Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6478950299

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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 Plasmolysis may be seen in onion cells that have been put into a sodium chloride solution. Plasmolysis occurs when water moves out of the cells and the cell surface membrane pulls away from the cell wall.

You will observe the effect of different concentrations of sodium chloride solution on onion cells in samples of onion tissue. You will use your observations to determine the concentration of sodium chloride in three solutions, **U1**, **U2** and **U3**.

You are provided with onion tissue in approximately 50 cm^3 of each of the three different concentrations of sodium chloride solution.

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 microscope slides of the three samples of onion tissue in **U1**, **U2** and **U3**
- observe 15 cells on each microscope slide and record how many of these cells show any sign of plasmolysis.

Carry out step 1 to step 11.

step 1 Label **one** clean and dry microscope slide **U1**. Put the slide on a paper towel.

step 2 Put a few drops of the solution in the beaker labelled **U1** onto the microscope slide.

step 3 Remove **one** piece of onion tissue from the beaker labelled **U1**. Cut the piece of onion tissue so that it is between approximately 0.5 cm × 0.5 cm and 1 cm × 1 cm. Put the remaining onion tissue back into the beaker labelled **U1**.

step 4 Peel off the inner epidermis from the piece of onion tissue.

step 5 Put the inner epidermis on the microscope slide, as shown in Fig. 1.1. If the piece of epidermis is folded, you may need to add more drops of solution. The inner epidermis will float and can then be unfolded.

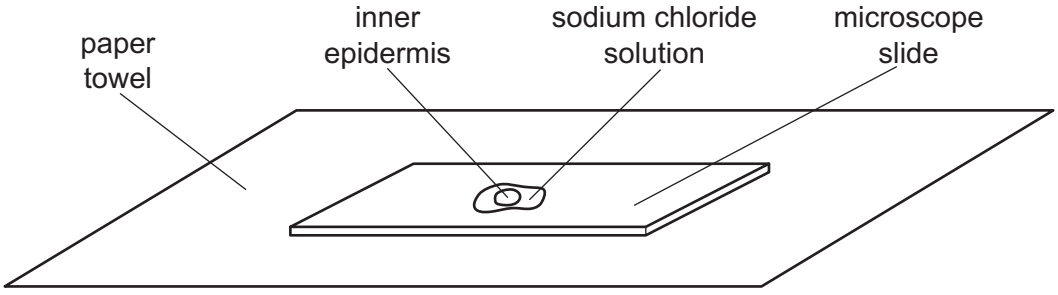


Fig. 1.1

step 6 Put a coverslip over the piece of inner epidermis on the microscope slide. Use a paper towel to remove any excess solution that is outside the coverslip.

step 7 Observe the cells of the epidermis using the microscope. You may need to reduce the amount of light entering the microscope to observe the cells clearly.

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step 8 Using the ×10 objective lens, observe 15 cells. You may need to move the slide to change the field of view.

step 9 Count how many of these 15 cells are undergoing plasmolysis. Record your results in **(a)(i)**.

step 10 Repeat step 1 to step 9 using the onion tissue in **U2**.

step 11 Repeat step 1 to step 9 using the onion tissue in **U3**.

You will need to use slide **U1** again for **(a)(iii)**.

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

[4]

(ii) The concentrations of sodium chloride solutions are: 0.10 mol dm^{-3}, 0.50 mol dm^{-3} and 1.00 mol dm^{-3}.

Using your results from **(a)(i)**, identify which solution is **U1**, **U2** or **U3**.

0.10 mol dm^{-3} .....

0.50 mol dm^{-3} .....

1.00 mol dm^{-3} .....

[1]

(iii) Observe the cells on slide **U1**.

Select a group of **four** adjacent touching cells. Each cell needs to touch at least **two** other cells.

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

[5]

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(iv) Explain, in terms of water potential, your observations for slide **U1**.

.....

.....

.....

.....

.....

..... [3]

(b) A student investigated the effect of different concentrations of sucrose solution on the mass of potato pieces.

- Five different concentrations of sucrose solution were used.
- The masses of five potato pieces were measured before and after soaking in these different sucrose solutions.
- The percentage change in mass was then calculated for each potato piece.
- The procedure was repeated three times.
- The mean percentage change in mass as a result of soaking was then calculated for each concentration of sucrose.

Table 1.1 shows the results of this investigation.

