

PRACTICE PAPER 01 (2026-27)

CHAPTER 08: HEREDITY (STEP-BY-STEP SOLUTIONS)

SUBJECT: SCIENCE

MAX. MARKS : 40

CLASS : X

DURATION : 1½ hrs

General Instructions:

- (i) All questions are compulsory.
- (ii) This question paper contains **20** questions divided into five Sections A, B, C, D and E.
- (iii) **Section A** comprises 10 MCQs and Assertion-Reason questions of **1 mark** each. **Section B** comprises 4 Very Short Answer questions of **2 marks** each. **Section C** comprises 3 Short Answer questions of **3 marks** each. **Section D** comprises 1 Long Answer question of **5 marks**. **Section E** comprises 2 Case Study Based questions of **4 marks** each.
- (iv) There is no overall choice. Internal choice is provided in Section E.
- (v) Use of calculators is not permitted.

SECTION - A

Questions 1 to 10 carry 1 mark each.

1. A pure tall pea plant (TT) is crossed with a pure short pea plant (tt). The F_1 plants will be
- (a) all TT and tall (b) all Tt and tall
(c) half tall and half short (d) all Tt and medium height

Solution:

Ans: (b) all Tt and tall

- Every F_1 plant gets T from one parent and t from the other. One copy of T is enough for tallness; there are no 'halfway' heights.

2. When F_1 tall plants (Tt) are self-pollinated, the ratio of tall to short plants in the F_2 generation is
- (a) 1 : 2 : 1 (b) 3 : 1
(c) 1 : 1 (d) 9 : 3 : 3 : 1

Solution:

Ans: (b) 3 : 1

- Genotypes TT : Tt : tt = 1 : 2 : 1; TT and Tt are both tall, so tall : short = 3 : 1 (one quarter short).

3. In a cross between pea plants with round, yellow seeds (RRYY) and wrinkled, green seeds (rryy), the F_2 generation shows the phenotypic ratio
- (a) 3 : 1 (b) 1 : 2 : 1
(c) 9 : 3 : 3 : 1 (d) 1 : 1 : 1 : 1

Solution:

Ans: (c) 9 : 3 : 3 : 1

- round-yellow : round-green : wrinkled-yellow : wrinkled-green = 9 : 3 : 3 : 1, showing independent inheritance.

4. Apart from the sex chromosomes, the number of pairs of chromosomes in human body cells is
- (a) 22 (b) 23
(c) 44 (d) 46

Solution:

Ans: (a) 22

- 22 pairs have a maternal and a paternal copy; the 23rd pair is the sex chromosomes.

5. A section of DNA that provides information for one protein is called a
- (a) chromosome (b) gene
(c) nucleus (d) gamete

Solution:

Ans: (b) gene

6. In some reptiles, the sex of the young ones is determined by
- (a) the sex chromosome from the father
(b) the sex chromosome from the mother
(c) the temperature at which fertilised eggs are kept
(d) the size of the egg

Solution:

Ans: (c) the temperature at which fertilised eggs are kept

- Sex determination here depends on an environmental cue, not on genes.

7. In an asexually reproducing species, trait X is found in 70% of the population and trait Y in 15%. Which trait is likely to have arisen earlier?
- (a) Trait X (b) Trait Y
(c) Both arose together (d) Cannot be predicted at all

Solution:

Ans: (a) Trait X

- A variation that arose earlier has been passed on through more generations of division, so it is present in a larger proportion of the population.

8. Mendel was able to arrive at the laws of inheritance mainly because he
- (a) studied inheritance in human beings
(b) kept count of the individuals showing a particular trait in each generation
(c) used only plants that reproduce asexually
(d) studied only one generation of plants

Solution:

Ans: (b) kept count of the individuals showing a particular trait in each generation

- He blended his knowledge of science and mathematics with careful counting.

In the following questions 9 and 10, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (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.

9. **Assertion (A):** All F_1 plants from a cross between pure tall and pure short pea plants are tall.
Reason (R): Tallness is a dominant trait, so a single copy of 'T' is enough to make the plant tall.

Solution:

Ans: (a)

- All F_1 plants are Tt; the dominant T is expressed. R explains A.

10. **Assertion (A):** A child who inherits an X chromosome from the father will be a boy.
Reason (R): Women have a perfect pair of sex chromosomes, XX.

Solution:

Ans: (d)

- (A) is false: X from the father gives XX – a girl; Y from the father gives a boy. (R) is true.

SECTION - B

Questions 11 to 14 carry 2 marks each.

- 11.** What are dominant and recessive traits? Explain with the example of tall and short pea plants.

