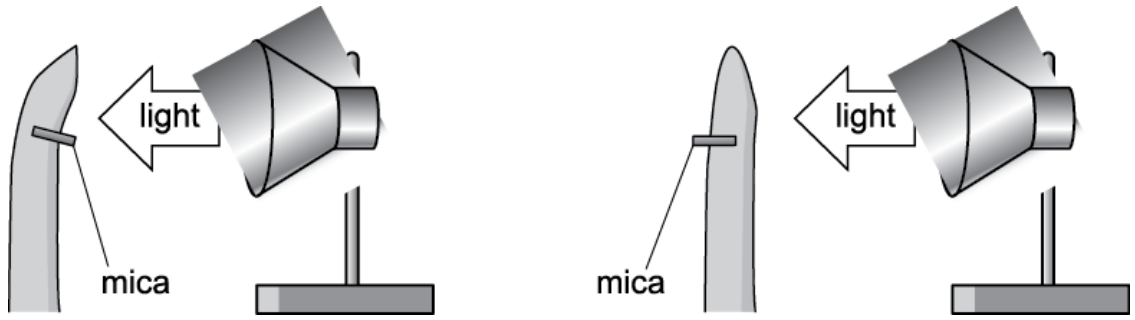
Plant Responses

1. In 1913, scientist Peter Boysen-Jensen investigated phototropism in plants.

He inserted mica plates into growing shoots illuminated from one side only. Mica allows electrical impulses to pass through, but does not allow soluble molecules to pass through.

The diagram below summarises Boysen-Jensen's results.



Which of the following statements correctly explains these results?

1 The factor causing phototropism moves away from the tip.

2 The factor causing phototropism is not an electrical impulse.

3 The factor causing phototropism moves away from light.

A 1, 2 and 3

B Only 1 and 2

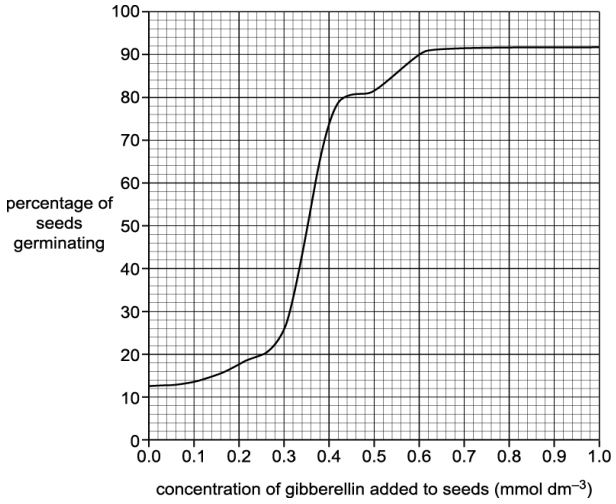
C Only 2 and 3

D Only 1

Your answer

[1]

2. The following graph shows the results of a study into the effects of gibberellin concentration on the germination of seeds.



Which of the following statements correctly describes the data in the graph?

1. 13% of cells germinate without the addition of extra gibberellin.
2. Gibberellin concentrations of greater than 0.5 mmol dm^{-3} do not result in seed germination greater than 84%.
3. Concentration of gibberellin has the biggest effect on seed germination between 0.21 mmol dm^{-3} and 0.35 mmol dm^{-3}.

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

[1]

3. The following passage outlines the process of phototropism in plants:

Auxin is synthesised in cells at the ..... of the shoot. Auxin causes the cells to ..... on one side, so the stem bends.

Scientists originally thought auxin was ..... by light but this was disproved by the fact that plants growing in the dark and plants growing in unilateral light had ..... auxin levels.

Which option, **A** to **D**, is the correct sequence of missing words?

A meristem, shorten, destroyed, different
B tip, elongate, destroyed, similar
C meristem, shorten, synthesised, raised
D tip, elongate, synthesised, similar

Your answer ☐

[1]

4. The commercially grown tobacco plant, *Nicotiana rustica*, has many pests. One such insect pest is *Manduca sexta*, which causes damage to the stems and leaves of *N. rustica*.

The tiny wasp *Cotesia congregata* lays its eggs inside the body of *M. sexta*. When the larvae develop they feed on the body of the host, eventually killing it.

N. rustica produces a volatile organic compound called volicitin when its leaves are damaged.

Volicitin attracts *C. congregata* at high concentrations.

Which of the following explains why *N. rustica* releases volicitin?

