

## PRINCIPLE OF INHERITANCE & VARIATION

1. Which of the following are reasons for Mendel's success?
  - (i) Usage of pure lines or pure breeding varieties.
  - (ii) Consideration of one character at a time.
  - (iii) Maintenance of statistical records of experiments.
  - (iv) Knowledge of linkage and incomplete dominance.

(A) (i) and (ii) only                      (B) (i), (ii) and (iii)  
(C) (i) and (iv) only                      (D) (ii), (iii) and (iv)
2. Read the given statements and select the correct option.

Statement 1: Mendel worked on garden pea (*Pisum sativum*).

Statement 2: Garden pea belongs to family malvaceae.

(A) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.  
(B) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.  
(C) Statement 1 is correct and statement 2 is incorrect.  
(D) Both statements 1 and 2 are incorrect.
3. In four o'clock plants, the gene for red flower colour (R) is incompletely dominant over the gene for white flower colour (r), hence the plants heterozygous for flower colour (Rr) have pink flowers. What will be the ratio of offsprings in a cross between red flowers and pink flowers?

- (A) 75% red flowers, 25% pink flowers
- (B) All red flowers
- (C) 50% red flowers, 50% pink flowers
- (D) Red: pink: white::1:2:1

4. Complete the given table showing different possibilities of genotypes and their corresponding blood group, by selecting the correct option.

Genotypes	Blood groups
$IAIA$ , ___ (i)	B AB O
$IBIB$ , ___ (ii)	
___ (iii) (iv)	
___	

- (i) (ii) (iii) (iv) (i) (ii) (iii) (iv)
- (A)  $IAIA$   $IBIB$   $IAIB$   $IAi$  (B)  $IAIA$   $IBIB$   $IAIB$   $IAi$
- (C)  $IAi$   $IBi$   $IAIB$   $IBi$  (D)  $IAi$   $IBi$   $IAIB$   $IBi$

5. Fruit shape in shepherd's purse (*Capsella bursa*) is of two types – triangular and top-shaped. Triangular fruit shape (T) is dominant over top-shape (t). Following table summarizes the results of several crosses.

Cross Strain	Result
1 × tt Strain	All triangular
2 × tt Strain	1 triangular : 1 top-shaped
3 × tt	All top-shaped

Strain 4 × tt	3 triangular : 1 top-shaped
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Which pair of strains possess the genotype Tt?

- (A) Strains 2 and 3                      (B) Strains 2 and  
(C) Strains 1 and 3                      (D) Strains 1 and 4

6. Read the given statements and select the correct option.

Statement 1: The law of segregation is one of the most important contributions to the biology.

Statement 2: It introduced the concept of heredity factors as discrete physical entities which do not become blended.

- (A) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.  
(B) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.  
(C) Statement 1 is correct and statement 2 is incorrect.  
(D) Both statements 1 and 2 are incorrect.

7. Read the given statements and select the correct option.

Statement 1: Test cross is used to determine an unknown genotype within one breeding generation.

Statement 2: Test cross is a cross between F1 hybrid and dominant parent.

- (A) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.  
(B) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.

- (C) Statement 1 is correct and statement 2 is incorrect.  
 (D) Both statements 1 and 2 are incorrect.

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

Column I	Column II
A. Dihybrid test cross	(i) 9 : 3 : 3 : 1
B. Law of segregation (ii)	Dihybrid cross
C. Law of independent assortment	(iii) 1 : 1 : 1 : 1
D. ABO blood group in man	(iv) Purity of gametes
	(v) Multiple allelism

- (A) A-(iii), B-(iv), C-(ii), D-(v)  
 (B) A-(i), B-(iv), C-(ii), D-(v)  
 (C) A-(iii), B-(ii), C-(iv), D-(v)  
 (D) A-(ii), B-(v), C-(iii), D-(i)
9. When a cross is made between a tall plant with yellow seeds (Tt Yy) and a tall plant with green seeds (Tt yy), what is the true regarding the proportions of phenotypes of the offsprings in F<sub>1</sub> generation?

Proportion of Tall and Green	Proportion of Dwarf and Green
(A) $\frac{3}{8}$	$\frac{1}{8}$
(B) $\frac{2}{8}$	$\frac{1}{8}$
(C) $\frac{1}{8}$	$\frac{3}{8}$
(D) $\frac{2}{8}$	$\frac{2}{8}$

10. Refer the given statements and select the correct option.

- (i) Percentage of homozygous dominant individuals obtained by selfing Aa individuals is 25%.
  - (ii) Types of genetically different gametes produced by genotype AABbcc are 2.
  - (iii) Phenotypic ratio of monohybrid F<sub>2</sub> progeny is case of *Mirabilis jalapa* is 3: 1.
- (A) All the statements are true.
  - (B) Statements (i) and (ii) are true, but statement (iii) is false.
  - (C) Statements (i) and (iii) are true, but statement (ii) is false.
  - (D) Statements (ii) and (iii) are true, but statement (i) is false.