Solution:

A trait that is expressed even when only **one copy** of its factor (gene) is present is **dominant**; a trait expressed only when **both copies** are the same is **recessive**. [1]

Example: TT and Tt plants are both **tall**, so 'T' (tallness) is dominant. Only tt plants are **short**, so 't' (shortness) is recessive. [1]

- 12.** Explain how a gene can control the height of a plant.

Solution:

Step 1: Plant height depends on the amount of a growth-triggering **plant hormone**. Step 2: The amount made depends on the efficiency of an **enzyme** involved in making it. [1]

Step 3: The enzyme is a protein made from the information in a **gene**. If the gene works well, the enzyme is efficient, much hormone is made and the plant is **tall**; if the gene is altered, the enzyme is less efficient, less hormone is made and the plant is **short**. Thus genes control traits. [1]

- 13.** (a) Why do plants in a field of sugarcane show very little variation, while human beings show quite distinct variations?

(b) Why do variants in a species not all have equal chances of survival?

Solution:

(a) Sugarcane is grown by **vegetative propagation** (asexual), so variation arises only from small inaccuracies in DNA copying. Humans reproduce **sexually**, which combines DNA from two different individuals and creates much greater diversity. [1]

(b) Depending on the nature of its variation, each individual has different advantages in its environment. e.g. bacteria that can withstand heat **survive better in a heat wave**. This selection of variants by environmental factors is the basis of evolution. [1]

- 14.** A man with free earlobes and a woman with attached earlobes have a son with attached earlobes. Is this information enough to decide which trait - free or attached earlobes - is dominant? Give a reason.

Solution:

No. [½]

The result can be explained either way: if attached were recessive, the father could carry one hidden copy for attached earlobes; if attached were dominant, the son could have got it from the mother. A single family with one child is too small a sample. [1]

To decide, we need data from **many families** (or a large class survey, as in Activity 8.1) and look at the ratios of offspring. [½]

SECTION - C

Questions 15 to 17 carry 3 marks each.

15. A pure-breeding tall pea plant is crossed with a pure-breeding short pea plant.

- (a) Show the cross up to the F_2 generation using a checkerboard.
- (b) Write the phenotypic and genotypic ratios of the F_2 generation.
- (c) What experiment would confirm that the F_2 tall plants are not all alike?

Solution:

(a) Parents: TT (tall) $\times$ tt (short). Gametes: T and t. F_1 : all **Tt (tall)**. $F_1 \times F_1$ (self-pollination): Tt $\times$ Tt; gametes T, t from each.

Gametes	T	t
T	TT (tall)	Tt (tall)
t	Tt (tall)	tt (short)

F_2 generation

[1½ marks]

(b) Phenotypic ratio tall : short = **3 : 1**; genotypic ratio TT : Tt : tt = **1 : 2 : 1**. [1]

(c) Let each F_2 tall plant **self-pollinate**: TT plants give only tall progeny, while Tt plants give some short progeny (about one quarter). [½]

16. (a) Why must each germ cell have only one set of genes?

- (b) The genes for seed shape and seed colour are inherited independently. How does the presence of genes on separate chromosomes make this possible?
- (c) How is the chromosome number of the species kept constant from one generation to the next?

Solution:

(a) Each body cell has two sets of genes, one from each parent. If germ cells also had two sets, every new generation would have **twice the genes** of the previous one. With one set per germ cell, fusion of two germ cells restores exactly two sets. [1]

(b) Each gene set is present not as one long thread of DNA but as **separate, independent pieces - chromosomes**. Every germ cell takes one chromosome from each pair, of either maternal or paternal origin, so genes on different chromosomes (e.g. for 'R' and 'y') are **not linked** and can be inherited independently. [1]

(c) Each germ cell gets one chromosome from each pair; when two germ cells combine during fertilisation the **normal number of chromosomes is restored** in the progeny, ensuring the stability of the DNA of the species. [1]

17. (a) If one bacterium divides, and the two bacteria formed divide again, how similar will the four bacteria be? Why?

- (b) Why does sexual reproduction generate greater diversity?
- (c) What does the second generation inherit in a reproducing population?

Solution:

(a) The four bacteria will be **very similar**, with only very minor differences, because the differences arise only from **small inaccuracies in DNA copying**. [1]

(b) In sexual reproduction, variations accumulated in **two different individuals** are combined, creating new combinations of traits each time. [1]

(c) It inherits the **differences of the first generation** as well as **newly created differences**; so variation accumulates over generations. [1]

SECTION - D

Question 18 carries 5 marks.

18. A pea plant with round, yellow seeds (RRYY) is crossed with a pea plant with wrinkled, green seeds (rryy).

(a) What will be the genotype and phenotype of the F_1 plants?

(b) Write the four types of gametes produced by the F_1 plants.

(c) Work out the F_2 generation using a checkerboard and give the phenotypic ratio.

