15. Control and Coordination

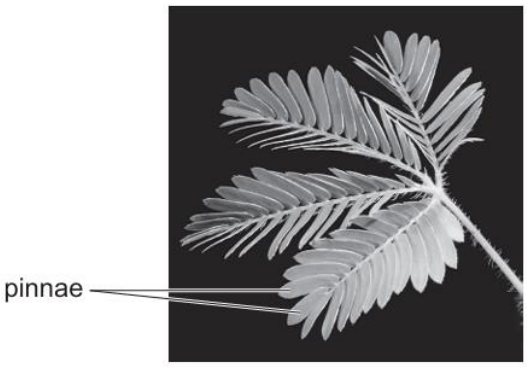
15.2 Control and Coordination in Plants

Paper 4

Question Paper

1 The leaves of *Mimosa pudica* plants are made of a number of structures known as pinnae. The pinnae fold when the leaf is touched. This closes the leaf.

Fig. 4.1 shows an open leaf of *M. pudica* before it is touched. Fig. 4.2 shows the same leaf that has closed after being touched.



A open (not touched)

Fig. 4.1



B closed (touched)

Fig. 4.2

(a) A touch stimulus to an *M. pudica* leaf causes an action potential to be generated.

The action potential results in changes in cells, which cause the leaf to close.

Fig. 4.3 shows the mechanism in *M. pudica* cells that causes the leaf to close.

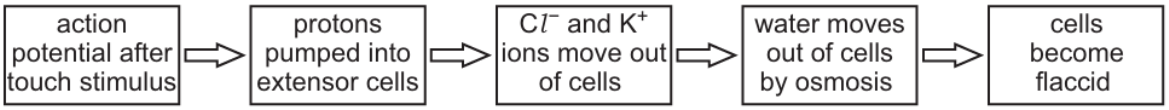


Fig. 4.3

The leaves of *M. pudica* and the leaves of Venus fly traps move in response to touch stimuli, but the mechanisms that cause the responses are different.

Describe the differences between the mechanism shown in Fig. 4.3 and the mechanism that causes the closure of the modified leaves in Venus fly traps.

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2 *Oryza* is a genus of grass plants that includes the rice, *Oryza sativa*, a food crop.

(a) Farmers flood fields of rice because this encourages faster growth and higher yields.

(iv) Auxin is a plant growth hormone that affects the growth of rice stems.

Explain how auxin affects the growth of rice stems.

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3 There are more than 600 plant species in the genus *Ipomoea*. Many species are grown for their attractive flowers, and some species are used as crop plants.

(d) Scientists are researching whether abscisic acid can be used in crop treatment to increase yield. Evidence suggests that abscisic acid modifies the effect of auxin on elongation growth in plants.

(i) Scientists investigated the effect of different concentrations of abscisic acid on root elongation in seedlings of thale cress, *Arabidopsis thaliana*.

The seedlings were divided into four groups:

- a control group (0.0 μmol abscisic acid)
- three experimental groups, each treated with a different concentration of abscisic acid: 0.1 μmol, 1.0 μmol, or 10.0 μmol.

For each group of seedlings, root length was measured for six days during treatment. The rate of root elongation was calculated each day.

The results are shown in Fig. 3.3.

Key

● control (no abscisic acid)

