Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5141702751

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 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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2	
Total	

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

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[Turn over

1 The bacterium *Streptococcus pneumoniae* is commonly found in the throat. *S. pneumoniae* produces hydrogen peroxide as it grows. A sample can be taken from a patient's throat and tested to measure the concentration of hydrogen peroxide. This can be used as a measure of the growth of the bacteria.

You will determine the growth of bacteria by measuring the concentration of hydrogen peroxide in a solution that represents a sample taken from a patient. You will do this by measuring how long it takes for a sample of hydrogen peroxide to cause a colour change in a reaction mixture. The faster the mixture changes to a blue-black colour, the higher the concentration of hydrogen peroxide, and the greater the growth of bacteria.

You will use a range of known concentrations of hydrogen peroxide to estimate the concentration of hydrogen peroxide in a sample.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
R1	dilute sulfuric acid	irritant	100
R2	starch solution	low	10
R3	potassium iodide solution	low	10
R4	sodium thiosulfate solution	low	10
H	2.0% hydrogen peroxide solution	irritant	25
U	solution representing patient sample	irritant	10
W	distilled water	low	100

If any solution 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 carry out a **serial** dilution of the 2.0% hydrogen peroxide solution, **H**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of hydrogen peroxide solution in addition to the 2.0% hydrogen peroxide solution, **H**.

After the serial dilution is completed, you will need to have 10 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 hydrogen peroxide solution transferred
- a labelled arrow to show the volume of distilled water, **W**, added
- a label under the beaker to show the concentration of the hydrogen peroxide solution.

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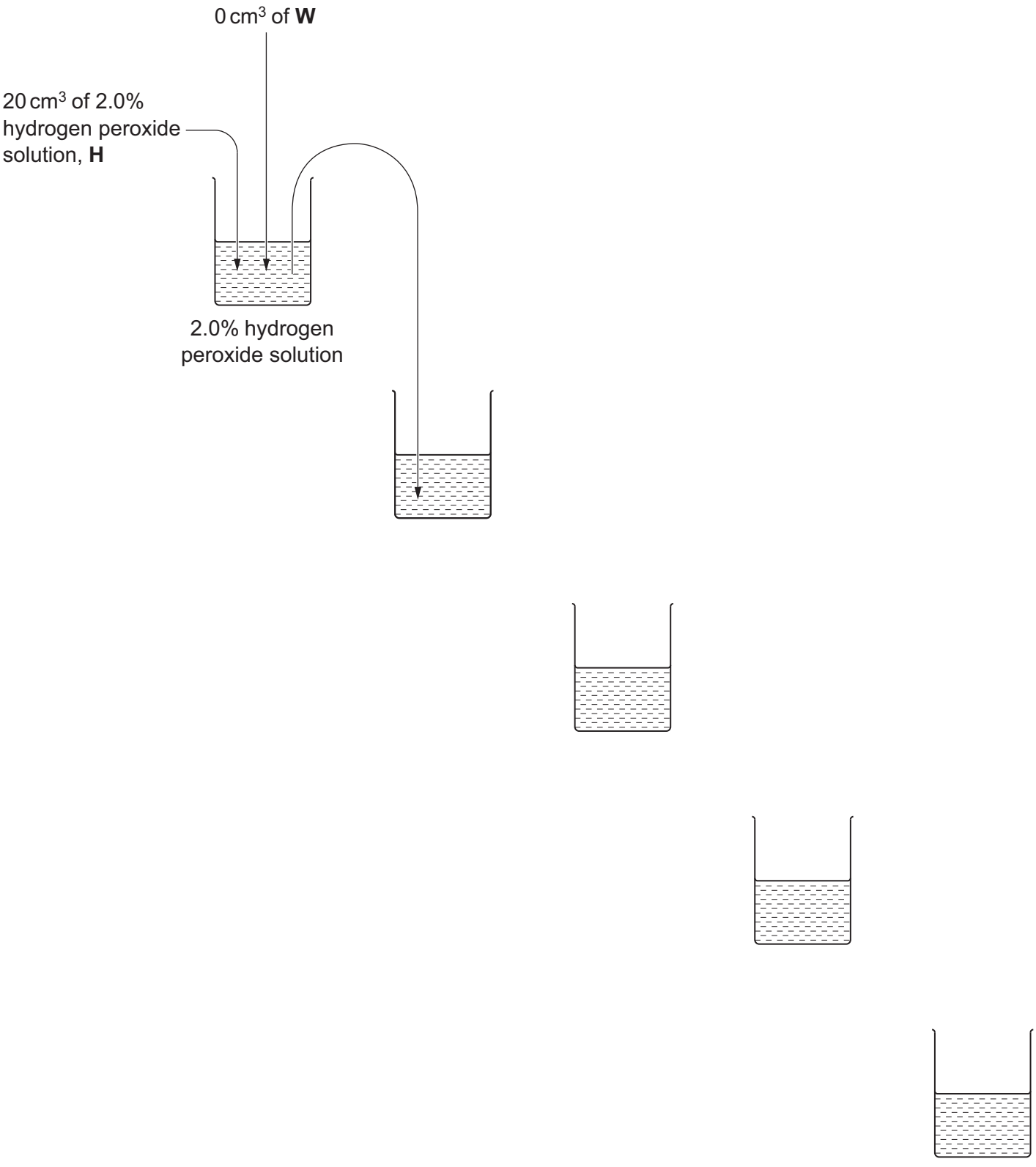


Fig. 1.1

[3]

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Carry out step 1 to step 17.

step 1 Prepare the concentrations of hydrogen peroxide solution as shown in Fig. 1.1.

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

step 3 Put 10 cm^3 of **R1** into each test-tube.

step 4 Put 1 cm^3 of **R2** into each test-tube.

step 5 Put 1 cm^3 of **R3** into each test-tube.

step 6 Put 1 cm^3 of **R4** into each test-tube.

step 7 Stir the contents of each test-tube with a glass rod.

step 8 Put 1 cm^3 of the 2.0% hydrogen peroxide solution into the appropriately labelled test-tube.

step 9 Stir the contents of the test-tube and immediately start timing.

step 10 Record in **(a)(ii)** the time taken for a blue-black colour to appear.

If the blue-black colour does **not** appear after 180 seconds, stop timing and record as 'more than 180'.

step 11 Repeat step 8 to step 10 with the other concentrations of hydrogen peroxide solution prepared in step 1.

(ii) Record your results in an appropriate table.

[5]

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A sample can be taken from a patient's throat and tested to measure the concentration of hydrogen peroxide. You will be testing a solution, **U**, that represents a sample taken from a patient's throat.

You will need to estimate the concentration of hydrogen peroxide in **U**. This can be used as a measure of the growth of bacteria.

step 12 Label 3 test-tubes **U1**, **U2** and **U3**.

step 13 Repeat step 3 to step 7.

step 14 Add 1 cm^3 of **U** to test-tube **U1**.

step 15 Stir the contents of the test-tube and immediately start timing.

step 16 Record in **(a)(iii)** the time taken for a blue-black colour to appear.

step 17 Repeat step 14 to step 16 using test-tubes **U2** and **U3**.

(iii) Record the time taken for a blue-black colour to appear.

U1 = ...

U2 = ...

U3 = ...
[1]

(iv) Calculate the mean time taken for the blue-black colour to appear for sample **U**.

Show your working.

mean time = ...
[1]

(v) Use your results in **(a)(ii)** and **(a)(iv)** to estimate the concentration of hydrogen peroxide in sample **U**.

concentration of hydrogen peroxide in sample **U** = ... [1]

(vi) Explain why repeating the measurement for sample **U** allows you to have more confidence in your estimate.

.....

.....

..... [1]

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(vii) With reference to your estimate for sample **U**, describe **one** other modification to the procedure that would allow a more accurate estimate of the concentration of hydrogen peroxide in sample **U**.

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.....

..... [1]

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(b) Scientists investigated the effect of temperature on hydrogen peroxide production in a different species of bacterium, *Streptococcus pyogenes*.

Cultures of the bacterial cells were incubated at 2 different temperatures for 168 hours. The percentage of bacterial cells that were able to produce hydrogen peroxide was measured.

The results are shown in Table 1.2.

Table 1.2

time / hours	percentage of bacterial cells able to produce hydrogen peroxide	
	bacterial cells at 20 °C	bacterial cells at 37 °C
24	6.0	3.0
48	10.0	3.0
72	12.0	3.2
96	16.0	5.2
168	19.8	5.4

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

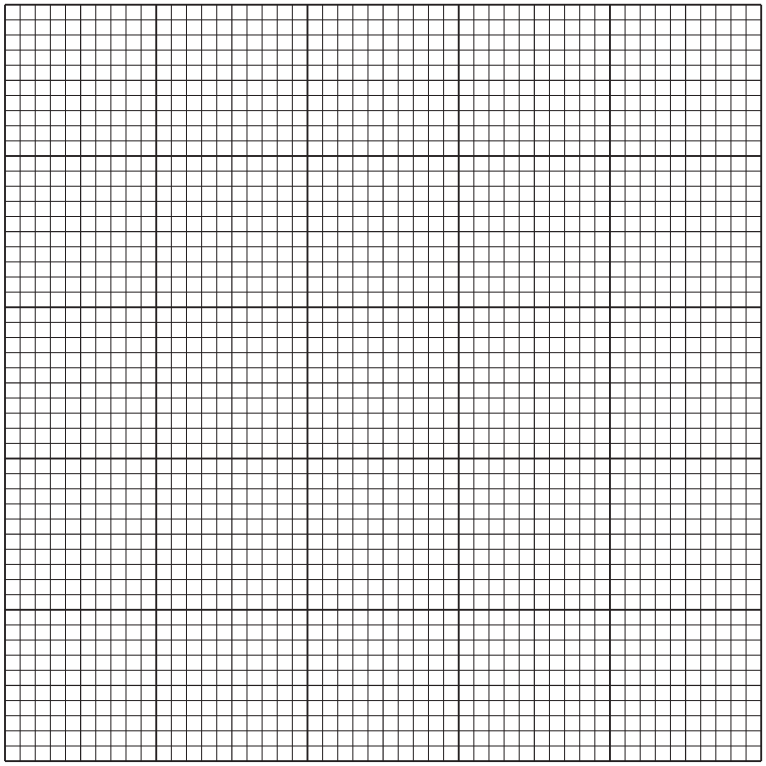


Fig. 1.2

[4]

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(ii) State **two** conclusions from the results of the investigation at the 2 temperatures.

1 .....

.....

.....

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2 .....

.....

.....

.....

[2]

(iii) A sample was taken at 20 °C that showed 14.5% of the bacteria were able to produce hydrogen peroxide.

Use your graph in Fig. 1.2 to estimate when the sample was taken.

Show on your graph how you obtained your estimate, and give your answer to the nearest hour.

sample taken ..... hours

[2]

(iv) State **one** variable that the scientists would need to keep constant so that the results at the 2 temperatures could be compared.

.....

.....

..... [1]

[Total: 22]

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

(a) **(i)** Draw a large plan diagram of the whole section on **J1**. Use a sharp pencil.

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

[5]

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(ii) Observe the epidermis of the stem on **J1**.

Select a group of **four** adjacent epidermal cells.

Each cell must touch at least **one** other cell.

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

[5]

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(iii) Fig. 2.1 is a photomicrograph of a stained transverse section of a stem from a different type of plant from **J1**.

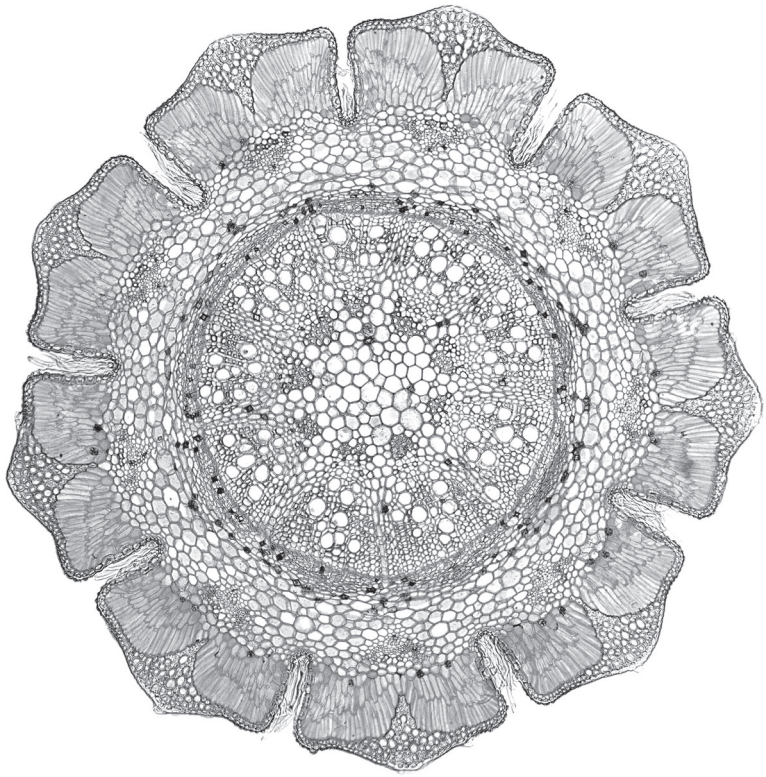


Fig. 2.1

Identify **three** observable differences, other than colour, between the stem section on **J1** and the stem section in Fig. 2.1.

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

Table 2.1

feature	J1	Fig. 2.1
1		
2		
3		

[3]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a stem from a different type of plant.

You will calculate the density of vascular bundles in the stem section. The circle represents the area of the stem.

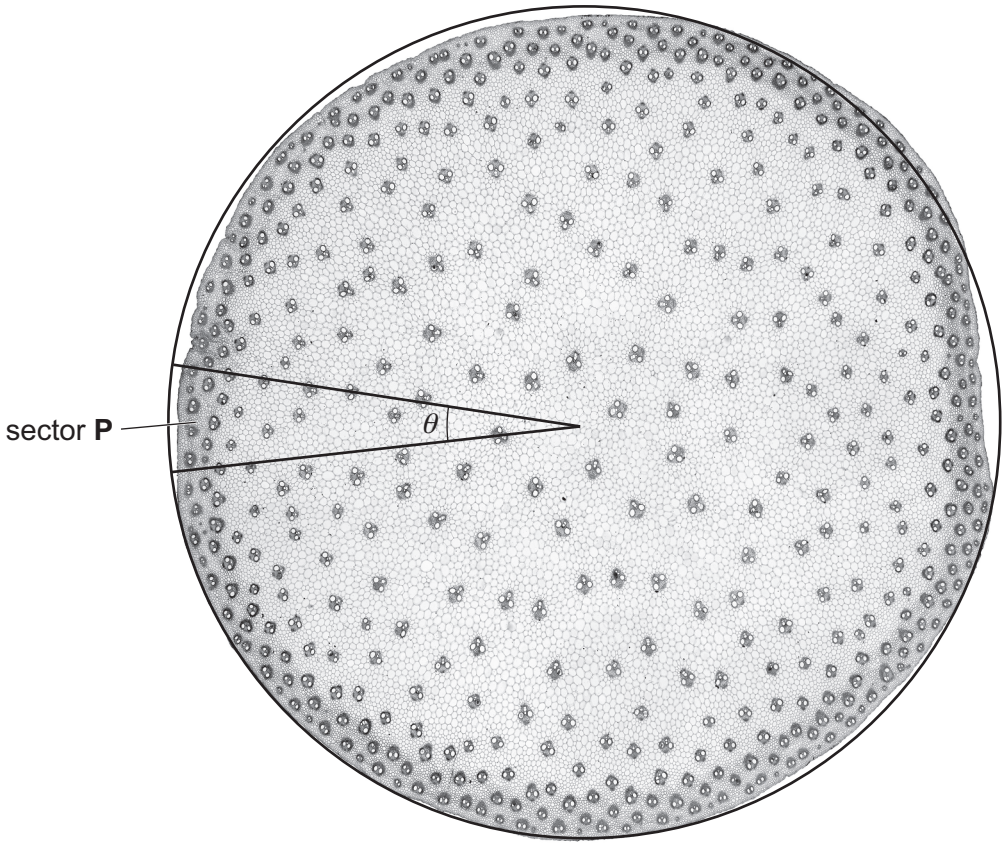


Fig. 2.2

(i) To calculate the density of vascular bundles you will first need to count the number of whole vascular bundles in sector **P**.

number of whole vascular bundles in sector **P** = ... [1]

(ii) Use your answer to **(b)(i)** to estimate the total number of vascular bundles in the stem section shown in Fig. 2.2.

angle θ = 15°

Show your working.

total number of vascular bundles = ...
[2]

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(iii) The stem section shown in Fig. 2.2 has an actual area of 44 mm^2.

