DPP - Daily Practice Problems

Chapter-wise Sheets

Date : _____ **Start Time :** _____ **End Time :** _____

BIOLOGY CB27

SYLLABUS : Principles of inheritance and variation

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. Cross between AaBB and aaBB will form
(a) 1 AaBB : 1aaBB (b) All AaBB
(c) 3 AaBB : 1 aaBB (d) 1 AaBB : 3 aaBB

2. Red (RR) *Antirrhinum* is crossed with white (WW) one. Offspring RW are pink. This is an example of
(a) dominant -recessive
(b) incomplete dominance
(c) hybrid
(d) supplementary genes

3. The dihybrid ratio in F_2 - generation is
(a) 1 : 1 : 1 : 1 (b) 2 : 1 : 2 : 1
(c) 3:1 (d) 9 : 3 : 3 : 1

4. Genetic map is one that
(a) shows the distribution of various species in a region
(b) establishes sites of the genes on a chromosome
(c) establishes the various stages in gene evolution
(d) show the stages during the cell division

5. A gene pair hides the effect of another gene. The phenomenon is
(a) epistasis (b) dominance
(c) mutation (d) None of the above

6. Independent assortment of genes does not take place when
(a) genes are located on homologous chromosomes
(b) genes are linked and located on same chromosomes
(c) genes are located on non-homologous chromosomes
(d) All the above

7. Extranuclear inheritance occurs in
(a) peroxisome and ribosome
(b) chloroplast and mitochondria
(c) mitochondria and ribosome
(d) chloroplast and lysosome

8. Test cross involves
(a) crossing between two F_1 hybrids
(b) crossing the F_1 hybrid with a double recessive genotype
(c) crossing between two genotypes with dominant trait
(d) crossing between two genotypes with recessive trait

9. When one gene controls two or more different characters simultaneously, the phenomenon is called
(a) apomixis (b) pleiotropy
(c) polyploidy (d) polyteny

RESPONSE GRID					
1. (a)(b)(c)(d)	2. (a)(b)(c)(d)	3. (a)(b)(c)(d)	4. (a)(b)(c)(d)	5. (a)(b)(c)(d)
6. (a)(b)(c)(d)	7. (a)(b)(c)(d)	8. (a)(b)(c)(d)	9. (a)(b)(c)(d)	

Space for Rough Work

10. ABO blood group system is due to
(a) multifactor inheritance
(b) incomplete dominance
(c) multiple allelism
(d) epistasis

11. In humans, male XXY and female XXXX occur due to
(a) aneuploidy
(b) euploidy
(c) Nutosomal syndrome
(d) none of these

12. Haemophilia is more common in males because it is a
(a) Recessive character carried by Y-chromosome
(b) Dominant character carried by Y-chromosome
(c) Dominant trait carried by X-chromosome
(d) Recessive trait carried by X-chromosome

13. The most striking example of point mutation is found in a disease called
(a) thalassemia (b) night blindness
(c) down's syndrome (d) sickle cell anaemia

14. In Down's syndrome of a male child, the sex complement is
(a) XO (b) 45 + XY
(c) 45 + XX (d) XXY

15. Barr body in mammals represents
(a) all the heterochromatin in female cells
(b) Y-chromosomes in somatic cells of male
(c) all heterochromatin in male and female cells
(d) one of the two X-chromosomes in somatic cells of females

16. A person with the sex chromosomes XXY suffers from
(a) Down's syndrome
(b) Klinefelter's syndrome
(c) Turner's syndrome
(d) Gynandromorphism

17. *Drosophila* flies with XXY genotype are females, but human beings with such genotype are abnormal males. It shows that
(a) Y-chromosome is essential for sex determination in *Drosophila*.
(b) Y-chromosome is female determinant in *Drosophila*.
(c) Y-chromosome is male determination in human beings.
(d) Y-chromosome has no role in sex determination either in *Drosophila* or in human beings.