⊙ 0.1 μmol of abscisic acid

× 1.0 μmol of abscisic acid

△ 10.0 μmol of abscisic acid

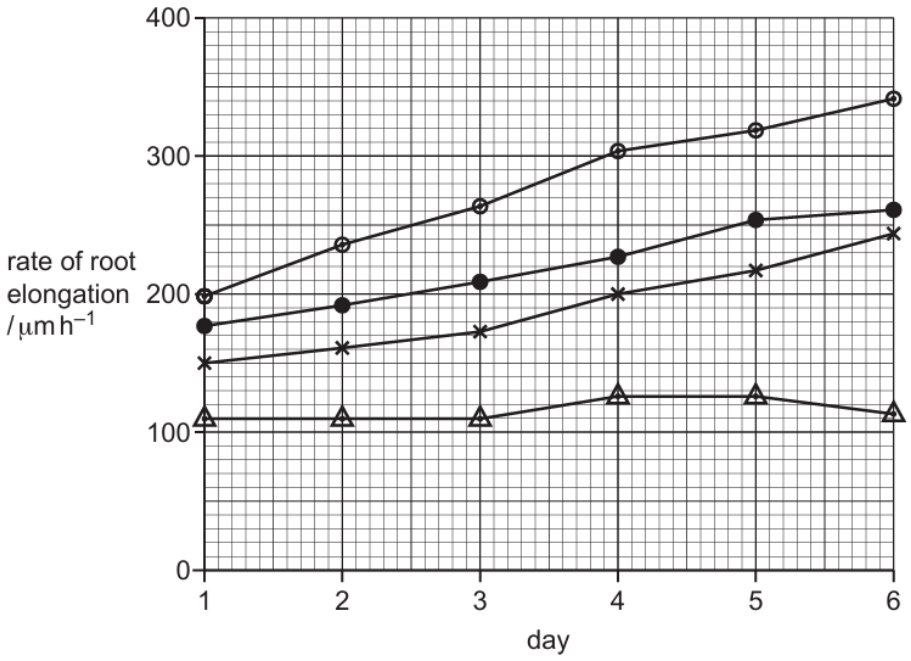


Fig. 3.3

With reference to Fig. 3.3, describe the effect of treatment with abscisic acid on the rate of root elongation.

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(ii) The passage outlines the role of auxin in elongation growth in plants.

Complete the passage by using the most appropriate scientific terms.

The binding of auxin to receptors causes ..... to be pumped into cell walls.

This activates proteins called expansins, which disrupt the links between

..... microfibrils. The cell walls are then able to expand.

[2]

4 **(a)** Gibberellin is a plant hormone that has an important role in seed germination.

Fig. 6.1 is a diagram of a section through a barley seed (grain).

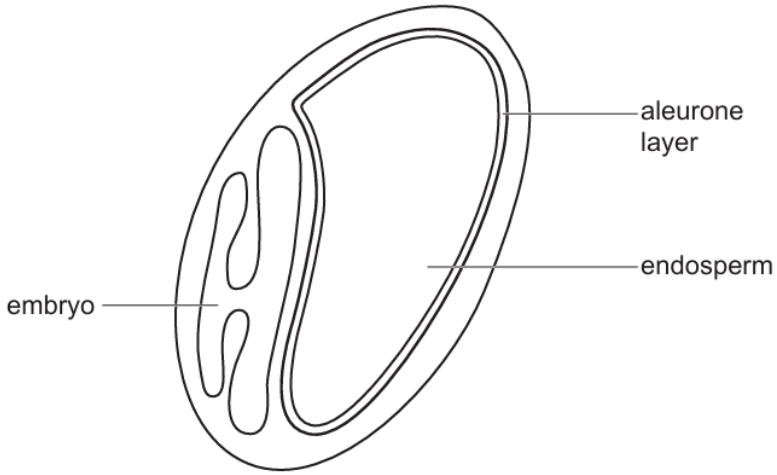


Fig. 6.1

On Fig. 6.1:

- Draw **one** arrow, labelled **G**, to show the movement of gibberellin during germination.
- Draw **one** arrow, labelled **A**, to show the movement of amylase during germination.

[2]

(b) Outline the role of amylase in seed germination.

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(c) The germination of three groups of seeds of the plant *Penstemon digitalis* was investigated.

The seeds were soaked for 24 hours in distilled water or in a solution of gibberellin. They were then sown on filter paper in dishes and kept moist for 10 days.

Fig. 6.2 shows the results for each group.

