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BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

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 [ ].

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Total	

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[Turn over

1 Agar that has been stained with a blue indicator can be used to investigate diffusion.

Hydrochloric acid diffuses into blue-stained agar changing the colour of the agar from blue to yellow.

You will investigate the effect of different concentrations of hydrochloric acid on the distance the acid diffuses into the agar (diffusion distance).

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	30
U	unknown concentration of hydrochloric acid	irritant	10
W	distilled water	none	50
	6 test-tubes containing blue agar	none	–

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

You will need to:

- prepare different concentrations of hydrochloric acid
- measure the diffusion distance of each concentration of hydrochloric acid after 10 minutes and after 20 minutes
- use your results to estimate the concentration of hydrochloric acid in **U**.

You will need to carry out a serial dilution of the 2.0 mol dm^{-3} hydrochloric acid, **H**, to reduce the concentration by **a factor of ten** 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 9 cm^3 of each concentration available to use.

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

Each beaker should have:

- a labelled arrow to show the volume of hydrochloric acid transferred
- a labelled arrow to show the volume of distilled water, **W**, added
- a label under each beaker to show the concentration of the hydrochloric acid.

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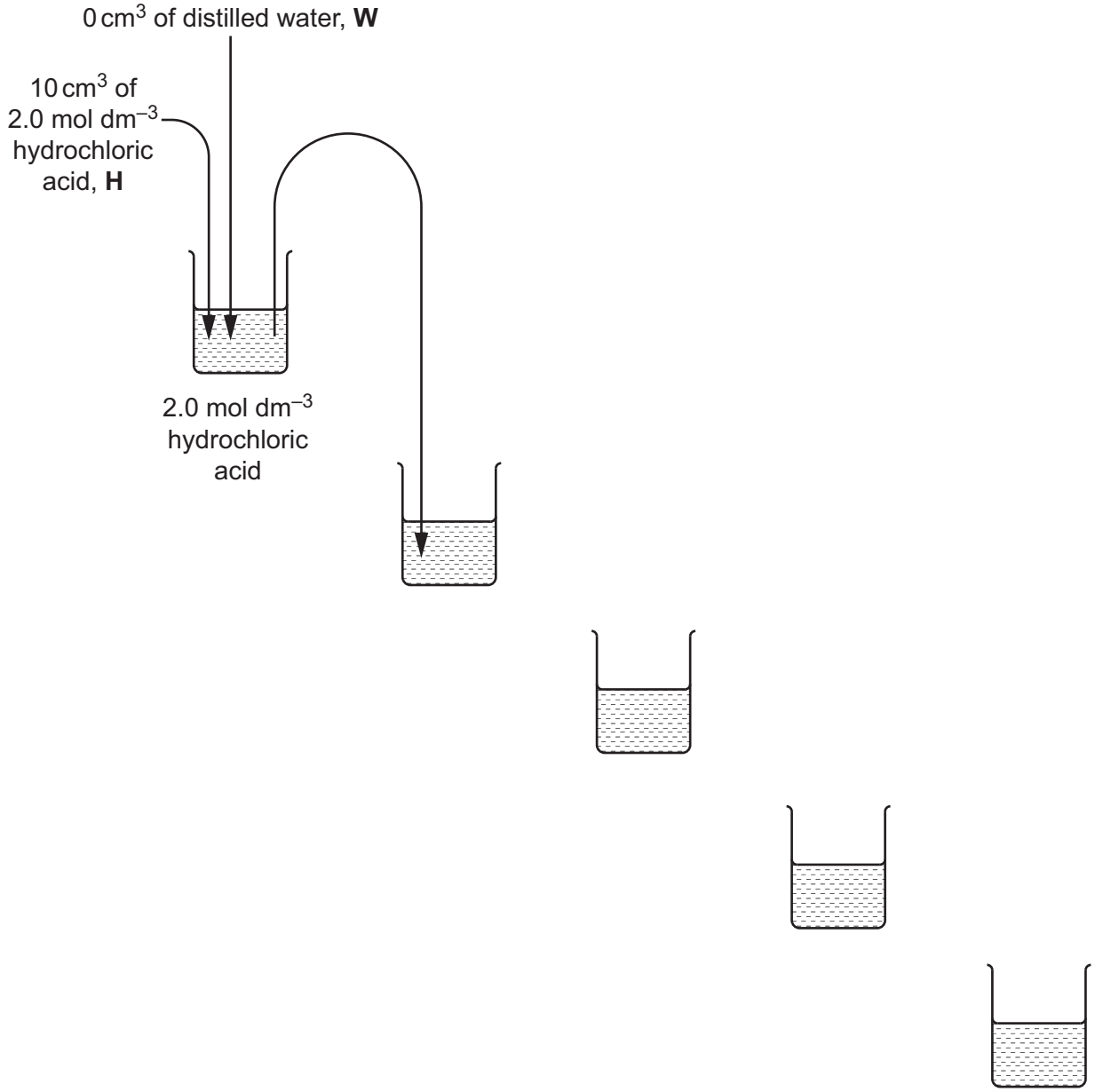


Fig. 1.1

[3]

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Carry out step 1 to step 10.

step 1 Prepare the concentrations of hydrochloric acid as shown in Fig. 1.1.

step 2 Label **one** test-tube containing blue agar with the label **U**.

step 3 Label the other test-tubes containing blue agar with the concentrations of hydrochloric acid prepared in step 1.

step 4 Put 1 cm^3 of 2.0 $mol\,dm^{-3}$ hydrochloric acid, **H**, into the appropriately labelled test-tube.

step 5 Put 1 cm^3 of each of the other concentrations of hydrochloric acid, as prepared in step 1, into the appropriately labelled test-tube.

step 6 Put 1 cm^3 of the unknown concentration of hydrochloric acid, **U**, into the test-tube labelled **U**.

In step 7 and step 9 you will need to wait for 10 minutes. While you are waiting, use your time to continue with other parts of Question 1.

step 7 Start timing and wait for 10 minutes.

step 8 After the 10 minutes, measure the depth of yellow agar (diffusion distance), shown in Fig. 1.2, for each concentration of hydrochloric acid and for **U**.
Record your results in **(a)(ii)**.

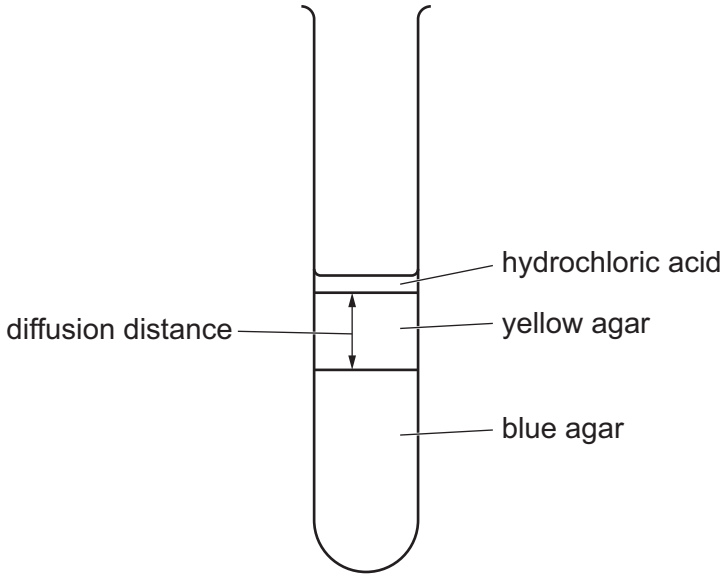


Fig. 1.2

step 9 Continue timing and wait for a further 10 minutes (20 minutes in total).

step 10 After the 10 minutes, measure the depth of yellow agar (diffusion distance) for each concentration of hydrochloric acid and **U**. Record your results in **(a)(ii)**.

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(ii) Record your results in an appropriate table.

[6]

(iii) Explain how the concentration of hydrochloric acid affects the diffusion distance.

.....

.....

..... [1]

(iv) Suggest **one** source of error in the procedure described in step 8 and step 10 of this investigation.

.....

.....

..... [1]

(v) Use your results at 20 minutes to estimate the concentration of hydrochloric acid in **U**.

concentration of hydrochloric acid in **U** = ...mol dm^{-3} [1]

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(vi) Suggest **two** improvements to the procedure that would give you a more accurate value for your estimated concentration of hydrochloric acid in **U**.

1 .....

.....

.....

2 .....

.....

.....

[2]

(vii) For the 2.0 mol dm^{-3} hydrochloric acid, calculate the rate of diffusion over 20 minutes.

Show your working and use appropriate units.

rate of diffusion = ...

[2]

(viii) One hypothesis for this investigation is:

the rate of diffusion decreases over time.

Show, with a tick (✓) in the appropriate box, whether your results support or do **not** support this hypothesis.

results support hypothesis ☐

results do **not** support hypothesis ☐

Give **one** reason for your answer.

reason .....

.....

..... [1]

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Question 1 continues on page 8.

(b) A student investigated the effect of temperature on cell membranes by measuring the diffusion of pigment from beetroot cells.

The student immersed discs of beetroot in water at different temperatures for 10 minutes.

A colorimeter was used to determine how much pigment had diffused into the water by measuring the percentage transmission of light through each sample of water.

The results are shown in Table 1.2.

Table 1.2

temperature / °C	percentage transmission of light
10	86
30	84
45	70
60	23
75	14

(i) Plot a graph of the data shown in Table 1.2 on the grid in Fig. 1.3.

Use a sharp pencil.

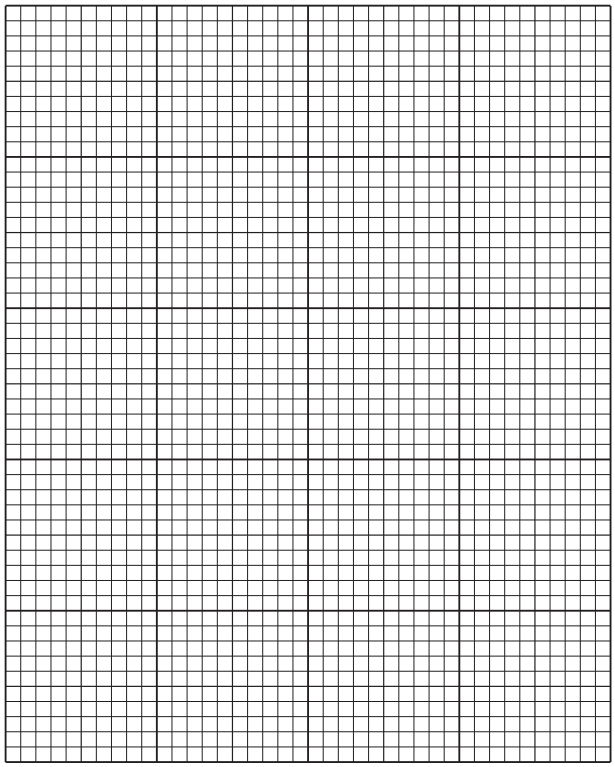


Fig. 1.3

[4]

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(ii) Temperature affects the permeability of the cell membrane.

State **one** reason for the change in permeability between 45 °C and 60 °C.

.....

.....

..... [1]

[Total: 22]

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2 **J1** is a slide of a stained transverse section through a leaf.

(a) **(i)** Draw a large plan diagram of the region of the leaf section on **J1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

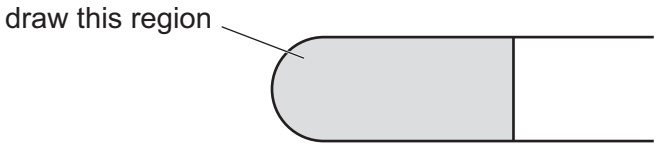


Fig. 2.1

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

[5]

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(ii) The upper epidermis of the leaf on **J1** has a thicker cuticle than the lower epidermis.

Observe the upper epidermis and the layer of cells beneath it.

Select a group of four adjacent cells. This group must include **two** cells from the upper epidermis and **two** cells from the layer beneath the epidermis.

Each cell must touch at least **two** of the other cells.

- Make a large drawing of this group of four cells.
- Use **one** ruled label line and label to identify the cell wall of **one** epidermal cell.

