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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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8324906618

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2023**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's use	
1	
2	
Total	

This document has **16** pages. Any blank pages are indicated.

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1 Agar stained with universal indicator can be used to investigate diffusion.

When hydrochloric acid diffuses into the agar it changes the colour from green to pink.

You will investigate the diffusion of different concentrations of hydrochloric acid in agar.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	2.0 mol dm^{-3} hydrochloric acid	irritant	20
W	distilled water	none	30
	2 Petri dishes containing agar	none	–
sheet T	sheet T	–	–

If **H** comes into contact with your skin, wash off immediately with cold water.

It is recommended that you wear suitable eye protection.

You will need to:

- prepare different concentrations of hydrochloric acid, **H**
- measure the diffusion distance for each concentration of hydrochloric acid.

You will need to carry out a **serial** dilution of the 2.0 mol dm^{-3} hydrochloric acid, **H**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of hydrochloric acid in addition to 2.0 mol dm^{-3} hydrochloric acid, **H**.

After the serial dilution is completed, you will need to have 5 cm^3 of each concentration available to use.

(a) (i) Complete Fig. 1.1 to show how you will prepare your serial dilution.

Fig. 1.1 shows the beakers you will use.

For each beaker, add labelled arrows to show:

- the volume of hydrochloric acid transferred
- the volume of distilled water, **W**, added.

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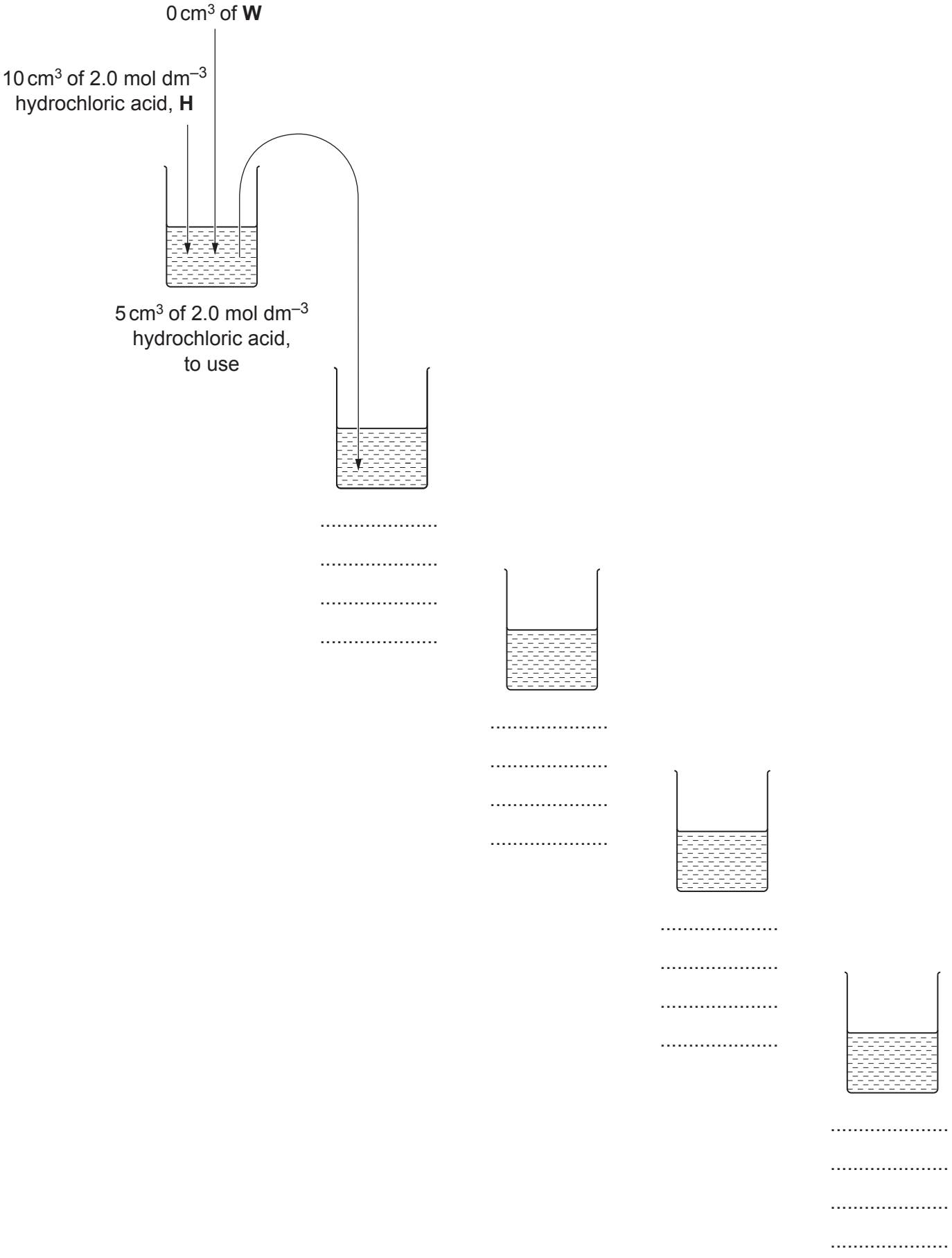