Use your answer in **(b)(ii)** to calculate the density of vascular bundles in the stem section.

Give your answer to **two** significant figures.

Show your working.

vascular bundle density = ... mm^{-2}
[2]

[Total: 18]

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2025**

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1 Dialysis tubing is a partially permeable membrane. Glucose molecules can diffuse through the dialysis tubing.

You are required to investigate the diffusion of glucose across dialysis tubing.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
G	20.0% glucose solution	low	50
W	distilled water	low	200
Benedict's	Benedict's solution	harmful irritant	40
D	length of dialysis tubing in distilled water	low	–

If any solution 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:

- put glucose solution into dialysis tubing surrounded by water
- take samples of the water surrounding the dialysis tubing
- test for the presence of glucose in each sample of water.

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Carry out step 1 to step 11.

step 1 Draw a mark 8 cm from the top of a large test-tube, as shown in Fig. 1.1.

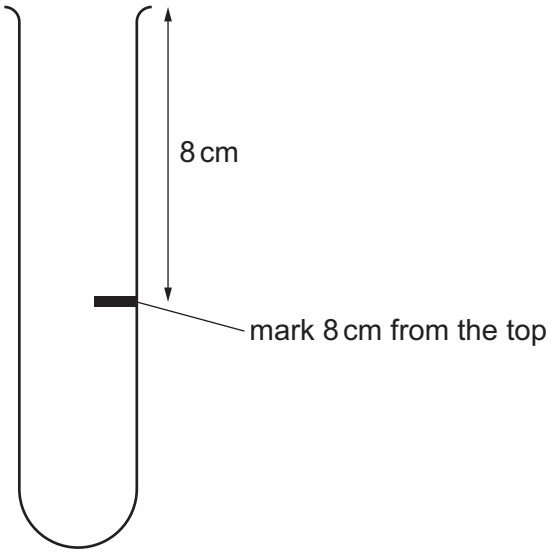


Fig. 1.1

step 2 Remove the dialysis tubing from beaker **D**. Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

step 3 The whole length of the dialysis tubing needs to be separated to allow the tubing to be filled with solution. To do this, rub the whole length gently between your finger and thumb.

step 4 Put 10 cm^3 of 20.0% glucose solution, **G**, into the open end of the dialysis tubing.

step 5 Rinse the outside of the dialysis tubing by dipping it in the water in beaker **D**.

step 6 Put the dialysis tubing containing **G** into the large test-tube and keep it in position using an elastic band as shown in Fig. 1.2.

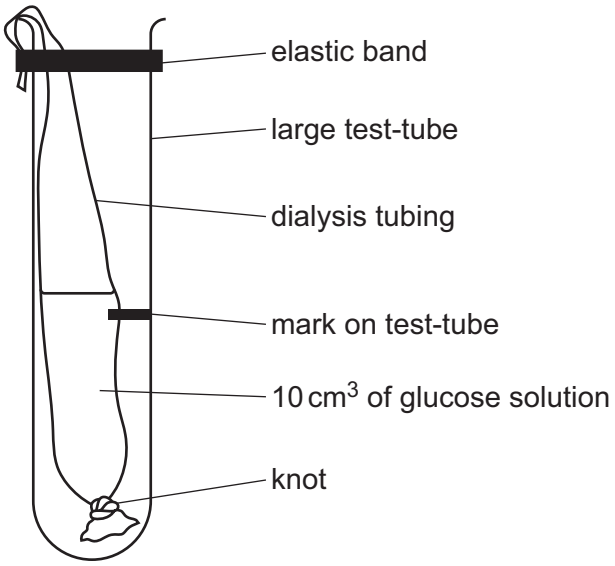


Fig. 1.2

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step 7 Put distilled water into the large test-tube so that the top of the water is above the level of the glucose solution in the dialysis tubing.

step 8 Start timing.

You are required to take samples of the water surrounding the dialysis tubing every 5 minutes for 15 minutes. You will collect three samples.

step 9 Label three test-tubes with the times the samples of water will be taken (**5**, **10** and **15**).

step 10 After 5 minutes (step 8), put a 1 cm^3 syringe into the water surrounding the dialysis tubing so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **5**. Repeat this action to remove another 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **5**. The test-tube labelled **5** will now contain a 2 cm^3 sample. Do **not** stop timing.

step 11 Repeat step 10 at 10 minutes and at 15 minutes using the appropriately labelled test-tubes.

You need to carry out a dilution of the 20.0% glucose solution, **G**, to make a 1.0% glucose solution. You will need 20 cm^3 of this 1.0% glucose solution.

(a) (i) Complete Table 1.2 to show the volume of distilled water, **W**, you will use to make 20 cm^3 of a 1.0% glucose solution.

Table 1.2

volume of 20.0% glucose solution, G / cm^3	**volume of distilled water, W / cm^3**
1	.....

[1]

step 12 Prepare the 1.0% glucose solution as shown in Table 1.2.

You will need to carry out a **serial** dilution of the 1.0% glucose solution you have prepared in step 12 as shown in Fig. 1.3. You must reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of glucose solution in addition to the 1.0% glucose solution from step 12.

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

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(ii) Complete Fig. 1.3 to show how you will prepare your serial dilution.

Each beaker should have:

- a labelled arrow to show the volume of glucose solution transferred
- a labelled arrow to show the volume of distilled water, **W**, added.

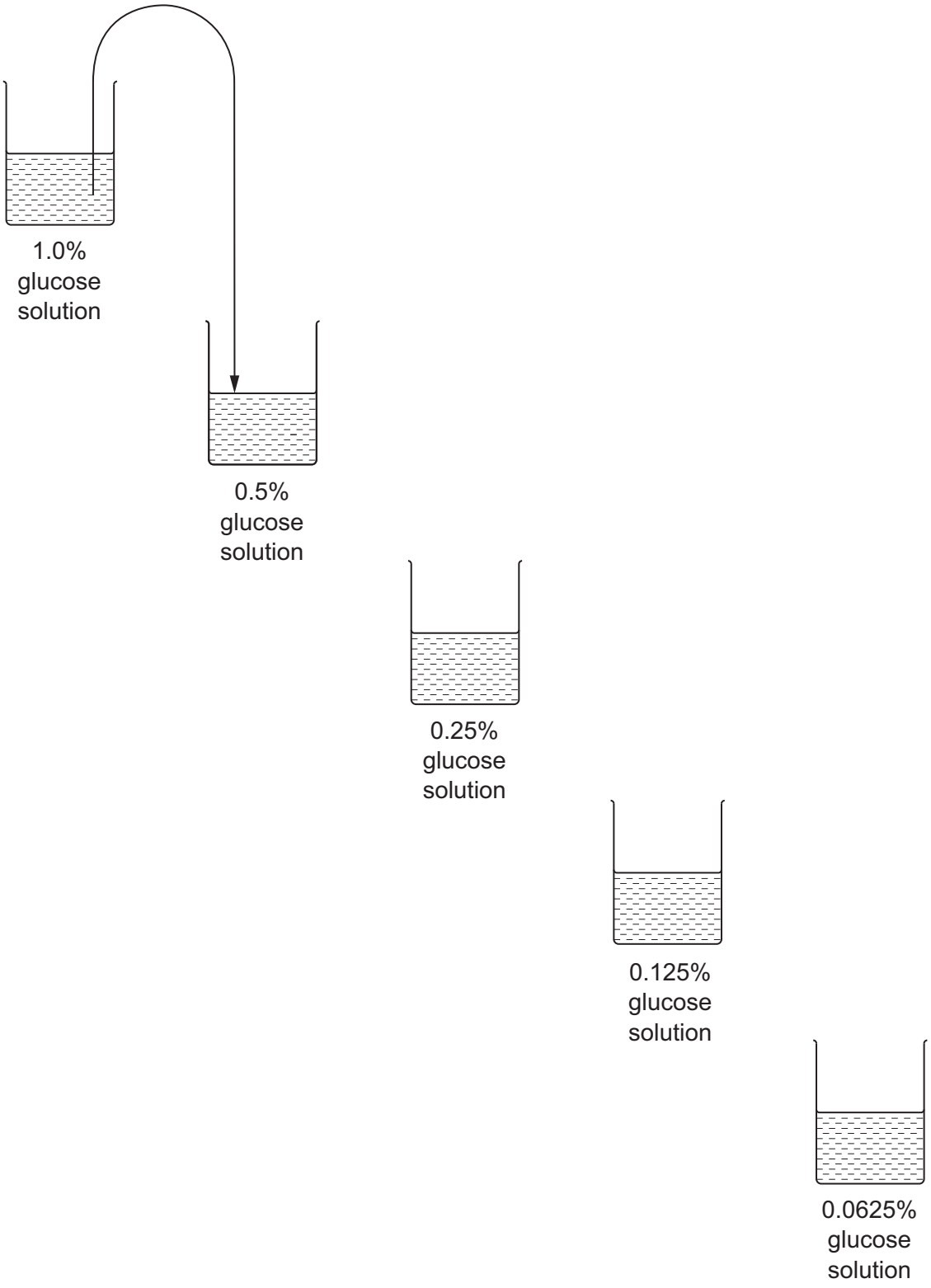


Fig. 1.3

[2]

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step 13 Set up a boiling water-bath ready for step 18 and step 22.

step 14 Prepare the concentrations of glucose solution as shown in Fig. 1.3.

step 15 Label 5 test-tubes with the concentrations of glucose solution shown in Fig. 1.3.

step 16 Put 2 cm^3 of the 1.0% glucose solution into the appropriately labelled test-tube.

(iii) You are required to carry out the Benedict's test on the glucose solutions that you have prepared in step 14.

State the volume of Benedict's solution you will use for each reducing sugar test. Explain why you have selected this volume.

volume of Benedict's solution ..... cm^3

explanation .....

.....

[1]

step 17 Put the volume of Benedict's solution stated in **(a)(iii)** into the test-tube labelled 1.0%. Shake gently to mix.

step 18 Put this test-tube into the boiling water-bath and record in Table 1.3 the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 19 Remove the test-tube from the boiling water-bath.

step 20 Repeat step 16 to step 19 using 2 cm^3 of each of the other concentrations of glucose solution.

(iv) Complete Table 1.3 to record your results.

Table 1.3

percentage concentration of glucose	
1.0	
0.5	
0.25	
0.125	
0.0625	

[1]

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You are required to carry out the Benedict's test on the three samples collected from the water surrounding the dialysis tubing (**5**, **10** and **15**).

step 21 Put the volume of Benedict's solution stated in **(a)(iii)** into the test-tube labelled **5**. Shake gently to mix.

step 22 Put this test-tube into the boiling water-bath and record in **(a)(v)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 23 Remove the test-tube from the boiling water-bath.

step 24 Repeat step 21 to step 23 for the other samples (**10** and **15**).

(v) Record your results in an appropriate table.

[4]

(vi) State **one** source of error when carrying out the Benedict's test.

.....

..... [1]

(vii) Use your results in **(a)(iv)** and **(a)(v)** to estimate the percentage concentration of glucose in the samples taken at **5**, **10** and **15** minutes.

percentage concentration of glucose in sample **5** = ...

percentage concentration of glucose in sample **10** = ...

percentage concentration of glucose in sample **15** = ...

[1]

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(viii) Suggest a reason for the percentage concentrations of glucose estimated in **(a)(vii)**.

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..... [1]

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Question 1 continues on page 10.

(b) A dialysis membrane, similar to dialysis tubing, is used in the treatment of kidney disease.

During this treatment, the blood of a person with kidney disease is passed through a dialysis machine to remove unwanted waste products from the blood.

The machine contains dialysate which is a solution of glucose and ions. Blood flows through the dialysis machine and is separated from the dialysate by a membrane. Some molecules diffuse from the blood into the dialysate. This is shown in Fig. 1.4.

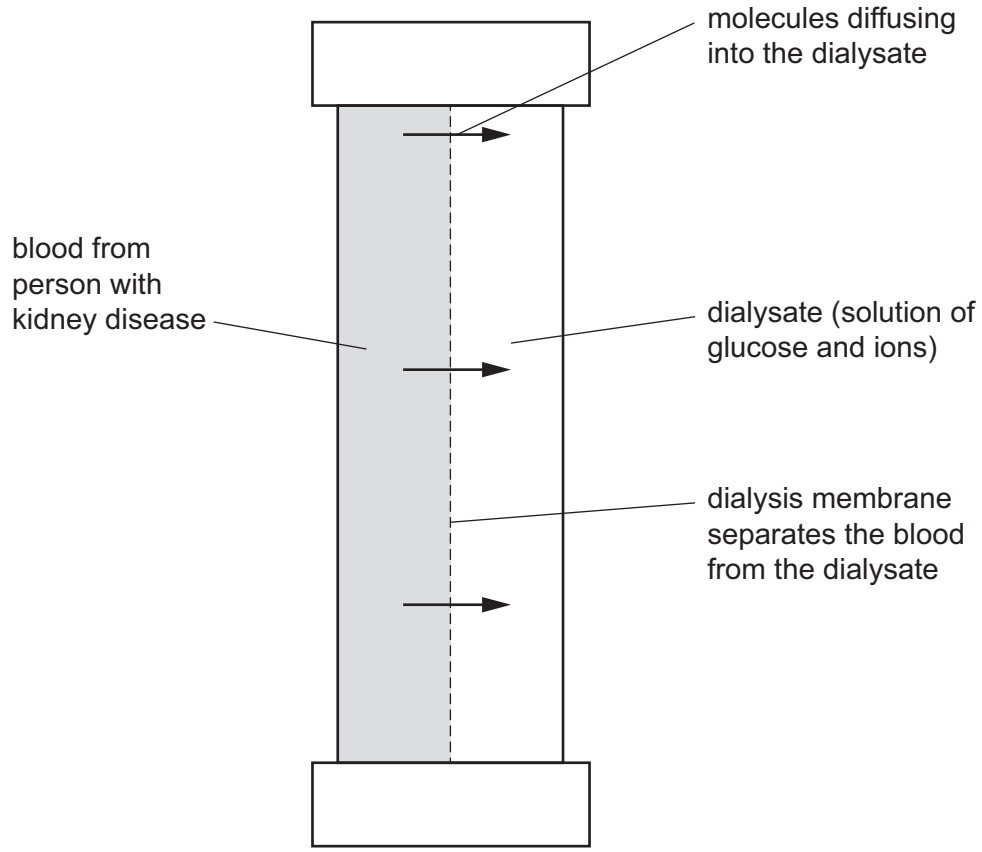


Fig. 1.4

Scientists studied the movement of two molecules, **P** and **Q**, found in the blood of a person with kidney disease. They wanted to see if these two molecules would remain in the blood or move out of the blood across the dialysis membrane into the dialysate.

The scientists took samples of blood from a person using a dialysis machine every 5 minutes for 20 minutes and recorded the concentration of **P** and **Q** in these samples. The results are shown in Table 1.4.

Table 1.4

time sample was taken from the blood / min	concentration of P in the blood / arbitrary units	concentration of Q in the blood / arbitrary units
0	200	400
5	205	280
10	200	150
15	195	90
20	200	75

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(i) Plot a line graph of the data in Table 1.4 on the grid in Fig. 1.5.

Use a sharp pencil.

