male condition does not occur in
a) Birds
b) Humans
c) *Drosophila*
d) Honey bee

189. In a typical Mendelian cross which is a dihybrid cross, one parent is homozygous for both dominant traits and another parent is homozygous for both recessive traits. In the F_2 generation, both parental combinations and recombinations appear. The phenotypic ratio of parental combinations to recombinations, is
a) 10:6
b) 12:4
c) 9:7
d) 15:1

190. The genotype of a plant showing the dominant phenotype can by
a) Test cross
b) Dihybrid cross
c) Pedigree analysis
d) Back cross

191. If a man who is colourblind marries a women, who is pure normal for colour vision, the chances of their sons have colour blindness is
a) 100%
b) 50:50
c) 0%
d) 75 : 25

192. When a tall pea plant (TT) is crossed with dwarf plant (tt) what will be the F_2-generation?
a) All tall plants
b) All dwarf plants
c) Both tall and dwarf plants in 1 : 1 ratio
d) Both tall and dwarf plants in 3 : 1 ratio

193. Broadly the genetic disorders may be classified in …A… group Mendelian disorder and …B… disorders. Mendelian disorder are mainly determined by …C… in single gene.
Choose the correct option for A, B and C
a) A-two, B-chromosomal, C-genetic
b) A-two, B-chromosomal, C-inversion
c) A-two, B-chromosomal, C-alteration
d) A-three, B-chromosomal, C-deficiency

194. …A… individual show …B… phenotype but they are the …C… of the disease as there is 50% probability of transmission of mutant gene to its progeny
Choose the correct option for A, B and C
a) A-homozygous, B-affected, C-carrier
b) A-homozygous, B-unaffected, C-carrier
c) A-heterozygous, B-unaffected, C-carrier
d) A-heterozygous, B-affected, C-carrier

195. If male is TT and female is tt than they contribute pollen and egg respectively with
a) T and T gametes
b) tt and TT gametes
c) TT and tt gametes
d) T and t gametes

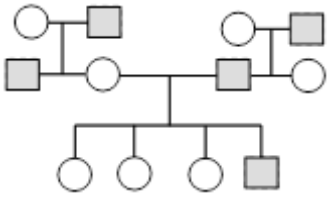
196. Number of linkage group in *Pisum sativum* is
a) 2
b) 5
c) 7
d) 9

197. 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 RRYY × rryy?
a) Only round seeds with green cotyledons
b) Only wrinkled seeds with yellow cotyledons
c) Only wrinkled seeds with green cotyledons
d) Round seeds with yellow cotyledons and wrinkled seeds with yellow cotyledons

198. BB = for black colour alleles

bb = for brown colour alleles
Offspring of a cross between a black mouse and brown mouse allowed to interbreed than find out the percentage of black coat in them
a) 75%
b) 50%
c) Cross is not possible because black and brown mouse are different species
d) 100%

199. Given pedigree chart indicates



a) Autosomal recessive trait
b) Y-linkage trait
c) Autosomal dominant trait
d) Sex linkage recessive trait

200. The mutant haemoglobin molecule undergoes polymerization under low oxygen tension causing the change in the shape of RBC from biconcave to elongated structure. This property of RBC is found in
a) Haemophilia b) Colour blindness c) Phenylketonuria d) B-thalassaemia

201. XO type of sex determination is seen in
a) Man b) Grasshopper c) *Drosophila* d) Birds

202. TtRr represents (heterozygous tall, heterozygous pink). If this plant is self crossed then (T-dominant, t-recessive, R-dominant, r-recessive)
I. 25% plant have red flower
II. 25% plant have white flower
III. 50% plant have pink flower
IV. 50% plant are tall
Choose the correct option
a) I and II b) I, II and III c) II, III and IV d) I, II, III and IV

203. Chimera is produced due to
a) Somatic mutations
b) Reverse mutations
c) Lethal mutations
d) Pleiotropic mutations

204. How many pairs of true breeding varieties were selected by Mendel for his experiment on pea plant
a) 12 b) 13 c) 7 d) 15

205. Syndrome stands for
a) A group of symptoms
b) Viral disease
c) Diseased condition
d) Dwarf organism

206. Parents with blood group-A and AB will not produce offspring with blood group
a) A b) AB c) B d) O

207. The genetic deficiency of ADH-receptor leads to
a) Diabetes mellitus
b) Glycosuria
c) Diabetes insipidus
d) Nephrogenic diabetes

208. Which of the following observation made Mendel in refutation of the blending theory of inheritance?
a) Red plant crossed with white-the resulting progeny was pink
b) Features of offspring are not intermediate
c) Gametes carrying different type of alleles could not fuse successfully
d) After meiosis, two copies of given gene end up in the same gamete

209. Mutations are generally
a) Recessive b) Polymorphic c) Lethal d) dominant

210. The 'Cri-du-chat' syndrome is caused by the change in chromosome structure involving
a) Deletion b) Duplication c) Inversion d) translocation

211. Pedigree analysis indicated that Mendel's principal are also applicable to …A… genetics with some modifications find out like …B… inheritance, sex linked inheritance and others.
Choose the correct option for *A* and *B*
a) A-animal; B-quantitative
b) A-human; B-qualitative
c) A-human; B-quantitative
d) A-animal; B-qualitative

212. Which one of the following traits of garden pea studied by Mendel was a recessive feature?
a) Green pod colour
b) Round seed colour
c) Axial flower position
d) Green seed colour

213. Genes for cytoplasmic male sterility in plants are generally located in
a) Mitochondrial genome
b) Cytosol
c) Chloroplast genome
d) Nuclear genome

214. A distinct mechanism that usually involves a short segment of DNA with remarkable capacity to move from one location in a chromosome to another is called
a) DNA replication
b) DNA hybridization
c) DNA recombination
d) DNA transposition

215. When F_1-generation progeny resembles both the parents this is called
a) Condominance
b) Incomplete dominance
c) Both (a) and (b)
d) Complete dominance

216. The individual from which a pedigree analysis initiated is called
a) Probend
b) Propositus
c) Both (a) and (b)
d) Origin

217. Plant which used by Hugo de Vries for mutation experiment was
a) *Oenothera lamarckiana*
b) *Solanum tuberosum*
c) *Ficus elastica*
d) None of the above

218. A person is suffering from disease phenylketonuria, which is an autosomal recessive disease. Which of these is lacking in the person?
a) Homogentisic acid
b) Phenylalanine hydroxylase
c) Caeruloplasmin
d) Cystine

219. Haemophilia in man is due to
a) Sex-linked inheritance
b) Sex-limited inheritance
c) Sex-influenced inheritance
d) Primary non-disjunction

220. When a dihybrid cross is fit into a Punnett square with 16 boxes, the maximum number of different phenotypes available, are
a) 8
b) 4
c) 2
d) 16

221. $2n$-2 is known as
a) Monosomic
b) Trisomic
c) Nullisomy
d) Polyploidy

222. A man and a woman, who do not show any apparent sign of a certain inherited disease, have seven children (two daughter and five 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

223. Colourblindness is caused due to
a) Recessive female chromosome
b) Dominant female chromosome
c) Dominant male chromosome
d) linkage

224. Which principle/law has been called the 2nd law of inheritance?
a) Law of independent assortment
b) Law of segregation
c) Law of dominance
d) Law of paired factor

225. Mendel's experiment were based on hybridization between two plants differing in
a) A pair of contrasting character
b) Three pairs of contrasting character
c) Many pairs of contrasting character
d) None of the above

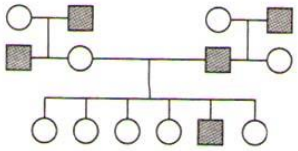
226. Alleles can be similar as in the case of …A… like ...B… or can be dissimilar as in the case of …C… like …D… Choose the correct option for A,B,C and D
   a) A-heterozygous, B-T T or T t, C-homozygous, D-T T
   b) A-homozygous, B-T T or t t, C-heterozygous, D-T t
   c) A- homozygous, B-T t , C- heterozygous , D-T T
   d) A- homozygous, B-T t , C- heterozygous , D-t t

227. The Barr body is observed in
   a) Basophils of male
   b) Neutrophils of female
   c) Basophils of female
   d) Eosinophils

228. The phenotypic ratio of a monohybrid cross in F_2-generation is
   a) 3 :1
   b) 1 : 2 : 1
   c) 2 : 1 : 1
   d) 9 : 3 : 3 : 1

229. Total number of wrinkled seed in previous question
   a) 4
   b) 3
   c) 2
   d) 1

230. This pedigree is of a rare trait, in which children have extra fingers and toes. Which one of the following patterns of inheritance is consistent with this pedigree?

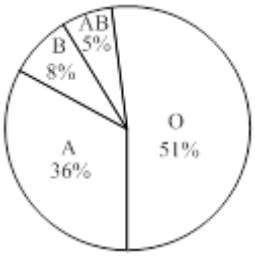


   a) Autosomal recessive
   b) Autosomal dominant
   c) Y-linkage
   d) Sex –linked recessive

231. 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-fourth colourblind and one-fourth normal
   d) All colourblind

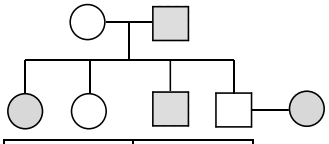
232. Barr body is produced due to partial inactivation of one X-chromosome in female. This is called
   a) Dosage compensation
   b) Facultative heterochromatisation
   c) Both (a) and (b)
   d) None of the above

233. Percentage of blood groups in India is given in the diagram below. Choose the correct option from the given statements



   a) Only 10% of individuals are heterozygous for blood group alleles
   b) Group A is the most common as it is the homozygous recessive group
   c) The alleles for blood group A and O are dominant to the allele for blood group O
   d) Any individual, selected at random from the sample population, has a 1 in 20 chance of being blood group AB

234. find out the genotype of father and mother is the given pedigree chart



Mother	Father

   a) A A | A A
   b) A a | A a

c) | A A | a a |

d) | a a | A a |

235. Analysis of traits of several generation of a family in the form of diagram is called
a) Gene analysis
b) Chromosome analysis
c) Allele analysis
d) Pedigree analysis

236. Among the following which one is the mutagenic agent?
a) Visible light
b) Penicillin
c) Formalin
d) Water vapour

237. Frameshift mutation and base pair substitution changes the
a) Nucleotide structure
b) Nucleotide sequence
c) Nucleoside sequence
d) Sugar phosphate sequence

238. A women with blood-O has a child with blood group-O. She claims that a man with blood group-A is the father of her child. What would be the genotype of the father, if her claim is right?
a) I^OI^O
b) I^AI^B
c) I^AI^O
d) I^BI^O

239. The terminal end of chromosomes is called
a) Centromere
b) Telomere
c) Chromomere
d) metamere

240. Mendel conducted experiments for
a) 7 years
b) 6 years
c) 5 years
d) 4 years

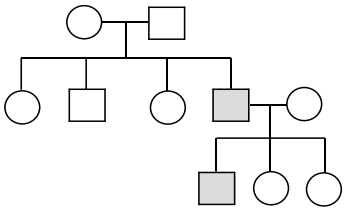
241. Cross between unrelated group of organisms, is called
a) Hybridization
b) Test cross
c) Back cross
d) heterosis

242. If $AAbb \times aaBB$,then phenotypic ratio of its progeny will be
a) 9 : 3 : 3 : 1
b) 1 : 2 : 1
c) 1 : 1 : 1 : 1
d) 4 : 1

243. I. Short statured with small round head
II. Furrowed tongue and partially opened mouth
III. Palm is broad with characteristic palm crease
IV. Slow physical, psycomotor and mental development
These are the characters of
a) Down's syndrome
b) Turner's syndrome
c) Klinefelter's syndrome
d) Edward syndrome

244. Which of the following statements are false?
I. A Dominant allele determines the phenotype when paired with a recessive allele
II. A recessive allele is weaker than a dominant allele
III. A recessive allele do not shows its effects when paired with a dominant allele
IV. A dominant allele is always better for an organism
a) II, I and IV
b) II, III and IV
c) I, II and III
d) I, III and IV

245. Following pedigree chart shows



a) Recessive and autosomal
b) Recessive and sex-linked
c) Dominant and sex-linked
d) Dominant and autosomal

246. 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

247. Which of the following is not a hereditary disease?
a) Cretinism
b) Cystic fibrosis
c) Thalassemia
d) Haemophilia

248. F_1- progeny of a cross between pure tall and dwarf plant is always

a) Tall b) Short c) Intermediate d) None of these

249. Gynaecomastia is a common feature seen in
a) Down's syndrome b) Turner's syndrome
c) PKU d) Klinefelter's syndrome

250. Dominant lethal gene is one which
a) Allows the organism to survive but not reproduce b) Determines sex of offsprings
c) Allows the organism to survive and reproduce d) Kills the organism

251. Total number of round seed in a cross between pure yellow round and pure green wrinkled seeds in F_2 is (out of total 16 resulted)
a) 9 b) 12 c) 11 d) 10

252. Linked gene is related to …A… and unlinked gene is related to …B…
Choose correct option for A and B
a) A-linkage; B-crossing over b) A-crossing over; B-linkage
c) A-crossing over; B-recombination d) A-recombination; B-crossing gene

253. The linkage map of X-chromosomes of fruit fly has 66 units, with yellow body gene (y) at one end and bobbed hair (b) gene at the other end. The recombination frequency between these two genes (y and b) should be
a) $\leq 50\%$ b) 100% c) 66% d) $>50\%$

254. In man, which of the following genotypes and phenotypes may be the correct result of aneuploidy in sex chromosomes?
a) 22 pairs+XXY males b) 22 pairs+XX females
c) 22 pairs+XXXY females d) 22 pairs+X females

255. Experimental evidence of chromosomal theory of inheritance was given by
a) HT Morgan b) TH Morgan c) H de Vries d) DH Vries

256. Theoretically in incomplete dominance one allele function as normal, while another allele may function as
a) Normal allele b) Non-functional allele
c) Normal but less efficient allele d) All of the above

257. In a family, man have blood group-A and women have blood group-B. Blood group of their children will be
a) Only A b) A or B or AB or O c) Only O d) Only B

258. Principle or laws of inheritance were enunciated by
a) Mendel b) Morgan c) Bateson d) Punnett

259. Mendel's law was explained by
a) Meiosis b) Mitosis c) Both (a) and (b) d) None of these

260. Which statement about Mendel is true?
a) His discoveries concerning genetic inheritance were generally accepted by scientific community at his time
b) He discovered linkage
c) He believed that genetic traits of parents will usually blend in their children
d) His principles about genetics apply usually to plants and animals

261. The loss of chromosomal segment is due to
a) Polyploidy b) Deletions c) Duplications d) Inversions

262. Symbol *A*, *B* and *C* indicates

a) Carrier female b) Effected female c) Death of female d) Normal female

263. The chromosomal condition in Turner's syndrome is
a) 21 trisomy with XY b) 44 autosomes + XXY
c) 44 autosomes + XYY d) 18 trisomy with XY

264. If a child is of O blood group and his father is of B blood group, the genotype of father is
a) I^OI^O b) I^AI^B c) I^OI^B d) I^OI^A

265. Work of Beadle and Tatum on *Neurospora crassa* proved that
a) Complementary genes b) Blending inheritance
c) Multiple allels d) psedoalleles

266. The F_2-generation offspring in a plant showing incomplete dominance, exhibit
a) Variable genotypic and phenotypic ratio b) a genotypic ratio of 1 : 1
c) a phenotypic ratio of 3 : 1 d) Similar genotypic and phenotypic ratio of 1 : 2 : 1

267. Cytoplasmic inheritance always shows
a) Paternal characters b) Maternal characters
c) Parental characters d) Little paternal and more maternal characters

268. Type of gamete participating in selfing of members in monohybrid cross are of
a) One type b) Two type c) Four type d) Many type

269. In sickle-cell anaemia, GAG is replaced by
a) GGA b) GUG c) AAG d) GGG

270. Genes, when close together on a chromosome, are known as
a) Linkage b) Mutation c) Translation d) transscription

271. If a character is always transmitted directly from a father to all his sons and from their sons to all their sons, then which chromosome carries the gene for the character?
a) Autosome b) X-chromosome c) Y-chromosome d) None of these

272. Hugo de Vries is famous for
a) Natural selection theory b) Mutation theory
c) Organic theory d) Chemical theory

273. Jumping genes in maize were discovered by
a) Hugo de Vries b) Barbara McClintock c) T H Morgan d) Mendel

274. A plant of F_1- generation has genotype 'AABbCC'. On selfing of this plant, the phenotypic ratio in F_2-generation will be
a) 3 : 1 b) 1 : 1
c) 9 : 3 : 3 : 1 d) 27 : 9 : 9 : 9 : 3 : 3 : 3 :1

275. The character that is expressed in the F_1-generation is called the
a) Recessive character b) Dominant character
c) Codominant character d) None of these

276. Chromosomal theory of inheritance was proposed by
a) Gregor Mendel b) Hugo de Vries c) Bridges d) Sutton and Boveri

277. In sex linkage, the speciality is
a) Atavism b) Criss-cross inheritance
c) Reversion d) Gene flow

278. Mother = A blood group
Father = AB blood group
The child will not have
a) A blood group b) O blood group c) B blood group d) A blood group

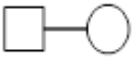
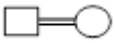
279. The chromosome constitution $2n$-2 of an organism represents
a) Monosomic b) Nullisomic c) Haploid d) trisomic

280. Phenylalanine does not changed to tyrosine. This condition is seen in
a) Sickle-cell anaemia b) Phenylketonuria
c) Thalassaemia d) Haemophilia

281. When the chromosome number of a given organism has one additional chromosome in one of the homologous pairs, the addition is known as
a) Trisomy b) Monosomy c) Polyploidy d) nullisomy

282. What type of gametes will form by genotype rr Yy?
a) ry, rY b) RY, Ry c) Ry, Yy d) RR, Yy
283. The term 'genetics' was introduced in
a) 1906 b) 1905 c) 1904 d) 1903
284. Mutant genes that give slightly modified phenotypes are
a) Heteroalleles b) Recessive alleles c) Isoalleles d) Dominant alleles
285. Which of the following is an example of sex-linked disease?
a) AIDS b) Colour blindness c) Syphilis d) Gonorrhoea
286. Mutations can be induced with
a) IAA b) Ethylene c) Gamma radiations d) Infra red radiations
287. Which of the following is an inherited disorder?
a) Leprosy b) Goitre c) AIDS d) Albinism
288. The title of Mendel's paper, while presenting at Brunn Natural History Society in 1865 was
a) Laws of inheritance b) Laws of heredity
c) Experiments on pea plants d) Experiments on plant hybridisation
289. XO chromosomal abnormality in humans causes
a) Turner's syndrome b) Down's syndrome
c) Darwin's syndrome d) Klinefelter's syndrome
290. Milk secretion and baldness, both the traits belongs to
a) Sex limited b) Sex linked c) Sex influenced d) Autosomal traits
291. The daughter born to haemophilic father and normal mother could be
a) normal b) Carrier c) Haemophilic d) None of these
292. Blood grouping is the example of
a) Multiple allele b) Condominance
c) Both (a) and (b) d) Independent assortment
293. A true breeding plant producing red flowers is crossed with a pure plant producing white flowers. Allele for red colour of flower is dominant. After selfing the plants of first filial generation, the proportion of plants producing white flowers in the progeny would be
a) $\frac{3}{4}$ b) $\frac{1}{4}$ c) $\frac{1}{3}$ d) $\frac{1}{2}$
294. …A… is sex linked recessive disease. Which shows its transmission from …B… female to …C… progeny. Choose the correct option for A, B and C
a) A-haemophilia, B-carrier, C-male b) A-cystic fibrosis, B-carrier, C-male
c) A-sickle-cell anaemia, B-carrier, C-male d) A-phenylketonuria, B-carrier, C-male
295. Crossing over is advantageous because it brings about
a) Variation b) Linkage c) Inbreeding d) Stability
296. Father of 'genetics' is
a) De Vries b) Mendel c) Bateson d) Robert Hooke
297. The recessive gene that always produces its effect, is
a) Pleiotropic gene b) Complementary gene
c) Holandric gene d) Supplementary gene
298. When different alleles of the same gene are present on an individual, the individual is a
a) Heterozygous b) Diploid c) Homozygous d) mosaic
299. Sex linked traits are the traits determined by
a) Sex chromosome b) Autosomes c) Allosomes d) All of these
300. Number of Barr body in XXXY is
a) 1 b) 2 c) 3 d) 4
301. 21 trisomy in humans causes
a) Klinefelter's syndrome b) Down's syndrome
c) Tumer's syndrome d) Patau's syndrome

302. Paternal baldness, moustaches and beard in human males are example of
a) Sex differentiating traits b) Sex determining traits
c) Sex-linked traits d) Sex-influenced traits
303. Polytene chromosomes in salivary glands of *Drosophila* are formed as a result of
a) Endoduplication b) Duplication without separation
c) Replication of DNA without cell division d) All of the above
304. A normal women whose father was colourblind, is married to a normal man. The sons would be
a) 75% colourblind b) 50% colourblind c) All normal d) All colourblind
305. Match the symbols with statement

1.  5. 
2.  6. 
3.  7. 
4. 

A. Diseased (death)
B. Carrier (female) of X-linked recessive gene
C. Marriage in blood relatives
D. Unknown sex
Codes
A B C D
a) 1 2 3 4 b) 6 5 7 4
c) 2 1 3 4 d) 6 2 3 4
306. The female children of haemophilic father and carrier mother are
a) All haemophilic b) Half haemophilic, half carrier
c) All normal d) All carrier
307. Genetic counsellors can identify heterozygous individuals by
a) Height of individuals b) Colour of individuals
c) Screening procedures d) All of these
308. How many conditions exhibit in dissimilar sex chromosomes?
a) 2 b) 3 c) 4 d) 5
309. Number of chromosomes in Down's syndrome are
a) 46 b) 47 c) 48 d) 49
310. Which phenomena leads to the variation in DNA
a) Mutation b) Linkage c) Both (a) and (b) d) Mitosis
311. External morphology or appearance or descriptive term of an genotype is called
a) Genotype b) Phenotype c) Both (a) and (b) d) None of these
312. In which of the following, there is no defect in the sex chromosome?
a) Turner's syndrome b) Down's syndrome
c) Colour blindness d) Klinefelter's syndrome
313. The traits which are not expressed due to a particular gene but are expressed by products of sex hormones are
a) Sex influenced traits b) Autosomal traits c) Allosomic traits d) Sex linked traits
314. Choose the correct option for the chromosomal disorders
I. Colour blindness
II. Down's syndrome
III. Phenylketoria
IV. Turner's syndrome
V. Thalassaemia

a) I, II and III b) II, IV and V c) III, IV and V d) II and IV

315. First time who used the term frequency of recombination?
a) Alfred Sturtevant b) Alfred Nobel c) Pasteur d) Mendel

316. Who postulated the mutation theory?
a) Mendel b) Darwin c) Lamarck d) Hugo de Vries

317. Choose the chemical used in artificial polyploidy
a) Polyethylene glycol b) Sodium alginate
c) Acenaphthene d) Sodium hypochlorite

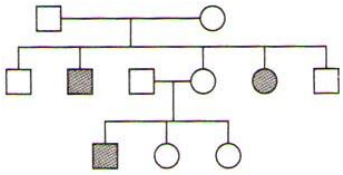
318. Linkage groups are always present on the
a) Homologous chromosomes
b) Analogous chromosomes
c) Sex chromosomes
d) Heterologous chromosomes

319. Sex determination in an organism is given by $\frac{X}{A} = 1.5$, then organism will be
a) Male b) Female c) Super female d) Intersex

320. Emasculation is the removal of
a) Flower buds b) Anthers before dehiscence
c) Carpels before dehiscence d) Mature flowers

321. The genes, which remain confined to differential region of Y-chromosome, are
a) Autosomal genes b) Holandric genes c) Sex-linked genes d) Mutant genes

322. Study the pedigree chart given below.



What does it show?
a) Inheritance of a sex- linked inborn error of metabolism like phenylketonuria
b) Inheritance of a condition like phenylketonuria as an autosomal recessive trait
c) The pedigree chart is wrong as this is not possible
d) Inheritance of a recessive sex – linked disease like haemophilia

323. Mutation cannot change
a) RNA b) Environment c) Enzyme d) DNA

324. One of the parents of a cross has mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2-progenies that mutation is found in
a) One –third of the progenies b) None of the progenies
c) All of the progenies d) Fifty per cent of the progenies

325. Mendel does not get linkage due to
a) Dominance b) Independent assortment
c) Segregation d) Genes on same chromosome

326. Frameshift mutation arises due to
a) Deletion of base pair of DNA b) Insertion of base pair of DNA
c) Both (a) and (b) d) Change in single base pair of DNA

327. Genes A, B and C are linked. Genes A and B are more close than A and C. Find out the correct option for the given statements
I. A might be before B and C
II. B might be between A and C
III. C might be between A and B
IV. More crosses has occurred between A and C than A and B
a) I and II b) II and III c) III and IV d) I, II and IV

328. In previous question find out the ratio between round and wrinkled seed texture
a) 3 : 1 b) 2 : 2 c) 1 : 1 d) 9 : 6 : 1

329. Which of the following blood groups' person can not donate blood to other?
a) AB blood group b) O blood group c) A blood group d) B blood group

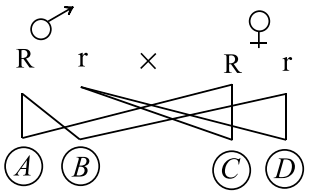
330. Which of the following is not related to sex chromosome X or Y?
a) Turner's syndrome b) Klinefelter's syndrome
c) Down's syndrome d) Haemophilia and colourbindness

331. Inheritance of characters not located in the gene but the young one resembling only the female part is due to
a) Cytoplasmic inheritance b) Chromosomal inheritance
c) Plastid inheritance d) epigenesis

332. Mendel found the phenotype of the F_1 heterozygote Tt was to be exactly like the …A… parent in appearance, he proposed that in a pair of dissimilar factors, one dominates the other (as in the F_1) and hence is called the …B… factor, while the other factor is …C…
Choose the correct option for A, B and C
a) A-T T, B-dominant, C-recessive b) A-T t, B-dominant, C-recessive
c) A-t t, B-dominant, C-recessive d) A-T t, B-Recessive , C-dominant

333. Which of the following pairs of features is a good example of polygenic inheritance?
a) Human height and skin colour b) ABO blood groups in humans and flower colour of *Mirabilis jalapa*
c) Hair pigment of mouse and tongue rolling in humans d) Humans eye colour and sickle cell anaemia

334. Find the phenotype of A, B, C, D from given cross (R-Red and r = white)



a) A-Red, B-Red, C-Red, D-White b) A-Red, B-Red, C-White , D-White
c) A-Pink, B-Red, C-White, D-White d) A-Pink, B-Red, C-Red, D-White

335. Incomplete dominance is shown by
a) Primrose b) *Mirabilis* c) *Helianthus* d) China rose

336. Which of the following genes show the hetertozygous condition?
a) Rr b) RR c) Rr d) None of these

337. Rrrr (progeny): Red (dominant) flowers (heterozygous) were crossed with white flower. The result will be
a) 350 → Red : 350 → white b) 450 → Red : 250 → white
c) 380 → Red : 320 → white d) None of the above

338. A common test to find the genotype of a hybrid is by
a) Crossing of one F_2-progeny with male parent b) Crossing of one F_2-progeny with female parent
c) Studying the sexual behaviour of F_1-progenies d) Crossing of one F_1-progeny with male parent

339. Which of the following has the least number of chromosomes?
a) *Amoeba* b) *Drosophila*
c) *Pheretima* d) *Ascaris megalocephala*

340. In given genetic basis of human blood group table find out which belongs to blood group A, B, AB and O

S.no.	Allele from Parent 1	Allele from Parent 2	Genotype of Offsprings
I.	I^A	I^A	I^AI^A

II.	I^A	I^B	I^AI^B
III.	I^A	i	I^A i
IV.	I^B	I^A	I^AI^B
V.	I^B	I^B	I^BI^B
VI.	I^B	i	I^B i
VII.	i	i	i i

A	B	AB	O

a)

I,III	V,VI	II,IV	VII

b)

I,IV	VI,II	II,III	V

c)

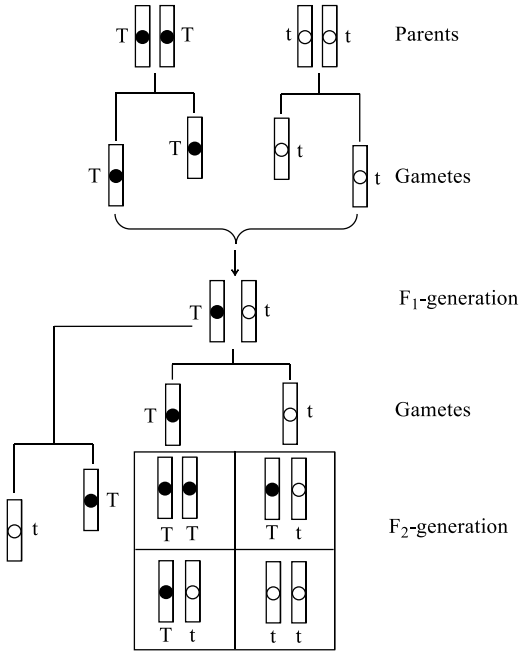
VII	II,IV	V,VI	I,II I

d)

I,III	II,IV	V,VI	VII

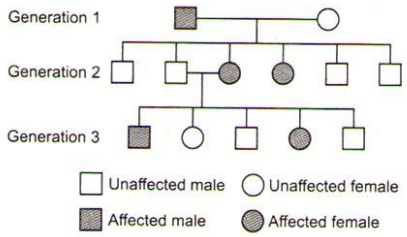
341. The chemical nature of chromatin is as follows
   a) Nucleic acids
   b) Nucleic acid and histone proteins
   c) Nucleic acids, histone and non-histone proteins
   d) Nucleic acids and non-histone proteins

342. What does this diagram indicate?



   a) Law of dominance interpretated on basis of genes
   b) Law of segregation interpretated on basis of genes
   c) Law of independent assortment interpretated on basis of genes
   d) Simply gamete genes

343. Given below is a pedigree chart showing the inheritance of a certain sex- linked trait in humans.

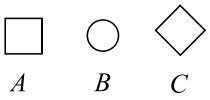


   The trait traced in the above pedigree chart is
   a) Dominant X-linked b) Recessive X-linked c) Dominant Y-linked d) Recessive Y-linked

344. Mendel observed that certain character did not assort independently. Later, scientist found that this is due to
   a) Linkage in traits b) Crossing over

c) Both (a) and (b) d) Dominance of one trait over the other

345. Identify the symbols given below and the correct option with respect to *A*, *B* and *C*



a) A-Male, B-Female, C-Sex unspecified b) A-Male, B-Female, C-Sterile
c) A-Male, B-Female, C-Fertile d) A-Female, B-Male, C-Sex unspecified

346. Mendel investigated characters in garden pea plant that were manifested in two ….. trait
a) Similar b) Non-zygote c) Identical d) Opposite

347. Phenylketonuria disease is a
a) Autosomal dominant b) Autosomal recessive
c) Sex linked recessive d) Sex linked dominant

348. The literal meaning of chromosome is
a) Painted body b) Coloured body c) Doubling body d) Thread like body

349. The F_2 genotypic ratio of monohybride cross is
a) 1 : 1 b) 1: 2 : 1 c) 2 : 1 : 2 d) 9 : 3 : 3 : 1

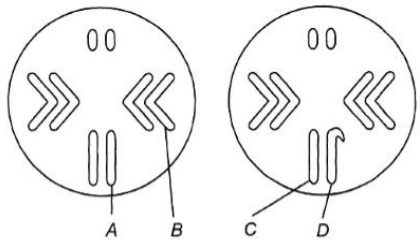
350. The offspring produced from a marriage have only O or A blood groups. Which of the following genotypes would be, the possible genotypes of the parents?
a) I^AI^A and I^AI^O b) I^OI^O and I^OI^O c) I^AI^A and I^AI^O d) I^AI^O and I^AI^O

351. 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

352. The lowest number of chromosomes is found, in which of the following?
a) *Haplopappus gracilis* b) *Poa litorosa* c) *Salix tetrasperma* d) *Ageratum coigzoides*

353. The genes for seven characters of pea plant that were considered in Mendel hybridisation experiment are present on
a) 4 chromosome b) 5 chromosome c) 7 chromosome d) 8 chromosome

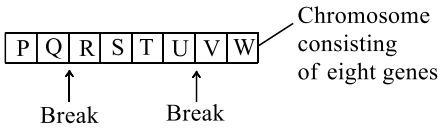
354. Chromosome diagram of the given fruitfly tick the correct choice for autosome labelled



a) A b) C c) D d) B

355. Identify the wrong 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 chromosome
c) The human males have one of their sex chromosomes much shorter than other
d) In domesticated fowls, the sex of the progeny depends on the type of sperm rather than the egg

356. The chromosome shown in the diagram below is broken at the points which are indicated by the arrows and the genes between these points became inverted



The resulting order of the genes will be
a) PQUTSRVW b) WVUTSRQP c) PQTURSVW d) VWUTSRPQ

357. Which of these is a dominant factor?
a) Rh factor b) Haemophilia c) Albinism d) Colour blindness

358. A person with unknown blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His one friend who has a valid cerificate of his own blood type, offers for blood donationwithout delay. What would have been the type of blood group of the donor friend?
a) Type AB b) Type O c) Type A d) Type B

359. If Mendel had studied 7 traits using a plant of 12 chromosomes instead of 14
Choose the correct option for probable result
a) He would have discovered crossing over
b) He would have discovered blending
c) He would have not discovered independent assortment
d) All of the above

360. In thalassaemia, the affected chain of a haemoglobin is
a) α-globin chain b) β-globin chain c) Both (a) and (b) d) None of these

361. Sex chromosomes in male of silkworm is
a) X b) Y c) XX d) No X no Y

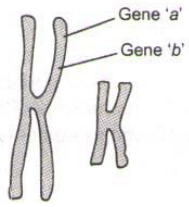
362. A hereditary disease, which is never passed on from father to son is
a) Autosomal linked disease b) X-chromosomal linked disease
c) Y-chromosomal linked disease d) None of the above

363. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridized, then F_2-segregation wii show
a) Higher number of the recombinant types b) Segregation in the expected 9 : 3 : 3 : 1 ratio
c) Segregation in 3 : 1 ratio d) Higher number of the parental types

364. During …A… both members of chromosome pair as well as …B… separate and pass to different gametes. Choose the correct option for A and B
a) A-mitosis; B-allele pair b) A-meiosis; B-allele pair
c) A-allele pair; B-meiosis d) A-allele pair; B-mitosis

365. Genetic map is one that
a) Shows the stages during the cell division
b) Shows the distribution of various species in a region
c) Establishes sites of the genes on a chromosome
d) Establishes the various stages in gene evolution

366. Given below 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 colourblindness d) Phenylketonuria and haemophilia

367. Human females have
a) 22 pairs of autosomes and one pair of sex chromosome
b) 21 pairs of autosomes and two pairs of sex chromosome
c) 23 pairs of autosomes and one pair of sex chromosome
d) 20 pairs of autosomes and one pair of sex chromosome

368. The progenies are found to be male sterile after crossing two plants. This is due to some genes, which are present in
a) Mitochondria b) Cytoplasm c) Nucleus d) chloroplast

369. Mutation may results in the
a) Change in genotype b) Change in phenotype

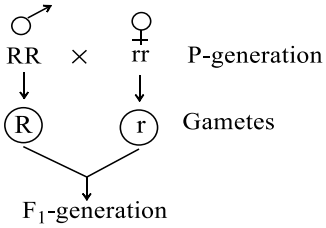
c) Change in metabolism d) All of these

370. In cross between yellow round (YYRR) and pure breeding pea plants having green wrinkled (yyrr) find out the total seeds (plants) having yellow colour in F_2-generation
a) 12 b) 10 c) 14 d) 11

371. A cross in which parents differ in a single pair of contrasting character is callled
a) Monohybrid cross b) Dihybrid cross c) Trihybrid cross d) Tetrahybrid cross

372. Calvin bridges demonstrated sex determining factor is the ratio of number of
a) X-chromosome to autosome b) Autosome to X-chromosome
c) Y-chromosome to X-chromosome d) Y-chromosome to autosome

373. Find out the genotype and phenotype of F_1-generation (R = dominant and red, r = recessive and white) from the given cross



a) Rr and white b) Rr and red c) Rr and pink d) Can not predict

374. Which one of the following conditions correctly describes the manner of determining the sex in the given example?
a) XO type of sex chromosomes determine male sex in grasshopper
b) XO condition in humans as found in Turner's syndrome, determines female sex
c) Homozygous sex chromosomes (XX) produce male in *Drosophila*
d) Homozygous sex chromosomes, (ZZ) determine female sex in birds.

375. Ratio observed in dihybrid cross (phenotypically)
a) 3 : 1 b) 1 : 2 : 1 c) 9 : 7 d) 9 : 3 : 3 :1

376. Trisomy stands for
a) $2n-1$ b) $2n+2$ c) $2n+3$ d) $2n+1$

377. Klinefelter's syndrome results from
a) XX egg of Y sperm b) XX egg and XY sperm
c) X egg and YY sperm d) XY egg and X sperm

378. A couple whose sons are colourblind with AB blood group, identify the parents from the following.
a) Mother colourblind with A blood group, and father normal with blood group-B
b) Mother normal with blood group-A, and father colourblind with blood group-B
c) Mother colourblind with blood group-B, and father normal with blood group-B
d) Mother normal with blood group-A, and father colourblind with blood group-B

379. Which of the following chromosomal mutation are most likely to take place when homologous chromosomes are undergoing synapsis?
a) Inversion and translocation b) Deletion and duplication
c) Inversion and deletion d) Translocation and duplication

380. What percentage of homozygous Rh^- will be born amongst four children of a couple where the husband is heterozygous for Rh^+ and wife is homozygous for Rh^-gene?
a) 25% b) 50% c) 75% d) 100%

381. Mendel could not find out linkage because
I. some genes are linked but they are too far apart for crossing over to be distinguished from independent assortment
II. linked genes, were never tested for the same time in same cross
III. all seven genes, were present on the same chromosomes
IV. all seven genes were present on 4 chromosome but they were present far apart
Find out the correct option

a) I and II b) II and III c) III and IV d) IV only

382. Haemophilia is also called
a) Bleeders disease b) Blood disease c) RBC disease d) All of these

383. The genes located in the same chromosome do not separate and are inherited together over its generations due to the phenomenon of
a) Complete linkage b) Incomplete linkage
c) Incomplete recombination d) Complete recombination

384. Universal donor is
a) O Rh^+ b) O Rh^- c) AB Rh^+ d) AB Rh^-

385. Persons with Klinefelter's syndrome have chromosomes
a) XX b) XY c) XXY d) XYY

386. Mendel crossed tall and dwarf plant. In F_2-generation both the tall and dwarf plants were produced. This shows
a) Blending of characters b) Atavism
c) Non-blending of characters d) Intermediate characters

387. Sex- limited and sex- linked genes are located on
a) Autosomes b) X-chromosome c) Y-chromosome d) Both (b) and (c)

388. How many different types of gametes can be formed by F_1progeny, resulting from the following cross?
AA BB CC × aa bb cc
a) 3 b) 8 c) 27 d) 64

389. Point mutation involves
a) Insertion b) Change in single base pair
c) Duplication d) deletion

390. A person with type A blood group may safely receive a transfusion of
a) Type-AB b) Type-A and type –O
c) Type-A and type –AB d) Type-AB and type –O

391. In which cross will you get most pink flowers?
a) Red × red b) Red × pink c) Pink × pink d) Red × white

392. *Triticale* has been produced by the intergenic hybridization of
a) Wheat and rice b) Wheat and rye c) Wheat and aegilops d) Rice and maize

393. Which one of the following characters studied by Mendel in garden pea was found to be dominant?
a) Green seed colour b) Terminal flower position
c) Green pod colour d) Wrinkled seed

394. Mendel's experimental material was
a) *Pisum sativum* b) *Lathyrus odoratus* c) *Oryza sativa* d) *Mirabilis jalappa*

395. Which of the following is not considered as mutagen?
a) Lower temperature b) X-rays
c) Higher temperature d) UV rays

396. The physical expression or appearance of a character is called as
a) Morphology b) Genotype c) Phenotype d) Ecotype

397. Carrier organism refers to an individual, which carries a
a) Dominant gene, that is not expressed b) Recessive gene, that is not expressed
c) Recessive gene, that is expressed d) Dominant gene, that is expressed

398. In previous question, find out which alphabete (A-D) labelled for X and Y-chromosome
X Y
a) A D b) A,C D
c) C D d) B D

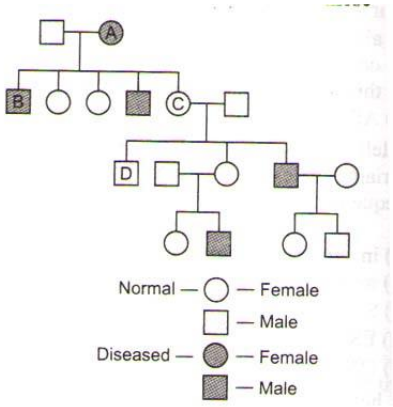
399. In amniocentesis of a pregnant woman, it is found that the embryo contains both, Barr body and F-body. The syndrome likely to be associated with the embryo is

a) Edward' syndrome b) Down's syndrome
c) Klinefelter's syndrome d) Patau's syndrome

400. In the previous question, find out the chances of fifth child to be albino
a) 1 in 2 b) 1 in 4 c) 1 in 3 d) 1 in 5

401. Three children in a family have blood types O, AB and B respectively. What are the genotypes of their parents?
a) I^Ai and I^Bi b) I^AI^B and i i c) $I^B\ I^B$ and $I^A\ I^A$ d) $I^A\ I^A$ and I^B i

402. The chromosomal arrangement results in
a) Euploidy b) Aneuploidy c) Duplication d) polyploidy

403. 

