Principles of Inheritance and Variation

Class 12 Biology · 24 NEET MCQs with answers & explanations

Principles of Inheritance and Variation is one of NEET's heaviest chapters. Mendelian genetics, incomplete dominance, co-dominance, multiple allelism (blood groups), sex-linked inheritance, chromosomal disorders and pedigree analysis are all tested. Problem-solving questions dominate — practising crosses and ratios is more important than memorising definitions.

Key Ratios & Concepts

Concept	Key Fact
Monohybrid ratio	3:1 (F2 phenotypic); 1:2:1 (genotypic)
Dihybrid ratio	9:3:3:1 (F2 phenotypic); independent assortment of non-linked genes
Incomplete dominance	F2 → 1:2:1 (e.g. snapdragon flower colour: red × white → pink)
Co-dominance	Both alleles express equally (e.g. ABO blood groups: I^A I^B → AB)
Sex-linked (X)	Colour blindness, haemophilia — more common in males (XY hemizygous)
Chromosomal disorders	Down (trisomy 21), Turner (45,X), Klinefelter (47,XXY)

Questions

Q1. Experimental verification of the chromosomal theory of inheritance was demonstrated through the work of which scientist?

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

Q2. In a Mendelian monohybrid cross, the separation of the two alleles of a gene during gamete formation represents which law?

(A) Law of dominance
(B) Law of independent assortment
(C) Law of segregation
(D) Law of linkage

Q3. In a cross between pure tall (TT) and pure dwarf (tt) pea plants, the phenotype of all F1 progeny will be:

(A) Dwarf
(B) Both tall and dwarf
(C) Tall
(D) Intermediate height

Q4. A testcross to determine genotype of a dominant phenotype individual involves crossing with:

(A) Homozygous dominant
(B) F1 heterozygote
(C) Another dominant phenotype
(D) Homozygous recessive

Q5. The chromosomal theory of inheritance was proposed independently by:

(A) Sutton and Boveri
(B) Mendel and Morgan
(C) Darwin and Wallace
(D) Watson and Crick

Q6. The chromosomal theory of inheritance correlates chromosome behaviour during meiosis with:

(A) Protein synthesis
(B) Mendel's laws of inheritance
(C) DNA replication
(D) Mutation frequency

Q7. In a heterozygous pea plant (Tt), only the tall phenotype is expressed. This demonstrates:

(A) Law of Dominance
(B) Law of Segregation
(C) Law of Independent Assortment
(D) Law of Linkage

Q8. The Law of Segregation is also referred to as:

(A) Law of Dominance
(B) Law of Purity of Gametes
(C) Law of Blending
(D) Law of Unit Characters

Q9. A colour-blind man marries a woman who is homozygous for normal colour vision. What is the probability that their son will be colour-blind?

(A) 0
(B) 25%
(C) 50%
(D) 100%

Q10. Mendel selected seven pairs of contrasting characters in pea plants. Which combination contains only characters actually studied by Mendel?

(A) Root length, seed colour, flower colour and stem height
(B) Leaf shape, seed texture, root colour and pod length
(C) Flower scent, seed oil content, root thickness and stem diameter
(D) Seed shape, seed colour, flower colour and stem height

Q11. In a dihybrid cross, the number of different gamete types produced by AaBb individual is:

(A) 2
(B) 4
(C) 8
(D) 16

Q12. In dihybrid cross AaBb × AaBb, the probability of obtaining genotype aabb is:

(A) 1/8
(B) 1/4
(C) 1/16
(D) 3/16

Q13. In humans, sex determination follows which chromosomal system?

(A) XX-XY system
(B) ZZ-ZW system
(C) Haplodiploidy
(D) XO system

Q14. Which parent determines the sex of offspring in humans?

(A) Mother
(B) Father
(C) Both parents equally
(D) Neither parent

Q15. A sudden heritable change in genetic material is called:

(A) Mutation
(B) Variation
(C) Recombination
(D) Segregation

Q16. The term 'mutation' was first coined by:

(A) Gregor Mendel
(B) Hugo de Vries
(C) Thomas Morgan
(D) Charles Darwin

Q17. A genetic disorder caused by alteration in a single gene is called:

(A) Mendelian disorder
(B) Chromosomal disorder
(C) Polygenic disorder
(D) Multifactorial disorder

Q18. Which of the following is a Mendelian disorder?

(A) Down syndrome
(B) Haemophilia
(C) Turner syndrome
(D) Klinefelter syndrome

Q19. A woman with blood group A has a child with blood group O. Which genotype must the woman possess?

(A) I^AI^A
(B) I^Bi
(C) I^Ai
(D) ii

Q20. Which statement correctly explains why Mendel selected pea plants for his experiments?

(A) They reproduce only asexually
(B) They lack contrasting characters
(C) They have a single chromosome pair
(D) Several contrasting traits; easy self- and cross-pollination

Q21. According to Mendel, allele pairs separate during:

(A) Fertilisation
(B) S phase of mitosis
(C) Gamete formation
(D) Phenotypic expression

Q22. The Law of Independent Assortment applies when genes are located on:

(A) Homologous chromosomes
(B) Sister chromatids
(C) Linked chromosomal regions
(D) Different chromosome pairs

Q23. The phenotypic ratio in F2 generation of a monohybrid cross is:

(A) 3:1
(B) 1:2:1
(C) 9:3:3:1
(D) 1:1

Q24. In F2 of a monohybrid cross, the genotypic ratio of homozygous dominant : heterozygous : homozygous recessive is:

(A) 2:1:2
(B) 1:2:1
(C) 3:1:3
(D) 1:1:1

Answer key

1-B	**2-C**	**3-C**	**4-D**	**5-A**	**6-B**	**7-A**	**8-B**
9-A	**10-D**	**11-B**	**12-C**	**13-A**	**14-B**	**15-A**	**16-B**
17-A	**18-B**	**19-C**	**20-D**	**21-C**	**22-D**	**23-A**	**24-B**

Answers with explanations

Q1 — Answer: (B) T.H. Morgan
T.H. Morgan experimentally verified the chromosomal theory using Drosophila and demonstrated linkage and sex-linked inheritance. Sutton and Boveri proposed the chromosomal theory, whereas Mendel established the laws of inheritance.