1 volicitin release reduces herbivory in *N. rustica*
2 volicitin release increases *M. sexta* growth rate
3 volicitin release reduces parasitism of *M. sexta* by *C. congregata*

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

[1]

5. Which of the following statements, **A** to **D**, is evidence for geotropism?

A leaves are shed from deciduous plants in the autumn
B roots grow downwards
C shoots grow towards the light
D flowers can change position throughout the day

Your answer ☐

[1]

6. Many trees drop their leaves in the autumn.

Which of the following plant hormones is/are thought to be involved in the control of leaf drop?

1 auxin
2 ethene
3 gibberellin

A 1, 2 and 3
B only 1 and 2
C only 2 and 3
D only 1

Your answer ☐

[1]

7. Many plants have defensive responses to herbivores.

State **one** example of a response that plants use against herbivory.

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[1]

8. Plants have evolved response mechanisms to a variety of abiotic and biotic stimuli.

Flowering plants respond to changes in the length of day. The advantage of this response is that these plants begin to flower only when environmental conditions are favourable.

Karl Hamner studied the effect of exposure to light and darkness on flowering in cocklebur plants. He placed cocklebur plants in darkness for different periods of time. Some of his results are shown in Table 6.1.

Period of darkness (h)	Flash of light during the period of darkness?	Flower production
8.5	No	Yes
6.5	No	No
12.5	Red light after 6 hours	No
12.5	Red light after 6 hours, followed by a flash of far red light	Yes
6.5	Several flashes of far red light	Yes

Table 6.1

Suggest what conclusions can be drawn from the results in Table 6.1 about the effect of exposure to light and darkness on flowering in cockleburs.

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[3]

9. Plant hormones affect the growth of plant tissues in different ways.
One such effect is to promote the formation of seedless fruit.
Cytokinins are a group of plant hormones.
A commercial plant hormone firm carried out research into three different cytokinins: kinetin, zeatin and diatin.
The firm investigated the effect of adding different volumes of each cytokinin on the production of seedless fruit.
The cytokinins were sprayed on the flowers of different plants. Over time, the mass of seedless fruits produced by the plants was measured.

Fig. 21 is a summary of their results.

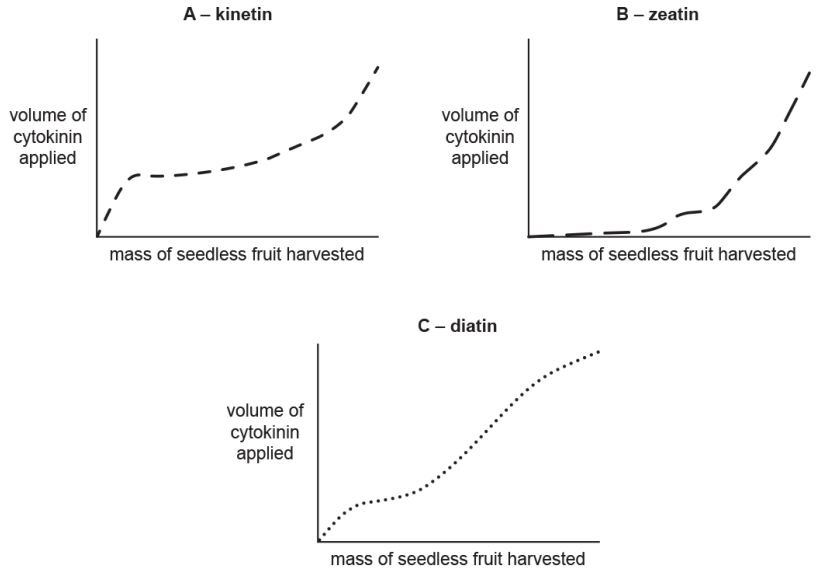

Fig. 21

On the basis of these results, the firm decided to use diatin in their new plant spray.
The firm made the following claim on their packaging:
Diatin is scientifically proven to cause production of seedless fruit when applied to flowers.

Evaluate the firm's claim, using the evidence in Fig. 21.

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[6]

10(a). Students investigated the effect of light on the growth of garden cress seedlings.

- A total of 120 seedlings were divided into 2 groups of 60.
- Group A was grown in darkness for 2 days.
- Group B was grown for 1 day in darkness and then for 1 day in white light using the set-up shown in Fig. 3.1.