In the above pedigree, assume that no outsider marrying in, carry a disease. Write the genotypes of C and D.
a) X^CY and X^CX^C b) XX^C and XY c) XY and X^CX^C d) X^CX^C and X^CX

404. The specific pair of chromosomes which determine the sex of the individual called
a) Sex chromosomes b) Allosomes c) Heterosomes d) All of these

405. The 'Cri-du-chat' syndrome is caused by change in chromosome structure involving
a) Deletion b) Duplication c) Inversion d) translocation

406. During his experiments, Mendel used the term factor for
a) Genes b) Traits c) Characters d) Qualities

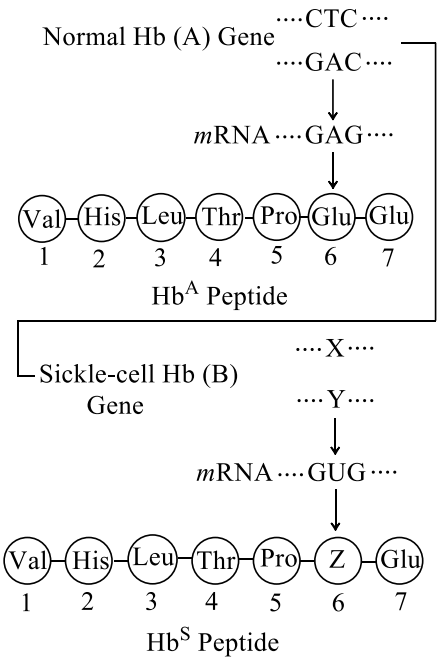
407. In a monohybrid cross involving incomplete dominance, the phenotypic ratio equals the genotypic ratio in F_2- generation. The ratio is
a) 3 : 1 b) 1 : 2 : 1 c) 1 : 1 : 1 : 1 d) 9 : 7

408. The genome of *Caenorhabditis elegans* consists of
a) 3 million base pairs and 30,000 genes b) 180 million base pairs and 13,000 genes
c) 4.7 million base pairs and 4,000 genes d) 97 million base pairs and 18,000 genes

409. Albinism is caused by the deficiency of
a) Amylase b) Tyrosinase c) Phenylalanine d) Xanthene oxidase

410. The ABO blood grouping in human beings is an example for
I.Dominance
II.Incomplete dominance
III.Codominance
IV.Multiple alleles
a) I and II b) II , III and IV c) I , III and IV d) III and II

411. Sickle-cell anaemia is an autosomal linked recessive trait can be transmitted from parents to the offspring when both the partners are carrier for all the genes or heterozygous. The disease is controlled by a single pair of allele, Hb^A and Hb^S. Identify X, Y and Z



a) GTG GAC Val (GUG)
b) CAC CTC val (GUG)
c) GTA GAG val (GUG)
d) GTC GAC val (GUG)

412. Diploid cells have
a) Two chromosomes
b) One set of chromosomes
c) Two pairs of homologous chromosomes
d) Two sets of chromosomes

413. Single gene can produce more than one effect. Like starch synthesis in pea plant. It has two alleles (B and b) for starch synthesis the phenotypes of which are also given below
B B, b b, B b
I. BB – round seed, large starch synthesis
II. bb – wrinkle seed, less starch synthesis
III. Bb – intermediate size seed, intermediate less starch synthesis
Choose the correct option
a) I and II
b) II and III
c) III and I
d) I, II and III

414. After examining the blood groups of husband and wife, the doctor advised them not to have more than one child, the blood group of the couple are likely to be
a) male $Rh^-$and female Rh^+
b) Female $Rh^-$and male Rh^+
c) Male and female Rh^+
d) Male and female Rh^-

415. A person with blood group-A has
a) Antigen-A and antibody-b
b) Antigen-B and antibody-a
c) Both antibodies
d) No antibody and no antigen

416. Which of the following is not a correct match?
a) Sex determination — A chromosomal phenomenon
b) Y-chromosome — Autosomal
c) Red–green colour blindness in human — A sex-linked character
d) An abnormal chromosome number in each cell — A case of polyploidy

417. In law of independent assortment. How many factors are involved? (for a dihybrid cross)
a) 2
b) 3
c) 4
d) 1

418. Mother B homozygous, father A unknown, therefore, possible blood group in progeny is
a) AB and B possible
b) AB and A possible
c) A and B possible
d) O possible

419. Consider the following four statements I, II, III and IV and select the correct statements
I. Mendelian experiments has a large sampling size, which gave greater credibility to the data that he collected
II. Recessive allele influences the appearance of the phenotype even in the presence of a dominant allele

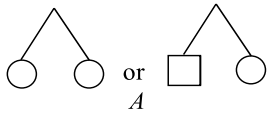
III. Multiple alleles can be found only when population studies are made
IV. In F_2-generation of a Mendelian monohybrid cross, the tall and dwarf traits were identical to their parental types and shows blending inheritance
The correct statements are
a) I and III b) III and IV c) II and IV d) II and III

420. When released from ovary, human egg contain
a) One Y-chromosome b) Two X-chromosome c) One X-chromosome d) XY-chromosome

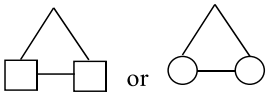
421. The tendency of offsprings to differ from their parents is called
a) Variation b) Heredity c) Inheritance d) Resemblance

422. The gene, which controls many characters, is called
a) Codominant gene b) Polygene c) Pleiotropic gene d) Multiple gene

423. The given diagram *A* and *B* indicates



A



B

a) A-Zygotic twins; B-Dizygotic twins b) A-Dizygotic twins; B-Identical twins
c) A-Zygotic twins; B-Identical twins d) A-Identical twins; B-Dizygotic twins

424. Which of the following statement is/are correct regarding law of segregation?
a) Alleles separate with each other during gametogenesis
b) The segregation of factors is due to the segregation of chromosomes during meiosis
c) Law of segregation is called as law of purity of gametes
d) All of the above

425. Which of the following discoveries resulted in a Nobel Prize?
a) Recombination of linked genes b) Genetic engineering
c) X-rays induce sex-linked recessive lethal mutations d) Cytoplasmic inheritance

426. When alleles of two contrasting characters are present together, one of the character expresses itself during the cross while the other remains hidden. This is the
a) Law of purity of gametes b) Law of segregation
c) Law of dominance d) Law of independent assortment

427. In which phase of meiosis-I the two chromosome can align at the metaphase plate independently of each other
a) Metaphase-II b) Metaphase-I c) Anaphase-I d) Telophase-I

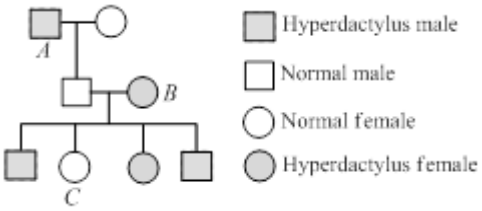
428. When a mutation is limited to the substitution of one nucleotide for another, it is called
a) Translocation b) Point mutation
c) Base inversion d) Sugar phosphate deletion

429. Types of genotype observed in a dihybrid cross are
a) 9 b) 12 c) 4 d) 6

430. In Morgan's experiments on linkage, the percentage of white eyed, miniature-winged recombinants in F_2-generation is
a) 1.3 b) 37.2 c) 62.8 d) 73.2

431. Which cross was used to study the independent assortment?
a) Monohybrid cross b) Dihybrid cross c) Trihybrid cross d) Tetrahybrid cross

432. Hyperdactyly (the possession of more than 12 finger) is determined by the dominant allele (H) and normal condition by recessive allele (h).
The diagram shows a family tree in which some members of the family are hyperdactylus



Find out the genotype of A, B and C

a) A-Hh, B-Hh, C-hh b) A-HH, B-Hh, C-hh c) A-Hh, B-HH, C-hh d) A-Hh, B-HH, C-hh

433. Which of the following statements about mutation are true?
I. Mutations are the source of new alleles for genes
II. Organisms are able to create mutations to meat their specific needs
III. Mutations are random events and can happen in any cell at any time
IV. Most mutations tend to be harmful or have no effect on an organisms
a) I, II and III b) I, II, III and IV c) I, III and IV d) I and III

434. Centromere is also called
a) Chromomere b) Secondary constriction
c) Primary constriction d) chromocentre

435. Which of the following statements are false?
I. Specific mutations are acquired because they are needed
II. Recessive alleles follows different laws of inheritance than dominant alleles do
III. Offspring get two copies of each gene from each parent
IV. Gametes fuses without regard to which alleles they carry
a) II and III b) II and IV c) II, III and IV d) I, II and IV

436. Which contributed to Mendel's success?
I. Selection of pea plant
II. Knowledge of history
III. One character at one time
IV. His statistical knowledge
Choose the correct option
a) I, II, III and IV b) II and III c) I, III and IV d) IV, III and II

437. In XX and XO chromosomal sex determination there is absence of one chromosome in
a) Male b) Female c) Both (a) and (b) d) None of these

438. Which of the following is true about linkage
I. It is phenomenon in which more recombinants are produced in F_2-generation
II. More parental combination are produced in F_2-generation
III. Genotype which are present in F_1 hybrid. Reappear in high frequency in F_2-generation
IV. It is a phenomenon in which two chromosome are linked
a) Only I b) Only II c) I and III d) III and IV

439. The total number of progeny obtained through dihybrid cross of Mendel is 1280 in F_2-generation. How many are recombinants?
a) 240 b) 360 c) 480 d) 720

440. A child of blood group-O cannot have parents of blood groups
a) A and A b) AB and O c) A and B d) B and B

441. Rh factor is present in
a) All vertebrates b) All mammals
c) All reptiles d) Man and rhesus monkey only

442. Which of the following condition is called monosomic?
a) $2n+1$ b) $2n+2$ c) $n+1$ d) $2n-1$

443. A man of blood group–A marries woman of blood group-AB, which type of progeny would indicate that man is heterozygous?

a) O b) B c) A d) AB

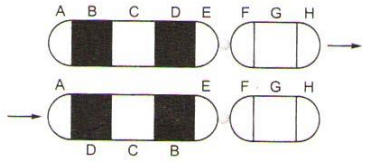
444. The children of a haemophilic man and a normal women are
   a) All haemophilic
   b) Only daughters are haemophilic
   c) Only sons are haemophilic
   d) Neither sons nor daughter are haemophilic

445. In man, four phenotypes of blood groups are due to the presence of antigen-A and antigen-B on the RBC. The chromosome that has the gene to control these antigens is
   a) X-chromosome b) 21^{st} chromosome c) 9^{th} chromosome d) 7^{th} chromosome

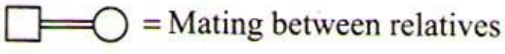
446. More men suffer from colourblindness than women because
   a) Women are more resistant to disease than men
   b) The male sex hormone testosterone causes the disease
   c) The colourblind gene is carried on the 'Y' chromosome
   d) Men are hemizygous and one defective gene is enough to make them colourblind

447. 'Cri-du–chat' syndrome in humans is caused by the
   a) Fertilization of an XX egg by a normal Y-bearing sperm
   b) Loss of half of the short arm of chromosome 5
   c) Loss of half of the long arm of chromosome 5
   d) Trisomy of 21st chromosome

448. Given below is representation of a kind of chromosomal mutation. What is the kind of mutation represented?



   a) Deletion b) Duplication
   c) Inversion d) Reciprocal translocation

449. Which 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)  = Affected male

450. Ischihara chart is used to detect
   a) Tuberculosis b) Eye sight c) Colour blindness d) Diabetes

451. Genes exibiting multiple effects are known as
   a) Complementary genes b) Pleiotropic genes
   c) Cistrons d) Pseudogenes

452. A person with blood group –AB has
   a) AB antigen b) a and b antibodies c) no antigen d) antibody-a

453. Excessive growth of hair on the pinna is a feature found only in males because
   a) The female sex hormone oestrogen suppresses the character in females
   b) The gene responsible for the character is present on the Y-chromosomes only
   c) The gene responsible for the character is recessive in females and dominant only in males
   d) The character is induced in males as males produce testosterone

454. 3:1 ratio in F_2-generation is explained by
   a) Law of partial dominant b) Law of dominant
   c) Law of incomplete dominant d) Law of purity of gametes

455. Incomplete dominance is different from complete dominance in having

a) Phenotypic ratio b) Genotypic ratio c) Both (a) or (b) d) None of these

456. A true breeding plant producing red flowers is crossed with a pure plant producing white flowers. Allele for red colour of flower is dominant. After selfing the plants of first filial generation, the proportion of plants producing white flowers in the progeny would be
a) 9 : 3 : 3 : 1 b) 12 : 3 : 1 c) 9 : 3 : 4 d) 9 : 6 : 1

457. Studies of human sex-linked trait shows that
a) Male are affected mostly b) Female are carrier mostly
c) Both (a) and (b) d) Neither (a) or (b)

458. If a cross between two individuals produces offspringe with 50% dominant character (A) and 50% recessive character (a),then the genotypes of parents are
a) $Aa \times Aa$ b) $Aa \times aa$ c) $AA \times aa$ d) $AA \times Aa$

459. Mendel choose the garden pea plant for his experiment and his findings were based on
a) Artificial pollination b) Cross-pollination
c) Self and artificial pollination d) None of the above

460. Lack of independent assortment of two genes 'A' and 'B' in fruit fly-*Drosophila* is a due to
a) Repulsion b) Recombination c) Linkage d) Crossing over

461. One of the following is not the type of blood groups or blood factors.
a) Lewis and Duffy b) Buffs and Kips c) ABO and Rh d) Rh and MN

462. Is it possible that same genotype have different phenotype?
a) No – because identical genotype give identical phenotype
b) No – because of mutation
c) Yes – because different environment can produce different phenotype of the same genotype
d) Yes – because phenotype decides the genotype

463. ABO blood groups in human 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) Three b) One c) Four d) Two

464. Probability of genotype TTrr in F_2-generation of a dihybrid cross is
a) $\frac{1}{16}$ b) $\frac{3}{16}$ c) $\frac{9}{16}$ d) $\frac{6}{16}$

465. In a cross between individuals with genotypes Tt Rr, if the resulting number of offsprings is 16, then identify the number of genotypes with TtRr and TtRR amongst them.
a) 1 and 2 b) 2 and 3 c) 3 and 1 d) 4 and 2

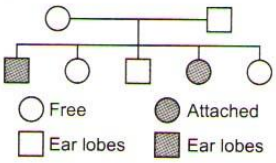
466. Which of the following genotypes does not produce any sugar polymer on the surface of the RBC?
a) $I^A\ I^A$ b) I^B i c) I^AI^B d) i i

467. The diagrammatic representation of the chromosomes of an individual is called
a) Idiogram b) Karyotype c) Phenotype d) diploidy

468. In *Mirabilis*, a hybrid for red (RR) and white (rr) flower produces pink (Rr) flower. A plant with pink flower is crossed with white flower, the expected phenotypic ratio is
a) Red : pink : white(1 : 2 : 1) b) Pink : white(1 : 1)
c) Red : pink (1 : 1) d) Red : white (3 : 1)

469. A marriage between normal visioned man and colourblind woman will produce, which of the following types of offsprings?
a) Normal sons and carrier daughters b) Colourblind sons and carrier daughters
c) Colourblind sons and 50%carrier daughters d) 50% colourblind sons and 50%carrier daughters

470. Given below is a pedigree chart of a family with five children. It shows the inheritance of attached ear lobes as opposed to the free ones. The squares represent the male individuals and circles the female individuals. Which of the following conclusions drawn is correct?



a) The parents are homozygous recessive
b) The trait is Y-linked
c) The parents are homozygous dominant
d) The parents are heterozygous

471. I. Myotonic dystrophy is an autosomal dominant trait
II. Sickle-cell anaemia is an autosomal recessive trait
III. Failure of segregation of alleles results in chromosomal loss
IV. Failure of segregation of allele result in chromosomal gain
V. Cystic fibrosis is a Mendelian disorder
Correct statements are
a) I, II, III and IV
b) I, III, IV and V
c) I, II, IV and V
d) All of these

472. Haemophilia is more commonly seen in human males than in human females because
a) This disease is due to a X-linked dominant mutation
b) A greater proportion of girls die in infancy
c) This disease is due to a X-linked recessive mutation
d) This disease is due to a Y- linked recessive mutation

473. Which one of the following was the rediscoverer of Mendel's work?
a) Muller
b) Morgan
c) Correns
d) Bridge

474. $\frac{1}{4}:\frac{1}{2}:\frac{1}{4}$ ratio of TT : Tt : tt can be depicted mathematically binomial expression as (ideally)
a) $(ax+by)^2$
b) $(ax+by)^3$
c) $(Ax+By)^4$
d) $ax+by$

475. Pure red flowers was crossed with pure white flowers. Red is dominant. After selfing of F_1-generation, the proportions of plants producing white flowers in progeny would be
a) ¾
b) ¼
c) 1/3
d) ½

476. Which of the following abnormalities, results from an unnatural presence of a Barr body?
a) Turner's syndrome
b) Down's syndrome
c) Klinefelter's syndrome
d) All of these

477. When normal and mutant alleles are present on opposite chromosomes of homologous pair, the heterozygotes are called as
a) *cis* heterozygotes
b) Homologous heterozygotes
c) *trans* heterozygotes
d) None of the above

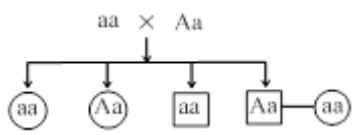
478. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid is often superior to both its parents. This phenomenon, is called
a) Transformation
b) Splicing
c) Metamorphosis
d) heterosis

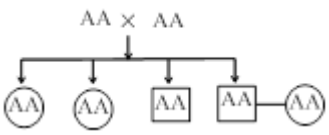
479. The types of gametes produced by a heterozygous allelic pair is/are
a) 1
b) 2
c) 3
d) Many

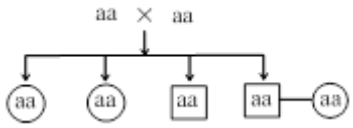
480. Prokaryotic genetic system has
a) DNA and histone
b) DNA and no histone
c) No DNA and histone
d) No DNA and no histone

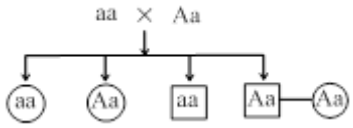
481. A chromosome in which the centromere is situated close to its end so that one arm is very short and the other very long is
a) Acrocentric
b) Metacentric
c) Sub- metacentric
d) telocentric

482. Write the genotype of the previous questions

a)


b)


c) 

d) 

483. Sickle cell anaemia is
   a) An autosomal linked dominant trait
   b) Caused by substitution of valine by glutamic acid in the β-globin chain of haemoglobin
   c) Caused by a change in base pair of DNA
   d) Characterized by elongated sickle like RBCs with a nucleus

484. Improvement of human race through hereditary qualities is called
   a) Disruptive b) Directional c) Stabilizing d) Coevolution

485. ...A... gene produces all gametes that are similar, while a ....B... produces two kinds of gametes each having one allele with equal proportion
   Choose the correct option for A and B
   a) A-homozygous; B-heterozygous
   b) A-homozygous; B-dominance
   c) A-homozygous; B-recessive
   d) A-heterozygous; B-homozygous

486. In which one of the following combinations (a-d) of the number of the chromosomes is the present day hexaploid wheat correctly represented?

Combination	Monosomic	Haploid	Nullisomic	Trisomic

   a) 27-28-42-43 b) 7-82-40-42 c) 21-7-42-43 d) 41-21-40-43

487. When the number of recombinant progeny is usually less than the number expected in independent assortment it is called
   a) Complete linkage
   b) Incomplete linkage
   c) Complete recombination
   d) Complete independent assortment

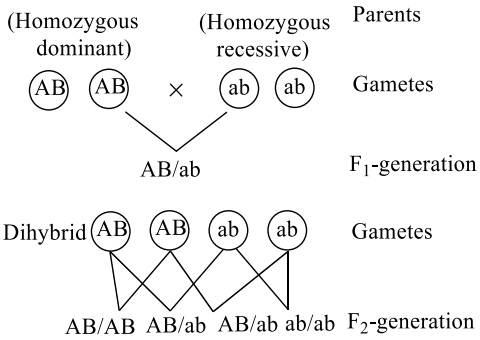
488. The enzyme missing in phenylketonuria is
   a) Phenylalanine hydroxylase
   b) Phenylalanine reductase
   c) Phenylalanine oxidase
   d) Phenylalanine oxidoreductase

489. Gene is
   a) One pair of allele
   b) Alternative form of a gene
   c) Present in allelic form on homologous
   d) Both (a) and (c) are correct

490. The telomeres of eukaryotic chromosomes consist of short sequences of
   a) Thymine rich repeats
   b) Cytosine rich repeats
   c) Adenine rich repeats
   d) Guanine rich repeats

491. In Mendelian dihybrid cross when heterozygous Round Yellow are self crossed. Round Green offsprings are represented by the genotype
   a) RrYy,RrYY and RRYy b) Rryy,RRyy, and rryy c) rrYy andrrYY d) Rryy and RRyy

492. Study the given test cross and choose the correct option for F_2-generation



a) Hybrid cross (9 : 3 : 3 : 1)
b) Hybrid cross (3 : 1)
c) Dihybrid cross (12 : 4)
d) Dihybrid linked gene cross (3 : 1)

493. Mendel's principle of segregation means that the germ cells always receive
a) One pair of alleles
b) One quarter of the genes
c) One of the paired alleles
d) Any pair of alleles

494. Law based on fact that the characters don't show any blending and both the characters are recovered as such in F_2-generation although one character was absent in F_1-progeny, is
a) Law of purity of gametes
b) Law of independent assortment
c) Law of incomplete dominance
d) Law of dominance

495. In *Melandrium*, the sex determination type is
a) XX-XY
b) XX-XO
c) ZZ-ZW
d) XY-XO

496. The effect of todays radioactive fall out will probably be more harmful to children of future generation than to children now living because
a) Infants are more susceptible to radiations
b) Susceptibility to radiation increase with age
c) Mutated genes are frequently recessive
d) Contamination of milk supply is not cummulative

497. Select the statement which is not correct.
a) Polygenic character is controlled by multiple alleles
b) In case of polygenic inheritance, thousands of intermediate phenotypes are found between two extreme ones
c) Height, weight, skin colour are polygenic
d) ABO blood group system is an example of multiple allelism

498. Linkage was first suggested by
a) Sutton and Boveri
b) Morgan
c) De Vries
d) Pasteur

499. X-linked recessive gene is
a) Always expressed in male
b) Always expressed in female
c) Lethal
d) Sub-lethal

500. Gene for colour blindness is located on
a) Y-chromosome
b) 13^{th} chromosome
c) X-chromosome
d) 21^{st} chromosome

501. A. $\frac{X}{A} = 1$
B. $\frac{X}{A} >$ more than 1
C. $\frac{X}{A} = 0.5$
Here, X = number of X-chromosome
A = set of autosomal pair
Choose the correct option for A, B and C result
a) A-female B-meta female C-male
b) A-female B-meta female C-female
c) A-female B-female C-male
d) A-meta female B-female C-male

502. The ABO blood group are controlled by
a) I-gene
b) c-gene

c) B-gene d) n-gene

503. Which of the following is considered as a recessive character of Mendel?
a) Round seed b) Wrinkled seed c) Axial flower d) Green pod

504. When an animal has both the characters of male and female, it is called
a) Intersex b) Superfemale c) Supermale d) gynadromorph

505. Point mutation arises due to change in
a) Single base DNA b) Single base pair of DNA
c) Segment of DNA d) Double base pair of DNA

506. colour blindness is more observed in …….humans
a) Male b) Female c) Infent d) In old age

507. Mendel cross tall and dwarf plant. In F_2-generation the observed ratio was 3:1 (tall: short). From this result, he deduced
I. law of dominance
II. law of independent assortment
III. law of segregation
IV. incomplete dominance
Choose the correct option
a) I, II, III and IV b) I and III c) II, III and IV d) I, II and III

508. Genetic or chromosomal symbol used for the person who is having sickle-cell anaemia is
a) $Hb^s\ Hb^s$ b) $Hb^a\ Hb^a$ c) $Hb^g\ Hb^g$ d) $Hb^m\ Hb^m$

509. Which of the following is true regarding human genetics?
a) Most characters are controlled by one gene
b) Same characters are controlled by more then two genes
c) Same characters are not inherited according to Mendel's law
d) All of the above

510. Foetal sex is determined by examining cells from amniotic fluid looking for
a) Chiasmata b) Barr bodies c) Sex chromosomes d) None of these

511. Sex-linked allele or disease never passes from
a) Women to her daughter
b) Man to daughter
c) Women to grand daughter
d) Man to his son

512. What is genotypic ratio in a dihybrid cross?
a) 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1 b) 2 : 4 : 2 : 1 : 2 : 1 : 1 : 2 : 1
c) 1 : 4 : 2 : 1 : 1 : 1 : 2 : 1 d) 4 : 2 : 1 : 1 : 1 : 1 : 2 : 1 : 1

513. The law of segregation of characters is also called the law of purity of gametes because
a) Gametes have only one of the two alleles for each characters b) Gametes cannot be contaminated
c) Gametes are very different types of cells d) It was just another name adopted accidentally

514. Four children belonging to the same parents have the following blood groups A, A, AB and O. Hence, the genotypes of the parents are
a) Both parents are homozygous for 'A' group
b) One parent is homozygous for 'A' and another parent is homozygous for 'B'
c) One parent is heterozygous for 'A' and another parent is heterozygous for 'B'
d) Both parents are homozygous for'B' group

515. Mendel work later formulated into laws of
I. Linkage
II. Segregation
III. Incomplete dominance
IV. Independent assortment

Choose the correct option

a) I, III and IV b) II and IV c) II, III and IV d) I, II and III

516. Barr body is associated with

a) Sex chromosome of female b) Sex chromosome of male

c) Autosome of female d) Autosome of male

517. A man can inherit his X-chromosome from his

a) Maternal grandmother or maternal grandfather b) Father

c) Maternal grandfather d) Paternal grandfather

518. The types of gametes formed by the genotype Rr Yy are

a) RY, Ry, rY, ry b) RY, Ry, ry, ry c) Ry, Ry, Yy, ry d) Rr, RR, Yy, YY

519. Mating of an organism to a double recessive in order to determine whether it is homozygous or heterozygous for a character under consideration, is called

a) Reciprocal cross b) Test cross c) Dihybrid cross d) Back cross

520. Polyploidy means occurrence of

a) Haploid sets of chromosomes b) Diploid sets of chromosomes

c) More than diploid sets of chromosomes d) All of the above

521. Both husband and wife have normal vision though their fathers were colourblind and mothers did not have any gene for colour blindness. The probability of their daughter becoming colourblind is

a) 50% b) 75% c) 25% d) None of these

522. L –shaped chromosomes are also called

a) Acrocentric b) Telocentric c) Sub–metacentric d) None of these

523. A homozygous sweet pea plant with blue flowers (RR) and long pollen ($R_0\ R_0$)is crossed with a homozygous plant having red flowers (rr) and round pollen ($r_0\ r_0$). The resultant F_1hybrid is test crossed. Which of the following genotype does not appear in its progeny?

a) $Rrrr_0$ b) $RrRr_0$ c) Rrr_0r_0 d) rrR_0r_0

524. A diseased man marries a normal woman and they get three daughters and five sons. All the daughters were diseased and sons were normal. The gene of this disease is

a) Sex-linked dominant b) Sex-linked recessive

c) Sex-limited character d) Autosomal dominant

525. A polygenic trait is controlled by 3 genes A, B and C. In a cross AaBbCc× AaBbCc, the phenotypic ratio of the offsprings was observed as 1 : 6 : x: 20 : x: 6 : 1.

What is the possible value of x?

a) 3 b) 9 c) 15 d) 25

526. Chromosomal mutations occurs due to

I. Deletion II. Duplication

III. Translocation IV. Inversion

Choose the correct option

a) I, II and III b) II, III and IV c) I, III and IV d) All of these

527. The allele which expresses itself in both homozygous and heterozygous condition is called

a) Dominant allele b) Recessive allele

c) Incomplete dominant allele d) Split allele

528. Equatorial division and reductional division takes place in which types of cell division

a) Meiosis, mitosis b) Mitosis, meiosis c) Both (a) and (b) d) Amitosis, meiosis

529. Monohybrid test cross ratio is

a) 3 : 1 b) 2 : 1 c) 1 : 1 d) 9 : 3 : 3 : 1

530. Who gave the term ‘genetics’?

a) Mendel b) Robert Hooke c) Bateson d) Purkinje

531. In which of the following disorders, blood has a defective haemoglobin?

a) Haemophilia b) Haematuria c) Haematoma d) Sickle cell anaemia

532. In sickle cell anaemia, the glutamic acid is replaced by

a) Proline b) Alanine c) Serine d) Valine

533. Which 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

534. Find out the percentage of dominant phenotype in cross between Pp and Pp. P-dominant, p-recessive
a) 25% b) 50% c) 75% d) 100%

535. Gametes produced by a homozygous individual is/are of …. types
a) 1 b) 2 c) 3 d) Many

536. What will be the gametic chromosomes number of a cell, if somatic cell have 40 chromosomes?
a) 10 b) 20 c) 30 d) 40

537. Human female possesses 44+XX chromosomes. The secondary oocyte shall have
a) 44 + XX b) 22 + X c) 22 d) 44

538. Select the correct statement from the ones given below with respect to dihybrid cross.
a) Antirrhinum b) Pisum c) Solanum d) Hibiscus

539. Test cross is when
a) F_1 crossed with heterozygous parent
b) F_1 crossed with homozygous dominant parent
c) F_1 crossed with homozygous recessive parent
d) F_1 crossed with homozygous parent

540. Sex chromosomes are also known as
a) Autosomes b) Allosomes c) Genome d) karyotype

541. Euploidy is best explained by
a) Exact multiple of a haploid set of chromosomes
b) One chromosome less than the haploid set of chromosomes
c) One chromosome more than the haploid set of chromosome
d) One chromosome more than the diploid set of chromosomes

542. In which year Mendel's work rediscovered
a) 1900 b) 1901 c) 1902 d) 1903

543. Which of the following diseases is governed by pleiotropic genes?
a) Sickle cell anaemia b) Haemophilia c) Colour blindness d) None of these

544. Inheritance of skin colour in human is an example of
a) Chromosomal aberration
b) Codominance
c) Point mutation
d) Polygenic inheritance

545. Heterochromatin remains condensed in which part of chromosome?
a) Secondary construction–I
b) Secondary construction–II
c) Telomeres
d) Both (a) and (b)

546. A plant of F_1- generation has genotype 'AABbCC'. On selfing of this plant, the phenotypic ratio in F_2-generation will be
a) Polyploidy
b) Incomplete dominance
c) Multiple allelism
d) polygeny

547. Which have great importance in genetics?
a) *Penicillium* b) *Claviceps* c) *Neurospora* d) None of these

548. Number of Barr bodies in XXXXY is
a) 1 b) 2 c) 3 d) 4

549. Dihybrid ratio of the linked gene is
a) 1 : 1 b) 1 : 1 : 1 : 1 c) 9 : 3 : 3 : 1 d) 3 : 1

550. Polyploidy can be induced by the application of
a) Auxin b) Kinetin c) Colchicine d) ethylene

551. If a plant having yellow or round seeds was crossed with another plant having green and wrinkled seeds then F_1-progeny are in the ratio

a) 15 : 1 b) 1 : 15
c) 1 :13 d) All yellow and round seeds

552. Which of the following, can be used to describe the alleles correctly?
a) Alternative form of a gene b) Dominant form of gene
c) Recessive form of a gene d) One gene pair

553. Which of the following animals is mostly used in genetics experiments?
a) Butterfly b) Fruit fly c) Housefly d) Dragon fly

554. Which of the following diseases results from the genetic inability to synthesize a single enzyme?
a) Colour blindness b) Down's syndrome c) Phenylketonuria d) Diabetes

555. Balbiani rings are the structural features of
a) Allosomes
b) Polytene chromosomes
c) Autosomes
d) Lampbrush chromosomes

556. Sometimes, there are more than two alleles for a given chromosome locus. In this case, a trait is controlled by
a) Codominance b) Pseudodominance
c) Incomplete dominance d) Multiple alleles

557. Two pea plants were subjected for cross pollination. Of the 183 plants produced in the next generation,94 plants were found to be tall and 89 plants were found to be dwarf. The genotypes of the two parental plants are likely to be
a) TT and tt b) Tt and Tt c) Tt and tt d) TT and TT

558. In haplodiploidy determination of sex, males is
a) Haploid b) Diploid c) Haplodiploid d) Diplohaploid

559. A cross between F_1-hybrid and a heterozygous parent (Tt × tT) gives the phenotypic ratio of
a) 1 : 1 b) 3 : 1 c) 2 : 1 d) 4 : 1

560. When mutation is confined to only one substitution, it is called
a) Translocation b) Point mutation c) Base inversion d) Frame shift

561. Letter symbol refers to the dominant factors give a …A… or upper case latter of the alphabet. A corresponding …B… or lower case letter is used for recessive factor. Here A and B refers to
a) A-capital; B-small b) A-small; B-capital
c) A-capital; B-capital d) A-small; B-small

562. In a gene pool, along with beneficial mutations those mutations also exists which are damaging to an individual. It has been found that these mutations are irreversible because
I. they have survival value
II. they are acquired
III. they are recessive and carried by heterozygous individuals only
IV. they show genetic drift
Choose the incorrect option for given statement
a) I and III b) I and II c) II and IV d) Only III

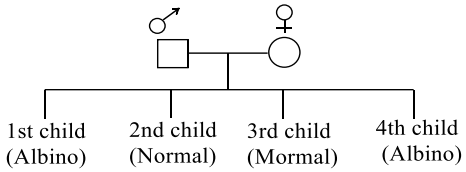
563. In a medicolegal case of accidental interchange between two babies in a hospital, the baby of the blood group-A could not be rightly given to a couple with
a) Husband of O group and wife of AB group b) Husband of A group and wife of O group
c) Husband of B group and wife of O group d) Husband of AB group and wife of A group

564. The plasma membrane of the red blood cells has …A… polymers that protrude from its surface and the kind of sugar is controlled by the gene. The gene I has three alleles …B… The alleles I^A and I^B produce a slightly different form of the sugars, while allele i doesn't produce any …C…
Choose the correct option for A, B and C
a) A-protein, B $-$ I^A $I^B I^O$, C-protein b) A-protein, B $-$ I^A $I^B I^O$, C-sugar
c) A-sugar, B $-$ I^A $I^B I^O$, C-protein d) A-sugar, B $-$ I^A I^BI, C-sugar

565. The person famous for experimental genetics
a) TH Morgan b) Sutton c) Boveri d) Robert Hooke

566. Morgan worked with tiny fruit fly names as
a) *Drosophila melanogaster* b) *Mangifera indica*
c) *Mirabilis jalapa* d) *Drosophila indica*

567.



A=Normal allele, a = Albino allele.
Find out genotype of ♂ and
(father and mother)

Father ♂	Mother ♀

a)
A a	A A

b)
A A	A a

c)
A A	A A

d)
A a	A a

568. Linkage group is
a) Linearly arranged group of linked gene b) Non-linearly arranged group of linked gene
c) Non-linearly arranged group of unlinked gene d) Non-linearly arranged group of single gene

569. Some individuals with blood group –A may inherit the genes for blonde hair, while other individuals with blood group – A may the gene for brown hair. This can be best explained by the principle of
a) 3 : 1 b) 9 : 3 : 3 :1 c) 1 : 1 d) 1 : 1 : 1 : 1

570. I. 100% parental combinations are found in F_2-generation
II. F_2 phenotypic ratio is 3 : 1 in dihybrid cross
III. Dihybrid test cross ratio is 1 : 1 in F_2-generation
IV. Linked genes tends to separate frequently
Choose the correct options from the above given statements
a) I, II and IV b) I, III and IV c) II, III and IV d) I, II and III

571. The following diagram shows two chromosomes and the lettered number represents the genes

Chromosome 1								Chromosome 2			
P	Q	R	S	T	U	V	W	E	F	G	H

Which of the following would result if a translocation occurred between chromosome 1 and 2?
a) P Q R S W V U T E F G H b) P Q R S T U V W E F G H
c) P Q R S T U V W E F H d) P Q R S T U V W E F G H G H

572. Experimental verification of the chromosomal theory of inheritance was given by
a) Gregor Johann Mendel b) Hugo de Vries
c) Langdon Down d) Thomas Hunt Morgan

573. A gene that masks another gane's expression, is called
a) Dominant b) Recessive c) Epistatic d) Assorted

574. Transposons are
a) House- keeping genes b) Jumping genes
c) Transporting genes d) Stationary genes

575. Which of the following law was discovered first by Mendel?
a) Law of dominance b) Law of segregation
c) Law of independent assortment d) Law of sex determination

576. Unit of inheritance that required to express a particular trait of organism is called
a) Factors b) Genes c) Phenotype d) Genotype

577. Sex limited traits are the
a) Traits appeard in particular sex

b) Traits which governed by genes present in both sexes
c) Traits which influenced by the sex hormones
d) All of the above

578. Variation stands for differences in traits of progenies from
a) Each other
b) Parents
c) Both (a) and (b)
d) From mother only

579. In which mode of inheritance, do you expect more maternal influence among the offsprings?
a) Autosomal
b) Cytoplasmic
c) Y-linked
d) X-linked

580. Mutagens are
a) Chemical agents which cause change in DNA
b) Physical agents which cause mutation
c) Cancer producing agents
d) Both (a) and (b)

581. Which is incorrect for Mendelism?
a) Works on garden pea
b) Law of segregation proved by monohybrid cross
c) Discovered linkage
d) All of the above

582. In heterozygous condition, the individual expression of both the alleles in the phenotype is exemplified by
a) Colourblindness
b) AB blood group
c) Rh factor
d) A and B blood group

583. Polyploid derived from two different species is called
a) Autopolyploid
b) Triploid
c) Allopolyploid
d) monoploid

584. Walter Sutton is famous for his contribution to
a) Genetic engineering
b) Totipotency
c) Quantitative genetics
d) Chromosomal theory of inheritance

585. Humans knew from as early as …A… BC that one of the causes of variation was hidden in …B… reproduction. They exploided …C… that were naturally present in wild population, *A*, *B* and *C* here refer to
a) A-8000-1000 BC, B-sexual, C-variations
b) A-8000-15000 BC, B-sexual, C-similarity
c) A-8000-15000 BC, B-sexual, C-similarity
d) A-20000-25000 BC, B-sexual, C-similarity

586. Punnett square was developed by
a) RC Punnett
b) RB Punnett
c) RD Punnett
d) RE Punnett

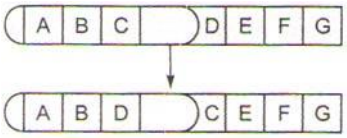
587. Female is heteromorphic and male is homomorphic in
a) Fishes and bird
b) Reptiles
c) Butterflies and moth
d) All of these

588. Absence of one sex chromosome causes
a) Turner's syndrome
b) Klinefelter's syndrome
c) Down's syndrome
d) Tay-Sach's syndrome

589. Mendelian recombinations are due to
a) Linkage
b) Mutations
c) Dominant characters
d) Independent assortment

590. The important things to remember are that chromosomes as well as genes occur in …A… . The two alleles of a gene pair are located on homologous sites on …B… chromosomes
Choose the correct choice for A and B
a) A-single, B-analogous
b) A-pair, B-analogous
c) A-pair, B-homozygous
d) A-single, B-heterozygous

591. The type of chromosomal aberration indicated in the diagram shows



a) Interstitial translocation
b) Reciprocal translocation
c) Pericentric inversion
d) Paracentric inversion

592. Who proposed chromosomal theory of linkage?
a) Morgan
b) Castle
c) Both (a) and (b)
d) Bateson

593. Which factor expresses itself in homozygous and even in heterozygous condition?
a) Dominant factor
b) Weak factor
c) Recessive factor
d) Incomplete factor

594. Number of autosomes in human are
a) 23 pairs
b) 22 pairs
c) 46 chromosomes
d) 33 pairs of chromosomes

595. A tall plant was grown in nutrient deficient soil and remained dwarf. When it is crossed with dwarf plant then
a) All hybrid plants are dwarf
b) All hybrid plants are tall
c) 50% tall and 50% dwarf
d) 75% tall and 25% dwarf

596. A man of blood group-A, marries a woman of blood group-B, both of them are heterozygous for blood group, chances of their first child having blood group AB will be
a) 25%
b) 50%
c) 75%
d) 100%

597. Mendel's laws of inheritance are applicable only for
a) Protista
b) Monera
c) Diploid organism
d) Both (a) and (b)

598. The factors which expresses only in homozygous condition is
a) Dominant
b) Recessive
c) Hidden
d) Cryptic

599. Human skin colour is the example of
I. multiple gene inheritance
II. three separate genes controlling this trait
III. single gene controlling this trait
IV. two gene controlling this trait
V. environment plays a significant role in this trait
Choose the correct option
a) I, II and III
b) II, III and IV
c) III, IV and V
d) I, II and V

600. In haemophilia, a single protein that is a part of cascade of protein involved in …A… of …B… is affected. Single cut will result in …C… bleeding.
Choose the correct option for A, B and C
a) A-coagulation, B-RBC, C-continuous
b) A-coagulation, B-WBC, C-continuous
c) A-clotting, B-blood, C-continuous
d) A-coagulation, B-blood, C-continuous

601. In *Drosophila*, the allele for a normal grey body colour G is dominant to ebony body g. The following table summarises the results of several crosses

S.No	Cross	Result
I.	Strain 1 × gg	All wild type
II.	Strain 2 × gg	1 wild type : 1 ebony
III.	Strain 3 × gg	All ebony
IV.	Strain 4 × gg	3 wild type : 1 ebony

Which strains both have the genotype Gg?
a) I and III
b) I and IV
c) II and III
d) II and IV

602. An Rh^-individual receives Rh^+blood. The recipient becomes
a) Sterile
b) Dead
c) No reaction
d) isoimmunized

603. In a mutational event, when adenine is replaced by guanine, it is the case of
a) Frameshift mutation
b) Transcription
c) transition
d) transversion

604. Recessive characters are expressed
a) On any autosome
b) On both the chromosomes of female
c) When they are present on X-chromosomes of male
d) When they are present on X-chromosomes of female

605. The crossing of F_1 to any one of the parents is called
a) Back cross
b) Test cross
c) F_1 cross
d) All of these

606. In cross between yellow round (YYRR) and green wrinkled (yyrr) find out the ratio between seeds having yellow and green seed colour
a) 3 : 2
b) 3 : 1
c) 9 : 7
d) 7 : 9

607. Genes for colour blindness is carried by
I. Abnormal development
II. Father
III. Mother
IV. Autosomes
a) I and II
b) II and III
c) III and I
d) I and IV

608. Monosomy and trisomy are respectively
a) $n-1, n+2$
b) $2n+2, 2n+1$
c) $2n-1, 2n+1$
d) $n-2, 2n+1$

609. I. Haemophilia
II. Cystic fibrosis
III. Sickle-cell anaemia
IV. Colour blindness
V. Cancer
VI. Plague
VII. Phenylketonuria
VIII. Thalassaemia
Choose the correct options for Mendelian disorders
a) I, II, III, IV, VI, VIII
b) I, II, III, IV, VII, VIII
c) I, II, III, IV, V, VI
d) I, II, III, IV, V, VIII

610. in α-thalassaemia, the affected chromosomes is
a) 16th
b) 17th
c) 18th
d) 19th

611. The first hybrid progenies obtained by Mendel were called
a) F_1- progeny
b) F_0- progeny
c) F_2- progeny
d) F_3- progeny

612. What type of gametes will form by genotype RrYy?
a) RY , Ry , rY , ry
b) RY , Ry , ry , ry
c) Ry , Ry , Yy , ry
d) Rr , RR , Yy , YY

613. A condition, where a certain gene is present in only a single copy in a diploid cell, is called
a) Heterozygous
b) Monogamous
c) Homozygous
d) hemizygous

614. Frequency of crossing over is …A… in linked gene …B… in unlinked gene.
Choose correct combination for A and B
a) A-more; B-less
b) A-less; B-more
c) A-same; B-same
d) A-same; B-happened

615. Find out the phenotypic and genotypic ratios in previous question
a) 1 : 2 : 1, 1 : 3
b) 1 : 2 : 1, 3 : 1
c) 1 : 2 : 1, 1 : 2 : 1
d) 1 : 3 : 1, 1 : 2 : 1

616. Which one of the following is necessary to start clotting of blood?
a) Heparin
b) Serotonin
c) Thromboplastin and Ca^{2+}
d) Fibrinogen and prothrombin

617. The organism chosen by Mendel to explain the law of inheritance is
a) *Drosophila melanogaster*
b) *Antirrhinum majus*
c) *Pisum sativum*
d) *Homo sapiens*

618. A woman is married for the second time. Her first husband was ABO blood type A, and her child by that marriage was type O. Her new husband is type B and their child is type AB.
What is the women's ABO genotype and blood type?

a) $I^A I^O$; Blood type A b) $I^A I^B$; Blood type AB c) $I^B I^O$; Blood type B d) $I^O I^O$; Blood type O

619. A couple has 6 children-5 are girls and 1 is boy. The percentage of having a girl on next time is
a) 10% b) 20% c) 50% d) 100%

620. On selfing RrTt, we produce 400 plants, find out number of plants with genotype RrTt.
a) 100 b) 225 c) 50 d) 300

621. In the ABO system of blood groups, if both antigens are present but no antibody, the blood group of the individual would be
a) B b) O c) AB d) A

622. Barr body in mammals represents
a) All the heterochromatin in female cells
b) One of the two X-chromosomes in somatic cells of females
c) All the heterochromatin in male and female cells
d) The Y-chromosome in somatic cells of male

623. When a segment of a chromosome breaks and later rejoins after 180°rotation,it is known as
a) Deletion b) Duplication
c) Inversion d) Interstitial translocation

624. Human skin colour is controlled by several gene pairs. Let us assume here that there are just three gene pairs on different chromosomes and that for each pair there are two alleles an incompletely dominant one that codes for no melanin deposition and an incompletely recessive one that codes for no melanin deposition. If a very dark skinned person marries a very light skinned women, what will be the chance that their offspring will have very dark skin?
a) 0 b) 1/4 c) 5/8 d) 9/64

625. If a cross is made between AA and aa, the nature of F_1-progeny will be
a) Genotypically AA, phenotypically a b) Genotypically Aa, phenotypically a
c) Genotypically Aa, phenotypically A d) Genotypically aa, phenotypically A

626. In Barr body (sex-chromatin) of a normal female
a) One of the X-chromosome of paternal side becomes inactive to form Barr body
b) Y-chromosomes form Barr body
c) Heterochromatin condense near centre of nucleus to form Barr body
d) One of the X-chromosome of maternal side becomes inactive and form Barr body near nuclear membrane

627. In certain plant species, red flower colour is incompletely dominant to white flower colour (the heterozygote is pink) and tall stems are completely dominant to dwarf stem. If a tall pink plant (TtRr) is crossed with a tall white plant (TTrr), which one of the following type of plants would be produced in the offsprings?
a) Tall pink and tall white b) Dwarf pink and tall red
c) Dwarf red and tall pink d) Tall pink and dwarf white

628. Which is true about meiotic cell division?
I. Meosis only occurs in diploid organism without any exception
II. RNA is replicated during S-phase
III. Chromatids of a chromosome separate during anaphase-I
IV. Only sperms are produce by this process
a) I and III b) I and II c) Only I d) III and IV

629. Work of Beadle and Tatum on *Neurospora crassa* proved that
a) Replication of DNA is semi-conservative b) Viruses have genetic material
c) Every gene is responsible for specific enzymes d) Plant cells are totipotent

630. Which of the following pairs of chromosomal mutation are most likely to occur when homologous chromosomes are under going synapsis?
a) Deletion and inversion b) Duplication and translocation
c) Deletion and duplication d) Inversion and translocation

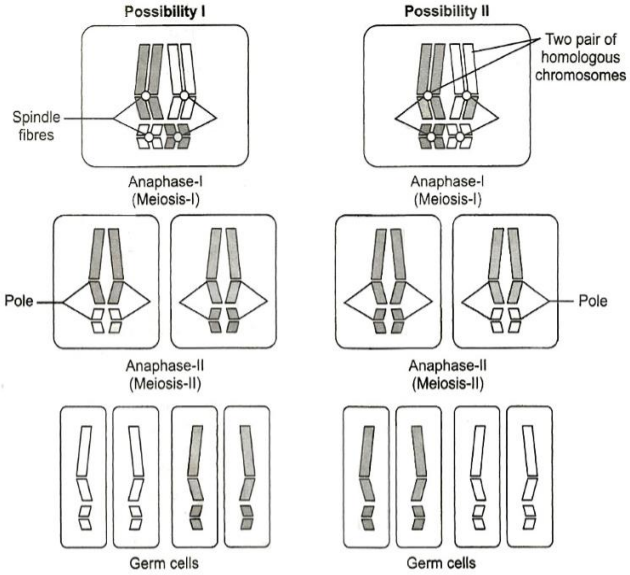
631. Down's syndrome is an example of
a) Anueploidy b) Polyteny c) Polyploidy d) Monoploidy

632. Mendel's works were read out the
a) Natural History Society in Russia b) Natural History Society in America
c) Natural History Society in Brunn d) Natural History Society in Germany

633. Genes of which of the following disorder are present exclusively on the X-chromosome in humans or concerned with
a) Baldness b) Red-green colour blindness
c) Facial hair/moustaches in males d) Night blindness

634. In a given plant, red colour (R) of fruit is dominant over white fruit (r); and tallness (T) is dominant over dwarfness (t). If a plant with genotype RRTt is crossed with a plant of genotype rrtt, what will be the percentage of tall plants with red fruits in the next generation?
a) 100% b) 25% c) 50% d) 75%

635. The figure depicits



a) Linkage b) Independent assortment
c) Law of dominance d) Equational division

636. Pick out the correct statements.
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 are correct b) I and III are correct
c) II and V are correct d) I , II and IV are correct

637. Allelic sequence variations, where more than one variant (allele) at a locus in a human population with a frequency greater than 0.01, is referred to as
a) Incomplete dominance b) Multiple allelism
c) SNP d) DNA polymorphism

638. Sex chromosomes of a female bird are represented by
a) XO b) XX c) XY d) ZW

639. How many types of gametes may be produced by genotype D/d : E/e : F/f?
a) 27 b) 8 c) 3 d) 6

640. If a colourblind women marries a normal visioned man their sones will be
a) All normal visioned b) One half normal and one half colourblind
c) Three fourth colourblind and one fourth normal d) All colourblind

641. Genic balance theory of sex determination, stated by C B Bridges, is related to
a) *Drosophila melanogaster* b) rumex
c) Snapdragon d) None of the above

642. In human beings, 45 chromosomes/single X/XO abnormality causes
a) Down's syndrome b) Klinefelter syndrome c) Turner's syndrome d) Edward's syndrome

643. When a cluster of genes show linkage behaviour they
a) Do not show independent assortment b) Induce cell division
c) Do not show a chromosome map d) Show recombination during meiosis

644. Colour blindness is a failure to discriminate between
a) Red and blue b) Red and green c) Red and black d) Red and white

645. Linkage group in *E.coli* is/are
a) 4 b) 2 c) 1 d) 5

646.