[5]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a leaf from a different plant from **J1**.

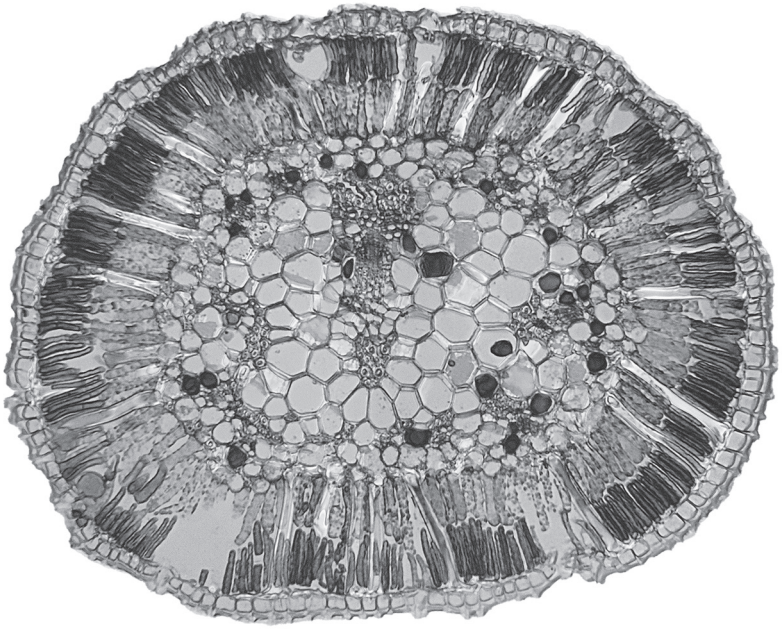


Fig. 2.2

(i) Identify **three** observable differences, other than colour, between the section on **J1** and the section in Fig. 2.2.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.2

[3]

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(ii) The leaf in Fig. 2.2 grows in a dry habitat.

For **one** observable feature in Fig. 2.2, explain how this allows the plant to survive in a dry habitat.

feature .....

explanation .....

.....

[1]

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

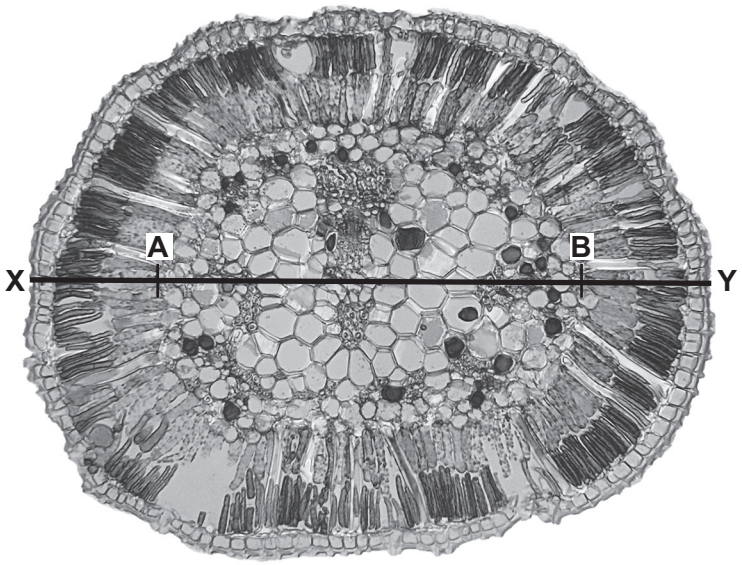


Fig. 2.3

In Fig. 2.3:

- the line **X**–**Y** represents the width of the whole leaf section
- the line **A**–**B** represents the width of the central region.

Calculate the width of the central region as a percentage of the width of the whole leaf section.

Show your working.

answer = ...% [4]

[Total: 18]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

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CANDIDATE NUMBER

8650546643

BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2025**

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.
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INFORMATION

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1 Invertase is an enzyme that catalyses the breakdown of sucrose into glucose and fructose.

Invertase can be extracted from yeast cells.

You will investigate the effect of an invertase extract on a sucrose solution and estimate the concentration of reducing sugars produced.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
E	invertase extract	irritant	20
R	0.5% reducing sugar solution	none	40
W	distilled water	none	100
S	0.2% sucrose solution	none	20
Benedict's	Benedict's solution	harmful irritant	20

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

You will need to make the different concentrations of reducing sugar solution using the 0.5% reducing sugar solution, **R**.

You will need to prepare 20 cm^3 of each concentration, using **R** and **W**.

Table 1.2 shows the concentrations of reducing sugar you will use.

Decide which volumes of **R** and **W** you will use.

(a) (i) Complete Table 1.2 to show how you will prepare the concentrations of reducing sugar using **R** and **W**.

Table 1.2

percentage concentration of reducing sugar	volume of R / cm^3	volume of W / cm^3
0.5	20.0	0.0
0.1		
0.05		
0.01	0.4	
0	0.0	20.0

[2]

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Preparing reducing sugar standards.

Carry out step 1 to step 8.

step 1 Set up a water-bath and heat it to boiling, ready for step 6 and step 15.

step 2 In the beakers provided, prepare the concentrations of reducing sugar shown in Table 1.2.

step 3 Label test-tubes with the concentrations of reducing sugar stated in Table 1.2.

step 4 Put 2 cm^3 of **Benedict's** solution into each labelled test-tube.

step 5 Put 2 cm^3 of the 0.5% reducing sugar solution, **R**, into the appropriately labelled test-tube.

step 6 Put the test-tube containing **R** into the water-bath and start timing.

step 7 Record in **(a)(ii)** the time taken to the first appearance of a colour change.
If there is **no** colour change after 120 seconds, stop timing and record the results as 'more than 120'.

step 8 Repeat step 5 to step 7 with the other concentrations of reducing sugar.

(ii) Record your results in an appropriate table.

[5]

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Investigating invertase.

Carry out step 9 to step 16.

step 9 Label **one** test-tube **W** and label **one** test-tube **E**.

step 10 Put 1.0 cm^3 of 0.2% sucrose solution, **S**, into these test-tubes.

step 11 Add 1.0 cm^3 of distilled water, **W**, to test-tube **W** and mix well.

step 12 Add 1.0 cm^3 of invertase extract, **E**, to test-tube **E** and mix well.

step 13 Leave the test-tubes for 5 minutes.

step 14 After the 5 minutes, put 2 cm^3 of **Benedict's** solution into each test-tube.

step 15 Put the test-tubes in the water-bath prepared in step 1.

step 16 Record in **(a)(iii)** the time taken to the first appearance of a colour change.
If there is **no** colour change after 120 seconds, stop timing and record the results as 'more than 120'.

(iii) Record the time taken to the first appearance of a colour change in test-tube **W** and test-tube **E**.

result for **W** ..... s

result for **E** ..... s
[1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the concentration of reducing sugar in test-tube **W** and test-tube **E**.

concentration in test-tube **W** = ... %

concentration in test-tube **E** = ... %
[1]

(v) With reference to the invertase extract, distilled water and sucrose solution, explain the results in **(iv)**.

test-tube **W** .....

.....

.....

test-tube **E** .....

.....
[3]

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(vi) Suggest **two** improvements to the procedure that would give you a more accurate value for your estimated concentration of reducing sugar in test-tube **E**.

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.....

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.....

[2]

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(b) Yeast cells also produce the enzyme catalase. Catalase breaks down hydrogen peroxide into oxygen gas and water.

A student added different concentrations of catalase enzyme to hydrogen peroxide and counted the number of oxygen bubbles produced in 5 minutes.

Table 1.3 shows the results of the investigation.

Table 1.3

percentage concentration of catalase	number of bubbles of oxygen in 5 minutes
0.0	1
2.0	22
4.0	44
6.0	50
8.0	94
10.0	118

(i) Plot a graph of the data shown in Table 1.3 on the grid in Fig. 1.1.

Use a sharp pencil.

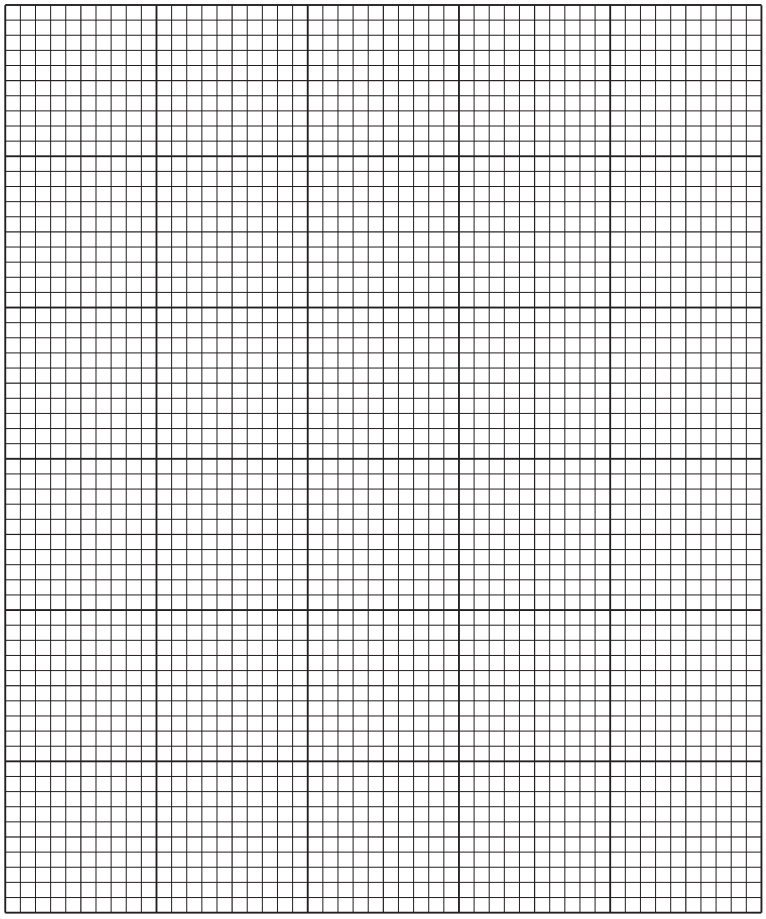


Fig. 1.1

[4]

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(ii) State the percentage concentration of catalase that gave an anomalous result.

..... percentage concentration
[1]

(iii) Describe the trend shown by the results.

.....

.....

..... [1]

(iv) Suggest an explanation for the result at 0% concentration of catalase.

.....

.....

..... [1]

(v) The student observed that the size of the bubbles varied.

Suggest a more accurate method of measuring the oxygen produced.

.....

.....

..... [1]

[Total: 22]

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2 **K1** 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 **K1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

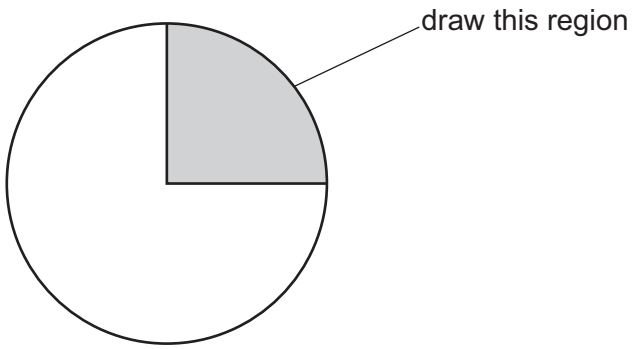


Fig. 2.1

Use **one** ruled label line and label to identify a vascular bundle.

[5]

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(ii) Observe one vascular bundle of the section on **K1**.

