Master Testing Agency
Practice papers, exam-standard · www.mastertestingagency.com

Principles of Inheritance and Variation — CBSE Class 12 Biology Chapter Test

FREE CHAPTER TEST · CLASS XII · BIOLOGY (044) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case-based questions of 4 marks each, with sub-parts of 1, 2 and 1 marks.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 1 question in Section D, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Draw neat, labelled diagrams wherever necessary.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Biology (044) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Master Testing Agency is an independent test-prep publisher, not affiliated with, endorsed by or connected to the Central Board of Secondary Education (CBSE) or any other exam-conducting body.

Chapter: Principles of Inheritance and Variation · **Topics:** Mendel's laws of inheritance · Deviations: incomplete dominance, codominance, multiple alleles · Pleiotropy and polygenic inheritance · Linkage and recombination · Sex determination and mutation · Mendelian and chromosomal disorders

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. How many pairs of contrasting traits of the garden pea did Mendel study? 1

(A) 7 (B) 5

(C) 14 (D) 2

2. The number of different kinds of gametes formed by a plant of genotype AaBbCc (three unlinked genes) is 1

(A) 3 (B) 6

(C) 8 (D) 9

3. Mendel's work was rediscovered in 1900 independently by 1

(A) Morgan, Sturtevant and Bridges (B) Sutton and Boveri

(C) Watson and Crick (D) de Vries, Correns and von Tschermak

4. A man of blood group AB marries a woman of blood group O. Their children can have blood group 1

(A) AB or O (B) A or B

(C) AB only (D) A, B, AB or O

5. Polyploidy (an increase in whole sets of chromosomes) is most commonly seen in 1

(A) humans (B) birds

(C) plants (D) insects

6. A haemophilic man marries a woman who is homozygous normal. The probability that their son will be haemophilic is 1

(A) 50 % (B) 0 %

(C) 25 % (D) 100 %

7. **Assertion (A):** Pedigree analysis cannot be used to study the inheritance of traits in humans. 1
Reason (R): Control crosses cannot be performed in humans.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

8. **Assertion (A):** Mendel's experiments on the garden pea gave clear, countable results. 1
Reason (R): The pea has many easily distinguished pairs of contrasting traits and is naturally self-pollinated, so true-breeding lines are easy to obtain.

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. (a) State Mendel's law of segregation. Why is it also called the law of purity of gametes? 2

OR

(b) Distinguish between incomplete dominance and codominance, with one example of each.

10. (a) What is pleiotropy? Give one example. 2

OR

(b) What is polygenic inheritance? Explain with the example of human skin colour.

11. Who proposed the chromosomal theory of inheritance? State its main idea. 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. A pure-breeding pea plant with round, yellow seeds (RRYY) is crossed with one with wrinkled, green seeds (rryy). Write the genotype of the F_1, the gametes it forms, and the phenotypic ratio of the F_2. Which law does this cross illustrate? 3

13. A man of blood group A and a woman of blood group B have a child of blood group O. (i) Write the genotypes of the parents. (ii) What blood groups can their other children have, and with what probability? (iii) Which two types of inheritance does the ABO system show? 3

14. A woman with normal vision, whose father was colour-blind, marries a man with normal vision. (i) Write the genotypes of the woman and the man. (ii) What fraction of their sons and of their daughters are expected to be colour-blind? (iii) Why is colour blindness more common in males? 3

SECTION D

This section comprises 1 case-based question of 4 marks, with sub-parts of 1, 2 and 1 marks.

15. Thomas Hunt Morgan crossed fruit flies (Drosophila melanogaster) to study genes on the X chromosome. In one cross, involving body colour (yellow) and eye colour (white), only 1.3 % of the F_2 flies were recombinants. In another cross, involving eye colour (white) and wing size (miniature), 37.2 % were recombinants.

(I) Give one reason why Drosophila is well suited for genetic studies. [1]

(II) Explain why the two crosses gave such different percentages of recombinants. What do the percentages tell us about the positions of the genes? [2]

(III) Who used the frequency of recombination to map the positions of genes on a chromosome? [1]

OR

(III) What is meant by recombination? [1]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) Explain Mendel's monohybrid cross between pure tall and pure dwarf pea plants up to the F_2 generation, giving the phenotypic and genotypic ratios. State the law of dominance. How would you find out whether a tall F_2 plant is homozygous or heterozygous? 5

OR

(b) (i) Describe the XO, XY and ZW mechanisms of sex determination, with one example each. Explain why it is the father who determines the sex of a human child.
(ii) What is a point mutation? What are frameshift mutations? Give one example of a mutagen.