Linked Gene pair	Cross Over Value (COV)
T and U	25
T and V	5
V and U	30
U and W	10
V and W	20

COV are given for linked gene pair. Find out their sequence in the chromosome
a) VTWU b) TVWU c) BTWVU d) VWTU

647. The tendency of offsprings to resemble their parents is called
a) Variation b) Heredity c) Inheritance d) Resemblance

648. In case of incomplete dominance, what will be the phenotypic ratio of F_2 generation?
a) 1 : 2 : 1 b) 3 : 1 c) 1 : 1 : 1 : 1 d) 9 : 3 : 3 :1

649. The major reason for the success of Mendelian experiments was
a) Garden pea was true breeding b) Garden pea was cross breeding
c) Garden pea was heterozygous d) Garden pea was not easily available

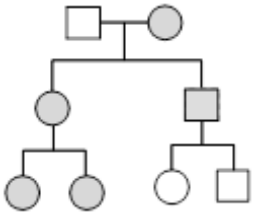
650. Which of the following is best suited for codominance?
a) Both of recessive b) Both of dominant c) One is recessive d) One is dominant

651. ABO blood group system is given by
a) Landsteiner b) Wallace c) de Vries d) Lamarck

652. Which of the following is generally used for induced mutagenesis in crop plants?
a) Alpha particles b) X-rays
c) UV (260nm) d) Gamma rays (from cobalt 60)

653. Genetic recombination is due to
a) Fertilization and meiosis b) Mitosis and meiosis
c) Fertilization and mitosis d) None of the above

654. Identify the type of inheritance in the given diagram



a) Dominant X-linked b) Recessive X-linked
c) Dominant Y-linked d) Cytoplasmic or mitochondrial inheritance

655. Linkage gene do not shows
a) Independent assortment b) 9 : 3 : 3 : 1
c) Segregation d) All of the above

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

a) Haploids are reproductively more stable than diploids
b) Mutagens penetrate in haploids more effectively than in diploids
c) Haploids are more abundant in nature than diploids
d) All mutations whether dominant or recessive are expressed in haploids

657. Mendel's work remain unrecognized for long time due to
I. Communication was not easy
II. Concept of factors which did not blend was not accepted
III. Use of mathematics to explain biological problem was unacceptable
IV. He could not provide any physical proof for the existence of factors
Choose the right combination
a) I and II b) II and III c) III and IV d) All of these

658. Ratio of progeny, when a red coloured heterozygote is crossed with a white coloured plant in which red colour is dominant to white colour
a) 3 : 1 b) 1 : 1 c) 1 : 2 : 1 d) 9 : 3 : 3 : 1

659. Mendel self-pollinated the F_2-plant and found that ...A... plants continued to generate dwarf plant in ...B... and ....C... generations. He concluded that the genotype of the dwarfs is ...D....
Choose the correct option for A, B, C and D
a) A-dwarf, B-F_3, C-F_4, D-homozygous
b) A-dwarf, B-F_3, C-F_4, D-heterogygous
c) A-tall, B-F_5, C-F_6, D-homozygous
d) A-tall, B-F_5, C-F_6, D- heterogygous

660. The possibility of erythroblastosis foetalis occurring during the second pregnancy is when
a) The baby is $Rh^+$and mother Rh^-
b) The baby and mother are Rh^+
c) The baby and mother are Rh^-
d) The baby is $Rh^-$and mother Rh^+

661. I. Enborn error of metabolism
II. Homozygous recessive autosomal alleles on chromosomes 12 causes absence of the specific enzyme
III. A specific amino acid do not changes into tyrosine
IV. Accumulation of phenylpyruvic acid and other derivatives leading to mental retardation
The above facts refer to
a) Muscular dystrophy
b) Phenylketonuria
c) Turner's syndrome
d) Down's syndrome

662. How many phenotype and genotypes are possible in ABO blood group systems?
a) Four, five b) Four, six c) Four, seven d) Three, four

663. Lack of independent assortment of two genes-A and B in fruit fly-*Drosophila* is due to
a) Repulsion b) Recombination c) Linkage d) Crossing over

664. Mendel was successful in discovering the principles of inheritance as
a) He took pea plants for his experiments
b) He did not encounter linkage between the genes for the characters he considered
c) He had an in-depth knowledge on hybridization
d) He was a famous mathematician

665. The common point of attachment of all the arms of polytene chromosome, is known as
a) Centromere b) Chromomere c) Chromocentre d) centrosomes

666. Choose the correct option for allotetraploid
a) AABB b) AAAA c) AAABB d) BBBB

667. Mutation is more common when it is present in
a) Recessive condition
b) Dominant condition
c) Constant in population
d) None of these

668. Allelism refers to
a) genic interactions controlling a character
b) Multiple genes controlling a character
c) Expression of many characters by a single gene
d) Alternative forms of a gene at a given locus

669. Which one pair of parents is most likely get a child, who would suffer from haemolytic disease of new born?

a) Rh^+ mother and Rh^- father
b) Rh^- mother and Rh^- father
c) Rh^+ mother and Rh^+ father
d) Rh^- mother and Rh^+ father

670. Mendel performed test cross to know the
a) Genotype of F_1 b) Genotype of F_2 c) Genotype of F_3 d) Genotype of F_4

671. Change in single base pair
a) May not change the phenotype
b) Quickly changed the phenotype
c) Change the natural process
d) None of the above

672. Find out the correct statement.
a) Monosomy and nullisomy are the two types of euploidy
b) Polyploidy is more common in animals than in plants
c) Polyploids occur due to the failure in complete separation of sets of chromosomes
d) $2n$-1 condition results in trisomy

673. In phenylketonuria, the phenylalanine gets converted to
a) Acetic acid b) Phenyl acetic acid c) Phenyl pyruvic acid d) Pyruvic acid

674. Which one of the following is a genetically transmitted character?
a) Colourblindness b) Hydrocephalus c) Haemophilia d) All of these

675. Identify the correct choice for given symbols (A and B)

a) A-consenguineous mating; B-mating
b) A-mating; B-mating between relatives
c) A-mating; B-consenguineous mating
d) Both (b) and (c)

676. F_1-hybrid is intermediate between the two parents. The phenomenon is
a) Codominance
b) Dominance
c) Blending inheritance
d) Incomplete dominance

677. Multiple phenotype seen in
a) Pleiotropy
b) Incomplete dominance
c) Multiple allelism
d) Polygenic inheritance

678. After a mutation at a genetic locus character of an organism changes due to the change in
a) Protein structure
b) DNA replication
c) Protein synthesis pattern
d) RNA transcription pattern

679. In XX and XY type of sex determination, the males are
a) Homogametic b) Heterogametic c) Both (a) and (b) d) Isogametic

680. Dihybrid ratio of test cross 1 : 1 : 1 :1 proves that
a) F_1hybrid produces four different progenies
b) F_1 hybrid produces two different progenies
c) Parents produce two different progenies
d) None of the above

681. A homozygous sweet pea plant with blue flowers (RR) and long pollen (R_0 R_0)is crossed with a homozygous plant having red flowers (rr) and round pollen (r_0 r_0). The resultant F_1hybrid is test crossed. Which of the following genotype does not appear in its progeny?
a) $\frac{1}{4}$ b) $\frac{1}{8}$ c) $\frac{1}{16}$ d) $\frac{3}{16}$

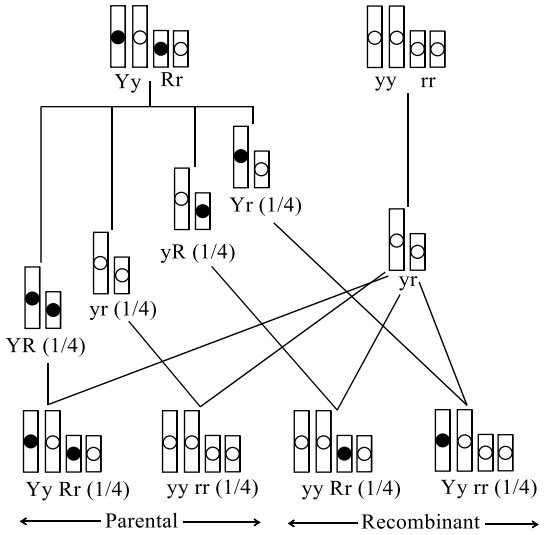
682. Mendel's findings were rediscovered by
a) De Vries b) Correns c) Tschermark d) All of these

683. 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

684. Percentage of recessive phenotype in a cross between PP and Pp, when P is dominant, p recessive
a) 25% b) 50% c) 35% d) 100%

685. Genes are made up of
a) Histones b) Hybrocarbons c) Polynucleotides d) Lipoproteins

686. The diagram indicates



a) Test cross of monohybrid
b) Test cross of dihybrid
c) Back cross of dihybird
d) Back cross of monohybrid

687. Type of substitution takes place in sickle-cell anaemia is
a) Acidic amino acid to an neutral amino acid
b) Glutamic acid by valine
c) GUG to GAG
d) All of the above

688. In the hexaploid wheat, the haploid (*n)* and basic (*x*) numbers of chromosomes are
a) *n*=7 and *x*=21
b) *n*=21 and *x*=21
c) *n*=21 and *x*=14
d) *n*=21 and *x*=7

689. Persons who are colourblind can not distinguish
a) Red and green colour
b) Yellow and white colour
c) Black and white colour
d) Yellow and blue colour

690. Haploid-diploid mechanism of sex determination (haplodiploidy) takes place in
a) Bees
b) Wasps
c) Ants
d) All of these

691. Sickle-cell anaemia happens due to …A… mutation in which …B… of haemoglobin is affected. Fill the correct option for A and B
a) A-point; B-β-chain
b) A-chromosomal; B-α-chain
c) A-allele; B-α-chain
d) A-non-allele; B-chain

692. The gene of sickle cell anaemia is inherited by
a) Blood cells
b) Bone cells
c) Sex chromosomes
d) autosomes

693. A character, which is expressed in a hybrid is called
a) Dominant
b) Recessive
c) Codominant
d) epistatic

694. The first definite proof of mutagenic action of X-rays was given by
a) Muller
b) Hooker
c) Lister
d) Leeuwenhoek

695. If the genotype of an individual consists of only one type of genes at same locus. It is called
a) Homozygous
b) Heterozygous
c) Monoallelic
d) Uniallelic

696. The nucleoprotein structures that occur at the ends of the chromosomes are
a) Centrosomes
b) Telomeres
c) Centromeres
d) Satellites

697. In polytene chromosomes dark bands are visible. These bands are formed by the position of
a) Protein particles
b) Chromomeres on chromonemata
c) Nucleosomes
d) None of the above

698. Chances of segregation of alleles in gametes are
a) 25%
b) 35%
c) 50%
d) 75%

699. In *Drosophila*, gene for white eye mutation is also responsible for depigmentation of body parts. Thus , a gene that controls several phenotypes is called
a) Oncogene
b) Epistatic gene
c) Hypostatic gene
d) Pleiotropic gene

700. Hypertrichosis is an example of which inheritance?

a) Holandric b) Incomplete sex-linked
c) Sex –influenced d) Sex –limited

701. The mutagenic agent among following is
a) Ethyl methane b) Ethylene c) 2, 4-D d) IAA

702. The most important example of point mutation is found in a disease called
a) Thalassemia b) Night blindness c) Down's syndrome d) Sickle-cell anaemia

703. When tall and dwarf plants are crossed, from which cross 1 : 1 ratio is obtained?
a) Tt and tt b) tt and tt c) Tt and Tt d) TT and Tt

704. Failure of segregation of chromatid during cell division cycle results in the gain or loss of chromosome which as called
a) Aneuploidy b) Hypopolyploidy c) Hyperpolyploidy d) Polyploidy

705. Genes are present on
a) Chromosomes b) Lamellae c) Plasma membrane d) mesosomes

706. Out of 7 contrasting trait pairs selected by Mendel how many traits were dominant and recessive?
a) 7 and 7 b) 8 and 6 c) 6 and 8 d) 5 and 9

707. Example of environmental determination of sex is/are
a) Alligators b) Turtles c) *Bonelia* d) All of these

708. Dominant allele are expressed in
a) Second generation b) Homozygous condition
c) Heterozygous condition d) Both (b) and (c)

709. If the ratio between X-chromosomes and complete set of autosome is 0.5. Then the individual will be
a) Female b) Superfemale c) Male d) Supermale

710. When a tall plant with rounded seeds (TTRR) is crossed with a dwarf plant with wrinkled seeds (ttrr), the F_1-generation consists of tall plants with rounded seeds. How many types of gametes, an F_1 -plant would produce?
a) One b) Three c) Four d)

711. The leaf colour of certain plants is controlled by one gene. For that gene, the allele G = orange and g = green. You have a plant with orange leaves, but do not know whether that plant's genotype is GG or Gg. If you cross your unknown plant with one of the plants whose genotype is listed below, you will be able to determine your unknown's genotype. With which plant would you cross it?
a) GG b) Gg c) Gg d) Either of parents

712. Which of the following discoveries resulted in a Nobel Prize?
a) Recombination of linked genes
b) Genetic engineering
c) X-rays induce sex-linked recessive lethal mutations
d) Cytoplasmic inheritance

713. A boy has a normal brother and a colourblind sister. What is true about his parents?
a) His father was normal but mother was colourblind b) His father was colourblind but mother was carrier
c) Both father and mother were colourblind d) Both father and mother were normal

714. By seeing the ratio of F_1 and F_2-generation Mendel proposed that something was stably passed down unchanged over successive generation and called this something as
a) Alleles b) Genes c) Chromosomes d) Factors

715. Extranuclear inheritance is a consequence of presence of genes in
a) Mitochondria and chloroplasts b) Endoplasmic recticulum and mitochondria
c) Ribosomes and chloroplast d) Lysosomes and ribosomes

716. The F_2genotypic ratio of monohybride cross is
a) 0% b) 25% c) 50% d) 100%

717. Colour blindness is due to defect in
a) Cones b) Rods c) Rods and cones d) Rhodopsin

718. In F_2-generation, quantitative inheritance 1 : 4 : 6 : 4 : 1 is obtained instead of

a) 9 : 3 : 3 :1 b) 8 : 6 : 4 :1 c) 7 : 4 :1 : 4 d) 6 : 6 : 4 : 7

719. Leaf colour in *Mirabilis jalapa* is an example of
a) Non-Mendelian inheritance b) Mendelian inheritance
c) Chemical inheritance d) Both (b) and (c)

720. I. Trisomy of sex (X) chromosome
II. XXY+44
III. 21st trisomy
IV. Sterile male
V. Gynaecomastia
Choose the correct option for Klinefelter's syndrome
a) I, II, III and IV b) I, II, IV and V c) II, III, IV and V d) I, III, IV and V

721. Consider the following statement regarding ABO blood group in human
I. It is controlled by multiple allele
II. It shows codominance
III. Codominance can be manifested phenotypically in human
IV. It follows the Mendel law of inheritance
Which of the following statements (s) are correct?
a) Only I is correct b) I and II are correct
c) II and III are correct d) IV and II are correct

722. Brachydactyly is due to
a) Dominant gene on the autosome b) Recessive gene on the autosome
c) Dominant gene on the sex chromosome d) None of the above

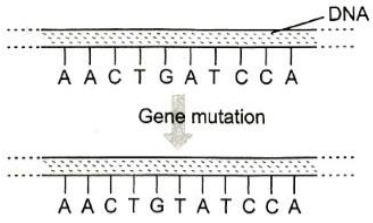
723. Which of the following chromosomal formulation is responsible for the expression of meta-male character in *Drosophila*?
a) 2A+3X b) 3A+3X c) 4A+3X d) 3A+XY

724. When there are more than two allele controlling the same character. These are called
a) Many alleles b) Polyalleles c) Multiple alleles d) All of these

725. Monohybrid cross deals with
a) One character b) Two character c) Three characters d) Four characters

726. X-chromosomes of female, in a case of sex-linked inheritance, can be passed on to
a) Only female progeny b) Only male progeny
c) Only in grand daughter d) Male and female progeny

727. Identify the type of mutation in given diagram



a) Inversion b) Insertion c) Deletion d) Substitution

728. The recessive parental trait is expressed without any blending in the F_2-generation, we can infer. That F_1-plants produce gamete by the process of …A… and allele of parental pair separate …B… from each other and only one gamete is transmitted a gamete. Here A and B are
a) A-mitosis; B-aggregate b) A-meiosis; B-segregate
c) A-meiosis; B-aggregate d) A-mitosis; B-segregate

729. If a cross between two individuals produces offspringe with 50% dominant character (A) and 50% recessive character (a),then the genotypes of parents are
a) Sex linked alleles b) Asexually reproducing forms
c) Sexually interbreeding forms d) Diploid homozygous forms

730. The similar and dissimilar sex chromosomes of females and males are described as

a) Hormomorphic b) Heteromorphic c) Both (a) and (b) d) Isomorphic

731. Starch synthesis gene in pea plant in heterozygous condition produces starch grain of intermediate size. This shows
   a) Complete dominance
   b) Incomplete dominance
   c) Codominant
   d) Dominant

732. Select the correct bases of DNA, RNA and amino acid of beta chain resulting in sickle cell anaemia.

	DNA	RNA	Amino Acid
a)	CTC/GAG	GUG	Glutamic acid
b)	CAC/GAG	GUG	Valine
c)	CAC/GTC	GAG	Valine
d)	CTC/GAG	GUG	Valine

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: ANSWER KEY :

1)	b	2)	a	3)	c	4)	a	145)	b	146)	b	147)	a	148)	a
5)	c	6)	d	7)	a	8)	b	149)	c	150)	d	151)	a	152)	a
9)	a	10)	b	11)	d	12)	a	153)	c	154)	d	155)	a	156)	a
13)	d	14)	c	15)	a	16)	a	157)	a	158)	c	159)	a	160)	c
17)	c	18)	a	19)	d	20)	c	161)	c	162)	c	163)	d	164)	c
21)	c	22)	a	23)	a	24)	d	165)	c	166)	c	167)	c	168)	b
25)	a	26)	b	27)	c	28)	a	169)	c	170)	c	171)	c	172)	c
29)	c	30)	c	31)	c	32)	c	173)	b	174)	b	175)	a	176)	a
33)	a	34)	c	35)	c	36)	b	177)	b	178)	c	179)	d	180)	b
37)	b	38)	d	39)	a	40)	d	181)	a	182)	b	183)	d	184)	b
41)	d	42)	a	43)	c	44)	a	185)	b	186)	b	187)	a	188)	a
45)	b	46)	b	47)	b	48)	a	189)	a	190)	a	191)	c	192)	d
49)	d	50)	c	51)	a	52)	a	193)	c	194)	c	195)	d	196)	c
53)	a	54)	d	55)	b	56)	c	197)	d	198)	a	199)	b	200)	a
57)	a	58)	a	59)	a	60)	a	201)	b	202)	a	203)	d	204)	c
61)	d	62)	b	63)	c	64)	d	205)	a	206)	d	207)	d	208)	b
65)	c	66)	c	67)	b	68)	d	209)	a	210)	a	211)	c	212)	d
69)	c	70)	d	71)	c	72)	d	213)	a	214)	d	215)	a	216)	c
73)	d	74)	c	75)	c	76)	d	217)	a	218)	b	219)	a	220)	b
77)	a	78)	a	79)	a	80)	c	221)	c	222)	d	223)	a	224)	a
81)	c	82)	b	83)	b	84)	a	225)	a	226)	b	227)	b	228)	a
85)	d	86)	a	87)	a	88)	c	229)	a	230)	c	231)	d	232)	c
89)	c	90)	c	91)	a	92)	d	233)	d	234)	d	235)	d	236)	a
93)	a	94)	a	95)	d	96)	a	237)	b	238)	c	239)	b	240)	a
97)	d	98)	c	99)	c	100)	c	241)	a	242)	a	243)	a	244)	b
101)	c	102)	b	103)	c	104)	c	245)	a	246)	d	247)	a	248)	a
105)	c	106)	a	107)	a	108)	b	249)	d	250)	d	251)	b	252)	a
109)	d	110)	a	111)	c	112)	c	253)	b	254)	a	255)	b	256)	b
113)	a	114)	d	115)	d	116)	a	257)	b	258)	a	259)	a	260)	d
117)	b	118)	c	119)	a	120)	d	261)	b	262)	a	263)	d	264)	c
121)	a	122)	a	123)	b	124)	b	265)	b	266)	d	267)	b	268)	b
125)	c	126)	a	127)	c	128)	b	269)	b	270)	a	271)	c	272)	b
129)	d	130)	c	131)	a	132)	c	273)	b	274)	a	275)	b	276)	d
133)	b	134)	d	135)	d	136)	b	277)	b	278)	b	279)	b	280)	b
137)	c	138)	d	139)	c	140)	d	281)	a	282)	a	283)	a	284)	a
141)	a	142)	b	143)	a	144)	c	285)	b	286)	c	287)	d	288)	d

289)	a	290)	a	291)	b	292)	c	477)	c	478)	d	479)	b	480)	b
293)	b	294)	a	295)	a	296)	b	481)	a	482)	a	483)	b	484)	b
297)	c	298)	c	299)	a	300)	b	485)	a	486)	d	487)	b	488)	a
301)	b	302)	d	303)	d	304)	b	489)	d	490)	d	491)	d	492)	d
305)	b	306)	b	307)	c	308)	c	493)	c	494)	a	495)	a	496)	c
309)	b	310)	a	311)	b	312)	b	497)	a	498)	a	499)	a	500)	c
313)	a	314)	d	315)	a	316)	d	501)	a	502)	a	503)	b	504)	a
317)	c	318)	a	319)	c	320)	b	505)	a	506)	a	507)	b	508)	a
321)	b	322)	d	323)	b	324)	b	509)	d	510)	b	511)	d	512)	a
325)	b	326)	c	327)	d	328)	a	513)	a	514)	c	515)	b	516)	a
329)	a	330)	c	331)	a	332)	a	517)	c	518)	a	519)	b	520)	c
333)	a	334)	a	335)	b	336)	a	521)	d	522)	c	523)	b	524)	a
337)	a	338)	d	339)	d	340)	a	525)	c	526)	d	527)	a	528)	b
341)	c	342)	b	343)	a	344)	a	529)	c	530)	c	531)	d	532)	d
345)	a	346)	d	347)	b	348)	b	533)	c	534)	c	535)	a	536)	b
349)	b	350)	d	351)	b	352)	a	537)	b	538)	a	539)	c	540)	b
353)	a	354)	c	355)	d	356)	a	541)	a	542)	a	543)	a	544)	d
357)	a	358)	b	359)	c	360)	c	545)	a	546)	c	547)	a	548)	c
361)	c	362)	b	363)	d	364)	b	549)	d	550)	c	551)	d	552)	a
365)	c	366)	c	367)	a	368)	a	553)	b	554)	c	555)	b	556)	d
369)	d	370)	a	371)	a	372)	a	557)	c	558)	a	559)	b	560)	b
373)	b	374)	a	375)	d	376)	d	561)	a	562)	d	563)	c	564)	d
377)	a	378)	a	379)	b	380)	b	565)	a	566)	a	567)	d	568)	a
381)	a	382)	a	383)	a	384)	b	569)	d	570)	d	571)	b	572)	d
385)	c	386)	c	387)	a	388)	b	573)	c	574)	b	575)	b	576)	b
389)	b	390)	b	391)	d	392)	a	577)	d	578)	c	579)	b	580)	d
393)	c	394)	a	395)	a	396)	c	581)	c	582)	b	583)	c	584)	d
397)	b	398)	b	399)	c	400)	b	585)	a	586)	a	587)	d	588)	a
401)	a	402)	b	403)	b	404)	d	589)	d	590)	c	591)	d	592)	c
405)	a	406)	a	407)	b	408)	d	593)	a	594)	b	595)	b	596)	a
409)	b	410)	c	411)	a	412)	d	597)	c	598)	b	599)	d	600)	c
413)	d	414)	b	415)	a	416)	b	601)	d	602)	d	603)	c	604)	c
417)	a	418)	a	419)	a	420)	c	605)	a	606)	b	607)	b	608)	c
421)	a	422)	c	423)	b	424)	d	609)	b	610)	a	611)	a	612)	a
425)	c	426)	c	427)	b	428)	b	613)	a	614)	b	615)	c	616)	c
429)	a	430)	b	431)	b	432)	d	617)	c	618)	a	619)	c	620)	a
433)	c	434)	c	435)	d	436)	c	621)	c	622)	b	623)	c	624)	a
437)	a	438)	a	439)	c	440)	b	625)	c	626)	d	627)	a	628)	c
441)	d	442)	d	443)	b	444)	d	629)	c	630)	c	631)	a	632)	c
445)	c	446)	d	447)	b	448)	c	633)	b	634)	c	635)	b	636)	d
449)	a	450)	c	451)	b	452)	a	637)	d	638)	d	639)	b	640)	d
453)	b	454)	b	455)	a	456)	b	641)	a	642)	c	643)	a	644)	b
457)	c	458)	b	459)	c	460)	c	645)	c	646)	a	647)	b	648)	a
461)	b	462)	c	463)	c	464)	a	649)	a	650)	b	651)	a	652)	d
465)	d	466)	d	467)	a	468)	b	653)	a	654)	d	655)	d	656)	d
469)	b	470)	d	471)	d	472)	c	657)	d	658)	b	659)	a	660)	a
473)	c	474)	a	475)	b	476)	c	661)	b	662)	b	663)	c	664)	b

665)	**c**	**666)**	**a**	**667)**	**b**	**668)**	**d**	**705)**	**a**	**706)**	**a**	**707)**	**d**	**708)**	**d**
669)	**d**	**670)**	**b**	**671)**	**a**	**672)**	**c**	**709)**	**c**	**710)**	**d**	**711)**	**b**	**712)**	**c**
673)	**c**	**674)**	**d**	**675)**	**d**	**676)**	**d**	**713)**	**b**	**714)**	**d**	**715)**	**a**	**716)**	**c**
677)	**d**	**678)**	**a**	**679)**	**b**	**680)**	**a**	**717)**	**a**	**718)**	**a**	**719)**	**a**	**720)**	**b**
681)	**a**	**682)**	**d**	**683)**	**d**	**684)**	**b**	**721)**	**b**	**722)**	**c**	**723)**	**b**	**724)**	**c**
685)	**c**	**686)**	**b**	**687)**	**d**	**688)**	**d**	**725)**	**a**	**726)**	**d**	**727)**	**b**	**728)**	**b**
689)	**b**	**690)**	**d**	**691)**	**a**	**692)**	**d**	**729)**	**b**	**730)**	**c**	**731)**	**b**	**732)**	**b**
693)	**a**	**694)**	**a**	**695)**	**a**	**696)**	**b**								
697)	**b**	**698)**	**c**	**699)**	**d**	**700)**	**a**								
701)	**a**	**702)**	**d**	**703)**	**a**	**704)**	**a**								

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

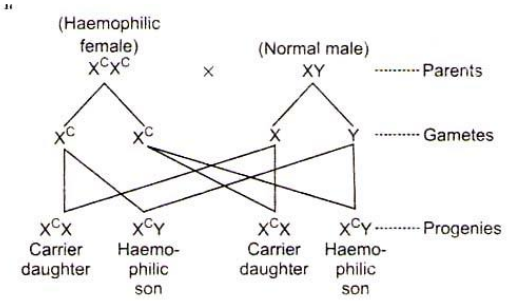
Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: HINTS AND SOLUTIONS :

1 **(b)**
Haemophilia is a recessive X-linked disease. A female with defected single X-chromosome is normal but, carrier of disease, and male with defected single X-chromosome is haemophilic.



2 **(a)**
Genetic disorder may be grouped into two categories
(i) **Mendelian Disorders** These genetic disorder are mainly caused by alternation and mutation in the single gene. They are transmitted to offsprings following the principle of inheritance. Mendelian disorder can be dominant or recessive. *e*. *g*., haemophilia, colour blindness, sickle-cell anaemia, cystic fibrosis, phenylketonuria, thalassaemia.
(ii) **Chromosomal Disorders** Chromosomal disorder are caused due to excess, absence, or abnormal arrangement of one or more chromosome, *e*. *g*., Turner's syndrome, Down's syndrome, etc

3 **(c)**
The term gene was coined by **Johanssen.**

4 **(a)**
A dihybrid cross involves two pairs of contrasting characters, *e.g.*, yellow round seeded plant and wrinkled. Green seedes plant(both pure lines) homozygous. When a dihybrid cross is made between two pure line of homolzygous parents, then the F_1 generation shows hybrids with dominant phenotypic effect. When F_1 heterozygous plants are self-ferilized to produceF_2 generation, four types of combinations are obtained of which two are similar to parental combination and other two are new combinations. The phenotypic dihybrid ratio of these four combinations in F_2 generation comes out to be 9 : 3 : 3 : 1, while the genotypic dihybrid ratio is 1 : 2 : 2 : 4 : 1 : 2: 1 : 2 : 1.

5 **(c)**
Chromosome is made up of DNA and histone proteins.

6 **(d)**
Baldness is not a sex-limited trait. Balaness is a sex influenced trait.

Linkage is an exception to the principle of independent assortment in heredity.

Galactosemia is a hereditary disease that is caused by the lack of a liver enzyme required to digest galactose.

Small population size results in random genetic drift in population.

7 **(a)**
The F_1 offsprings of pure tall and pure dwarf are heterozygoous tall, which on selfing produces 1 : 1 ratio of breeding tall to breeding dwarf.

8 **(b)**

Exposure of 'X' rays enhance the frequency of crossing over

9 **(a)**

The genotype of trihybrid would be AaBbCc. Eight different types of gametes ABC, ABc, AbC, Abc, aBC, aBc, abC, abc would be formed. The number of zygotes would be $8^2 = 64$.

10 **(b)**

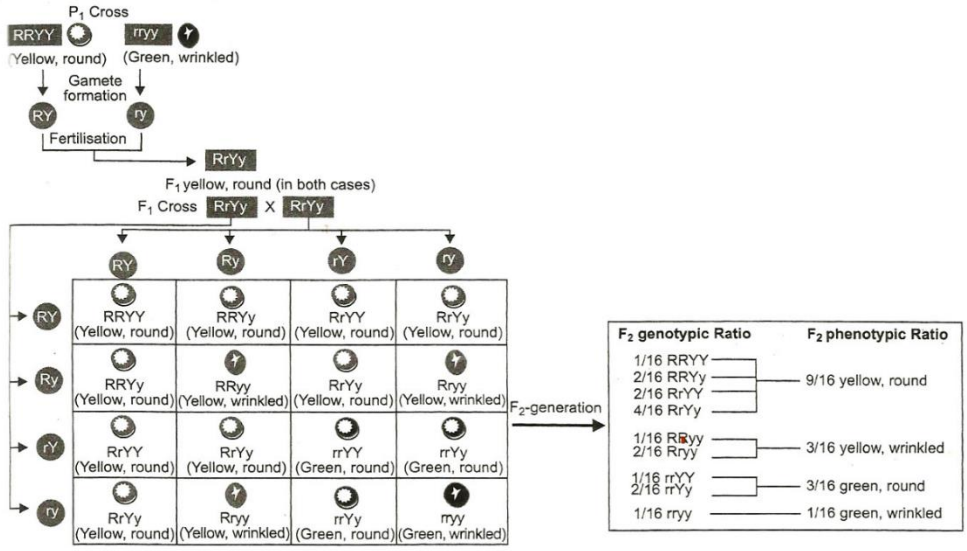
The genetic composition of an organism, *i.e.,* the combination of all alleles possessed by an organism is called genotype

11 **(d)**

In polyploidy there are more than one set of chromosomes is presen't in an organisms. It only happens when cytokinesis doesn't take place in proper way

12 **(a)**

12



A dihybrid cross in pea plant between yellow round (smooth) seeded and green wrinkled seeded plant. The cross proves the principle of independent assortment

13 **(d)**

When the F_1-hybrid (Rr Yy) of a dihybrid cross is test crossed (crossed with double recessive parent rryy), the F_2-offspring appear in the phenotypic and genotypic ratio of 1 : 1 : 1 : 1 confirming that F_1-offspring was heterozygous in both the traits. It is a cross between RrYy × rryy.

14 **(c)**

Allelomorphs or simply called allele represents a pair of contrasting characters

15 **(a)**

Harmful mutation does not get elimated from the gene pool because most of the harmful mutations are recessive and they carried by heterozygous condition in the individual. If they (mutation) are dominant then they easily get eliminated by the death of an organism

16 **(a)**

A-Common, B-Rare

17 **(c)**

Mendel died in 1884 long before his work came to recognized. It was in 1900 when three worker independently rediscovered the principles of heredity already worked out by Mendel.
They were Hugo de Vries of Holland, Carl Correns of Germany and Eric Tiron and Tschermark of Austria

18 **(a)**

In gynandromorphs, some cells of body contain XX and some cells XY genotype.

19 **(d)**

Post Mendelian Discoveries

Gene interaction is the influence of alleles and nonalleles ion the normal phenotypic expression of genes. It is two types, **intragenic** (allelic) and intergenic (nonallelic). In the intragenic interaction the two allels (present on the same gene locus on the two homologous chromosome) of a gene interact in such a way as to produce a phenotypic expression different from typical

dominant-recessive phenotype, *e*. *g*., incomplete dominance, codominance, multiple alleles.
In intergenic or non-allelic interaction, two or more independent gene present on the same or different chromosomes interact to produce different expression, *e*. *g*., epistasis, duplicate genes, complementary genes, supplementary genes, lethal genes, inhibitory genes, etc.

20 **(c)**
Intermediate inheritance is incomplete dominance in which dominant factor of a heterozygote does not completely mask the expression of recessive allele. In incomplete dominance, genotypic and phenotypic ratio remain the same and is 1 : 2 : 1.

21 **(c)**
Green pod colour is dominant.
7 dominant traits, 7 recessive traits total 14 traits or 7 oppossing pairs of traits

Characters	Dominant Traits	Recessive Traits
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Violet	White
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Stem height	Tail	Dwarf

22 **(a)**
I^A I^B are the dominant form of I gene, I is recessive form

23 **(a)**
A-statistical analysis; B-mathematical logic

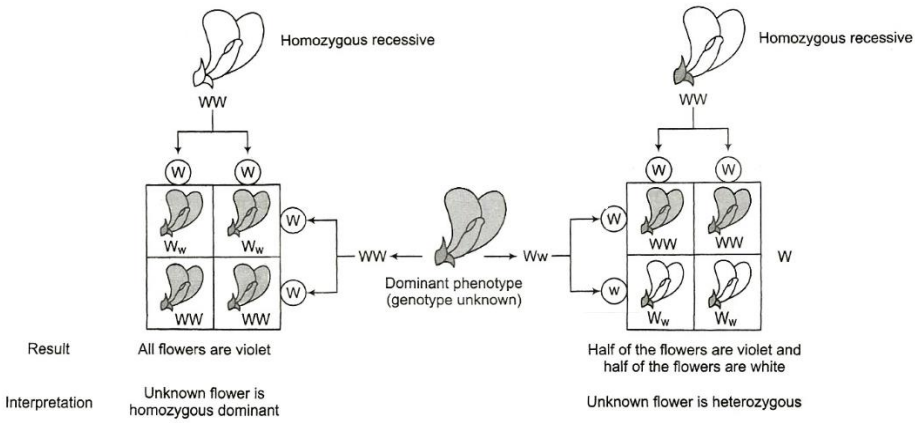
24 **(d)**
ZW and ZZ and ZOZZ.
ZW **and** ZZ **Type of Sex Determination** This mechanism operates in certain insects (butterflies and moths) and in vertebrates (fishes, reptiles and birds). The male has two homomorphic sex chromosomes (ZZ) and is homogametic and the female has two heteromorphic sex chromosomes (ZW) and is heterogametic. There are thus two types of eggs with Z and with W and only one type of sperms. *i.e.*, each with Z

	A + Z	A + O
A + Z	AA + ZZ	AA + ZO
A + Z	AA + ZZ	AA + ZO
	Males	Females

WZ-ZZ types of sex determination

25 **(a)**
If a character is expressed equally in the homozygous and heterozygous conditions, it is called **dominant** and the other character is said to be **recessive**. In given question, 'Tall' character is dominant over 'dwarf', hence, the cross shows dominance and segregation of traits.

26 **(b)**
The best method to determine homozygosity and heterozygosity of an individual is back cross.
Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



27 **(c)**
Presence of one Barr body indicates the person under investigation is a normal female.

28 **(a)**

A-Male, B-Female, C-Gametes.

XY and XY type sex determination seen in many insect and mammals including humans. Males have X and Y chromosome along with autosome and females have pair of 'X' chromosome along with autosome

Parents Phenotypes Male Female

Genotypes 44A + XY 44A + XX

Gametes 22A + X 22A+Y 22A + A22A + X

22A+ X 22A+X

Children 22A + X 44A + XX 44 A + XY Female

22A + Y 44 A + XY 44 A + XY Male

Sex ratio Female : Male = 1 : 1

In plants The flowering plants are mostly bisexual and lack sex chromosomes. The unisexual flowering plants tent to have XX-XY type of sex chromosomal mechanism for sex determination. The female plants are XX and male plants are XY.

XX and XO Type of Sex Determination

Found in insect like grasshopper, cockroaches and bugs. Males have only X sex-chromosome and autosomes, female have pair of X-chromosome and autosome

Parents Phenotypes Male Female

Genotypes $AA + XO$ $AA + XX$

Gametes $A + X, A + O$ $A + X, A + Y$

F_1-generation

	A + X	A + X
A + X	AA + XO	AA + XO
A + O	AA + XO	AA + XO

Genotypes

XX-XO type of sex determination

29 **(c)**

Female is sterile.

Disorders	Autosomal/Sex Linked	Symptoms	Effects
Down's syndrome	Autosomal aneuploidy (trisomy, +21)	Mongolian eyefold (epicanthus), open mouth, protruded tongue, projected lower lip, many loops on finger tip, palm crease	Retarded mental development IQ (below 40)
Turner's syndrome	Sex chromosomal monosomy 44 + XO	Short stature females (<5'), webbed neck, body hair absent menstrual cycle absent. Sparse pubic hair, underdeveloped breasts narrow lips puffy fingers	Sterile hearing problem
Klinefelter's syndrome	Sex chromosomal aneuploidy (tri/tetrasomy of X chromosome) 44+XXY 44+XXXY	The males are tall with long legs, testes small, sparse body hair, Barr body present, breast enlargement	Gynaecomastia azospermia sterile

Some Examples of Aneuploidy

(i) **Down's syndrome**-21 trisomy

Symptoms

(a) Short statured with small round head

(b) Partially open mouth with protruding furrowed tongue
(c) Palm is broad with characteristic palm crease
(d) Slow mental development
(ii) **Turner's syndrome**
Cause Absence of one of the X-chromosomes, resulting in the karyotype 44+XO
Symptoms
(a) Sterile female with rudimentary ovaries
(b) Shield-shaped thorax
(c) Webbed neck
(d) Poor development of breasts
(e) Short stature, small uterus, puffy fingers
(iii) **Klinefelter's syndrome**
Cause Presence of an additional copy of X-chromosome resulting in the karyotype 44+XXY
Symptoms
(a) Sex of the individual is masculine but possess feminine characters
(b) Gynaecomastia, *i.e.*, development of breasts
(c) Poor beard growth and often sterile
(d) Feminine pitched voice

30 **(c)**
The environmental stress (as pesticides) does not cause the direct changes in genome, instead, it simply selects rather persisting mutations, which result in phenotypes that are better adapted to the new environment (*e.g.*, certain pesticides).

31 **(c)**
A **Lampbrush chromosomes** is made up of two homologous chromosomes held at several places by chiasmata. The chromosomes are found in oocytes of many invertebrates and all vertebrates except some mammals. Lampbrush chromosomes are found during the extended diplotene phase of first meiotic division.

32 **(c)**
A gene consists of a polynucleotide sequence that encodes a functional polypeptide or RNA sequence.

33 **(a)**
XY and XY type sex determination seen in many insect and mammals including humans. Males have X and Y chromosome along with autosome and females have pair of 'X' chromosome along with autosome
Parents Phenotypes Male Female
Genotypes 44A + XY 44A + XX
Gametes 22A + X 22A+Y 22A + A22A + X
22A+ X 22A+X
Children 22A + X 44A + XX 44 A + XY Female
22A + Y 44 A + XY 44 A + XY Male
Sex ratio Female : Male = 1 : 1
In plants The flowering plants are mostly bisexual and lack sex chromosomes. The unisexual flowering plants tent to have XX-XY type of sex chromosomal mechanism for sex determination. The female plants are XX and male plants are XY.
XX and XO Type of Sex Determination
Found in insect like grasshopper, cockroaches and bugs. Males have only X sex-chromosome and autosomes, female have pair of X-chromosome and autosome
Parents Phenotypes Male Female
Genotypes $AA + XO$ $AA + XX$
Gametes $A + X, A + O$ $A + X, A + Y$
F_1-generation

	A + X	A + X
A + X	AA + XO	AA + XO
A + O	AA + XO	AA + XO

Genotypes

XX-XO type of sex determination

34 **(c)**
Frameshift mutations are the mutations caused by insertion (*i.e.*, addition) or deletion of one or more nitrogen bases in the DNA or RNA. This type of mutation alters the nucleotide sequences in all

the genes and hence, the genetic code is changed totally, fro the point of mutation which results in the change in biochemical behaviour of the genes. **Base pair substitution mutations** involve **substitution of a aitrogen base** by another base or by some derivative of nitrogen base.

35 **(c)**
According to law of segregation, the heredity character in the form of alleles segregate from each other during gamete formation, *i.e,* each gamete carry only one allele of each gene. This is also called law of purity of gametes. When tall and dwarf plants are crossed only tall plants are produced in F_1 generation. By selfing of these F_1 plants tall and dwarf plants produced in 3 : 1 ratio.

36 **(b)**
Mendel's law are able to predict accurately the pattern of inheritance for a situation in which alleles shows the complete dominance. Effect of environment, other alleles did not explained by the Mendel. Mendel did not know about the polygenic traits also

37 **(b)**
Blood group-O has no antigens but A and B antibodies.

38 **(d)**
Colour blindness disease was detected by **Wilson** in 1910**.**

39 **(a)**
In the dihybrid cross between RRYY and rryy parents, the number of RrYy genotypes in F_2-generation will be four.

40 **(d)**
Allelism refers to presence of alternative forms of a gene at a given locus. Alleles or allelomorphs are the two contrasting aspects of the same character present at a locus of homologous pair of chromosomes. Now –a-days, the same aspect in duplicate (TT or tt) of a character is also considered an allele.

41 **(d)**
The women with albinic father has gene for albinism. When this women marries with albinic men, they produce normal and albinic in 1 : 1 ratio.

42 **(a)**
ZO and ZZ type of sex determination. This mechanism occurs in certain buttterfiles and moths. The female is heterogametic and produces two types of eggs half with Z and half without Z-chromosome. The males have homomorphic sex chromosomes and is homogametic. It forms only one kind of sperms, each with Z-chromosome

Parents **Phenotypes** Male Female
Genotypes AA + ZZ AA +ZO
Gametes A+Z, A+Z A +Z, A+O
F_1-generation

	A + Z	A + O
A + Z	AA + ZZ	AA + ZO
A + Z	AA + ZZ	AA + ZO
	Males	Females

ZO-ZZ type of sex determination

43 **(c)**
Mendel's law of independent assortment states that,"the alleles of different genes segregate independently of each other during meiosis".

44 **(a)**
XX and XO chromosome.
XY and XY type sex determination seen in many insect and mammals including humans. Males have X and Y chromosome along with autosome and females have pair of 'X' chromosome along with autosome

Parents Phenotypes Male
Female
Genotypes 44A + XY
44A + XX
Gametes 22A + X 22A+Y
22A + A22A + X
22A+ X 22A+X
Children 22A + X 44A + XX 44 A + XY
Female
22A + Y 44 A + XY 44 A + XY
Male
Sex ratio Female : Male = 1 : 1
In plants The flowering plants are mostly bisexual and lack sex chromosomes. The unisexual flowering plants tent to have XX-XY type of sex chromosomal mechanism for sex determination. The female plants are XX and male plants are XY.
XX and XO Type of Sex Determination

Found in insect like grasshopper, cockroaches and bugs. Males have only X sex-chromosome and autosomes, female have pair of X-chromosome and autosome

Parents Phenotypes Male Female

Genotypes $AA + XO$ $AA + XX$

Gametes $A + X, A + O$ $A + X, A + Y$

F_1-generation

	A + X	A + X
A + X	AA + XO	AA + XO
A + O	AA + XO	AA + XO

Genotypes

XX-XO type of sex determination

45 **(b)**

A-Chromatid, B-Allele pair, C-Genetic composition

46 **(b)**

The position of centromere determines the shape of chromosome.

47 **(b)**

After schooling Mendel joined Augustinian monastery of St. Thomas at Brunn (then in Austria now Brunn in Czechoslovakia) in 1843 at the age of 21. At the age of 25 (1847), he was made a prist in that monastery

48 **(a)**

It was TH Morgan who clearly proved and define linkage on the basis of the breeding experiments in fruitfly. In 1911, Morgan and Castle proposed 'chromosomal' theory of linkage'

49 **(d)**

Francis Galton(1885) gave the term eugenics. Eugenics is the improvement of human race by the application of principles of genetics. The other meaning of eugenics is 'science of being well born'.

50 **(c)**

The **test cross** involves the crossing of F_1 hybrid with a double recessive genotypic parent. By test cross, the heterozygocity and homozygocity of the organism can be tested.

51 **(a)**

Tetraploid endosperm is obtained, when a diploid female and tetraploid male plants are crossed.

52 **(a)**

Colour Blindness

(i) It is a sex-linked recessive disorder

(ii) It results in defect in either red or and green cone cells of eye resulting in failure to discriminate between red and green colour

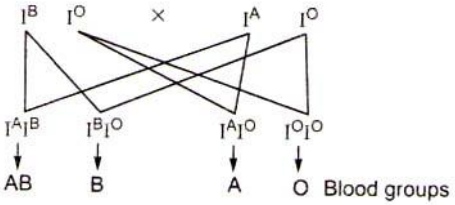
(iii) The gene for colour blindness is present on X-chromosome

(iv) It is observed more in males (X^cY) because of presence of only one X-chromosome as compared to two chromosomes in famales

53 **(a)**

When the F_1-hybrid is crossed with recessive parent, both phenotypes appear in progeny and this is called test cross. It gives 1 : 1 ratio in monohybrid cross and 1 : 1 : 1 : 1 ratio in dihybrid cross.