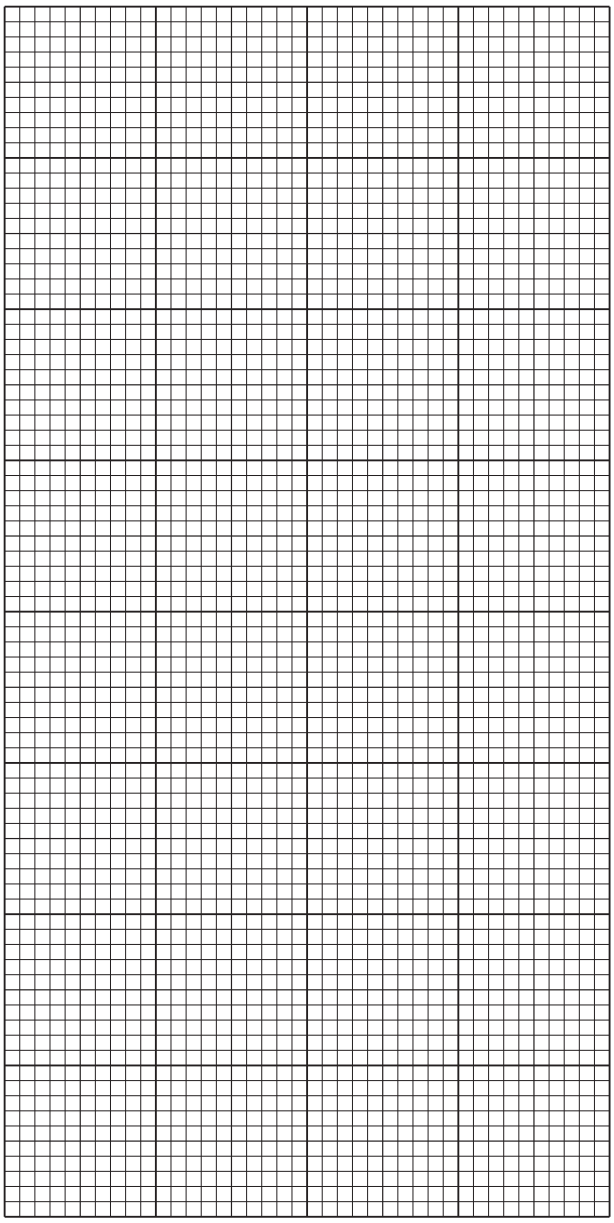


Fig. 1.5

[4]

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(ii) Calculate the percentage decrease in concentration of **Q** between 5 minutes and 20 minutes.

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

..... %
[2]

(iii) Suggest a reason for the rate of decrease in the concentration of **Q** from 0 to 10 minutes and from 10 to 20 minutes.

0 to 10 minutes .....

.....

.....

10 to 20 minutes .....

.....

.....
[2]

[Total: 20]

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Question 2 starts on page 14.

2 **K1** is a slide of a stained transverse section through a root.

(a) **(i)** Draw a large plan diagram of the region on **K1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

Use **one** ruled label line and the label **T** to identify a tissue involved in transport of substances throughout the plant.

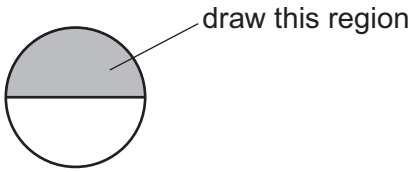


Fig. 2.1

[5]

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(ii) Observe the cells in the centre of the root on **K1**.

Select a group of **four** adjacent cells.

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

Make a large drawing of this group of **four** cells.

[4]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section through the root of a different plant to **K1**.

One difference between the section in Fig. 2.2 and the section on **K1** has been labelled.

Identify **three** other observable differences between the section in Fig. 2.2 and the section on **K1**.

Draw **three** label lines on Fig. 2.2 to label the **three** differences you have identified. You should complete the labels to describe the differences you observe.

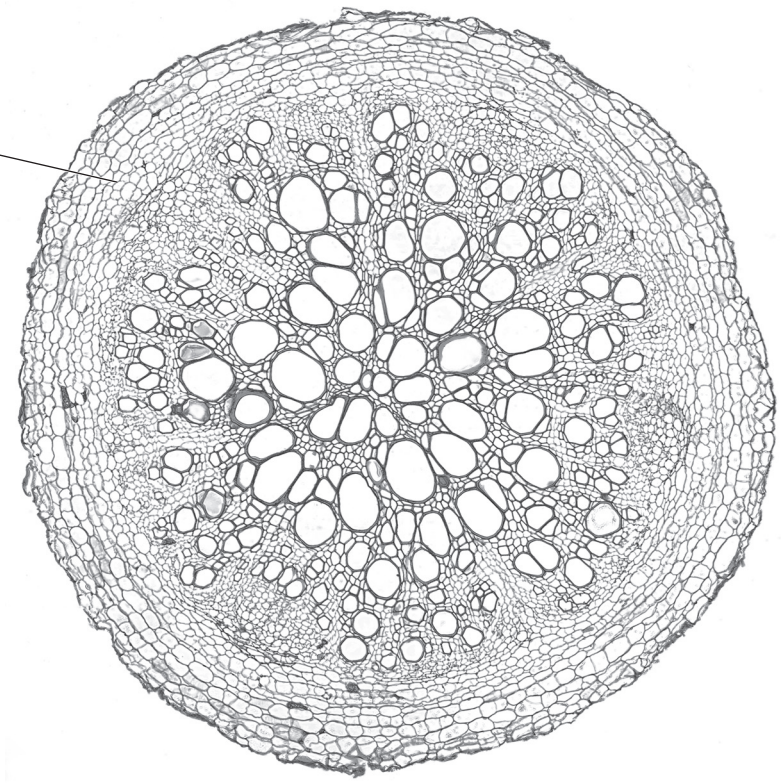


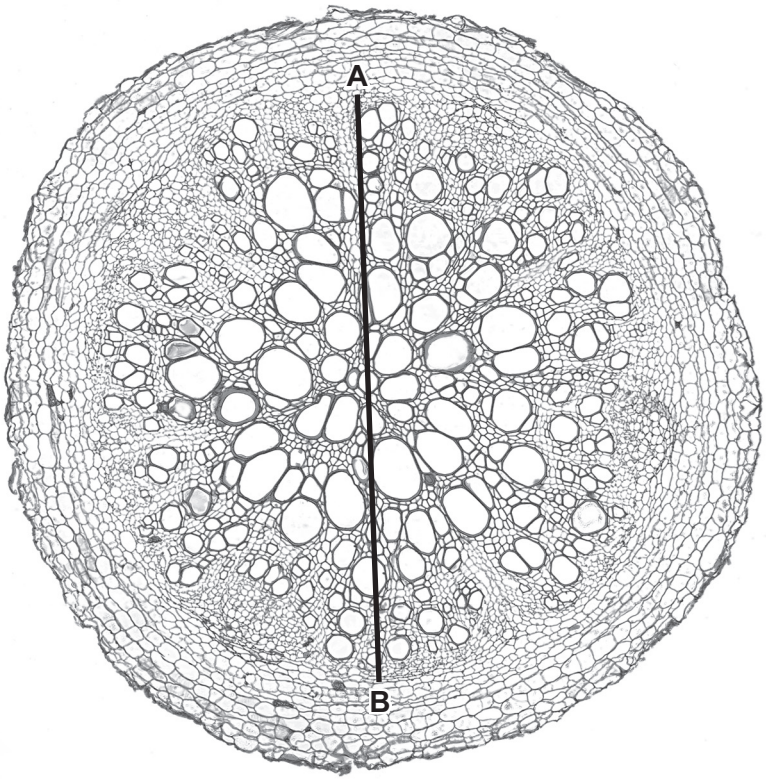
Fig. 2.2

[4]

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(c) A student was asked to find the area of the vascular tissue in a transverse section of root.

The student grew one plant for three weeks and took a section from one of the roots. This section is shown in Fig. 2.3.



magnification ×35

Fig. 2.3

The vascular tissue is the central region of the section.

Assume that the vascular tissue is a circle. The line **A–B** is the diameter of the vascular tissue.

(i) Calculate the actual area of the vascular tissue.

Use the formula: area = πr^2, where $\pi = 3.14$.

actual area of the vascular tissue = ... mm^2
[4]

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(ii) The student wrote a hypothesis which stated that:

The area of vascular tissue in a root section changes as the plant grows.

Suggest modifications to the method used in **(c)** to investigate this hypothesis.

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..... [3]

[Total: 20]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0199211725

BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 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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[Turn over

1 (a) A plant produces sugars in its leaves. The sugars produced are needed by other parts of the plant and are transported through the phloem as sucrose.

Sucrose is transported to the roots where it is stored as starch. Some of the sucrose is transported to the fruit of the plant where it is stored as fructose and glucose. Sucrose is also transported to the seeds of the plant.

Water and mineral ions are taken up through the roots where they are transported through the xylem to the rest of the plant.

Solutions were made to represent extracts of different tissues and fluids found in a plant:

- fluid in the phloem
- root tissue
- seed tissue
- fruit tissue
- fluid in the xylem

You are provided with **4** solutions, **S1**, **S2**, **S3** and **S4**.

You will:

- identify the biological molecules present in each of the 4 solutions
- suggest which solution, **S1**, **S2**, **S3** or **S4**, could represent each of the plant extracts.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
A	dilute hydrochloric acid	irritant	20
H	sodium hydrogencarbonate powder	low	-
Benedict's	Benedict's solution	harmful irritant	40
Iodine	iodine solution	irritant	20
S1	solution 1	low	60
S2	solution 2	low	60
S3	solution 3	low	60
S4	solution 4	low	60

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

It is recommended that you wear suitable eye protection.

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You will need to:

- carry out the test for reducing sugars
- carry out the test for non-reducing sugars
- carry out the test for starch
- identify the biological molecules in **S1**, **S2**, **S3** and **S4**.

(i) State the reagent or reagents that are used to test for reducing sugars **and** the colour or colours produced if reducing sugars are present.

reagent or reagents .....

colour or colours .....

Describe how you will carry out the test for reducing sugars.

.....

.....

.....

[1]

step 1 Label 4 test-tubes **S1**, **S2**, **S3** and **S4**.

step 2 Put 1 cm^3 of each solution into the appropriately labelled test-tube.

step 3 Carry out the test for reducing sugars on **S1**, **S2**, **S3** and **S4** described in **(a)(i)**.

step 4 Record the colours observed in **(a)(iii).**

(ii) State the reagent or reagents that are used to test for non-reducing sugars **and** the colour or colours produced if non-reducing sugars are present.

reagent or reagents .....

colour or colours .....

Describe how you will carry out the test for non-reducing sugars.

.....

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[2]

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step 5 Label 4 clean test-tubes **S1**, **S2**, **S3** and **S4**.

step 6 Put 1 cm^3 of each solution into the appropriately labelled test-tube.

step 7 Carry out the test for non-reducing sugars on **S1**, **S2**, **S3** and **S4** described in **(a)(ii)**.

step 8 Record the colours observed in **(a)(iii)**.

step 9 Label 4 clean test-tubes **S1**, **S2**, **S3** and **S4**.

step 10 Put 1 cm^3 of each solution into the appropriately labelled test-tube.

step 11 Carry out the test for starch on **S1**, **S2**, **S3** and **S4**.

step 12 Record the colours observed in **(a)(iii)**.

(iii) Record your results in an appropriate table.

[5]

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(iv) Complete Table 1.2 to suggest which solution (**S1**, **S2**, **S3** or **S4**) could represent each of the plant extracts.

Use your results in **(a)(iii)** and the information on plant transport given in **(a)**.

A solution could represent more than one plant extract.

Table 1.2

plant extract	solution
fluid in the phloem	**S**...
root tissue	**S**...
seed tissue	**S**...
fruit tissue	**S**...
fluid in the xylem	**S**...

[2]

(v) Protein could be present in some of the solutions.

Describe how you would identify which solutions contain protein.

.....

.....

.....

..... [2]

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(b) A scientist investigated the effect of light on the concentration of sugars in a plant for 24 hours. The plant was kept in the dark for the first 8 hours and then exposed to light for the remaining 16 hours.

Samples were taken from the leaves and from the phloem sieve tubes. The concentration of sugars in each sample was measured.

The results are shown in Table 1.3.

Table 1.3

time / hours	concentration of sugars / μmol	
	leaves	phloem sieve tubes
0	0.38	0.22
5	0.21	0.17
8	0.13	0.11
15	0.24	0.16
24	0.39	0.22

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

Use a sharp pencil.

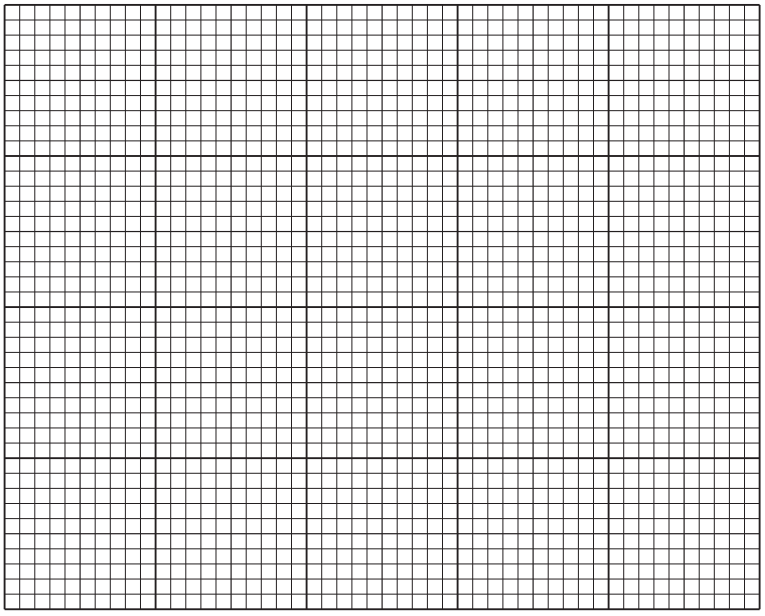


Fig. 1.1

[4]

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(ii) Describe the trend for the concentration of sugars in the leaves and phloem sieve tubes shown in Fig. 1.1.

.....

.....

.....

..... [1]

(iii) Suggest an explanation for the trend in the data when the plant was in the dark and when the plant was in the light.

plant in the dark .....

.....

.....

plant in the light .....

.....

.....

[2]

(iv) Calculate the percentage increase in the concentration of sugars in the leaves between 15 and 20 hours.

Show your working.

percentage increase .....%

[2]

[Total: 21]

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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 the region on **L1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

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

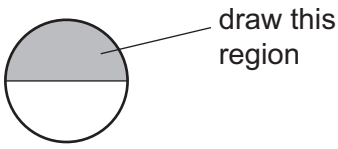


Fig. 2.1

[5]

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(ii) Observe the xylem vessel elements in the organ on **L1**.

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]

(iii) Identify the plant organ on **L1** and give a reason for your answer.

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..... [1]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section of the same organ from a different plant to **L1**.

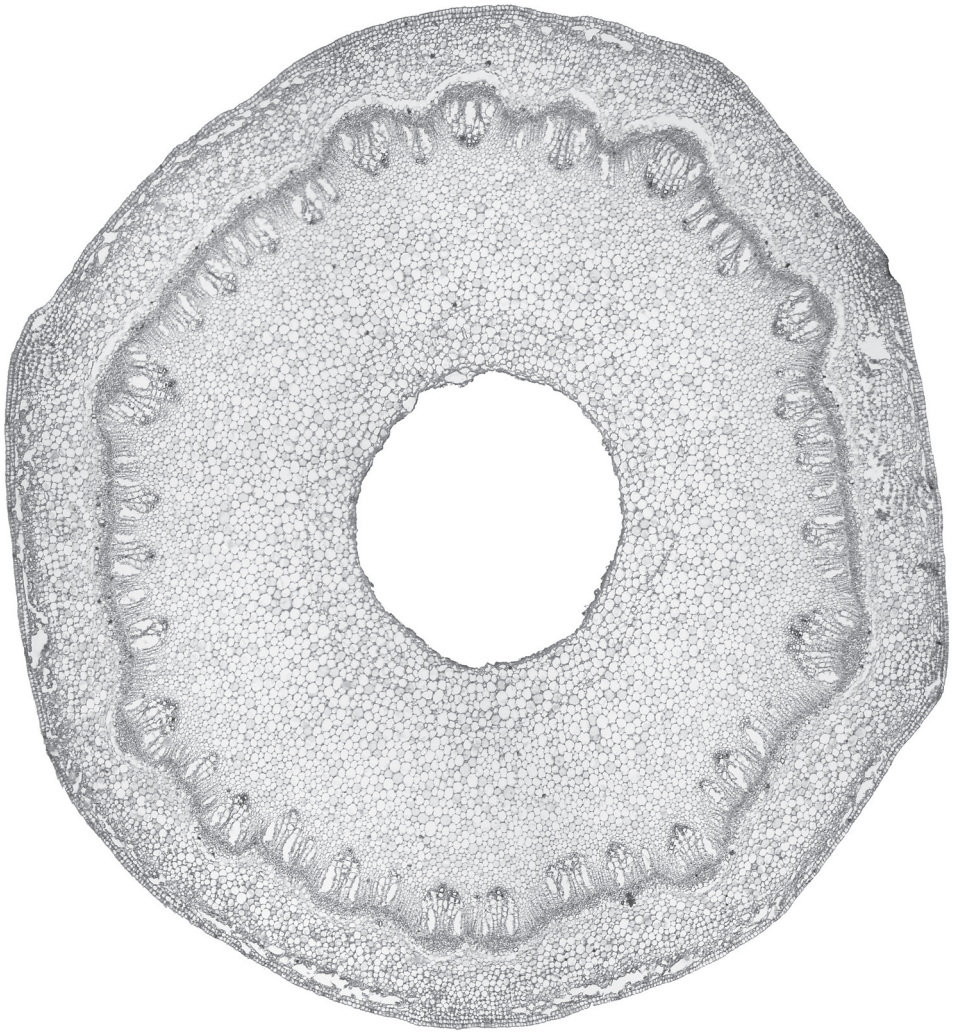


Fig. 2.2

Identify **two** observable differences, other than colour, between the section on **L1** and the section in Fig. 2.2.

