Heredity

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. In pea plants (T = tall, t = dwarf), the cross TT × tt gives plants in the ratio:

(a) all tall **(b)** 3 tall : 1 dwarf
(c) 1 tall : 3 dwarf **(d)** 1 tall : 1 dwarf

2. A pure-breeding plant with round seeds is crossed with a pure-breeding plant with wrinkled seeds, and the F_1 plants are self-pollinated. Out of 104 F_2 seeds, about how many are round?

(a) 52 **(b)** 104 **(c)** 26 **(d)** 78

3. Mendel carried out his experiments on:

(a) maize **(b)** the fruit fly **(c)** the garden pea **(d)** mice

4. Which of these traits is dominant in pea plants?

(a) constricted pods **(b)** round seeds
(c) white flowers **(d)** green seeds

5. A pea plant with the genotype Gg (G = green, g = yellow) has:

(a) pods of an in-between kind **(b)** yellow pods
(c) some green and some yellow pods **(d)** green pods

6. Pea plants YyVv × YyVv are crossed (Y = yellow, y = green; V = violet, v = white). What fraction of the offspring will have green and white characters?

(a) 1/16 **(b)** 9/16 **(c)** 1/32 **(d)** 3/4

7. For a couple, each child is equally likely to be a boy or a girl. What is the probability that their next child is a girl?

(a) 15/16 **(b)** 31/32 **(c)** 1 **(d)** 1/2

8. Assertion (A): In pea plants (I = inflated, i = constricted), a cross Ii × ii gives pods in the ratio 3 inflated : 1 constricted.
Reason (R): Each parent passes one of its two copies of a gene to each offspring, each copy with an equal chance.

(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 — Short answer — 8 × 2 = 16 marks

9. In pea plants, I = inflated, i = constricted. Cross Ii with Ii. Give the genotypes of the offspring with their ratio, and the ratio of the phenotypes.

10. Pea plants IIAA × iiaa are crossed (I = inflated, i = constricted; A = axial, a = terminal) and the F_1 plants are self-pollinated. Out of 896 F_2 plants, how many of each kind are expected?

11. A cross between two pea plants gave 501 tall plants and 167 dwarf plants. What were the genotypes of the parents? (T = tall, t = dwarf)

12. What is the difference between an inherited trait and an acquired trait? Give an example of each.

13. What kinds of gametes can a pea plant of genotype AA produce?

14. A couple has 1 son. What is the probability that their next child is a daughter? What is the probability that their next 4 children are all daughters?

15. Classify each trait as inherited or acquired: the ability to swim; blood group; knowledge of mathematics; natural hair colour.

16. A cross gave 1,908 green pods and 658 yellow pods. Find the ratio green : yellow (to 2 decimal places, as x : 1). Which simple ratio is it close to, and what were the parents? (G = green, g = yellow)

Section C — Word problems — 4 × 4 = 16 marks

17. Explain Mendel's monohybrid cross between a tall and a dwarf pea plant up to the F_2 generation.

18. A pure-breeding pea plant with violet flowers and green pods (VVGG) is crossed with one with white flowers and yellow pods (vvgg). (a) What are the genotype and phenotype of the F_1? (b) What gametes does an F_1 plant make? (c) Give the F_2 phenotypes and the number of each expected among 784 plants. (d) What does this show?

19. Cross iiGg with iiGg (I = inflated, i = constricted; G = green, g = yellow). List the kinds of offspring (phenotypes) and give their ratio. Show the working for each trait separately.

20. A couple has 4 boys. (a) What sex chromosomes do the mother's eggs and the father's sperm carry? (b) Who decides the sex of the child? (c) What is the probability that the next child is a girl? (d) What is the probability that the next 2 children are both boys?

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Answer key

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Q	Answer	Working
1	**(a) all tall**	offspring: all Tt
2	**(d) 78**	round : total = 3 : 4
3	**(c) the garden pea**	—
4	**(b) round seeds**	—
5	**(d) green pods**	G is dominant, so one copy is enough
6	**(a) 1/16**	1/4 × 1/4
7	**(d) 1/2**	$(1/2)^1$
8	**(d) A is false, but R is true.**	A is false: offspring Ii : ii = 1 : 1, so 1 inflated : 1 constricted. R is true.
9	**Genotypes II : Ii : ii = 1 : 2 : 1; phenotypes 3 inflated : 1 constricted**	gametes I, i × I, i
10	**inflated pods and axial flowers: 504; inflated pods and terminal flowers: 168; constricted pods and axial flowers: 168; constricted pods and terminal flowers: 56**	9 : 3 : 3 : 1, each part = 896 ÷ 16 = 56
11	**Tt × Tt**	a 3 : 1 ratio: both parents hybrid
12	**Inherited traits are passed from parents through genes (e.g. eye colour). Acquired traits are developed during life and not passed on, because they do not change the DNA of the reproductive cells (e.g. a scar, or knowledge).**	—
13	**A (one kind only)**	each gamete gets one copy of each gene
14	**1/2 (earlier children do not change it); 1/16**	each child: X or Y sperm equally likely; $(1/2)^4$
15	**the ability to swim: acquired; blood group: inherited; knowledge of mathematics: acquired; natural hair colour: inherited**	—
16	**2.90 : 1, close to 3 : 1; parents Gg × Gg**	1908 ÷ 658
17	**TT (tall) × tt (dwarf): all F_1 plants are Tt and tall. F_1 plants self-pollinate: Tt × Tt gives TT, Tt, Tt, tt. F_2 genotype ratio 1 : 2 : 1; phenotype ratio 3 tall : 1 dwarf. The dwarf trait, hidden in F_1, reappears in F_2.**	—
18	**(a) VvGg, with violet flowers and green pods. (b) VG, Vg, vG, vg. (c) violet**	—

Q	Answer	Working
	flowers and green pods 441, violet flowers and yellow pods 147, white flowers and green pods 147, white flowers and yellow pods 49 (9 : 3 : 3 : 1). (d) The two traits are inherited independently.	
19	**constricted green pods : constricted yellow pods = 3 : 1**	pod shape: all constricted; pod colour: 3 green : 1 yellow; multiply
20	**(a) Every egg carries X; half the sperm carry X and half carry Y. (b) The father, through the sperm. (c) 1/2. (d) 1/4.**	$(1/2)^2$

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