18. 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

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

20. The "Cri-du-Chat" syndrome is caused by change in chromosome structure involving
(a) deletion (b) duplication
(c) inversion (d) translocation

21. Biometric genetics deals with :
(a) the biochemical explanations of various genetical phenomena
(b) the effect of environment on genetic set up organisms
(c) the genetical radiations on the living organisms
(d) the inheritance of quantitative traits

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

23. 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

24. Chromosome complement with 2n – 1 is called
(a) Monosomy (b) Trisomy
(c) Nullisomy (d) Tetrasomy

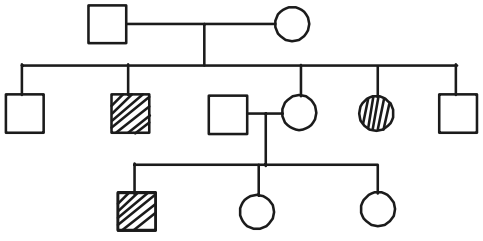
RESPONSE GRID					
	10. ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ	**13.** ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ	**16.** ⓐⓑⓒⓓ	**17.** ⓐⓑⓒⓓ	**18.** ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ	**23.** ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ

Space for Rough Work

25. In a cross between AABB × aabb, the ratio of F_2 genotypes between AABB, AaBB, Aabb and aabb would be
(a) 9 : 3 : 3 : 1 (b) 2 : 1 : 1 : 2
(c) 1 : 2 : 2 : 1 (d) 7 : 5 : 3 : 1

26. The basis of karyotaxonomy is
(a) Number of nucleoli
(b) Sedimentation rate of ribosomes
(c) Chromosome banding
(d) Chromosome number

27. Study the pedigree chart given below:

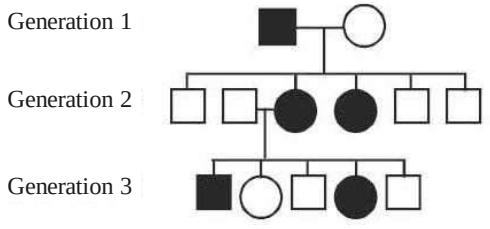


What does it show?
(a) Inheritance of a recessive sex-linked disease like haemophilia
(b) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria
(c) Inheritance of a condition like phenylketonuria as an autosomal recessive trait
(d) The pedigree chart is wrong as this is not possible

28. Which one is a hereditary disease ?
(a) Cataract (b) Leprosy
(c) Blindness (d) Phenylketonuria

29. Diploid chromosome number in humans is
(a) 46 (b) 44
(c) 48 (d) 42

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

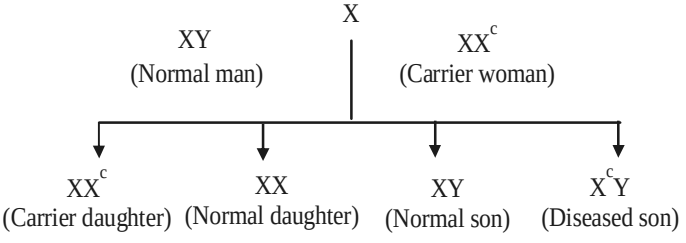


Key :
Unaffected male Affected male
Unaffected female Affected female

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

31. In maize, coloured endosperm (C) is dominant over coloureless (c); and full endosoperm (R) is dominant over shrunken (r). When a dihybrid of F_1 generation was test crossed, it produced your phenotypes in the following percentage:
Coloured full - 48% Coloured shrunken - 5%
Colourless full - 7% Colourless shrunken - 40%
From this data, what will be the distance between two non-allelic genes?
(a) 48 units (b) 5 units
(c) 7 units (d) 12 units

32. Inheritance of which of the following traits is shown in the given cross?



(a) X-linked dominant trait
(b) X-linked recessive trait
(c) Autosomal dominant trait
(d) Autosomal recessive trait

33. More than two alternate forms of a gene present on the same locus are called (i). They are produced due to repeated (ii) of the same gene but in different directions. Their well known example is (iii).