54 **(d)**



Thus, the genotype of parents will be BO × AO.

55 **(b)**

Symbol in pedigree chart represents still death

56 **(c)**

Histones are basic proteins found in the eukaryotic chromosomes. These are rich in basic amino acids lysine and arginine. There are basically five types of histones, *i.e.*, H_1, H_2A, H_2B, H_3 and H_4 which have been studied in almost all eukaryotic cells.

57 **(a)**

In monosomic condition, one chromosome is missing from the somatic chromosome complement. It is denoted by $2n$-1. When somatic cells of an organism contain three copies of one chromosome, the condition is known as trisomy. It is denoted by $2n$+1. Therefore, monosomic trisomy is represented as $2n$-1+1.

58 **(a)**

Baldness is common in humans. Hereditary baldness is carried by a dominant autosomal gene. It develops only in men and never in women.

59 **(a)**

Thalassaemia

(i) It is an autosome-linked recessive disesase
(ii) It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin
(iii) Anaemia is the characteristic of this disease
(iv) Thalassaemia is classified into two types

1. **α-thalassaemia** Production of α-globin chain is affected. It is controlled by the closely linked genes HBA1 and HBA2 on chromosome 16. It occurs due to mutation or deletion of one or more of the four genes.
2. **β-thalassaemia** Production of β-globin chain is affected. It occurs due to mutation of one or both HBB genes on chromosome 11

60 **(a)**
The term 'mutation' was introduced by Hugo de Vries in 1901 and his mutation theory of evolution called mutation theory of evolution. Mutation is new sudden inheritable change in organism due to permanent change in their genotype

61 **(d)**
Because in sex linked inheritance the chance of girl or female to be affected is almost nill. Generally, the females are carriers and in heterozygous condition

62 **(b)**
Non-disjunction is the condition in which the separation of chromosome doesn't take place during cell division. In 44+XY non-disjunction there is non-separation of XY gene is there, which leads to the formation of sperm having genotypes, 22+XY and 22

63 **(c)**
Linkage prevents independent assortment.

64 **(d)**
Sex influenced trait.
Finalization of sex at the time of fertilization is known as sex determination. All sex linked character show criss-cross inheritance and firstly it was studied and discovered by TH Morgan (1910). *Sex related trait may be divided into three types*
(i) **Sex Linked Traits** They are those traits the determining genes of which are found on the sex chromosomes. All the sex-linked traits present on a sex chromosome are inherited together
(ii) **Sex Limited Traits** They are autosomal traits which are expressed in a particular sex in response to sex hormones although their genes also occur in the other sex, *e.g.,* milk secretion in mammalian females, pattern baldness in males. The gene for baldness behaves as an autosomal dominant in males and autosomal recessive in females
(iii) **Sex Influenced Traits** The traits are not due to particular genes but are by products of sex hormones, *e.g.*, low pitched voice, beard moustaches. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of testosterone

65 **(c)**
Since in an individual only two alleles can be present, multiple alleles can be found only when population studies are made

66 **(c)**
Biological concept of species says that only the members of a species can breed freely in nature to produce fertile offsprings. The plant tobacco (*Nicotiana*) has two different species, *Nicotiana tobaccum* and *Nicotiana sylvestris*. These two species cannot reproduce freely.

67 **(b)**
In duplication there is increase in size of genes by duplication of it segment of a chromosome. Mainly seen in case of plants. But in deletion there is loss of genes or segment of chromosome

68 **(d)**
The types of gametes produced by a plant depend upon the number of hetrozygous pair.

Number of types of gametes$=2^n$

N=Number of heterozygous pair

$2^1 = 2$

The gametes are-ABC and AbC.

69 **(c)**
In **trisomic condition**, diploid organism have extra chromosome represented by the chromosomal formula$2n + 1$. One of the pairs of chromosomes has an extra member, so that a trivalent may be formed during meiotic prophase, *e.g.*, **Down's syndrome** (45+XX or 45+XY), Klinefelter's syndrome (44 + XXY).

In **monosomic**, diploid organism has one chromosome of a single pair missing with genomic formula $2n - 1$. Monosomics can from two kind of gametes, (n) and (n-1),

e.g., **Turner's syndrome** (44 + X).

70 **(d)**
When a normal man marries a normal woman, whose father was colourblind then their 50% sons are colourblind (50% sons normal) and all the daughters are phenotypically normal(carrier woman also are phenotypically normal).

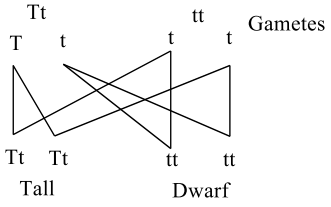
The female parent is carrier as it receives a defective X-chromosome from her father.

71 **(c)**
Testosterone in male secreted by Leydig cells. In the male testosterone is essential for development of secondary sexual character and related to baldness also

72 **(d)**
The disorder cystic fibrosis, sickle cell anaemia, colour blindness and haemophilia are caused due to the abnormality in gene (Mendelian factor). Turner's syndrome is due to chromosomal abnormality. It is characterized by 44 autosomes and only one X-chromosome.

73 **(d)**
Haemophilia is a X-linked disorder not Y-linked.

74 **(c)**
(Homozygous tall) × (Homozygous dwarf)



Phenotypic ratio 1 : 1 (50% tall, 50% dwarf)
Genotypic ratio 1 : 1

75 **(c)**
γ − rays generally induce mutations.

76 **(d)**
Since genotypes/phenotypes of both parents are same but only sources of gametes are reversed, these crosses are called **reciprocal crosses.**

77 **(a)**
Man has only one X-chromosome that is inherited to his daughter. Therefore, a hereditary disease, which is X-chromosomal linked, is never passed on from father to son.

78 **(a)**
Bateson gave the coupling and repulsion hypothesis for linkage and crossing over.
Similar genes remain together they don't go for crossing over. Bateson called them coupling gones.
While on the other hand dissimilar gene segregate crossing over takes place. Bateson called them repulsion parents gene

79 **(a)**
The blood group type in human provides an example of multiple allelism (*i.e.*, presence of more than two allele for one gene). There are three A, B and O blood groups allele usually given the symbolI^A, I^B and I^i. I^A and I^B are codominant to each other but both are dominant to I^i. The offspring of parents having I^A and I^1 allele with be I^AI^i having blood group-A.

A-I^AI^i

B-I^BI^i

AB-I^AI^B

O-I^iI^i

80 **(c)**
A person having 45 chromosomes instead of 46 due to lack of Y-chromosome is suffering from **Turner's syndrome.**

81 **(c)**
Opposite phenomena.
Strength of linkage between two genes inversely proposed to the distance of two gene means if two genes are closely placed then they have high percentage of linkage and if they placed for then there is low percentage of linkage.
Linkage and recombination are two opposite phenomena. In linkage two genes remains united and in recombination the two get apart due to crossing over during gametogenesis (meiosis)

82 **(b)**
Johanssen (1909) proposed the term gene. Genes are made up of DNA, *i.e.*, a DNA segment associated with proteins, which can be copied in

the form of RNA and is responsible for hereditary characters. Genes have full control over protein synthesis.

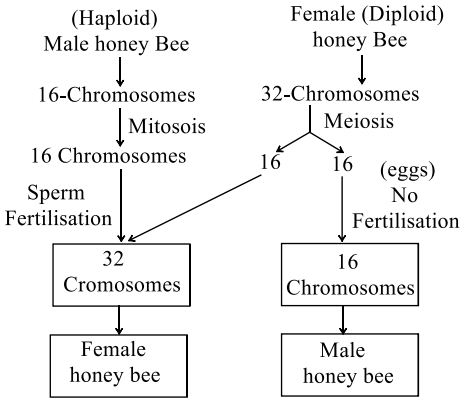
83 **(b)**

$2n$ (diploid).

Haploid diploid mechanism of sex determination (haplodiploidy).

Hymenopterous insect such as bees, wasps ants show unique phenomena in which an unfertilized egg develops into male and female develops from fertilized egg.

In honeybee, the quality of food determines whether a diploid larva will become a fertile queen or a sterile worker female. A larva fed on royal jelly a secretion from the mouth of mussing workers grows into a queen, whereas a larva fed on pollen and nectar grows into a worker bee



84 **(a)**

For the given case, the imprints need to be used only on plates with streptomycin.

85 **(d)**

Phenylketonuria (PKU) is homozygous recessive autosomal disorder associated with metabolism and the gene for it is present on chromosome-12. **Huntington's disease (Huntington's chorea)** is a dominant autosomal disorder due to an allele on short arm of chromosome-4. **Sickle cell anaemia** is due to codominant autosomal allele Hb^S present on chromosome-11.

86 **(a)**

The genes are arranged in a linear fashion on the chromosome.

87 **(a)**

According to $cis - trans$ effect of **Lewis**, when two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be pseudoalleles and phenomenon as **pseudoallelism**.

88 **(c)**

Factor-II – Prothrombin

Factor –III – Thromboplastin

Factor –VIII – Antihaemophilic globulin

Factor –XII – Hageman factor

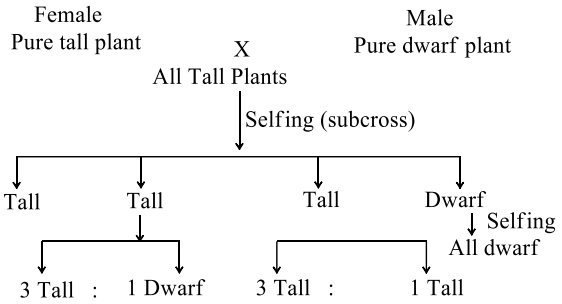
89 **(c)**

The longest chromosome is seen in *Trillium* (30μ).

90 **(c)**

F_1.

Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



This three generations of pea plants after crossing a pure tall plant with a dwarf one. The plants of F_1-generation are all tall, of F_2-generation three tall and one dwarf. One third of the tall plants are pure, while the remaining behave as hybrids

F_1-generation Seeds collected from the parental generation called first filial generation or F_1-generation

F_2-generation F_1-plants pollinated among them self (self breeding or inbreeding) and seed produced by F_1-plants called F_2-generation. They were in ratio 3:1 (three tall and one dwarf).

F_3-generation Mendel allowed F_2-plant to form seed by self-pollination called F_3-generation. Mendel observed that tall and dwarf plant behave differently

(i) Dwarf plant produced dwarf plant on self-pollinated

(ii) In tall plants one third plants breed true so they were pure

(iii) Other two third plant behave like parents and give tall to dwarf plants 3 : 1 indicate that their parents have dwarf genes also

91 **(a)**

A-Linked; B-Unlinked gene

92 **(d)**

Allelic sequence variation has traditionally been described as a DNA polymorphism if more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01. In simple terms, if an inheritable mutation is observed in a population at high frequency, it is referred to as DNA polymorphism.

93 **(a)**

A-Extremely, B-Carrier, C-Haemophilia

94 **(a)**

The Rh factor causes erythroblastosis foetalis, when a woman who is Rh^- marries a man, who is Rh^+ , their first child will be safe (which is Rh^+) but during pregnancy some blood of foetus and mother mixes due to which the mother develops antibodies against her foetus antigen which is Rh^+.

95 **(d)**

Landsteiner divided human population into four groups based on the presence of antigens found in their RBCs. Each group represented a blood group. Thus, there are four types of blood groups A, B, AB and O. Blood group-O does not contain any antigen on RBCs, hence can be given to any person, that's why, this blood group is called universal donor.

96 **(a)**

Alleles or allelomorphs are alternative forms of the same gene, *e.g.*, for height of plant 'T' and 't'. Homologous chromosomes are a pair of chromosomes having similar genes, which control the same characters.

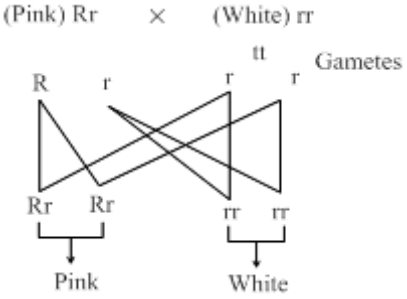
97 **(d)**

Telomeres are ends of chromosome, that have repetitive DNA sequences and are stable and resistant to exonuclease digestion hence, essential for chromosome stability.

98 **(c)**

Intermediate inheritance also called the incomplete dominance. In that inheritance the phenotypic and genotypic ratio are same. The classical examples are = four O' clock plant and snapdragon.

Mirabilis jalapa shows incomplete dominance



The ratio of pink and white flower will be 1 : 1

99 **(c)**

Mendelian disorder may be dominant or recessive

100 **(c)**

In African population, sickle cell anaemia provides immunity against malaria.

101 **(c)**

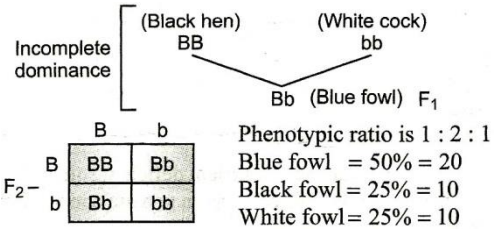
Aneuploidy is the variations in individual chromosomal number. Actually, loss or gain of individual chromosomes upsets the balance and, hence normal development is not possible.

103 **(c)**

Black feathered hen = BB

White feathered cock = bb

Blue feathered fowl = Bb



104 **(c)**

Histones are special type of basic protein associated with DNA and form chromosome. RNA, protein, carbohydrate, fat, doesn't find in chromosomes

105 **(c)**

In pedigree

Square represents male blackened square or circle represents affected individual.

Horizontal line represents-parents

The study of inheritance of genetic traits in several generations of a human family in the form

of a family tree diagram is called **pedigree analysis**.

Advantages

(i) It helps in genetic counselling to avoid disorders

(ii) It shows the origin of a trait and flow of a trait in a family

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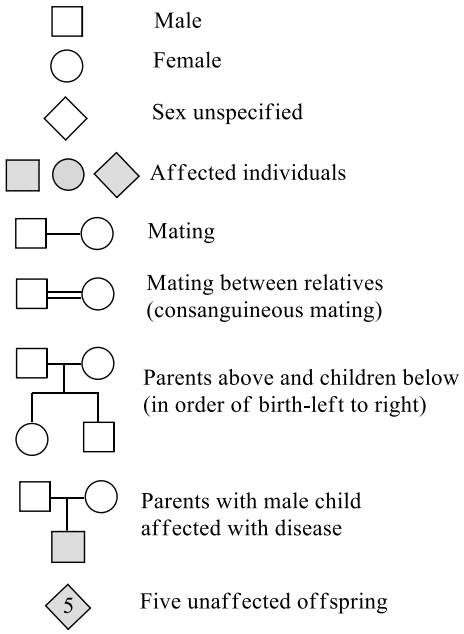
Signosed in the pedigree are



106 **(a)**

In the given pedigree chart only males are affected. So, it can be easily inferred that the given trait is connected to Y-chromosome. The genes, which are present on the Y-chromosome are called holoandric genes

107 **(a)**

In the gametogenesis meiosis occur. The diploid chromosome become haploid, so the probability of side is sperm lacking one recessive autosomal allele and holandric gene is half

108 **(b)**

F_3-generation obtained by selfing of F_2-generation.

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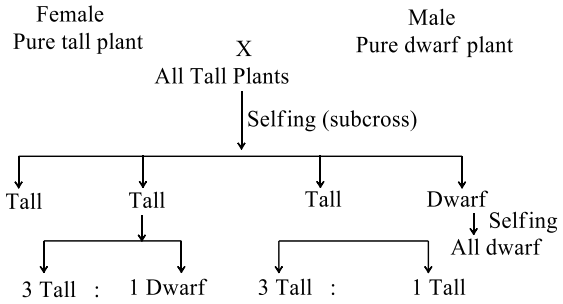

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109 **(d)**

W Bateson and **R C Punnett** observed complementary gene interaction for flower colour in sweet pea (*Lathyrus odoratus*). In complementary interaction, two separate pairs of genes interact to produce the phenotype in such a way that neither of the dominant genes is expressive unless the other one is present. In F_2 generation, complementary genes produce a ratio of 9 : 7.

110 **(a)**

Occasionally a single gene product may produce more than one effect. For example starch synthesis in pea seeds is controlled by one gene. It has two allele (B and b). Starch is synthesized effectively by BB and have bigger grains. In contrast bb homozygous have lesser efficiency in starch synthesis and produce smaller grains

111 **(c)**
In *Drosophila*, sex is determined by the ratio number of X-chromosomes to the set of autosomes.

112 **(c)**
The genotypic and phenotypic ratio of **1 : 2 : 1** with **red, pink** and **white** flowers are produced in *Mirabilis jalapa*, when red flowered plants (RR) are crossed with white flowered (rr). It occurs due to allelic gene interactions, called, **incomplete dominance**. In which, both of the allelomorphic genes will have partial or incomplete dominance and F_1-hybrid will show mixture of characters of two parents.

113 **(a)**
Meiosis is an important stage in sexual reproduction. During meiosis, genetic recombination occurs as a result of crossing over.

114 **(d)**
Blood group of children may be A, B, AB and O.

115 **(d)**
The genes, which are present very far from each other tend to get unlinked and they arethe most chances for crossing over

116 **(a)**
Given diagram depicits the sex linked inheritance in given options haemophilia is the sex-linked character

117 **(b)**
Incomplete dominance or blending inheritance is the phenomenon, in which the two genes of allelomorphic pair are not related as dominant or recessive but each of them expresses itself partially, thus the F_1 hybrids exhibit a mixture or blending of characters of both the parents. In F_2 generation, the phenotypic ratio obtained is 1 : 2 : 1.

118 **(c)**
Haemophilia is a disease, which is caused due to lack of blood clotting factor. It appears only in human male which can be transferred to their grandson through his carrier daughter.

119 **(a)**
In the given option only codominance does not obey Mendel's laws.

The phenomenon of expression of both the alleles in heterozygote is called codominance. As the result the phenotype is different from both homozygous genotype.

Examples

1. Blood group is the good example codominance
2. ABO blood groups are controlled by gene I. The gene (l) has three allele I^A, I^B, i, I^A, I^B produce slilghtly different form of sugar while i does not produce any kind of sugar.
3. I^A, I^B are dominant alleles where as i is recessive alleles
4. Since, there are three different allele, there are six different combination of these three alleles are possible and four phenotypes (A, B, AB and O)

Genetic Basis of Blood Groups in Human Population

Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood Types of Offspring
I^A	I^A	I^AI^A	A
I^A	I^B	I^AI^B	AB
I^A	i	I^Ai	A
I^B	I^A	I^AI^B	AB
I^B	I^B	I^BI^B	B
I^B	i	I^Bi	B
i	i	ii	O

When I^A and I^B are present together they both express their own types of sugars this is because of co-dominance. ABO blood grouping also provides a good example of multiple alleles.

Here, you can see that there are more than two, *i.e.,* three alleles governing the same character. Since, in an individual only two alleles can be present multiple alleles can be found only when population studies care made. Dominance is not an autonomous features of a gene. It depends on much on the gene product

120 **(d)**
11th.

Thalassaemia

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(ii) It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin
(iii) Anaemia is the characteristic of this disease

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122 **(a)**

TH Morgan.

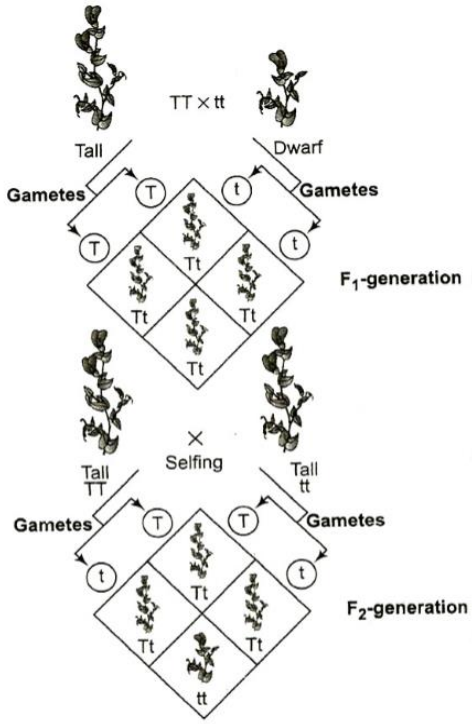
Father of experimental genetics is TH Morgan. He is also called the fly man of genetics because of selecting fruit fly (*Drosophila melanogaster*) as research material in experimental genetics

123 **(b)**

Mendel gave the laws of inheritance, which provides the mechanism that explains the pattern of inheritance

124 **(b)**

The genotypic ratio can be find out of a dominant phenotype by test cross or by simply Punnett square.



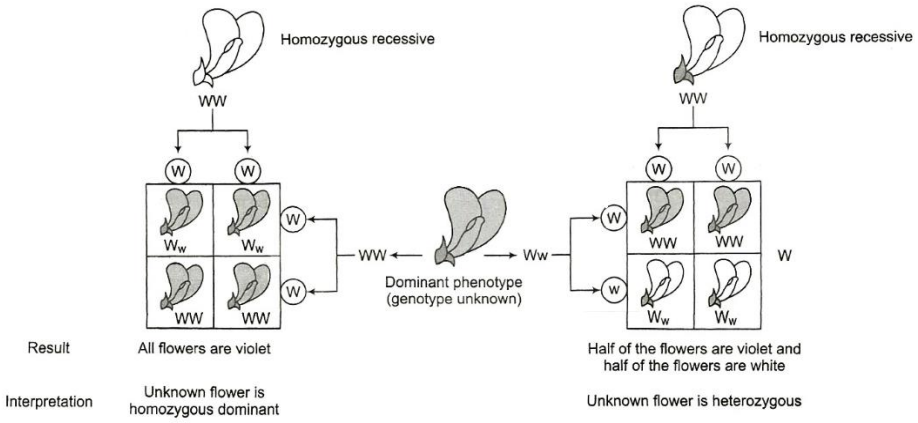
Phenotypic ratio Tall : Dwarf

Genotypic ratio TT : Tt : tt

1 : 2 : 1

A Punnett square used to understand to typical monhybrid cross conducted by Mendal between true-breeding tall plants and true-breeding dwarf plants

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



125 **(c)**

Genes for baldness are located on autosomes and influenced by androgens, thus, this is more common in men than in women.

126 **(a)**

The number of characters studied by Mendel was seven which were present on four chromosomes. Three contrasting characters with respect to pea pod are (i) pod shape,(ii) pod colour, (iii)pod position.

127 **(c)**

Chlorinated hydrocarbons are mutagen pollutants which can cause mutation in gene.

128 **(b)**

Both genes and chromosomes (Mendelian factors) whether dominant or recessive are transmitted from generation to generation in the pure or unaltered form. It is also called law of purity of gametes

129 **(d)**

The study of inheritance of genetic traits in several generations of a human family in the form of a family tree diagram is called **pedigree analysis**.

Advantages

(i) It helps in genetic counselling to avoid disorders

(ii) It shows the origin of a trait and flow of a trait in a family

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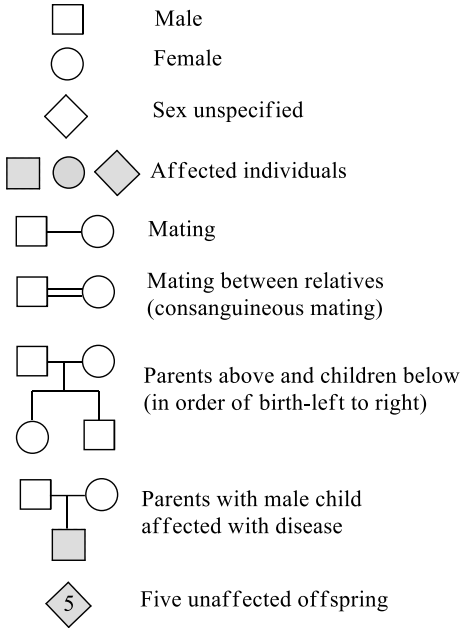
Signosed in the pedigree are



130 **(c)**

Some genes control phenotypic traits and at the same time they also influence the viability of the individuals. The influence of these genes on viability is such that it may cause death of individual carrying them. Such genes are called **lethal genes**.

131 **(a)**

Absence of one X-chromosome (44 with XO).

Disorders	Autosomal/Sex Linked	Symptoms	Effects
Down's syndrome	Autosomal aneuploidy (trisomy, +21)	Mongolian eyefold (epicanthus), open mouth, protruded tongue, projected lower lip, many	Retarded mental development IQ (below 40)

		loops on finger tip, palm crease	
Turner's syndrome	Sex chromosomal monosomy 44 + XO	Short stature females (<5'), webbed neck, body hair absent menstrual cycle absent. Sparse pubic hair, underdeveloped breasts narrow lips puffy fingers	Sterile hearing problem
Klinefelter's syndrome	Sex chromosomal aneuploidy (tri/tetrasomy of X chromosome) 44+XXY 44+XXXY	The males are tall with long legs, testes small, sparse body hair, Barr body present, breast enlargement	Gynaecomastia azospermia sterile

Some Examples of Aneuploidy

(i) **Down's syndrome**-21 trisomy

Symptoms

(a) Short statured with small round head

(b) Partially open mouth with protruding furrowed tongue

(c) Palm is broad with characteristic palm crease

(d) Slow mental development

(ii) **Turner's syndrome**

Cause Absence of one of the X-chromosomes, resulting in the karyotype 44+XO

Symptoms

(a) Sterile female with rudimentary ovaries

(b) Shield-shaped thorax

(c) Webbed neck

(d) Poor development of breasts

(e) Short stature, small uterus, puffy fingers

(iii) **Klinefelter's syndrome**

Cause Presence of an additional copy of X-chromosome resulting in the karyotype 44+XXY

Symptoms

(a) Sex of the individual is masculine but possess feminine characters

(b) Gynaecomastia, *i.e.*, development of breasts

(c) Poor beard growth and often sterile

(d) Feminine pitched voice

132 **(c)**

The recessive genes located on X-chromosome in humans are always expressed in males because a female may be homozygous or heterozygous, while male is always hemizygous (*i.e.*, only one allele is present).

133 **(b)**

Strength of linkage between two genes inversely proposed to the distance of two gene means if two genes are closely placed then they have high percentage of linkage and if they placed for then there is low percentage of linkage.

Linkage and recombination are two opposite phenomena. In linkage two genes remains united

and in recombination the two get apart due to crossing over during gametogenesis (meiosis)

134 **(d)**

Fruitfly is excellent model for genetics because

(i) Life cycle is very short (14 days)

(ii) Can be feed on simple synthesis medium

(iii) Single mating produces large number of progeny

(iv) Clear differentiation of sexes

(v) Variation can be seen simply by hand lens or simple microscope

(vi) They (fruitfly) are easy to handle

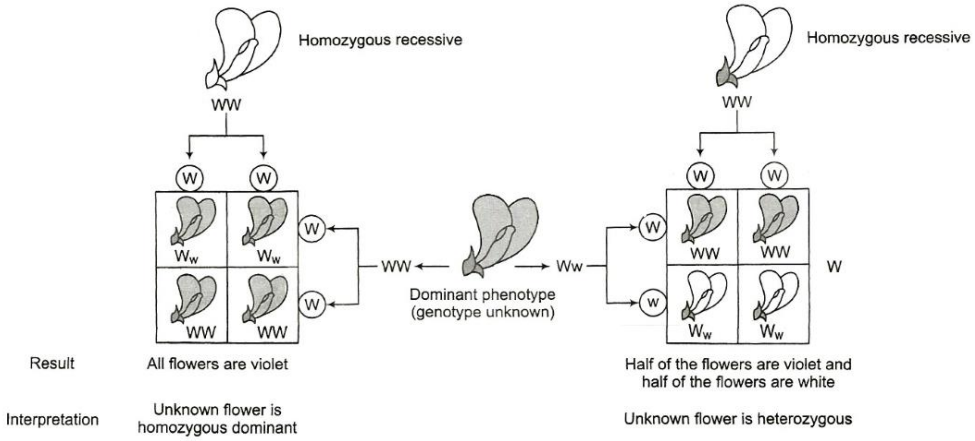
136 **(b)**

If both parents have blood group-AB then the possible blood groups of children are A, B and AB.

137 **(c)**

Test cross is a cross in which the dominant F_1-plant crosses with the homozygous recessive parents plant.

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism

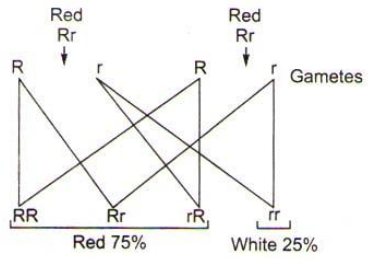


138 **(d)**

The ability of a gene to have multiple effects is known as **pleiotropy** and this phenomenon pleiotropism. The basis of pleiotropy is the interrelationship between the metabolic pathways that may contribute towards different phenotypes.

139 **(c)**

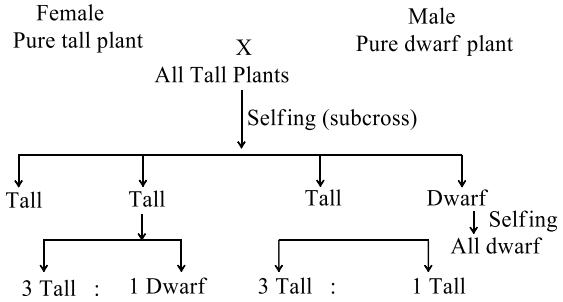
When two pea plants having red (dominant) coloured flowers with unknown genotype are crossed, the 75% red and 25% white flowered plants will be produced by following the law of Mendel. This is possible only if the parents are heterozygous.



141 **(a)**

$\frac{1}{4}$ th and $\frac{3}{4}$th.

Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



This three generations of pea plants after crossing a pure tall plant with a dwarf one. The plants of F_1-generation are all tall, of F_2-generation three tall and one dwarf. One third of the tall plants are pure, while the remaining behave as hybrids

F_1-generation Seeds collected from the parental generation called first filial generation or F_1-generation

F_2-generation F_1-plants pollinated among them self (self breeding or inbreeding) and seed produced by F_1-plants called F_2-generation. They were in ratio 3:1 (three tall and one dwarf).

F_3-generation Mendel allowed F_2-plant to form seed by self-pollination called F_3-generation. Mendel observed that tall and dwarf plant behave differently

(i) Dwarf plant produced dwarf plant on self-pollinated

(ii) In tall plants one third plants breed true so they were pure

(iii) Other two third plant behave like parents and give tall to dwarf plants 3 : 1 indicate that their parents have dwarf genes also

142 **(b)**

Night blindness is nutritional deficiency disease generally happens due to deficiency of vitamin-A

143 **(a)**

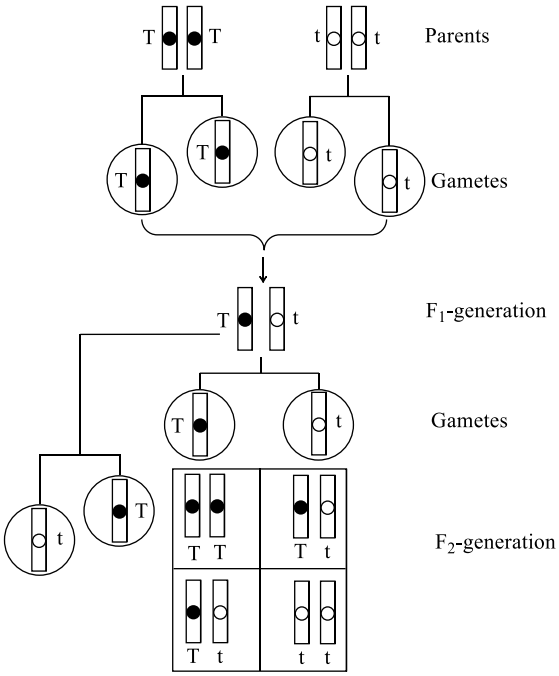
The genotypic ratio of monohybrid cross is 1 : 2 : 1, whereas the phenotypic ratio is 3 : 1.

9 : 3 : 3 : 1 is the phenotypic ratio of dihybrid cross (the cross made to study the inheritance of two pairs of factors or alleles of two genes).

144 **(c)**

Chromosomal Theory of Inheritance

Walter Sutton and Theodore Boveri noted that the behavior of chromosomes was parallel to the behaviour of genes and used chromosome movement to explain Mendel's laws.



Law of segregation interpreted on the basis of genes or factors (solid and hollow) situated on two homologous chromosomes.

Comparison between the Behaviour of Chromosomes and Genes

Chromosomes	Genes
Segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	Segregate of gamete formation and only one of each pair is transmitted to a gamete
Independent pairs segregate independently of each other	One pair segregates independently of another pair

Sutton and Boveri argued that the pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance. Experimental verification of chromosomal theory of inheritance was given by Thomas Hunt Morgan. Morgan worked with tiny fruitfly (*Drosphila melanogaster*)

145 **(b)**

The females have **homozygous** XX sex chromosomes, while males have **heterozygous** XY-chromosome. Y-chromosome is shorter than X-chromosome.

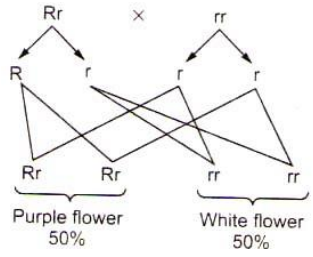
146 **(b)**

The **Down's syndrome** (Mongolian idiocy) arises due to **trisomy** of **21st chromosome**, *i.e.*, total 47 chromosomes will present in such person. The main features are mental deficiency, short stature, round face, flaccid muscles, protruding tongue, etc.

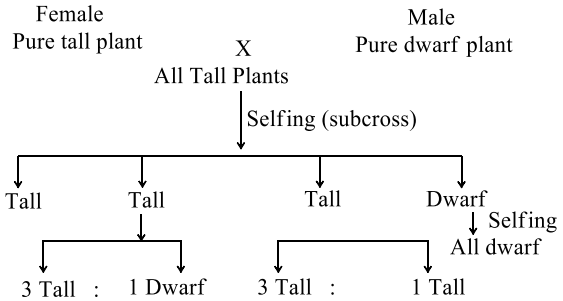
147 **(a)**
ZW-ZZ system of sex determination occurs in certain insects (gypsy moth) and vertebrates such as fishes, reptiles and birds and plants such as *Fragaris elatior*.

148 **(a)**
The Sudden and heritable change in the genetic make up of an individual is called **mutation**. The term mutation was introduced by Hugo de Vries.

149 **(c)**
According to law of purity of gametes, when the gametes are formed, they carry only one allele of the gene considered.



150 **(d)**
The recessive trait shown by F_2 and F_3-generation both but firstly it was observed in F_2-generation. Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



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151 **(a)**
A-A; B-Genetic disorders

152 **(a)**
Heredity (L. *Hereditas* – Heirship or inheritance) is the transmission of genetically based characters from parents to their offspring.

The process by which characters are transferred from one generation to the next generation is called inheritance

153 **(c)**
Huntington's chorea is a fatal disease of man. It is characterized by uncontrolled jerking of body and progressive degeneration of central nervous system. The mean age for the onset of these symptoms is between 35 to 40. This disease is caused by an autosomal dominant gene.

154 **(d)**
Movement of chromosomes towards poles requires centromere.

155 **(a)**
Klinefelter's syndrome is represented by 44 autosomes + XXY.

157 **(a)**
Man has only one X-chromosomes that is inherted to has daughter. Therefore, a heredftary disease, which is X-chromosomal linked, is never passed on from father to son.

159 **(a)**
Chromosomal theory of linkage states that
(i) Linked gene present on same chromosome
(ii) They lie in linear sequence in chromosome
(iii) There is tendency to maintain the parental combination
(iv) Strength of linkage between two gene is inversely proposal to the distance of two gene and *vice-versa*

160 **(c)**
In the diploid organism (plants and animals) the chromosome or DNA number becomes double just before the cell division

161 **(c)**
Genetics is the branch of biology which deals with the inheritance and variations

162 **(c)**
Balbiani first observed these chromosomes in the salivary glands of midge *Chironomus* in 1881. These polytene chromosomes are considered as somatic giant tubules and also reported from fat bodies some other dipterans also, *e.g.*, *Drosophila, Chironomus, Sciaca, Rhyncosciara,* etc.

163 **(d)**
Sir Archibald Edward Garrod was an English physician, who pioneered the field of inborn errors of metabolism. He was born on November 25, 1857, in London and died on March 28, 1936, in Cambridge.

164 **(c)**
Punnett square is a table, in which all possible combinations of gametes and progeny are displayed in a grid structure.

165 **(c)**
Erythroblastosis foetalis is a haemolytic disease of newborn children. Erythroblastosis foetalis can occur when father is Rh positive and mother is Rh negative. An Rh negative woman can be sensitized when she bears an Rh^+ child and Rh^+ children may have erythroblastosis.

166 **(c)**
When F_1 hybrid is crossed with its recessive parents, it is called as **test cross**.By test cross, the herterozygosity and homozygosity of the organism can be tested. The test cross ratio in monohybrid cross is 1 : 1 and in dihybrid cross, ratio wii be 1 : 1 : 1 : 1.

167 **(c)**
Inversion involves a reverse order of genes in a part of chromosome.

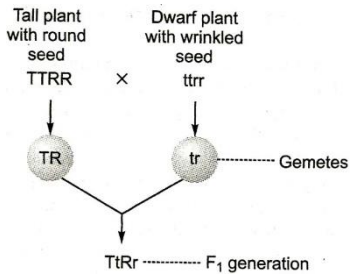
168 **(b)**
The gamete mother cells ($2n$) are called **meiocytes**, which undergo meiosis to form gametes (n) . The chromosome number in the melocytes($2n$) of housefly is 12.

169 **(c)**
Genes which codes for a pair a contrasting traits is called alleles. They are slightly different forms of the same gene, $e.g.$, TT, tt, tT

170 **(c)**
Haemophilia and colour blindness are both X-linked recessive diseases. The gene for both is found on X-chromosome only.

Albinism, Sickle-cell anaemia and thalassemia are autosomal diseases.

171 **(c)**
Mendel described the inheritance of recessive and dominant genes. Phenylketonuria (PKU) is an autosomal recessive mutation of gene on chromosome-12.

172 **(c)**


Thus, there is no dwarf plant with wrinkled seeds in F_1-generation.

173 **(b)**
The term genetics (*Gk. Genesis*=descent) was coined by **Bateson** in 1906. Genetics is the study of principles and mechanism of heredity and variations.

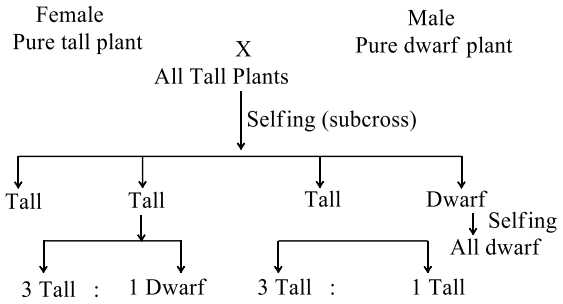
174 **(b)**
In human beings, 46 chromosomes are found, in which only one pair XY takes part in sex

determination. These are known as **sex chromosomes** or **allosomes**, rest 22 pairs are known as **autosomes**.

175 **(a)**

Mendel obtained the recessive character in F_2 by self pollinating the F_1-plants.

Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



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176 **(a)**

Criss-cross Inheritance It is a type of sex-linked inheritance, where a parent passes the traits to the grand child of the same sex through offspring of the opposite sex, that is, father passes the traits to grandson through his daughter (diagynic), while the mother transfers traits to her grand daughter through her son (dia-andric).

It was first studied by Morgan (1910) in case of eye colour in *Drosophila*. Criss-cross inheritance is applicable to most sex-linked disorders in humans, *e*. *g*., red green colour blindness, haemophilia

177 **(b)**

Heterozygous.

The diploid condition in which the alleles at a given locus are identical is called homozygous or pulls. In homozygous condition, organism have two similar genes or alleles for a particular character in homologous pair of chromosomes, *e*. *g*., TT or tt.

Organisms containing two different alleles or individual containing both dominant and recessive genes of an allele pair, *e*. *g*., Tt is known as heterozygous or hybrid

178 **(c)**

Mendel conducted artificial pollination/cross pollination using true breeding pea lines A true breeding line is one that having undergone continuous self pollination, shows stable trait inheritance and expression for several generation

179 **(d)**

Morgan and his group found that when genes were grouped on the same chromosome, some genes were very tightly linked (showed very low recombination), while others were loosely linked (showed higher recombination).

180 **(b)**

Polygene results in quantitative inheritance, which is characterized by occurrence of intermediate forms between the parental type. In case of crossing between AABBCC (dark colour) and aabbcc (light colour), in F_2-generation seven phenotypes will obtain with ratio 1 : 6 : 15 : 20 : 15 : 6 : 1. The total number of progeny is 64, out of which only two will be likely resemble with either parents. Hence, their proportion in F_2-generation would be 3.12, *i.e.*, less than 5%

181 **(a)**

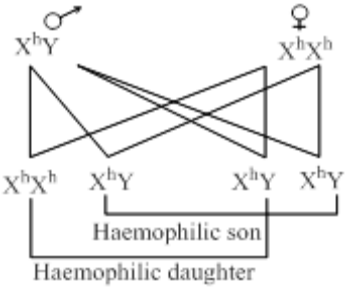
In cancer cells there is uncontrolled cell division. In them chromosomal abbreviation is commonly found

182 **(b)**

The given case is the example of **codominance.**

183 **(d)**

Males and female are haemophilic definately. If their father and mother both are haemophilic



184 **(b)**

Polyploidy is the phenomenon, which leads to increase in the number of chromosomes thus, increasing in the number of genes. Due to cumulative effect of genes, new characters appear, which results into formation of new species.

185 **(b)**

Mendel is called father of genetics. There are three laws of Mendel in respect of inheritance:

7. Law of dominance
8. Law of segregation or Law of purity of gametes or Law of splitting of hybrids.
9. Law of independent assortment

186 **(b)**

Test cross is a cross between F_1 hybrid with its recessive parent.

187 **(a)**

Homogametic.

XY and XY type sex determination seen in many insect and mammals including humans. Males have X and Y chromosome along with autosome and females have pair of 'X' chromosome along with autosome

Parents Phenotypes Male Female

Genotypes 44A + XY 44A + XX

Gametes 22A + X 22A+Y 22A + A22A + X

22A+ X 22A+X

Children 22A + X 44A + XX 44 A + XY Female

22A + Y 44 A + XY 44 A + XY Male

Sex ratio Female : Male = 1 : 1

In plants The flowering plants are mostly bisexual and lack sex chromosomes. The unisexual flowering plants tent to have XX-XY type of sex chromosomal mechanism for sex determination. The female plants are XX and male plants are XY.

XX and XO Type of Sex Determination

Found in insect like grasshopper, cockroaches and bugs. Males have only X sex-chromosome and autosomes, female have pair of X-chromosome and autosome

Parents Phenotypes Male Female

Genotypes $AA + XO$ $AA + XX$

Gametes $A + X, A + O$ $A + X, A + Y$

F_1-generation

	A + X	A + X
A + X	AA + XO	AA + XO
A + O	AA + XO	AA + XO

Genotypes

XX-XO type of sex determination

In most of cases the female produce similar sex chromosome called homomorphic. In most of cases the male produce dissimilar sex chromosome called hetermorphic

188 **(a)**

In birds, usually female is designated as ZW, being heterogametic and male is designated as ZZ being homogametic.

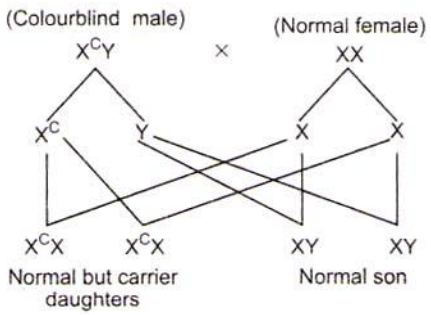
189 **(a)**

A cross of round yellow seeds (both dominant) and green wrinkled seed (both recessive) plants produced 9 : 3 : 3 : 1 ratio of plants (phenotypic)in F_2 generation. The ratio of parental to recombinant is 10 : 6 here because the 9 and 1 are of parental type and 3 & 3 are recombinant.

190 **(a)**

In genetics, a test cross, first introduced by **Gregor Johann Mendel,** is used to determine weather an individual exhibiting a dominant trait is homozygous or heterozygous for that traits. More simply, test cross determines the genotype of an individual with a dominant phenotype. The test cross is defind as being a type of back cross between the recessive homozygote parents and F_1 generation.

191 **(c)**



So, all sons in the progeny will be normal.

192 **(d)**

When a tall pea plant (TT) is crossed with dwarf plant (tt), the F_1progeny shows all plants hybrid tall and on selfing of F_1progeny, the F_2generation shows both tall and dwarf plant in the ratio 3 : 1. Out of three tall plants, one is pure tall (TT) and two are hybrid tall (Tt).

193 **(c)**

A-Two, B-Chromosomal, C-Mutation

194 **(c)**

A-Heterozygous, B-Unaffected, C-Carrier

196 **(c)**

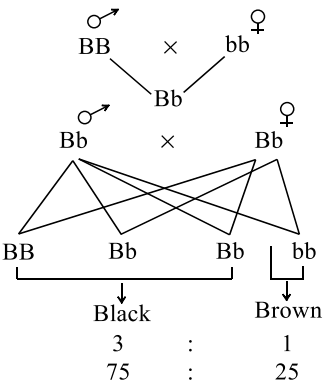
Linkage group will be equal to haploid number of chromosomes. *Pisum sativum* has seven pairs of chromosomes, therefore linkage group is also **seven**.

197 **(d)**

When a cross (dihybrid) is made between plants bearing round yellow (RRYY) and wrinkled green (rryy) seeds, all the plants in F_1-generation are with yellow round seeds (showing the genotype RrYy).

198 **(a)**

Black colour is dominant over the recessive so by cross it is easily infered that 75% of the offspring are black and 25% are brown



199 **(b)**

There are only very few characters, which are present on the Y-chromosome of male. Like hypertrichosis. Given pedigree analysis is the example of Y-linked inheritance because all male progeny is affected

200 **(a)**

Haemophilia.

Genetic or chromosomal symbol used for person who is having sickle-cell anaemia Ps – Hb^s Hb^s.