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

Table 2.1

feature	L1	Fig. 2.2
1		
2		

[3]

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(c) Fig. 2.3 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. 2.3 is 1.0 mm.

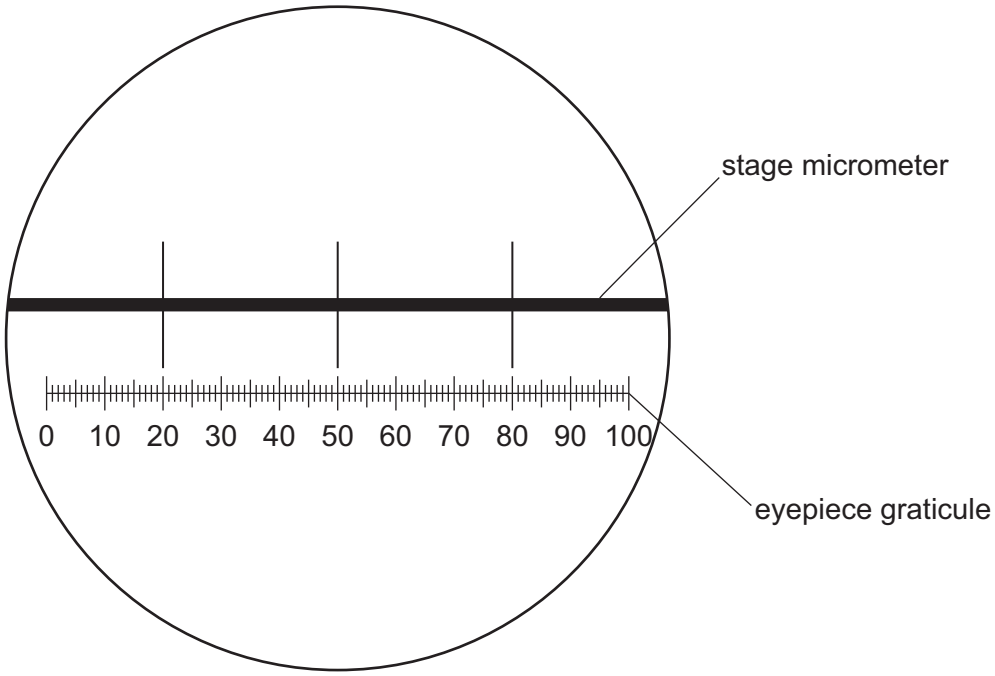


Fig. 2.3

(i) Calculate the actual length of **one** eyepiece graticule unit shown in Fig. 2.3.

Give your answer in micrometres (μm).

Show your working.

actual length = ... μm
[2]

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Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.2. This was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.3. The eyepiece graticule has been placed across the width of the tissue.

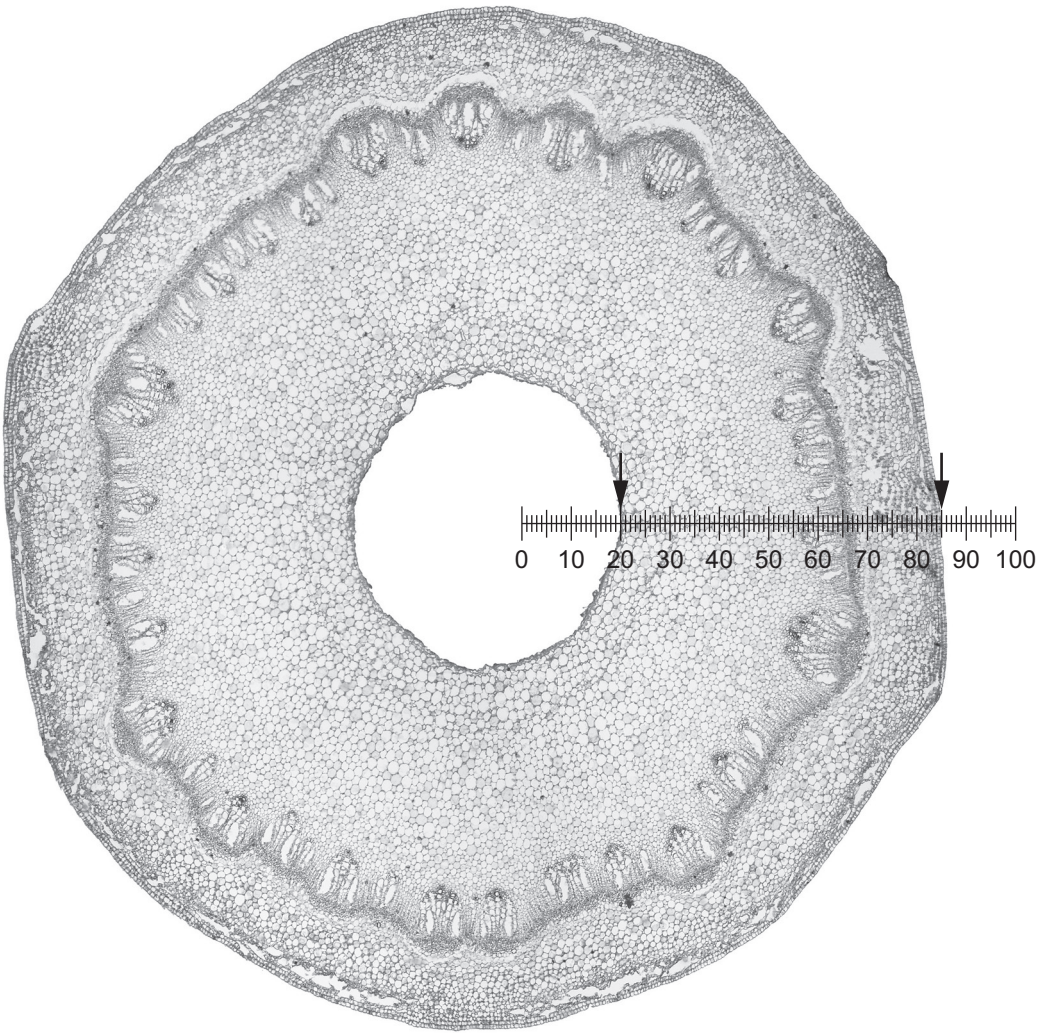


Fig. 2.4

(ii) Use your calibration of one eyepiece graticule unit from **(c)(i)** to calculate the actual width of the tissue between the arrows on Fig. 2.4.

Show your working and use appropriate units.

actual width of the tissue between the arrows .....

[2]

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(iii) The width of the tissue in Fig. 2.4 varies. Suggest how you could more accurately calculate the width of the tissue.

.....

..... [1]

[Total: 19]

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CENTRE NUMBER

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6771164767

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 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 Dialysis tubing is a partially permeable membrane. Some molecules such as glucose molecules can diffuse through pores in the membrane.

You are required to investigate the diffusion of glucose through the pores in dialysis tubing using two different concentrations of glucose.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
R	20.0% glucose solution	low	20
S	10.0% glucose solution	low	20
G	1.0% glucose solution	low	30
W	distilled water	low	100
Benedict's	Benedict's solution	harmful irritant	20
D1	length of dialysis tubing in distilled water	low	–
D2	length of dialysis tubing in distilled water	low	–

If any solution 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:

- put two different concentrations of glucose solution into dialysis tubing surrounded by water
- take a sample of the water surrounding the dialysis tubing
- test the sample for the presence of glucose.

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Carry out step 1 to step 10.

step 1 Draw a mark 8 cm from the top of a large test-tube, as shown in Fig. 1.1.

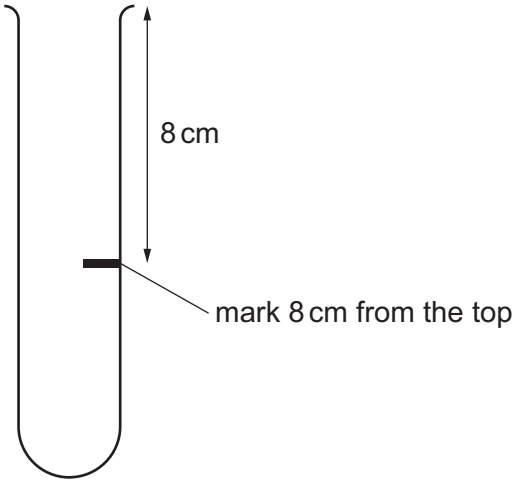


Fig. 1.1

step 2 Remove the dialysis tubing from beaker **D1**. Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

step 3 The whole length of the dialysis tubing needs to be separated to allow the tubing to be filled with solution. To do this, rub the whole length of the dialysis tubing gently between your finger and thumb.

step 4 Put 10 cm^3 of 20.0% glucose solution, **R**, into the open end of the dialysis tubing.

step 5 Rinse the outside of the dialysis tubing by dipping it in the water in beaker **D1**.

step 6 Put the dialysis tubing containing **R** into the large test-tube and keep it in position using an elastic band as shown in Fig. 1.2.

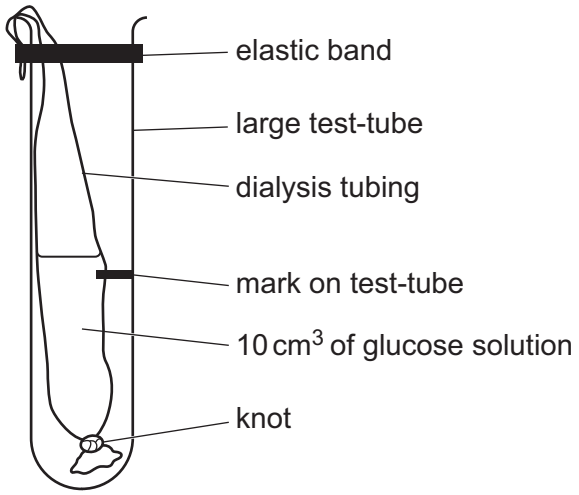


Fig. 1.2

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step 7 Put distilled water into the large test-tube so that the top of the water is above the level of the glucose solution in the dialysis tubing.

step 8 Start timing and leave the dialysis tubing in the distilled water for 15 minutes.

step 9 Repeat step 1 to step 7 using the dialysis tubing in the container labelled **D2** and the 10.0% glucose solution, **S**, instead of **R**.

step 10 Start timing and leave the dialysis tubing in the distilled water for 15 minutes.

While you are waiting, continue with preparing the glucose standards.

Preparing glucose standards

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

You will need to prepare **four** concentrations of glucose solution in addition to the 1.0% glucose solution, **G**.

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

(a) (i) Complete Fig. 1.3 to show how you will prepare your serial dilution.

Each beaker should have:

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

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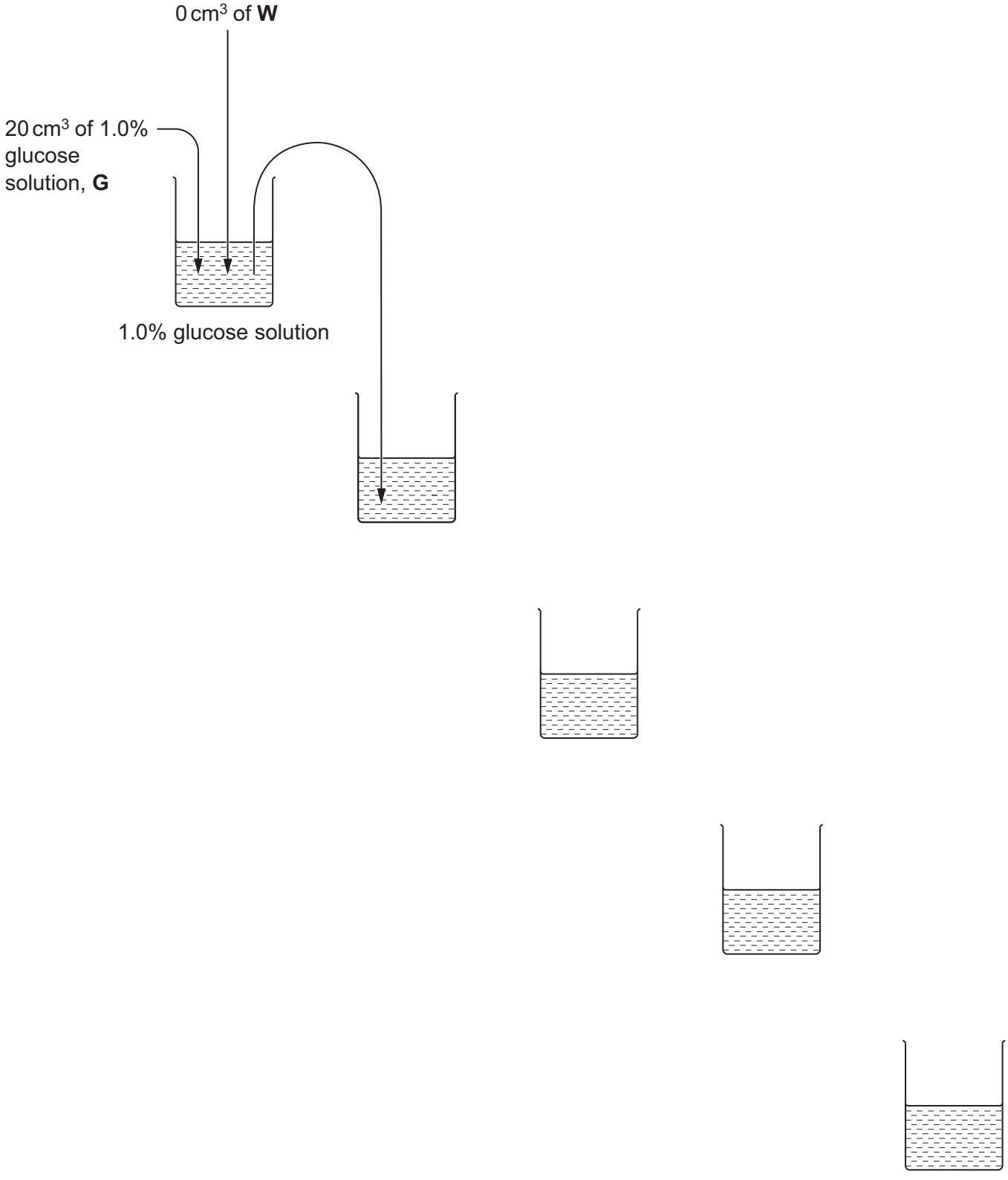


Fig. 1.3

[3]

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Carry out step 11 to step 19.

step 11 Set up a boiling water-bath ready for step 16.

step 12 Prepare the concentrations of glucose solutions as shown in Fig. 1.3.

step 13 Label 5 test-tubes with the concentrations prepared in step 12.

step 14 Put 1 cm^3 of each glucose concentration into the appropriately labelled test-tube.

step 15 Put 1 cm^3 of **Benedict's** into each of the test-tubes. Shake gently to mix.

step 16 Put the test-tube containing 1.0% glucose solution into the boiling water-bath. Start timing.

step 17 Record in **(a)(ii)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 18 Remove the test-tube from the boiling water-bath.

step 19 Repeat step 16 to step 18 with the other glucose concentrations.

You will need the boiling water-bath again in step 25.

(ii) Record your results in an appropriate table.

[5]

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Carry out step 20 to step 23.

step 20 Label a small test-tube **R1**.

step 21 After 15 minutes (step 8), put a 1 cm^3 syringe into the water surrounding the dialysis tubing containing **R**, so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **R1**.

step 22 Label a small test-tube **S1**.

step 23 After 15 minutes (step 10), put a 1 cm^3 syringe into the water surrounding the dialysis tubing containing **S**, so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **S1**.

You will determine the concentrations of glucose in **R1** and **S1** by:

- carrying out the Benedict's test on **R1** and **S1**
- using your results to estimate the concentration of glucose in **R1** and **S1**.