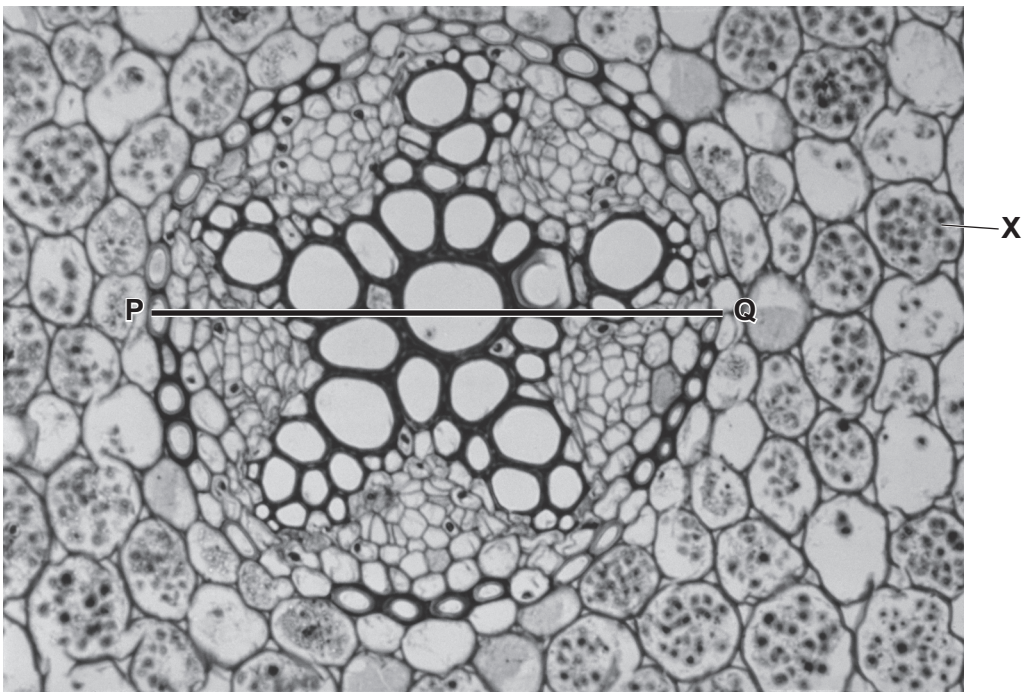
Select **one** large xylem vessel element and a group of **three** adjacent smaller xylem vessel elements.

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

[5]

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(b) Fig. 2.2 is a photomicrograph of a vascular bundle from the root of the same plant species as the stem on **K1**.



magnification ×350

Fig. 2.2

(i) Line **P–Q** represents the width of the vascular bundle.

Use the magnification and the line **P–Q** to calculate the actual width of the vascular bundle.

Show your working **and** give your answer in micrometres (μm).

actual width = ... μm
[3]

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(ii) Identify **one** observable similarity and **two** observable differences between the vascular bundle in Fig. 2.2 and the vascular bundle on **K1**.

similarity

.....

.....

differences

1 .....

.....

2 .....

.....

[4]

(iii) The cell labelled **X** on Fig. 2.2 has structures that contain a storage polysaccharide.

State a suitable reagent for identifying this polysaccharide.

..... [1]

[Total: 18]

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Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6453291273

BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

2 hours

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1 When plant tissue is placed into a solution of sodium chloride, water moves between the sodium chloride solution and the cells in the plant tissue.

You will investigate the effect of surface area of plant tissue on the movement of water between a sodium chloride solution and the cells in a sample of plant tissue.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	5 cylinders of plant tissue in distilled water	none	–
S	2.0 mol dm^{-3} sodium chloride solution	none	200

It is recommended that you wear suitable eye protection.

You will need to:

- cut cylinders of plant tissue into different lengths
- soak different lengths of plant tissue in sodium chloride solution for 20 minutes
- measure the final length of the plant tissue.

Carry out step 1 to step 12.

step 1 Using the forceps, put the cylinders of plant tissue onto the white tile.

step 2 Cut each cylinder of plant tissue to 40 mm length.

The cylinders of plant tissue all have the same diameter, as shown in Fig. 1.1. The radius is calculated by dividing the diameter by 2.



Fig. 1.1

(a) (i) Measure the diameter of one cylinder of plant tissue **and** calculate the radius, *r*.

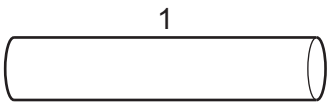
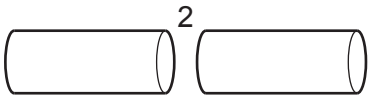
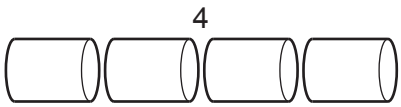
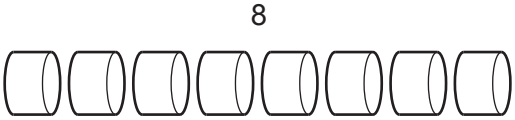
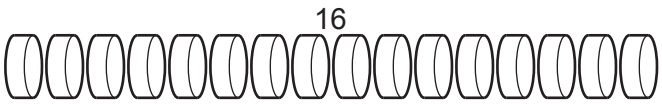
diameter = ...

r = ...
[1]

To investigate the effect of surface area, you will use one whole cylinder of plant tissue and cut the other cylinders into a different number of pieces.

step 3 Label five beakers with the number of pieces of plant tissue (**n**) as shown in Table 1.2.

Table 1.2

beaker labelled	number of pieces of plant tissue (n)	length (h) of each small piece / mm
1		40
2		20
4		10
8		5
16		2.5

step 4 Put **one** whole cylinder of plant tissue into the beaker labelled **1**.

step 5 Cut each of the other **four** cylinders of plant tissue into the number of pieces shown in Table 1.2 and put them into the appropriately labelled beaker.

In step 6 you will use a syringe to measure the volume of sodium chloride solution, **S**, you will put into each beaker.

(ii) State the volume of **S** that you will put into each beaker **and** give a reason for the volume that you have stated.

volume of **S** ..... cm^3

reason .....

.....

[1]

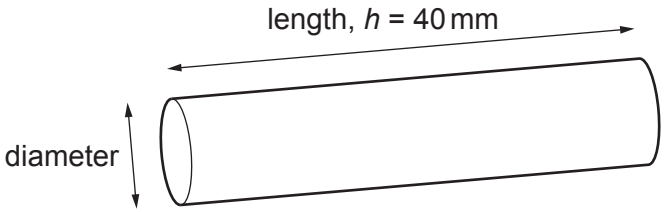
step 6 Put the volume of **S** you stated in **(a)(ii)** into each of the beakers.

step 7 Start timing and wait for 20 minutes.

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

Fig. 1.2 shows an example of how to calculate the total surface area of plant tissue placed in each beaker.

EXAMPLE: a cylinder with a length of 40 mm



surface area of cylinder = $2\pi r^2 + 2\pi r\, h$

$= (2 \times 3.14 \times r^2) + (2 \times 3.14 \times r \times 40)$

where:
$\pi = 3.14$
r = radius of cylinder = diameter ÷ 2
h = height or length of cylinder

The total surface area depends on the number of pieces, n.

Total surface area = surface area of one cylinder × number of pieces

$= (2\pi r^2 + 2\pi rh)n$

Fig. 1.2

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(iii) Complete Table 1.3 by calculating the total surface area of the **whole** piece of plant tissue (**1**) **and** the total surface area for the plant tissue cut into **16** pieces. Use the formulae shown in Fig. 1.2.

Show your working in Table 1.3.

Table 1.3

n	h / mm	surface area of one piece / mm^2	total surface area / mm^2
1	40		
16	2.5		

[2]

(iv) Describe what happens to the **total** surface area when one whole cylinder of plant tissue is cut into 16 smaller pieces.

.....

..... [1]

step 8 After the 20 minutes (step 7), pour the sodium chloride solution from around the cylinder of plant tissue in beaker **1** into the container labelled **For waste**. Put the plant tissue onto the white tile.

step 9 Measure the length of the cylinder of plant tissue. Record this length in **(a)(v)**.

step 10 Repeat step 8 for beaker **2**.

step 11 Place the cylinders of plant tissue end-to-end so that they are touching. Measure their total length, as shown in Fig. 1.3. Record this length in **(a)(v)**.

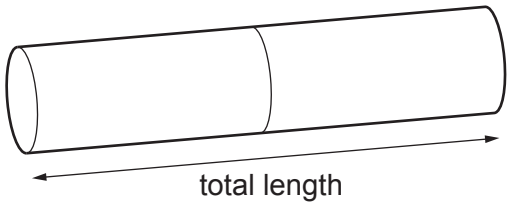


Fig. 1.3

step 12 Repeat step 10 and step 11 using the plant tissue in beaker **4**, beaker **8** and beaker **16**.

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(v) Record your results in an appropriate table.

[5]

(vi) With reference to the total surface area, describe the trend in your results.

.....

.....

..... [1]

(vii) Explain the trend you described in **(a)(vi)**.

.....

.....

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.....

.....

..... [2]

(viii) State **one** source of error in this investigation when measuring the dependent variable in step 11 and step 12.

.....

..... [1]

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(ix) Suggest how you could modify this procedure to investigate the effect of temperature on the movement of water between the sodium chloride solution and the cells in the plant tissue.

.....

.....

.....

.....

..... [2]

(b) A student investigated the effect of different concentrations of sodium chloride solution on red blood cells.

The student:

- counted the number of whole red blood cells in six samples of blood
- put each sample into a different concentration of sodium chloride solution for 10 minutes
- counted the number of whole red blood cells remaining in each concentration
- calculated the number of red blood cells remaining as a percentage of the number of red blood cells in each sample at the start.

The results are shown in Table 1.4.

Table 1.4

percentage concentration of sodium chloride	percentage number of whole red blood cells remaining
0.00	0.0
0.40	3.0
0.50	10.0
0.65	46.0
0.80	96.0
0.90	100.0

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

Use a sharp pencil.

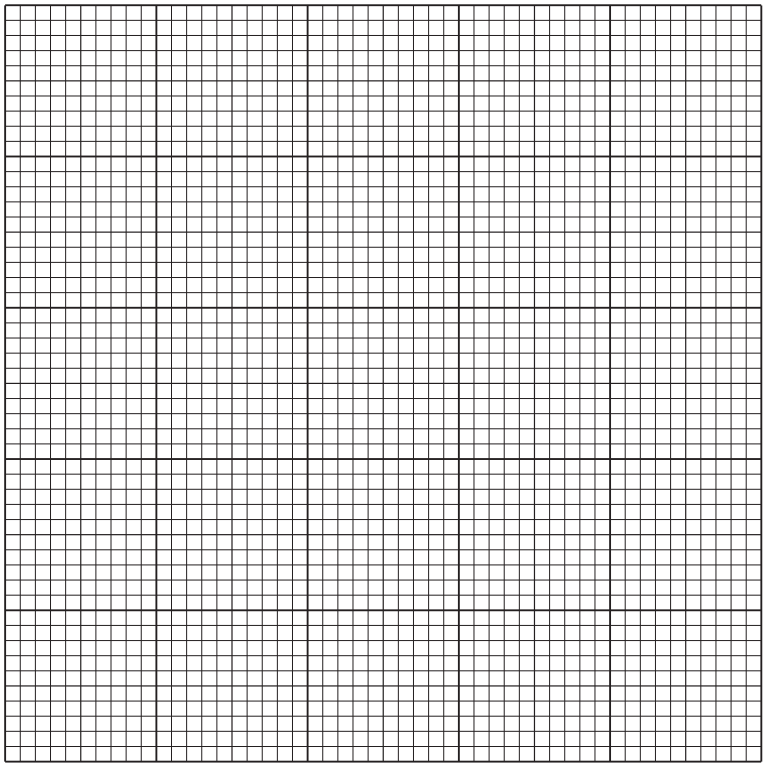


Fig. 1.4

[4]

(ii) State the concentration of sodium chloride solution that has the same water potential as the red blood cells.

sodium chloride concentration = ...% [1]

(iii) With reference to water potential, explain the effect of 0.4% sodium chloride solution on red blood cells.

.....

.....

.....

..... [1]

[Total: 22]

2 **L1** is a slide of a stained transverse section through a plant organ.

(a) **(i)** Draw a large plan diagram of a region of the organ on **L1** to include the epidermis and **two** vascular bundles. Use a sharp pencil.

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

[5]

(ii) Observe the xylem on the section of the plant organ on **L1**.

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

Each xylem vessel element must touch at least **one** of the other xylem vessel elements.

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

[5]

(b) Fig. 2.1 is a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

One division, on either the stage micrometer scale or the eyepiece graticule, is the distance between two adjacent lines.