Fig. 1.1

[3]

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step 1 Prepare the concentrations of hydrochloric acid, as decided in **(a)(i)**, in the beakers provided.

The different concentrations of hydrochloric acid will be put into wells cut into the agar.

The position of one well is shown in Fig. 1.2.

You need to decide where to put **four** more wells in the agar in each Petri dish so that the wells are positioned away from each other and away from the edge of the Petri dish. Hydrochloric acid will diffuse into the agar around each well.

(ii) Complete Fig. 1.2 by:

- drawing **four** small circles to show where you have decided the wells should be positioned in the agar
- labelling the **five** small circles in Fig. 1.2 with the concentrations of hydrochloric acid you prepared in step 1.

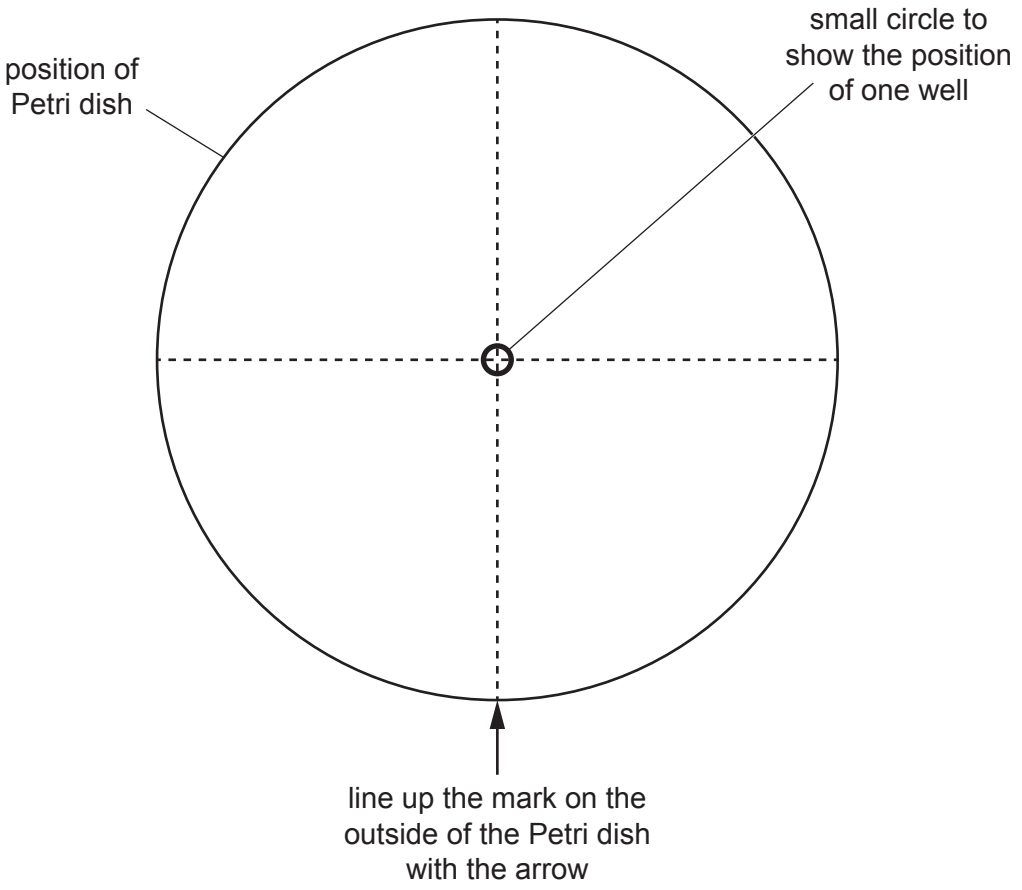


Fig. 1.2

[1]

