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CLASS X · SCIENCE (086) · BIOLOGY · CBSE BOARD EXAMINATION 2027

CHAPTER 8

Heredity

Answer Booklet · CBSE marking-scheme answers with marks for every point

Every question of the chapter booklet | Marks shown point by point | MCQ keys with reasons

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HOW TO USE THE ANSWERS

1. Answer the question in your notebook **first**. Open this booklet only to check.
2. Each answer is written the way the CBSE marking scheme sets it out: **value points**, with the **mark for each point** in orange beside it.
3. Give yourself marks point by point. Use the same **key words** in your own answers.
4. Equations must be balanced; diagrams must be labelled; numericals need formula, substitution and unit.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Model answers to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN SCIENCE ANSWERS

1. **MCQ and assertion–reason (1 mark):** only the correct option scores. The reason given here is for your understanding.
2. **2 and 3 marks:** one mark (or ½) for each correct **value point**. The examiner looks for the key word – a long answer without it scores less than a short answer with it.
3. **Equations:** a correct balanced equation earns its full mark; an unbalanced one, or one with wrong formulae, usually earns ½ or nothing.
4. **Numericals:** formula, substitution and the final answer **with unit** are marked separately.
5. **Diagrams:** marks for a correct drawing and for the labels asked for. An unlabelled diagram earns little.
6. **Case study (4 marks):** 1 + 1 + 2. **Long answer (5 marks):** the split is shown beside each point.

PART A · ANSWERS

A NCERT Practice – Answers

Marking-scheme answers for every question in Part A of the chapter booklet.

Variation and inherited traits

A1. What is meant by heredity and by variation? **[2]**

Heredity: the passing of traits from parents to offspring. 1

Variation: the differences among individuals of the same species. 1

A2. Why do offspring formed by asexual reproduction show very little variation, while those formed by sexual reproduction show more? **[2]**

Asexual: one parent; variation comes only from small errors in DNA copying. 1

Sexual: DNA from two parents is combined, giving new combinations and more variation. 1

A3. In a population of an asexually reproducing species, trait P is found in 70% of the individuals and trait Q in 15%. Which trait probably arose earlier? Why? **[2]**

Trait P. 1

A trait that arose earlier has had more generations to be passed on, so it is found in more individuals. 1

A4. How does the creation of variations help a species survive? Give an example. **[2]**

Some variants may be able to live through a change in surroundings that kills the others, so the species continues. 1

Example: in a heat wave, most bacteria in warming water die, but heat-resistant variants survive and multiply. 1

A5. Free and attached earlobes are seen among the students of a class. What does this show? From whom does a child get its earlobe type? [2]

Earlobe type is an inherited trait, and individuals of a species vary in it. 1

The child gets one copy of the gene from each parent; the combination decides the earlobe type. 1

Mendel's experiments

A6. Give three reasons why Mendel chose the garden pea for his experiments. [3]

It has many clear contrasting traits (tall/dwarf, round/wrinkled …). 1

It normally self-pollinates, so pure lines are easy to get; it can also be cross-pollinated by hand. 1

Short life cycle and many seeds from each cross. 1

A7. Name four pairs of contrasting traits of the pea plant studied by Mendel, writing the dominant form first. [2]

Tall/dwarf stem; round/wrinkled seed; 1

yellow/green seed; violet/white flower (also axial/terminal flower, inflated/constricted pod, green/yellow pod). 1

A8. How do Mendel's experiments show that a trait may be dominant or recessive? [3]

Pure tall × pure dwarf gave only tall plants in F1 – the dwarf trait did not show. 1