The length of one division on this stage micrometer is **0.1 mm**.

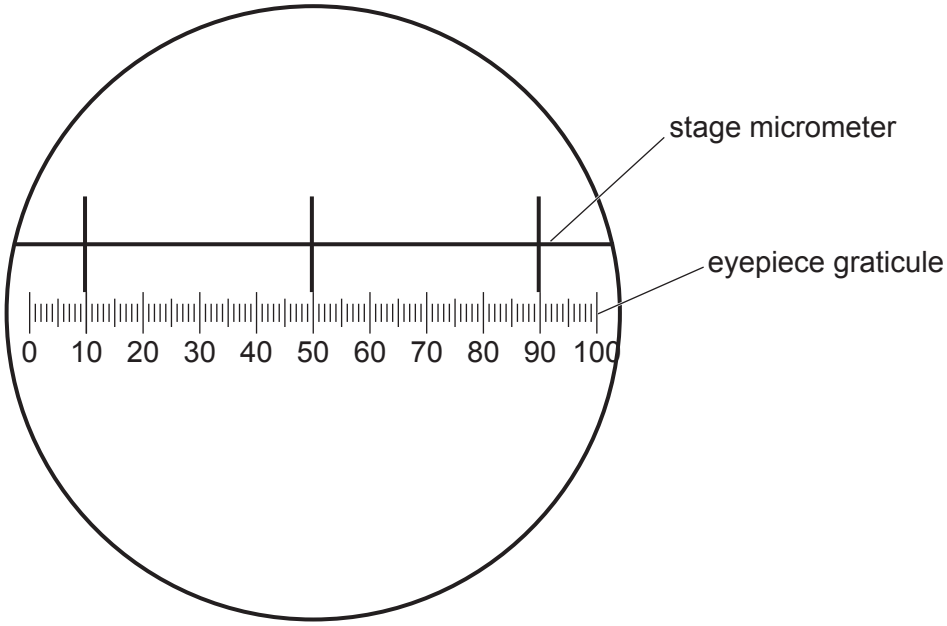


Fig. 2.1

(i) Use Fig. 2.1 to calculate the actual length of **one** eyepiece graticule unit.

Show your working and give your answer in micrometres (μm).

actual length = ... μm [2]

Fig. 2.2 is a photomicrograph of a stained transverse section of the same plant organ as the section on **L1** but from a different plant.

This was taken using the same microscope and eyepiece graticule as in Fig. 2.1.

The eyepiece graticule scale has been placed across one of the larger sections of vascular tissue, labelled **T** in Fig. 2.2.

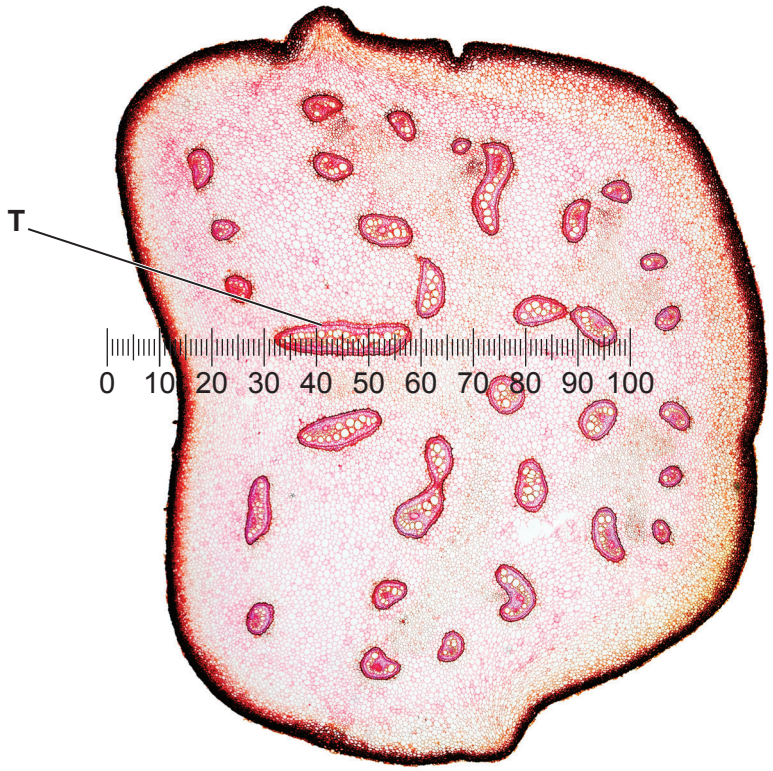


Fig. 2.2

(ii) Use the calibration of the eyepiece graticule unit from **(b)(i)** to calculate the actual length of the section of vascular tissue **T** in Fig. 2.2.

Show your working and use appropriate units.

actual length of the vascular tissue **T** = ... [2]

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

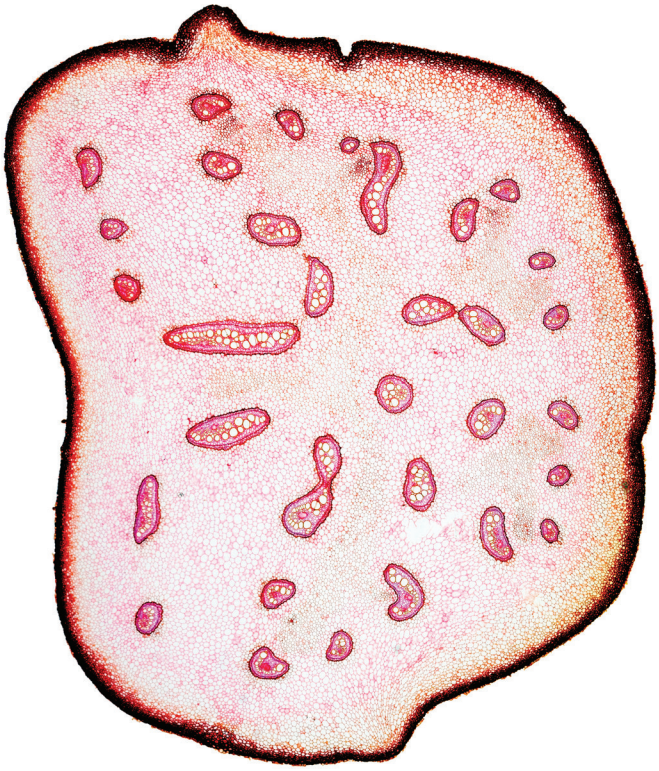


Fig. 2.3

(i) Identify **three** observable differences, other than colour, between the section on **L1** and the section in Fig. 2.3.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	L1	Fig. 2.3

[3]

(ii) Identify the plant organ on **L1** and in Fig. 2.3.

State how **one** observable feature helped you to identify the plant organ.

plant organ .....

.....

.....

[1]

[Total: 18]

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 2025**

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 [ ].

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1 Catalase is an enzyme found in yeast cells. It catalyses the breakdown of hydrogen peroxide to produce water and oxygen, as shown in Fig. 1.1.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

Fig. 1.1

You will investigate the effect of copper sulfate on the progress of this reaction. You will do this by stopping the reaction after 5 minutes and measuring the concentration of hydrogen peroxide remaining.

Potassium manganate(VII) is used to measure the concentration of hydrogen peroxide.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast suspension	none	20
H	hydrogen peroxide solution	irritant	20
C	1.0% copper sulfate solution	irritant	30
A	dilute sulfuric acid	irritant	30
P	potassium manganate(VII) solution	harmful	30
W	distilled water	none	150

If any solution comes into contact with your skin, wash off immediately under cold water.

You should wear suitable eye protection.

It is recommended that you wear gloves when using **A** and **P**.

You will need to carry out a serial dilution of the 1.0% copper sulfate solution, **C**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of copper sulfate solution in addition to the 1.0% copper sulfate solution, **C**.

After the serial dilution is completed, you need to have 10 cm^3 of each concentration available to use.

(a) (i) Complete Fig. 1.2 to show how you will prepare your serial dilution.

Each beaker should have:

- a labelled arrow to show the volume of copper sulfate solution transferred
- a labelled arrow to show the volume of distilled water, **W**, added
- a label under each beaker to show the concentration of the copper sulfate solution.

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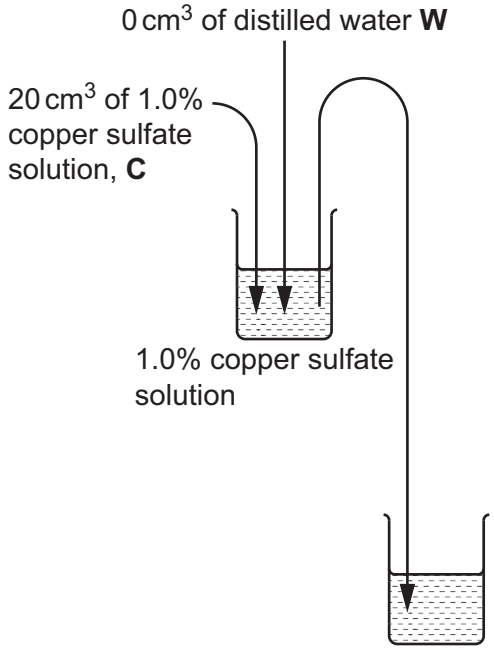


Fig. 1.2

[3]

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Carry out step 1 to step 7.

step 1 Prepare the concentrations of copper sulfate solution as shown in Fig. 1.2.

step 2 Label test-tubes with the concentrations prepared in step 1.

step 3 Put 1 cm^3 of the 1.0% copper sulfate solution into the appropriately labelled test-tube.

step 4 Put 1 cm^3 of each of the other concentrations of copper sulfate solution, as prepared in step 1, into the appropriately labelled test-tube.

step 5 Stir the yeast suspension, **Y**, and put 1 cm^3 of **Y** into each test-tube. Shake the test-tubes gently to mix. Wait for 2 minutes.

step 6 Put 1 cm^3 of hydrogen peroxide solution, **H**, into each test-tube. Shake gently to mix. Wait for 5 minutes.

step 7 After 5 minutes, put 2 cm^3 of sulfuric acid, **A**, into each test-tube. Shake gently to mix.

The addition of sulfuric acid stops the breakdown of hydrogen peroxide.

You will now compare the concentration of hydrogen peroxide remaining in each test-tube using potassium manganate(VII) solution, **P**.

- When a drop of **P** is added to hydrogen peroxide solution, you will see a pink colour that quickly turns colourless as **P** reacts with the hydrogen peroxide.
- You will continue adding **P**, one drop at a time, until the end-point is reached.
- The end-point is when the pink colour stays for at least 5 seconds.
- You will count the number of drops to reach the end-point.
- The greater the concentration of hydrogen peroxide, the more drops of **P** are needed to reach the end-point.

Carry out step 8 to step 14.

step 8 Fill the syringe labelled **P** with solution **P**.

step 9 Wipe the outside of the syringe with a paper towel.

step 10 Hold the syringe labelled **P** over the test-tube containing the **lowest** concentration of copper sulfate solution. Release **one** drop of **P** into the test-tube.

step 11 Shake the test-tube to mix. Observe the colour to see if the end-point is reached. The end-point is when the pink colour stays for at least 5 seconds.

step 12 Repeat step 10 and step 11, counting the total number of drops released until the end-point is reached. You may need to refill the syringe with **P**.

step 13 Record in **(a)(ii)** the number of drops of **P** added. If the end-point has **not** been reached with 30 drops, record the result as 'more than 30'.

step 14 Repeat step 8 to step 13 with each of the other concentrations of copper sulfate solution prepared in step 1.

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(ii) Record your results in an appropriate table.

[5]

(iii) Describe the effect of changing the concentration of copper sulfate solution on the concentration of hydrogen peroxide remaining in the test-tubes.

.....

.....

..... [1]

(iv) Describe **one** source of error in step 10 to step 12.

.....

.....

..... [1]

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River water can sometimes be contaminated with copper sulfate from factories.

You will use the procedure described in step 5 to step 12 to estimate the concentration of copper sulfate in a sample of river water, **R**.

You are provided with the materials shown in Table 1.2.