(C) 7 units

(D) 12 units

13. True-breeding red-eyed *Drosophila* flies with plain thoraxes were crossed with pink-eyed flies with striped thoraxes.

Red eye plain thorax × Pink eye striped thorax

The F1 flies were then test crossed against the double recessive.

The following F2 generation resulted from the cross:

80	16	12	92
Red eye	Red eye	Pink eye	Pink eye
Plain thorax	Striped thorax	Plain thorax	Striped thorax

What percentage number of recombinants resulted from the test cross?

(A) 12

(B) 14

(B) 16

(D) 28

(C)

Direction: Read the given paragraph to answer the Q. Nos.

53 and 54.

In a certain plant, yellow fruit colour (Y) is dominant to green fruit colour (y) and round shape (R) is dominant to oval shape (r). The two genes involved are located on different chromosomes.

14. Which of the following will results when plant YyRr is self-pollinated?
- (A) 9: 3: 3: 1 ratio of phenotypes only  
 (B) 9: 3: 3: 1 ratio of genotypes only  
 (C) 1: 1: 1: 1 ratio of phenotypes only  
 (D) 1: 1: 1: 1 ratio of phenotypes and genotypes
15. Which of the following is correct for the condition when plant YyRr is backcrossed with the double recessive parent?
- (A) 9: 3: 3: 1 ratio of phenotypes only  
 (B) 9: 3: 3: 1 ratio of genotypes only  
 (C) 1: 1: 1: 1 ratio of phenotypes only  
 (D) 1: 1: 1: 1 ratio of phenotypes and genotypes
16. 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.
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- (A) A-(ii), B-(iii), C-(i) (B) A-(iii), B-(ii), C-(i) (C) A-(i), B-(ii), C-(iii) (D) A-(ii), B-(i), C-(iii)

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

Column I	Column II
A. Multiple alleles	(i) Phenylketonuria in humans
B. Polygenes (multiple genes)	(ii) Blood groups in humans
C. Pleiotropy	(iii) Skin colour in humans

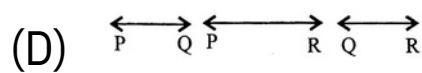
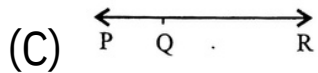
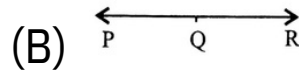
- (A) A-(ii), B-(i), C-(iii)  
 (B) A-(ii), B-(iii), C-(i)  
 (C) A-(iii), B-(ii), C-(i)  
 (D) A-(i), B-(iii), C-(ii)

18. Chromosomal theory of inheritance was given by

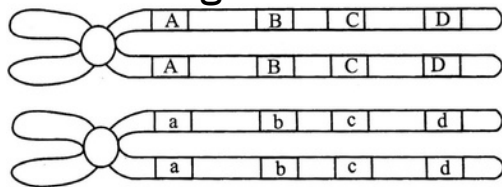
- (A) Morgan *et al* (B) Sutton and Boveri  
 (C) Hugo de Vries (D) Gregor J. Mendel.

19. Which three scientists independently rediscovered Mendel's work?
- (A) Avery, McLeod, McCarty
  - (B) Sutton, Morgan and Bridges
  - (C) Bateson, Punnett and Bridges
  - (D) de Vries, Correns and Tschermak
20. Read the given statements and select the correct option.  
Statement 1: The physical distance between two genes determines both the strength of linkage and frequency of crossing over between two genes. Statement 2: One cross-over reduces the occurrence of another cross-over in its vicinity. (A) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1. (B) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1. (C) Statement 1 is correct and statement 2 is incorrect. (D) Both statements 1 and 2 are incorrect.
21. Which of the following is suitable for experiment on linkage?
- (A)  $aaBB \times aaBB$
  - (B)  $AABB \times aabb$
  - (C)  $AaBb \times AaBb$
  - (D)  $AAbb \times AaBB$

22. If map distance between genes P and Q is 4 units, between P and R is 11 units, and between Q and R is 7 units, the order of genes on the linkage map can be traced as follows.