On self-pollinating F1, about one-quarter of the F2 plants were dwarf. 1

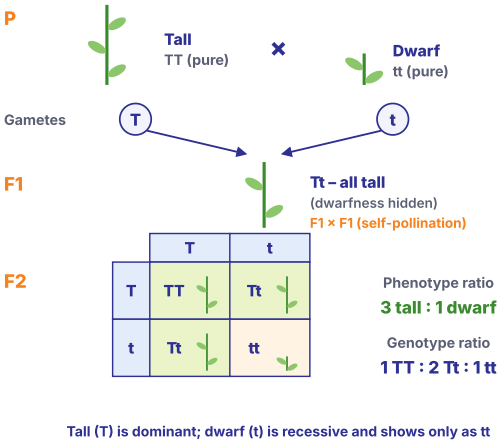
So the dwarf trait was present but hidden in F1 (recessive), while tall showed (dominant). 1

A9. Explain Mendel's monohybrid cross between a pure tall and a pure dwarf pea plant up to the F2 generation, giving the phenotypic and genotypic ratios. [5]

Parents TT × tt; gametes T and t. 1

F1: all Tt – tall. 1

F1 selfed: Tt × Tt; gametes T, t from each; Punnett square: 1



Tall (T) is dominant; dwarf (t) is recessive and shows only as tt

Phenotypic ratio 3 tall : 1 dwarf. 1

Genotypic ratio 1 TT : 2 Tt : 1 tt. 1

A10. How do Mendel's experiments show that traits are inherited independently? [3]

He crossed round-yellow (RRYY) with wrinkled-green (rryy) plants; F1 was all round-yellow. 1

The F2 had round-yellow, round-green, wrinkled-yellow and wrinkled-green seeds in the ratio 9 : 3 : 3 : 1. 1

New combinations (round-green, wrinkled-yellow) appeared, so the two traits were inherited independently. 1

A11. Tall pea plants with violet flowers were crossed with short plants with white flowers. All the offspring had violet flowers, but about half of them were short. Write the genotype of the tall parent and explain. [2]

TtWW. 1

All violet → the parent had only W (WW); half short → it carried one t (Tt), as the other parent was ttww. 1

A12. A man with blood group O and a woman with blood group B have a son with blood group O. Is this enough to tell which of the traits, B or O, is dominant? Why? [2]

No. 1

The son could get O from both parents whether B is dominant or recessive; one family is too small a sample – many crosses are needed. 1

A13. Children with light-coloured eyes are often found to have parents with light-coloured eyes. Can we say from this whether light eye colour is dominant or recessive? [2]

No. 1

The observation fits both cases; we need to see how the trait appears when light-eyed and dark-eyed people have children, over generations. 1

A14. Outline a project to find out which coat colour – black or white – is dominant in dogs. [3]

Take pure-breeding (true-breeding) black and white dogs and cross them. 1

Note the coat colour of all the puppies (F1): that colour is dominant. 1

Cross the F1 dogs among themselves: F2 should show about 3 dominant : 1 recessive, confirming the result. 1

Genes, chromosomes and expression

A15. What is a gene? How does a gene control the height of a plant? [3]

A section of DNA that carries the information for making one protein. 1

Height depends on a growth hormone, made with the help of an enzyme coded by a gene. 1

Efficient enzyme → more hormone → tall plant; altered gene → less efficient enzyme → less hormone → short plant. 1

A16. How is the equal genetic contribution of the male and the female parent ensured in the offspring? [2]

Each gamete gets only one chromosome of each pair (one set of genes). 1

At fertilisation the male and female gametes fuse, so the child gets one set from each parent. 1

A17. Why do gametes have only half the number of chromosomes found in body cells? [2]

When two gametes fuse, the zygote gets chromosomes from both. 1

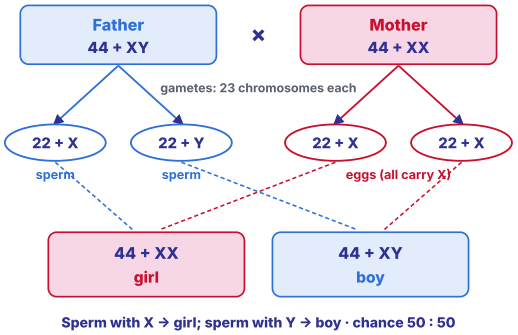
Halving keeps the chromosome number (and DNA) of the species constant from generation to generation. 1