Table 1.2

labelled	contents	hazard	volume / cm^3
R	sample of river water with unknown concentration of copper sulfate	irritant	20

step 15 Label a test-tube **R**. Put 1 cm^3 of **R** into the test-tube.

step 16 Repeat step 5 to step 12. Record the number of drops of **P** needed to reach the end-point in **(a)(v)**.

(v) State the number of drops needed to reach the end-point for sample **R**.

..... [1]

(vi) Use your results in **(a)(ii)** and **(a)(v)** to estimate the concentration of copper sulfate in the sample of river water, **R**.

..... [1]

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Question 1 continues on page 10.

(b) Some scientists investigated a possible treatment for controlling blood sugar levels in humans. The scientists measured the effect of an inhibitor found in green tea on the activity of the enzyme sucrase. This enzyme hydrolyses sucrose into glucose and fructose.

The results are shown in Table 1.3.

Table 1.3

concentration of inhibitor / mg cm^{-3}	percentage inhibition of sucrase
0.50	8.0
1.00	27.5
1.50	44.5
2.00	51.0
2.50	52.5

(i) Plot a graph of the data in Table 1.3 on the grid in Fig. 1.3.

Use a sharp pencil.

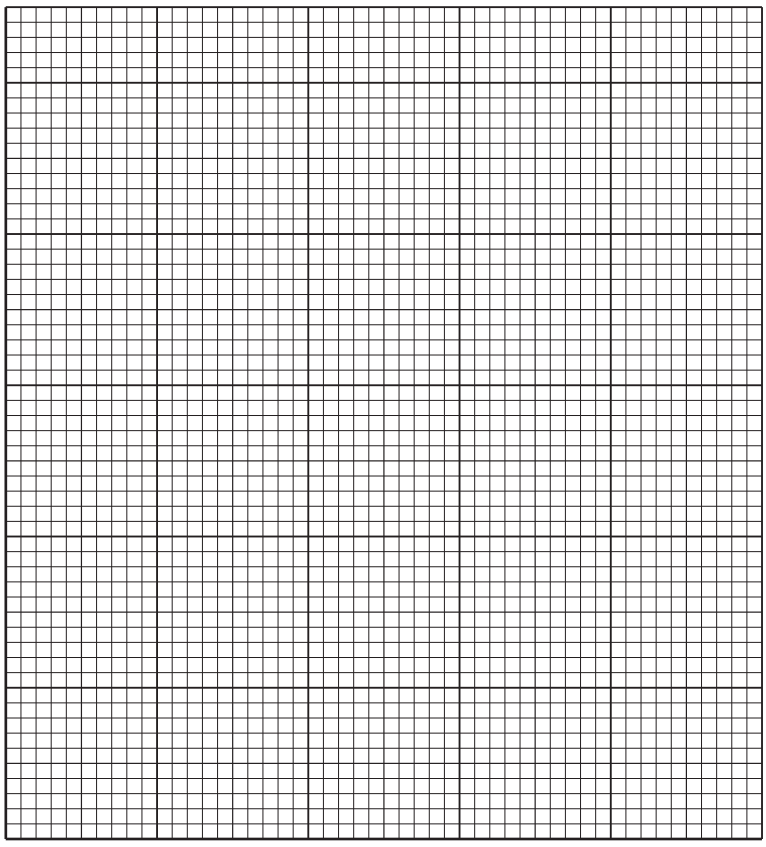


Fig. 1.3

[4]

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(ii) Draw **two** lines on your graph in Fig. 1.3 to show the concentration of inhibitor that causes 24% inhibition of sucrase. [1]

(iii) Suggest how the inhibitor in green tea reduces the activity of the enzyme sucrase.

.....

.....

.....

.....

..... [2]

(iv) The scientists calculated the percentage inhibition of sucrase by measuring the concentration of reducing sugars in the solution after 5 minutes.

Describe how the scientists could determine the concentration of reducing sugars in the solution.

.....

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.....

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..... [3]

[Total: 22]

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2 **M1** is a slide of a stained transverse section through a leaf.

(a) **(i)** Draw a large plan diagram of the region of the leaf on **M1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

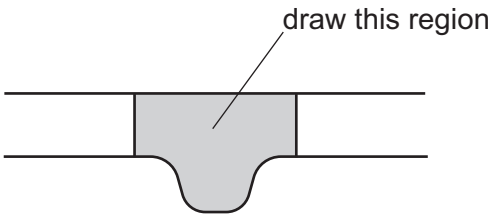


Fig. 2.1

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

[5]

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(ii) Observe the xylem vessel elements in the leaf on **M1**.

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

Each xylem vessel element must touch at least **one** other xylem vessel element.

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

[5]

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(b) Fig. 2.2 shows a photomicrograph of a transverse section through a different leaf from that on **M1**.

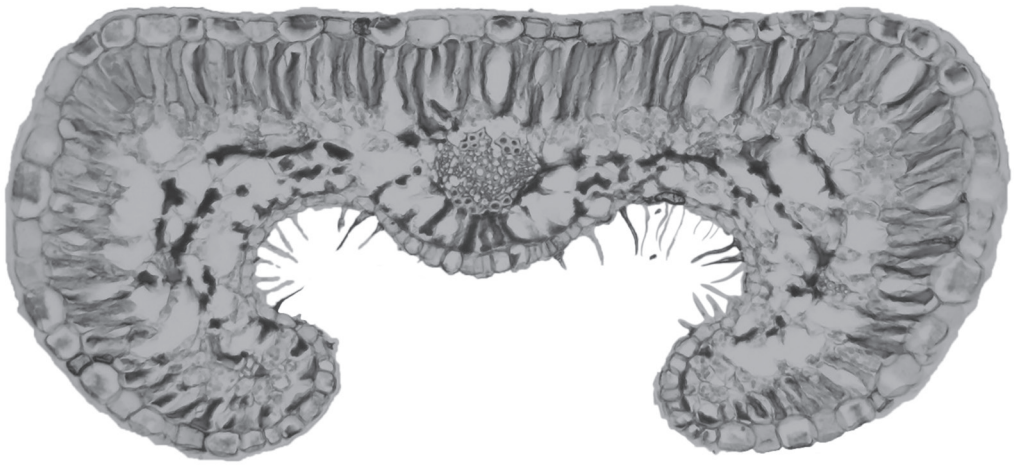


Fig. 2.2

Identify **three** observable differences, other than colour, between the section on **M1** and the section in Fig. 2.2.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.2

[4]

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

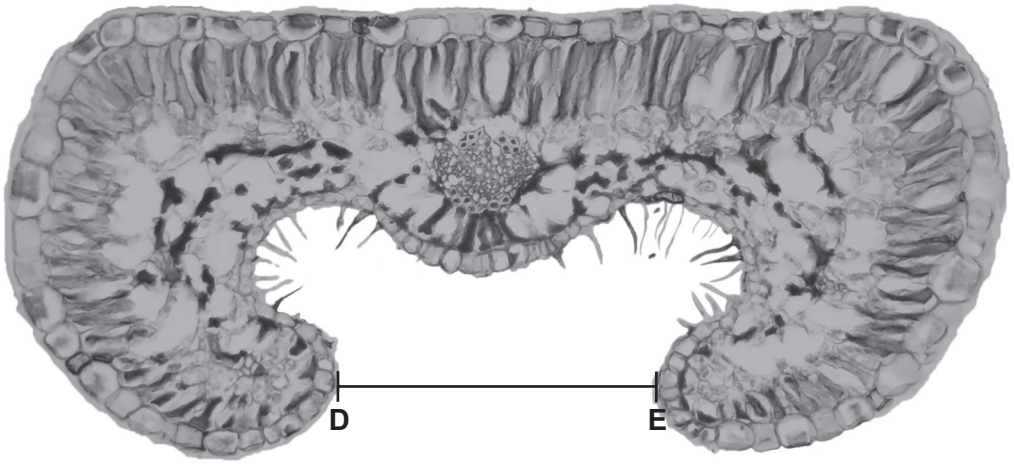


Fig. 2.3

Use the scale bar on Fig. 2.3 and the line **D**–**E** to calculate the actual length of the gap between the ends of the leaf.

Show your working, including units and give your answer in micrometres (μm).

actual length of gap = ... μm [4]

[Total: 18]

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

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 [ ].

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Total	

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1 Catalase is an enzyme found in plant tissues. It catalyses the breakdown of hydrogen peroxide, releasing oxygen gas.

When a mixture of catalase and hydrogen peroxide is put into a syringe, oxygen gas is produced and drops of the mixture come out of the nozzle of the syringe.

You will investigate the effect of different concentrations of catalase on the breakdown of hydrogen peroxide.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
E	100.0% catalase solution	irritant	50
H	hydrogen peroxide solution	irritant	30
W	distilled water	none	100

If any solution comes into contact with your skin, wash off immediately under cold water.

You should wear suitable eye protection.

You will need to make different concentrations of the catalase using proportional dilution of the 100.0% catalase solution, **E**.

You will need to prepare 20 cm^3 of each concentration, using **E** and **W**.

Table 1.2 shows how to prepare two of the concentrations of catalase you will use.

Decide which other concentrations of catalase you will use.

(a) (i) Complete Table 1.2 for the other concentrations you will use.

Table 1.2

percentage concentration of catalase	volume of E / cm^3	volume of W / cm^3
100.0	20.0	0.0
0.0	0.0	20.0

[2]

Carry out step 1 to step 8.

step 1 In the beakers provided, prepare the concentrations of catalase as shown in Table 1.2.

step 2 Label large test-tubes with the concentrations of catalase prepared in step 1.

step 3 Fill a 10 cm^3 syringe to the 5 cm^3 mark with hydrogen peroxide solution, **H**.

step 4 Fill the same syringe to the 10 cm^3 mark with the **100.0%** catalase solution.

step 5 Place the syringe in the large test-tube labelled **100.0%**, as shown in Fig. 1.1.

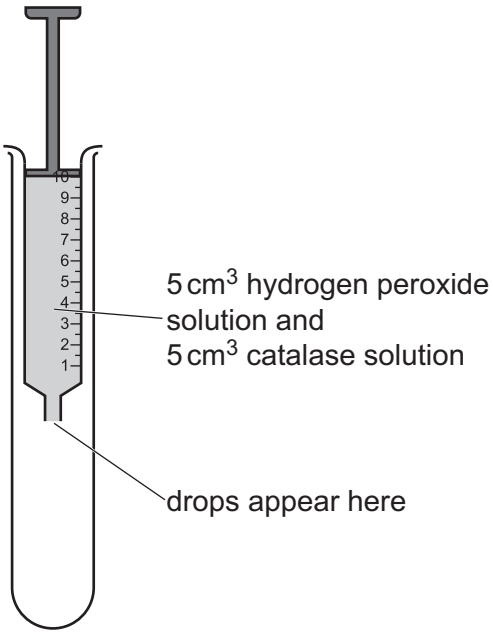


Fig. 1.1

step 6 Start the timer.

step 7 Count the number of drops produced in 60 seconds.
Record your results in **(a)(ii)**.

step 8 Repeat step 3 to step 7 using the other concentrations of catalase prepared in step 1.

(ii) Record your results in an appropriate table.

[5]

(iii) Describe the trend in your results.

.....

.....

..... [1]

(iv) Use your results in **(a)(ii)** to explain the effect of catalase concentration on the breakdown of hydrogen peroxide.

.....

.....

.....

.....

..... [2]

(v) State the independent variable in this investigation.

..... [1]

(vi) State **one** variable that was kept constant in the investigation.

.....

..... [1]

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(vii) Identify **two** sources of error in step 7.

1 .....

.....

.....

2 .....

.....

.....

[2]

(viii) Describe how you would modify the procedure to investigate the effect of substrate concentration on catalase activity.

.....

.....

.....

.....

..... [2]

(b) The catalase activity of germinating hyacinth seeds was measured when the seeds were placed in different concentrations of salt solution.

Table 1.3 shows the results of the investigation.

Table 1.3

concentration of salt solution / mmol dm^{-3}	catalase activity / arbitrary units
0	72
100	35
200	28
300	23
400	20
500	14

(i) Plot a graph of the data shown in Table 1.3 on the grid in Fig. 1.2.