Sickle-cell Anaemia

(i) It is an autosome-linked recessive trait

(ii) The disease is controlled by a single pair of allele Hb^s and Hb^s

(iii) Only the homozygous individuals for Hb^s, *i.e.*, Hb^sHb^s show the diseased phenotype

(iv) The heterozygous individuals are carriers (Hb^AHb^S)

(v) Due to point mutation, glutamic acid (Glu) is replaced by valine (Val) at the sixth position of β-globin chain of haemoglobin molecule

(vi) A single base substitution at sixth codon of the beta globulin gene from GAG to GUG. GAG code for glutamic acid and GUG code for valine.

(vii) Hb^S behaves as normal haemoglobin except under the oxygen stress where erythrocytes lose their circular shape and become sickle-shaped. As a result, the cells cannot pass through narrow capillaries. Blood capillaries are clogged and thus, affect blood supply to different organs

201 **(b)**

Grasshopper is an example of XO type of sex determination in which the males have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes .

202 **(a)**

Tr Rr (heterozygous tall and pink)

↓ (self crossed)

Tt Rr × Tt Rr

Gametes TR Tr tR tr

TR	TTRR (Red)	TTRr (Pink)	TrRR (Pink)	TrRr (Pink)
Tr	TTR (Pink)	TTrr	TrRr (Pink)	Ttrr
tR	TrRR	TrRr	ttRR	ttrR (Pink)
tr	TrRr	Ttrr	ttRr (Pink)	ttrr

1/16 TTRR
2/16 TTRr
2/16 TtRR
4/16 TtRr } 9/16 – 75%

1/16 TTrr
2/16 Ttrr } 3/16 – 25%

2/16 ttRR
2/16 ttRr } 3/16 – 50%

1/16 ttrr 1/16 – 50%

203 **(d)**

Chimera is an individual which has in its body cells of two or more genorypes *i.e.*, pletiotroic mutations. Chimeric individuals produced by transfections arise when some cells of an embryo become stably transfected.

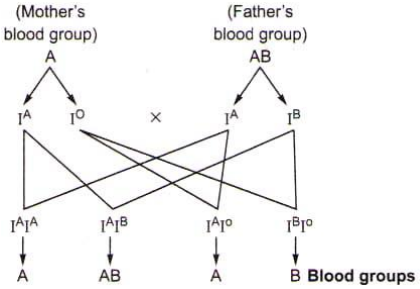
204 **(c)**

Mendel selected 14 pairs of true bruding pea plant varieties for his experiment

205 **(a)**

Syndrome stands for the group of symptoms, which indicates to a particular disease

206 **(d)**



Hence, parents with blood group-A and AB will not produce offsprings with blood group-O.

207 **(d)**

Nephrogenic diabetes is due to genetic deficiency of ADH-receptor linked to X-chromosome.

208 **(b)**

Mendel got only parental phenotype in the offspring. He didn't get only intermediate result. So, he could not formulated the blending theory of inheritance or observed linkage and crossing over

209 **(a)**

Mutations are large discontinuous sudden heritable change in the genotype. Mutation are generally **recessive** in nature.

210 **(a)**

Cri-du-chat syndrome (Cat –cry syndrome) was discovered by **Lejeune** in 1963 and is due to the deletion of a large part of the small arm of the 5th autosomes. Deletion is a type of mutation in which a segment is removed from chromosomes or DNA molecules.

211 **(c)**

A-Human; B-Quantitative

212 **(d)**

When a pair of contrasting characters are crossed with each together then F_1-generation has only one type of character. This expressed character is known as **dominant** character, while the character, which could not express in F_1-generation is known as **recessive** character. In pea plants, tallness, round seed, yellow seed, purple flower, green pod, inflated pod and axial flower are dominant over dwarfness, wrinkled seed, green seed, white flower, yellow pod, constricted pod and terminal flower, respectively.

213 **(a)**

Genes for cytoplasmic male sterility in plants are located in mitochondrial genome.

214 **(d)**

DNA **transposition** is the process, which involves the movement of DNA elements from one site in the genome to the other. It is mediated by transposase enzymes. These short segments of DNA (DNA elements) with remarkable capacity to move from one location in a chromosome to another, are called **transposons** or **jumping genes** or transposable elements or mobile genetic elements. These were first discovered by **Barbara McClintock** in maize (*Zea mays*) for which she got the Nobel Prize for physiology and medicine.

215 **(a)**

The phenomenon of expression of both the alleles in heterozygote is called codominance. As the result the phenotype is different from both homozygous genotype.

Examples

10. Blood group is the good example codominance
11. ABO blood groups are controlled by gene I. The gene (l) has three allele I^A, I^B, i, I^A, I^B produce slilghtly different form of sugar while i does not produce any kind of sugar.

12. I^A, I^B are dominant alleles where as i is recessive alleles

13. Since, there are three different allele, there are six different combination of these three alleles are possible and four phenotypes (A, B, AB and O)

Genetic Basis of Blood Groups in Human Population

Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood Types of Offspring
I^A	I^A	I^AI^A	A
I^A	I^B	I^AI^B	AB
I^A	i	I^Ai	A
I^B	I^A	I^AI^B	AB
I^B	I^B	I^BI^B	B
I^B	i	I^Bi	B
i	i	ii	O

When I^A and I^B are present together they both express their own types of sugars this is because of co-dominance. ABO blood grouping also provides a good example of multiple alleles.

Here, you can see that there are more than two, *i.e.,* three alleles governing the same character. Since, in an individual only two alleles can be present multiple alleles can be found only when population studies care made. Dominance is not an autonomous features of a gene. It depends on much on the gene product

216 **(c)**
If pedigree initiated from male it is called proposity. It pedigree initiated from female it is called propista. So, individual from which a pedigree initiated could be proband or propositus

217 **(a)**
Hugo de Vries used *Oenothera lamarckana* for his mutation experiment.

218 **(b)**
Phenylketonuria is due to deficiency of liver enzyme phenylalanine hydroxylase.

219 **(a)**
Haemophilia is a sex-linked character (X-linked recessive trait). It is a rare human blood disorder, in which, blood clotting is deficient, resulting in severe bleeding internally and externally. The condition is due to lack of fibrin in the blood and is controlled by two closely linked genes on the X-chromosome that are responsible for the production of different clotting factors.

220 **(b)**
A cross between two individuals for studing inheritance of two characters is known as dihybrid cross.the phenotypic ratio in F_2-generation of a dihybrid cross is 9 :3 : 3 : 1, therefore, the maximum number of different phenotypes available are four.

221 **(c)**
Nullisomy is an aneuploid condition, in which a pair of homologous chromosomes is deficient and represented as $2n$-2. **Monosomy** is an aneuploid condition, in which a chromosomes is deficient from its homologue and represented at $2n$-1.

222 **(d)**
For the given case, the disease is sex-linked recessive.

223 **(a)**
Colour blindness and haemophilia are diseases caused by X-linked recessive genes. Colour blindness involving faulty perception of red and green light and follows an X-linked pattern of inheritance.

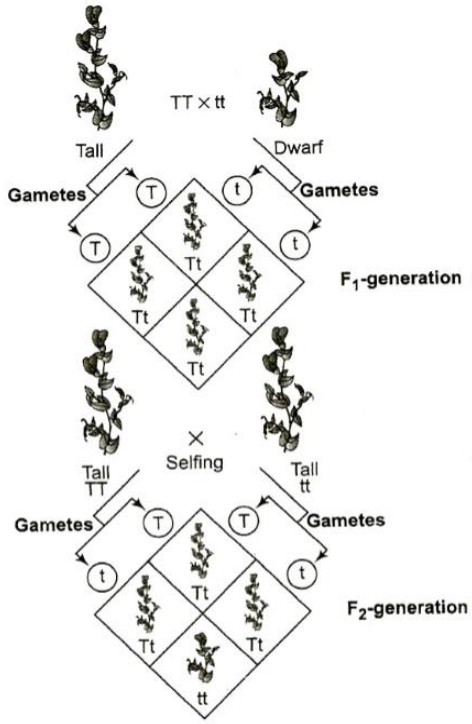
224 **(a)**
Principle or law of independent assortment has been called the second law of Mendelism by Correns

225 **(a)**
Mendel's hybridization strategy was use of two plants differing in a pair of contrasting character in case of monohybrid cross and two pair of contrasting characters in dihybrid cross

226 **(b)**
A-heterozygous, B-TT or tt, C-Heterozygous

227 **(b)**
Drumsticks of Barr body are the sex chromatin present in the neutrophils (polymorphonuclear leucocyte) of 3 to 5 % cells in females and are absent in males.

228 **(a)**



Phenotypic ratio Tall : Dwarf

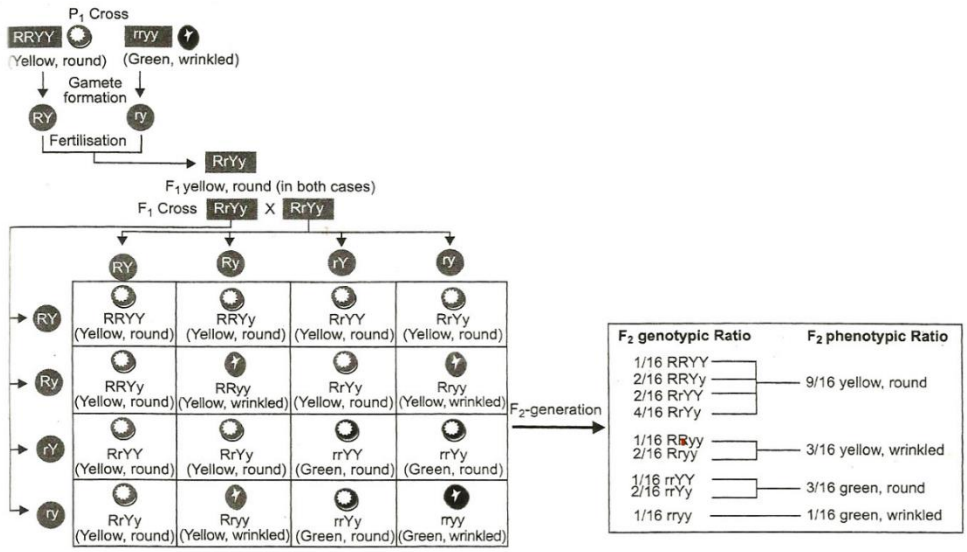
Genotypic ratio TT : Tt : tt

1 : 2 : 1

A Punnett square used to understand to typical monhybrid cross conducted by Mendal between true-breeding tall plants and true-breeding dwarf plants

229 **(a)**

4.



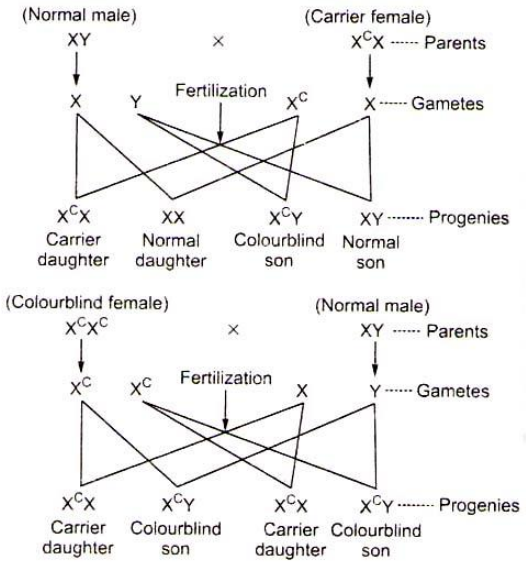
A dihybrid cross in pea plant between yellow round (smooth) seeded and green wrinkled seeded plant. The cross proves the principle of independent assortment

230 **(c)**

In the given pedigree chart, squares are representing males and circles representing females. In F_1generation, 2-male are diseased and in next generation only male is diseased. This shows the inheriatnce of a Y-linked disease.

231 **(d)**

Colour blindness is a disease, in which a person is unable to differentiate between red and green colour. The gene for this disease is located on the X-chromosome. So, if a colourblind woman marries a normal man, it will produce all the sons colourblind (X^cY). In case of a carrier woman, the probability of a colourblind and normal son is 50 : 50



232 **(c)**

Sex Chromatin in Interphase Nuclei Barr and Bertram (1949) found that interphase nuclei of human females stained with orcein possess small distinct chromatin body called **sex chromatin, Barr body** or **X-chromatin**

Barr body is found attached to nuclear envelops in oral mucosa, any where in the nucleus in nerve cells and as **drumstick** or small rod at one side of nucleus in neutrophil or polymorphonuclear leucocytes (Davidson and Smith)

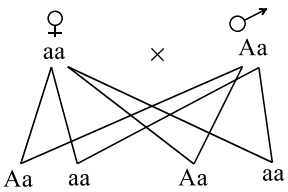
Barr body is produced due to partial inactivation of one X-chromosome and development of facultative heterochromatin in it. Any of the two X-chromosomes can become heterochromatic. It begins in the late blastocyst stage (roughly 16 day of embryonic life). Partial inactivation of one X-chromosomes in females is called **Dosage compensation**

233 **(d)**

As given in the chart the AB blood group percentage is 5% in India.

So, it can be said that any individual, selected at random from sample population has 1 in 20 chance of being blood group AB

234 **(d)**



The pedigree given in question is the most probable autosomal disease

235 **(d)**

The study of inheritance of genetic traits in several generations of a human family in the form of a family tree diagram is called **pedigree analysis**.

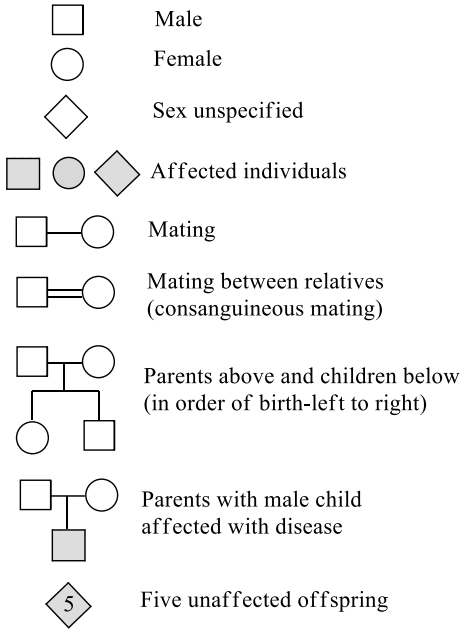
Advantages

(i) It helps in genetic counselling to avoid disorders

(ii) It shows the origin of a trait and flow of a trait in a family

(iii) It is important to know the possibility of a recessive allele that can cause genetic disorders like colour blindness, haemophilia, etc.

Signosed in the pedigree are



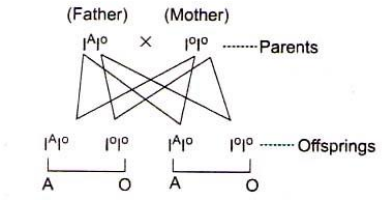
236 **(a)**

The non-ionizing radiations of visible light (UV rays) have been found to produce mutagens in culture media, which induced mutations in irradiated organism placed in these media for few hours. These rays cause hydration of cytosine and thymine. In humans, it causes DNA damage producing thymine dimers, however, generally it does not create any serious problem due to DNA repair system.

237 **(b)**

Nucleotide sequence is also called the base-pair sequence. In frame-shift mutation or base pair substitution the nucleotide sequence get changed

238 **(c)**



So, if a woman with 'O' blood group has a child with blood group-O claims a man with blood group-A as father, then the genotype of claimed person should be I^AI^O.

240 **(a)**
Mendel carried out hybridization experiments on garden pea for 7 years from 1856-1863

241 **(a)**
Cross between two genetically unlike individuals is called **hybridization**.

242 **(a)**

AAbb × aaBB
↓
AaBb
AaBb × AaBb
↓

	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

The phenotypic ratio will be 9 : 3 : 3 : 1.

Dihybrid test cross gives 1 : 1 : 1 : 1 ratio.

Law of segregation gives 1 : 2 : 1 genotypic ratio in F_2-generation.

243 **(a)**
Some Examples of Aneuploidy
(i) **Down's syndrome**-21 trisomy
Symptoms
(a) Short statured with small round head
(b) Partially open mouth with protruding furrowed tongue
(c) Palm is broad with characteristic palm crease
(d) Slow mental development
(ii) **Turner's syndrome**
Cause Absence of one of the X-chromosomes, resulting in the karyotype 44+XO
Symptoms
(a) Sterile female with rudimentary ovaries
(b) Shield-shaped thorax
(c) Webbed neck
(d) Poor development of breasts
(e) Short stature, small uterus, puffy fingers
(iii) **Klinefelter's syndrome**
Cause Presence of an additional copy of X-chromosome resulting in the karyotype 44+XXY
Symptoms
(a) Sex of the individual is masculine but possess feminine characters
(b) Gynaecomastia, *i.e.*, development of breasts
(c) Poor beard growth and often sterile
(d) Feminine pitched voice

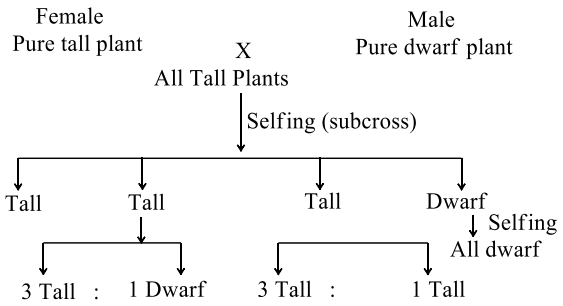
244 **(b)**
A recessive allele is not weaker than the dominant allele. It (recessive allele) does not shows its effect (in the presence of dominant allele) because of modified or different enzymes. A recessive allele make its gene product even when paired with the dominant allele. It is not necessary that dominant allele always better (in the case of dominant disease)

245 **(a)**
Given pedigree analysis indicates the transmission of autosomal recessive trait from parents to their offsprings

246 **(d)**
Phenotype is the observable characteristics or the total appearance of an organism. It is determined by its genes, the dominance relationships between the alleles and by the interaction during development between its genetic constitution (genotype) and the environment.

247 **(a)**
Cretinism is caused by deficiency of thyroid hormones in infants.

248 **(a)**
Tall.
Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



This three generations of pea plants after crossing a pure tall plant with a dwarf one. The plants of F_1-generation are all tall, of F_2-generation three tall and one dwarf. One third of the tall plants are pure, while the remaining behave as hybrids

F_1-generation Seeds collected from the parental generation called first filial generation or F_1-generation

F_2-generation F_1-plants pollinated among them self (self breeding or inbreeding) and seed produced by F_1-plants called F_2-generation. They were in ratio 3:1 (three tall and one dwarf).

F_3-generation Mendel allowed F_2-plant to form seed by self-pollination called F_3-generation. Mendel observed that tall and dwarf plant behave differently

(i) Dwarf plant produced dwarf plant on self-pollinated

(ii) In tall plants one third plants breed true so they were pure

(iii) Other two third plant behave like parents and give tall to dwarf plants 3 : 1 indicate that their parents have dwarf genes also

249 **(d)**

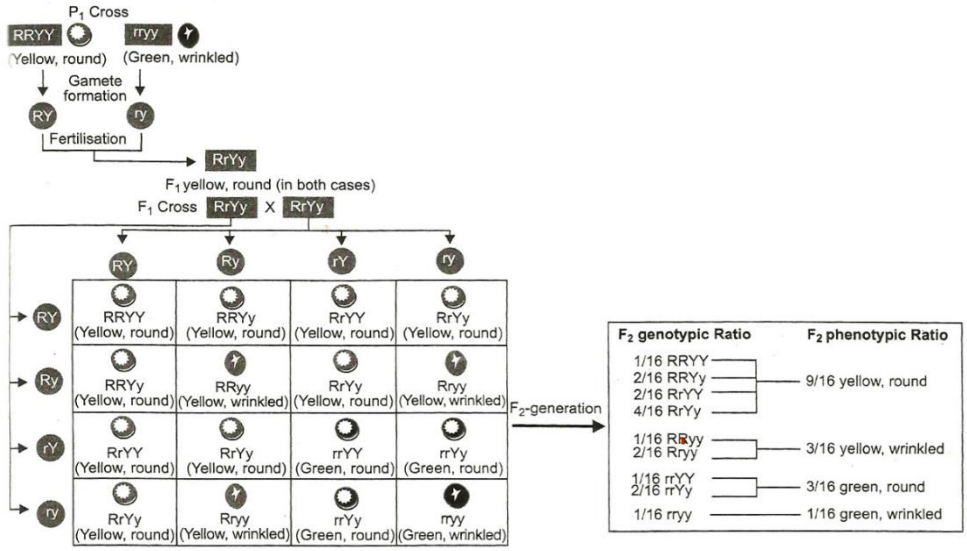
The persons suffering from Klinefelter's syndrome have normal external genitelia but internally testes are absent or reduced. Sparse body hair and gynecomastia (female like breast development) is also seen.

250 **(d)**

Dominant lethal gene kills the organism.

251 **(b)**

12.



A dihybrid cross in pea plant between yellow round (smooth) seeded and green wrinkled seeded plant. The cross proves the principle of independent assortment

252 **(a)**

A-Linkage; B-Crossing over

253 **(b)**

The actual distance between two genes is said to be equivalent to the percentage of crossing over between these two genes. Since the two genes lie at the ends of the chromosome, there are 100% chances of their segregation during crossing over.

254 **(a)**

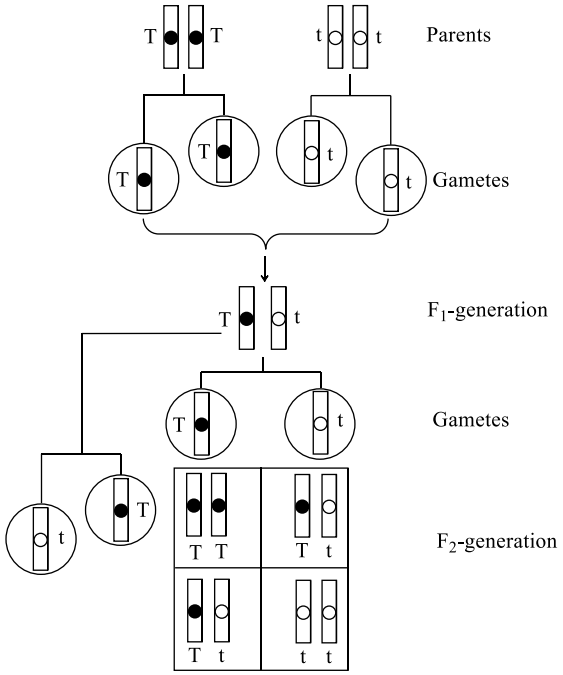
In **trisomic** $(2n + 1)$ condition, organism has one extra chromosome, *e.g.*, Klinefelter's syndrome (22 pair + XXY).

255 **(b)**

TH Morgan.

Chromosomal Theory of Inheritance

Walter Sutton and Theodore Boveri noted that the behavior of chromosomes was parallel to the behaviour of genes and used chromosome movement to explain Mendel's laws.



Law of segregation interpreted on the basis of genes or factors (solid and hollow) situated on two homologous chromosomes.

Comparison between the Behaviour of Chromosomes and Genes

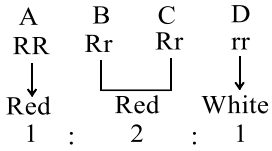
Chromosomes	Genes
Segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	Segregate of gamete formation and only one of each pair is transmitted to a gamete
Independent pairs segregate independently of each other	One pair segregates independently of another pair

Sutton and Boveri argued that the pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the chromosomal theory of inheritance.

Experimental verification of chromosomal theory of inheritance was given by Thomas Hunt Morgan. Morgan worked with tiny fruitfly (*Drosphila melanogaster*)

256 **(b)**

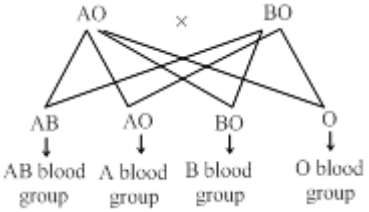
Rr and red because the R is dominant r so, the F_1-hybrid will be red



257 **(b)**

There are two possibility for blood group A = AA and AO.

There are two possibility for blood group B = BB or BO cross between AO, BO. Give four types of blood groups are AB, A, B, O



258 **(a)**

Principle or law of inheritance were enunciated by Mendel. There are four principals or laws of inheritance based on monohybrid and polyhybrid cross.

(i) One gene inheritance

1. Principle of paired factors
2. Law of dominance
3. Principle of law of segregation

(ii) Inheritance of two genes

4. Principles or law of independent assortment

259 **(a)**

Mendel's laws explained by the meiosis (gametogenesis). Like law of independent assortment, law of segregation, etc.

260 **(d)**

Mendel's discoveries concerning genetic inheritance were generally did not accepted by scientific community at that time. Mendel did not discovered linkage and blending inheritance

261 **(b)**

Deletion is a chromosomal aberration in which there is loss of a chromosomal segment.

262 **(a)**

There are three symbols for the carrier (heterozygous condition). ⊙ ⊗ and ◑ Generally, the carriers are females so there is rounded structure

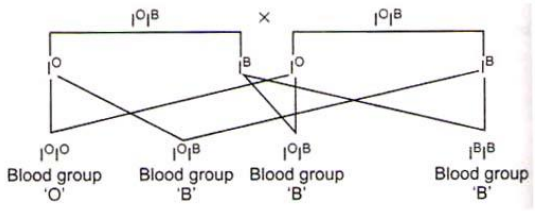
263 **(d)**

Turner's syndrome is a disorder caused due to the absence of one of the X-chromosome, *i.e.*, 45 with XO (44 autosomes + XO). Such females are sterile

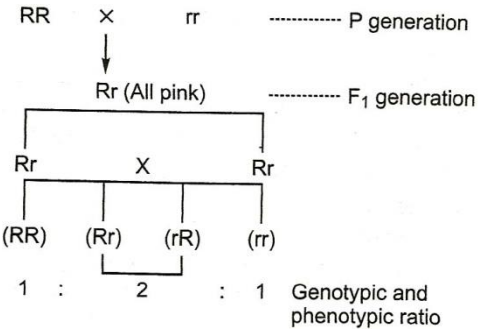
as ovaries are rudimentary besides other features including lack of other secondary sexual characters.

264 **(c)**
Genotype of a person with blood group-B may be I^BI^B or I^OI^B, person with genotype I^BI^B can not produce offsprings with blood group-O in any case but if the person's genotype is I^OI^B, then its offsprings may have blood group-O.

eg,



265 **(b)**
Incomplete dominance or **blending inheritance** was first seen in *Mirabilis jalapa*(4'O clock plant). Here, when red flowers are crossed with white flowers variety the F_1-hybrid is pink and F_2 ratio is 1 red : 2 pink : 1 white.



266 **(d)**
In **incomplete** (partial or intermediate) **dominance**, the effect of dominant allele is diluted or modified, so that the phenotypic expression of the concerned trait in a hybrid is distinguishable from both parental type. Consequently, both phenotypic and genotypic ratios in F_2-generation are 1 : 2 : 1.

267 **(b)**
Cytoplasmic inheritance always shows maternal characters.

268 **(b)**
Type of gamete participating in selfing of members in monohybrid cross is of two types.

269 **(b)**
GAG code for glutamic acid in haemoglobin *m*RNA replaced by GUG code which code for valine in haemophillic haemoglobin *m*RNA

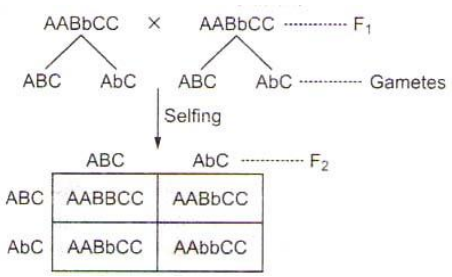
270 **(a)**
Linkage is the inheritance of certain genes as a group because they are parts of the same chromosome. Linked genes do not show independent assortmant. Linkage was first suspected and theorized in 1903 by **Sutton** and **Boveri.**

271 **(c)**
If a character is transmitted from father to his sons and then to grandson only, it means it is located on Y-chromosome (inheritance of Y-linked genes).

272 **(b)**
The term 'mutation' was coined by Hugo de Vries (1901). He also proposed mutation theory of evolution. The mutational theory of evolution published in 1903. Hugo de Vries worked on *Oenothera lamarckiana* (evening primorse). Out of a population of 54343 plants, de Vries observed 834 mutation and concluded that the primary force of evolution is mutation

273 **(b)**
'Jumping genes' or **movable genetic elements** were discovered by **'Barbara McClintock'** (1902-92) in maize. These 'controlling elements' could move from one location to another on the chromosome.

274 **(a)**
Since AABbCC contains only one heterozygous allelic pair, 'Bb', the cross would behave as monohybrid cross leading to phenotypic ratio in F_2-generation.



Phenotypic ratio is 3 : 1

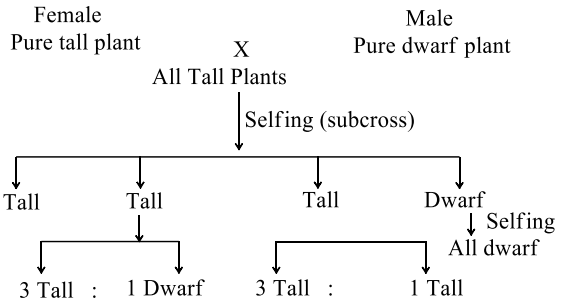
275 **(b)**

Dominant character.

Law or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

276 **(d)**

Sutton and **Boveri** proposed chromosomal theory of inheritance. This theory believes that chromosomes are vehicles of hereditary information possess mendelian factors segregate and assort independently during transmission from one generation to the next.

277 **(b)**

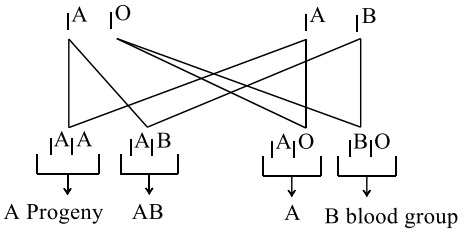
In sex-linkage, the speciality is criss-cross inheritance. Criss cross inheritance is a type of sex linked inheritance where a parent passes the traits to the grand child of the same sex through offspring of the opposite sex, that is father passes the traits to grandson through his daughter while the mother transfers traits to her grand daughter through her son, criss cross inheritance establish the relationship between gene and the sex chromosomes.

278 **(b)**

For the blood group A, there will be two type of genotype$-I^AI^A, I^AI^D$.

For the blood group AB there will be only one genotype$-I^AI^B$.

Case I When parent blood group I^AI^O and I^AI^B



Case II When parent blood group are I^AI^A and I^AI^D

279 **(b)**

Nullisomic$=2n-2$

Monosomic$=2n-1$

Trisomic$=2n+1$

Haploid$=n$

280 **(b)**

Phenylketonuria (Folling; 1934). It is an inborn, autosomal, recessive metabolic disorder in which the homozygous recessive individual lacks the enzyme **phenylalanine hydroxylase** needed to change phenylalanine (amino acid) to tyrosine (amino acid) in liver. It results in hyperphenylalanine

281 **(a)**

Trisomy : An individual having one extra chromosome of a set $(2n+1)$.

282 **(a)**

Only two types of gametes are formed by genotype rrYy

	r	r
y	ry	ry
Y	rY	rY

283 **(a)**

1906.

Genetics word is derived from the Greek word *genesis*, which stands for descent. Term genetics was introduced by Bateson in 1906 branch of Biology that deals with the study of heredity and variations

284 **(a)**

Mutant gene that gives slightly modified phenotypes are called heteroalleles.

285 **(b)**

Colour blindness and haemophilia are well known examples of sex-linked diseases.

286 **(c)**

Gamma radiations are ionizing radiations and are physical mutagens. They are used as mutagens in such materials, where nucleus is deep seated, *e.g.*, seeds, stem, cutting, etc. Sharbati Sonora variety of wheat has been developed by gamma radiations on 'Sonora 64' variety (Mexican dwarf wheat variety).

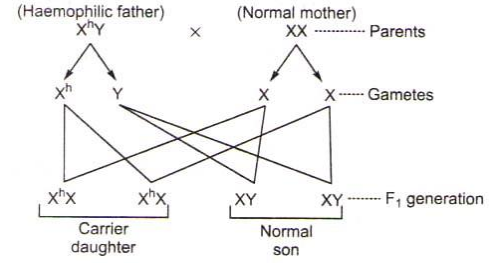
287 **(d)**
Albinism is a genetic disorder.

288 **(d)**
Mendel's paper 'experiments on plant hybridisation' was published in the 'Proceeding of Brunn Natural Science Society' in 1805

289 **(a)**
If O gamete (no X or Y) fuses with X gamete, the resulting XO zygote will survive and form a sterile female. This situation is called **Turner's syndrome**.

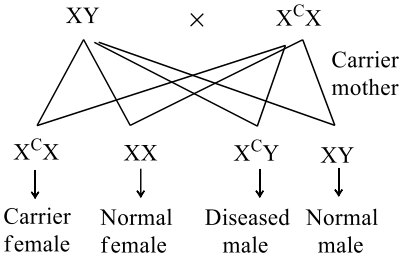
290 **(a)**
Milk secreting and baldness both trait belongs to the sex limited trait.
Finalization of sex at the time of fertilization is known as sex determination. All sex linked character show criss-cross inheritance and firstly it was studied and discovered by TH Morgan (1910). *Sex related trait may be divided into three types*
(i) **Sex Linked Traits** They are those traits the determining genes of which are found on the sex chromosomes. All the sex-linked traits present on a sex chromosome are inherited together
(ii) **Sex Limited Traits** They are autosomal traits which are expressed in a particular sex in response to sex hormones although their genes also occur in the other sex, *e.g.,* milk secretion in mammalian females, pattern baldness in males. The gene for baldness behaves as an autosomal dominant in males and autosomal recessive in females
(iii) **Sex Influenced Traits** The traits are not due to particular genes but are by products of sex hormones, *e.g.*, low pitched voice, beard moustaches. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of testosterone

291 **(b)**
Haemophilia is an X-linked disease, it is transmitted from mother to son.



292 **(c)**
ABO blood group in human beings are as follow
(i) codominant
(ii) dominant-recessive
(iii) multiple allele

294 **(a)**
Haemophilia is also called Bleeder's disease. It is a sex linked recessive disorder. It transmit from carrier female to male progeny



295 **(a)**
The important sources of variation are mutations and recombinations (crossing over).

296 **(b)**
Gregor Johann Mendel (1822-1884) is known as the father of genetics because he was the first to demonstrate the mechanism of transmission of characters from one generation to the other

297 **(c)**
Holandric gene occurs on the Y-chromosome only. It is inherited only by the male line and is a recessive gene that always expresses.

298 **(c)**
When a gene pair (allele) contains two different genes in an organism then the organism is considered as **heterozygous** for the particular character.

299 **(a)**
Finalization of sex at the time of fertilization is known as sex determination. All sex linked character show criss-cross inheritance and firstly it was studied and discovered by TH Morgan (1910). *Sex related trait may be divided into three types*

(i) **Sex Linked Traits** They are those traits the determining genes of which are found on the sex chromosomes. All the sex-linked traits present on a sex chromosome are inherited together
(ii) **Sex Limited Traits** They are autosomal traits which are expressed in a particular sex in response to sex hormones although their genes also occur in the other sex, *e.g.,* milk secretion in mammalian females, pattern baldness in males. The gene for baldness behaves as an autosomal dominant in males and autosomal recessive in females

(iii) **Sex Influenced Traits** The traits are not due to particular genes but are by products of sex hormones, *e.g.*, low pitched voice, beard moustaches. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of testosterone

300 **(b)**
The number of Barr bodies is one less than the number of X-chromosomes present in an individual, *e*. *g*., 1 for normal XX, 2 for XXXY

301 **(b)**

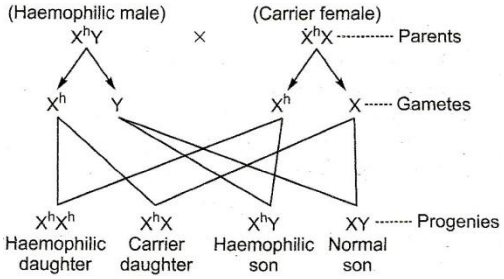
Disorders	Autosomal/Sex Linked	Symptoms	Effects
Down's syndrome	Autosomal aneuploidy (trisomy, +21)	Mongolian eyefold (epicanthus), open mouth, protruded tongue, projected lower lip, many loops on finger tip, palm crease	Retarded mental development IQ (below 40)
Turner's syndrome	Sex chromosomal monosomy 44 + XO	Short stature females (<5'), webbed neck, body hair absent menstrual cycle absent. Sparse pubic hair, underdeveloped breasts narrow lips puffy fingers	Sterile hearing problem
Klinefelter's syndrome	Sex chromosomal aneuploidy (tri/tetrasomy of X chromosome) 44+XXY 44+XXXY	The males are tall with long legs, testes small, sparse body hair, Barr body present, breast enlargement	Gynaecomastia azospermia sterile

302 **(d)**
Sex influenced traits are not due to particular genes but are by-products of sex hormones, *e.g.*, low pitched voice, beard, moustaches and baldness in human. The gene for balaness behaves as an autosomal dommant in males and autosomal recessive in females.

303 **(d)**
The numerous strands of polytene chromosomes are produced but to repeated replication of the paired chromosomes without any cell division (endoduplication) so, that the number of strands in a chromosomes doubles after every round of DNA replication.

304 **(b)**
50% of the sons would be colourblind.

306 **(b)**



So, half the daughters are haemophilic, whereas other half are carrier.

307 **(c)**

Genetic counselling is the giving of information and advice about the risk of genetic diseases like colour blindness, haemophilia, albinism and outcomes.Genetic screening is a part of genetic counselling, which includes parental diagnosis (like amniocentesis),carrier diagnosis and predictive diagnosis.

308 **(c)**

Dissimilar sex chromosome condition are

(i) XY and XY (ii) XX and XO

(iii) ZW and ZZ (iv) ZO and ZZ

309 **(b)**

Down's syndrome is due to the trisomy of 21st pair of autosome. Therefore, a Down's syndrome patient has 47 chromosomes, *i.e.*, 45 A + XX/XY.

310 **(a)**

Mutation is the ultimate source of variation. It is said by Hugo de Vries. Mitosis and linkage does not lead to the variation in genetic material

311 **(b)**

External morphology or appearance or descriptive term of an genotype is called phenotype

312 **(b)**

Down's syndrome (Mongolian idiocy) is a congenital disorder caused by trisomy of chromosome-21, often by non disjunction.

313 **(a)**

Sex influenced trait.

Finalization of sex at the time of fertilization is known as sex determination. All sex linked character show criss-cross inheritance and firstly it was studied and discovered by TH Morgan (1910). *Sex related trait may be divided into three types*

(i) **Sex Linked Traits** They are those traits the determining genes of which are found on the sex chromosomes. All the sex-linked traits present on a sex chromosome are inherited together

(ii) **Sex Limited Traits** They are autosomal traits which are expressed in a particular sex in response to sex hormones although their genes also occur in the other sex, *e.g.,* milk secretion in mammalian females, pattern baldness in males. The gene for baldness behaves as an autosomal dominant in males and autosomal recessive in females

(iii) **Sex Influenced Traits** The traits are not due to particular genes but are by products of sex hormones, *e.g.*, low pitched voice, beard moustaches. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of testosterone

314 **(d)**

Chromosomal Disorders These genetic disorders are caused due to absence or excess or abnormal arrangement of one or more chromosomes. These are **non-heritable** and pedigree analysis of a family does not help in tracing the pattern of inheritance of such chromosomal disorders. These are of two types abnormalities due to aneuploidy and aberrations either autosome or in sex chromosomes

315 **(a)**

Alfred Sturtevant.

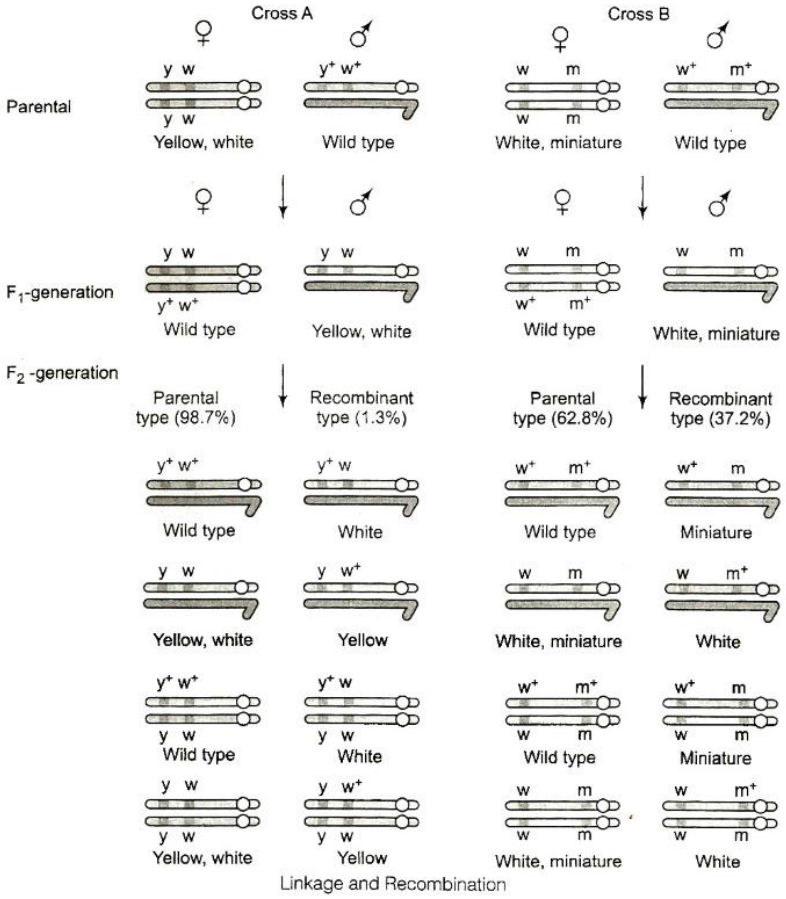
Linkage and Recombination

Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were sex linked. The crosses were similar to the dihybrid crosses carried out by Mendel in peas.

He observed that when two genes were grouped on the same chromosome, same genes are highly linked of associated and show low recombination.

When the genes are clearly present linked they show higher recombination.

Morgan attributed this due to the physical association or linkage of the two genes and coined the term linkage to describe this physical association of genes on a chromosome and the term recombination to describe the generation of non-parental gene combinations.
His student Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.
Morgan hybridized yellow bodied and white eyed females with brown bodied and red eyed male (wild type) (cross-A) and inter-crossed their F_1-progeny



Linkage and Recombination

316 **(d)**
Hugo de Vries conducted his experiments on evening primrose and postulated the mutation theory. As per this theory, new species were formed by sudden appearance of variations (mutations) rather than continuous variations.

317 **(c)**
Many chemicals such as acenaphthene, chloral hydrate, colchicine, sulphanil amide, mercury chloride, hexachlorcyclohexane, etc, are used to induce polyploidy. Polyethyl glycol is used in protoplast fusion.

318 **(a)**
Linkage chromosome always present on the chromosome, which represents the same trait called homologous chromosomes

319 **(c)**
According to the genic balance theory of sex determination given by **Bridges**, ratio between the number of X-chromosomes and number of complete sets of autosomes will determine the sex. According to this theory, if the X/A ratio is 1.5, then organism will be **super female**.

320 **(b)**
Emasculation is necessary for the controlled or artificial pollination. Removal of male part (anther) called emasculation

321 **(b)**
The genes, which remain confined to differential region of Y-chromosome are called **holandric genes**. These genes are not expressed in females Y-linked holandric genes are transmitted directly from father to son.

322 **(d)**

The given pedigree analysis shows inhertancs of a recessive sex-linked disease like haemophilia.

323 **(b)**

The word **mutation** was first described by **Hugo de Vries** in 1900. Mutation is a sudden heritable change in the characteristics of anorganism. These may result due to the change in genes (DNA or RNA), enzymes, change in chromosome that involves several genes or a change in the plasmogene. But mutation cannot change the **environment.**

324 **(b)**

It is the female reproductive cell, which usually carries more cytoplasm and cytoplasmic organelles than the male cell and hence, naturally would be expected to influence Non-Mendelian traits. Since in the present case, the male parent (not female) had mutation in mitochondria, there are negligible chances of the mutation being inherited.

325 **(b)**

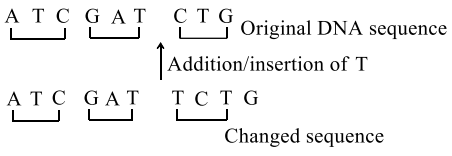
The principle of independent assortment states that members of one pair of factors assorted independently of member of other gene pair. Mendel studied the characters which were located on four different chromosome. It is not applicable for genes located on same chromosome, *i.e.*, linked genes.

326 **(c)**

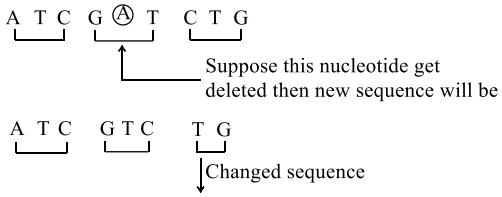
Deletion and insertion of one base leads to entire change of DNA base pair sequence.

DNA base pair sequence is called reading frame

Condition I If there is insertion of one base



Condition II If there is deletion of one base



327 **(d)**

The more cross over between A and C than A and B will be possible only when B is present in between A and C. So by taking this consideration the sequence would be A → B → C. This gene sequence also fulfil the other statements also (I, II, IV)

328 **(a)**

3 : 1

Law of Independent Assortment

Mendel also worked with and crossed pea plants that different in two characters/factor.

He crossed between pea plant that has seeds with yellow colour and round shape and other that has seeds of green colour and wrinkled shaped.

Ratio appeared as 9 : 3 : 3 : 1 such ratio appeared for several character that Mendel studied

9/16 = Yellow round 3/16 = Yellow wrinkled

3/16 = Green yellow 1/16 = Green wrinkled

Based on such observation Mendel concluded second law of inheritance called law of independent assortment.

According to this principle or law the two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation and get randomly re-arranged in the offspring producing both parental and new combination of traits.

Thus, the phenotypic ratio of a dihybrid cross is 9 : 3 : 3 : 1. The occurrence of four types of plants (more than parental types) in the F_2 generation of dihybrid cross shows that the factors of each of the two characters assort independent of the others as if the other pair of factors are not present. It can also be proved by studying the individual characters of seed colour and seed texture sepraterly.