Table 1.1

sucrose concentration / mol dm^{-3}	trial	initial mass / g	final mass / g	change in mass / g	percentage change in mass	mean percentage change in mass
0.0	**1**	2.4	2.5	0.1	+4.2	+8.2
	2	2.5	2.8	0.3	+12.0	
	3	2.4	2.6	0.2	+8.3	
0.2	**1**	2.4	2.5	0.1	+4.2	
	2	2.4	2.5	0.1	+4.2	
	3	2.3	2.4	0.1		
0.4	**1**	2.5	2.5	0.0	+0.0	+1.3
	2	2.5	2.6	0.1	+4.0	
	3	2.5	2.5	0.0	+0.0	
0.6	**1**	2.6	2.5	–0.1	–3.8	–6.7
	2	2.5	2.3	–0.2	–8.0	
	3	2.4	2.2	–0.2	–8.3	
0.8	**1**	2.4	2.2	–0.2	–8.3	–9.9
	2	2.4	2.2	–0.2	–8.3	
	3	2.3	2.0	–0.3	–13.0	

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(i) Use the data in Table 1.1 to calculate the percentage change in mass of the potato piece soaked in 0.2 mol dm^{-3} sucrose solution in trial 3.

Show your working.

percentage change in mass = ...
[1]

(ii) Use the data in Table 1.1 to calculate the **mean** percentage change in mass of the potato pieces soaked in the 0.2 mol dm^{-3} sucrose solution.

Show your working.

mean percentage change in mass = ...
[1]

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[Turn over

(iii) Plot a graph of the **mean** data in Table 1.1 on the grid in Fig. 1.2.

Draw the line of best fit.

Use a sharp pencil.

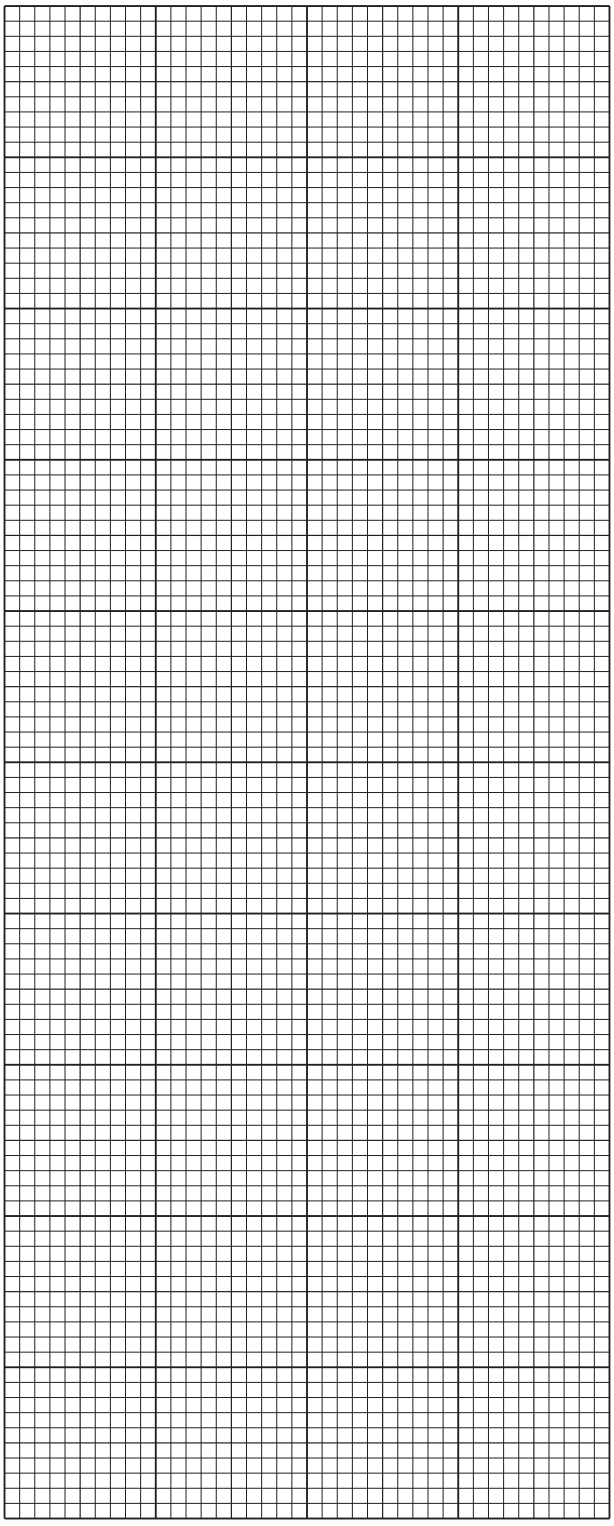


Fig. 1.2

[4]

(iv) Use your graph in Fig. 1.2 to estimate the concentration of sucrose solution that would result in **no** change in mass of the potato pieces.

concentration of sucrose solution = ...mol dm^{-3} [1]

[Total: 20]

2 Many plants store starch in their roots. The amount of starch present in roots can vary with the seasons.

In the summer months, when plants are actively growing, the starch present in roots is lower than during the winter months.