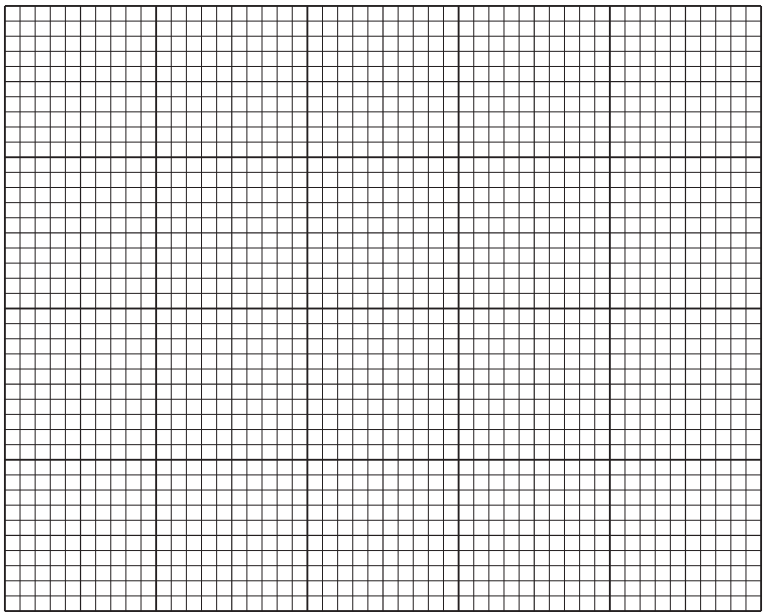


Fig. 1.2

[4]

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(ii) A germinating hyacinth seed was placed in a salt solution of unknown concentration. The catalase activity was found to be 54 arbitrary units.

Estimate the concentration of salt solution at which the seed was germinated.

Show on your graph how you obtained your estimate.

concentration = ... mmol dm^{-3} [2]

[Total: 22]

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

(a) **(i)** Draw a large plan diagram of the leaf section on **N1** shown by the shaded region in Fig. 2.1 (midrib).

Use a sharp pencil.

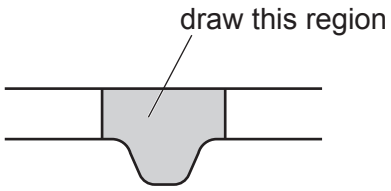


Fig. 2.1

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

[5]

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(ii) Observe the cells in the lower epidermis surrounding the midrib on the section of the leaf on **N1**.

Select a line of **four** adjacent lower epidermal cells.

- Make a large drawing of this line of **four** cells.
- Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

(b) Fig. 2.2 shows a photomicrograph of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

One division, on either the stage micrometer scale or the eyepiece graticule, is the distance between two adjacent lines.

The length of one division on the stage micrometer in Fig. 2.2 is **1.0 mm**.

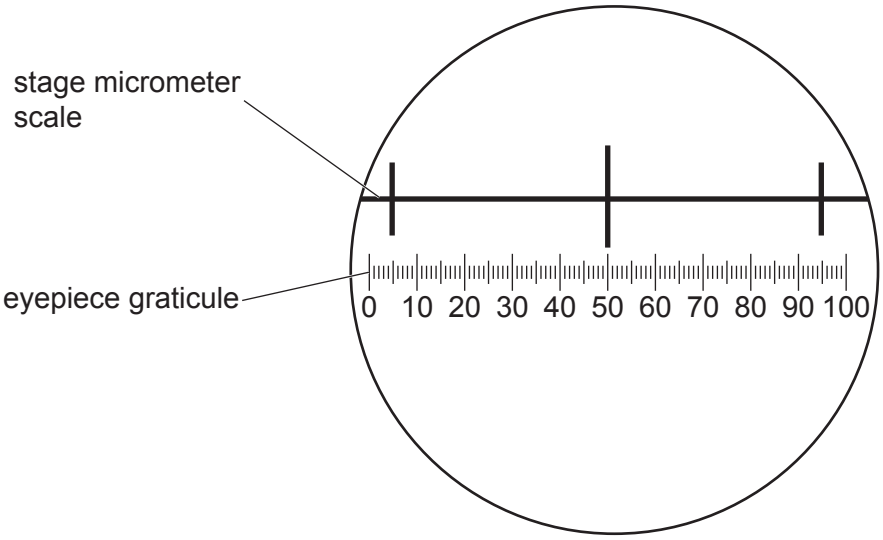


Fig. 2.2

(i) Calculate the actual length of **one** eyepiece graticule unit shown in Fig. 2.2.

Give your answer in micrometres (μm).

Show your working.

actual length = ... μm [2]

(ii) Fig. 2.3 is a photomicrograph of a transverse section of a leaf from another plant of the same species as **N1**.

Fig. 2.3 was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.2.

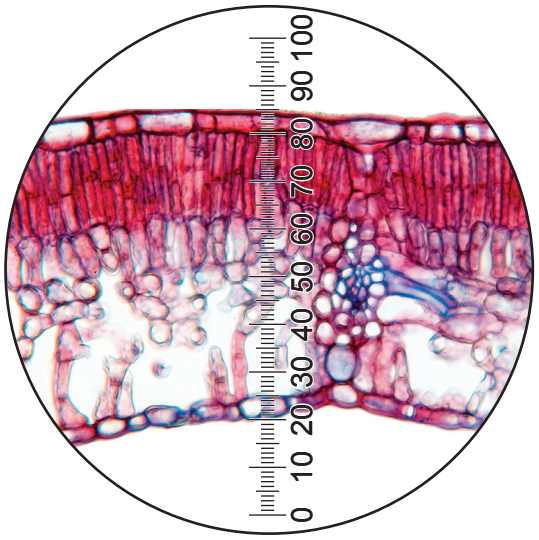


Fig. 2.3

Use the calibration of the eyepiece graticule unit from **(b)(i)** to calculate the actual width of the leaf in Fig. 2.3.

Show your working.

actual width = ... [2]

(iii) Identify **three** observable differences, other than colour, between the leaf section on **N1** and the leaf section in Fig. 2.3.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	N1	Fig. 2.3

[4]

[Total: 18]

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BIOLOGY **9700/37**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

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 [ ].

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1 When plant tissue is placed into a solution of sodium chloride, water moves between the sodium chloride solution and the cells in the plant tissue.

You will investigate the effect of surface area of plant tissue on the movement of water between a sodium chloride solution and the cells in a sample of plant tissue.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	5 cylinders of plant tissue in distilled water	none	–
S	2.0 mol dm^{-3} sodium chloride solution	none	200

It is recommended that you wear suitable eye protection.

You will need to:

- cut cylinders of plant tissue into different lengths
- soak different lengths of plant tissue in sodium chloride solution for 20 minutes
- measure the final length of the plant tissue.

Carry out step 1 to step 12.

step 1 Using the forceps, put the cylinders of plant tissue onto the white tile.

step 2 Cut each cylinder of plant tissue to 40 mm length.

The cylinders of plant tissue all have the same diameter, as shown in Fig. 1.1. The radius is calculated by dividing the diameter by 2.

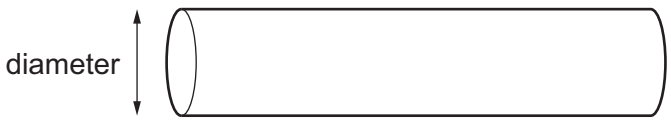


Fig. 1.1

(a) (i) Measure the diameter of one cylinder of plant tissue **and** calculate the radius, *r*.

diameter = ...

r = ...

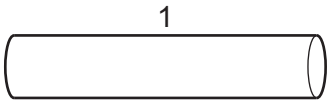
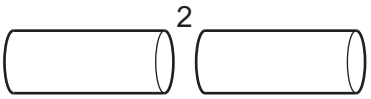
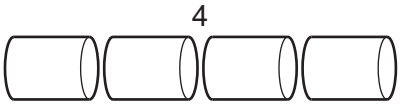
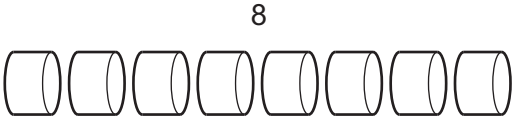
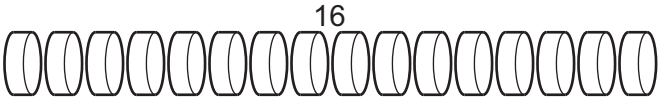
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To investigate the effect of surface area, you will use one whole cylinder of plant tissue and cut the other cylinders into a different number of pieces.

step 3 Label five beakers with the number of pieces of plant tissue (**n**) as shown in Table 1.2.

Table 1.2

beaker labelled	number of pieces of plant tissue (n)	length (h) of each small piece / mm
1		40
2		20
4		10
8		5
16		2.5

step 4 Put **one** whole cylinder of plant tissue into the beaker labelled **1**.

step 5 Cut each of the other **four** cylinders of plant tissue into the number of pieces shown in Table 1.2 and put them into the appropriately labelled beaker.

In step 6 you will use a syringe to measure the volume of sodium chloride solution, **S**, you will put into each beaker.

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(ii) State the volume of **S** that you will put into each beaker **and** give a reason for the volume that you have stated.

volume of **S** ..... cm^3

reason .....

.....

[1]

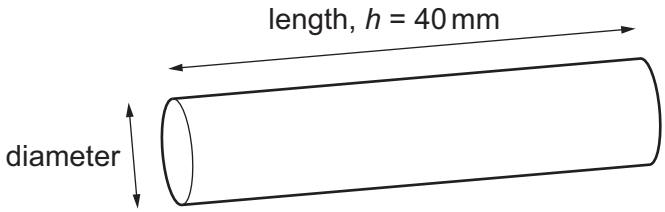
step 6 Put the volume of **S** you stated in **(a)(ii)** into each of the beakers.

step 7 Start timing and wait for 20 minutes.

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

Fig. 1.2 shows an example of how to calculate the total surface area of plant tissue placed in each beaker.

EXAMPLE: a cylinder with a length of 40 mm



surface area of cylinder = $2\pi r^2 + 2\pi r\, h$

$= (2 \times 3.14 \times r^2) + (2 \times 3.14 \times r \times 40)$

where:
$\pi = 3.14$
r = radius of cylinder = diameter ÷ 2
h = height or length of cylinder

The total surface area depends on the number of pieces, n.

Total surface area = surface area of one cylinder × number of pieces

$= (2\pi r^2 + 2\pi rh)n$

Fig. 1.2

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(iii) Complete Table 1.3 by calculating the total surface area of the **whole** piece of plant tissue (**1**) **and** the total surface area for the plant tissue cut into **16** pieces. Use the formulae shown in Fig. 1.2.

Show your working in Table 1.3.

Table 1.3

n	h / mm	surface area of one piece / mm^2	total surface area / mm^2
1	40		
16	2.5		

[2]

(iv) Describe what happens to the **total** surface area when one whole cylinder of plant tissue is cut into 16 smaller pieces.

.....

..... [1]

step 8 After the 20 minutes (step 7), pour the sodium chloride solution from around the cylinder of plant tissue in beaker **1** into the container labelled **For waste**. Put the plant tissue onto the white tile.

step 9 Measure the length of the cylinder of plant tissue. Record this length in **(a)(v)**.

step 10 Repeat step 8 for beaker **2**.

step 11 Place the cylinders of plant tissue end-to-end so that they are touching. Measure their total length, as shown in Fig. 1.3. Record this length in **(a)(v)**.

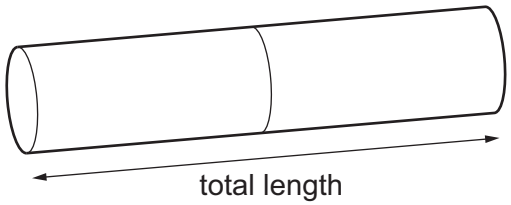


Fig. 1.3

step 12 Repeat step 10 and step 11 using the plant tissue in beaker **4**, beaker **8** and beaker **16**.

(v) Record your results in an appropriate table.

[5]

(vi) With reference to the total surface area, describe the trend in your results.