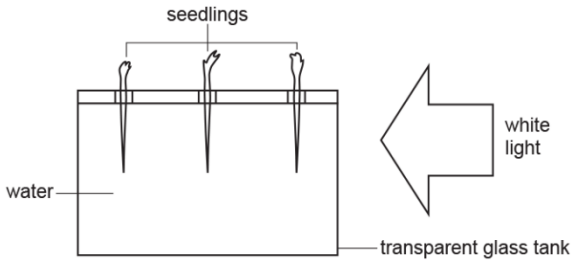

Fig. 3.1

The results of the students' experiment are shown in Tables 3.1 and 3.2.

Group	Mean length (mm)		Mean mass (µg)	
	stem	root	stem	root
A	13	18	102	60
B	25	23	160	120

Table 3.1

	Number of seedlings	
Direction of growth in Group B	**stem**	**root**
Away from light	2	29
Neither away from nor towards light	3	20
Towards light	55	11

Table 3.2

i. * Describe and explain the results shown in Tables 3.1 and 3.2.

[6]

ii. The students wanted to test whether there was a significant difference between the stem lengths of the seedlings in Group A and the seedlings in Group B.

State the name of the most appropriate statistical test for the students to use.

[1]

iii. Justify your choice of statistical test given in part **(ii)**.

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[1]

iv. Table 3.2 records the direction of growth as:

- away from light
- neither away from nor towards light
- towards light.

The students used the chi-squared test to determine whether the direction of root growth was significantly different from their expectations.

Their null hypothesis was:

There is no difference between the expected direction of root growth and the observed direction of root growth.

The calculated chi-squared value was 8.10.

The students compared their chi-squared value of 8.10 to the values in Table 3.3.

Degrees of freedom	Probability (*p*)		
	0.10	**0.05**	**0.01**
1	2.71	3.84	6.64
2	4.60	5.99	9.21
3	6.25	7.82	11.34
4	7.78	9.49	13.28
5	9.24	11.07	15.09

Table 3.3

What can the students conclude about their results based on a chi-squared value of 8.10?

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[3]

(b). Students investigated the effect of plant hormone concentration on root growth.

i. State the name of a plant hormone that would be expected to affect root growth.

_____ **[1]**

ii. In the investigation, the students controlled light, temperature and mineral concentration.

State one **other** factor that the students should have controlled in this investigation.

_____ **[1]**

(c). The growth of plant roots is thought to be controlled by specialised cells called statocytes.

One hypothesis for how a statocyte controls root growth involves small organelles called amyloplasts and is shown in Fig. 3.2.

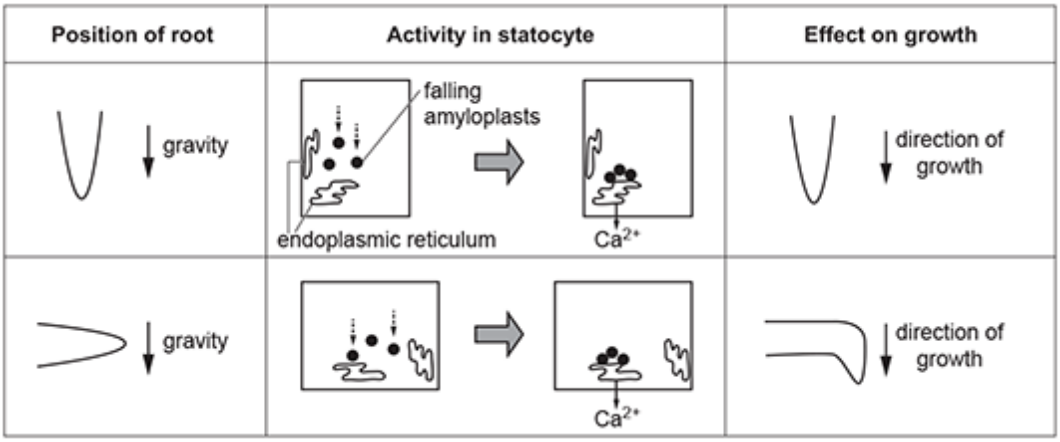

Fig. 3.2

What can you conclude from the information in Fig. 3.2 about how a statocyte controls root growth?

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_____ **[2]**

11. * The orange tree, *Citrus sinensis,* is an important crop plant.

Scientists applied the following treatments to commercial orange trees:

- Gibberellins were applied at various stages of development.
- Auxins were applied during development and to mature orange trees.

The treated orange trees were compared to untreated orange trees. Scientists observed that the treated trees:

- had slightly shorter roots
- grew taller
- all began to grow within two days of each other
- had fewer and shorter side branches
- retained their fruit and leaves for longer.

Suggest explanations for each of these observations.