	(i)	(ii)	(iii)
(a)	Epistatic genes	Crossing over	polydactyly
(b)	Multiple alleles	mutations	human blood groups
(c)	Supplementary	mutations	hypertrichosis
(d)	Linked genes	Crossing over	aljaptonuria

RESPONSE GRID					
	25. ⓐⓑⓒⓓ	**26.** ⓐⓑⓒⓓ	**27.** ⓐⓑⓒⓓ	**28.** ⓐⓑⓒⓓ	**29.** ⓐⓑⓒⓓ
	30. ⓐⓑⓒⓓ	**31.** ⓐⓑⓒⓓ	**32.** ⓐⓑⓒⓓ	**33.** ⓐⓑⓒⓓ	

Space for Rough Work

34. In fruit files, long wing is dominant to vestigial wing. When heterozygous long-winged files were crossed with vestigial-winged files, 192 offsprings were produced. Of these, 101 had long wings and 91 had vestigial wings.
If an exact Mendelian ratio had been obtained, then the number of each phenotype would have been

	Long-winged	Vestigial-winged
(a)	64	128
(b)	96	96
(c)	128	64
(d)	192	0

35. Phenotypic and genotypic ratio is similar in case of
(a) complete dominance
(b) incomplete dominance
(c) over dominance
(d) epistasis

36. To determine the genotype of a tall plant of F_2 generation, Mendel crossed this plant with a dwarf plant. This coss represents a
(a) test cross (b) back cross
(c) reciprocal cross (d) dihybrid cross

37. Match Column-I with Column-II and select the correct option from the codes given below.

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

38. Chromosomal theory of inheritanc was given by
(a) Morgan et al (b) Sutton and Boveri
(c) Hugo de Vries (d) Gregor J. Mendel

39. What is true about the crossing over between linked genes?
(a) No crossing over at all
(b) High percentage of crossing over
(c) Hardly any crossing over
(d) None of these

40. Which of the following is incorrect regarding ZW-ZZ type of sex determination?
(a) It occurs in birds and some reptiles
(b) Females are homogametic and males are heterogametic
(c) 1 : 1 sex ratio is produced in the offsprings
(d) All of these

41. Red green colourblindness is a sex linked trait. Which of the given statements is not correct regarding colourblindness?
(a) It is more common in males than in females
(b) Homozygous recessive condition is required for the expression of colourblindness in females
(c) Males can be carriers of the trait
(d) Colourblind women always have colourblind father and always produce colourblind son.

42. At a particular locus, frequency of allele A is 0.6 and that of allele a is 0.4. What would be the frequency of heterozygotes in a random mating population at equilibrium?
(a) 0.36 (b) 0.16
(c) 0.24 (d) 0.48

43. The distance between the genes is measured by
(a) Angstrom (b) map unit
(c) Dobson unit (d) millimetre

44. Which of the following trait is controlled by dominant autosomal genes?
(a) Polydactyly
(b) Huntigton's chorea
(c) PTC (phenylthiocarbomide) tasting
(d) All of these

45. The mutations that involve addition, deletion or substitution of a single base pair in a gene are referred to as
(a) point mutations (b) lethal mutations
(c) silent mutations (d) retrogressive mutations

RESPONSE GRID					
	34. ⓐⓑⓒⓓ	**35.** ⓐⓑⓒⓓ	**36.** ⓐⓑⓒⓓ	**37.** ⓐⓑⓒⓓ	**38.** ⓐⓑⓒⓓ
	39. ⓐⓑⓒⓓ	**40.** ⓐⓑⓒⓓ	**41.** ⓐⓑⓒⓓ	**42.** ⓐⓑⓒⓓ	**43.** ⓐⓑⓒⓓ
	44. ⓐⓑⓒⓓ	**45.** ⓐⓑⓒⓓ			