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Carry out step 2 to step 14.

step 2 Draw a mark on the outside edge of one of the Petri dishes containing agar.

step 3 Put the Petri dish on Fig. 1.2 so that the mark on the edge of the Petri dish lines up with the arrow in Fig. 1.2. Keep the Petri dish in this position over Fig. 1.2 for the whole of step 4.

step 4 Use a straw to cut wells in the agar at the positions of the small circles on Fig. 1.2:

- put the end of a straw on the surface of the agar over the centre small circle
- carefully push the straw into the agar
- lift up the straw to leave a well in the agar
- hold the straw over the container labelled **For waste**
- blow gently through the straw to remove the agar from the end of the straw
- if the small circle of agar is **not** lifted by the straw, use a scalpel or mounted needle to carefully remove the agar and put it in the container labelled **For waste**.

step 5 Remove the Petri dish from Fig. 1.2 and leave it for use in step 7.

step 6 Repeat step 2 to step 4 with the other Petri dish containing agar.

You are provided with **sheet T** for use in step 7 and step 8.

step 7 Put one of the Petri dishes on circle **A** on **sheet T** so that the mark on the edge of the Petri dish lines up with the arrow.

step 8 Put the other Petri dish on circle **B** on **sheet T** so that the mark on the edge of the Petri dish lines up with the arrow.

step 9 For each Petri dish, **A** and **B**, use a pipette to carefully put 2.0 mol dm^{-3} hydrochloric acid, **H**, into the appropriate well in the agar, as labelled in Fig. 1.2.

step 10 Repeat step 9 for the other concentrations of hydrochloric acid labelled in Fig. 1.2.

Do **not** move the Petri dishes after the wells have been filled with the hydrochloric acid.

step 11 Start timing.

Between step 11 and step 12, you will be leaving the Petri dishes on **sheet T** for 20 minutes.

Use this time to continue with other parts of Question 1.

step 12 After leaving the Petri dishes for 20 minutes, use a pipette to remove the hydrochloric acid from the wells in both Petri dishes. Put this hydrochloric acid into the beaker labelled **For waste**.

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step 13 Measure the diffusion distance, as shown in Fig. 1.3, for each concentration of hydrochloric acid in both Petri dishes.

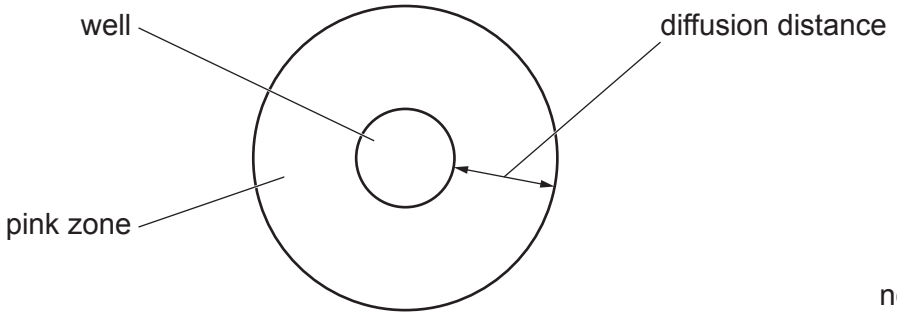


Fig. 1.3

step 14 Record your results in **(a)(iii)**.

(iii) Record your results in an appropriate table.

[5]

(iv) Calculate the rate of diffusion for 2.0 mol dm^{-3} hydrochloric acid, **H**.

Show your working and use appropriate units.

rate = ... [2]

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(v) A student observed that the rate of diffusion was **not** constant during the investigation.

Suggest how the student could modify the procedure to investigate the change in the rate of diffusion.

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(b) A scientist studied the rate of absorption of the amino acid alanine through the wall of the small intestine.

A concentration gradient was maintained throughout the investigation and all other variables were kept constant.

The results are shown in Table 1.2.

Table 1.2

percentage concentration of alanine	rate of absorption / $\mu m\ h^{-1}$
5	300
14	950
30	1625
50	1750
70	1775

(i) Plot a graph of the data shown in Table 1.2 on the grid in Fig. 1.4.

Use a sharp pencil.