In the winter months, many of the cells are storing starch in starch grains.

Fig. 2.1 is a photomicrograph of a stained transverse section through a root in winter.

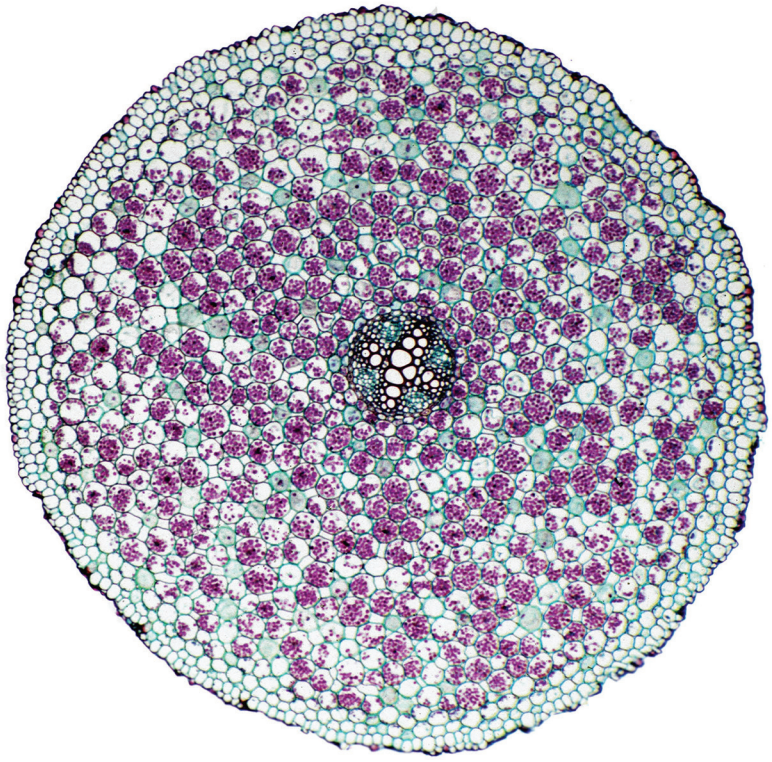


Fig. 2.1

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(a) Draw a large plan diagram of the whole section shown in Fig. 2.1. Use a sharp pencil.

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

[5]

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(b) Iodine solution can be used to test for the presence of starch in root extracts. The concentration of starch in a root extract can be determined by the colour observed when iodine solution is added.

You will need to:

- prepare different concentrations of starch suspension
- estimate the concentration of starch in two root extracts
- identify the season in which each root extract was taken.

You are provided with the materials shown in Table 2.1.

Table 2.1

labelled	contents	hazard	volume / cm^3
S	1.0% starch suspension	none	50
iodine	iodine solution	none	20
W	distilled water	none	150
R1	root extract	none	20
R2	root extract	none	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 need to carry out a **serial** dilution of the 1.0% starch suspension, **S**, to reduce the concentration by a **factor of 10** between each successive dilution.

You will need to prepare **four** concentrations of starch suspension in addition to the 1.0% starch suspension, **S**.

After the serial dilution is completed, you will need to have 9 cm^3 of each concentration available to use.

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[Turn over

(i) Complete Fig. 2.2 to show how you will prepare your serial dilution.
Fig. 2.2 shows the beakers you will use.

For each beaker, add labelled arrows to show:

- the volume of starch suspension transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of the starch suspension.