(d) Which new combinations of traits appear in F_2 , and what conclusion did Mendel draw from them?

Solution:

(a) Gametes of parents: RY and ry. F_1 : **RrYy - round, yellow.** Round and yellow are dominant. [1]

(b) Each gamete takes one gene for shape and one for colour: **RY, Ry, rY, ry.** [1]

(c) $F_1 \times F_1$ (RrYy $\times$ RrYy):

Gametes	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Counting the 16 boxes: round-yellow (R_Y_) = 9; round-green (R_yy) = 3; wrinkled-yellow (rrY_) = 3; wrinkled-green (rryy) = 1.

Phenotypic ratio = **9 : 3 : 3 : 1.** [2]

(d) New combinations: **round-green** and **wrinkled-yellow** (not present in either parent).

Conclusion: the traits for seed shape and seed colour are **inherited independently** of each other. [1]

SECTION - E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

- 19.** A student repeated some of Mendel's experiments with pea plants differing in seed shape and recorded the results:

Cross	Parents crossed	Seeds obtained in the progeny
1	Pure-breeding round $\times$ pure-breeding wrinkled	120 round, 0 wrinkled
2	F_1 plants of cross 1, self-pollinated	450 round, 152 wrinkled
3	F_1 plant of cross 1 $\times$ pure-breeding wrinkled	205 round, 199 wrinkled

- (a) Which trait is dominant? How does cross 1 show this? **(1)**
(b) What is the approximate ratio in cross 2? Write the genotypes of the round-seeded plants obtained in it. **(1)**
(c) Explain the result of cross 3 using a checkerboard. What does this cross tell us about the F_1 plant? **(2)**

OR

- (c) Of the 450 round-seeded plants in cross 2, about how many would you expect to be pure-breeding? Explain. **(2)**

Solution:

(a) Round is dominant. In cross 1, all F_1 seeds are round - only one parental trait is seen, so it is the dominant one. [1]

(b) $450 : 152 \approx 3 : 1$ ($450 \div 152 \approx 2.96$). Round plants: **RR and Rr**. [$\frac{1}{2} + \frac{1}{2}$]

(c) F_1 (Rr) $\times$ wrinkled (rr): gametes R, r $\times$ r.

Gametes	r
R	Rr (round)
r	rr (wrinkled)

Expected round : wrinkled = **1 : 1**, matching 205 : 199. This shows the F_1 round plant carries a hidden recessive factor, i.e. it is **Rr**, not RR. [2]

OR

(c) Among round F_2 plants, $RR : Rr = 1 : 2$, so **one-third** are pure-breeding (RR). [1]

Expected pure-breeding plants = $450 \times \frac{1}{3} = \mathbf{150}$. [1]

20. Read the passage and answer the questions that follow.

Different species use very different strategies to determine sex. In some reptiles the temperature of the fertilised eggs decides it, and snails can even change sex. In human beings, sex is largely genetically determined. Of the 23 pairs of human chromosomes, 22 pairs have a maternal and a paternal copy, but one pair – the sex chromosomes – is not always a perfect pair. A couple who have two daughters are being told by relatives that the mother is 'responsible' for not having a son.

- (a) Give one example each of an organism whose sex is determined by (i) an environmental factor and (ii) is not genetically fixed. **(1)**
(b) Why are the sex chromosomes in men said to be a 'mismatched pair'? **(1)**
(c) Show, with a cross, how the sex of a child is determined in human beings. Is the relatives' claim correct? What is the chance that their third child will be a boy? **(2)**

OR

- (c) Write the sex chromosomes present in (i) a human egg, (ii) the two kinds of sperm and (iii) the zygote that develops into a girl. Why do all children inherit an X chromosome from the mother? **(2)**

Solution:

(a) (i) Some **reptiles** – temperature of the eggs. (ii) **Snails** – individuals can change sex. [$\frac{1}{2}$ + $\frac{1}{2}$]

(b) Men are **XY**: one is a normal-sized **X** while the other is a short one called **Y**. Women have a perfect pair, **XX**. [1]

(c) Mother (**XX**) gives only X eggs; father (**XY**) gives X or Y sperms.

Egg / Sperm	X	Y
X	XX (girl)	XY (boy)
X	XX (girl)	XY (boy)

The sex of the child depends on whether the father contributes **X (girl)** or **Y (boy)**, so the claim against the mother is **incorrect**. Each child has a **50% (1 in 2)** chance of being a boy, regardless of earlier children. [2]

OR

(c) (i) Egg: **X**. (ii) Sperms: **X** or **Y**. (iii) Zygote of a girl: **XX**. [$1\frac{1}{2}$]

The mother has only X chromosomes (**XX**), so every egg carries an X. [$\frac{1}{2}$]

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