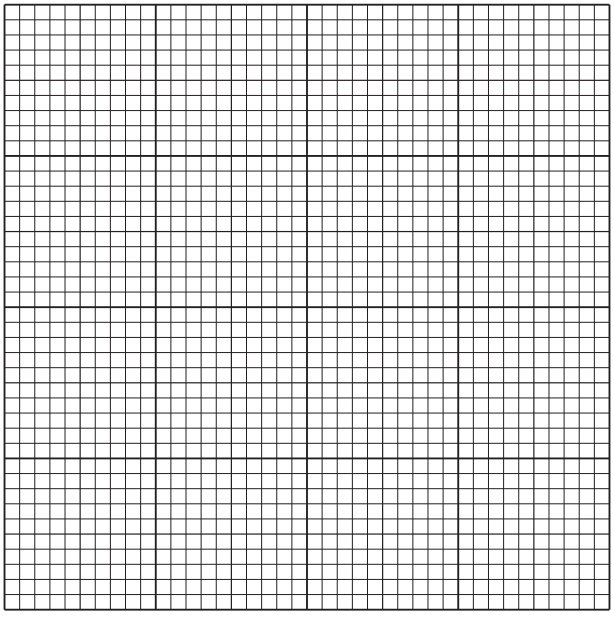


Fig. 1.4

[4]

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(ii) Amino acids are transported into cells by facilitated diffusion.

Explain the shape of your graph in Fig. 1.4.

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..... [3]

[Total: 21]

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2 **N1** is a slide of a stained transverse section through a plant stem.

(a) **(i)** Draw a large plan diagram of the region of the stem on **N1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

Use **one** ruled label line and label to identify the epidermis.

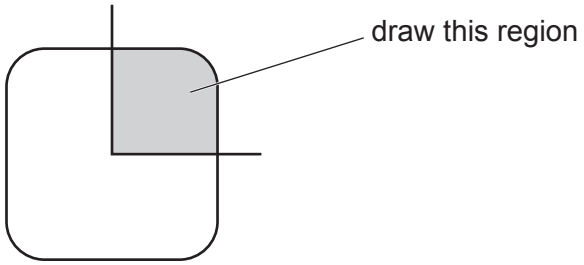


Fig. 2.1

[5]

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(ii) Observe the xylem on the section of the stem on **N1**.

Select a line of **four** adjacent xylem vessel elements.

Each xylem vessel element must touch at least **one** of the other xylem vessel elements that you have selected.

- Make a large drawing of this line of **four** xylem vessel elements.
- Use **one** ruled label line and label to identify the lumen.

[5]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section through a different stem from **N1**.

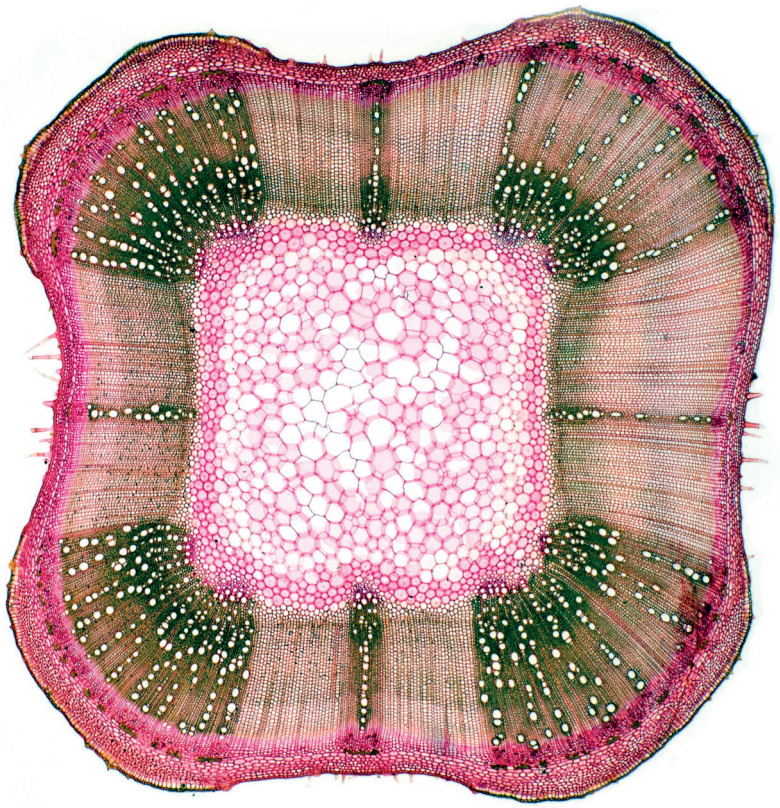


Fig. 2.2

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The section on **N1** and the section in Fig. 2.2 have some similar structures.