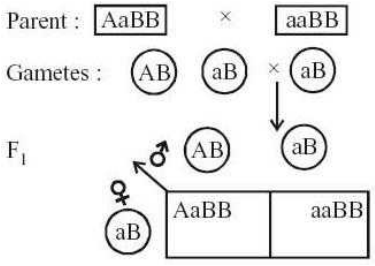
Space for Rough Work

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 27 - BIOLOGY			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

HINTS & SOLUTIONS

DPP /CB27

1. (a) AaBB × aaBB on crossing gives 50% individuals having genotype AaBB and 50% individuals having genotype aaBB.



2. (b) Incomplete dominance is the phenomenon where none of the alleles are dominant, with the effect that the hybrid produced by crossing two pure individuals is a mixture between the parents.

3. (d) When a pair of contrasting characters are studied during hybridization, it is called dihybrid cross. In F_2-generation, its ratio is 9 : 3 : 3 : 1.
It means when parents having –
Yellow, round seeds (IIRR) Crossed with green wrinkled seeds (iirr)
will give
9 – Yellow round seeds.
3 – Yellow wrinkled seed.
3 – Green round seeds.
1 – Green wrinkled seeds

4. (b) Genetic mapping help in studying the architecture of the chromosomes and of entire genome.

5. (a) Epistasis is the phenomenon of masking or suppressing the phenotypic impression of a gene pair by a non allelic gene pair which impresses its own effect.

6. (b) Independent assortment of genes takes place only when they are located on separate non-homologus chromosomes. Where two or more than two genes are located on same chromosome, independent assortment will not be possible.

7. (b) In eukaryotic cells, two cytoplasmic organelles, mitochondria and chloroplast of green plants, contain their own genetic materials.

8. (b) A cross of F_1 hybrid with its recessive homozygous parent is called the test cross. It is done to determine the genotype of a given plant. If the given plant has homozygous dominant traits then on test cross it gives all dominant trait plants but if it is heterozygous dominant than it gives dominant and recessive phenotypes in 1 : 1 ratio.

9. (b) Pleiotropy is the condition in which a single gene influences more than one trait.
Polyploidy is a condition in which individuals have more than two complete sets of chromosomes.
Apomixis is a reproductive process in plants that superficially resembles normal sexual reproduction but there is no fusion of gametes.

10. (c) A gene may have more than two alternative forms occupying the same locus on a chromosome, such alleles are known as multiple alleles and the phenomenon is turned as multiple allelism. ABO blood group has 3 alleles. I^O, I^A or A, I^B or B.

11. (b) Aneuploidy is the numerical change in the chromosome number of the genome. Euploidy is the phenomenon of having multiple or more than twice the number of genome.

12. (d) Haemophilia is a sex linked recessive trait carried by X chromosome (also known as bleeder's disease).

13. (d) Sickle cell anaemia (in which nucleotide triplet CTC is changed to CAC) affects the β-globin chain of haemoglobin. Since these changes occur at a particular locus or point of a chromosome where specific gene is located, they are called as point mutation.

14. (b) Down's syndrome is due to trisomy of 21st chromosome and is an autosomal abnormality.

15. (d) A barr body is one of the X-chromosomes in somatic cells of females. If there are more X-chromosomes, then there will be more barr bodies.

16. (b) Down's syndrome develops due to trisomy of chromosome number 21. In Turner's syndrome, the effect appears due to fusion of a gamete without sex chromosome and a gamete with one X-chromosome (44 + X). Klinefelter individuals are phenotypically males. The defect appears due to fusion of egg having unreduced sex complement (A + X X) with a gamete carrying Y chromosome (44 + XXY). Gynandromorphism occurs among *Drosophila*. In such individuals one half of the body shows male characters and the other half shows female characters.