Q2 — Answer: (C) Law of segregation
The law of segregation states that the two alleles of a gene separate during gamete formation, so each gamete receives only one allele. Independent assortment concerns the segregation of alleles of different genes on different chromosomes. Dominance describes the masking of one allele by another, not gamete formation.

Q3 — Answer: (C) Tall
TT × tt produces all Tt offspring; T is completely dominant over t, so all F1 are tall. Intermediate phenotype would indicate incomplete dominance, which does not apply here.

Q4 — Answer: (D) Homozygous recessive
Testcross uses homozygous recessive (tt) so any recessive offspring unambiguously reveals a recessive allele in the tested parent. Crossing with dominant individuals cannot reveal hidden recessive alleles.

Q5 — Answer: (A) Sutton and Boveri
Sutton and Boveri independently proposed that Mendelian factors (genes) are located on chromosomes, based on the parallel behaviour of chromosomes and hereditary units. Mendel-Morgan and Darwin-Wallace are incorrect pairings for this theory.

Q6 — Answer: (B) Mendel's laws of inheritance
Chromosome segregation and independent assortment during meiosis directly parallel Mendel's laws of segregation and independent assortment. Protein synthesis and DNA replication are unrelated to inheritance patterns.

Q7 — Answer: (A) Law of Dominance
In Tt, the T allele masks expression of t, demonstrating Law of Dominance. Segregation relates to gamete separation; independent assortment involves non-linked gene pairs.

Q8 — Answer: (B) Law of Purity of Gametes
Alleles separate during gamete formation without blending or contaminating each other, hence called Law of Purity of Gametes. Blending inheritance was the pre-Mendelian incorrect view.

Q9 — Answer: (A) 0
The father is XcY and the mother is XNXN. Every son receives Y from the father and XN from the mother, giving XNY genotype. Therefore none of the sons will be colour-blind. All daughters will be carriers.

Q10 — Answer: (D) Seed shape, seed colour, flower colour and stem height
Mendel's seven characters included seed shape, seed colour, flower colour, pod shape, pod colour, flower position and stem height. Root length, leaf shape, flower scent and oil content were not among his selected pairs.

Q11 — Answer: (B) 4
Gamete types = 2^n where n = number of heterozygous gene pairs; AaBb has n = 2, so $2^2 = 4$ gametes (AB, Ab, aB, ab). Option C (8) applies to trihybrid AaBbCc individuals.

Q12 — Answer: (C) 1/16
P(aa) = 1/4 and P(bb) = 1/4; by multiplication rule for independent genes: 1/4 × 1/4 = 1/16. Option A (1/8) is a common error from adding rather than multiplying probabilities.

Q13 — Answer: (A) XX-XY system
Human males are XY and females are XX — this is the XX-XY system of sex determination.

Q14 — Answer: (B) Father
The father produces X-bearing and Y-bearing sperms; the mother produces only X-bearing eggs. Hence the father determines offspring sex.

Q15 — Answer: (A) Mutation
Mutation is defined as a sudden heritable change in genetic material; unlike variation, it is specifically a change at the DNA sequence level.

Q16 — Answer: (B) Hugo de Vries
Hugo de Vries coined the term 'mutation' while studying discontinuous variations in Evening Primrose (Oenothera lamarckiana).

Q17 — Answer: (A) Mendelian disorder
Mendelian disorders arise from mutation in a single gene and follow Mendelian inheritance patterns; chromosomal disorders involve changes in chromosome number or structure.

Q18 — Answer: (B) Haemophilia
Haemophilia is caused by mutation in a single X-linked gene; Down, Turner, and Klinefelter syndromes are chromosomal disorders caused by aneuploidy.

Q19 — Answer: (C) IAi
An O-group child has genotype ii and must receive an i allele from each parent. Since the mother has phenotype A, her genotype must be IAi to carry the i allele. IAIA cannot produce an i-bearing gamete. IBi gives blood group B, not A. ii gives blood group O, not A.

Q20 — Answer: (D) Several contrasting traits; easy self- and cross-pollination
Pea plants offered distinct contrasting characters, short generation time, large offspring numbers and easy controlled self- and cross-pollination. These features enabled Mendel to study inheritance systematically. The other options are factually incorrect for pea plants.

Q21 — Answer: (C) Gamete formation
Segregation of alleles occurs during gamete formation (meiosis), not fertilisation or mitosis. Fertilisation is when gametes fuse, not separate.

Q22 — Answer: (D) Different chromosome pairs
Independent assortment operates only when genes are on non-homologous (different) chromosome pairs. Linked genes on same chromosome violate this law.

Q23 — Answer: (A) 3:1
Monohybrid cross (Tt × Tt) gives 3 tall : 1 dwarf in F2 phenotypic ratio. The 1:2:1 is genotypic, not phenotypic.

Q24 — Answer: (B) 1:2:1
Monohybrid F2 yields TT : Tt : tt = 1:2:1. The phenotypic 3:1 ratio groups TT and Tt together; genotypically they are distinct classes.

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