17. (a) Describe the cause and the pattern of inheritance of haemophilia, sickle-cell anaemia, phenylketonuria and thalassemia. 5

OR

(b) What are chromosomal disorders? Describe the causes and the main features of Down's syndrome, Klinefelter's syndrome and Turner's syndrome.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(A)	(C)	(D)	(B)	(C)	(B)	(D)	(A)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (A). Mendel studied seven pairs, such as tall/dwarf stem, round/wrinkled seed and yellow/green seed.

Q2. Answer (C). Each gene gives two kinds of gamete independently: $2 \times 2 \times 2 = 8$.

Q3. Answer (D). Three scientists independently rediscovered Mendel's results on the inheritance of characters in 1900.

Q4. Answer (B). $I^AI^B \times ii$ gives I^Ai (A) or I^Bi (B).

Q5. Answer (C). Failure of cytokinesis after telophase can give polyploidy, which is often seen in plants.

Q6. Answer (B). Sons receive their X chromosome from the mother, who carries only the normal allele.

Q7. Answer (D). Because control crosses are not possible in humans, the inheritance of a trait is studied through its family history: pedigree analysis. A is false, R is true. Answer D.

Q8. Answer (A). The clear-cut traits and true-breeding lines let Mendel count the progeny of each type. R explains A. Answer A.

Q9. (2 marks) Answer: (a) alleles separate into gametes; (b) pink snapdragon; blood group AB.
(a) The two alleles of a gene, present together in a parent, segregate (separate) during gamete formation, so each gamete receives only one of them. [1] The alleles do not blend or mix; each gamete is 'pure' for one allele of each character. [1]
OR (b) Incomplete dominance: the F_1 shows a phenotype intermediate between the parents, e.g. pink snapdragon (Antirrhinum) flowers from red × white. [1] Codominance: both alleles are fully expressed together in the F_1, e.g. blood group AB (I^AI^B). [1]

Q10. (2 marks) Answer: (a) one gene, several effects; phenylketonuria; (b) human skin colour.
(a) A single gene affecting more than one phenotypic character. [1] Example: phenylketonuria — a mutation in the gene for phenylalanine hydroxylase causes mental retardation and a reduction in hair and skin pigmentation. [1]
OR (b) A trait controlled by three or more genes, each adding to the phenotype, so the trait shows a continuous range, e.g. human skin colour. [1] With three genes A, B, C, AABBCC is darkest, aabbcc lightest, and AaBbCc has an intermediate skin colour; the effect of the environment is added on. [1]

Q11. (2 marks) Answer: Sutton and Boveri; genes are carried on chromosomes.
Walter Sutton and Theodore Boveri. [1] Chromosomes, like Mendel's factors (genes), occur in pairs, segregate at gamete formation and assort independently, so the genes are carried on the chromosomes. [1]

Q12. (3 marks) Answer: RrYy; RY, Ry, rY, ry; 9 : 3 : 3 : 1; independent assortment.
F_1: RrYy (round, yellow). [½] Gametes: RY, Ry, rY, ry in equal proportions. [1]
F_2: round yellow : round green : wrinkled yellow : wrinkled green = 9 : 3 : 3 : 1. [1]
The law of independent assortment: when two pairs of traits are combined in a hybrid, the segregation of one pair is independent of the other. [½]

Q13. (3 marks) Answer: $I^Ai \times I^Bi$; A, B, AB, O each 1/4; multiple alleles and codominance.
(i) Man I^Ai, woman I^Bi (the O child must have received i from each). [1]
(ii) I^AI^B (AB), I^Ai (A), I^Bi (B), ii (O) — each with a probability of 1/4. [1]
(iii) Multiple alleles (three alleles, I^A, I^B, i) and codominance (I^A and I^B both expressed in AB). [1]

Q14. (3 marks) Answer: X^CX^c, X^CY; sons 1/2, daughters 0; X-linked recessive.