23. Given diagram shows a pair of homologous chromosomes during meiosis



Maximum crossing over will occur between genes

(A) A and a, D and d

(B) C and d, c and D

(C) B and c, b and C

(D) A and d, a and D

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

Column I	Column II
A. Multiple allelism (i)	Tt × tt
B. Back cross	(ii) Tt × TT
C. Test cross	(iii) Human blood groups
D. Crossing over	(iv) Non-parental gene combination

E. Recombination	(v) Non-sister chromatids
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(A) A-(iii), B-(i), C-(ii), D-(v), E-(iv) (B) A-(iii), B-(ii), C-(i), D-(v), E-(iv) (C) A-(iii), B-(ii), C-(i), D-(iv), E-(v) (D) A-(iv), B-(ii), C-(i), D-(v), E-(iii)

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

Column I	Column II
A. Gregor J. Mendel	(i) Chromosomal theory of inheritance
B. Sutton and Boveri	(ii) Laws of inheritance
C. Henking	(iii) <i>Drosophila</i>
D. Morgan	(iv) Discovered X-body

(A) A-(ii), B-(i), C-(iv), D-(iii) (B) A-(iv), B-(i), C-(ii), D-(iii) (C) A-(iv), B-(ii), C-(i), D-(iii) (D) A-(ii), B-(iii), C-(iv), D-(i)

26. In honey bees, females are (i) having \_\_\_\_\_ chromosomes and males are (iii) having \_\_\_\_\_ (iv) chromosomes.

(i) (ii) (iii) (iv)

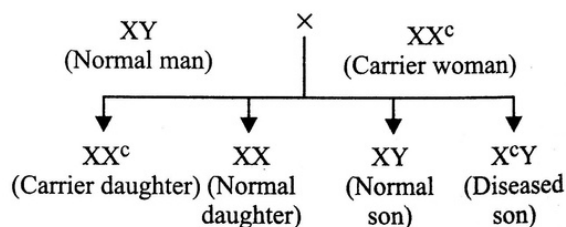
- (A) Diploid 46 Haploid 23
- (B) Haploid 23                  Diploid 46
- (C) Diploid 32 Haploid 16
- (D) Haploid 16                  Diploid 32

27. 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).

Which of the following correctly fills the above statement?

- | (i)                     | (ii)          | (iii)              |
|-------------------------|---------------|--------------------|
| (A) Epistatic genes     | Crossing over | Polydactyly        |
| (B) Multiple alleles    | Mutations     | Human blood groups |
| (C) Supplementary genes | Mutations     | Hypertrichosis     |
| (D) Linked genes        | Crossing over | Alkaptonuria       |

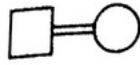



28. Inheritance of which of the following traits is shown in the given cross?



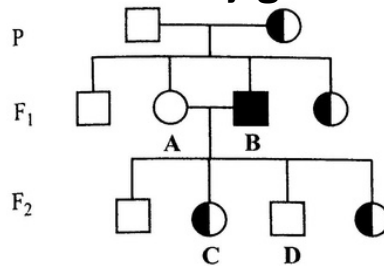
- (A) X-linked dominant trait
- (B) X-linked recessive trait

- (C) Autosomal recessive trait
- (D) Autosomal dominant trait

29. Which one is the incorrect match?

- (A)  - Consanguineous mating
- (B)  - Sex unspecified
- (C)  - Male
- (D)  - Affected individuals

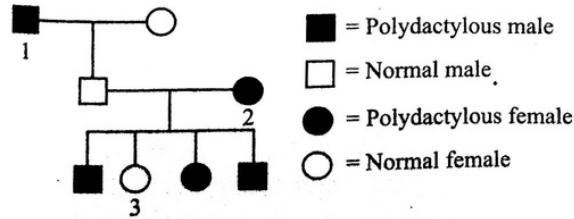
30. Study the given pedigree chart showing the inheritance of an X-linked trait controlled by gene 'r'.



What will be the genotypes of individuals A, B, C and D respectively?

