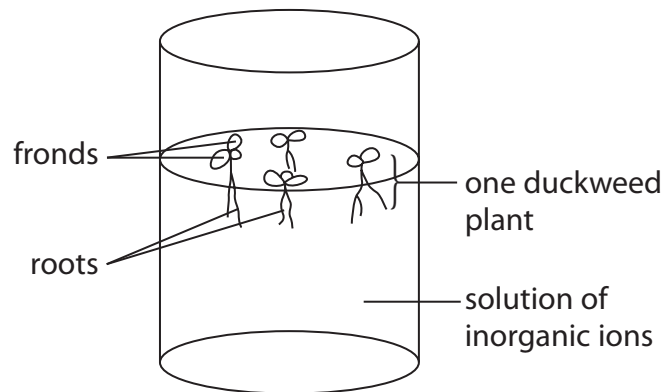


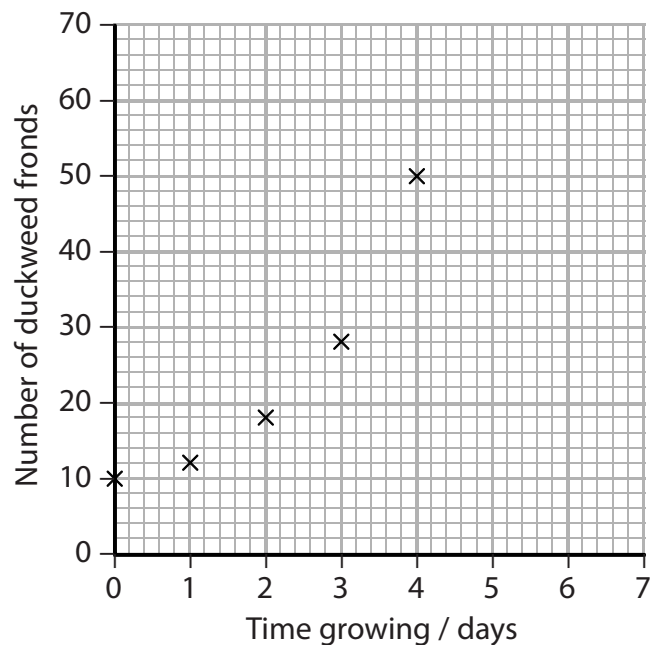
- 1 Duckweed is a small plant that floats on the surface of water. It could be a source of animal feed as it grows very quickly. Duckweed absorbs dissolved inorganic ions and this decreases water pollution.

Duckweed grows by producing more fronds, which then separate into new plants.

The diagram below shows some duckweed growing in a beaker containing a solution of inorganic ions.



- (a) The graph below shows the growth of duckweed over a four-day period.



- 2 The photograph below shows apples on a tree. The mass of apples produced by an apple tree depends on the type of fertiliser used. Fertilisers provide inorganic ions required by plants.



Magnification $\times 0.5$

(a) Plants use inorganic ions. Place a cross (☒) in the box that identifies the correct response.

(i) Plants require the following inorganic ion to make the amino acids required for growth

(1)

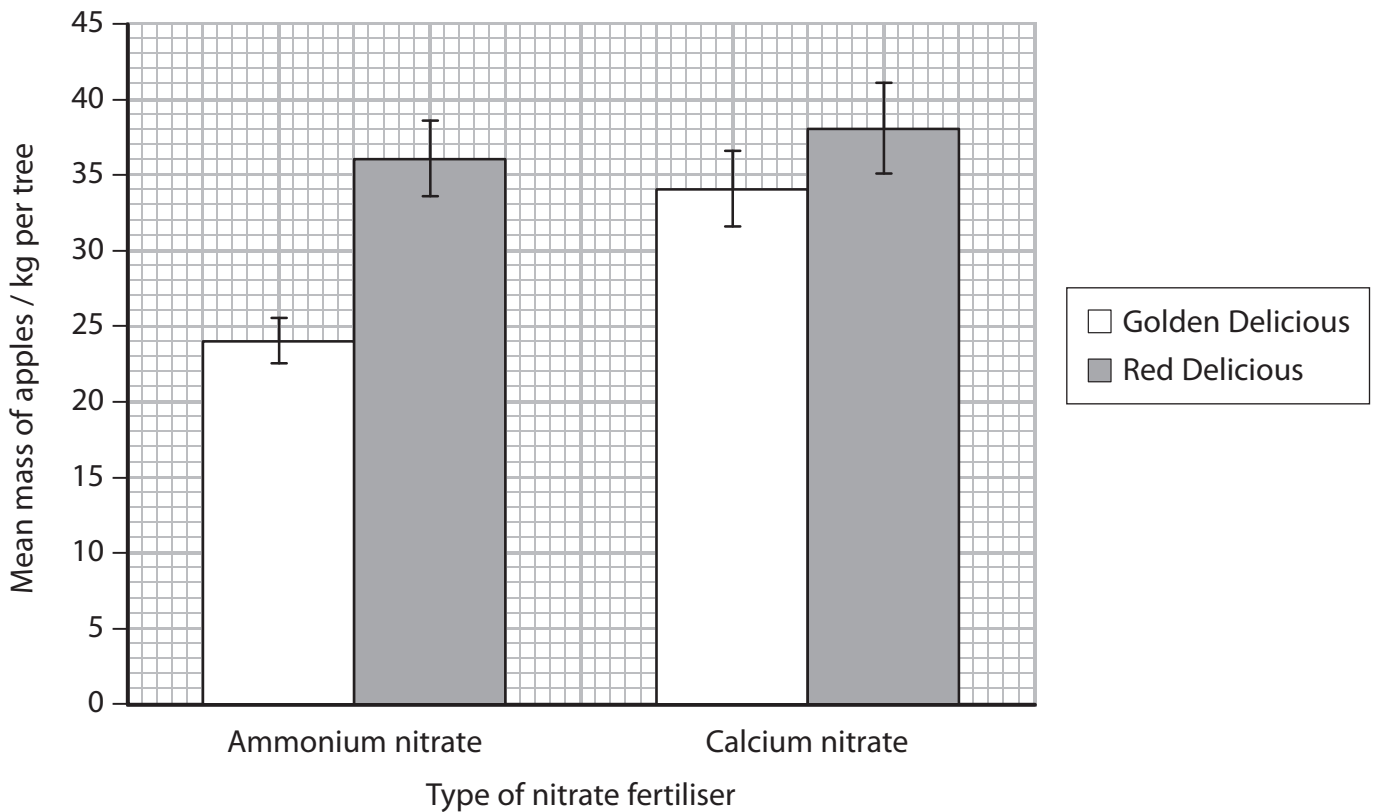
- A calcium
- B nitrate
- C phosphate
- D sulfate