Estimating the concentration of glucose in samples R1 and S1

Carry out step 24 to step 28.

step 24 Put 1 cm^3 of **Benedict's** into the test-tube labelled **R1**. Shake gently to mix.

step 25 Put the test-tube into the boiling water-bath. Start timing.

step 26 Record in **(a)(iii)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 27 Remove the test-tube from the boiling water-bath.

step 28 Repeat step 24 to step 27 with the test-tube labelled **S1**.

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(iii) Record your results for **R1** and **S1**.

result for **R1** ..... s

result for **S1** ..... s
[1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the percentage concentration of glucose in **R1** and **S1**.

percentage concentration of glucose in **R1** = ...%

percentage concentration of glucose in **S1** = ...%
[1]

(v) Suggest a reason for the percentage concentrations of glucose estimated in **R1** and **S1** in **(a)(iv)**.

.....

.....

.....

..... [2]

(vi) Calculate the average **rate** at which the percentage concentration of glucose is increasing in the water surrounding the dialysis tubing containing **R**.

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

average rate of increase of percentage concentration of glucose ..... per minute
[1]

(vii) Suggest how you could modify this investigation to obtain a more accurate estimate for the concentration of glucose in sample **R1**.

.....

.....

.....

.....

..... [2]

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(viii) A possible source of error when carrying out step 21 is shown in Table 1.2.

Complete Table 1.2 by stating the type of error as systematic **or** random, **and** the effect the error may have on the results.

Table 1.2

source of error	systematic error or random error	effect on the results
the line at 1.0 cm^3 on the syringe used in step 21 actually measures a volume of 0.95 cm^3 and not 1.0 cm^3		

[1]

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(b) Fruits contain a range of naturally occurring sugars that make them taste sweet. These sugars include glucose, fructose and sucrose. Scientists measured the mass of these sugars in apple and pineapple.

The results are shown in Table 1.3.

Table 1.3

type of sugar	mass of sugar / g per 100 g fruit	
	apple	pineapple
glucose	2.3	1.3
fructose	6.9	2.3
sucrose	1.9	5.2

(i) Draw a bar chart of the data in Table 1.3 on the grid in Fig. 1.4.

Use a sharp pencil.

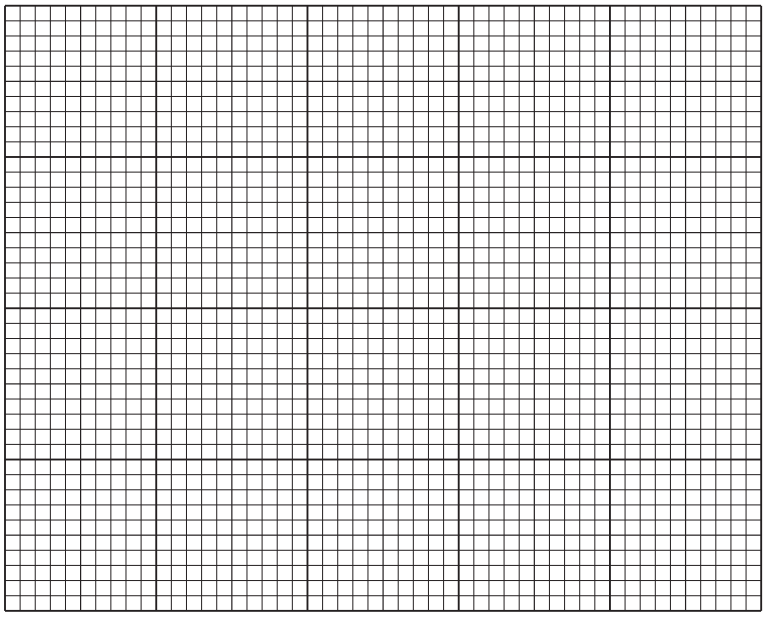


Fig. 1.4

[4]

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(ii) Calculate the percentage difference in the mass of sucrose per 100 g of pineapple compared to the mass of sucrose per 100 g of apple.

Show your working.

percentage difference in the mass of sucrose = ...
[1]

[Total: 21]

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

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

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

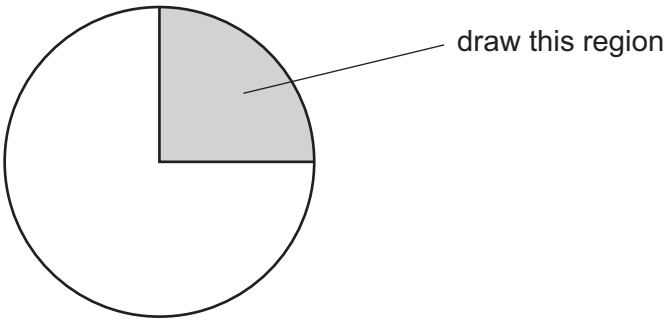


Fig. 2.1

[5]

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

Select a group 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 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 stained transverse section of a stem from a different plant to **M1**.

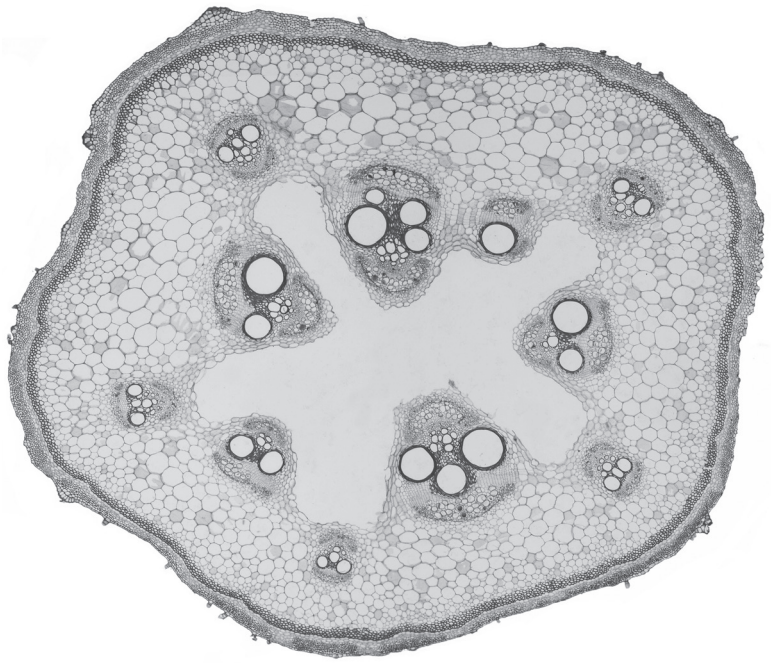


Fig. 2.2

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

Record these **three** observable differences in an appropriate table.

[4]

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(c) Fig. 2.3 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. 2.3 is 1.0 mm.

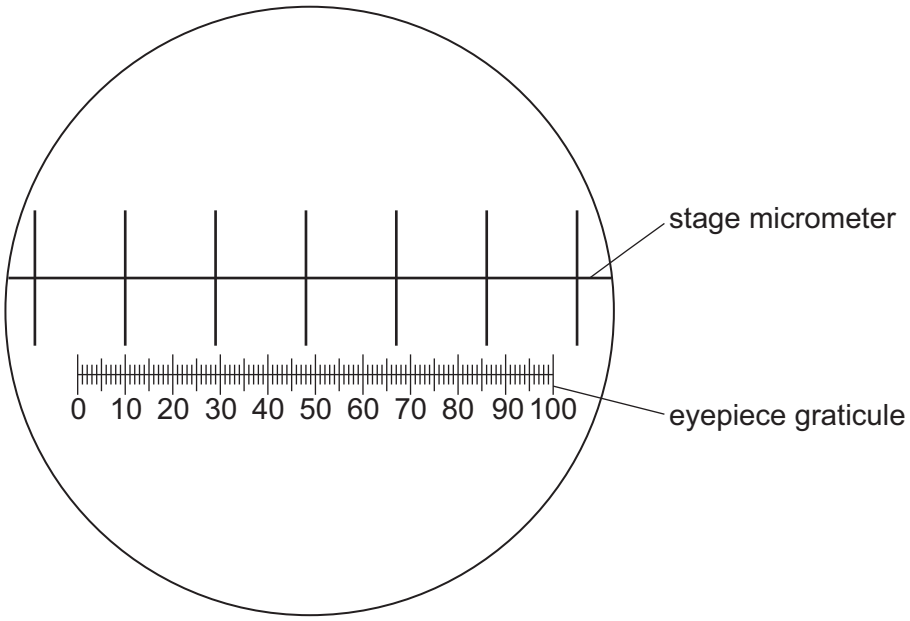


Fig. 2.3

(i) Calculate the actual length of one eyepiece graticule unit shown in Fig. 2.3.

Give your answer in micrometres (μm).

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

actual length of one eyepiece graticule unit = ... μm
[3]

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(ii) Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.2. This was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.3.

The eyepiece graticule has been placed across the length of a vascular bundle.

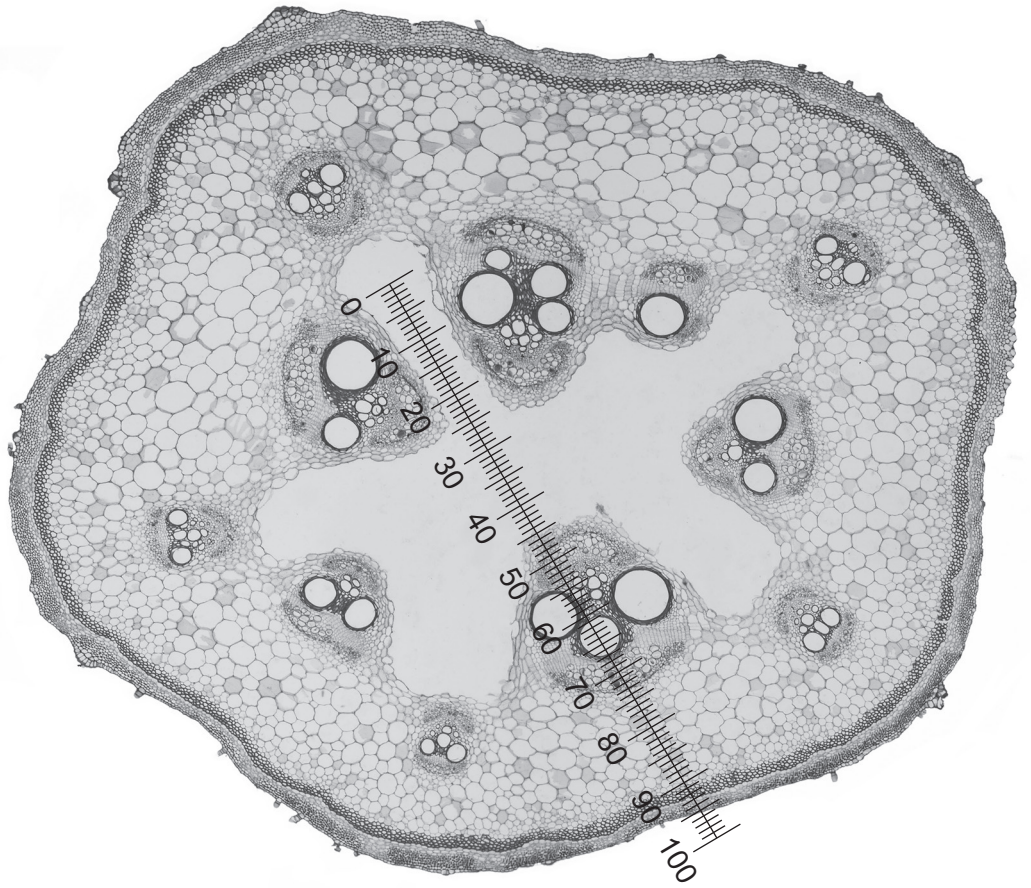


Fig. 2.4

Use the calibration of the eyepiece graticule unit from **(c)(i)** to calculate the actual length of the vascular bundle in Fig. 2.4.

Show your working and use appropriate units.

actual length of the vascular bundle = ...
[2]

[Total: 19]

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CENTRE NUMBER

CANDIDATE NUMBER

7151470844

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 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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[Turn over

1 Yeast cells contain enzymes that hydrolyse sucrose into reducing sugars, as shown in Fig. 1.1.

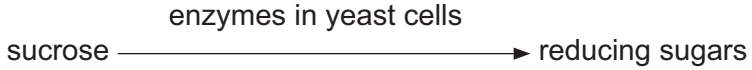


Fig. 1.1

You will investigate the activity of the enzymes in yeast cells that are immobilised in sodium alginate beads and yeast cells that are in a suspension ('free' yeast cells).

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast cell suspension	low	20
A	sodium alginate solution	low	20
C	calcium chloride solution	low	20
S	sucrose solution	low	50
Benedict's	Benedict's solution	harmful irritant	20
W	distilled water	low	50

If any solution 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:

- immobilise some of the yeast cells in sodium alginate
- put the immobilised yeast cells and some 'free' yeast cells into sucrose solution
- test both solutions for reducing sugars
- compare the activity of immobilised yeast cells and 'free' yeast cells.

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Investigating the activity of the enzymes in immobilised yeast cells

Carry out step 1 to step 20.

step 1 Put 10 cm^3 of sodium alginate, **A**, into a beaker.

step 2 Stir the yeast cell suspension, **Y**, and put 10 cm^3 of **Y** into the beaker containing **A**. Mix well.

step 3 Use a 1 cm^3 syringe to collect 1 cm^3 of the mixture of **A** and **Y**. Wipe the outside of the syringe.

step 4 Hold this syringe over the beaker containing calcium chloride solution, **C**, as shown in Fig. 1.2.

step 5 Slowly press down on the plunger so that a drop of the mixture is released into **C**. The drop will form a bead.

step 6 Repeat step 5 until all of the mixture in the syringe has been formed into beads.

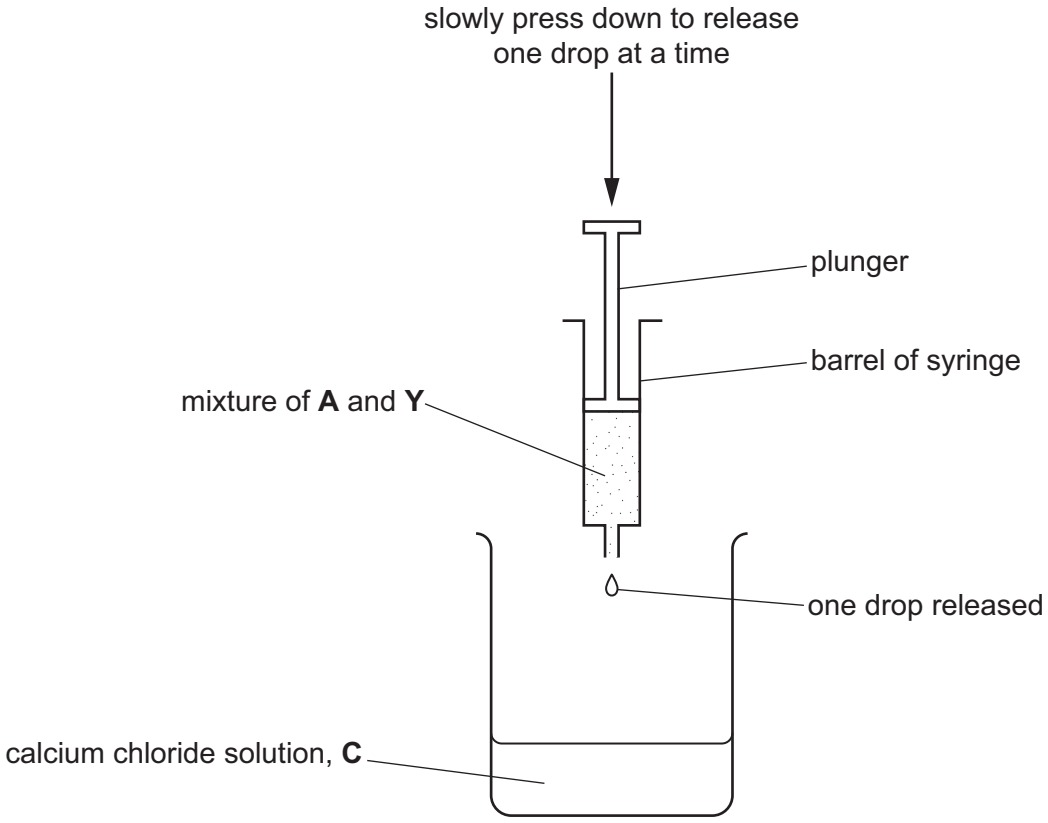


Fig. 1.2

step 7 Leave the beads in the beaker for at least 5 minutes.

step 8 Set up a boiling water-bath ready for step 18.

step 9 Label a beaker **B**.

step 10 Put 20 cm^3 of sucrose solution, **S**, into the beaker labelled **B**.

step 11 Label 5 test-tubes **1**, **2**, **3**, **4** and **5**.