Sex determination

A18. How is the sex of a child determined in human beings? Show with a flow chart. [3]

Mother XX gives only X eggs; father XY gives X or Y sperms in equal numbers. 1

Flow chart: 1



X sperm + X egg → XX girl; Y sperm + X egg → XY boy. 1

A19. "A mother is responsible for the sex of her child." Do you agree? Give a reason. [2]

No. 1

All eggs carry X; it is the father's sperm (X or Y) that decides the sex. 1

A20. Name two ways, other than sex chromosomes, by which sex is decided in some animals. [2]

In some reptiles, by the temperature at which the fertilised eggs are kept. 1

In snails, individuals can change sex. 1

A21. How many pairs of chromosomes do human cells have? How many are sex chromosomes, and how do they differ in men and women? [2]

23 pairs: 22 pairs of autosomes and 1 pair of sex chromosomes. 1

Women: XX (a perfect pair); men: XY (a mismatched pair, Y is short). 1

PART B · ANSWERS

B Exemplar Practice – Answers

Marking-scheme answers for every question in Part B of the chapter booklet.

Multiple choice

Q	Answer	Working / reason
B1	**(c)** White flower	Violet flower is dominant over white.
B2	**(b)** 3 : 1	3 dominant : 1 recessive.
B3	**(a)** 1 : 2 : 1	1 TT : 2 Tt : 1 tt.
B4	**(c)** 4	9 : 3 : 3 : 1 – four kinds.
B5	**(b)** 1 : 1	Half Tt, half tt.
B6	**(b)** XY	A mismatched pair.
B7	**(a)** 22	22 pairs + 1 pair of sex chromosomes.
B8	**(b)** 50%	Half the sperms carry Y.
B9	**(b)** genes	Units of heredity.
B10	**(b)** DNA	A gene is a section of DNA.

Short answer

B11. A pea plant with the genotype RrYy is self-pollinated. What fraction of the offspring will have wrinkled green seeds? Name the new combinations of traits that appear. [2]

Wrinkled green (rryy): 1/16. 1

New combinations: round green and wrinkled yellow. 1

B12. In a cross between two tall pea plants, 25% of the offspring were dwarf. What are the genotypes of the parents? Show the cross. [2]

Both parents are Tt (each carries the dwarf allele). 1

Tt × Tt → 1 TT : 2 Tt : 1 tt, so one-quarter (25%) are tt, dwarf. 1

B13. Pure red-flowered plants were crossed with pure white-flowered plants; all F1 plants had red flowers. The F1 plants were self-pollinated and gave 600 F2 plants. Which trait is dominant? How many red and white plants are expected? [3]

Red is dominant (all F1 red). 1

F2 ratio 3 red : 1 white. 1

Red = ¾ × 600 = 450; white = ¼ × 600 = 150. 1

B14. How can a tall plant carry the gene for dwarfness? How can you find out whether a tall plant is TT or Tt? [2]

A tall plant can be heterozygous (Tt); tall is dominant, so the t stays hidden. 1

Cross it with a dwarf (tt) plant: if any offspring are dwarf, the plant is Tt; if all are tall, it is TT. 1

B15. Distinguish between genotype and phenotype with an example. [2]

Genotype: the genes an organism has, e.g. TT, Tt or tt. 1

Phenotype: the trait that shows, e.g. tall or dwarf (TT and Tt are both tall). 1

B16. In some reptiles the sex of the young depends on temperature. Why is sex determination in humans called genetic? [2]

In humans the sex is decided by the sex chromosomes (genes) the child inherits. 1

XX gives a girl and XY a boy, whatever the surroundings. 1

PART C · ANSWERS

C Board Pattern Practice – Answers

Marking-scheme answers for every question in Part C of the chapter booklet.

