Plant Growth and Development

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. The plant hormone that promotes cell division is:

(a) abscisic acid **(b)** ethylene **(c)** auxin **(d)** cytokinin

2. Which plant hormone promotes cell division?

(a) Abscisic acid **(b)** Ethylene **(c)** Cytokinin **(d)** Gibberellin

3. Leaf A grows from 4 cm^2 to 5 cm^2 and leaf B from 10 cm^2 to 11 cm^2 in the same day. Which has the higher relative growth rate?

(a) Both are equal **(b)** Leaf B **(c)** Leaf A **(d)** Cannot be told

4. Maize is a day-neutral plant. Grown with 11 hours of light a day, it will:

(a) flower **(b)** die at once

(c) not flower **(d)** flower only after vernalisation

5. A root 13 mm long grows arithmetically by 7 mm a day. Its length after 13 days is:

(a) 91 mm **(b)** 111 mm **(c)** 20 mm **(d)** 104 mm

6. Which hormone was discovered through the Darwins' canary grass coleoptiles; isolated by F. W. Went from oat coleoptiles?

(a) Auxin **(b)** Abscisic acid **(c)** Cytokinin **(d)** Ethylene

7. To which group of plant hormones does IAA (indole-3-acetic acid) belong?

(a) Cytokinin **(b)** Ethylene **(c)** Auxin **(d)** Abscisic acid

8. Assertion (A): Leaf A (50 cm^2 to 54 cm^2) has a higher relative growth rate than leaf B (5 cm^2 to 9 cm^2) over the same day.
Reason (R): Relative growth rate is the growth in a given time divided by the starting size.

(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. What is the difference between arithmetic and geometric growth?

10. Give two effects of ethylene.

11. A stem grows arithmetically from 18 cm to 128 cm in 10 days. Find its growth rate, and its length after 15 days.

12. A colony of cells growing geometrically doubles every 8 hours. Starting from 1 cell, how many are there after 56 hours?

13. Chrysanthemum is a short-day plant with a critical day length of 12 hours. Will it flower with 11 hours of light a day? With 15 hours?

14. Name another compound in the same group of plant hormones as dormin.

15. A leaf grows from 5 cm^2 to 10 cm^2 in a day. Find its absolute and relative growth rates.

16. How was ethylene discovered?

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

17. Describe arithmetic and geometric growth, with their equations and growth curves.

18. Plant P grows arithmetically, adding 3 mm a day from 1 mm. Plant Q grows geometrically, doubling every day from 1 mm. (a) Find each length after 7 days. (b) Which equation describes each? (c) Why can geometric growth not continue for ever?

19. Leaf A grows from 8 cm^2 to 12 cm^2 and leaf B from 100 cm^2 to 104 cm^2 in one day. (a) Find the absolute growth rate of each. (b) Find the relative growth rate of each. (c) Which measure better compares how fast they are growing, and why?

20. Three plants, barley (long-day), spinach (long-day), cocklebur (Xanthium) (short-day), are grown with 16 hours of light a day. Taking the critical day length as 14 hours, which will flower? Which part of the plant senses the day length?

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Answer key

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Q	Answer	Working
1	**(d) cytokinin**	—
2	**(c) Cytokinin**	—
3	**(c) Leaf A**	relative growth rate = 1 ÷ starting size: A 25%, B 10% a day
4	**(a) flower**	day-neutral plants flower whatever the day length
5	**(d) 104 mm**	Lt = L0 + rt = 13 + 7 × 13
6	**(a) Auxin**	—
7	**(c) Auxin**	—
8	**(d) A is false, but R is true.**	A is false: A 8%, B 80%. R is true.
9	**In arithmetic growth only one daughter cell keeps dividing, so growth is a constant amount each time (a straight line, Lt = L0 + rt). In geometric growth both cells keep dividing, so growth speeds up (an S-shaped curve when nutrients become limited).**	—
10	**Promotes female flowers in cucumber; Causes leaf and flower abscission**	—
11	**11 cm a day; 183 cm**	r = (128 − 18) ÷ 10
12	**128**	7 doublings: 1 × 2^7
13	**Yes with 11 hours; no with 15 hours**	a short-day plant flowers only when the light period is shorter than 12 hours
14	**Abscisic acid itself**	—
15	**Absolute 5 cm^2 a day; relative 100% a day**	5 ÷ 5 × 100
16	**A volatile substance from ripe oranges that hastened ripening of bananas (H. H. Cousins)**	—
17	**Arithmetic: after mitosis one daughter cell divides and the other differentiates; growth is linear, Lt = L0 + rt (a root growing at a constant rate). Geometric: both daughter cells divide; W1 = W0 e^(rt), where r is the relative growth rate; growth starts slowly (lag phase), then fast (log or exponential phase), then slows as nutrients run short (stationary phase), giving an S-shaped (sigmoid) curve.**	—

Q	Answer	Working
18	**(a) P 22 mm; Q 128 mm; (b) P: Lt = L0 + rt (arithmetic); Q: W1 = W0 e^(rt), here doubling (geometric); (c) nutrients and space become limiting, so growth slows (S-shaped curve)**	P: 1 + 3 × 7; Q: 2^7
19	**(a) both 4 cm^2 a day; (b) A 50%, B 4% a day; (c) the relative rate, because it takes the starting size into account: A is growing much faster for its size**	relative growth rate = growth ÷ starting size
20	**barley: flowers; spinach: flowers; cocklebur (Xanthium): does not flower; the leaves sense the photoperiod**	—

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