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step 12 Put 1 cm^3 of **Benedict's** into each of the test-tubes.

step 13 After at least 5 minutes (step 7), separate the beads from solution **C** using the apparatus shown in Fig. 1.3.

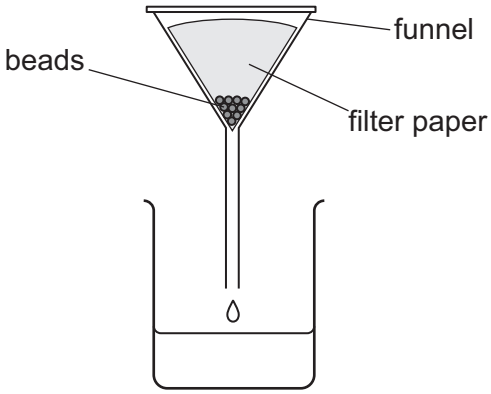


Fig. 1.3

After step 14 you will remove a sample from **B** every minute for 5 minutes.

step 14 Put all of the beads into the beaker labelled **B**. Stir and then start timing.

step 15 At 1 minute, stir the contents of beaker **B** and use a syringe to transfer 1 cm^3 of the solution surrounding the beads into the test-tube labelled **1**.

step 16 At 2 minutes, stir the contents of beaker **B** and use a syringe to transfer 1 cm^3 of the solution surrounding the beads into the test-tube labelled **2**.

step 17 Continue taking samples at 3, 4 and 5 minutes using the test-tubes labelled **3**, **4** and **5**.

step 18 Put test-tube **1** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, stop timing and record the time as 'more than 60'.

step 19 Remove the test-tube from the boiling water-bath.

step 20 Repeat step 18 and step 19 for the test-tubes labelled **2**, **3**, **4** and **5**.

Investigating the activity of the enzymes in 'free' yeast cells

To investigate the activity of the enzymes in 'free' yeast cells, you will need to test the samples with Benedict's solution **immediately** after the sample is taken.

The water-bath should be boiling throughout this part of the investigation.

Carry out step 21 to step 32.

step 21 Label a beaker **F**.

step 22 Put 20 cm^3 of sucrose solution, **S**, into the beaker labelled **F**.

step 23 Label 5 clean test-tubes **1**, **2**, **3**, **4** and **5**.

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step 24 Put 1 cm^3 of **Benedict's** into each of the test-tubes.

step 25 Stir the yeast cell suspension, **Y**, and put 0.5 cm^3 of **Y** into the beaker labelled **F**. Mix well and start timing.

The timer should **not** be stopped until you have completed step 32 – keep the timer running continuously.

step 26 At 1 minute, use a syringe to transfer 1 cm^3 of the solution in **F** into the test-tube labelled **1**. Do **not** stop the timer.

step 27 **Immediately** put test-tube **1** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, record the time as 'more than 60'.

step 28 Remove the test-tube from the boiling water-bath.

step 29 At 2 minutes, use a syringe to transfer 1 cm^3 of the solution in **F** into the test-tube labelled **2**. Do **not** stop the timer.

step 30 **Immediately** put test-tube **2** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, record the time as 'more than 60'.

step 31 Remove the test-tube from the boiling water-bath.

step 32 Repeat step 30 **and** step 31 at 3, 4 and 5 minutes using the test-tubes labelled **3**, **4** and **5**.

(a) (i) Record your results in an appropriate table.

[5]

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(ii) Describe **and** compare the trends in your results, with reference to the data in **(a)(i)**.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Suggest an appropriate control for the experiment.

.....

..... [1]

(iv) The samples taken from **B** were tested for the presence of reducing sugars after all 5 samples had been taken.

Suggest why each sample from **F** had to be tested for the presence of reducing sugars immediately.

.....

..... [1]

(v) Suspensions and solutions were stirred throughout the investigation. Explain **two** ways in which stirring increased the accuracy of the results.

1 .....

.....

.....

2 .....

.....

.....
[2]

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(vi) State **one** possible source of error when determining the dependent variable for the 'free' yeast cells. Suggest **one** improvement to the procedure that would increase the accuracy of measuring the dependent variable.

error .....

.....

.....

improvement .....

.....

.....

[2]

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(b) A scientist carried out an investigation to determine the effect of pH on the activity of immobilised catalase enzyme and 'free' catalase enzyme.

All other variables were kept constant.

The results are shown in Table 1.2.

Table 1.2

pH	activity of catalase / arbitrary units (au)	
	immobilised	free
5	68	50
6	88	62
7	99	96
8	98	65
9	94	48

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

Use a sharp pencil.

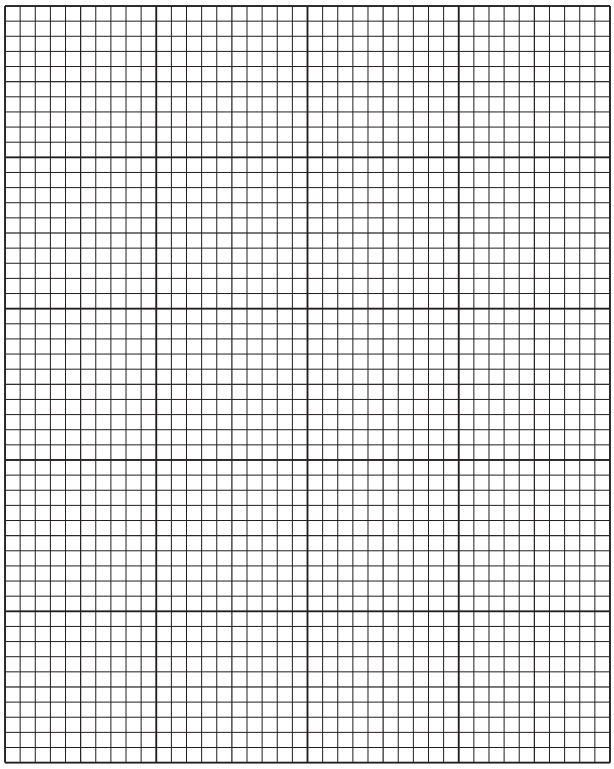


Fig. 1.4

[4]

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(ii) State **two** conclusions about how pH affects the activity of immobilised catalase compared to 'free' catalase.

1 .....

.....

.....

2 .....

.....

.....

[2]

[Total: 20]

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

(a) **(i)** Draw a large plan diagram of the whole section on **N1**. Use a sharp pencil.

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

[5]

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(ii) Observe the cortex on the section of the plant organ on **N1**. The cortex is the layer beneath the epidermis.

Select a group of **four** adjacent cortex cells.

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

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

[5]

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(b) Fig. 2.1 is a photomicrograph of a stained transverse section of the same organ from a different plant to **N1**.

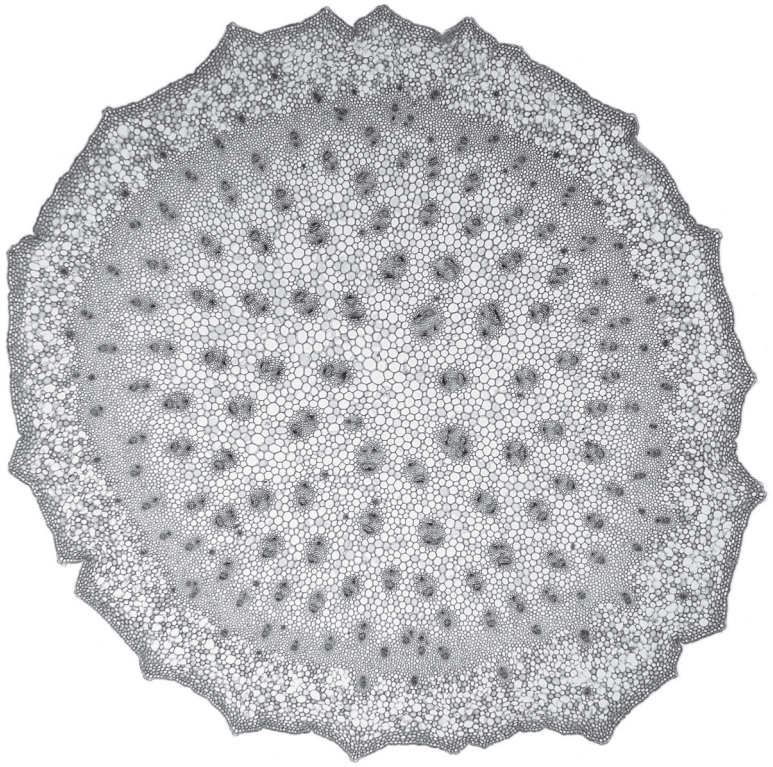


Fig. 2.1

Identify **three** observable differences, other than colour, between the section on **N1** and the section in Fig. 2.1.

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

Table 2.1

feature	N1	Fig. 2.1
1		
2		
3		

[4]

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(c) Fig. 2.2 is the same photomicrograph as that shown in Fig. 2.1.

A black dot has been placed at the centre of the section.

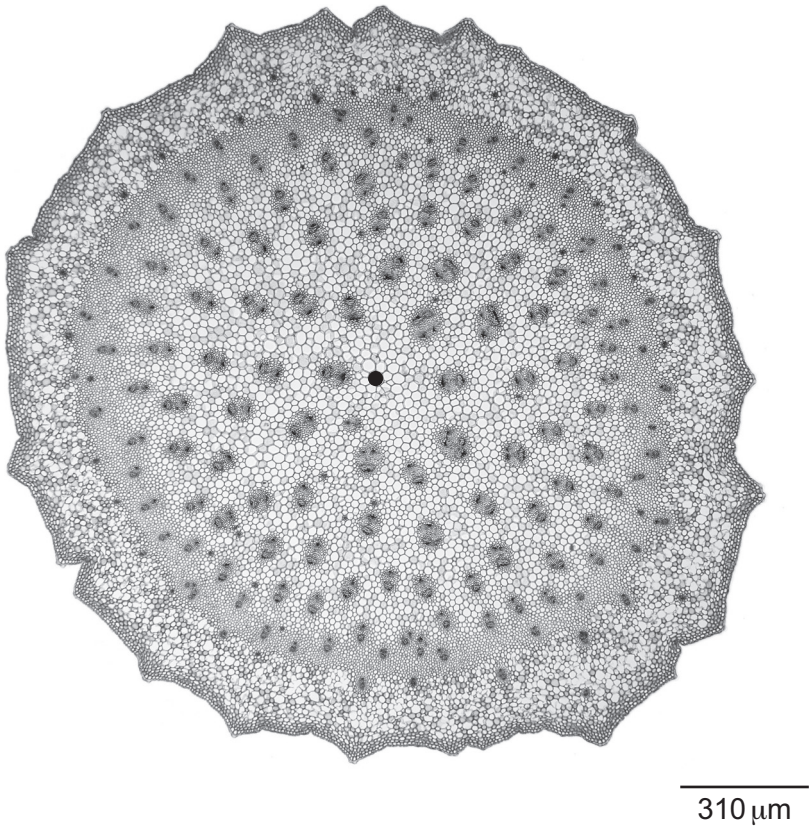


Fig. 2.2

(i) Determine the mean diameter of the section in Fig. 2.2.

Show your working and include units.

mean diameter = ...

[2]

(ii) Use the scale bar to calculate the mean actual diameter of the section in Fig. 2.2.

Show your working and include units.

mean actual diameter = ...

[2]

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(iii) Use the mean actual diameter calculated in **(c)(ii)** to calculate the magnification of Fig. 2.2.

Show your working and give your answer to the nearest whole number.

magnification = ...
[2]

[Total: 20]

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CANDIDATE NAME

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10601200443

BIOLOGY **9700/37**

Paper 3 Advanced Practical Skills 1 **October/November 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 Dialysis tubing is a partially permeable membrane. Some molecules such as glucose molecules can diffuse through pores in the membrane.

You are required to investigate the diffusion of glucose through the pores in dialysis tubing using two different concentrations of glucose.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
R	20.0% glucose solution	low	20
S	10.0% glucose solution	low	20
G	1.0% glucose solution	low	30
W	distilled water	low	100
Benedict's	Benedict's solution	harmful irritant	20
D1	length of dialysis tubing in distilled water	low	–
D2	length of dialysis tubing in distilled water	low	–

If any solution 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:

- put two different concentrations of glucose solution into dialysis tubing surrounded by water
- take a sample of the water surrounding the dialysis tubing
- test the sample for the presence of glucose.

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Carry out step 1 to step 10.

step 1 Draw a mark 8 cm from the top of a large test-tube, as shown in Fig. 1.1.

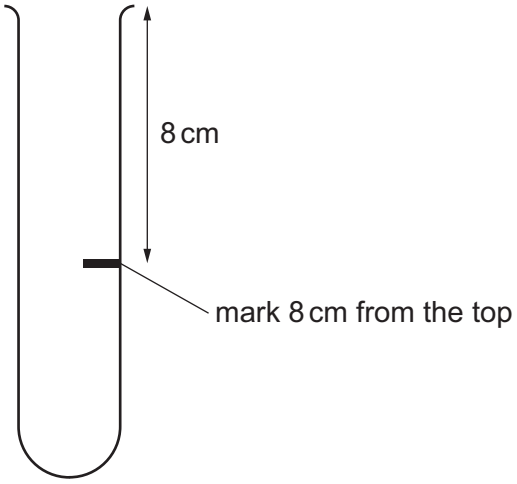


Fig. 1.1

step 2 Remove the dialysis tubing from beaker **D1**. Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

step 3 The whole length of the dialysis tubing needs to be separated to allow the tubing to be filled with solution. To do this, rub the whole length of the dialysis tubing gently between your finger and thumb.

step 4 Put 10 cm^3 of 20.0% glucose solution, **R**, into the open end of the dialysis tubing.

step 5 Rinse the outside of the dialysis tubing by dipping it in the water in beaker **D1**.

step 6 Put the dialysis tubing containing **R** into the large test-tube and keep it in position using an elastic band as shown in Fig. 1.2.

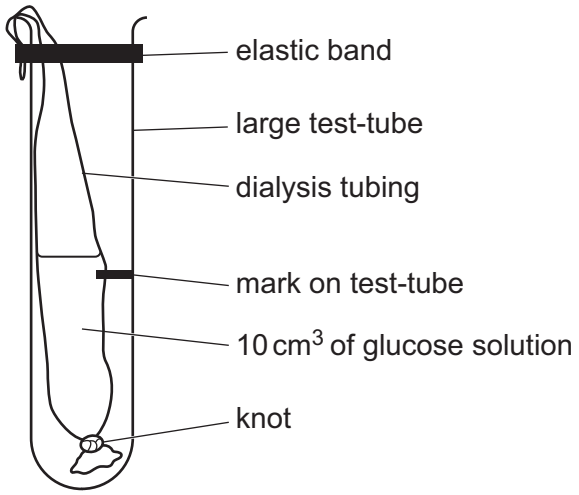


Fig. 1.2

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step 7 Put distilled water into the large test-tube so that the top of the water is above the level of the glucose solution in the dialysis tubing.

step 8 Start timing and leave the dialysis tubing in the distilled water for 15 minutes.

step 9 Repeat step 1 to step 7 using the dialysis tubing in the container labelled **D2** and the 10.0% glucose solution, **S**, instead of **R**.

step 10 Start timing and leave the dialysis tubing in the distilled water for 15 minutes.

While you are waiting, continue with preparing the glucose standards.

Preparing glucose standards

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

You will need to prepare **four** concentrations of glucose solution in addition to the 1.0% glucose solution, **G**.

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

(a) (i) Complete Fig. 1.3 to show how you will prepare your serial dilution.