Variation, genes and chromosomes

Q	Answer	Working / reason
C1	**(b)** 23	Half of 46.
C2	**(a)**	Both true; R explains A.

C3. "Proteins control the traits of an organism." Explain with the example of the height of a plant. [2]

A gene gives the information to make an enzyme (protein) that makes a growth hormone. 1

Efficient enzyme → more hormone → tall plant; a less efficient enzyme (altered gene) → less hormone → short plant. 1

C4. Give two reasons why variations are useful to a species. [2]

Some variants can survive sudden changes in the surroundings (heat, drought), so the species does not die out. 1

Variations add up over generations and give rise to diversity. 1

Monohybrid cross: dominant and recessive

Q	Answer	Working / reason
C5	**(a)** 100% and 75%	F1 all Tt; F2 3 : 1.
C6	**(b)** 1 : 2 : 1	From Tt × Tt.
C7	**(b)** recessive	It reappears in F2.
C8	**(a)**	Both true; R explains A.

C9. Pure violet-flowered pea plants were crossed with pure white-flowered plants. (a) What colour were the F1 flowers? (b) The F1 plants were self-pollinated – give the F2 ratio. (c) What do these results show? **[3]**

(a) All violet. 1

(b) 3 violet : 1 white. 1

(c) Violet is dominant and white recessive; the white factor stayed hidden in F1 and separated out in F2. 1

C10. Tt plants are self-pollinated and give 800 offspring. How many are expected to be tall, how many dwarf, and how many pure tall? **[3]**

Tall = ¾ × 800 = 600. 1

Dwarf = ¼ × 800 = 200. 1

Pure tall (TT) = ¼ × 800 = 200. 1

C11. Why does the dwarf trait disappear in the F1 generation and reappear in the F2? **[2]**

F1 plants are Tt; tall is dominant, so the dwarf factor is hidden. 1

The factors separate when gametes form; in F2 two t gametes can meet, giving tt (dwarf). 1

C12. Two tall pea plants were crossed and some of the offspring were dwarf. Explain with a cross. **[3]**

Dwarf offspring (tt) must get t from each parent, so both parents are Tt. 1

Gametes: T and t from each parent. 1

Tt × Tt → TT, Tt, Tt, tt: 3 tall : 1 dwarf. 1

Dihybrid cross

Q	Answer	Working / reason
C13	**(a)** all tall with round seeds	All TtRr.
C14	**(b)** 3	9 : 3 : 3 : 1.

C15. Mendel crossed pure round-yellow seeded plants with pure wrinkled-green seeded plants. (a) Give the phenotype and genotype of F1. (b) List the F2 phenotypes with their ratio. (c) What does this show? **[3]**

(a) Round, yellow; RrYy. 1

(b) Round yellow 9 : round green 3 : wrinkled yellow 3 : wrinkled green 1. 1

(c) Seed shape and seed colour are inherited independently. 1

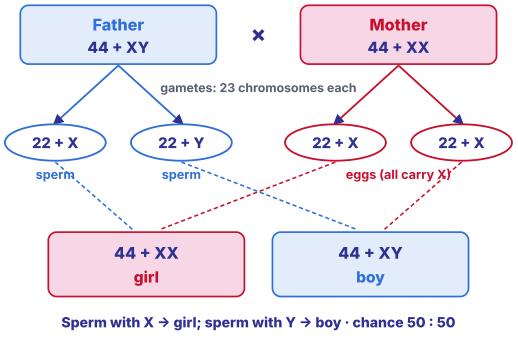
Sex determination

Q	Answer	Working / reason
C16	**(c)** either X or Y	The father is XY.
C17	**(b)** Snail	Sex in snails is not fixed.
C18	**(c)**	A is true; R is false.