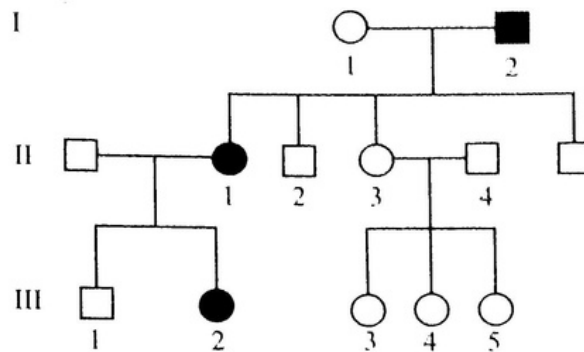
- (A) XX, XrY, XrX, XY
  - (B) XrX, XY, XX, XY
  - (C) XrX, XrYr, XrXr, XrY
  - (D) XX, XrYr, XX, XY
31. In humans, polydactyly (i.e., presence of extra fingers and toes) is determined by a dominant autosomal allele (P) and

the normal condition is determined by a recessive allele (p). Find out the possible genotypes of family members 1, 2 and 3 in the given pedigree.



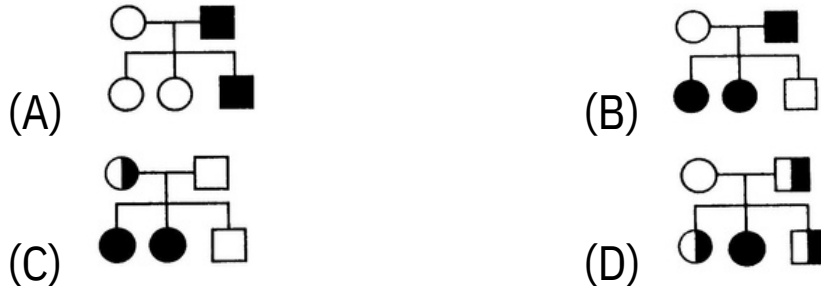
- |        |    |    |        |    |    |
|--------|----|----|--------|----|----|
| 1      | 2  | 3  | 1      | 2  | 3  |
| (A) PP | Pp | pp | (B) PP | PP | pp |
| (C) Pp | PP | Pp | (D) Pp | Pp | pp |

32. Fused ear lobes appear in the progeny due to an autosomal recessive gene. Work out the genotypes of members in the given pedigree.

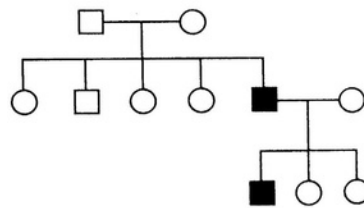


- |        |      |       |        |      |       |
|--------|------|-------|--------|------|-------|
| I-2    | II-3 | III-1 | I-2    | II-3 | III-1 |
| (A) aa | Aa   | Aa    | (B) aa | AA   | AA    |
| (C) Aa | Aa   | Aa    | (D) aa | Aa   | AA    |

33. Wife is PTC non-taster and husband is PTC taster. Their son is taster but daughter are non-tasters. This is not a sex linked trait. Which pedigree is correct?

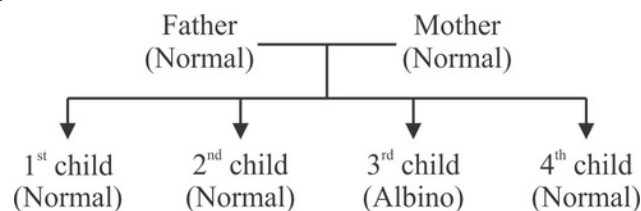


34. In the following pedigree chart, the mutant trait is shaded black. The gene responsible for the trait is



- (A) dominant and sex linked
- (B) dominant and autosomal
- (C) recessive and sex linked
- (D) recessive and autosomal

Direction: Refer the given family tree and answer the questions 96 and 97.



35. If A = normal allele, a = albino allele, then genotypes of father and mother are respectively



- (A) Aa and Aa
- (C) Aa and AA

- (B) AA and Aa
- (D) Aa and aa

36. What are the chances of this couple's fifth child being an albino? (A) 1 in 1 (C) 1 in 3

(B) 1 in 2

(D) 1 in 4

37. The disease sickle-cell anaemia is caused by the substitution of (i) by (ii) at the (iii) position of (iv) globin chain of haemoglobin molecule. Which of the following correctly fills the blanks in the above statement? (A) (i) valine, (ii) glutamic acid, (iii) sixth, (iv) beta (B) (i) glutamic acid, (ii) valine, (iii) sixth, (iv) beta (C) (i) glutamic acid, (ii) valine, (iii) fifth, (iv) beta (D) (i) valine, (ii) glutamic acid, (iii) fifth, (iv) beta