(ii) Plants require magnesium ions as a component of

(1)

- A cellulose
- B chlorophyll
- C phytochrome
- D protein

(b) The graph below shows the effect of different nitrate fertilisers on the mean mass of apples produced by Golden Delicious and Red Delicious apple trees.



(i) Using the information in the graph, describe the effects of the fertilisers on the mean mass of Golden Delicious apples produced.

(2)

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(ii) A farmer has decided to plant apple trees.

Suggest how the farmer could use the information given in the graph.

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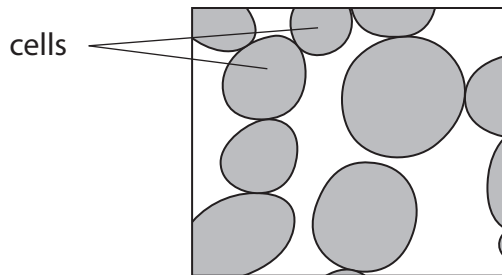
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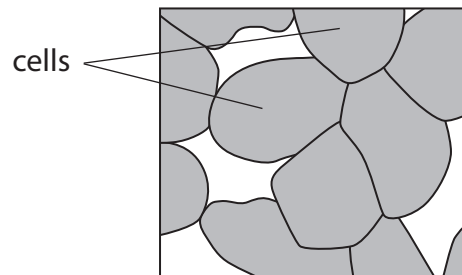
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(c) Apples with a high proportion of calcium stay firmer and can be stored for longer.

Scientists examined cells from Golden Delicious apples stored for seven months. They compared the cell structure of apples from trees given ammonium nitrate with those given calcium nitrate.



Cells from apples grown on trees given ammonium nitrate



Cells from apples grown on trees given calcium nitrate

Golden Delicious apples from trees given calcium nitrate were firmer than those from trees given ammonium nitrate.

Using information from the diagrams and your knowledge of the structure of plant cell walls, suggest an explanation for this difference.

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(Total for Question 2 = 10 marks)

3 Plants usually take up nitrogen as nitrate ions for use in growth.

(a) An investigation was undertaken to study the effect of nitrate ion concentration on mitosis in the root tip of wheat seedlings.

Wheat seedlings were grown in a mineral solution containing a nitrate ion concentration of 3.3 mmol dm^{-3} . Root tip samples were taken and the number of cells undergoing mitosis per 500 cells was counted.

This was repeated using a nitrate ion concentration of 6.6 mmol dm^{-3} . The results are shown in the table below.

Nitrate ion concentration / mmol dm^{-3}	Number of cells undergoing mitosis per 500 cells
3.3	25
6.6	19

(i) Using the information in the table, describe the effect of nitrate ion concentration on mitosis in root tips.

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(ii) Suggest why a prediction of the number of cells undergoing mitosis, if the nitrate ion concentration used were 9.9 mmol dm^{-3} , would be unreliable.

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(iii) To count the number of cells undergoing mitosis, a root tip squash was carried out.

Give **two** potential safety risks associated with the root tip squash technique. For one of the risks you have given, suggest a precaution to reduce the risk.

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(b) Describe an experiment to find the optimum nitrate ion concentration for the growth of wheat seedling roots.