(i) Woman X^CX^c (a carrier: she received X^c from her father); man X^CY. [1]

(ii) Sons: 1/2 colour-blind (X^cY), 1/2 normal. Daughters: none colour-blind (1/2 carriers). [1]

(iii) It is X-linked recessive: a male, with only one X, shows the trait if he has one recessive allele; a female must have two. [1]

Q15. (4 marks) Answer: (I) short life cycle, many progeny; (II) linkage strength ~ distance; (III) Sturtevant, or non-parental gene combinations.

(I) Any one: it can be grown on a simple synthetic medium; it completes its life cycle in about two weeks; a single mating produces a large number of progeny; males and females are clearly different; it shows many easily seen hereditary variations. [1]

(II) Genes on the same chromosome are linked and tend to be inherited together; they are separated only by crossing over. [1] Yellow and white are very close together (tightly linked, few recombinants), while white and miniature are farther apart (loosely linked, many recombinants); the frequency of recombination is a measure of the distance between genes. [1]

(III) Alfred Sturtevant. [1]

OR (III) The production of non-parental combinations of genes (by crossing over between linked genes). [1]

Q16. (5 marks) Answer: (a) 3 : 1 and 1 : 2 : 1; test cross; (b) XO, XY, ZW; point and frameshift mutations.

(a) P: TT (tall) × tt (dwarf); gametes T and t; F_1: all Tt, tall. [1] F_1 selfed: gametes T and t from each parent; F_2: TT, Tt, Tt, tt. [1] Phenotypic ratio 3 tall : 1 dwarf; genotypic ratio 1 TT : 2 Tt : 1 tt. [1] Law of dominance: characters are controlled by discrete units (factors) that occur in pairs; in a dissimilar pair one (the dominant) expresses itself and the other (recessive) does not. [1] Test cross with the recessive parent (tt): if all offspring are tall the plant is TT; if half are dwarf (1 : 1) it is Tt. [1]

OR (b) (i) XO type (grasshopper): females XX, males XO (one chromosome fewer); males produce gametes with or without X (male heterogamety). [1] XY type (humans, Drosophila): females XX, males XY; the male produces X- and Y-bearing sperms in equal numbers, so the sex of the child depends on the sperm that fertilises the ovum — the father determines the sex. [1] ZW type (birds): females ZW (female heterogamety), males ZZ. [1]

(ii) A point mutation changes a single base pair (e.g. sickle-cell anaemia). Deletions or insertions of base pairs shift the reading frame (frameshift mutations). [1] Chemical and physical factors that cause mutations are mutagens, e.g. UV radiation. [1]

Q17. (5 marks) Answer: (a) X-linked recessive, autosomal recessive ×3; (b) aneuploidy; Down 47 (+21), Klinefelter 47 XXY, Turner 45 XO.

(a) Haemophilia: X-linked recessive; a protein of the cascade for blood clotting is affected, so even a small cut bleeds for long; passed from carrier mothers (heterozygous, unaffected) to sons; females are very rarely affected (the mother must be at least a carrier and the father haemophilic). [1½] Sickle-cell anaemia: autosomal recessive; Glu → Val at the sixth position of the β-globin chain (GAG → GUG) gives HbS, which makes red cells sickle-shaped at low oxygen. [1] Phenylketonuria: autosomal recessive inborn error of metabolism; the enzyme that converts phenylalanine to tyrosine is missing, so phenylalanine and its derivatives accumulate in the brain (mental retardation) and are excreted in urine. [1½] Thalassemia: autosomal recessive; mutation or deletion reduces the synthesis of α- or β-globin chains, giving abnormal haemoglobin and anaemia (a quantitative problem, while sickle-cell anaemia is qualitative). [1]

OR (b) Chromosomal disorders arise from the absence, excess or abnormal arrangement of chromosomes; failure of chromatids to segregate gives aneuploidy (gain or loss of a chromosome), and failure of cytokinesis gives polyploidy. [1] Down's syndrome: trisomy of chromosome 21 (47 chromosomes); short stature, small round head, furrowed tongue, partly open mouth, broad palm with a characteristic palm crease, retarded physical, psychomotor and mental development. [1½] Klinefelter's syndrome: 47, XXY; overall masculine development but some feminine development (gynaecomastia); sterile. [1½] Turner's syndrome: 45, XO (absence of one X); sterile females with rudimentary ovaries and lack of other secondary sexual characters. [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every ratio and probability in this paper was checked independently by computer, by making each cross from the parents' genotypes.