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_____ **[6]**

12. Flowering plants often produce fruit.

State **one** hormone that promotes the ripening of fruit.

_____ **[1]**

13. Herbicides work in a number of different ways.

i. Some herbicides, known as phenoxy herbicides, mimic the action of the auxin, indoleacetic acid (IAA).

What is the normal action of IAA in plant cells?

_____ **[1]**

ii. The herbicide atrazine works by disabling plastoquinone, one of the proton pumps in photosystem II.

Explain how atrazine would kill a susceptible plant.

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_____ **[5]**

14. Bonsai trees are miniature versions of full-sized trees grown in small pots. Bonsai trees can be grown from a range of different woody plants. They are carefully grown and cut to give the desired shape.

The following observations have been made about the growth of bonsai trees:

- Removing the top growing tip encourages a bushier shape.
- Allowing the tip to grow encourages a more conical shape.
- Allowing the tip to grow prevents the lower stems from growing evenly.

A student drew the following conclusion for these observations:

> These observations suggest that a plant hormone plays an important part in the growth of bonsai trees.

Using your knowledge of plant growth, evaluate the student's conclusion.

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_____ **[3]**

15(a). Gibberellin causes stem elongation in plants.

Fig. 17.1 shows the effect of gibberellin on cabbage plants.

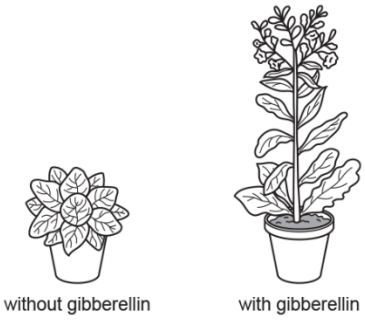

Fig. 17.1

Gibberellin causes an increase in the distance between the leaves on the stem, which is known as the internodal length.

Explain why gibberellin is classed as a plant **hormone**.

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_____ **[3]**

(b). A scientist carried out an investigation into the effect of gibberellin on cabbage plants.

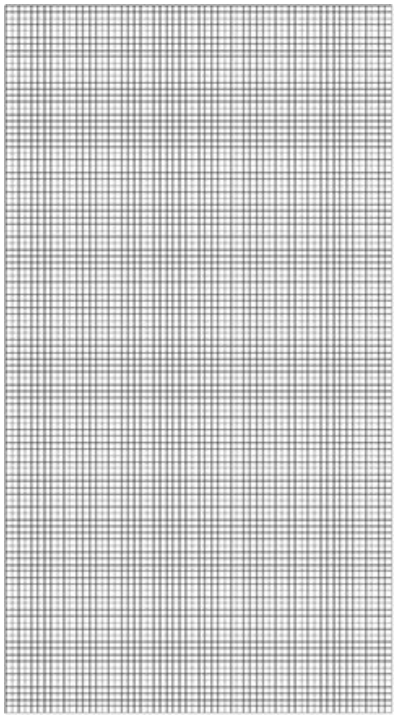
The scientist applied a range of volumes of gibberellin and measured the rate of increase of internodal length over 30 days.

Table 17 shows the scientist's results.

Volume of gibberellin applied ($x10^{-3}$ cm^3 kg^{-1} day^{-1})	**Rate of increase of internodal length (mm day^{-1})**
0.0	1
0.2	1
0.4	2
0.6	4
1.2	47
1.4	48
1.8	49
1.9	50
2.0	50

Table 17

i. Plot the results from Table 17 as a suitable graph.



[4]

ii. Gibberellin causes an increase in internodal length.

State one **other** role of gibberellin in plants.

_____

_____ **[1]**

16. A response affected by plant hormones is phototropism.

A student completed an investigation into phototropism in cress seeds.

This was the method used:

- Place 50 cress seeds (*Lepidium sativum*) on a sterile paper towel in a petri dish.
- Water with 10 cm^3 of distilled water.
- Repeat for 3 different sets of seeds:
  – Set 1 is placed in a box to prevent light shining on the seeds.
  – Set 2 is placed in a box with light from above only.
  – Set 3 is placed in a box with light from the right hand side only.
- Keep all 3 sets at 25 °C.
- After 72 hours, remove 20 of the seedlings from each set and count how many have bent.

Identify **two** limitations of the student's method.

For each limitation, explain how it limits the validity of conclusions that can be drawn **and** suggest an improvement that would improve the validity of conclusions made.

limitation 1:

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explanation:

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improvement:

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limitation 2:

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explanation:

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improvement:

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[6]