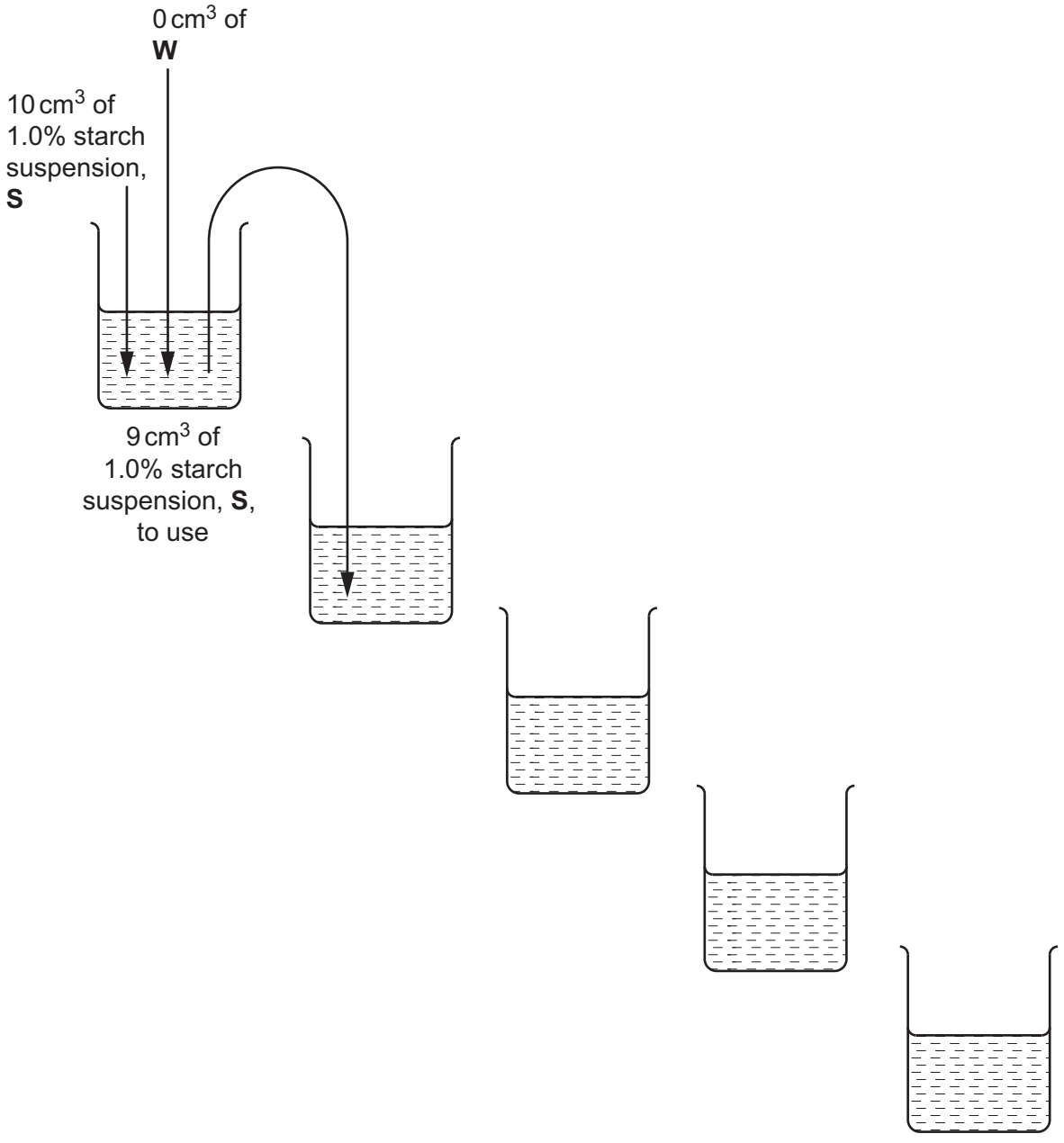


Fig. 2.2

[3]

Carry out step 1 to step 6.

step 1 Prepare the concentrations of starch suspension as decided in **(b)(i)** and shown in Fig. 2.2. Mix well.

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

step 3 Put 5 cm^3 of each concentration of starch solution into the appropriately labelled test-tube.

step 4 Put 3 drops of **iodine** into each of the test-tubes. Shake gently to mix.

step 5 Place the white card behind the test-tubes and observe the colour of the liquid in each test-tube. You may see the same colour in more than one test-tube.

step 6 Compare the colour of the liquid in each test-tube with the key in Fig. 2.3. Record your observations in **(b)(ii)** using only the symbols shown in the key in Fig. 2.3.

Key

colour	**symbol**
blue-black	++++++
dark blue	+++++
purple	++++
dark brown	+++
brown	++
yellow-orange	+

Fig. 2.3

(ii) Record your results in an appropriate table.

[3]

(iii) Identify the dependent variable in this investigation.