One example of a similar structure is shown in Table 2.1.

Identify **three** more observable structures that are similar on the section on **N1** and the section in Fig. 2.2 and describe how each observable structure is similar.

Record and describe these **three** observable similarities in Table 2.1.

Table 2.1

similar structure	how the structures are similar
xylem	xylem vessel elements present in distinct lines in the vascular bundles

[4]

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(c) Fig. 2.3 is the same photomicrograph as that shown in Fig. 2.2.

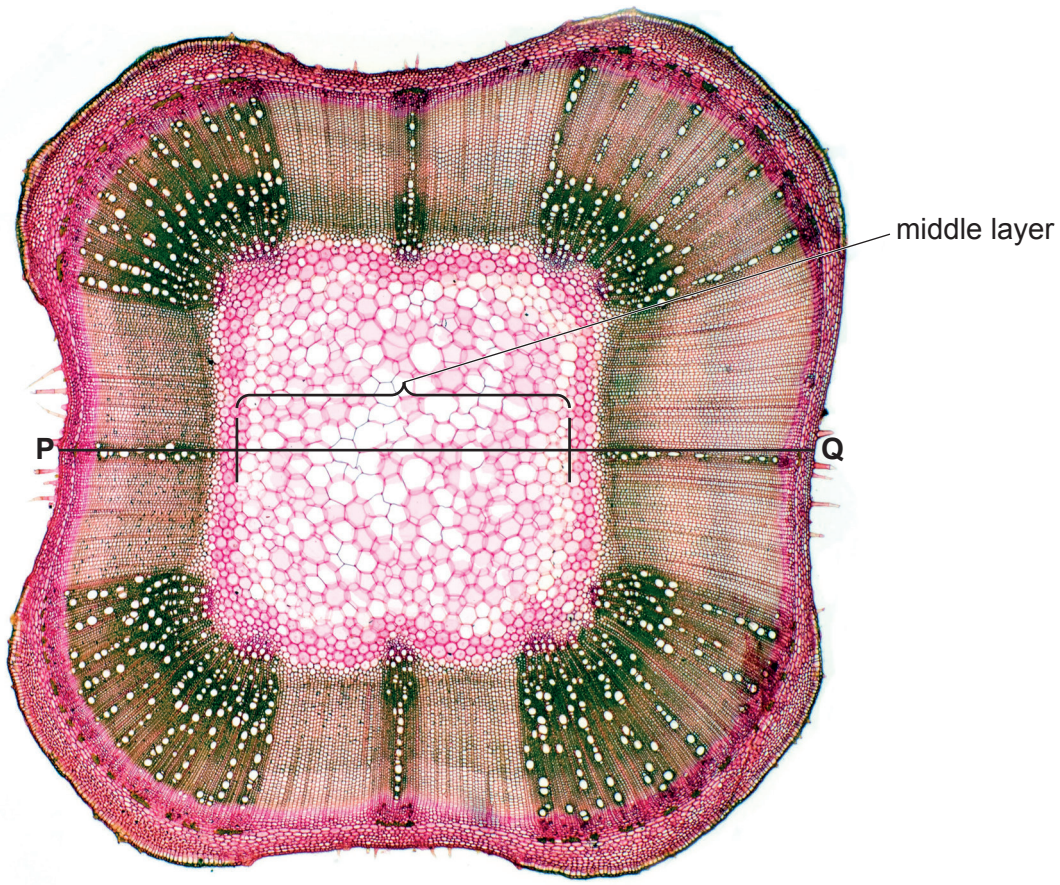


Fig. 2.3

(i) In Fig. 2.3 the line **P**–**Q** represents the width of the whole stem section. The middle layer of the stem section is also labelled.

Calculate the width of the middle layer as a percentage of the width of the whole stem section.

Show your working and give your answer to **two** significant figures.

answer = ... % [4]

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(ii) The width of the middle layer varies at different positions around the stem.

State how to determine the mean width of the middle layer of the stem section in Fig. 2.3.

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..... [1]

[Total: 19]

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