Seed colour Yellow (9+3 = 12) : Green (3+1 = 4) or 3 : 1

Seed Texture Round (9+3 = 12) : Wrinkled (3+1 = 4) or 3 : 1

The result of each character similar to monohybrid ratio. Generally, the dihybrid cross used to study the independent assortment of genes

329 **(a)**

AB blood group person cannot donate blood to others but can receive blood from all blood groups and hence, called **universal recipient**.

330 **(c)**

Down's syndrome or Mongolian idiocy is not related to sex chromosome X or Y. It is due to the trisomy of 21st chromosome, *i.e.*, total 47

chromosomes. The main features are mental deficiency, short stature, round face, flaccid muscles, small ears protruding tongue and epithelial folds over the eyes (to give Mongolian look).

331 **(a)**
Genes, (DNA) present in cytoplasm are known as cytoplasmic genes or plasma genes. These are responsible for cytoplasmic inheritance or extrachromosomal inheritance.

332 **(a)**
A-TT, B-dominant, C-Recessive

333 **(a)**
In polygenic inheritance, several sets of alleles may produce cumulative effect on the same character, *e.g.*, human height and skin colour.

335 **(b)**
When F_1-hybrids exhibited a mixture of characters of two parents, the case is considered as that of incomplete or blending inheritance. It simply means that two genes or allelomorphic pair are not related as dominant or recessive, but each of them expresses itself partially partially. For example, in 4 O'clock plant (*Mirabilis jalapa*),when plants with red flower (homozygous,RR) are crossed with plants having white flower (homozygous,rr),the herterozygous F_1-hybrid (Rr) bear pink flower.

336 **(a)**
When a gene pair (allele) contains two different genes in an orgenism then the organism is considered as **heterozygous** for that particular character. Gene pair 'Rr' shows the heterozygous condition.

338 **(d)**
Test cross, crossing of F_1-progeny to the recessive parent is used to find the genotype of the progeny.

339 **(d)**
Amoeba cheris contains 500 chromosomes and *Ascaris megalocephala* contains only **two** chromosomes in each nucleus, *ie*, least number of chromosomes.

340 **(a)**

Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood Types of Offspring
I^A	I^A	I^AI^A	A
I^A	I^B	I^AI^B	AB
I^A	i	I^Bi	A
I^B	I^A	I^AI^A	AB
I^B	I^B	I^BI^B	B
I^B	i	I^Bi	B
i	i	ii	O

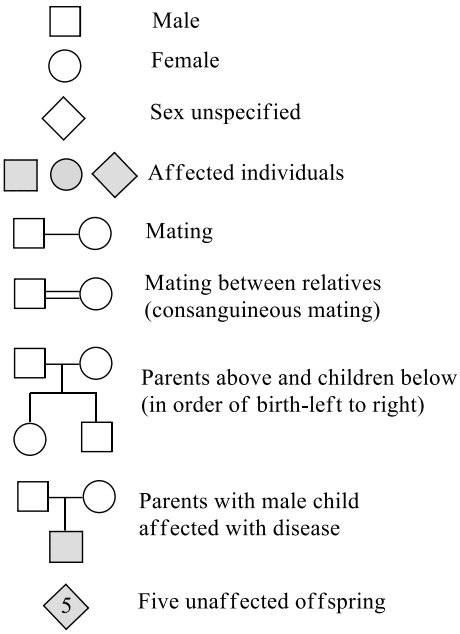
341 **(c)**
Chromatin is the material, of which eukaryotic chromosomes are composed. Chemically, chromatin consists of nucleic acids, histone, and non-histone proteins.

342 **(b)**
As we can see in the diagram given in question there are only one trait considered. So, this diagram depict law of segregation explained on the behalf of gene in which genes or factors are indicated as solid and yellow situated on two different chromosome

343 **(a)**
The disease in the given pedigree chart is X-linked dominant because, it is inherited by female child from her father and none of the male child is affected (X-linked). As disease expressed in female inspite of two XX-chromosomes, it will be dominant.

344 **(a)**
Mendel did not observe linkage that was observed later by another scientists (T H Morgan).

345 **(a)**
A-Male, B-Female, C-Sex unspecified.
The study of inheritance of genetic traits in several generations of a human family in the form of a family tree diagram is called **pedigree analysis**.
Advantages
(i) It helps in genetic counselling to avoid disorders
(ii) It shows the origin of a trait and flow of a trait in a family
(iii) It is important to know the possibility of a recessive allele that can cause genetic disorders like colour blindness, haemophilia, etc.
Signosed in the pedigree are



346 **(d)**

Opposing.

7 dominant traits, 7 recessive traits total 14 traits or 7 oppossing pairs of traits

Characters	Dominant Traits	Recessive Traits
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Violet	White
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Stem height	Tail	Dwarf

347 **(b)**

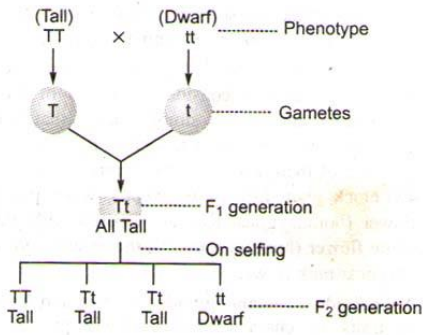
Autosomal recessive

348 **(b)**

Chromosomes (*Chromo* – coloured; some – body) So, the literal meaning of chromosome is the coloured body

349 **(b)**

Monohybrid cross involves single pair of contrasting traits or characters.



Phenotypic ratio 3 : 1

Genotypic ration 1 : 2 : 1

351 **(b)**

Selfing of F_1 hybrids in dihybrid cross gives 9 : 3 : 3 : 1 ratio of progeny. The gametes produced by Aa, Bb are of four types (AB, aB, Ab, ab).

352 **(a)**

Haplopappus gracilis has lowest number of chromosomes out of the given options.

353 **(a)**

Scientist later discovered or found that the gene for seven characters that were took by Mendel in his experiment is present on four chromosome but Mendel was Lucky because seven gene were not linked

354 **(c)**

Drosophila have 3 pairs of autosome and one pair sex chromosome. Sex determination in *Drosophila* is exactly similar to the human beings, *i.e.*, female is homogenetic and male is heterogametic. In the given diagrams, 'A' belongs to the female *Drosophila* and 'B' belongs to the male *Drosophila*

1 indicates = X-chromosomes in female *Drosophila*

2 indicates = Autosome

3 indicates = X-chromosomes in male *Drosophila*

4 indicates = Y-chromosome in male *Drosophila*

355 **(d)**

In domesticated fowls, the sex of progeny depends on the type of egg rather than sperm, as two different types of gametes are produced by females (ZW), while males have a same pair of sex chromosome (ZZ).

356 **(a)**

Given example is the example of inversion mutation in which the order of genes in a chromosome get inverted

357 **(a)**
Persons having Rh factor is called $Rh^+$and without Rh factor Rh^-. $Rh^+$is **dominant** over Rh^-.

358 **(b)**
Blood type 'O' has no igen but both types of antibodies 'a' and 'b'. The person with blood type 'O' is universal donor.

359 **(c)**
Law of independent assortment discovered by Mendel because all of his selected traits were present on the different chromosomes. None of his trait present on the same chromosome.
If Mendel had studied 7 traits using plant of 12 chromosome instead of 14 then it is most probable that he would have not discovered the law of independent assortment

360 **(c)**
Thalassaemia have two major kinds
α-thalassaemia and β-thalassaemia.
According to defective gene in α or β-chain of haemoglobin.
Thalassaemia
(i) It is an autosome-linked recessive disesase
(ii) It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin
(iii) Anaemia is the characteristic of this disease
(iv) Thalassaemia is classified into two types

5. **α-thalassaemia** Production of α-globin chain is affected. It is controlled by the closely linked genes HBA1 and HBA2 on chromosome 16. It occurs due to mutation or deletion of one or more of the four genes.
6. **β-thalassaemia** Production of β-globin chain is affected. It occurs due to mutation of one or both HBB genes on chromosome 11

361 **(c)**

370 **(a)**

In silkworm (insect), **female** has **XY** and **male** has **XX** type of sex chromosomes. This is essentially opposite to that of mammals.

362 **(b)**
The X-chromosome linked disease never passed on from father to son because the X-chromosome of father go to the daughter during inheritance.

363 **(d)**
Law of independent assortment does not applicable when the gene of different character occupy on the same homologous chromosome, *i.e.*, linked gene.

364 **(b)**
A-Meiosis; B-Allele pair

365 **(c)**
Genetic map is a diagram, which shows the relative position of genes on a chromosome.
Strutevant in 1911 prepared the first genetic map of two chromosomes of fruitfly.

366 **(c)**
Haemophilia and red green colour blindness, both are sex linked recessive gene on 'X' chromosome.

Body height is an example of polygenic inheritance.

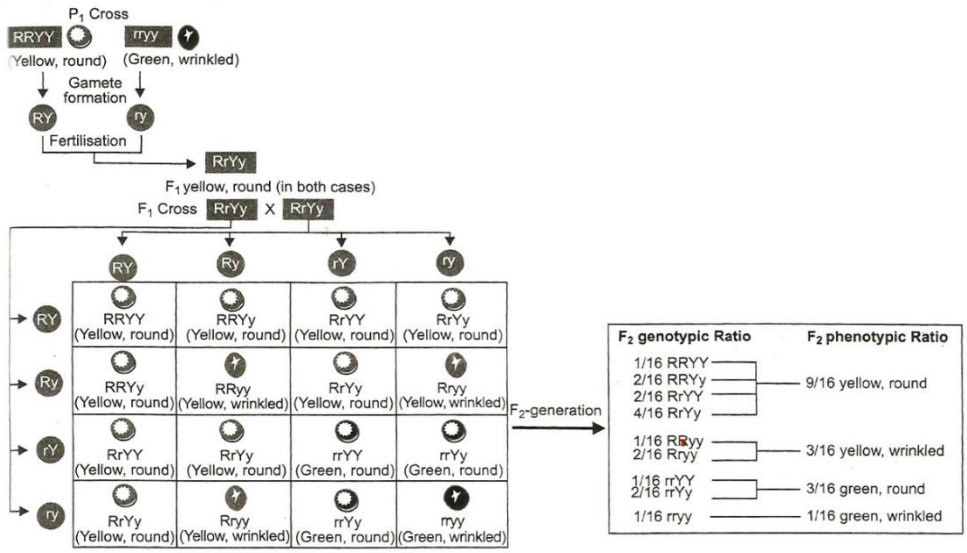
Rhesus blood group is based on the presence or absence of

Rh-protein on the surface of RBC.
Phenylketonuria (PKU) is a recessive autosomal variation.

367 **(a)**
Human's have 22 pairs of autosomes and one pair of sex chromosome

368 **(a)**
There are evidences that the gene for cytoplasmic male sterility particularly in maize reside in **mitochondria**.

369 **(d)**
In most cases if there is a change in genotype than it ultimately leads to change in phenotype also



A dihybrid cross in pea plant between yellow round (smooth) seeded and green wrinkled seeded plant. The cross proves the principle of independent assortment

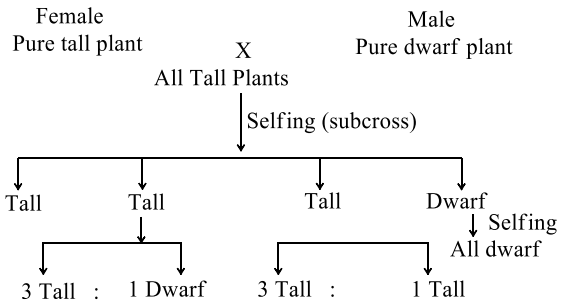
371 **(a)**

A cross in which parents differ in a single pair of contrasting character is called monohybrid cross. From the monohybrid cross the Mendel gave law of segregation, law of paired factor and law of dominance.

Law or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

372 **(a)**

Genic Balance Theory of Sex The theory of genic balance given by Calvin Bridges (1926) states that instead of XY-chromosomes sex is determined by the genic balance or ratio between X-chromosomes and autosome genomes

The theory is basically applicable to *Drosophila melanogaster* over, which bridges worked. He found that the genic ratio X IA of 1.0 produces fertile females whether the files have XX + 2A or XXX + 3A chromosome complement. A genic ration (X I A) of 0.5 forms a male fruitfly. This occurs in XY + 2A as well as XO + 2A

Chromosome Complement	X/A Ratio	Sexual Morphology
X X X + 2A	3/2 or 1.5	Metafemale
X X X + 3A	3/3 or 1.0	Female
X X + 2A	2/2 or 1.0	Female
X X + 3A	2/3 or 0.67	Inter sex
X X X +4A	3/4 or 0.75	Inter sex
X O + 2A	1/2 or 0.5	Male
X Y +2A	1/2 or 0.5	Male
X Y +3A	1/3 or 0.33	Metamale

373 **(b)**

Rr and red because the R is dominant r so, the F_1-hybrid will be red

374 **(a)**

Grasshopper is an example of XO type of sex determination in which the male have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes (2A + XX).

375 **(d)**

9:3:3:1.

Law of Independent Assortment

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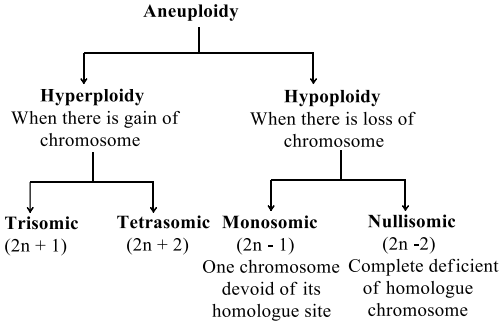
Seed Texture Round (9+3 = 12) : Wrinkled (3+1 = 4) or 3 : 1
The result of each character similar to monohybrid ratio. Generally, the dihybrid cross used to study the independent assortment of genes

376 **(d)**
Trisomy stands for $2n+1$.
Chromosomal disorders are caused due to excess, absence or abnormal arrangement of one or more chromosomes.
Sometimes the chromatids fail to segregate during cell division, resulting in gain or loss of a chromosome. This is called **aneuploidy**
Aneuploidy is also called heteroploidy
Aneuploidy is of two kinds
(i) Hyperploidy (ii) Hypoploidy

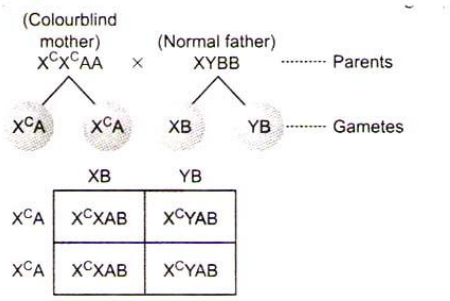


377 **(a)**
The genotype of Klinefelter syndrome is XXY. In this there is one extra X-chromosome. This extrachromosome comes when there is non-disjunction of X-chromosome in ova-or-sperm fuses with Y or X-chromosome of sperm or ova resulting XXY genotype

378 **(a)**
Colour blindness is caused by recessive sex-linked gene carried by X-chromosome. So, in male, one recessive gene is sufficient for its expression, *i.e.*, (X^CY) but female needs two recessive gene(X^CX^C) for the expression of colour blindness.

Mother will colourblind with A blood group and father normal with blood group-B as—

So, all the sons will be colourblind with AB blood group.



379 **(b)**
Deletion and duplication occurs in homologous chromosomes usually during meiosis. In deletion, some part of chromosome is lost while in duplication a piece of chromosome is copied next to an identical section, thus, increasing chromosome length.

380 **(b)**
The husband is heterozygous for Rh^+so, it will (Rh rh) and wife is homozygous of Rh^- so, it will have genetic alleles (rh rh) :

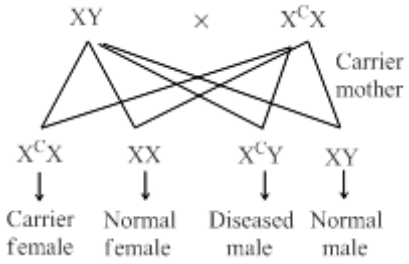
So, 50% homozygous Rh^- children will be born.

381 **(a)**
Mendel could not find out linkage because all of his experimental characters of pea were not linked. They were present far apart from each other

382 **(a)**

Bleeder's disease.

Haemophilia is also called Bleeder's disease. It is a sex linked recessive disorder. It transmit from carrier female to male progeny



383 **(a)**

Complete linkage.

Linkage and Recombination

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He observed that when two genes were grouped on the same chromosome, same genes are highly linked of associated and show low recombination.

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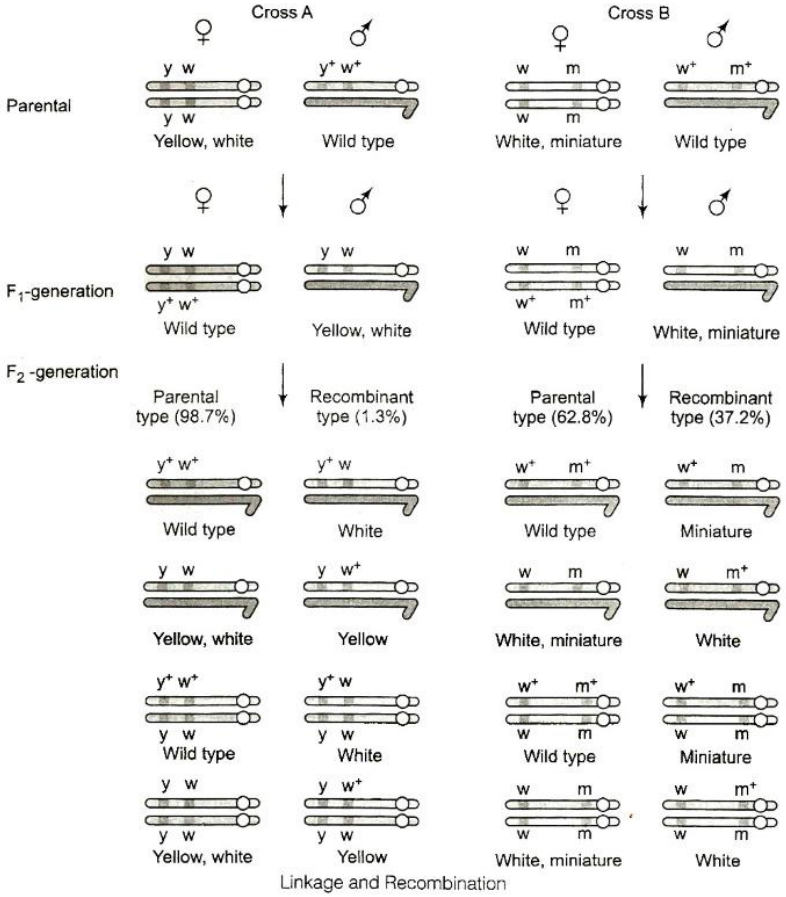


Linkage and Recombination

In the incomplete linkage we get some recombinant progeny but in complete linkage the recombinant progeny percentage is very less as compared to incomplete linkage

384 **(b)**

With regard to transfusions of whole blood or packed red blood cells, individuals with O type negative blood are often called universal donors, and those with type AB positive blood are universal recipients, however, these terms are only generally true with respect to possible reactions of the recipients anti-A and anti-B antibodies to transferred red blood cells.

385 **(c)**
The individuals suffering from Klinefelter's syndrome disease show trisomy of X-chromosomes, *i.e.*, they contain 47 chromosomes in total with 22 autosomes (XXY).

386 **(c)**
Dominant and recessive were expressed or appeared together separately. This shows that there is no mixing of characters means non-blending of character

387 **(a)**
Sex-limited and sex-linked genes are located on autosomes.

388 **(b)**
Types of gametes $= 2^n$

n=Number of heterozygotes considered, i.e., monohybrid cross($n=1$), dihybrid cross ($n=2$), trihybrid cross ($n=3$) and so on. AA BB CC × aa bb cc is a trihybrid cross, therefore, different types of gametes are

$$= 2^n$$

$$= (2)^3$$

$$= 2 \times 2 \times 2 = 8$$

389 **(b)**
The **point mutations** involves alterations in the structure of gene by altering the structure of DNA. Point mutations are of two types- (i) base pair substitution and (ii) frameshift mutation.

390 **(b)**
Type A blood group receive blood A and O type.

391 **(d)**
Pink colour flower is the intermediate character. It is obtained maximum by crossing of homozygous red and white flower
Example (Red) (White)

RR × rr

Rr (pink) – All progeny have pink colour

392 **(a)**
Triticale is the hybrid variety, which is obtain by crossing between wheat and rye.
'*Triti*' is for wheat and 'cale' is for rye together it is called *Triticale*. Its production value is higher than both wheat (*Triticum*) and rye (*Secale*)

393 **(c)**
Mendel found that tallness, round shape of seed, yellow colour of seed, purple colour of flower, green colour of pod,inflated nature of pod and axial position of flower were domianant over dwarfness, wrinkled seed, green colour of seed, white colour of flower, yellow colour of pod , constricted nature of pod and terminal position of flower.

394 **(a)**
Garden pea is the common name for *Pisum sativum* which was the experimental material of Mendel's experiments

395 **(a)**
Mutations can be induced by a number of agents called mutagens.

Physical mutagen- UV rays, X-rays, cosmic rays, high temperature.

Chemical mutagens- 5 bromouracil, proflavin.

396 **(c)**
The observable characteristics of an organism is called phenotype. These are determined by its genes

397 **(b)**
Carrier organism refers to an individual, which carries a recessive gene that is not expressed.

398 **(b)**
$X = 1, 3\ Y = 4$.
Drosophila have 3 pairs of autosome and one pair sex chromosome. Sex determination in *Drosophila* is exactly similar to the human beings, *i.e.*, female is homogenetic and male is heterogametic. In the given diagrams, 'A' belongs to the female *Drosophila* and 'B' belongs to the male *Drosophila*
1 indicates = X-chromosomes in female *Drosophila*
2 indicates = Autosome
3 indicates = X-chromosomes in male *Drosophila*

4 indicates = Y-chromosome in male *Drosophila*

399 **(c)**
In the given case, embryo contains one Barr body and one F-body, which corresponds to XXY related to Klinefelter's syndrome.

400 **(b)**
The chances of fifth child to be albino in previous question would be one in four

401 **(a)**
Genotypes of the parents shall be I^Ai and I^Bi.

402 **(b)**
Aneuploidy is the deletion or addition of few chromosomes from the original genomes.

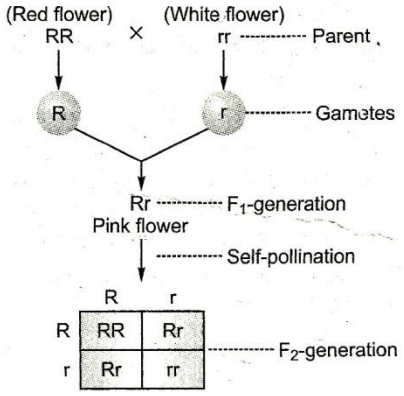
403 **(b)**
Genotypes of C and D are XX^c and XY respectively.

404 **(d)**
Allosomes, heterosomes are the synonymous used for sex chromosomes

405 **(a)**
Cri-du-chat syndrome also known as chromosome 5p deletion syndrome, 5p minus syndrome or Lejeune's syndrome is a rare genetic disorder due to a missing part of chromosome-5. This syndroms is associated with malformation of the larynx.

406 **(a)**
During his experiments, Mendel called factors something unchanged that pass from parent to offspring through the gametes over successive generation

407 **(b)**
In case of incomplete dominance, when pink flowers of F_1-generation, are self-pollinated, they develop red (RR), pink (Rr) and white(rr) flowers in the ratio 1 : 2 : 1, respectively, genotypically as well as phenotypically.



Genotypic ratio—RR : Rr : rr

1 : 2 : 1

Phenotypic ratio—Red : Pink : White

1 : 2 : 1

408 **(d)**
Genome of model organisms

Organism	Number of Bass Pair	Number of Gene
Bacteriophage	10 thousand	-
Escherichia coli	4.7 million	4,000
Saccharomyces	12 million	6,000
cerevisiae		
Caenohabditis	97 million	18,000
elegans		
Drosophila	180 million	13,00
melanogaster		
Human	3 million	30,000
Lily	106 billion	-

409 **(b)**
Albinism is caused by the absence of enzyme **tyrosinase**, which is necessary for the synthesis of melanin.

410 **(c)**
In human beings, ABO blood grouping is an example of dominance, codominance and multiple alleles.

411 **(a)**
In sickle-cell anaemia only one nucleotide substitution takes place from T to A.

Genetic or chromosomal symbol used for person who is having sickle-cell anaemia Ps – Hb^s Hb^s.

Sickle-cell Anaemia

(i) It is an autosome-linked recessive trait

(ii) The disease is controlled by a single pair of allele Hb^s and Hb^s

(iii) Only the homozygous individuals for Hb^s, *i.e.*, Hb^sHb^s show the diseased phenotype

(iv) The heterozygous individuals are carriers (Hb^AHb^S)

(v) Due to point mutation, glutamic acid (Glu) is replaced by valine (Val) at the sixth position of β-globin chain of haemoglobin molecule

(vi) A single base substitution at sixth codon of the beta globulin gene from GAG to GUG. GAG code for glutamic acid and GUG code for valine.

(vii) Hb^S behaves as normal haemoglobin except under the oxygen stress where erythrocytes lose their circular shape and become sickle-shaped. As a result, the cells cannot pass through narrow capillaries. Blood capillaries are clogged and thus, affect blood supply to different organs

412 **(d)**

A cell or an organism having two copies of a single genome (with chromosome number $2x$) is called **diploid.**

413 **(d)**

All the given statements are correct.

Occasionally a single gene product may produce more than one effect. For example starch synthesis in pea seeds is controlled by one gene. It has two allele (B and b). Starch is synthesized effectively by BB and have bigger grains. In contrast bb homozygous have lesser efficiency in starch synthesis and produce smaller grains

In starch synthesis gene following condition to seen

BB – rounded (due to more starch synthesis)

bb – wrinkled (due to less starch synthesis)

Bb – in between rounded of wrinkled size. It produce starch of intermediate quantity between BB to bb homozygous condition. So, it is incomplete dominance.

Therefore, dominance is not an autonomous feature of a gene or the product that it has information for. It depends as much on the gene product and the production of a particular phenotype from this product as it does on the particular phenotype that we choose to examine, in case more than one phenotype is influenced by the same gene

414 **(b)**

When Rh^- mother carries Rh^+ foetus, in the first pregnancy no serious problem occurs because Rh^+ antigen arises in child's blood and the concentration of antibodies produced in mother's blood due to immunization by child's Rh^+ antigen will be rather low.

415 **(a)**

Blood group-A has antigen-A and antibody-b.

416 **(b)**

Chromosomes are of two type, **autosomes** and **sex chromosomes** (allosomes). Y-chromosome is the sex chromosome.

417 **(a)**

Law of Independent Assortment

Mendel also worked with and crossed pea plants that different in two characters/factor.

He crossed between pea plant that has seeds with yellow colour and round shape and other that has seeds of green colour and wrinkled shaped.

Ratio appeared as 9 : 3 : 3 : 1 such ratio appeared for several character that Mendel studied

9/16 = Yellow round 3/16 = Yellow wrinkled

3/16 = Green yellow 1/16 = Green wrinkled

Based on such observation Mendel concluded second law of inheritance called law of independent assortment.

According to this principle or law the two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation and get randomly re-arranged in the offspring producing both parental and new combination of traits.

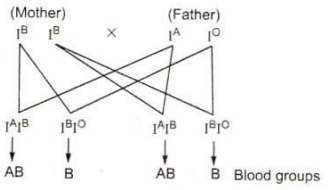
Thus, the phenotypic ratio of a dihybrid cross is 9:3:3:1. The occurrence of four types of plants (more than parental types) in the F_2 generation of dihybrid cross shows that the factors of each of the two characters assort independent of the others as if the other pair of factors are not present. It can also be proved by studying the individual characters of seed colour and seed texture sepraterly.

Seed Colour Yellow (9+3 = 12) : Green (3+1 = 4) or 3 : 1

Seed Texture Round (9+3 = 12) : Wrinkled (3+1 = 4) or 3 : 1

The result of each character similar to monohybrid ratio. Generally, the dihybrid cross used to study the independent assortment of genes

418 **(a)**



Thus, possible groups are :**AB** and **B**.

419 **(a)**

Recessive alleles influence the appearance of the phenotype only when they are in homozygous condition.

Mendel did not find the blending inheritance in F_2-generation of a Mendelian monohybrid cross the tall and dwarf traits were identical to their parental types and doesn't show blending

420 **(c)**

The eggs are produced by meiosis, *i.e.*, reduction division. So, the egg contains one X-chromosome when released from ovary.

421 **(a)**

Variation.

Variation is the degree of difference in the progeny and between the progeny and the parents. The term variation is also used for a single difference in a trait

422 **(c)**

Pleiotropic gene is one which produces or controls more than one effects or characters. In other words, we can say that pleiotropic gene produces a major phenotypic trait and with that also influences some other phenotypic traits, *e.g.*, lethal genes, which are known to control the menifestation of some phenotypic trait alongwith affecting the viability of organism.

423 **(b)**

A-Dizygotic twins are the twins, which results from the fusion of two sperm with two ova. It is very rare in case of human beings.

B-Monozygotic twins are the twins, which results from the fusion of one sperm with one ova leads to zygote. This zygote later on divide and give rise to two or more zygote. In this cells of all progeny have the identical genome

425 **(c)**

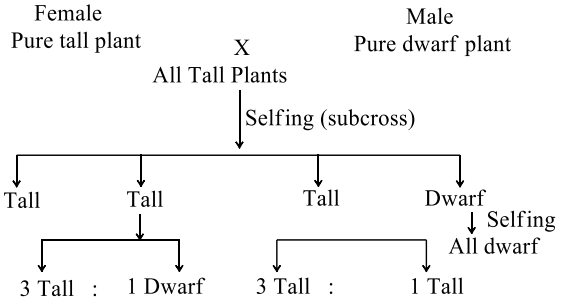
H J Muller was awarded Nobel Prize in 1946 for his discovery of the production of mutations by X-ray irradiation.

426 **(c)**

Law or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

427 **(b)**

It is metaphase

428 **(b)**

When heritable alterations occur in a very small segment of DNA molecule, *i.e.*, a single nucleotide or nucleotide pair then this type of mutations are called **point mutations**.

429 **(a)**

Dihybrid genotype ratio. 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1 total nine types of genotype and four types of phenotype

430 **(b)**

In Morgan's experiment on linkage, the percentage of white eyed, miniature-winged recombinants in F^2generation is 37.2%. It is due to incomplete linkage, where two linked genes are sufficiently apart and the chances of their separation are quite good.

431 **(b)**

Dihybrid cross.

Law of Independent Assortment

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The result of each character similar to monohybrid ratio. Generally, the dihybrid cross used to study the independent assortment of genes

432 **(d)**
Dominant allele shows its effect in homozygous or heterozygous condition and recessive allele shows its effect only in homozygous condition.
Given pedigree chart possible only when the male parent in heterozygous for hyperdactyle. If it is homozygous for hyperdactyle then its son would also be the hyperdactyle as well

433 **(c)**
Mutation happens by itself. It is the spontaneous phenomena

434 **(c)**
The **centromere** lies within a thinner segment of chromosome, the **primary constriction.**

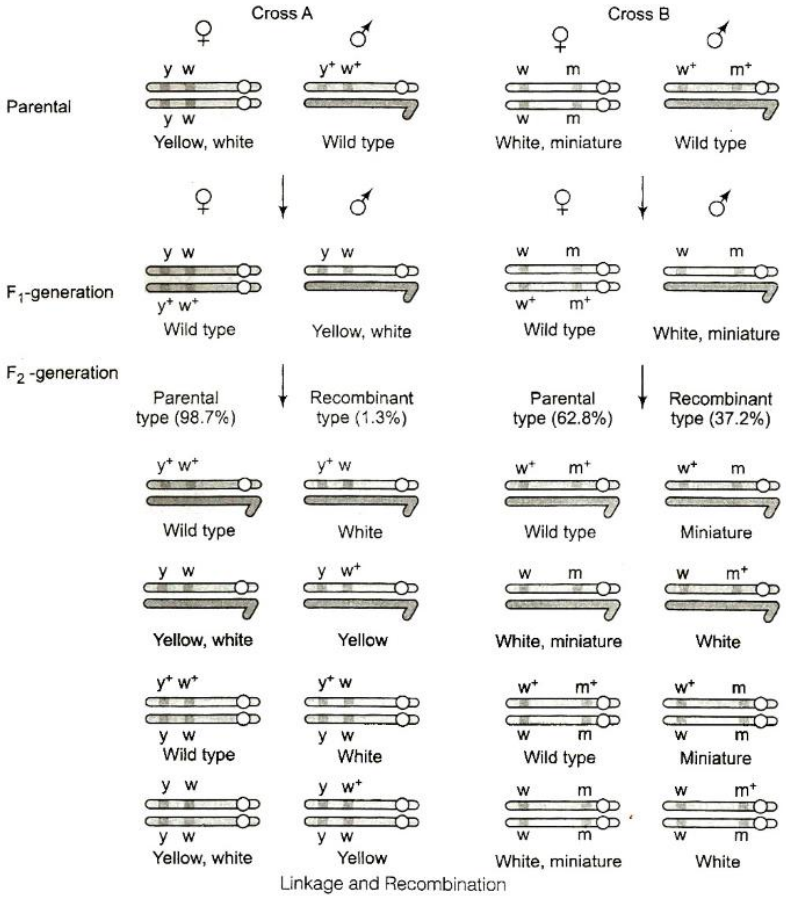
435 **(d)**
Mutations are not acquired. They are selected by the nature. Gametes fuse with regard to which alleles they carry

436 **(c)**
Mendel's knowledge background was mathematics and physics. In Vienna university he studied botany and physics. Later he became the teacher of physics and natural sciences.
Main reasons for Mendel's success were.
(i) Mendel took those traits, which were not linked
(ii) Mendel choose distinctive contrasting pairs
(iii) Mendel took one or two character at a time
(iv) Pea plant is ideal for controlled breeding
(v) Mendel kept complete record of every cross
(vi) Mendel used statistical method and law of probability (vi) Mendel used statistical method and law of probability

437 **(a)**
Insect, grasshopper, cockroaches and bugs have XX and XO type of sex determination in which XO happens to be male and XX happens to be female

438 **(a)**
Linkage and Recombination
Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were sex linked. The crosses were similar to the dihybrid crosses carried out by Mendel in peas.
He observed that when two genes were grouped on the same chromosome, same genes are highly linked of associated and show low recombination.
When the genes are clearly present linked they show higher recombination.
Morgan attributed this due to the physical association or linkage of the two genes and coined the term linkage to describe this physical association of genes on a chromosome and the term recombination to describe the generation of non-parental gene combinations.
His student Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome.

Morgan hybridized yellow bodied and white eyed females with brown bodied and red eyed male (wild type) (cross-A) and inter-crossed their F_1-progeny



439 **(c)**

In Mendel's dihybrid cross out of 16 progenies, 6 are recombinants so in case of 1280 progenies, the recombinants are

$= \frac{1280 \times 6}{16} = 480$ progenies.

440 **(b)**

A child of blood group-O cannot have parents of AB and O blood groups.

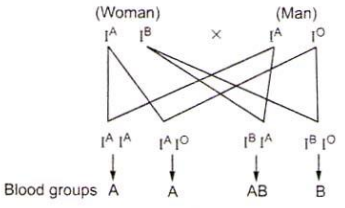
441 **(d)**

Rh factor was discovered by Landsteiner and Wiener (1940) in Rhesus monkey (*Macaca rhesus*). It is found in man and rhesus monkey only. Erythroblastosis foetails occurs when the mother is Rh^-, father is Rh^+ and foetus is Rh^+.

442 **(d)**

Monosomics $(2n-1)$ one chromosome less then diploid set of somatic chromosome number.

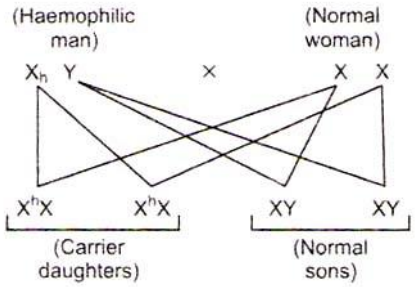
443 **(b)**



In this case, progeny with blood group-B is produced only when man is heterozygous, *i.e.*,I^AI^O.

444 **(d)**

The children of a haemophilic man and normal woman will be all normal. Neither sons nor daughters (only carrier) will be haemophilic



445 **(c)**
A set of three alleles present on chromosome number 9 is responsible for the four blood groups.

446 **(d)**
The gene for colour blindness is present on X-chromosome. If one X-chromosome of female have gene for colour blindness, this will be carrier (normal) but if a male have gene on X-chromosome it will be colourblind (since only one X-chromosome is present in male).

447 **(b)**
Cri-du–chat syndrome is caused by a conspiuous deletion in the short arm of 5th chromosome. These individuals asre severly impaired and their cat-like crying give the syndrome its name.

448 **(c)**
Inversion invoves a reverse order of genes in part of chromosome. ABCDEFGH has been shown in figure, where breaks occur between A and E. Reunion at broken ends may leads to inversion of the segment BCD into DCB. Indeletion, a section of chromosome is lost.

450 **(c)**
Ischihara chart is used to detect colour blindness.

451 **(b)**
The gene, which produces more than one phenotypic effect in an organism is called pleiotropic gene. It produces a major phenotypic traits and along with influences some other phenotypic traits, *e.g.* , sickle cell anaemia in man.

452 **(a)**
Persons with blood group-AB are called universal recipients because both antigens A and B are found in their blood and the two antibodies 'a' and 'b' are absent. Therefore, such persons can receive blood of all the blood groups.

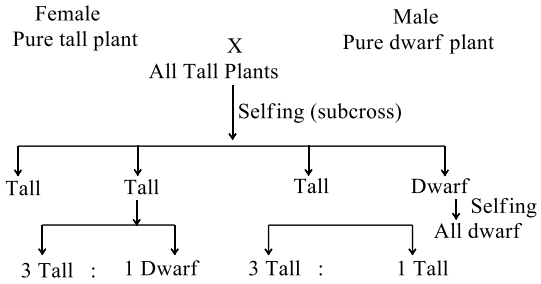
453 **(b)**
Genes in the non-homologous region of Y-chromosome pass directly from male to male. In man, the Y-linked or holandric genes such as ichthyosis, hystrix, gravis hypertrichosis (excessive development of hairs on pinna of ear) are transmitted directly from father to son.

454 **(b)**
3:1 ratio in F_2-generation explained by law of dominance Principle of law of dominance state that only dominant allele shows its effect evan in the heterozygous condition.

Law or Principle of Dominance

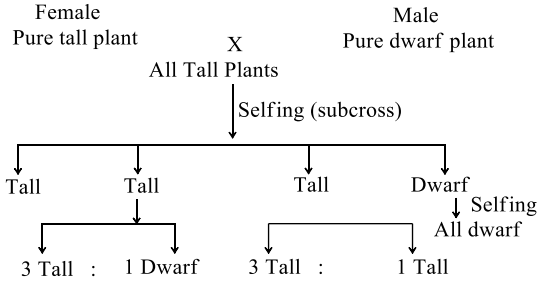
In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



This three generations of pea plants after crossing a pure tall plant with a dwarf one. The plants of F_1-generation are all tall, of F_2-generation three tall and one dwarf. One third of the tall plants are pure, while the remaining behave as hybrids

F_1-generation Seeds collected from the parental generation called first filial generation or F_1-generation

F_2-generation F_1-plants pollinated among them self (self breeding or inbreeding) and seed produced by F_1-plants called F_2-generation. They were in ratio 3:1 (three tall and one dwarf).

F_3-generation Mendel allowed F_2-plant to form seed by self-pollination called F_3-generation. Mendel observed that tall and dwarf plant behave differently

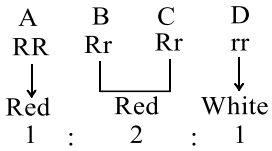
(i) Dwarf plant produced dwarf plant on self-pollinated

(ii) In tall plants one third plants breed true so they were pure

(iii) Other two third plant behave like parents and give tall to dwarf plants 3 : 1 indicate that their parents have dwarf genes also

455 **(a)**

Rr and red because the R is dominant r so, the F_1-hybrid will be red



456 **(b)**

In dominant epistasis, a dominant gene(epistatic) masks the expression of another dominant or recessive gene (hypostatic). Such interactions give the modified F_2 ratio as 12 : 3 : 1.

457 **(c)**

Studies of human sex-linked trait shows that males are affected and females are carrier in most casese.

The recessive genes located on X-chromosome in humans are always expressed in male because human male is **hemizygous**. It is the condition in which even recessive genes get expressed when it is present on one chromosome because the another copy of chromosome have very less genes

458 **(b)**

A cross between homozygous recessive and hetrozygous plant is called test cross. It gives 1 : 1 ratio in monohybrid and 1 : 1 : 1 : 1 ratio in dihybride cross.

459 **(c)**

The experimental material garden pea used by Mendel is a self-fertilised crop and artificial pollination

460 **(c)**

W Bateson (1905) explained the lack of independent assortment in sweet pea and **T H Morgan** (1905) in *Drosophila* due to linkage.

461 **(b)**

Buffs and Kips are not the types of blood groups or blood factor.

462 **(c)**

Environment can also influence the result of same genotype. Like, human skin colour. This is the example of incomplete dominance

463 **(c)**

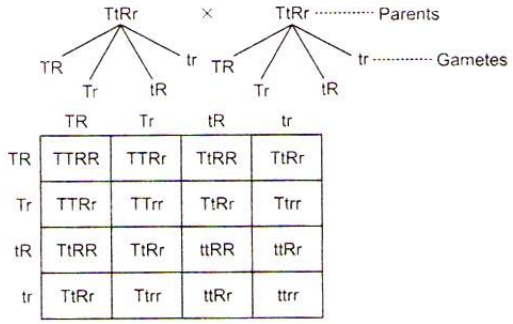
In ABO blood group system, inheritance of grouping is controlled by a single autosomal gene on chromosomal-9 with three major alleles A, B, an O $(I^A, I^B$ and $I^O)$. The ABO blood group system has at least 6 alleles. On the basis of presence or absence of antigens and antibodies four blood groups (phenotypes) have been differentiated-A, B, AB and O blood groups. The phenotype, genotype, antigen and antibody of blood group ABO.

Phenotype	Genotype	Antigen	Antibody
A	I^AI^O, I^AI^A	A	b
B	I^BI^O, I^BI^B	B	a
AB	I^AI^B	A, B	None
O	I^OI^O	None	a, b

464 **(a)**

The probability of genotype TTrr in F_2generation of a dihybrid cross is $\frac{1}{16}$.

465 **(d)**



So, the number of genotypes of TtRr = 4

and TtRR = 2

466 **(d)**

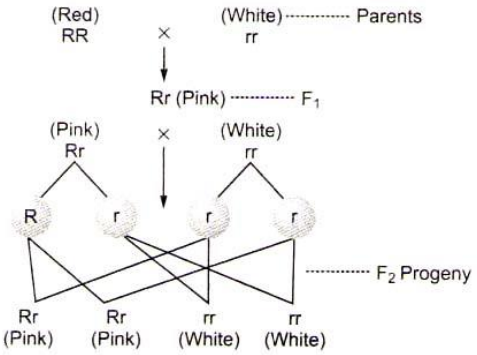
Blood group-O does not contain any antigen. Thus, ii does not produce any sugar polymer on the surface of the RBC.

467 **(a)**

Idiogram is the diagrammatic representation of the chromosomes of an individual.

468 **(b)**

Mirabilis jalapa shows incomplete dominance.



The ratio pink and white flowers will be 1 : 1.

469 **(b)**

The marriage between normal visioned man and colourblind woman will produce colourblind sons and carrier daughters.

470 **(d)**

In this pedigree chart of a family with five children, the parents are heterozygous.

471 **(d)**

Correct statements are

(i) Myotonic dystrophy is an autosomal dominant trait

(ii) Sickle-cell anaemia is autosomal recessive disease

(iii) Failure segregation result in chromosomal loss and gain. One daughter cell get one extrachromosome and other gets one less chromosome

(iv) Cystic fibrosis is Mendelian disorder

472 **(c)**

Haemophilia is X-linked recessive mutation thus, commonly seen in human males than in females.

473 **(c)**

Mendel 's work was rediscovered independently by three scientists, *i.e.*, **de Vries**(Dutch). **Carl Correns**(German) and **Tschermak**(Austrian).

474 **(a)**

$\frac{1}{4}:\frac{1}{2}:\frac{1}{4}$ ratio of TT, Tt, tt can be depicted mathematically binomial expression as $= (ax + by)^2$.

Monohybrid cross can be denoted as 1 : 2 : 1 (genetic) and the expression of binomial is also 1 : 2 : 1 so monohybrid cross can be represented in any of the given option (a or b or c) because their results are same

476 **(c)**

In the case of Klinefelter's syndrome, the male possesses a Barr body, while in the case of Turner's syndrome, the Barr body is absent.

477 **(c)**

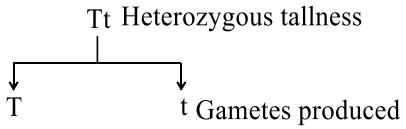
When a dominant gene and other recessive gene are present on opposite chromosomes of homologous pair, the heterozygotes are called as ***trans*** heterozygotes.

478 **(d)**

The superiority of the hybrids over either of the parents (dominant or recessive) is called hybrid vigour (G. Shull).Heterosis is equivalent of hybrid vigour.

479 **(b)**

As heterozygous alleles have two different types of chromosomes, *so they produce two types of genes*



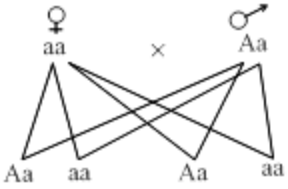
480 **(b)**

Prokaryotic nucleoid consists of DNA only; no histones associated with it.

481 **(a)**

In acrocentric chromosomes, centromere appears sub-terminal, *i.e.*, with a very small and a very long arm.

482 **(a)**



The pedigree given in question is the most probable autosomal disease

483 **(b)**

Sickle cell anaemia is caused by a change in a single base pair of DNA. It is a genetic disease reported from Negroes. In sickle cell haemoglobin the glutamic acid in β −chain is replaced by valine. The individuals of sickle cell anaemia are immune to malaria.

484 **(b)**
Directional selection operates on the range of phenotypes existing within the population and exerts selection pressure, which moves the mean phenotype towards one phenotypic extreme.