.....

.....

..... [1]

(vii) Explain the trend you described in **(a)(vi)**.

.....

.....

.....

.....

.....

.....

.....

..... [2]

(viii) State **one** source of error in this investigation when measuring the dependent variable in step 11 and step 12.

.....

..... [1]

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(ix) Suggest how you could modify this procedure to investigate the effect of temperature on the movement of water between the sodium chloride solution and the cells in the plant tissue.

.....

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.....

.....

..... [2]

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(b) A student investigated the effect of different concentrations of sodium chloride solution on red blood cells.

The student:

- counted the number of whole red blood cells in six samples of blood
- put each sample into a different concentration of sodium chloride solution for 10 minutes
- counted the number of whole red blood cells remaining in each concentration
- calculated the number of red blood cells remaining as a percentage of the number of red blood cells in each sample at the start.

The results are shown in Table 1.4.

Table 1.4

percentage concentration of sodium chloride	percentage number of whole red blood cells remaining
0.00	0.0
0.40	3.0
0.50	10.0
0.65	46.0
0.80	96.0
0.90	100.0

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

Use a sharp pencil.

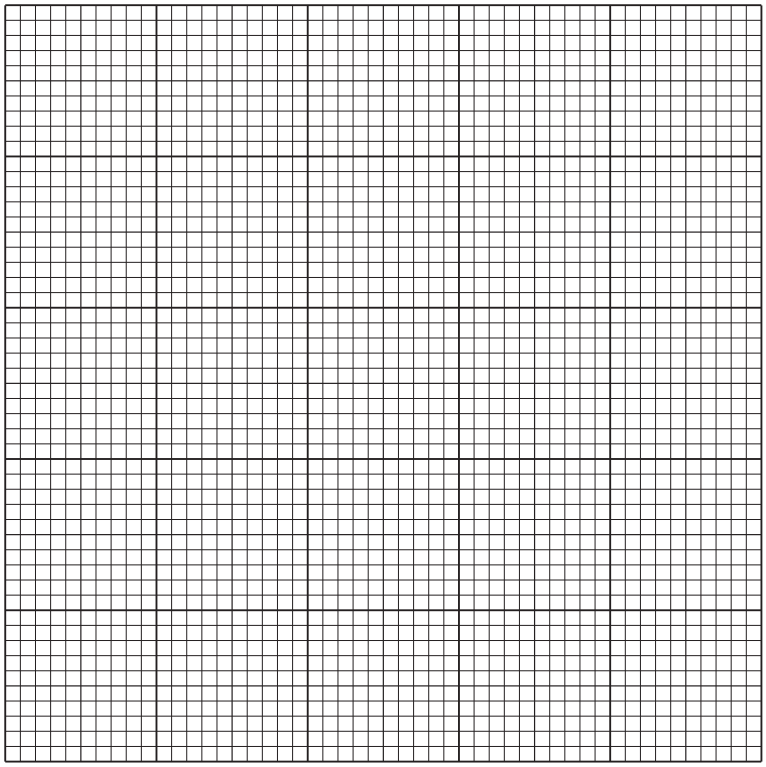


Fig. 1.4

[4]

(ii) State the concentration of sodium chloride solution that has the same water potential as the red blood cells.

sodium chloride concentration = ...% [1]

(iii) With reference to water potential, explain the effect of 0.4% sodium chloride solution on red blood cells.

.....

.....

.....

..... [1]

[Total: 22]

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2 **L1** is a slide of a stained transverse section through a plant organ.

(a) **(i)** Draw a large plan diagram of a region of the organ on **L1** to include the epidermis and **two** vascular bundles. Use a sharp pencil.

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

[5]

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(ii) Observe the xylem on the section of the plant organ on **L1**.

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

Each xylem vessel element must touch at least **one** of the other xylem vessel elements.

- 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. 2.1 is a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

One division, on either the stage micrometer scale or the eyepiece graticule, is the distance between two adjacent lines.

The length of one division on this stage micrometer is **0.1 mm**.

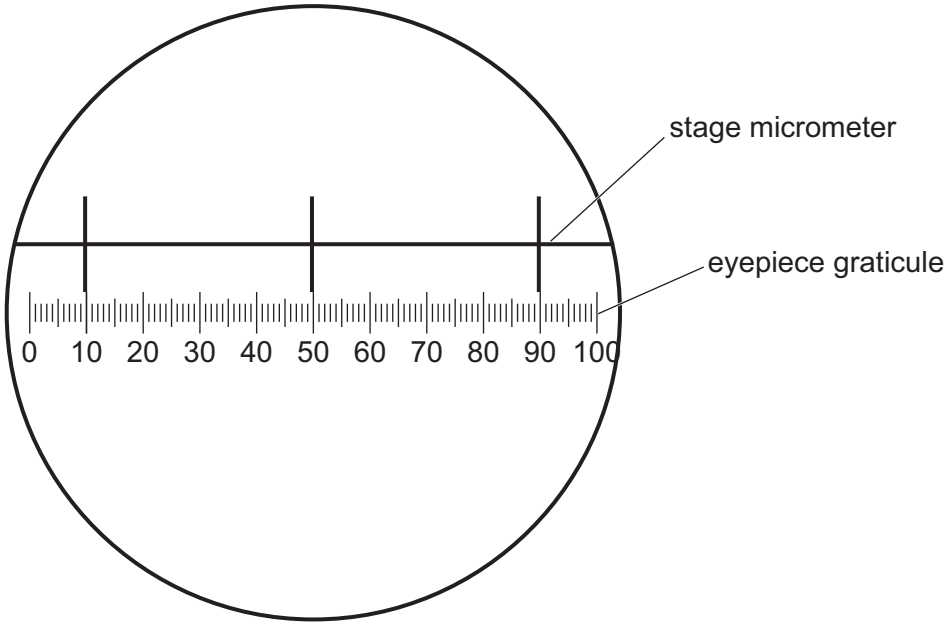


Fig. 2.1

(i) Use Fig. 2.1 to calculate the actual length of **one** eyepiece graticule unit.

Show your working and give your answer in micrometres (μm).

actual length = ... μm [2]

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Fig. 2.2 is a photomicrograph of a stained transverse section of the same plant organ as the section on **L1** but from a different plant.

This was taken using the same microscope and eyepiece graticule as in Fig. 2.1.

The eyepiece graticule scale has been placed across one of the larger sections of vascular tissue, labelled **T** in Fig. 2.2.

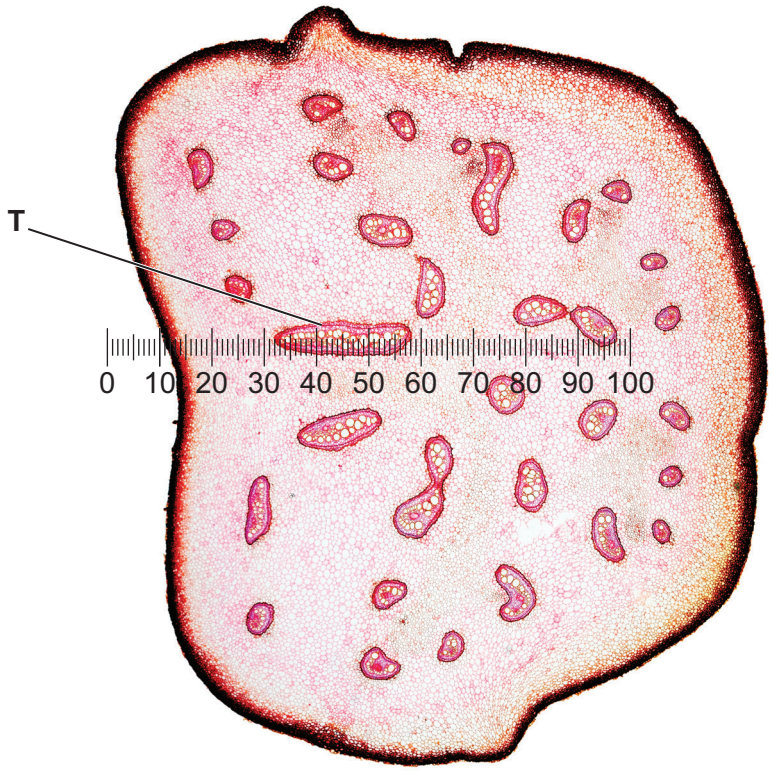


Fig. 2.2

(ii) Use the calibration of the eyepiece graticule unit from **(b)(i)** to calculate the actual length of the section of vascular tissue **T** in Fig. 2.2.

Show your working and use appropriate units.

actual length of the vascular tissue **T** = ... [2]

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

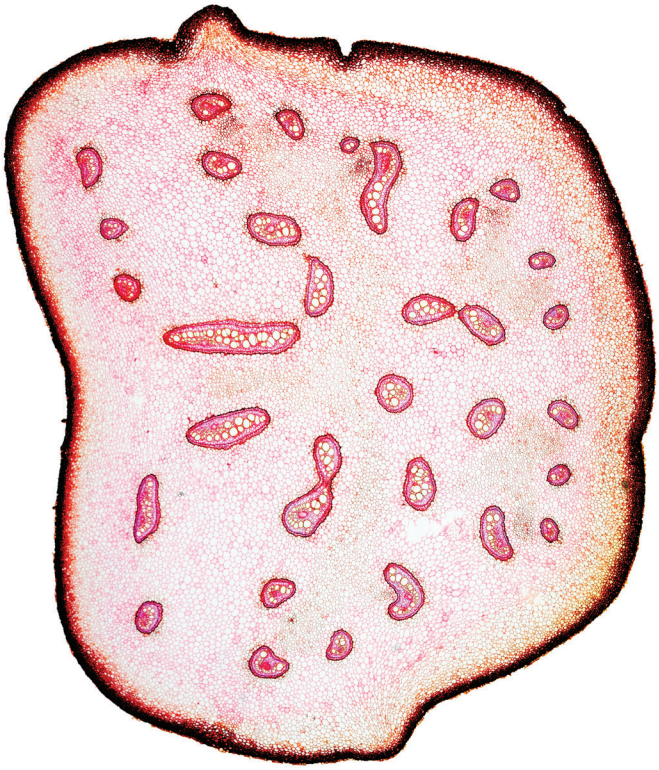


Fig. 2.3

(i) Identify **three** observable differences, other than colour, between the section on **L1** and the section in Fig. 2.3.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	L1	Fig. 2.3

[3]

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(ii) Identify the plant organ on **L1** and in Fig. 2.3.

State how **one** observable feature helped you to identify the plant organ.

plant organ .....

.....

.....

[1]

[Total: 18]

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BIOLOGY **9700/38**

Paper 3 Advanced Practical Skills 2 **May/June 2025**

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 [ ].

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1 Catalase is an enzyme found in yeast cells. It catalyses the breakdown of hydrogen peroxide to produce water and oxygen, as shown in Fig. 1.1.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

Fig. 1.1

You will investigate the effect of copper sulfate on the progress of this reaction. You will do this by stopping the reaction after 5 minutes and measuring the concentration of hydrogen peroxide remaining.

Potassium manganate(VII) is used to measure the concentration of hydrogen peroxide.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast suspension	none	20
H	hydrogen peroxide solution	irritant	20
C	1.0% copper sulfate solution	irritant	30
A	dilute sulfuric acid	irritant	30
P	potassium manganate(VII) solution	harmful	30
W	distilled water	none	150

If any solution comes into contact with your skin, wash off immediately under cold water.

You should wear suitable eye protection.

It is recommended that you wear gloves when using **A** and **P**.

You will need to carry out a serial dilution of the 1.0% copper sulfate solution, **C**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of copper sulfate solution in addition to the 1.0% copper sulfate solution, **C**.

After the serial dilution is completed, you need to have 10 cm^3 of each concentration available to use.

(a) (i) Complete Fig. 1.2 to show how you will prepare your serial dilution.

Each beaker should have:

- a labelled arrow to show the volume of copper sulfate solution transferred
- a labelled arrow to show the volume of distilled water, **W**, added
- a label under each beaker to show the concentration of the copper sulfate solution.