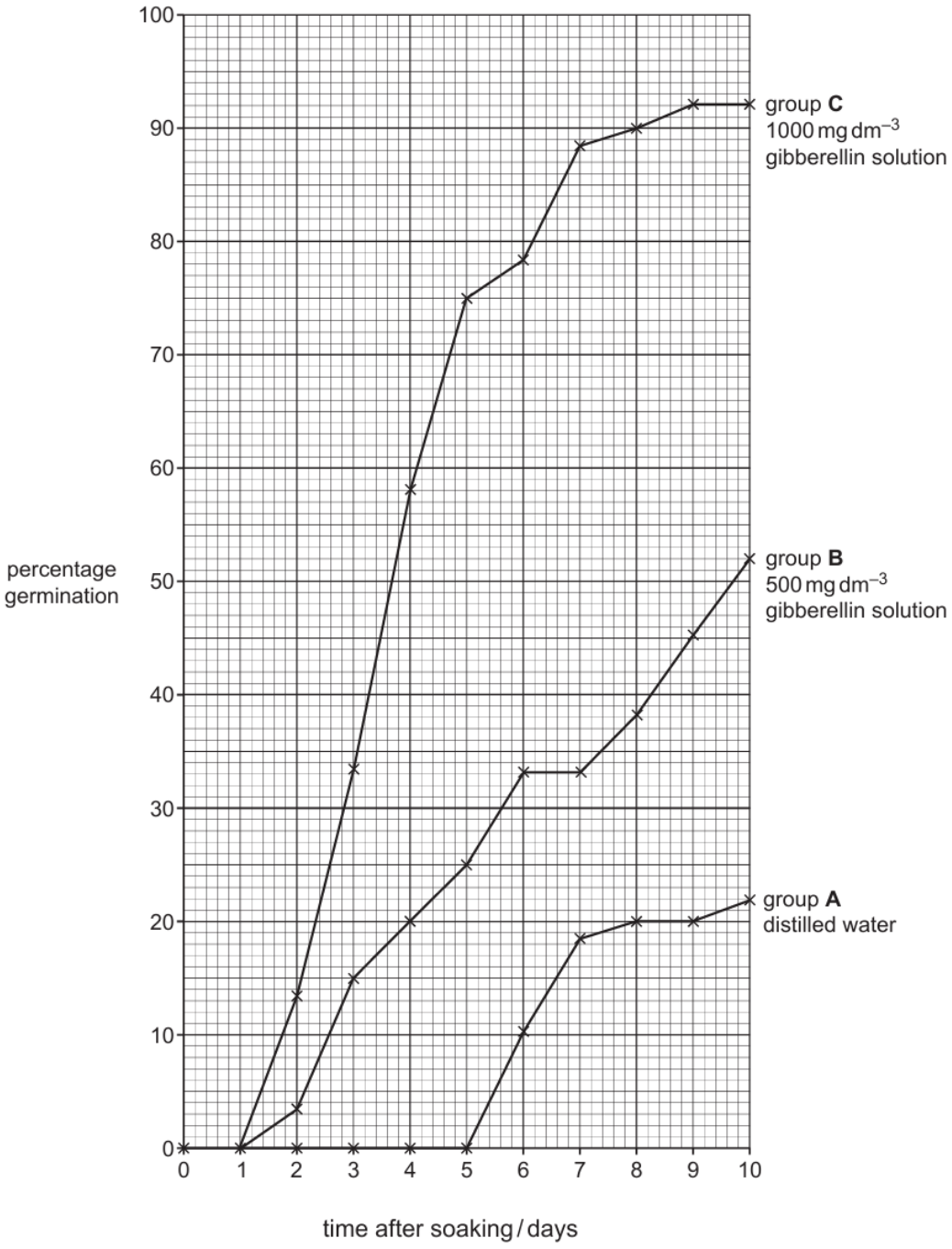


Fig. 6.2

Describe the results shown in Fig. 6.2.

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5 During the germination of barley seeds, amylase is produced.

(a) Describe the sequence of events that lead to the production of amylase during germination of barley seeds.

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(b) Malting is a process involved in the production of a drink called beer. During malting, barley seed germination is controlled so that the sugars produced during germination can be used in the production of beer.