Each beaker should have:

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

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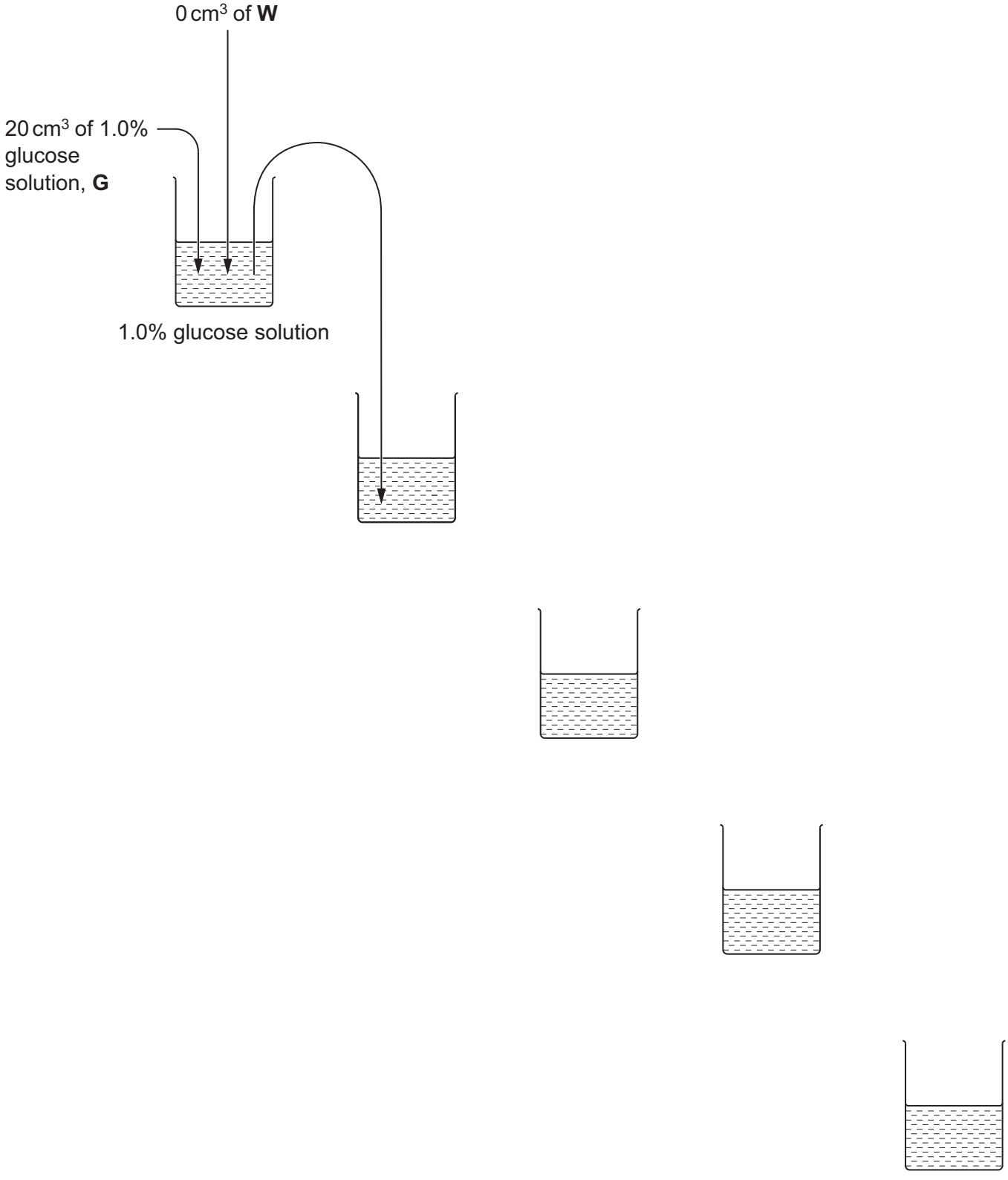


Fig. 1.3

[3]

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Carry out step 11 to step 19.

step 11 Set up a boiling water-bath ready for step 16.

step 12 Prepare the concentrations of glucose solutions as shown in Fig. 1.3.

step 13 Label 5 test-tubes with the concentrations prepared in step 12.

step 14 Put 1 cm^3 of each glucose concentration into the appropriately labelled test-tube.

step 15 Put 1 cm^3 of **Benedict's** into each of the test-tubes. Shake gently to mix.

step 16 Put the test-tube containing 1.0% glucose solution into the boiling water-bath. Start timing.

step 17 Record in **(a)(ii)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 18 Remove the test-tube from the boiling water-bath.

step 19 Repeat step 16 to step 18 with the other glucose concentrations.

You will need the boiling water-bath again in step 25.

(ii) Record your results in an appropriate table.

[5]

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Carry out step 20 to step 23.

step 20 Label a small test-tube **R1**.

step 21 After 15 minutes (step 8), put a 1 cm^3 syringe into the water surrounding the dialysis tubing containing **R**, so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **R1**.

step 22 Label a small test-tube **S1**.

step 23 After 15 minutes (step 10), put a 1 cm^3 syringe into the water surrounding the dialysis tubing containing **S**, so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **S1**.

You will determine the concentrations of glucose in **R1** and **S1** by:

- carrying out the Benedict's test on **R1** and **S1**
- using your results to estimate the concentration of glucose in **R1** and **S1**.

Estimating the concentration of glucose in samples R1 and S1

Carry out step 24 to step 28.

step 24 Put 1 cm^3 of **Benedict's** into the test-tube labelled **R1**. Shake gently to mix.

step 25 Put the test-tube into the boiling water-bath. Start timing.

step 26 Record in **(a)(iii)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 27 Remove the test-tube from the boiling water-bath.

step 28 Repeat step 24 to step 27 with the test-tube labelled **S1**.

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(iii) Record your results for **R1** and **S1**.

result for **R1** ..... s

result for **S1** ..... s
[1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the percentage concentration of glucose in **R1** and **S1**.

percentage concentration of glucose in **R1** = ...%

percentage concentration of glucose in **S1** = ...%
[1]

(v) Suggest a reason for the percentage concentrations of glucose estimated in **R1** and **S1** in **(a)(iv)**.

.....

.....

.....

..... [2]

(vi) Calculate the average **rate** at which the percentage concentration of glucose is increasing in the water surrounding the dialysis tubing containing **R**.

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

average rate of increase of percentage concentration of glucose ..... per minute
[1]

(vii) Suggest how you could modify this investigation to obtain a more accurate estimate for the concentration of glucose in sample **R1**.

.....

.....

.....

.....

..... [2]

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(viii) A possible source of error when carrying out step 21 is shown in Table 1.2.

Complete Table 1.2 by stating the type of error as systematic **or** random, **and** the effect the error may have on the results.

Table 1.2

source of error	systematic error or random error	effect on the results
the line at 1.0 cm^3 on the syringe used in step 21 actually measures a volume of 0.95 cm^3 and not 1.0 cm^3		

[1]

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(b) Fruits contain a range of naturally occurring sugars that make them taste sweet. These sugars include glucose, fructose and sucrose. Scientists measured the mass of these sugars in apple and pineapple.

The results are shown in Table 1.3.

Table 1.3

type of sugar	mass of sugar / g per 100 g fruit	
	apple	pineapple
glucose	2.3	1.3
fructose	6.9	2.3
sucrose	1.9	5.2

(i) Draw a bar chart of the data in Table 1.3 on the grid in Fig. 1.4.

Use a sharp pencil.

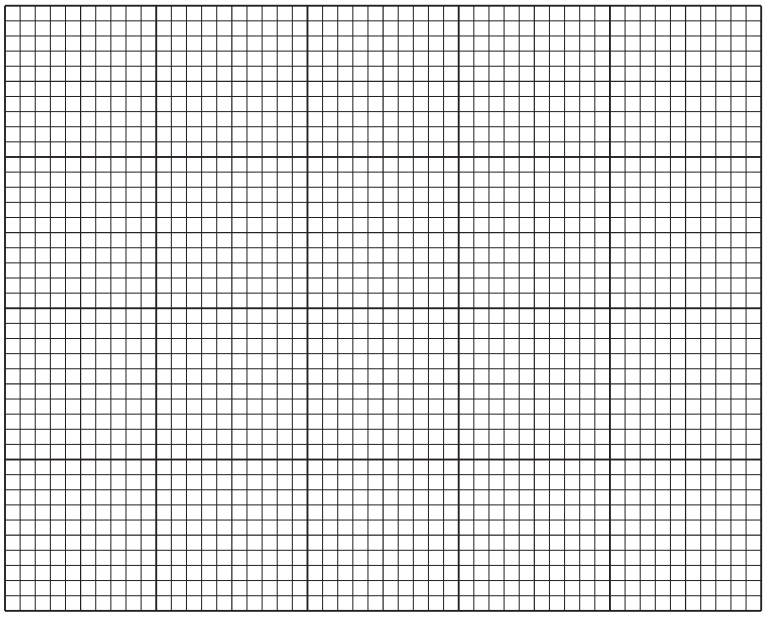


Fig. 1.4

[4]

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(ii) Calculate the percentage difference in the mass of sucrose per 100 g of pineapple compared to the mass of sucrose per 100 g of apple.

Show your working.

percentage difference in the mass of sucrose = ...
[1]

[Total: 21]

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

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

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

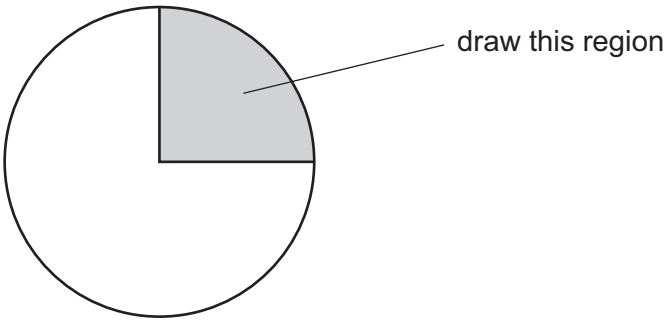


Fig. 2.1

[5]

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

Select a group 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 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 stained transverse section of a stem from a different plant to **M1**.

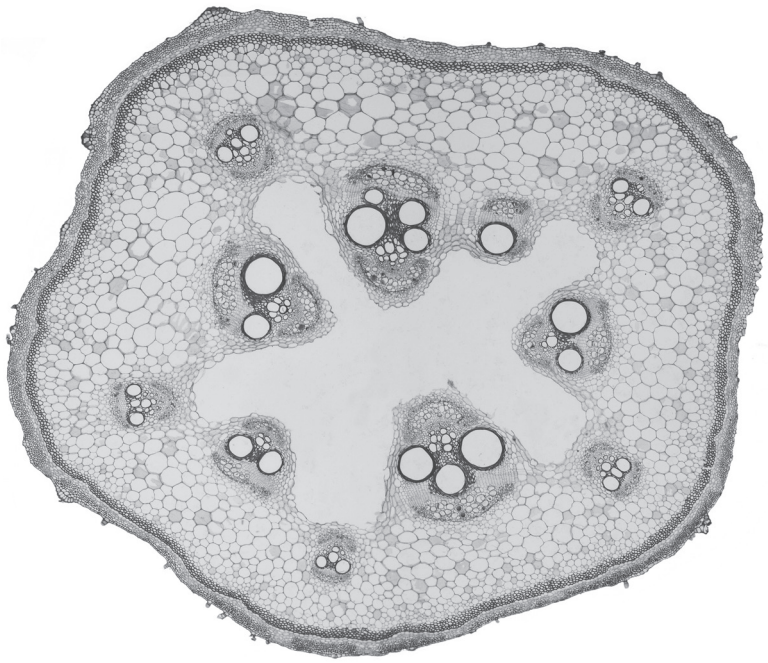


Fig. 2.2

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

Record these **three** observable differences in an appropriate table.

[4]

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(c) Fig. 2.3 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. 2.3 is 1.0 mm.

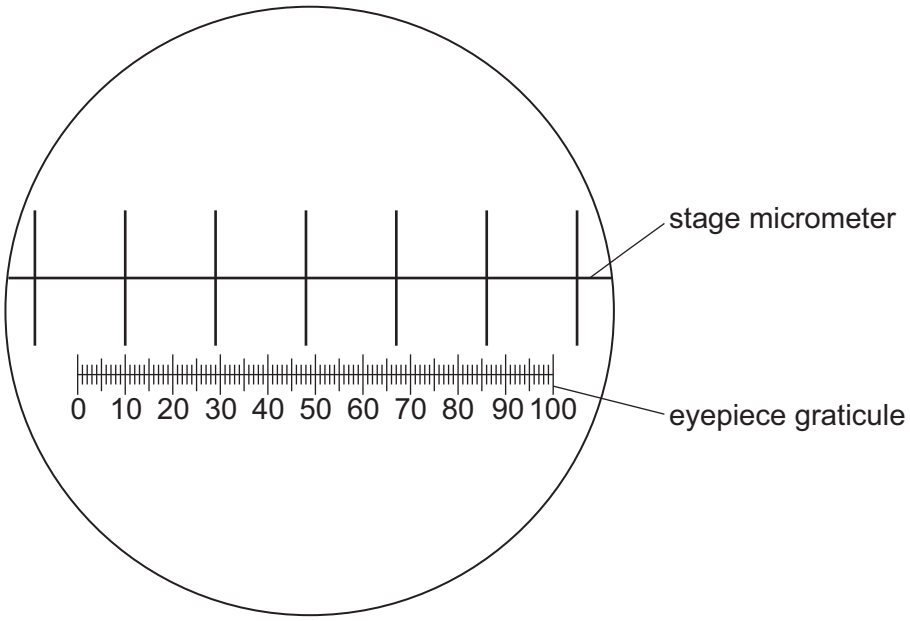


Fig. 2.3

(i) Calculate the actual length of one eyepiece graticule unit shown in Fig. 2.3.

Give your answer in micrometres (μm).

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

actual length of one eyepiece graticule unit = ... μm
[3]

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(ii) Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.2. This was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.3.

The eyepiece graticule has been placed across the length of a vascular bundle.

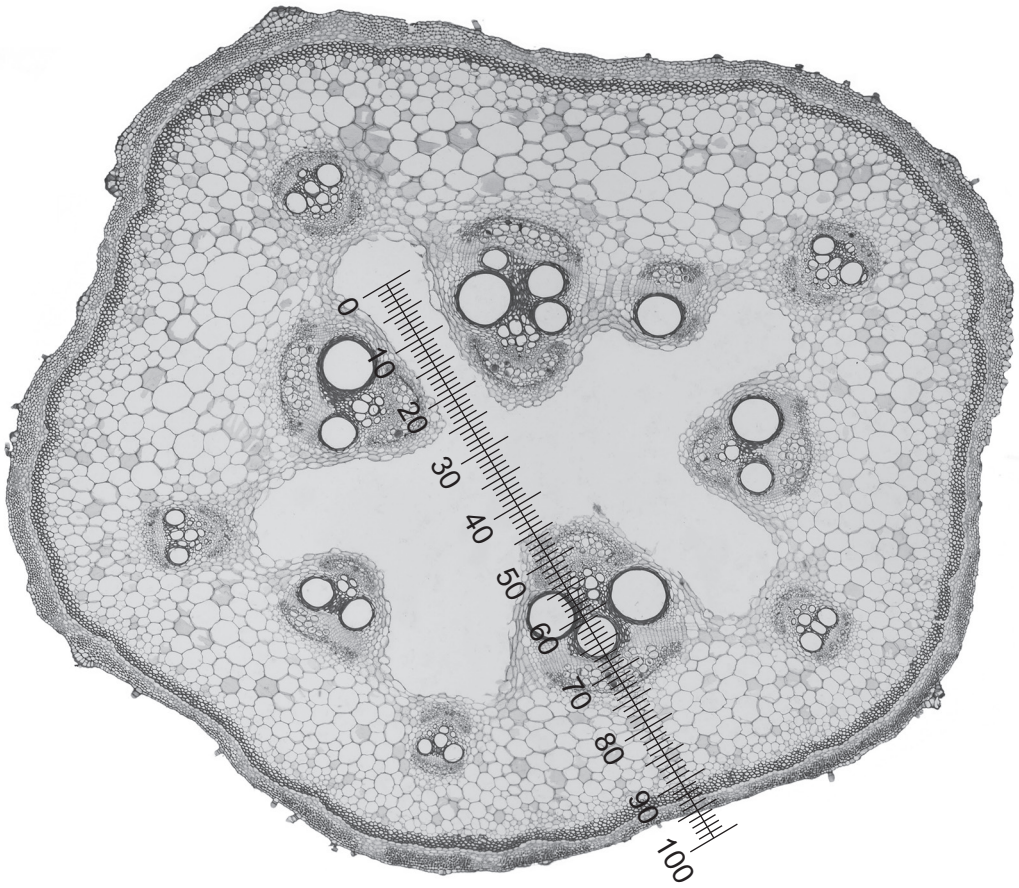


Fig. 2.4

Use the calibration of the eyepiece graticule unit from **(c)(i)** to calculate the actual length of the vascular bundle in Fig. 2.4.

Show your working and use appropriate units.

actual length of the vascular bundle = ...
[2]

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BIOLOGY **9700/38**

Paper 3 Advanced Practical Skills 2 **October/November 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 [ ].