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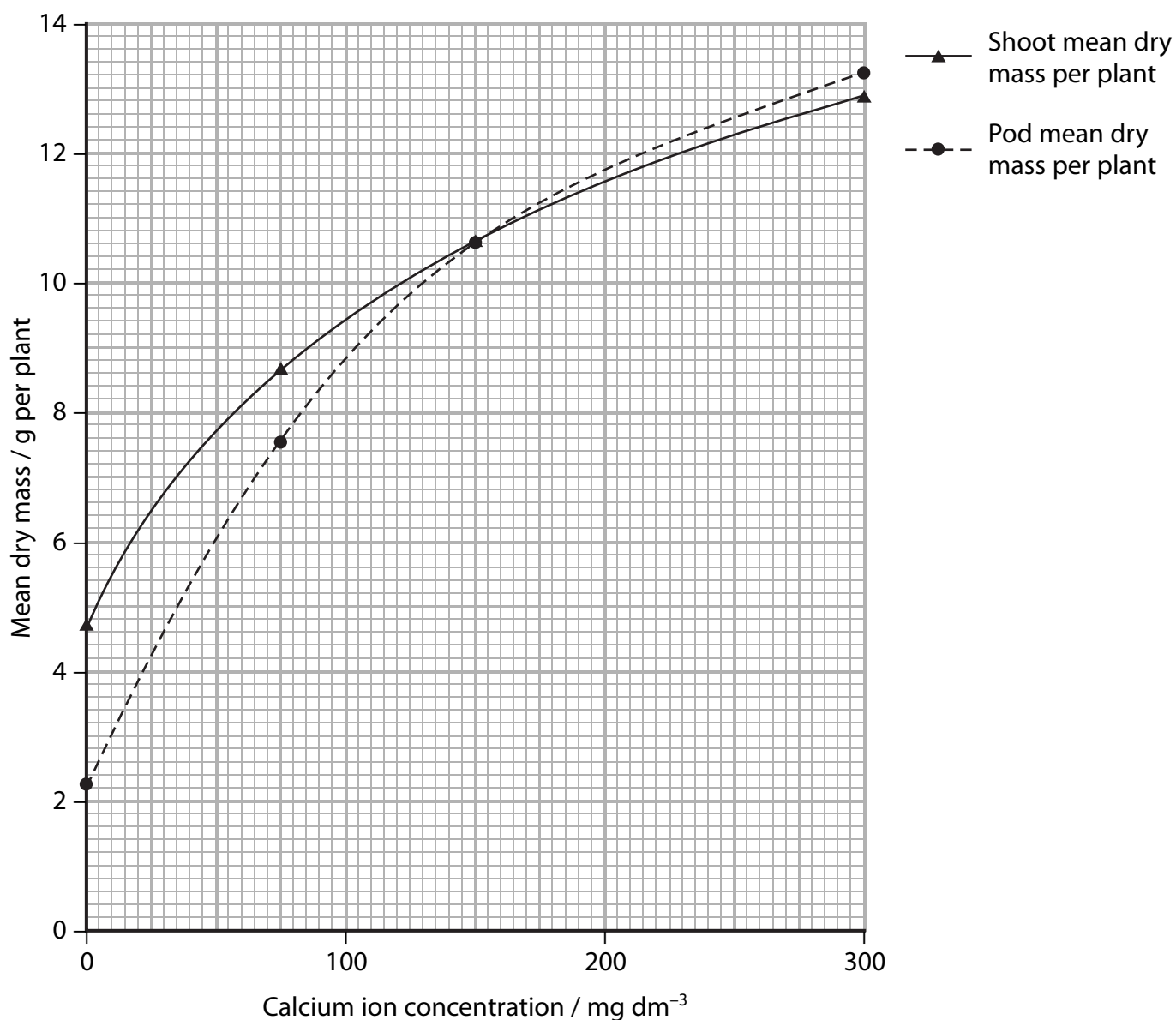
(Total for Question 3 = 10 marks)

- 4 A study was undertaken to investigate the effect of calcium ion concentration on the mass of shoots and the mass of pods of bean plants.

Two bean plants were grown in a pot and watered regularly with a solution containing all the required mineral ions except calcium. When the plants had produced mature bean pods, the shoots and the pods were dried and the mean dry masses were recorded.

This experiment was repeated three times, each with a different calcium ion concentration added to the watering solution.

The results are shown in the graph below.



(a) (i) Using the information in the graph, compare the effect of calcium ion concentration on the mean dry mass of shoots and the mean dry mass of pods in bean plants.

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(ii) Suggest how calcium ions contributed to the change in mass in the shoot of the bean plant.

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(b) During this investigation, it was found that there was a relationship between calcium ion concentration in the watering solution and total nitrogen uptake by the bean pods. The data are shown below.

Calcium ion concentration in the watering solution / mg dm^{-3}	Total nitrogen uptake by the bean pods / mg
0	70
75	220
150	290
300	350

(i) Describe the relationship between calcium ion concentration and total nitrogen uptake by the bean pods.

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