485 **(a)**
A-Homozygous; B-Heterozygous

486 **(d)**
The basic chromosome number of wheat is 7(x=7) and its hexaploid species contain 42(6× 7) chromosomes. Thus, it's monosomic (one chromosomes missing) contains **41**(42-1) chromosomes. Haploid contains **21** (half to the 42) chromosomes. Nullisomic (one chromosome pair missing) contains **40**(42-2) chromosomes and trisomic contain (one chromosome extra) **43**(42+1) chromosomes.

487 **(b)**
In the incomplete linkage we get some recombinant progeny but in complete linkage the recombinant progeny percentage is very less as compared to incomplete linkage

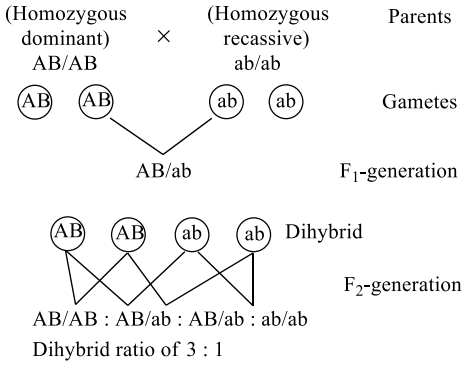
488 **(a)**
Phenylalanine hydroxylase.
Phenylketonuria (Folling; 1934). It is an inborn, autosomal, recessive metabolic disorder in which the homozygous recessive individual lacks the enzyme **phenylalanine hydroxylase** needed to change phenylalanine (amino acid) to tyrosine (amino acid) in liver. It results in hyperphenylalanine

489 **(d)**
Monohybrid cross can be denoted as 1 : 2 : 1 (genetic) and the expression of binomial is also 1 : 2 : 1 so monohybrid cross can be represented in any of the given option (a or b or c) because their results are same

490 **(d)**
Telomeres have unique structures, including short nucleotide sequences present as tandemly repeated units. Clusters of G residues in one strand and C residues in the other characterise telomeric DNA. Also, in some species the telomeres terminate with a single-stranded DNA (12-16 nucleotides long) rich in guanine.

491 **(d)**
Heterozygous Round Yellow has genotype RrYy. On selfing, Round Green offsprings produced and are represented by RRyy and Rryy, genotypes only (R=Round; yy=Green).

492 **(d)**
Dihybrid linked gene cross (3 : 1)
Linked Gene The linked genes do not show independent assortment but remain together and are inherited *en*-block producing only parental type of progeny. They give a dihybrid ratio of 3 : 1 and a test cross ratio of 1 : 1
Dihybrid ratio of two linkage genes



493 **(c)**
Law of segregation states that heredity characters in the form of allele separate from each other in the formation of gametes. Half of the gametes carry one allele and the other half carry other allele.

494 **(a)**
Law of purity of gamete states characters recovered in F_2-generation that was hiden F_1.
Principle of Law of Segregation This law is also called the purity of gametes. This law states that the two factors of a character present in individual keep their identity distinct separate at the time of gametogenesis (meiosis) or sporogenesis, factors get randomly distributed to different gametes and then get paired again in different offspring as per the principle of probability. The principal of segregation can be deduced in Punnett square

495 **(a)**
In *Melandrium*, sex is determined by X and Y-chromosomes. X-chromosome is shorter than the Y-chromosome. If Y-chromosome is present, the individual shall be male and if it is absent, it will be female.

496 **(c)**

Mutated genes are mostly recessive, which will affect the new generations.

497 **(a)**
Genes at more than one locus are called as **polygenes**. Variation in these genes in a particular population have a combined effect upon a particular phenotypic character. **Multiple alleles** are the more than two different forms of a gene, present on the same locus.

498 **(a)**
Linkage was first suggested by Sutton and Boveri when they formulated the famous chromosomal theory of inheritance. Betason and Punnett (1906) while on working on sweet pea also noticed that some factors remain together and don't show recombination or segregation

499 **(a)**
X-linked genes are represented twice in female and once in male.

500 **(c)**
Colour blindness is due to a recessive gene carried on the X-chromosome and therefore men are more likely to show the defect although women may be carriers.

501 **(a)**
A-Female B-Meta female C-Male.
Genic Balance Theory of Sex The theory of genic balance given by Calvin Bridges (1926) states that instead of XY-chromosomes sex is determined by the genic balance or ratio between X-chromosomes and autosome genomes
The theory is basically applicable to *Drosophila melanogaster* over, which bridges worked. He found that the genic ratio X IA of 1.0 produces fertile females whether the files have XX + 2A or XXX + 3A chromosome complement. A genic ration (X I A) of 0.5 forms a male fruitfly. This occurs in XY + 2A as well as XO + 2A

Chromosome Complement	X/A Ratio	Sexual Morphology
X X X + 2A	3/2 or 1.5	Metafemale
X X X + 3A	3/3 or 1.0	Female
X X + 2A	2/2 or 1.0	Female
X X + 3A	2/3 or 0.67	Inter sex
X X X +4A	3/4 or 0.75	Inter sex
X O + 2A	1/2 or 0.5	Male
X Y +2A	1/2 or 0.5	Male
X Y +3A	1/3 or 0.33	Metamale

502 **(a)**
The ABO blood group are controlled by I gene, which have three alleles (I^A, I^B, I^O)

503 **(b)**
Mendel studied seven different pair of contrasting characters, on the basis of studies on garden pea (*Pisum sativum*).

Dominant and recessive characters are as follows:

Character	Dominant	Recessive
The length of stem	Tall	Dwarf
The position of flower	Axial	Terminal
The colour of the pod	Green	Yellow
The shape of the pod	Inflated	Constricted
The shape of the seed	Round	Wrinkled
The colour of the seed coat	Coloured	White
The colour of the cotyledon	Yellow	Green

504 **(a)**
When an animal has both the characters of male and female, it is called **intersex.**

505 **(a)**
Mutation that takes place due to single base pair is called point mutation, *e*. *g*., Sickle-cell anaemia

506 **(a)**
Due to hemizygous condition in male the most of recessive sex linked disease seen in males. Generally female are carrier. Occasionally they affected by sex linked disease

507 **(b)**
Law of independent assortment deduced by Mendel by performing dihybrid cross (9:3:3:1). Incomplete dominance was not deduced by Mendel

508 **(a)**
Genetic or chromosomal symbol used for person who is having sickle-cell anaemia Ps – Hb^s Hb^s.
Sickle-cell Anaemia
(i) It is an autosome-linked recessive trait
(ii) The disease is controlled by a single pair of allele Hb^s and Hb^s

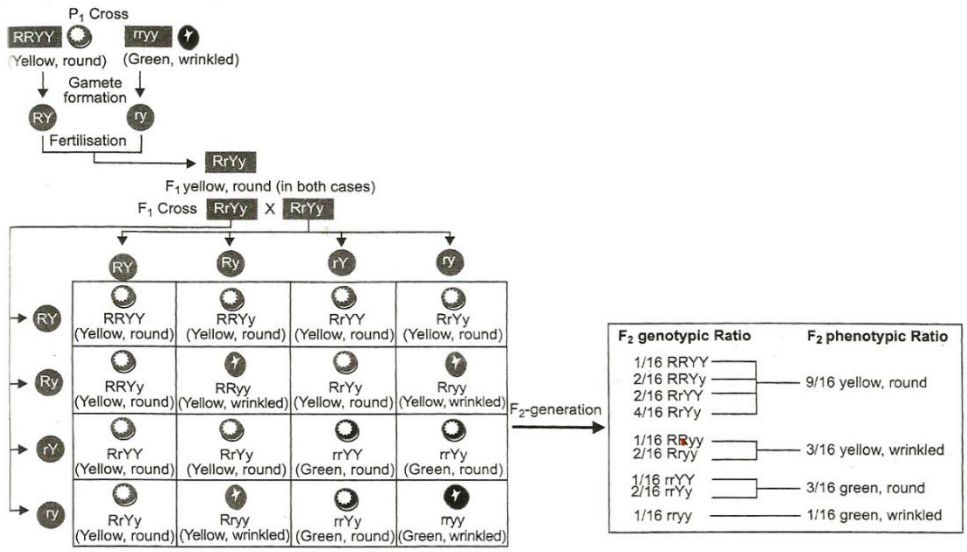
(iii) Only the homozygous individuals for Hb^s, *i.e.*, Hb^sHb^s show the diseased phenotype
(iv) The heterozygous individuals are carriers (Hb^AHb^S)
(v) Due to point mutation, glutamic acid (Glu) is replaced by valine (Val) at the sixth position of β-globin chain of haemoglobin molecule
(vi) A single base substitution at sixth codon of the beta globulin gene from GAG to GUG. GAG code for glutamic acid and GUG code for valine.
(vii) Hb^S behaves as normal haemoglobin except under the oxygen stress where erythrocytes lose their circular shape and become sickle-shaped. As a result, the cells cannot pass through narrow capillaries. Blood capillaries are clogged and thus, affect blood supply to different organs

509 **(d)**
In human most characters are controlled by one gene but some characters like human skin colour is controlled by more than one gene and some characters like ABO blood group and human stairs colour are not inherited according to Mendel inheritance pattern

510 **(b)**
Foetal sex is determined by Barr body test.

511 **(d)**
The sex-linked allele or disease never pass from men to his sons because alleles of sex linked disease present on the sex chromosome-X not Y. This condition is also called hemizygous condition

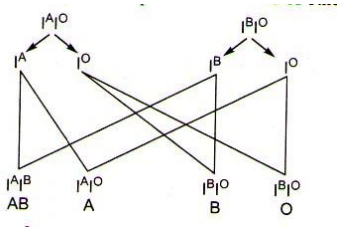
512 **(a)**
1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1



A dihybrid cross in pea plant between yellow round (smooth) seeded and green wrinkled seeded plant. The cross proves the principle of independent assortment

513 **(a)**
The law of segregation of characters is also called the law of purity of gametes because gametes have only one of the two alleles for each character.

514 **(c)**
In men, ABO blood group is best example of multiple allelism. The four children of blood group A, B, AB and O will be born if both the parents are heterozygous for A and B, *i.e.,* the genotype of one parent is I^AI^O and of other is I^BI^O.



515 **(b)**
Linkage and incomplete dominance were the post Mendelian discoveries.
Post Mendelian Discoveries
Gene interaction is the influence of alleles and nonalleles ion the normal phenotypic expression of genes. It is two types, **intragenic** (allelic) and intergenic (nonallelic). In the intragenic

interaction the two allels (present on the same gene locus on the two homologous chromosome) of a gene interact in such a way as to produce a phenotypic expression different from typical dominant-recessive phenotype, *e*. *g*., incomplete dominance, codominance, multiple alleles.
In intergenic or non-allelic interaction, two or more independent gene present on the same or different chromosomes interact to produce different expression, *e*. *g*., epistasis, duplicate genes, complementary genes, supplementary genes, lethal genes, inhibitory genes, etc.

516 **(a)**
Barr body is, infact, an X-chromosome, which has become inactive or heterochromatic. It is present in the nuclei of the cells of females (not males).

517 **(c)**
A man can inherit his X-chromosome from his maternal grandfather only because the X-chromosome of the paternal grandfather goes to sister of his father.

519 **(b)**
Test cross is the cross of an individual with its homolozygous recessive parent. In other words, we can say that it is a specialized back cross of F_1-hybrid with it's homozygous recessive parents in order to determine whether it is homozygous or heterozygous for a character.

520 **(c)**
Organism with more than two sets of chromosomes are known as **polyploids**. These may be triploid ($3n$), tetraploid ($4n$), and so on. Polyploidy may be of three types, *i.e.*, autopolyploidy, allopolyploidy and autoallopolyploidy.

522 **(c)**
L –shaped chromosomes are also called **sub – metacentric chromosomes**.

524 **(a)**
In the given case, the gene for disease is sex-linked dominant.

525 **(c)**
Polygenes show polygenic inheritance or quantitative inheritance. As genes are present on different chromosomes they will segregate independently during meiosis.

Number of individuals in $F_2 = 4^n$

$n =$ number of genes present

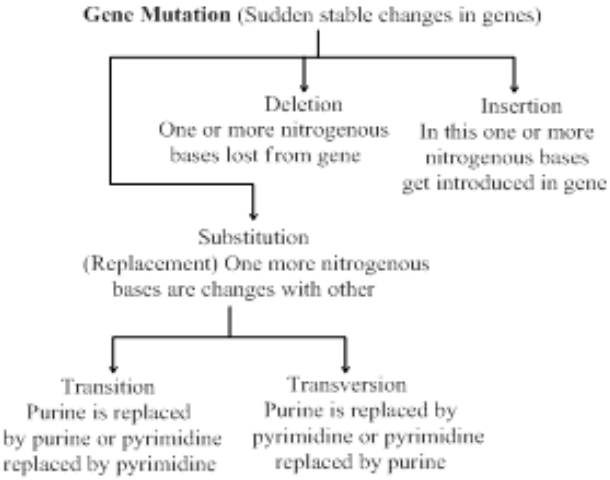
$= 4^3 = 64$ individuals

$1+6+2x+20+6+1=64$

$2x=64-34$

$x = \frac{30}{2} = 15$

526 **(d)**
Chromosomal mutation or change is the sudden inheritable change in the hereditary material of an organism. It caused due to the several ways like deletion, duplication, translocation, inversion, etc.



Main types of Mutation

Loss of Chromosome	Process
Loss of fragment of chromosome	Deletion
Inversion of fragment of chromosome	Inversion
Attachment of segment of one chromosome to another	Translocation
Repetition of a segment in a chromosome	Duplication

Gene Mutation	Process
Replacement of one base or more nucleotide	Substitution
Removal of one base or more nucleotide	Deletion
Addition of one base or more nucleotide	Addition

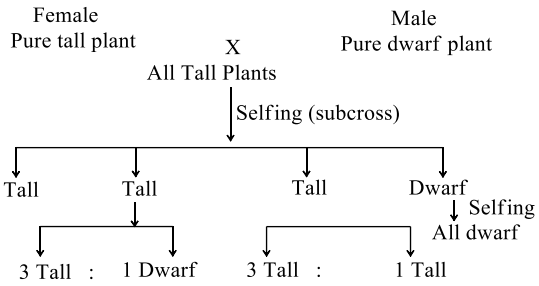
527 **(a)**

Law of dominance.

Law or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

(dominant allele)

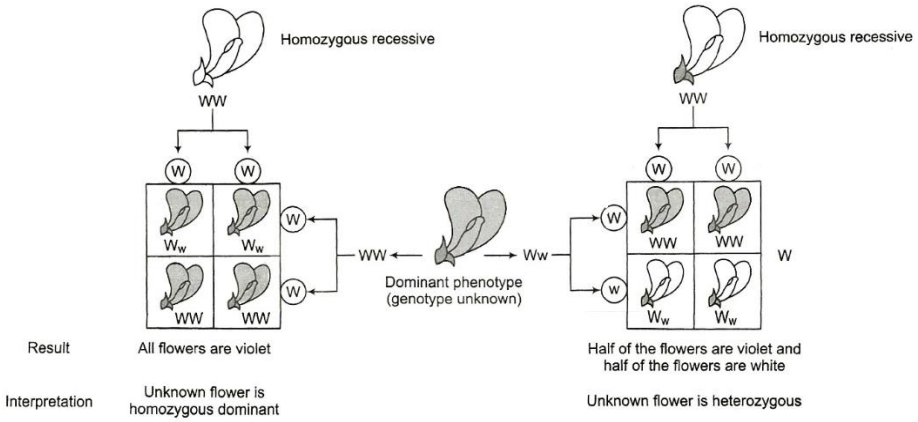
528 **(b)**

In mitosis cell division the chromosomal number remain the same that's way it is called equatorial division. In meiosis cell division the chromosomal number remain the half of the original one that is way it is called reductional division

529 **(c)**

In monohybrid test cross the unknown dominant trait progeny crossed with recessive parent and the ratio between dominant and recessive comes out to be 1 : 1 only if the testing progeny was heterozygous dominant and if it was homozygous than all the progeny would have dominant character.

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



The cross of heterozygous dominant with its recessive parent is called test cross. The test cross gives 1 : 1 ratio in monohybrid condition, whereas 1 : 1 : 1 : 1 in dihybrid condition

530 **(c)**

Genetics word is derived from the Greek word *genesis*, which stands for descent. Term genetics was introduced by Bateson in 1906 branch of Biology that deals with the study of heredity and variations

531 **(d)**

Sickle cell anaemia is a biochemical disorder inherited as a recessive trait. In this disease, the haemoglobin differs in electrophoretic mobility and physiochemical properties from normal haemoglobin.

532 **(d)**

A mutated gene Hb^Sproduces sickle cell haemoglobin, in which the sixth amino acid, *ie*, glutamic acid in β-chain of normal haemoglobin is replaced by amino acid valine causing sickle-shaped haemoglobin.

533 **(c)**

When F_1 hybrids exhibited a mixture on blending of chararcters of two parents, the case is considered as that of incomplete blending inheritance. It simply means that the two genes of allelomorphic pair are not related as dominant or recessive, but each them express itself partially.

534 **(c)**

Pp × Pp

Gemetes	P	P
P	PP	Pp
P	Pp	pp

Progeny 1, 2, 3 have the dominant trait and 4 progeny have recessive trait so the ratio between dominant of recessive progeny is 3 : 1 or percentage of dominant progeny is 75%

535 **(a)**

As homozygous have only one type of alleles, so they produce only one kind of gamete

536 **(b)**

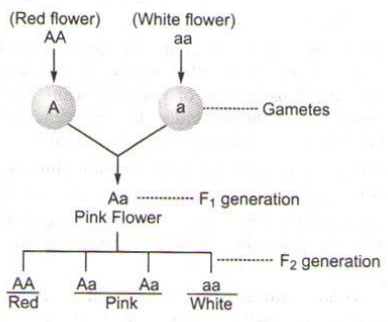
In higher plants, the gametes are formed by the mitotic division of microspores and megaspore. The microspores and megaspore are haploid since these are produced by the meiosis in microspore mother cell and megaspore mother cell respectively. The somatic cell has 40 chromosomes, *i.e.*, $2n = 40$. Then the germ cell also have 40 chromosomes. The germ cells divide by meiosis and produce four haploid (n) gametes therefore, the chromosomes number will be 20.

537 **(b)**

Secondary oocyte is haploid, hence, it possess 22 + X-chromosomes.

538 **(a)**

Incomplete dominance is seen in *Antirrhinum* (snapdragon).



539 **(c)**

Test cross is the cross of F_1 with its recessive parent. It is used to observed that the F_1 is homozygous or heterozygous. It gives 1 : 1 ratio in monohybrid and 1 : 1 : 1 : 1 ratio in dihybrid cross.

540 **(b)**

In human beings, 46 chromosomes are found, in which only one pair takes part in sex determination. These are known as **sex chromosomes** or **allosomes**, rest 22 pairs are known as **autosomes**.

541 **(a)**

Euploidy is a normal state having balanced number of chromosome, that is an exact multiple of the haploid set, *e.g.*, if a haploid number is 5 then euploidy number would be 5, 10, 15, 20, etc.

542 **(a)**

In 1900 the Mendel's law were rediscovered. Mendel died in 1884 long before his work came to recognized. It was in 1900 when three worker independently rediscovered the principles of heredity already worked out by Mendel.
They were Hugo de Vries of Holland, Carl Correns of Germany and Eric Tiron and Tschermark of Austria

543 **(a)**

Sickle cell anaemia, a hereditary disease is an example of **pleiotropy** (ability of a gene to have many effects).

544 **(d)**

The genes which individually have a small effect but collectively produce significant phenotypic expression are called polygenes. The inheritance of these genes is called polygenic inheritance, *e.g.*, skin colour in human.

545 **(a)**

In chromosome, heterochromatin remains condensed in secondary constriction.

546 **(c)**

Inheritance of ABO blood group shows **multiple allelism**.

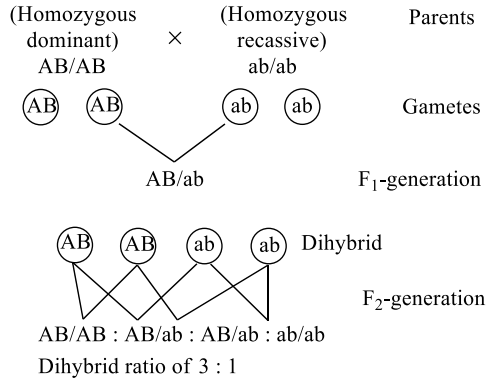
547 **(a)**

Neurospora complete their sexual life cycle in a few days and thus, make ideal organism for the study of laws of heredity. Penicillin, a potent

antibiotic is obtained from *Penicillium notatum* and LSD is obtained from *Claviceps purpurea*.

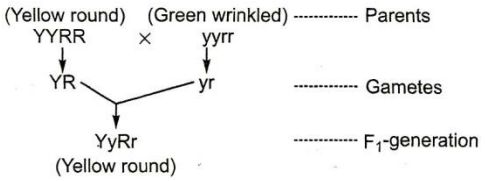
548 **(c)**
Barr body (sex chromatin) is the densely staining mass that represents an inactivated X chromosomes found in nuclei of somatic cells of most female mammals. Number of Barr bodies is one less than the total X-chromosomes, therefore number of Barr bodies in XXXXY $= 4 - 1 = 3$.

549 **(d)**
Linked Gene The linked genes do not show independent assortment but remain together and are inherited *en*-block producing only parental type of progeny. They give a dihybrid ratio of 3 : 1 and a test cross ratio of 1 : 1
Dihybrid ratio of two linkage genes



550 **(c)**
Colchicine is a poisonous chemical, isolated from seeds and bulbs of autumn crocus (*Colchicum autumnale*). It blocks spindle formation and thus, inhibits the movement of sister chromatids to the opposite poles. The resulting restitution nucleus includes all the chromatids. As a result, the chromosome number of the cell is doubled, which leads to polyploidy.

551 **(d)**
Mendel crossed a dominant homozygous yellow, round seeded plant with a recessive homozygous green and wrinkled seeded plant. The F_1-offsprings produced are heterozygous yellow, round seeded plants.



552 **(a)**
Dominant and recessive these two words are commonly used for the describing alleles

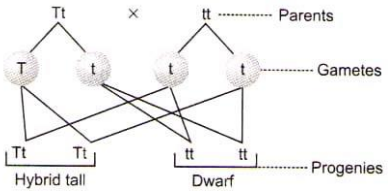
553 **(b)**
Fruit fly (*Drosophila*) is used in genetic experiments. As polytene chromosomes, sex determination and sex linked inheritance have been studied in fruit fly.

554 **(c)**
Phenylketonuria is caused by the absence or deficiency of the enzyme phenylalanine hydroxylase, which results in the accumulation of phenylalanine in all body fluids.

555 **(b)**
Balbiani rings are large RNA puffs reported in the salivary gland chromosomes of *Chironomus* insect during larval development.

556 **(d)**
Inheritance by multiple alleles causes a traits to exhibit more than ywo possible phenotypes.

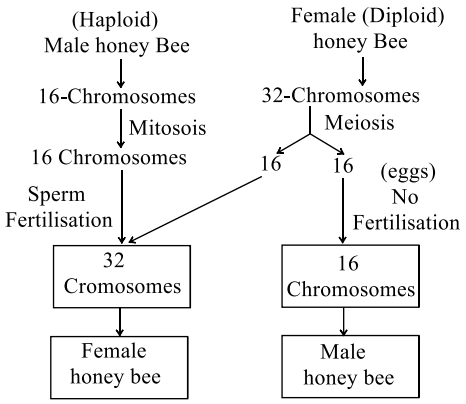
557 **(c)**
Test cross is a cross between homozygous recessive parent and F_1 offsprings. The genotypic ratio as well as phenotypic ratio of such cross is 1 : 1.



Analysis of the given data in question shows almost 1 : 1 (94:89) ratio. Hence, the genotype of the two parents will be Tt and tt.

558 **(a)**
Haploid.
Haploid diploid mechanism of sex determination (haplodiploidy).
Hymenopterous insect such as bees, wasps ants show unique phenomena in which an unfertilized egg develops into male and female develops from fertilized egg.
In honeybee, the quality of food determines whether a diploid larva will become a fertile queen or a sterile worker female. A larva fed on royal jelly a secretion from the mouth of mussing

workers grows into a queen, whereas a larva fed on pollen and nectar grows into a worker bee



559 **(b)**

In monohybrid test cross the unknown dominant trait progeny crossed with recessive parent and the ratio between dominant and recessive comes out to be 1 : 1 only if the testing progeny was heterozygous dominant and if it was homozygous than all the progeny would have dominant character.

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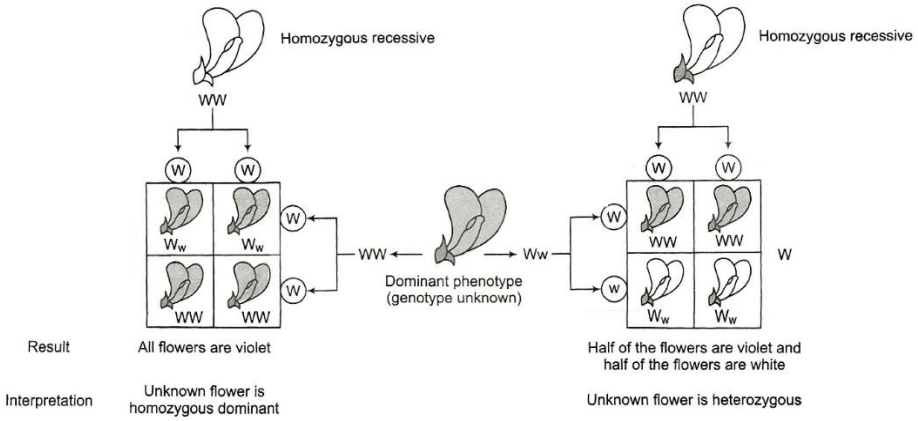
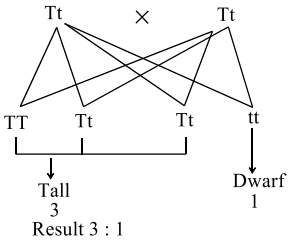


The cross of heterozygous dominant with its recessive parent is called test cross. The test cross gives 1 : 1 ratio in monohybrid condition, whereas 1 : 1 : 1 : 1 in dihybrid condition



560 **(b)**

When mutation is confined to only one substitution, deletion, insertion then this type of mutation is called point mutation. Sickle-cell anaemia is the example of point mutation in which the Glutamic acid (Glu) is replaced by valine (val) at the sixth position of β-globin chain of haemoglobin molecule

561 **(a)**

Mendel used letter symbols to denote factors. He used capital letters for dominant factors and small letters for recessive factor

562 **(d)**

Harmful mutation does not get eliminated from gene pool because mostly harmful mutation are recessive and carried by heterozygous individual

563 **(c)**

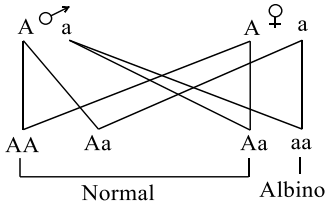
Father's blood group-B and mother's blood group-O will not be able to produce a offspring of blood group-A.

564 **(d)**
A-Sugar, B-I^A I^B, C-Sugar

565 **(a)**
Father of experimental genetics is TH Morgan. He is also called the fly man of genetics because of selecting fruit fly (*Drosophila melanogaster*) as research material in experimental genetics

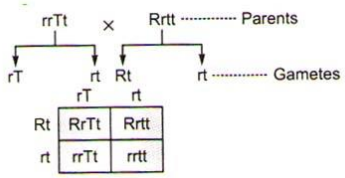
566 **(a)**
Thomas Hunt Morgan (the father of experimental genetics) selected fruitfly (*Drosophila melanogaster*) is also called Jackpot of genetics as experimental material

567 **(d)**
Albino is the recessive trait which comes only when there is homozygous condition. In the given problem the progenies are both albino and normal. This is possible only when their parents are heterozygous for normal colour



568 **(a)**
Linkage genes always arranged linearly on the homologous chromosome called linkage group

569 **(d)**



All the offsprings have different phenotypes.

Therefore, the phenotypic ratio obtained by crossing rrTt and Rrtt is 1 : 1 : 1 : 1.

570 **(d)**
Linked gene does not separate frequently. They remain together because linked gene lie very closely to each other

571 **(b)**
In translocation the segment of the one chromosome get attached to the other chromosome. Option A indicates inversion. Option '*b*' indicates translocation. Option '*c*' indicates deletion and option '*d*' indicates duplication

572 **(d)**
Experimental verification of the chromosomal theory of inheritance was given by **Thomas Hunt Morgan** and his colleagues. This led to discovering the basis for variation that sexual reproduction produced.

573 **(c)**
A gene is said to be **epistatic**, when its presence suppresses the effect of a gene at another locus. Epistatic genes are sometimes called **inhibiting genes** because of their effect on other genes, which are described as **hypoststic.**

574 **(b)**
Jumping genes or **mobile elements** or **transposons** or **transposable elements** are DNA sequences that are able to move from one site to another. Transposons were discovered by **Barbara McClintock**, an American Geneticist, in a corn plant.

575 **(b)**
Originally, Mendel proposed two laws, **firstly law of segregation** and then law of independent assortment. Mendel coined the term dominant for any trait that express itself when present with the factors for the contrasting trait, and used the word recessive for any trait that is not expressed when present alongwith contrasting dominant trait in the hybrid.

576 **(b)**
Based on the ratio of F_2 and F_3 generation, Mendel proposed that something was being stably passed down F_1 and F_2-generation) unchanged, from parent to offspring through the gametes, over successive generations.
He called these things as factors. Now we call them genes. Genes therefore, are the units of inheritance required to express a particular trait

577 **(d)**
Finalization of sex at the time of fertilization is known as sex determination. All sex linked character show criss-cross inheritance and firstly it was studied and discovered by TH Morgan (1910). *Sex related trait may be divided into three types*
(i) **Sex Linked Traits** They are those traits the determining genes of which are found on the sex chromosomes. All the sex-linked traits present on a sex chromosome are inherited together

(ii) **Sex Limited Traits** They are autosomal traits which are expressed in a particular sex in response to sex hormones although their genes also occur in the other sex, *e.g.,* milk secretion in mammalian females, pattern baldness in males. The gene for baldness behaves as an autosomal dominant in males and autosomal recessive in females

(iii) **Sex Influenced Traits** The traits are not due to particular genes but are by products of sex hormones, *e.g.*, low pitched voice, beard moustaches. In males, pattern baldness is related to both autosomal genes as well as excessive secretion of testosterone

578 **(c)**

Variation is the degree of difference in the progeny and between the progeny and the parents. The term variation is also used for a single difference in a trait

579 **(b)**

The more maternal influence can be expected in the cytoplasmic inheritances (*i.e.*, the inheritance of genes contained in the cytoplasm of a cell, rather than the nucleus). The reason is that of the female reproductive cell or the egg has large amount of cytoplasm containing many organelles which contain their own genes and can reproduce independently (*e.g.*, mitochondria and chloroplast) and which are consequently incorporated into the cytoplasm of all the cells of the embryo. The male reproductive cell (sperm and pollen) consists almost solely of a nucleus. Cytoplasmic organelles are thus, not inherited from the male parent. This is why, the cytoplasmic inheritance is also called **maternal inheritance**.

580 **(d)**

Mutagen may be physical or chemical agents, which causes change in DNA sequence. Like UV-radiation acridne dye, etc

581 **(c)**

Linkage process was fully explained as a theory by **T H Morgan** (1911).

582 **(b)**

Blood group-AB has antigen A and B on RBCs but no antibodies in plasma. The alleles A and B are codominant.

583 **(c)**

A polyploid having two or more distinct genome usually produced by chromosome doubling of interspecific hybrids is called **allopolyploid** or **interspecific polyploid**.

584 **(d)**

Chromosomal theory of inheritance was proposed by Walter Sutton and T. Boveri in 1902. Sutton and Boveri made a correlation between Mendel's conclusion about genes and the behaviour of chromosome during mitosis and meiosis.

Polygenes show quantitative inheritance. Nilsson Ehle (1909) explained it in Kernel colour of wheat and Davenport (1910) for skin colour in humans.

585 **(a)**

Early agriculturists (8000-1000 BC) knew that cause of variation hidden in the process of sexual reproduction. However, our ancestors had no idea about the scientific basis of inheritance and variation

586 **(a)**

Punnett square was developed by British geneticist Reginald C. Punnett. It is graphical representation, to calculate the probability of all possible genotypes of offspring in genetic cross

587 **(d)**

ZW **and** ZZ **Type of Sex Determination** This mechanism operates in certain insects (butterflies and moths) and in vertebrates (fishes, reptiles and birds). The male has two homomorphic sex chromosomes (ZZ) and is homogametic and the female has two heteromorphic sex chromosomes (ZW) and is heterogametic. There are thus two types of eggs with Z and with W and only one type of sperms. *i.e.*, each with Z

	A + Z	A + W
A + Z	AA + ZZ	AA + ZW
A + Z	AA + ZZ	AA + ZW
	Males	Females

WZ-ZZ types of sex determination

588 **(a)**

Turner's syndrome is due to monosomy$(2n-1)$ and the chromosome constituent is 44 + XO=45. The individual is female with under developed ovary, webbed neck. Kinefelter's syndrome is due to condition of 44+XXY=47.

The sex is male but have secondary sexual characters like female. Down's syndrome is due to trisomy of 21st chromosome.

589 **(d)**

According to Mendel' law of **independent assortment** two factors of each trait separate at random and independent of the factors of other traits at the time of meiosis (gametogenesis/sporogenesis) and get randomly as well as independently arranged in the offsprings.

590 **(c)**

A-Pair, B-Homozygous

591 **(d)**

Inversion : A piece of chromosomes is removed and rejoined in reverse orientation. It can be of two types:

7. **Pericentric Inversion** : The inverted segment does not contains centromere.

8. **Paracentric Inversion** : The inverted segment contains centromere.

592 **(c)**

Morgan and Castle.

It was TH Morgan who clearly proved and define linkage on the basis of the breeding experiments in fruitfly. In 1911, Morgan and Castle proposed 'chromosomal' theory of linkage'

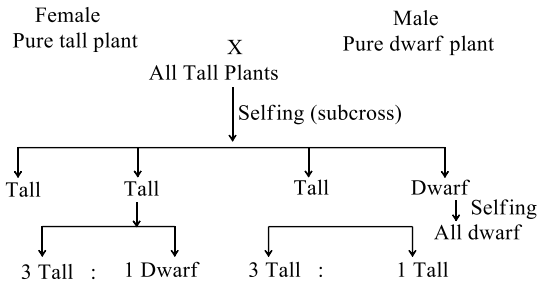
593 **(a)**

Dominant factor.

Law or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

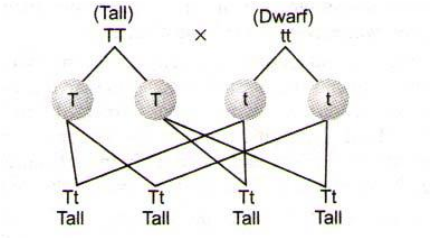
594 **(b)**

Human have 46 chromosomes out of which 22 pairs or 44 chromosomes are called **autosomes** and one pair of chromosomes (*i.e.*, XX in female and XY in male) are called **heterosomes** or **sex chromosomes**.

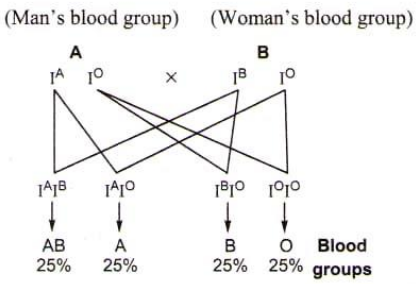
595 **(b)**

A tall plant was grown in nutrient deficient soil and remained dwarf; genetically, this plant has a genetic constitution of tall plant.

So, the cross between such plant and a dwarf plant will resulted into all hybrid tall plants.



596 **(a)**



There is 25% chances of first offspring having blood group-AB.

597 **(c)**

Paired factor or allele only applicable on the organism which are multicellular and diploid. Protista and Monera both are the unicellular

598 **(b)**

The allele which does not show its effect in heterozygous individual is called recessive factor

or recessive allele. It shows its phenotype only in absence of dominant factor or dominant allele

599 **(d)**

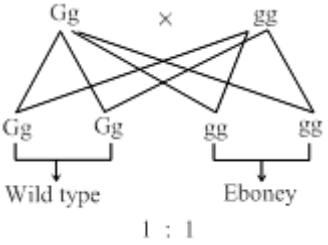
Human skin colour is the example of multiple gene inheritance. Human skin colour contributed by three separate genes. Environment also plays a significant role in determining human skin colour

600 **(c)**

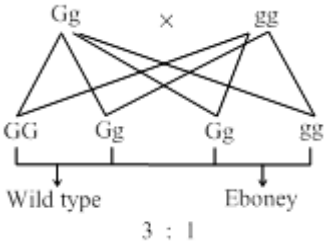
A-Clotting, B-Blood, C-Continuous

601 **(d)**

Condition **I** cross between Gg and gg



Condition **II** Cross between Gg and Gg



So, strain II and strain IV are heterogametic (Gg)

602 **(d)**

When Rh^- individual receive Rh^+ blood, individual becomes **isoimmunized.**

603 **(c)**

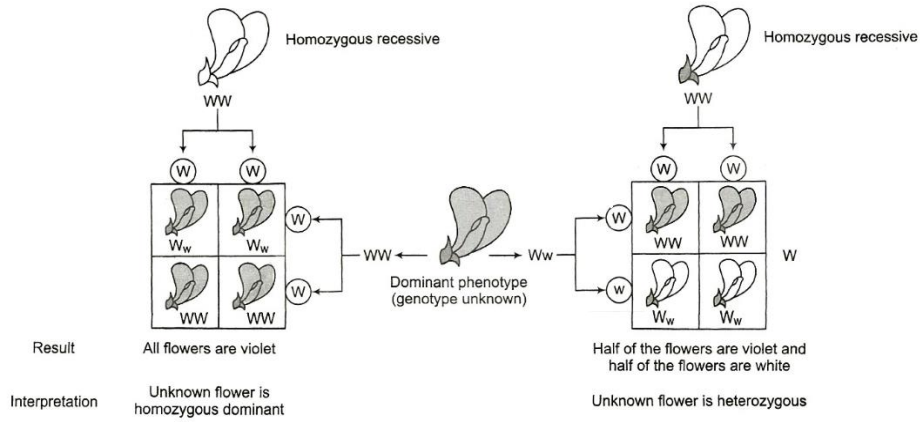
Incase of **transition**, purine base is replaced by another purine (*e.g.*, A by G) and pyrimidine is replaced by another pyrimidine (*e.g.*, C by T) and *vice versa*. In case of transversion, purine is replaced by a pyrimidine and *vice versa*.

604 **(c)**

Recessive characters are expressed when they are present in X-chromosome of male.

605 **(a)**

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



606 **(b)**

3 : 1

Law of Independent Assortment

Mendel also worked with and crossed pea plants that different in two characters/factor.

He crossed between pea plant that has seeds with yellow colour and round shape and other that has seeds of green colour and wrinkled shaped.

Ratio appeared as 9 : 3 : 3 : 1 such ratio appeared for several character that Mendel studied

9/16 = Yellow round 3/16 = Yellow wrinkled

3/16 = Green yellow 1/16 = Green wrinkled

Based on such observation Mendel concluded second law of inheritance called law of independent assortment.

According to this principle or law the two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation and get randomly re-arranged in the offspring producing both parental and new combination of traits.

Thus, the phenotypic ratio of a dihybrid cross is 9 : 3 : 3 : 1. The occurrence of four types of plants (more than parental types) in the F_2 generation of dihybrid cross shows that the factors of each of the two characters assort independent of the others as if the other pair of factors are not present. It can also be proved by studying the individual characters of seed colour and seed texture sepraterly.

Seed colour Yellow (9+3 = 12) : Green (3+1 = 4) or 3 : 1

Seed Texture Round (9+3 = 12) : Wrinkled (3+1 = 4) or 3 : 1

The result of each character similar to monohybrid ratio. Generally, the dihybrid cross used to study the independent assortment of genes

607 **(b)**

Colour blindness is the sex-linked recessive disease in which the defective gene carried by the X-chromosome. So, if a person is colourblind then it is due to the defective gene present in the father and mother

608 **(c)**

When there is a loss of one chromosome from the homologous pair, this is called **monosomy** ($2n$-1) and when there is addition of one chromosome to the homologous pair, this called **trisomy** ($2n$+1).

609 **(b)**

Haemophilia, cystic fibrosis, thalassaemia. Sickle-cell anaemia, colour blindness, phenylketonuria

Genetic disorder may be grouped into two categories

(i) **Mendelian Disorders** These genetic disorder are mainly caused by alternation and mutation in the single gene. They are transmitted to offsprings following the principle of inheritance. Mendelian disorder can be dominant or recessive. *e*. *g*., haemophilia, colour blindness, sickle-cell anaemia, cystic fibrosis, phenylketonuria, thalassaemia.

(ii) **Chromosomal Disorders** Chromosomal disorder are caused due to excess, absence, or abnormal arrangement of one or more chromosome, *e*. *g*., Turner's syndrome, Down's syndrome, etc

610 **(a)**

16th.

Thalassaemia

(i) It is an autosome-linked recessive disesase

(ii) It occurs due to either mutation or deletion resulting in reduced rate of synthesis of one of globin chains of haemoglobin

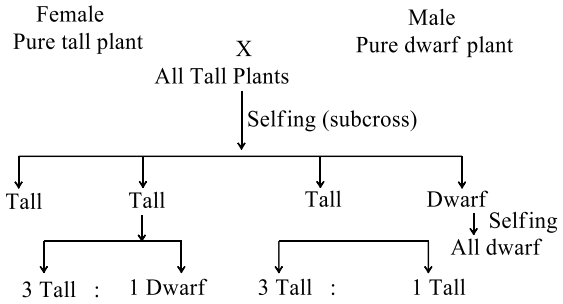
(iii) Anaemia is the characteristic of this disease

(iv) Thalassaemia is classified into two types

9. **α-thalassaemia** Production of α-globin chain is affected. It is controlled by the closely linked genes HBA1 and HBA2 on chromosome 16. It occurs due to mutation or deletion of one or more of the four genes.
10. **β-thalassaemia** Production of β-globin chain is affected. It occurs due to mutation of one or both HBB genes on chromosome 11

611 **(a)**

Mendel cross-pollinated a pure tall pea plant (100-120 cm hight) and a pure dwarf pea plant. (only 22 to 44 cm hight). He called them parental generation, expressed now-a-days by symbol P. This hybridization popularly called as monohybrid cross



This three generations of pea plants after crossing a pure tall plant with a dwarf one. The plants of F_1-generation are all tall, of F_2-generation three tall and one dwarf. One third of the tall plants are pure, while the remaining behave as hybrids

F_1-generation Seeds collected from the parental generation called first filial generation or F_1-generation

F_2-generation F_1-plants pollinated among them self (self breeding or inbreeding) and seed produced by F_1-plants called F_2-generation. They were in ratio 3:1 (three tall and one dwarf).

F_3-generation Mendel allowed F_2-plant to form seed by self-pollination called F_3-generation. Mendel observed that tall and dwarf plant behave differently

(i) Dwarf plant produced dwarf plant on self-pollinated

(ii) In tall plants one third plants breed true so they were pure

(iii) Other two third plant behave like parents and give tall to dwarf plants 3 : 1 indicate that their parents have dwarf genes also

613 **(a)**

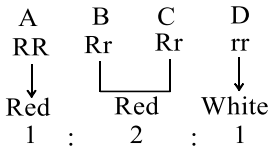
An individual containing both dominant and recessive genes or traits or characters of a allelic pair is known as **heterozygous** or hybrid.

614 **(b)**

A-Less; B-More

615 **(c)**

In the cross of incomplete dominance the genotypic and phenotypic ratio both are same. Rr and red because the R is dominant r so, the F_1-hybrid will be red



616 **(c)**

Thrombin facilitates the formation of the enzyme prothrombinase, which convert prothrombin into thrombin.

617 **(c)**

Mendel chose *Pisum sativum*(garden pea) to explain the laws of inheritance. His selection of garden pea was evidently not an accident, but the result of a long careful thought.

618 **(a)**

Blood groups are inherited from our biological parents in the same way as eye colour and other genetic traits. Within the ABO blood group system, the A and B genes are codominant, *i.e.*, these will be expressed whenever the gene is present. The O gene is silent and only expressed when neither A nor B is present.

619 **(c)**

Determination of sex of each child is an independent and exclusive event so the probability that whether the child will be a boy or a girl is 50% each in every case.

620 **(a)**

According to genotypic ratio of law of independent assortment for dihybrid cross, the RrTt genotype will be found in 100 plants out of 400 plants(as in 16 plants 4 having this type of genotype.

621 **(c)**

Blood group	Antigen on RBC	Antibody in Serum
A	A	Anti-b
B	B	Anti-a
AB	A and B	None
O	–	Anti-a and Anti-b

Hence, blood group-AB has no antibodies in serum.

622 **(b)**

If there are more than one X-chromosome then one X-chromosome remains active, while the other one becomes inactive and condenses to form Barr body. Barr body is a sex chromatin particle. Barr bodies can be used as a sex marker always occur in numbers one less than the total number of X-chromosomes.

623 **(c)**

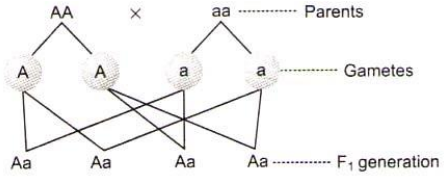
Inversions occur when there are two breaks in a chromosome and the intercalary segment reunites in a reverse order by rotating at 180°.

624 **(a)**

For the given case, there is no chance that the offsprings will have very dark skin.

625 **(c)**

If a cross is made between AA and aa, where **A** is dominant over **a**, then the nature of F_1progeny will be **genotypically Aa** and **phenotypically A**. It means that the genotype of progeny will have both **A** and **a** but it will show the external appearance or character (s) regulated by gene A.



626 **(d)**

In body cells of a normal female, one of the X-chromosome become inactive and form Barr body near the nuclear membrane.

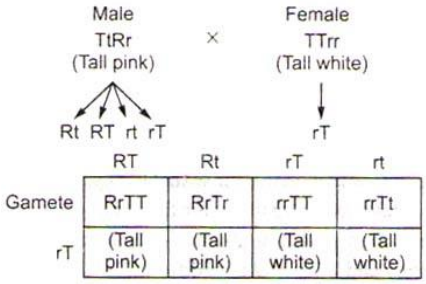
XY genotype has no Barr body.

XX genotype has single Barr body.

XXX genotype have two Barr bodies.

XXXX genotype have three Barr bodies.