..... [1]

Carry out step 7 to step 12.

step 7 Label a test-tube **R1**.

step 8 Put 5 cm^3 of **R1** into the test-tube you have labelled **R1**.

step 9 Put 3 drops of **iodine** into the same test-tube. Shake gently to mix.

step 10 Place the white card behind the test-tube and observe the colour of the liquid in the test-tube.

step 11 Compare the colour of the liquid in the test-tube with the key in Fig. 2.3. Record your observation in **(b)(iv)** using only the symbols shown in the key in Fig. 2.3.

step 12 Repeat step 7 to step 11, using **R2** instead of **R1**.

(iv) Record your observations for **R1** and **R2**, using the symbols shown in the key in Fig. 2.3.

R1 .....

R2 .....

[1]

(v) Using your results in **(b)(ii)** and **(b)(iv)**, estimate the concentration of starch in **R1** and **R2**.

R1 .....

R2 .....

[1]

(vi) Suggest how you could make improvements to the procedure so that a more accurate estimate of the concentration of starch in **R1** and **R2** could be obtained.

.....

.....

.....

.....

..... [2]

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(vii) Using the information given **and** the estimates in **(b)(v)**, identify which root extract was taken in the summer. Explain your answer.

root extract .....

explanation .....

.....

.....

[1]

(c) Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.1.

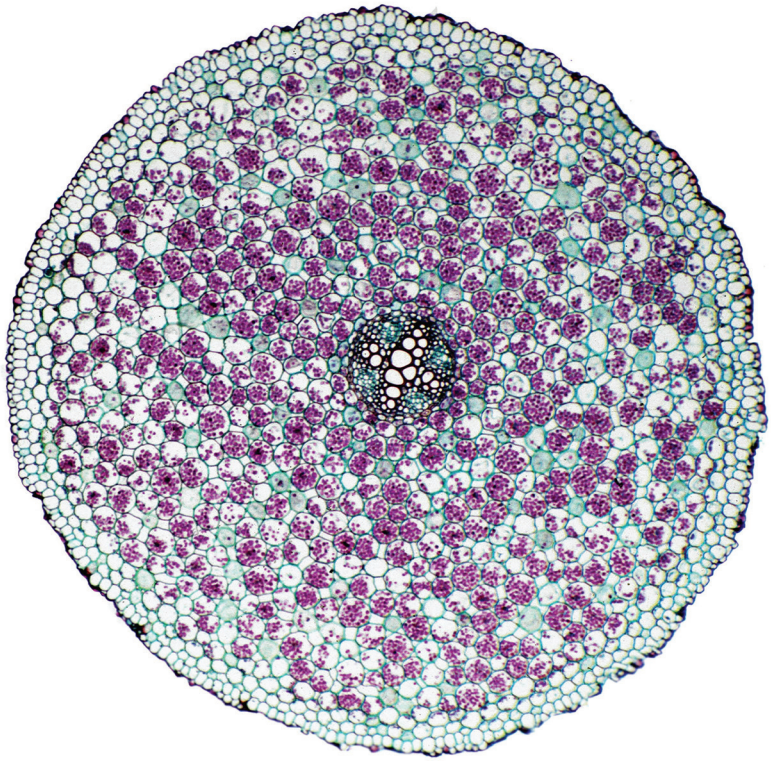


Fig. 2.4

Fig. 2.5 is a photomicrograph of a stained transverse section through a different root.