For Examiner's use	
1	
2	
Total	

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[Turn over

1 Yeast cells contain enzymes that hydrolyse sucrose into reducing sugars, as shown in Fig. 1.1.

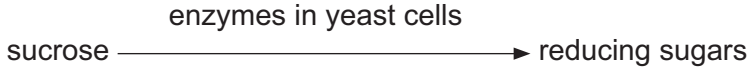


Fig. 1.1

You will investigate the activity of the enzymes in yeast cells that are immobilised in sodium alginate beads and yeast cells that are in a suspension ('free' yeast cells).

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast cell suspension	low	20
A	sodium alginate solution	low	20
C	calcium chloride solution	low	20
S	sucrose solution	low	50
Benedict's	Benedict's solution	harmful irritant	20
W	distilled water	low	50

If any solution 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:

- immobilise some of the yeast cells in sodium alginate
- put the immobilised yeast cells and some 'free' yeast cells into sucrose solution
- test both solutions for reducing sugars
- compare the activity of immobilised yeast cells and 'free' yeast cells.

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Investigating the activity of the enzymes in immobilised yeast cells

Carry out step 1 to step 20.

step 1 Put 10 cm^3 of sodium alginate, **A**, into a beaker.

step 2 Stir the yeast cell suspension, **Y**, and put 10 cm^3 of **Y** into the beaker containing **A**. Mix well.

step 3 Use a 1 cm^3 syringe to collect 1 cm^3 of the mixture of **A** and **Y**. Wipe the outside of the syringe.

step 4 Hold this syringe over the beaker containing calcium chloride solution, **C**, as shown in Fig. 1.2.

step 5 Slowly press down on the plunger so that a drop of the mixture is released into **C**. The drop will form a bead.

step 6 Repeat step 5 until all of the mixture in the syringe has been formed into beads.

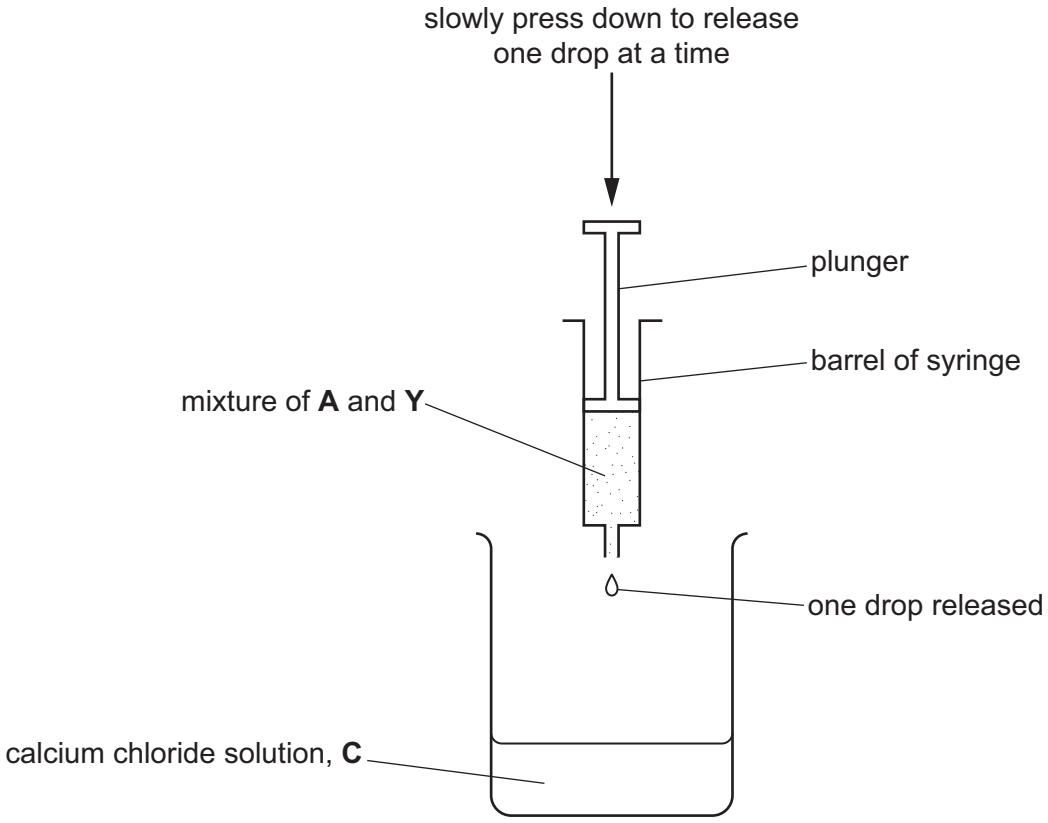


Fig. 1.2

step 7 Leave the beads in the beaker for at least 5 minutes.

step 8 Set up a boiling water-bath ready for step 18.

step 9 Label a beaker **B**.

step 10 Put 20 cm^3 of sucrose solution, **S**, into the beaker labelled **B**.

step 11 Label 5 test-tubes **1**, **2**, **3**, **4** and **5**.

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step 12 Put 1 cm^3 of **Benedict's** into each of the test-tubes.

step 13 After at least 5 minutes (step 7), separate the beads from solution **C** using the apparatus shown in Fig. 1.3.

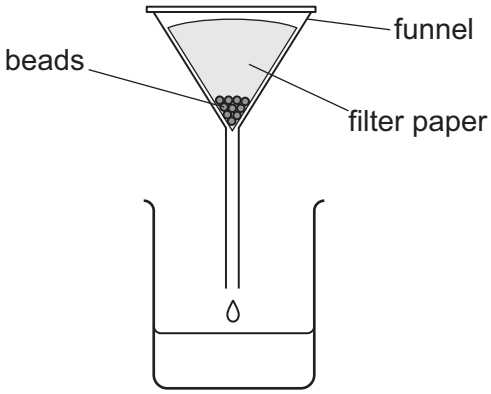


Fig. 1.3

After step 14 you will remove a sample from **B** every minute for 5 minutes.

step 14 Put all of the beads into the beaker labelled **B**. Stir and then start timing.

step 15 At 1 minute, stir the contents of beaker **B** and use a syringe to transfer 1 cm^3 of the solution surrounding the beads into the test-tube labelled **1**.

step 16 At 2 minutes, stir the contents of beaker **B** and use a syringe to transfer 1 cm^3 of the solution surrounding the beads into the test-tube labelled **2**.

step 17 Continue taking samples at 3, 4 and 5 minutes using the test-tubes labelled **3**, **4** and **5**.

step 18 Put test-tube **1** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, stop timing and record the time as 'more than 60'.

step 19 Remove the test-tube from the boiling water-bath.

step 20 Repeat step 18 and step 19 for the test-tubes labelled **2**, **3**, **4** and **5**.

Investigating the activity of the enzymes in 'free' yeast cells

To investigate the activity of the enzymes in 'free' yeast cells, you will need to test the samples with Benedict's solution **immediately** after the sample is taken.

The water-bath should be boiling throughout this part of the investigation.

Carry out step 21 to step 32.

step 21 Label a beaker **F**.

step 22 Put 20 cm^3 of sucrose solution, **S**, into the beaker labelled **F**.

step 23 Label 5 clean test-tubes **1**, **2**, **3**, **4** and **5**.

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step 24 Put 1 cm^3 of **Benedict's** into each of the test-tubes.

step 25 Stir the yeast cell suspension, **Y**, and put 0.5 cm^3 of **Y** into the beaker labelled **F**. Mix well and start timing.

The timer should **not** be stopped until you have completed step 32 – keep the timer running continuously.

step 26 At 1 minute, use a syringe to transfer 1 cm^3 of the solution in **F** into the test-tube labelled **1**. Do **not** stop the timer.

step 27 **Immediately** put test-tube **1** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, record the time as 'more than 60'.

step 28 Remove the test-tube from the boiling water-bath.

step 29 At 2 minutes, use a syringe to transfer 1 cm^3 of the solution in **F** into the test-tube labelled **2**. Do **not** stop the timer.

step 30 **Immediately** put test-tube **2** into the boiling water-bath and measure the time to the first colour change. Record your result in **(a)(i)**.

If there is no colour change after 60 seconds, record the time as 'more than 60'.

step 31 Remove the test-tube from the boiling water-bath.

step 32 Repeat step 30 **and** step 31 at 3, 4 and 5 minutes using the test-tubes labelled **3**, **4** and **5**.

(a) (i) Record your results in an appropriate table.

[5]

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(ii) Describe **and** compare the trends in your results, with reference to the data in **(a)(i)**.

.....

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.....

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.....

..... [3]

(iii) Suggest an appropriate control for the experiment.

.....

..... [1]

(iv) The samples taken from **B** were tested for the presence of reducing sugars after all 5 samples had been taken.

Suggest why each sample from **F** had to be tested for the presence of reducing sugars immediately.

.....

..... [1]

(v) Suspensions and solutions were stirred throughout the investigation. Explain **two** ways in which stirring increased the accuracy of the results.

1 .....

.....

.....

2 .....

.....

.....
[2]

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(vi) State **one** possible source of error when determining the dependent variable for the 'free' yeast cells. Suggest **one** improvement to the procedure that would increase the accuracy of measuring the dependent variable.

error .....

.....

.....

improvement .....

.....

.....

[2]

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(b) A scientist carried out an investigation to determine the effect of pH on the activity of immobilised catalase enzyme and 'free' catalase enzyme.

All other variables were kept constant.

The results are shown in Table 1.2.

Table 1.2

pH	activity of catalase / arbitrary units (au)	
	immobilised	free
5	68	50
6	88	62
7	99	96
8	98	65
9	94	48

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

Use a sharp pencil.

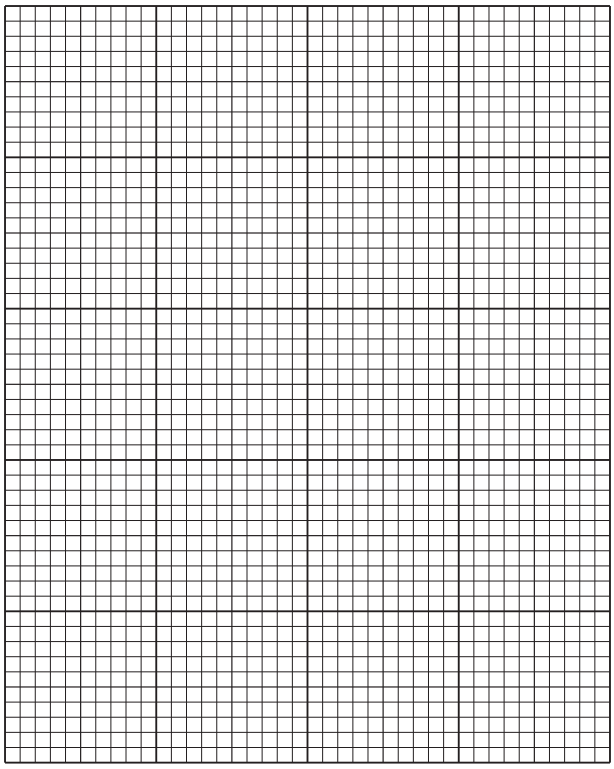


Fig. 1.4

[4]

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(ii) State **two** conclusions about how pH affects the activity of immobilised catalase compared to 'free' catalase.

1 .....

.....

.....

2 .....

.....

.....

[2]

[Total: 20]

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

(a) **(i)** Draw a large plan diagram of the whole section on **N1**. Use a sharp pencil.

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

[5]

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(ii) Observe the cortex on the section of the plant organ on **N1**. The cortex is the layer beneath the epidermis.

Select a group of **four** adjacent cortex cells.

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

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

[5]

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(b) Fig. 2.1 is a photomicrograph of a stained transverse section of the same organ from a different plant to **N1**.

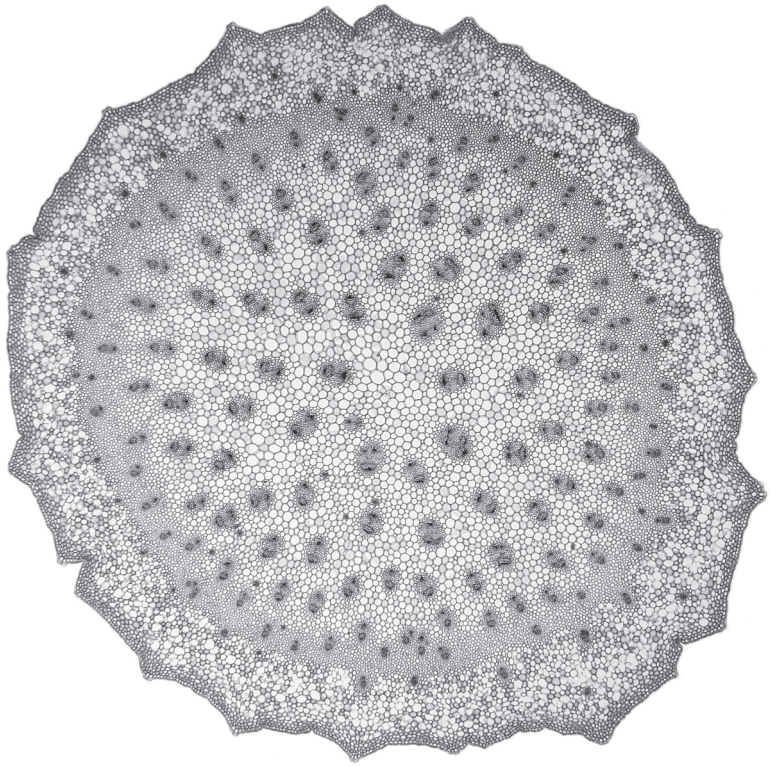


Fig. 2.1

Identify **three** observable differences, other than colour, between the section on **N1** and the section in Fig. 2.1.

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

Table 2.1

feature	N1	Fig. 2.1
1		
2		
3		

[4]

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(c) Fig. 2.2 is the same photomicrograph as that shown in Fig. 2.1.

A black dot has been placed at the centre of the section.

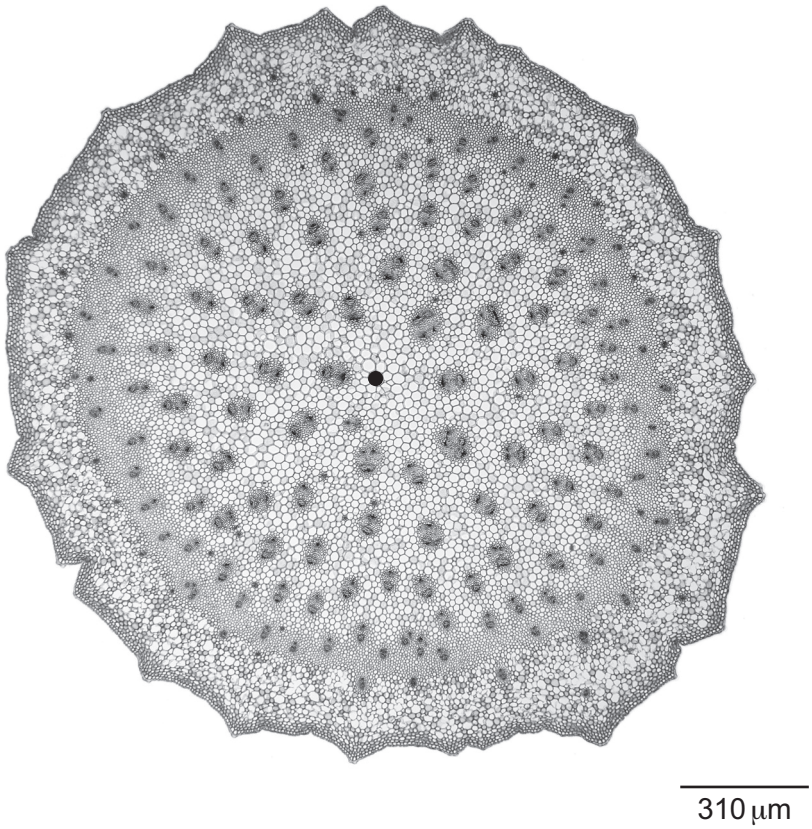


Fig. 2.2

(i) Determine the mean diameter of the section in Fig. 2.2.

Show your working and include units.

mean diameter = ...
[2]

(ii) Use the scale bar to calculate the mean actual diameter of the section in Fig. 2.2.

Show your working and include units.

mean actual diameter = ...
[2]

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(iii) Use the mean actual diameter calculated in **(c)(ii)** to calculate the magnification of Fig. 2.2.

Show your working and give your answer to the nearest whole number.

magnification = ...
[2]

[Total: 20]

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