627 **(a)**
Offsprings would be tall pink and tall white (genotypic ratio 1 :1)



629 **(c)**
Beadle and **Tatum** conducted experiment on pink bread mould (*Neurospora cressa*)

And stated that each gene has the information to produce one enzyme. This concept was formulated as one gene-one enzyme hypothesis.

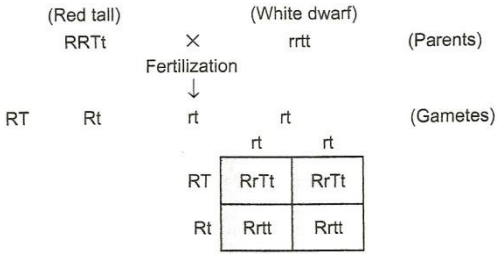
630 **(c)**
During synapsis, deletion and duplication occurs.

631 **(a)**
Aneuploidy is an abnormal number of chromosomes and is a type of chromosome abnormality. The presence of an extra chromosome 21 is found in Down's syndrome.

632 **(c)**
Mendel formulated his generalisation, which were read out at two meetings of Natural History Society of Brunn in 1855. His paper 'Experiments on Plant Hybridisation' was published in proceedings of Brunn Natural Science Society in 1866. Mendel died in 1884 without getting any recognition for his work

633 **(b)**
Red-green colour blindness or colour blindness is a genetic disorder in which eyes fail to distinguish red and green colours.

634 **(c)**



Phenotype of different plants is

11. All plants contain red fruits.
12. 50% plants are tall with red fruits.
13. 50% plants are dwarf with red fruits.

635 **(b)**
The process of gametogenesis or meiosis cell division is shown in the given diagram (in question). Which clearly indicates towards the Mendel's law of independent assortment. Because it says two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation (gametogenesis) and get randomly re-arranged in the offspring producing both parental and new combination of traits

636 **(d)**
Haemophilia or Bleeder's disease is a sex linked (X-linked recessive) disease. Down's syndrome is caused due to trisomy of chromosome 21 *(i.e.*, hyperploidy type of aneuploidy). Phenylketonuria is an autosomal recessive gene disorder.

Sickle cell anaemia in human, is also inherited as an autosomal recessive disorder.

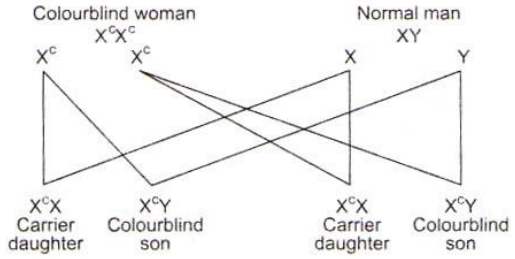
637 **(d)**
Allelic sequence variation has traditionally been described as a DNA polymorphism if more than one variant (allele) at a locus occurs in human population with a high frequency, it is referred to as DNA polymorphism.

638 **(d)**
ZW-ZZ system of sex determination occurs in certain insects and vertebrates such as fishes, reptiles and birds. Here, the female sex has one Z-chromosome and one W-chromosome.

639 **(b)**
Eight types of gametes will be produced.

640 **(d)**

In human colour blindness and haemophilia are X-linked disease.



All the sons are colourblind.

641 **(a)**

Bridges gave genic balance theory of sex determination, which is related to *Drosophila melanogaster*.According to him X-chromosome are carriers of genes for femaleness and autosomes are carriers of genes for maleness, so it is the ratio of X-chromosomes and autosomal sets which determine sex.

642 **(c)**

Turner's syndrome is a chromosomal disorder in which all or a part of one of the sex chromosomes is absent. Turners syndrome, having XO genotype are stelite females with poorly dereloped ovaries and underdeveloped breasts.

643 **(a)**

According to law of independent assortment of Mendel, alleles segregate randomly from each other, *i.e.*, all alleles separate from each other during gamete formation and are inherited independently from one anther. But genes, which are located on the same chromosomes (called linked genes) do not assort independently. Such type of genes are called **linked genes**, and this phenomenon is called as **linkage.**

644 **(b)**

Red and green.

Colour Blindness

(i) It is a sex-linked recessive disorder

(ii) It results in defect in either red or and green cone cells of eye resulting in failure to discriminate between red and green colour

(iii) The gene for colour blindness is present on X-chromosome

(iv) It is observed more in males (X^cY) because of presence of only one X-chromosome as compared to two chromosomes in famales

645 **(c)**

All those, which are located in the single chromosome set constitute a **linkage group**. *E. coli* contains a single linkage group.

646 **(a)**

The genes which have higher COV (Cross Over Value) are placed farthest and genes, which have lowest COV are placed close to each other.

V and U have highest COV = 30

T and V have lowest COV = 5

After gathering the other COV the sequence of genes will be VTWU

647 **(b)**

Heredity.

Heredity (L. *Hereditas* – Heirship or inheritance) is the transmission of genetically based characters from parents to their offspring.

The process by which characters are transferred from one generation to the next generation is called inheritance

648 **(a)**

When the F_2 individuals are crossed with its pure recessive parent, the cross is called test cross. The result of it, is always 1 : 1 in monohybrid cross and 1 : 1 : 1 : 1 in hybrid cross.

649 **(a)**

Main reasons for Mendel's success were.

(i) Mendel took those traits, which were not linked

(ii) Mendel choose distinctive contrasting pairs

(iii) Mendel took one or two character at a time

(iv) Pea plant is ideal for controlled breeding

(v) Mendel kept complete record of every cross

(vi) Mendel used statistical method and law of probability

650 **(b)**

In **codominance**, both the genes of an allelomorphic pair express themselves equally in F_1-hybrids. The ratio in F_2-generation is 1 : 2 : 1, both genotypically as well as phenotypically, *e.g.*, codominance of coat colour in cattle, and codominance of blood alleles in man.

651 **(a)**

Landsteiner recognized three blood groups, *i.e.* ,blood group-A (with antigen-A), blood group-B (with antigen-B) and blood group-O (without antigen).

652 **(d)**
Gamma rays are used to induce mutagenesis in crop plants.

653 **(a)**
Fertilization brings together the chromosomes of two mating types. Crossing over between these during meiosis leads to genetic recombination.

654 **(d)**
Cytoplasmic or mitochondrial inheritance is the inheritance in which the trait pass only from mother to all of their offspring. The genes of that inheritance present in the cytoplasm of ova that's way these genes goes to all of their offspring. As sperm have very less cytoplasm so this inheritance doesn't applicable for males

655 **(d)**
Linked gene don't show any accordance with Mendel's law because Mendel's law can be applied only on unlinked gene

656 **(d)**
Haploids plants can be produced in large number by anther and ovary cultures. Haploids may be useful for isolatio nof mutants, since, even recessive mutant alleles will be expressed in the mutagen treated generation itself.

657 **(d)**
Mendel's work remain unrecognized due to
(i) Communication was not easy
(ii) Concept of factors which did not blend was not accepted
(iii) Using of mathematics to explain biological problem was unacceptable
(iv) He could not provide any physical proof for the existence of factors

658 **(b)**
The cross of heterozygous dominant with its recessive parent is called test cross. The test cross gives 1 : 1 ratio in monohybrid condition, whereas 1 : 1 : 1 : 1 in dihybrid condition.

659 **(a)**
A-Dwarf (F_2), B-F_3, C-F_4, D-Homozygous

660 **(a)**
In first pregnancy, Rh^+blood from the foetus enters the circulation of an Rh^-mother, antibodies against the Rh antigen will be made.

661 **(b)**
Phenylketonuria (chromosomes 12)
(i) It is inborn error of metabolism and is inherited as autosomal recessive trait
(ii) The affected individual lacks an enzyme called phenylalanine hydroxylase that converts the amino acid phenylalanine into tyrosine in liver.
(iii) Phenylalanine is accumulated and gets converted into phenylpyruvic acid and other derivatives. This effects the brain, resulting in mental disorder

662 **(b)**
Four, six.
The phenomenon of expression of both the alleles in heterozygote is called codominance. As the result the phenotype is different from both homozygous genotype.

Examples

14. Blood group is the good example codominance
15. ABO blood groups are controlled by gene I. The gene (l) has three allele I^A, I^B, i, I^A, I^B produce slilghtly different form of sugar while i does not produce any kind of sugar.
16. I^A, I^B are dominant alleles where as i is recessive alleles
17. Since, there are three different allele, there are six different combination of these three alleles are possible and four phenotypes (A, B, AB and O)

Genetic Basis of Blood Groups in Human Population

Allele from Parent 1	Allele from Parent 2	Genotype of Offspring	Blood Types of Offspring
I^A	I^A	I^AI^A	A
I^A	I^B	I^AI^B	AB
I^A	i	I^Ai	A
I^B	I^A	I^AI^B	AB
I^B	I^B	I^BI^B	B
I^B	i	I^Bi	B
i	i	ii	O

When I^A and I^B are present together they both express their own types of sugars this is because of co-dominance. ABO blood grouping also provides a good example of multiple alleles.

Here, you can see that there are more than two, *i.e.,* three alleles governing the same character. Since, in an individual only two alleles can be

present multiple alleles can be found only when population studies care made. Dominance is not an autonomous features of a gene. It depends on much on the gene product

663 **(c)**

W Bateson (1905) explained the lack of independent assortment in sweet pea and **T H Morgan** (1910) in *Drosophila* due to linkage. When genes closely present adhere or link together in a group and transmitted as a single unit, the phenomenon is called linkage. It stops the process of independent assortment. Incomplete linkage is broken down due to the crossing over.

664 **(b)**

Mendel was successful in discovering the principles of inheritance as he did not encounter linkage between genes for the characters he considered. One of his principles-independent assortment is applicable only if the genes are located on different non-homologous chromosome pairs.

665 **(c)**

The polytene chromosomes radiate as 5 long and 1 short arm from a deeply staining and more or less amorphous structure called **chromocentre**. This chromocentre is formed by the fusion of centromeric region of all the chromosomes and in males, entire Y-chromosomes.

666 **(a)**

Polyploid An organism or its karyotype having more than two genomes called polyploid

Polyploidy is three types

(i) **Autopolyploidy** It is the type of polyploidy in which there is the numerical increase of same genome. *e*. *g*., autotriploid (AAA), autotetraploid (AAAA) *e*. *g*., maize, rice, gram

(ii) **Allopolyploidy** It has developed through hybridization between two species followed by doubling of chromosomes, *e*. *g*., AABB *e*. *g*., wheat, cotton, Nicotiana tobacum. Raphanobrassica and Triticale recently allopolyploids

(iii) **Autoallopolyploidy** It is a type of alloplyploidy in which one genome is in more than diploid state commonly autoallopolyploids are hexaploids (AAAABB) *e*. *g*., *Helianthus tuberosis*

667 **(b)**

Matation is more common when it is present in dominant condition. The reason is that the dominant mutant gene can express in both homozygous and heterozygous conditions.

668 **(d)**

Allelism refers to presence of alternative forms of a gene at a given locus. Alleles or allelomorphs are the two contrasting aspects of the same character present at a locus of homologous pair of chromosomes. Now-a –days, the same aspect in duplicate (TT or tt) of a character is also considered an allele.

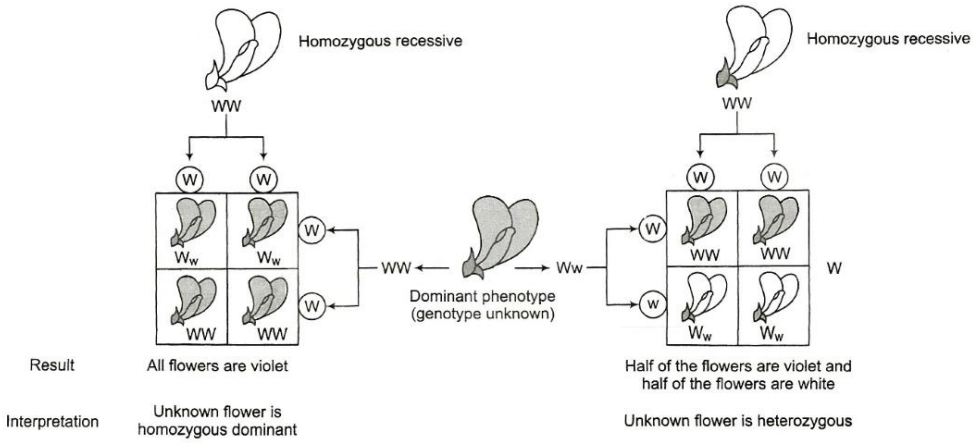
669 **(d)**

Rh factor was first reported by Landsteiner and Winer in rhesus monkey. When Rh^+man marry with Rh^-women the foetus will be Rh^+. This cause the condition called haemolytic disease (erythroblastosis foetalis).

670 **(b)**

Genotype of F_1- plant

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



671 **(a)**

Chang in single base pair may not change in phenotype. The codon is triplet and degenerate.

672 **(c)**

Organisms with more than two sets of chromosomes are known as **polyploids**. It may be triploid with three sets of chromosomes ($3n$) or tetraploid with four sets of chromosomes ($4n$) and so on.

673 **(c)**

Due to absence of phenylalanine hydroxylase the phenylalanine changes in to phenyl pyruvic acid. Lack of this enzyme is due to autosomal recessive defective gene on chromosome number 12

674 **(d)**

All of the given disorders are genetically transferred.

675 **(d)**

Consanguineous mating, is the mating, which happens between the person's own relationship

676 **(d)**

When F_1 hybrid is intermediate between two parents, there is no perfect dominance of one character upon other this phenomenon is called **incomplete dominance** and their inheritance as blending inheritance.

Example : 4 O' clock plant (*Mirabilis jalapa*).

678 **(a)**

After a mutation at a genetic locus, the character of an organism changes due to the change in **protein structure**.

679 **(b)**

Heterogametic.

XY and XY type sex determination seen in many insect and mammals including humans. Males have X and Y chromosome along with autosome and females have pair of 'X' chromosome along with autosome

Parents Phenotypes Male Female

Genotypes 44A + XY 44A + XX

Gametes 22A + X 22A+Y 22A + A22A + X

22A+ X 22A+X

Children 22A + X 44A + XX 44 A + XY Female

22A + Y 44 A + XY 44 A + XY Male

Sex ratio Female : Male = 1 : 1

In plants The flowering plants are mostly bisexual and lack sex chromosomes. The unisexual flowering plants tent to have XX-XY type of sex chromosomal mechanism for sex determination. The female plants are XX and male plants are XY.

XX and XO Type of Sex Determination

Found in insect like grasshopper, cockroaches and bugs. Males have only X sex-chromosome and autosomes, female have pair of X-chromosome and autosome

Parents Phenotypes Male Female

Genotypes $AA + XO$ $AA + XX$

Gametes $A + X, A + O$ $A + X, A + Y$

F_1-generation

	A + X	A + X
A + X	AA + XO	AA + XO
A + O	AA + XO	AA + XO

Genotypes

XX-XO type of sex determination

In most of cases the female produce similar sex chromosome called homomorphic. In most of

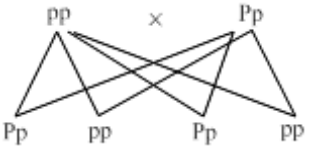
cases the male produce dissimilar sex chromosome called hetermorphic

680 **(a)**
Dihybrid cross is a cross involving two pairs of contrasting characters. A dihybrid test cross gives 1 : 1 : 1 : 1 ratio indicating that when F_1 hybrid is crossed with recessive parent the two pairs of factors segregate and assorting independently and produce four type of progenies.

682 **(d)**
In 1900 three workers independently rediscovered the principles of heredity already worked out by Mendel.
These workers were
(i) Hugo de Vries (Holland)
(ii) Carl Correns (Germany)
(iii) Erich von Tschermak (Austria)

683 **(d)**
The salivary gland chromosomes in the dipteran larvae have endoreduplicated chromosomes, which are useful in gene mapping.

684 **(b)**
Percentage of recessive phenotype = 50% (pp)
percentage of dominant phenotype = 50% (Pp and PP)



685 **(c)**
A gene consist of a polynucleotide sequence that encodes a functional polypeptide or RNA sequence

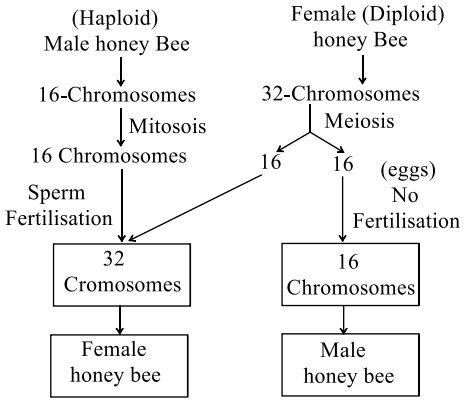
686 **(b)**
Test cross of dihybrid YyRr with double recessive yyrr gives four types of progeny 1 : 1 : 1 : 1 ratio due to presence of genes on separate chromosomes (unlinked genes)

687 **(d)**
In sickle-cell anaemia acidic amino acid (glutamic acid) is replaced by neutral amino acid (valine). It is caused because GUG (codes for glutamic acid) or placed by GAG (codes for valine)

688 **(d)**
The basic (x) numbers of chromosome of hexaploid wheat is 7 and haploid (n) number is 21.

689 **(b)**
Persons who are colourblind cannot distinguish red and green colour. Colour due to absence of cone cells.

690 **(d)**
Haploid diploid mechanism of sex determination (haplodiploidy).
Hymenopterous insect such as bees, wasps ants show unique phenomena in which an unfertilized egg develops into male and female develops from fertilized egg.
In honeybee, the quality of food determines whether a diploid larva will become a fertile queen or a sterile worker female. A larva fed on royal jelly a secretion from the mouth of mussing workers grows into a queen, whereas a larva fed on pollen and nectar grows into a worker bee



691 **(a)**
A-Point; B-β-chain

692 **(d)**
Sickle cell anaemia is a genetic disorder reported from nigroes due to a molecular mutation of gene Hb^A on chromosome 11 (autosome), which produces the β-chain of haemoglobin. In sickle cell anaemia, the sixth amino acid of haemoglobin (*i.e.*, glutamic acid) is replaced by valine.

693 **(a)**
In crossing between pure (homozygous) organisms for two contrasting characters, only one character of the pair appears in F_1 generation (hybrid), which is called **dominant**, while the other, which does not appear is called **recessive**.

694 **(a)**
Muller first gane the proof of mutagenic action of X-rays.

695 **(a)**

The diploid condition in which the alleles at a given locus are identical is called homozygous or pulls. In homozygous condition, organism have two similar genes or alleles for a particular character in homologous pair of chromosomes, *e*. *g*., TT or tt.

Organisms containing two different alleles or individual containing both dominant and recessive genes of an allele pair, *e*. *g*., Tt is known as heterozygous or hybrid

696 **(b)**

The tips of chromosomes are called **telomeres**. These show difference in structure and composition from rest of the chromosomes. Telomere has a unique property as it prevents the ends of chromosomes from sticking together alongwith it facilates attachment of chromosomes with nuclear envelope. Telomeres contain heterochromatin or repetitives DNA and bounded by specialized proteins.

697 **(b)**

Polytene chromosomes was reported by **Balbiani** (1881) from cells of salivary glands of insect larvae. Polytene chromosomes contain several dark stained regions called **bands** separated by lighter or less stained area called **interbands**. These dark bands are heterochromatin (genetically insert) area.

698 **(c)**

During meiosis or gametogenesis each chromosome/gene in allele has equal (50%) chances for separation. That is also called law of segregation

699 **(d)**

Pleiotropic gene (Gr. $Pleion = more$) is the gene having the ability to show multiple effects. In*Drosophila*, a gene for white eye mutation is also responsible for depigmentation of body parts thus a gene controlling more than one phenotype is called as pleiotropic gene.

700 **(a)**

Hypertrichosis is the excessive growth of hair on body. It is an example of **holandric inheritance**. Genes responable for this are located on Y chromosomes only which are also known as holandric genes. Y-linked holandric genes are transmitted directly from father to son.

701 **(a)**

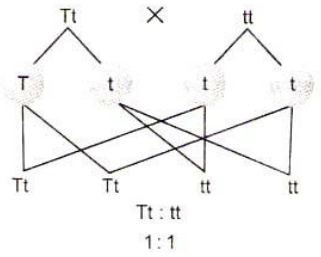
Ethyl methane is a mutagenic agent causing gene mutations.

702 **(d)**

Sickle-cell anaemia is caused due to base replacement leading to replacement of sixth amino acid in the β-chain. Glutamic acid is replaced by valine and causes sickle cell anaemia.

703 **(a)**

The cross between Tt and tt will show 1 : 1 ratio. Test cross is performed to know whether the parent is homozygous or heterozygous dominant.



704 **(a)**

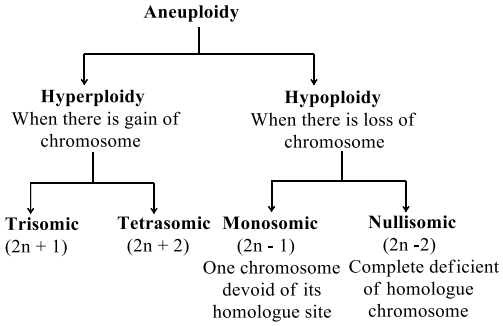
Chromosomal disorders are caused due to excess, absence or abnormal arrangement of one or more chromosomes.

Sometimes the chromatids fail to segregate during cell division, resulting in gain or loss of a chromosome. This is called **aneuploidy**

Aneuploidy is also called heteroploidy

Aneuploidy is of two kinds

(i) Hyperploidy (ii) Hypoploidy



705 **(a)**

Genes are segments of DNA. **Johanseen** (1909) described the gene as 'Unit of heredity' which can assigned to a particular character. **Morgan** and **Bridges** suggested that genes are located on chromosomes in linear fashion.

706 **(a)**

7 dominant traits, 7 recessive traits total 14 traits or 7 oppossing pairs of traits

Characters	Dominant Traits	Recessive Traits
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Violet	White
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Stem height	Tail	Dwarf

707 **(d)**

Environmental Determination of Sex

In *Bonellia*, a marine worm, the swimming larva has no sex if it settles down alone, it develops into a large (2.5 cm) female. If it lands on or near an existing female, a chemical from female causes the larva to develop into a tiny (1.3 cm) male.

In turtles, alligators, a temperature below 28°C produces more males, above 33°C produces more females and between 28°C – 33°C produces males and females in equal proportion

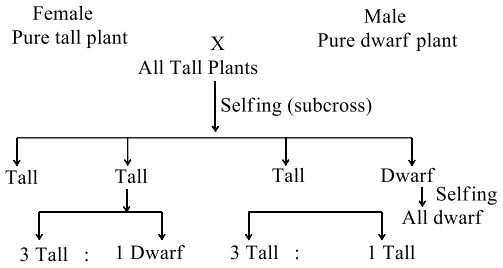
708 **(d)**

Dominant allele expressed in both homozygous and heterozygous condition.

or Principle of Dominance

In heterozygous individuals or hybrids a character is represented by two contrasting factors called alleles or allelomorphs. Out of the two contrasting alleles. Only one is able to express its effect in the individual. It is called dominant factor or dominant allele.

The other which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The cross between the pure tall and pure dwarf gives all progeny (F_1) tall.



The character shown by F_1 called dominant character

709 **(c)**

If the ratio between X-chromosomes and autosome is **0.5** then the individual will be **male** but if it is **1.0** then the individual will be **female**.

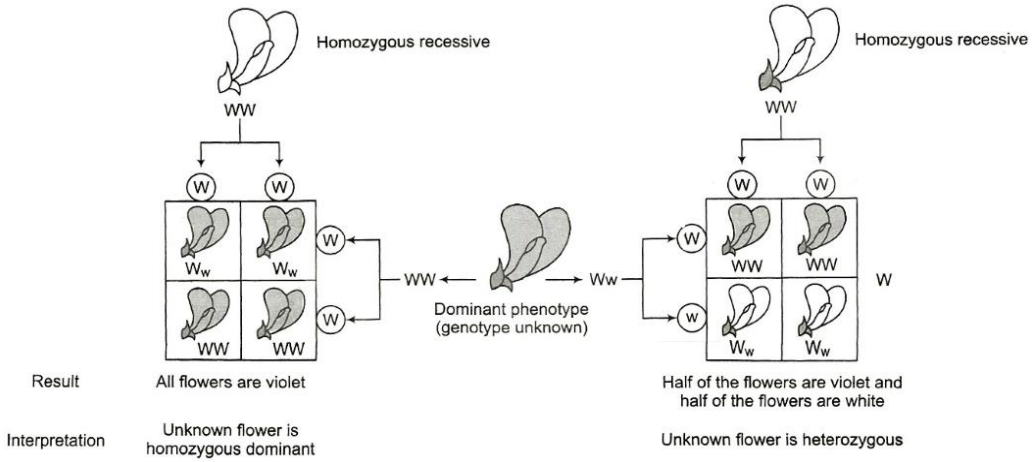
710 **(d)**

Column I	Column II
Metacentric	At the middle
Submetacentric	Slightly away from the middle
Acrocentric	Almost near the tip
Telocentric	At the tip

711 **(b)**

To know the genotype of dominant phenotype, we will cross that plant with the respective recessive phenotype. This is called test cross.

Crossing of F_1 (dominant phenotype) to any one of the parent called back cross and when phenotype of crossing parent is recessive than this is called test cross. The progeny of such cross can easily be analysed to predict the genotype of test organism



712 **(c)**
H J Muller was awarded **Nobel Prize** in 1946 for his discovery of the production of mutations by X-ray irradiation.

713 **(b)**
If the father is colourblind (X^cY) and the mother is a carrier (X^cX), then their son will be normal(XY) and daughter will be colourblind (X^cX^c).

714 **(d)**
Based on the ratio of F_2 and F_3 generation, Mendel proposed that something was being stably passed down F_1 and F_2-generation) unchanged, from parent to offspring through the gametes, over successive generations.
He called these things as factors. Now we call them genes. Genes therefore, are the units of inheritance required to express a particular trait

715 **(a)**
Extra –nuclear or extra-chromosomal or cytoplasmic or organellar inheritance is a consequence of presence of genes in mitochondrial and chloroplast DNA. Extra-chromosomal units function either independently or in collaboration with nuclear genetic system.

717 **(a)**
Colour blindness is a condition, in which, certain colours can not be distinguished due to a lack of one or more colour-absorbing pigments in the cone cells of the retina. Colour blindness is also occur due to recessive sex linked genes.

718 **(a)**
In F_2-generation, quantitative inheritance 1 : 4 : 6 : 4 : 1 is obtained in a dihybrid cross instead of 9 : 3 : 3 : 1.

719 **(a)**
The inheritance due to the genes found in cytoplasm (mitochondria and chloroplast) is called **cytoplasmic inheritance** or **non-Mendelian inheritance**. The leaves of *Mirabilis jalapa* may be green, white or variegated. This is due to cytoplasmic inheritance.

720 **(b)**
Klinefelter's syndrome.

Disorders	Autosomal/Sex Linked	Symptoms	Effects
Down's syndrome	Autosomal aneuploidy (trisomy, +21)	Mongolian eyefold (epicanthus), open mouth, protruded tongue, projected lower lip, many loops on finger tip, palm crease	Retarded mental development IQ (below 40)
Turner's syndrome	Sex chromosomal monosomy 44 + XO	Short stature females (<5'), webbed neck, body hair absent menstrual cycle absent. Sparse pubic hair, underdeveloped breasts narrow lips puffy fingers	Sterile hearing problem
Klinefelter's syndrome	Sex chromosomal aneuploidy (tri/tetrasomy of X chromosome) 44+XXY 44+XXXY	The males are tall with long legs, testes small, sparse body hair, Barr body present, breast enlargement	Gynaecomastia azospermia sterile

Some Examples of Aneuploidy

(i) **Down's syndrome**-21 trisomy

Symptoms

(a) Short statured with small round head

(b) Partially open mouth with protruding furrowed tongue

(c) Palm is broad with characteristic palm crease

(d) Slow mental development

(ii) **Turner's syndrome**

Cause Absence of one of the X-chromosomes, resulting in the karyotype 44+XO

Symptoms

(a) Sterile female with rudimentary ovaries

(b) Shield-shaped thorax

(c) Webbed neck

(d) Poor development of breasts

(e) Short stature, small uterus, puffy fingers

(iii) **Klinefelter's syndrome**

Cause Presence of an additional copy of X-chromosome resulting in the karyotype 44+XXY

Symptoms

(a) Sex of the individual is masculine but possess feminine characters

(b) Gynaecomastia, *i.e.*, development of breasts

(c) Poor beard growth and often sterile

(d) Feminine pitched voice

721 **(b)**

ABO blood group is an example of codominance because both allele express themself and is govern by multiple allele means it is controlled by more than two allele. ABO blood group system or A, AB, B and O blood group of human cannot judge by using physically the human individual

722 **(c)**

Brachydactyly is a disease characterized by small sized finger and is due to dominant gene on the sex chromosome.

723 **(b)**

On mating female *Drosophila* to diploid males, their progeny consist of following types :

18. AAAXXX – Triploid female

19. AAXX – Diploid female

20. AXXY – Diploid female

21. AAAXX – Intersex

22. AAAXXY – Intersex

23. AAXY – Normal male

24. AAXXX – Superfemale

25. AAAXY – Super male or metamale.

724 **(c)**

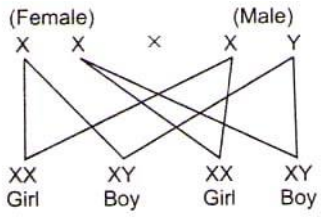
Human blood (ABO) is example of multiple alleles in which three alleles I^A, I^B, I^O governing the same trait

725 **(a)**

In monohybrid cross only one contrasting characters is taken like tallness and shortness, green-yellow

726 **(d)**

The X-chromosomes of females are represented in both the sexes as



Therefore, they are represented in both male and female progeny.

727 **(b)**

In the given diagram there is insertion of T in the given segment of gene so diagram depict insertion type of mutation

728 **(b)**

A-Meiosis; B-Segregate

729 **(b)**

Mendelian principles are based on sexual reproduction. Therefore, they are not applicable in case of asexually reproducing forms.

730 **(c)**

In most of cases the female produce similar sex chromosome called homomorphic. In most of cases the male produce dissimilar sex chromosome called hetermorphic

731 **(b)**

In starch synthesis gene following condition to seen

BB – rounded (due to more starch synthesis)

bb – wrinkled (due to less starch synthesis)

Bb – in between rounded of wrinkled size. It produce starch of intermediate quantity between BB to bb homozygous condition. So, it is incomplete dominance.

Therefore, dominance is not an autonomous feature of a gene or the product that it has information for. It depends as much on the gene product and the production of a particular phenotype from this product as it does on the particular phenotype that we choose to examine, in case more than one phenotype is influenced by the same gene

732 **(b)**

Sickle cell anaemia is a genetic disease reported from Negroes due to molecular mutation (mis-sense mutation) of gene Hb^Aon chromosome 11, which produces the β-chain of mature haemoglobin. The mutated gene HB^s produces sickle cell haemoglobin. The sixth amino acid, in β-chain of normal haemoglobin is glutamic acid which is replaced by valine in sickle cell haemoglobin. The sequence of DNA in mutated β-globin chain is CAC/GAG which on transcription results in codon GUG which produces valine in place of glutamic acid.

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: An organism with lethal mutation may not even develop beyond the zygote stage.

Statement 2: All types of gene mutations are lethal.

2

Statement 1: Phenylketonuria is a recessive hereditary disease caused by body's failure to oxidise an amino acid phenylalanine to tyrosine, because of defective enzyme.

Statement 2: It results in the presence of phenylalanine acid in urine.

3

Statement 1: Polytene chromosomes have a high amount of DNA.

Statement 2: Polytene chromosomes are formed by repeated replication of chromosomal DNA without separation of chromatids.

4

Statement 1: In humans, the gamete contributed by the male determines whether the child produced will be male or female.

Statement 2: Sex in humans is a polygenic trait depending upon a cumulative effect of some genes on X-chromosome and some on Y-chromosomes.

5

Statement 1: Persons suffering from haemophilia fail to produce blood clotting factor-VIII.

Statement 2: Prothrombin producing platelets in such persons are found in very low concentration.

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: ANSWER KEY :

1)	**c**	**2)**	**a**	**3)**	**a**	**4)**	**c**
5)	**b**						

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: HINTS AND SOLUTIONS :

1 **(c)**
Organisms with lethal mutation bear lethal genes that result in the death of the individual which carries them.

The completely that lethal genes usually cause death of the zygote.

Mutation is a sudden heritable change in the sequence genes occurring on the chromosomes. Mutation may be beneficial, normal, sub-lethal or lethal.

2 **(a)**
Phenylketonuria is due to deficiency of liver enzyme phenylalanine hydroxylase, which converts phenylalanine into tyrosine. It occurs in persons, who are homozygous recessive. It results with a high level of phenylalanine in blood, tissue fluids and urine.

3 **(a)**
Balbiani first observed these chromosomes in the salivary glands of midge *Chironomus* in 1881. That's why these are called **salivary gland chromosomes**. The polytene chromosomes are considered as somatic giant chromosomes and are formed by repeated replication of chromosomal DNA without separation of chromatids. After their discovery in salivary gland of larva, these chromosomes are also reported from **gut epithelium,Malpighian tubules** and **fat bodies** of some other dipterans also, *e.g.*, *Drosophila, Chironomus, Sciara, Rhyncosciara*, etc. These chromosomes are very long (up to 200 times their size during mitotic metaphase in *Drosophila*) and very thick. Thus, contain a high amount of DNA.

4 **(c)**
In humans, sex is determined by sex chromosomes. Sex chromosomes in human female are XX and in human male are XY. Human male produces X-containing gametes and Y-containing gametes, while human females only X-containing gametes. Therefore, males determine the sex of offspring. Sex in humans is a monogenic trait.

5 **(b)**
Haemophilia is a hereditary (X-linked recessive) disease, in which blood fails to clot due to absence of factor-VIII. This disease is also called haemophilia-A. Haemophilia –B or Christmas disease occurs due to factor-IX (plasma thrombin component) deficiency. Prothrombin producing platelets in such person are not found or occur in very low concentration.

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

Matrix-Match Type

This section contain(s) 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

1. Observe the sex determination in the following columns

Column-I	Column- II
(A) Male heterogamety	(1) Human XY
(B) Female heterogamety	(2) Hen ZW
(C) Male homogamety	(3) *Drosophila* XY
	(4) Grasshopper XO
	(5) Birds ZZ

CODES :

	A	B	C	D
a)	2,4	1	2	
b)	3,4	2	1	
c)	2,4	1	3	
d)	1,3,4	2	5	

2. Match the following columns

Column-I	Column- II
(A) Flower colour	(1) Violet/white
(B) Pod colour	(2) Green/yellow
(C) Seed colour	(3) Yellow/green

CODES :

	A	B	C	D
a)	1	2	3	
b)	1	3	2	
c)	3	2	1	
d)	3	1	2	

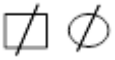
3. Match the following columns

Column-I	Column- II
(A) Autosomal linked recessive trait	(1) Down's syndrome
(B) Sex linked recessive disease	(2) Phenylketonuria
(C) Metabolic error linked to autosomal recessive trait	(3) Haemophilia
(D) Additional 21st chromosome	(4) Sickle-cell anaemia

CODES :

	A	B	C	D
a)	4	1	2	3
b)	4	3	2	1
c)	2	1	4	3
d)	3	4	1	2

4. Match the following columns

Column-I	Column- II
(A) 	(1) Death
(B) 	(2) Five unaffected offspring
(C) 	(3) Sex unspecified
(D) 	(4) Female
(E) 	(5) Male

CODES :

	A	B	C	D	E
a)	1	2	5	4	3
b)	1	2	4	3	3

c)	1	2	3	4	3
d)	5	4	3	2	3

5. Match the following columns

Column-I	**Column- II**
(A) Linkage	(1) Recombination of genes
(B) Mutation	(2) More than two set of chromosomes
(C) Crossing over	(3) Morgan
(D) Polyploidy	(4) De Vries

CODES :

	A	**B**	**C**	**D**
a)	3	4	1	2
b)	1	2	3	4
c)	4	3	2	1
d)	1	2	4	3

6. Identify the correct match between types of chromosomes and their descriptions.

Column-I	**Column- II**
(A) Metacentric	(1) At the tip
(B) Submetacentric	(2) Almost near the tip
(C) Acrocentric	(3) At the middle
(D) Telocentric	(4) Slightly away from the middle

CODES :

	A	**B**	**C**	**D**
a)	1	3	2	4
b)	4	3	2	1
c)	1	2	3	4
d)	4	3	1	2

7. Match the following columns

Column-I	**Column- II**
(A) Test cross	(1) 9 : 3 : 3 : 1

(B) Monohybrid cross (2) Tt × tt

(C) Back cross (3) Tt × TT

(D) Dihybrid cross (4) 3 : 1

CODES :

	A	B	C	D
a)	2	4	3	1
b)	2	4	1	4
c)	3	4	1	2
d)	1	4	1	3

8. Match the human genetic disorder in column I with the causative abnormal chromosome in column II.

Column-I	Column- II
(A) Sickle –cell anaemia	(1) Sex-linked (X-chromosome)
(B) Colour blindness	(2) Autosomal chromosome-7
(C) Phenylketonuria	(3) Autosomal chromosome-11
(D) Cystic fibrosis	(4) Autosomal chromosome-4
(E) Huntington's disease	(5) Autosomal chromosome-12

CODES :

	A	B	C	D	E
a)	3	5	1	2	4
b)	5	1	2	3	4
c)	4	1	5	2	4
d)	3	1	5	2	4
e)	2	1	5	3	4

9. Match the following columns

Column-I	Column- II
(A) Non-parental gene exchange	(1) Crossing over
(B) Non-sister chromatids	(2) X and Y
(C) Sex chromosome	(3) Sex-linked disease
(D) Haemophilia	(4) Recombination

CODES :

	A	B	C	D
a)	4	1	2	3
b)	2	1	4	3
c)	2	4	3	1
d)	2	4	1	3

10. Match the genetic phenomena with their respective ratios.

Column-I	Column- II
(A) Inhibitory gene ratio	(1) 9 : 3 : 4
(B) Complementary gene ratio	(2) 1 : 1 : 1 : 1
(C) Recessive epistasis ratio	(3) 12 : 3 : 1
(D) Dihybrid test cross ratio	(4) 13 : 3
(E) Dominant epistasis ratio	(5) 9 : 7

CODES :

	A	B	C	D	E
a)	5	4	3	2	1
b)	4	5	1	2	1
c)	1	2	4	3	1
d)	2	1	4	5	1
e)	5	4	1	2	1

11. Match the following columns

Column-I	Column- II
(A) Removal of anther	(1) Human blood group
(B) Laws of inheritance	(2) Emasculates
(C) Multiple allelism	(3) Blood group O
(D) Universal donor	(4) Mendal

CODES :

	A	B	C	D
a)	2	4	1	3

b)	3	4	1	2
c)	2	4	3	1
d)	2	1	4	3

12. Match the following columns

Column-I	Column- II
(A) Gregor Mendel	(1) Chromosomal theory of inheritance
(B) Sutton and Boveri	(2) Law of inheritance
(C) Henking	(3) Mendelian disorder
(D) Thalassaemia	(4) Discovered X-body

CODES :

	A	**B**	**C**	**D**
a)	4	2	1	3
b)	2	1	4	3
c)	4	1	2	3
d)	2	3	4	1

13. Match the following columns

Column-I	Column- II
(A) TT	(1) Homozygous
(B) Tt	(2) Heterozygous
(C) tt	(3)

CODES :

	A	**B**	**C**	**D**
a)	1	2	1	
b)	1	1	2	
c)	2	2	1	
d)	2	1	1	

14. Match the following columns

Column-I	Column- II
(A) ABO blood groups	(1) Dihybrid cross

(B) Law of segregation (2) Monohybrid cross

(C) Law of independent assortment (3) Base pairs substitution

(D) Gene mutation (4) Multiple allelism

CODES :

	A	**B**	**C**	**D**
a)	4	2	1	3
b)	2	1	4	3
c)	4	1	2	3
d)	2	3	4	1

15. Match the following columns

Column-I	**Column- II**
(A) Fruitfly	(p) $2n = 6+XY$
(B) Fowl	(q) $2n = 14+XX$
(C) Grasshopper	(r) $2n = 16+XO$
(D) Human	(s) $2n = 44+XY$

CODES :

	A	**B**	**C**	**D**
a)	I	ii	iii	
b)	ii	iii	iv	
c)	iii	iv	i	
d)	ii	i	iv	

16. Match Column I with Column II and find the correct answer.

Column-I	**Column- II**
(A) Monoploidy	(1) $2n$-1
(B) Monosomy	(2) $2n+1$
(C) Nullisomy	(3) $2n$+2
(D) Trisomy	(4) $2n$-2
(E) Tetrasomy	(5) n
	(6) $3n$

CODES :

	A	B	C	D	E
a)	5	1	4	2	3
b)	5	2	4	1	3
c)	6	5	3	4	3
d)	2	1	3	6	3
e)	1	5	3	2	3

17. Match the following columns.

Column-I	Column- II
(A) XX-XO method of sex determination	(1) Female heterogametic
(B) 1.5 X/A ratio	(2) Turner's syndrome
(C) Karyotype 45	(3) Hemiptera
(D) ZW-ZZ method of sex determination	(4) Metafemale

CODES :

	A	B	C	D
a)	2	4	1	3
b)	3	4	2	1
c)	4	1	2	3
d)	1	4	2	3

18. Match the items given in column I with those listed in column II. Choose the answer with correct combination of alphabets of the two columns.

Column-I	Column- II
(A) Monohydrid cross	(1) T and t
(B) Test cross	(2) TT
(C) Allels	(3) Tt × Tt
(D) Homozygous tall	(4) tt
	(5) Tt × tt

CODES :

	A	B	C	D
a)	3	5	4	2

b)	5	3	2	4
c)	3	5	1	2
d)	3	1	5	2

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: ANSWER KEY :

1)	d	2)	a	3)	b	4)	d	13)	a	14)	a	15)	c	16)	a
5)	a	6)	d	7)	a	8)	d	17)	b	18)	c				
9)	a	10)	b	11)	a	12)	b								

Session : 2025-26 **AS PER NEW NTA SYLLABUS**

Total Questions : 755

BIOLOGY (QUESTION BANK)

5.PRINCIPLES OF INHERITANCE AND VARIATION

: HINTS AND SOLUTIONS :

1 **(d)**

(i) **Male heterogamety** → Human (X, Y), grasshopper (x) and Drosphilia (X, Y)

(ii) **Female Heterogamety** birds (hen) = ZW

(iii) **Male Homogamy** birds (ZZ)

2 **(a)**

Flower colour – Violet/white

Pod colour – Green/yellow

Seed colour – Yellow/green

7 dominant traits, 7 recessive traits total 14 traits or 7 oppossing pairs of traits

Characters	Dominant Traits	Recessive Traits
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Violet	White
Pod shape	Full	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Stem height	Tail	Dwarf

3 **(b)**

Autosomal linked recessive trait – Sickle-cell anaemia

Sex-linked recessive disease – Haemophilia

Metabolic error linked to – Phenylketonuria autosomal recessive trait

Additional 21st chromosome – Down's syndrome

5 **(a)**

Linkage – TH Morgan

Mutation – de Vries

Crossing over – Recombination of genes (meiosis)

Polyploidy – More than two sets of chromosomes

6 **(d)**

Column I	Column II
Metacentric	At the middle
Submetacentric	Slightly away from the middle
Acrocentric	Almost near the tip
Telocentric	At the tip

7 **(a)**

Test cross – Tt × tt

Monohybrid cross – 3 : 1

Back cross – Tt × TT

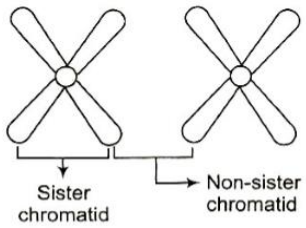
Dihybrid cross – 9 : 3 : 3 : 1

8 **(d)**

	Column I	Column II
1.	Sickle–cell anaemia	Autosomal chromosome-11
2.	Colour blindness	Sex-linked (X-chromosome)
3.	Phenylketonuria	Autosomal chromosome-12
4.	Cystic fibrosis	Autosomal chromosome-7
5.	Huntington's disease	Autosomal chromosome-4

9 **(a)**

Crossing over takes place only in non-sister chromatid. In sisters chromatids the crossing over does not take place



Non-parental gene exchange – Recombination

Non-sister chromatid – Crossing over

Sex chromosome – X and Y
Haemophilia – Sex-linked disease

10 **(b)**

Column I (Interaction)	Column II (Ratio)
Inhibitory gene	13 : 3
Complementary gene	9 : 7
Recessive epistasis	9 : 3 : 4
Dihybrid test cross	1 : 1 : 1 : 1
Dominant epistasis	12 : 3 : 1

11 **(a)**
Removal of anther – Emasculation
Law of inheritance – Mendel
Multiple allelism – Human blood group
Universal donor – Blood group O (because blood group O dont have any antigen)

12 **(b)**
Gregor Mendel – Law of inheritance
Sutton and Boveri – Chromosomal theory of inheritance
Henking – Discovered X-body
Thalassaemia – Mendelian disorder

13 **(a)**
TT – Homozygous
tT – Heterozygous
tt - Homozygous

14 **(a)**
ABO blood groups – Multiple allelism
Law of segregation – Monohybrid cross
Law of independent assortment – Dihybrid cross
Gene mutation – Base pair substitution

15 **(c)**

Animal	Chromosomes Complement
Fruitfly	$2n = 6+xy$ (heterogametic male)
Fowl	$2n = 14+x$ (homogametic male)
Grasshopper	$2n = 16+x$ (heterogametic male)
Human	$2n = 44+xy$ (heterogametic male)

16 **(a)**
The correct matching is

Column I	Column II
6. Monoploidy	n
2. Monosomy	$2n-1$
4. Nullisomy	5. $2n-2$
6. Trisomy	7. $2n+1$
8. Tetrasomy	*9. 2n+2*

17 **(b)**

XX-XO type of sex determination	Class-Hemiptera(true bugs)
1.5 X/A ratio	Metafemale
Karyotype 45	Turner's syndrome
ZW-ZZ method of sex determination	Female heterogametic

18 **(c)**

Column I (Charater)	Column II (Genotype)
Monohybrid cross	Tt × Tt
Test cross	Tt × tt
Alleles	T and t
Homozygous tall	TT