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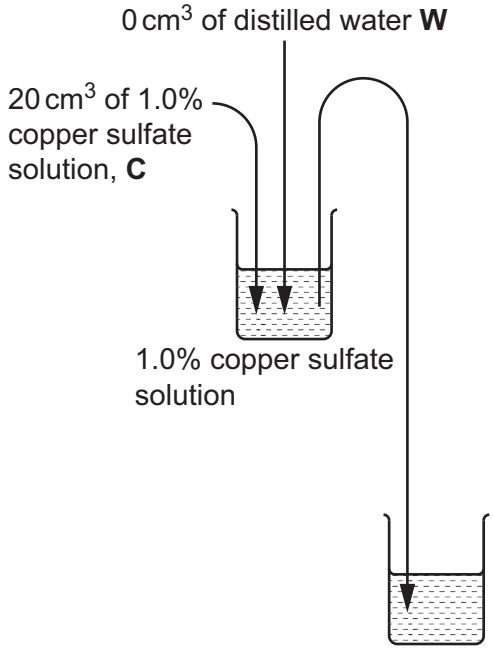


Fig. 1.2

[3]

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Carry out step 1 to step 7.

step 1 Prepare the concentrations of copper sulfate solution as shown in Fig. 1.2.

step 2 Label test-tubes with the concentrations prepared in step 1.

step 3 Put 1 cm^3 of the 1.0% copper sulfate solution into the appropriately labelled test-tube.

step 4 Put 1 cm^3 of each of the other concentrations of copper sulfate solution, as prepared in step 1, into the appropriately labelled test-tube.

step 5 Stir the yeast suspension, **Y**, and put 1 cm^3 of **Y** into each test-tube. Shake the test-tubes gently to mix. Wait for 2 minutes.

step 6 Put 1 cm^3 of hydrogen peroxide solution, **H**, into each test-tube. Shake gently to mix. Wait for 5 minutes.

step 7 After 5 minutes, put 2 cm^3 of sulfuric acid, **A**, into each test-tube. Shake gently to mix.

The addition of sulfuric acid stops the breakdown of hydrogen peroxide.

You will now compare the concentration of hydrogen peroxide remaining in each test-tube using potassium manganate(VII) solution, **P**.

- When a drop of **P** is added to hydrogen peroxide solution, you will see a pink colour that quickly turns colourless as **P** reacts with the hydrogen peroxide.
- You will continue adding **P**, one drop at a time, until the end-point is reached.
- The end-point is when the pink colour stays for at least 5 seconds.
- You will count the number of drops to reach the end-point.
- The greater the concentration of hydrogen peroxide, the more drops of **P** are needed to reach the end-point.

Carry out step 8 to step 14.

step 8 Fill the syringe labelled **P** with solution **P**.

step 9 Wipe the outside of the syringe with a paper towel.

step 10 Hold the syringe labelled **P** over the test-tube containing the **lowest** concentration of copper sulfate solution. Release **one** drop of **P** into the test-tube.

step 11 Shake the test-tube to mix. Observe the colour to see if the end-point is reached. The end-point is when the pink colour stays for at least 5 seconds.

step 12 Repeat step 10 and step 11, counting the total number of drops released until the end-point is reached. You may need to refill the syringe with **P**.

step 13 Record in **(a)(ii)** the number of drops of **P** added. If the end-point has **not** been reached with 30 drops, record the result as 'more than 30'.

step 14 Repeat step 8 to step 13 with each of the other concentrations of copper sulfate solution prepared in step 1.

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(ii) Record your results in an appropriate table.

[5]

(iii) Describe the effect of changing the concentration of copper sulfate solution on the concentration of hydrogen peroxide remaining in the test-tubes.

.....

.....

..... [1]

(iv) Describe **one** source of error in step 10 to step 12.

.....

.....

..... [1]

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River water can sometimes be contaminated with copper sulfate from factories.

You will use the procedure described in step 5 to step 12 to estimate the concentration of copper sulfate in a sample of river water, **R**.

You are provided with the materials shown in Table 1.2.

Table 1.2

labelled	contents	hazard	volume / cm^3
R	sample of river water with unknown concentration of copper sulfate	irritant	20

step 15 Label a test-tube **R**. Put 1 cm^3 of **R** into the test-tube.

step 16 Repeat step 5 to step 12. Record the number of drops of **P** needed to reach the end-point in **(a)(v)**.

(v) State the number of drops needed to reach the end-point for sample **R**.

..... [1]

(vi) Use your results in **(a)(ii)** and **(a)(v)** to estimate the concentration of copper sulfate in the sample of river water, **R**.

..... [1]

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Question 1 continues on page 10.

(b) Some scientists investigated a possible treatment for controlling blood sugar levels in humans. The scientists measured the effect of an inhibitor found in green tea on the activity of the enzyme sucrase. This enzyme hydrolyses sucrose into glucose and fructose.

The results are shown in Table 1.3.

Table 1.3

concentration of inhibitor / mg cm^{-3}	percentage inhibition of sucrase
0.50	8.0
1.00	27.5
1.50	44.5
2.00	51.0
2.50	52.5

(i) Plot a graph of the data in Table 1.3 on the grid in Fig. 1.3.

Use a sharp pencil.

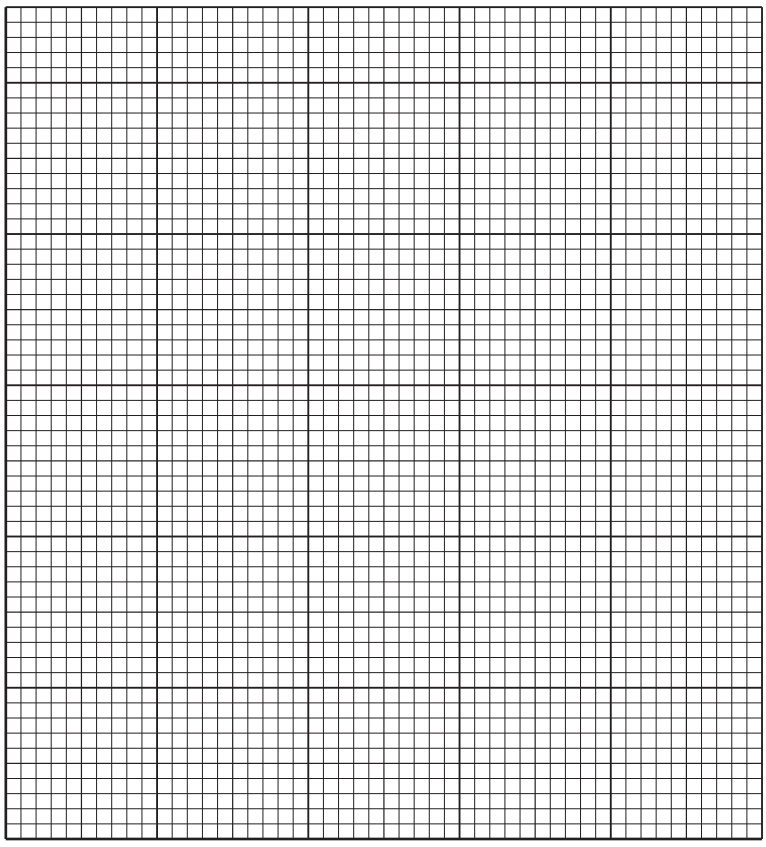


Fig. 1.3

[4]

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(ii) Draw **two** lines on your graph in Fig. 1.3 to show the concentration of inhibitor that causes 24% inhibition of sucrase. [1]

(iii) Suggest how the inhibitor in green tea reduces the activity of the enzyme sucrase.

.....

.....

.....

.....

..... [2]

(iv) The scientists calculated the percentage inhibition of sucrase by measuring the concentration of reducing sugars in the solution after 5 minutes.

Describe how the scientists could determine the concentration of reducing sugars in the solution.

.....

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.....

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..... [3]

[Total: 22]

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2 **M1** is a slide of a stained transverse section through a leaf.

(a) **(i)** Draw a large plan diagram of the region of the leaf on **M1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

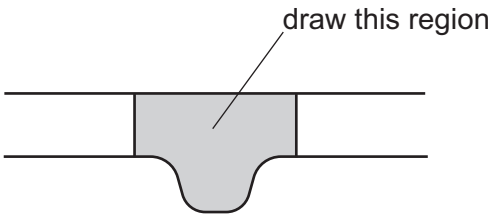


Fig. 2.1

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

[5]

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(ii) Observe the xylem vessel elements in the leaf on **M1**.

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

Each xylem vessel element must touch at least **one** other xylem vessel element.

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

[5]

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(b) Fig. 2.2 shows a photomicrograph of a transverse section through a different leaf from that on **M1**.

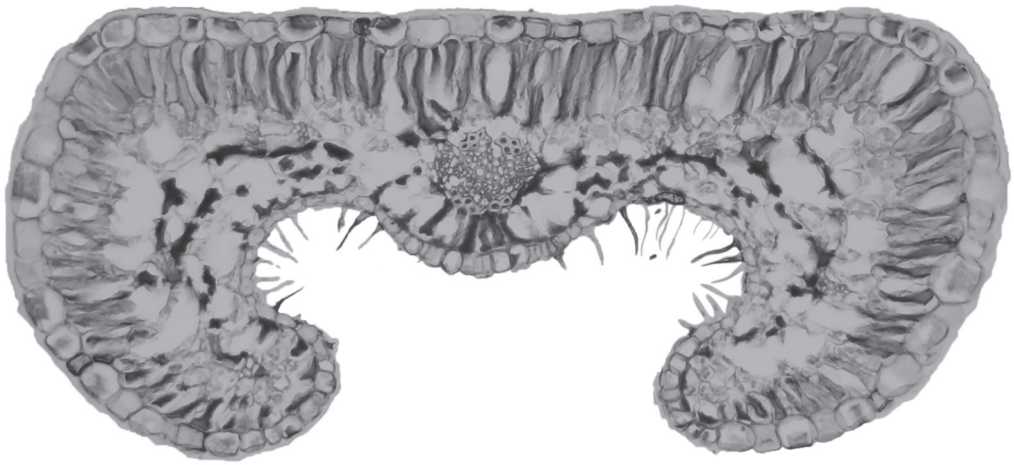


Fig. 2.2

Identify **three** observable differences, other than colour, between the section on **M1** and the section in Fig. 2.2.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.2

[4]

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

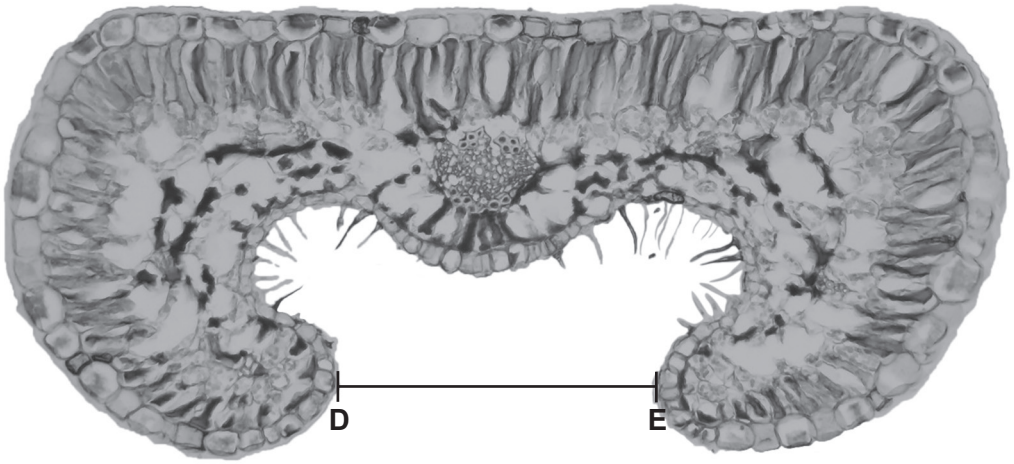


Fig. 2.3

Use the scale bar on Fig. 2.3 and the line **D**–**E** to calculate the actual length of the gap between the ends of the leaf.

Show your working, including units and give your answer in micrometres (μm).

actual length of gap = ... μm [4]

[Total: 18]

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