38. Which of the following is mismatched pair of disease and its related symptom?

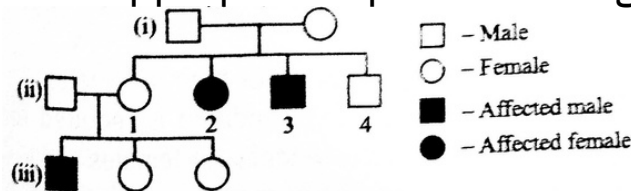
Disease	Symptom
(A) Phenylketonuria	Urine turns black on exposure to air
(B) Down's syndrome	Physical and mental retardation

- (C) Klinefelter's syndrome      Sterile males
- (D) Turner's syndrome      Sterile females

39. Due to nondisjunction of chromosomes during spermatogenesis, some sperms carry both sex chromosomes (22A + XY) and some sperms do not carry any sex chromosome (22A + O). If these sperms fertilize normal eggs (22A + X), what types of genetic disorders respectively appear among the offsprings?

- (A) Klinefelter's syndrome and Turner's syndrome
- (B) Turner's syndrome and Klinefelter's syndrome
- (C) Down's syndrome and Turner's syndrome
- (D) Down's syndrome and cri-du-chat syndrome

40. Study the given pedigree chart for sickle-cell anaemia and select the most appropriate option for the genotypes.



Genotypes of Genotypes of 1 and<sup>st</sup>  
 parents      3<sup>rd</sup> child in F<sub>1</sub>

- (A) HbA, HbS, HbA HbA, HbS, HbA HbA  
 HbA

- (B) HbA, HbS, HbA HbA, HbA, HbA HbA  
HbA
- (C) HbA, HbA, HbA, HbA, HbA HbS  
HbA HbS
- (D) HbA, HbS, HbA HbA, HbS, HbS HbS  
HbS

41. Find out the mismatched pair.

- (A) Haemophilia - Sex linked recessive
- (B) Cystic fibrosis - Autosomal recessive
- (C) Down's syndrome - Trisomy 21
- (D) Turner's syndrome - Y-linked

42. Refer the given statements

- (i) Incomplete or mosaic inheritance is an example of pre-Mendelian concept of blending inheritance.
- (ii) Test cross is a special type of back cross.
- (iii) Chromosomal aberrations are commonly observed in cancer cells.
- (iv) Thalassaemia is a Mendelian disorder.

Which of the above statements are correct?

- (A) (i) and (ii) only                      (B) (ii), (iii) and (iv)
- (C) (ii) and (iv) only                      (D) (i) and (iv) only

43. A colourblind man (XCY) marries a woman who is carrier for haemophilia (XXh). Which of the following is true for their progenies?
- (A) 25% female progenies carry the genes for both haemophilia and colourblindness.
  - (B) 25% male progenies carry only the gene for haemophilia.
  - (C) 25% female progenies carry only the gene for colourblindness.
  - (D) All of these
44. Result of a cross between a normal homozygous female and a haemophiliac male would be
- (A) normal males and normal females
  - (B) haemophiliac males and normal females
  - (C) normal males and carrier females
  - (D) haemophiliac males and carrier females
45. 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.

### ANSWERS

1. B 2. C 3. C 4. C 5. B 6. A 7. C 8. A 9. A 10. B  
11. D 12. D 13. B 14. A 15. D 16. A 17. B 18. B 19. D 20. B  
21. B 22. C 23. D 24. B 25. A 26. C 27. B 28. B 29. C 30. A  
31. D 32. A 33. A 34. D 35. A 36. D 37. B 38. A 39. A 40. D  
41. D 42. B 43. D 44. C 45. C

### SOLUTIONS

1. Mendel did not have any knowledge about linkage and incomplete dominance.
2. Mendel selected garden pea (*Pisum sativum*;  $2n = 14$ ) for his experiments. It belongs to family Fabaceae.
10. The phenotypic ratio of monohybrid F<sub>2</sub> generation in case of *Mirabilis jalapa* is 1 Red : 2 Pink : 1 white, due to incomplete dominance.
11. Plant H is formed by fusion of gametes yR and YR and hence has the genotype YyRR. Plant N is formed by fusion of gametes YR and yR and hence will have the same genotype as plant N i.e., YyRR.
12. 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.

13. Recombinants obtained from the cross are 16 red eye striped thorax flies and 12 pink eye plain thorax flies.

Total number of flies = 200

Total number of recombinants = 28

Therefore, percentage of recombinants  $\frac{28}{200} \times 100 = 14\%$

23. Increase in distance between two genes increases the frequency of crossing over while closeness of the genes reduces the chances of crossing over. Since A and d and a and D are located far away, maximum crossing over would occur between them.

29. It denotes a female.

45. 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.