Fig. 3.1 shows two features of a germinating barley seed during the first five days of malting:
- activity of the amylase enzyme
- the percentage of starch reserves remaining in the barley seed.

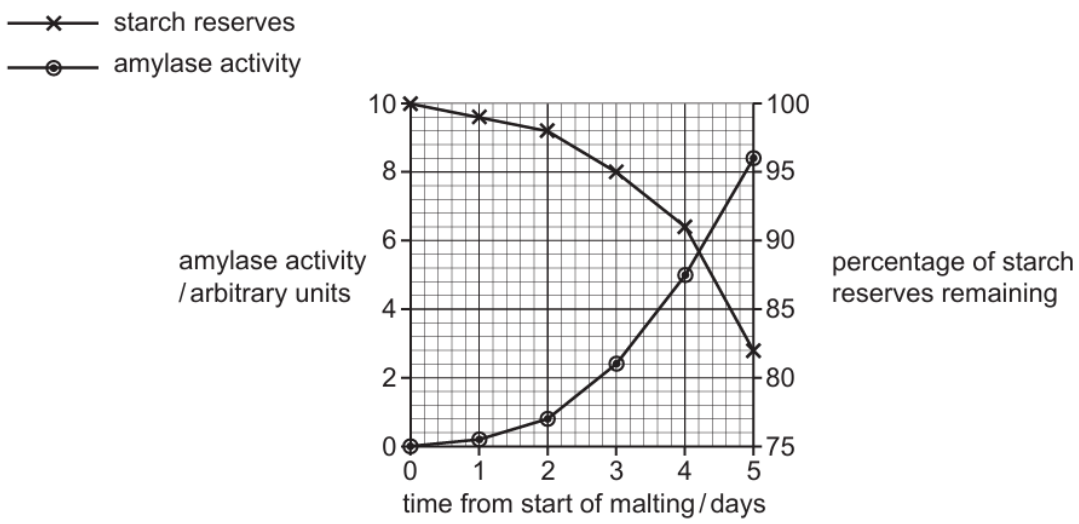


Fig. 3.1

(i) State the precise location of the starch reserves in the barley seed.

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(ii) With reference to Fig. 3.1, describe **and** explain the effect of malting on amylase activity and the percentage of starch reserves remaining in the germinated barley seed.

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..... [4]

(c) In the malting process, germination is stopped before the concentration of sugars in the germinating barley seeds exceeds a concentration that causes shoot or root growth.

Drying the germinating barley seeds at 50 °C is one method used to stop malting.

(i) Explain how this method would stop malting.

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..... [3]

(ii) Suggest why malting is stopped before shoot or root growth occurs.

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..... [1]

6 **(a)** Gibberellin is a plant growth regulator involved in barley seed germination. Production of gibberellin is stimulated by the uptake of water.

State the location of gibberellin synthesis in a barley seed during germination.

..... [1]

(b) Barley seeds germinate when placed on blotting (absorbent) paper soaked in water.

The germination of barley seeds placed on blotting paper soaked in solutions of different water potential was investigated.

The success of germination was measured as a germination index for:

- barley seeds placed on blotting paper soaked in water
- barley seeds placed on blotting paper soaked in 5 solutions of different water potential.

The results are shown in Fig. 5.1.

The higher the germination index value, the more successful the germination of the barley seeds.

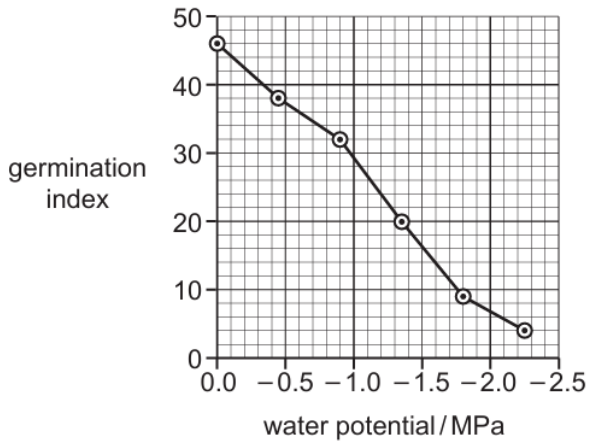


Fig. 5.1

(i) With reference to Fig. 5.1, describe the relationship between the germination index of barley seeds and water potential.