C19. Draw a flow chart to show how the sex of a child is determined in human beings. [3]

Parents: father 44 + XY, mother 44 + XX; gametes: sperms 22 + X or 22 + Y, eggs 22 + X. 1

Flow chart: 1



Zygotes: 44 + XX girl, 44 + XY boy, in equal chance. 1

C20. A couple has two daughters. What is the chance that their third child will be a son? Explain. [2]

50%. 1

Each birth is independent: half the father's sperms carry Y, so every time the chance of a boy is one in two. 1

Long answer

C21. (a) What are dominant and recessive traits? (b) A tall pea plant of unknown genotype is crossed with a dwarf plant, and half the offspring are dwarf. Find the genotype of the tall plant, showing the cross. (c) Why does self-pollination of the F1 of a tall × dwarf cross give a 3 : 1 ratio? [5]

(a) Dominant: shows even with one copy (in the hybrid); recessive: shows only when both copies are recessive. 1

(b) Tall plant is Tt: Tt × tt; 1

gametes T, t and t → Tt (tall) and tt (dwarf) in 1 : 1. 1

(c) F1 is Tt; each parent gives T and t gametes in equal numbers. 1

Random fusion gives TT, Tt, Tt, tt: 3 tall (TT, Tt) : 1 dwarf (tt). 1

C22. (a) How many autosomes and sex chromosomes does a human body cell have? (b) Explain with a flow chart how the sex of a child is determined. (c) Why is the chance of a boy or a girl equal? (d) Name an animal in which sex is not decided genetically. **[5]**

(a) 44 autosomes (22 pairs) and 2 sex chromosomes (XX or XY). 1

(b) Father XY gives X or Y sperms; mother XX gives X eggs. 1

X sperm + egg → XX girl; Y sperm + egg → XY boy (flow chart as in Q C19). 1

(c) X-bearing and Y-bearing sperms are made in equal numbers. 1

(d) Snail (can change sex) or some reptiles (decided by temperature). 1

PART D · ANSWERS

D Case-Based Questions – Answers

Marking-scheme answers for every question in Part D of the chapter booklet.

D1. Case Study · Repeating Mendel [4]

(i) Which seed shape is dominant? **[1]**

Round. 1

(ii) What is the ratio of round to wrinkled seeds in F2? **[1]**

1200 : 400 = 3 : 1. 1

(iii) Of the 1600 F2 seeds, how many are expected to be pure-breeding round (RR)? Show the cross. **[2]**

Rr × Rr → 1 RR : 2 Rr : 1 rr. 1

RR = ¼ × 1600 = 400 seeds. 1

OR

(iii) What is the genotype of the F1 plants, and what percentage of the F2 seeds are heterozygous? **[2]**

F1: Rr. 1

Rr is 2 out of 4, i.e. 50% of the F2 seeds. 1

D2. Case Study · Boy or Girl? [4]

(i) Which sex chromosomes does the father have? **[1]**

XY. 1

(ii) Whose gamete decides the sex of the child? **[1]**

The father's sperm (it carries X or Y). 1

(iii) Show with a cross that the chance of a boy in each birth is 50%. **[2]**

XY × XX → sperms X, Y; eggs X, X. 1

Offspring XX, XX, XY, XY – 2 girls : 2 boys, so 50% boys. 1

OR

(iii) How is the sex of the young decided in some reptiles and in snails? **[2]**

Some reptiles: by the temperature at which the fertilised eggs are kept. 1

Snails: individuals can change sex. 1

D3. Case Study · Two Traits Together [4]

(i) Write the genotype of the F1 plants. **[1]**

TtVv. 1

(ii) How many kinds of plants (phenotypes) appear in F2? **[1]**

Four: tall violet, tall white, short violet, short white. 1

(iii) How many of the 320 F2 plants are expected to be short with violet flowers, and how many tall with white flowers? **[2]**

Ratio 9 : 3 : 3 : 1, so each of these classes is 3/16 of the total. 1

Short violet = 3/16 × 320 = 60; tall white = 60. 1

OR

(iii) What do the new combinations in F2 show? State the law involved. **[2]**

Tall-white and short-violet are new combinations not seen in the parents. 1

Height and flower colour are inherited independently (law of independent assortment). 1