17. (c) Sex in *Drosophila* is a function of the ratio of the number of X chromosomes to the number of autosomal sets. Therefore a *Drosophila* with a X/A =1.0 will be a female whereas the one with a X/A ratio = 0.5 will be male. However, in humans the presence or absence of the Y chromosome determines sex.

18. (c) The lack of independent assortment in sweet pea and *Drosophila* is due to linkage.

19. (c) Baldness is a sex influenced trait. The dominance of alleles may differ in heterozygotes of the two sexes.

20. (a) Cri-du-chat/cat cry syndrome is due to the deletion of a large part of the small or one of the 5^{th} chromosome.

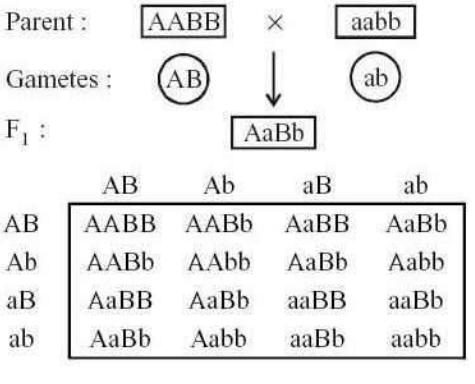
21. (d) Biometric genetics is the mathematical or statistical study of genetic phenomenon. In this branch, data of various genetic traits are analysed by applying the principles of statistics. It helps in the investigation of various genetic principles and checks their correctness and probability.

22. (b) In grasshopper the males lack a Y-sex chromosome and have only an X-chromosome. They produce sperm cells that contain either an X chromosome or no sex chromosome, which is designated as O.

23. (d) Linkage is the inheritance of genes of same chromosome together and capacity of these genes to retain their parental combination in subsequent generation. The strength of linkage between two genes is inversely proportional to the distance between the two. This means, two linked genes show higher frequency of recombination if the distance between them is higher and lower frequency if the distance is smaller.

24. (a)

25. (c) Genotype is the genetic make up of an individual irrespective of the mendelian characters or genes impressing.



26. **(d)**

27. **(c)**

28. **(d)** Phenylketonuria is a human genetic disorder in which the body does not contain the enzyme phenylalanine hydroxylase, necessary to metabolize phenylalanine to tyrosine, and converts phenylalanine instead to phenylpyruvic acid. As PKU is an autosomal recessive genetic disorder each parent must have at least one defective allele of the gene for PAH, and the child must inherit a defective allele from each parent. As such, it is possible for a parent with a PKU phenotype to have a child without PKU if the other parent possesses at least one functional allele of the gene for PAH. A child of two parents with the PKU phenotype will always receive two defective alleles so will always have PKU. The gene for PAH is located on chromosome 12.

29. **(a)** Chromosomes occur in homologous pairs. Somatic cells have diploid number of chromosomes. Humans have 23 pairs *i.e.* 46 chromosomes. 22 pairs of autosomes and 1 pair of sex chromosomes i.e. XX in females and XY in males.

30. **(a)**

31. **(d)** Given that recombinant percentage is 7% and 5% therefore, total recombinants would be 7 + 5 = 12%. It is known that one map unit is the distance that yields 1% recombinant chromosomes. Hence distance between two non-allelic genes = 12 map units.

32. **(b)** In the given cross, passing of disease is from carrier female to male progeny (criss-cross inheritance). Any trait that shows criss-cross inheritance is located on the sex chromosome.
Presence of a single recessive gene i.e. X^c in carrier individuals (XX^c) does not cause the disease, thus the trait is recessive.

33. **(b)**

34. **(b)** A cross between heterozygous long-winged flies and (homozygous) vestigial winged flies represents an example of test cross, in which the exact Mendelian ratio of 1 : 1 is obtained. i.e., 96 long-winged flies and 96 vestigial winged flies.