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..... [2]

(ii) Suggest explanations for the relationship shown in Fig. 5.1.

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..... [3]

(c) During barley seed germination, gibberellin stimulates the synthesis of enzymes.

State the name of one of these enzymes **and** the precise location of its synthesis.

enzyme .....

location .....

[2]

7 The Venus fly trap, *Dionaea muscipula*, is a carnivorous plant, native to wetlands of the East Coast of the USA. Mineral ions from decayed organisms are often washed away in these wetlands.

Fig. 7.1 shows a Venus fly trap leaf.

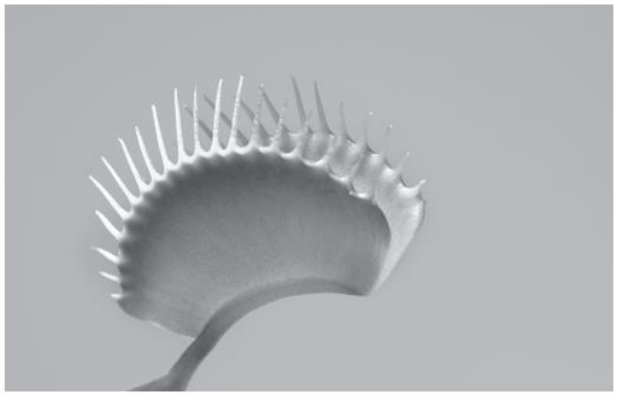


Fig. 7.1

(a) Suggest why a Venus fly trap benefits from catching insects in these wetlands.

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..... [2]

(b) **(i)** The leaves of the Venus fly trap will close if stimulated by an insect.

State which part of the leaf detects the stimulus.

..... [1]

(ii) Explain how the plant does not waste energy by closing when it does not need to, such as when a large drop of rain touches the receptor.

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(d) Describe how the production of action potentials in the leaf cells of the Venus fly trap can result in the leaves closing and trapping an insect.

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8 **(a)** Fig. 1.1 shows part of a cell in a growing region of a plant.

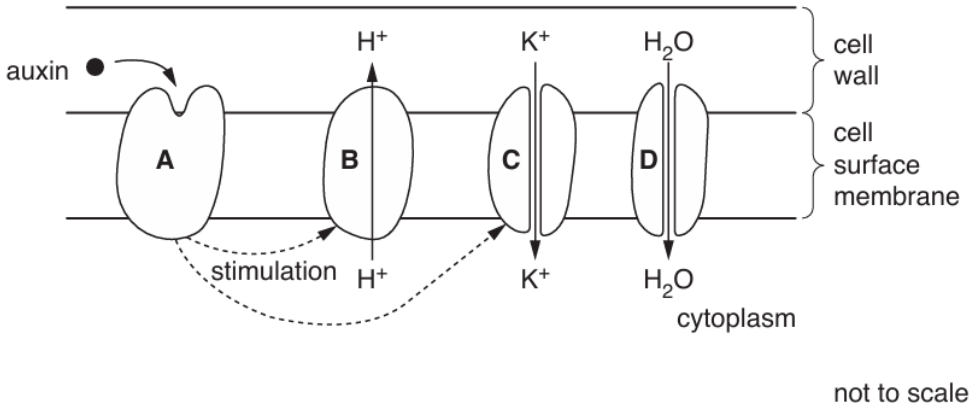


Fig. 1.1

(i) State the **type** of protein represented by **A**.

..... [1]

(ii) Proteins **B**, **C** and **D** are transport proteins.

Identify proteins **B**, **C** and **D**.

B .....

C .....

D .....

[3]

(b) Describe the effects on the cell wall of many hydrogen ions moving into the cell wall.

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(c) Explain the consequences of an influx of potassium ions into the cell.

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