35. **(b)** Incomplete dominance is the phenomenon of neither of the two alleles being dominant so that expression in the hybrid is intermediate between the expressions of the two alleles in homozygous state. F_2 phenotypic ratio is 1 : 2 : 1, similar to genotypic ratio.

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

37. **(a)** Quantitative inheritance (polygenic inheritance) is a type of inheritance controlled by one or more genes in which the dominant alleles have cumulative effect with each dominant allele expressing a part or unit of the trait, the full trait being shown only when all the dominant alleles are present. e.g., kernel colour in wheat, skin colour in human beings, human intelligence, height in human beings and several plants, etc.
The ability of a gene to have multiple phenotypic effects because it influences a number of characters simultaneously is known as pleitropy. The genes involved are called pleiotropic genes. It is not essential that all the traits are equally influenced. Sometimes the effect of a pleiotropic gene is more evident in case of one trait (major effect) and less evident in case of others (secondary effect). An example of this in humans is the disease phenylketonuria, which also produces abnormal phenotypic traits such as mental retardation, widely placed incisors, pigmented patches on the skin and excessive sweating for multiple alleles.

38. **(b)** Chromosomal theory of inheritance believes that chromosomes are vehicles of hereditary information which possess Mendelian factors or genes and it is the chromosomes which segregate and assort independently during transmission from one generation to the next. Chromosomal theory of inheritance was proposed by Walter Sutton and Theodore Boveri independently in 1902. But it was later modified and expanded by Morgan, Sturtevant and Bridges.

39. **(c)** Linked genes are those genes which do not show independent assortment but remain together because they are present on the same chromosome. In linkage, there is a tendency to maintain the parental gene combination except for occasional crossovers.

40. **(b)** In ZW-ZZ type of sex determination, 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: Z and W, and only one type of sperms, i.e., each with Z. Fertilization of an egg with Z chromosome by a sperm with Z chromosome gives a zygote with ZZ chromosomes (male).
Fertilization of an egg with W chromosome by a sperm with Z chromosome yields a zygote with ZW chromosomes (female). This mechanism operates in some vertebrates (fishes, reptiles and birds).

41. **(c)** Since colourblindness is a sex-linked recessive trait and males just have one X chromosome, they can never be the carriers. Males will always express the disease/phenotype.

42. **(d)** In a stable population, for a gene with two alleles, 'A' (dominant) and 'a' (recessive), if the frequency of 'A' is p and the frequency of 'a' is q, then the frequencies of the three possible genotypes (AA, Aa and aa) can be expressed by the Hardy-Weinberg equation:
$p^2 + 2pq + q^2 = 1$
where p^2 = Frequency of AA (homozygous dominant) individuals q^2 = Frequency of aa (homozygous recessive) individuals
2pq = Frequency of Aa (heterozygous) individuals
so, p = 0.6 and q = 0.4 (given)
$\therefore$ 2pq (frequency of heterozygote) = $2 \times 0.6 \times 0.4 = 0.48$.

43. **(b)** The distance between genes is measured by map unit. 1% crossing over between two linked genes is known as 1 map unit or centi Morgan (cM). 100% crossing over is termed as Morgan (M) and 10% crossing over as deci Morgan (dm).

44. **(d)** Dominant autosomal traits are caused by dominance autosomal genes. Some of the dominantly autosomal inherited disorder in human beings are : Polydactyly– presence of extra fingers and toes , Huntington's disease or Huntington's chorea — a disorder in which muscle and mental deterioration occurs and there is gradual loss of motor control resulting in uncontrollable shaking and dance like movement (chorea), phenylthiocarbamide (PTC) tasting, etc.

45. **(a)** Most of the gene mutations involve a change in only a single nucleotide or nitrogen base of the cistron. These gene mutations are called point mutations. e.g. sickle cell anaemia in which polypeptide chain coding for hemoglobin contains valine, instead of glutanic acid due to substitution of T by A in second position of triplet codon.