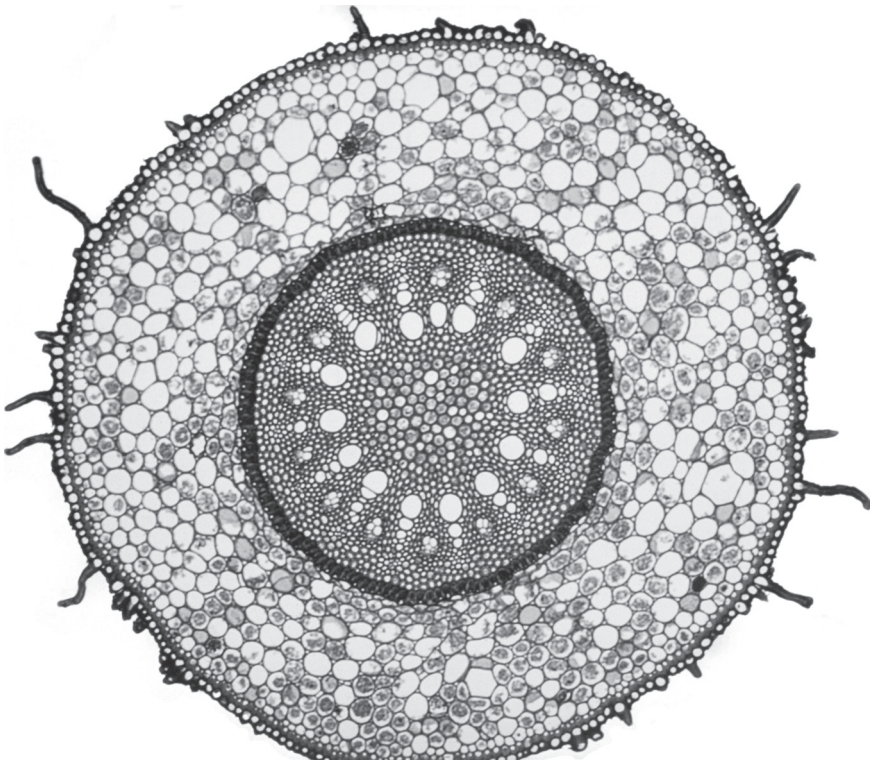


Fig. 2.5

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Identify **three** observable features, other than colour and presence of starch grains, that are different in the section in Fig. 2.4 compared with the section in Fig. 2.5.

Record the differences between these three observable features in Table 2.2.

Table 2.2

feature	Fig. 2.4	Fig. 2.5

[3]

[Total: 20]

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Cambridge International AS & A Level

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5538399305

BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2024**

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.
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- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
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1 Some fruits contain protease enzymes. These enzymes can denature the proteins in milk, causing the milk to clot.

You will investigate the effect of protease concentration on the time taken for milk to clot.

You will use your results to estimate the concentration of protease in a fruit extract.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	100% protease solution	none	50
M	milk	none	30
W	distilled water	none	100
U	fruit extract containing unknown protease concentration	none	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 different concentrations of protease solution, using proportional dilution of the 100% protease solution, **P**.

You will need to prepare 10 cm^3 of each concentration, using **P** and **W**.

Table 1.2 shows how to prepare one of the concentrations of protease you will use.

Decide which other concentrations of protease you will use.

(a) (i) Complete Table 1.2 to show how you will prepare the concentrations of protease you will use.

Table 1.2

percentage concentration of protease	volume of P / cm^3	volume of W / cm^3
100	10.0	0.0

[2]

Carry out step 1 to step 8.

step 1 Stir the 100% protease solution, **P**. In the beakers provided, prepare the concentrations of protease as shown in Table 1.2.

step 2 Label test-tubes with the concentrations of protease stated in Table 1.2.

step 3 Put 2 cm^3 of milk, **M**, into each labelled test-tube.

step 4 Put 1 cm^3 of the 100% protease solution, **P**, into the appropriately labelled test-tube. Start timing.

step 5 Hold the test-tube at an angle and slowly rotate the test-tube as shown in Fig. 1.1. Hold a piece of black card behind the test-tube and observe the thin layer of milk on the side of the test-tube.

step 6 As soon as a number of small clots appear, stop timing and record the value in **(a)(ii)**. If there are no clots after 180 seconds, stop timing and record as 'more than 180'.

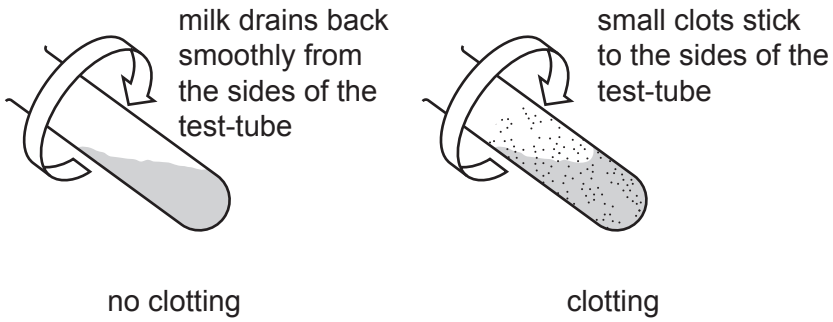


Fig. 1.1

step 7 Repeat step 4 to step 6 with each of the other concentrations of protease you prepared in step 1. Record your results in **(a)(ii)**.

step 8 Repeat step 2 to step 7 using clean test-tubes.

(ii) Record the **two** sets of results in an appropriate table.

[5]

(iii) Suggest **one** source of error in the procedure described in step 6 of this investigation.

.....

.....

..... [1]

(iv) Suggest why the procedure was repeated.

.....

.....

..... [1]

(v) To estimate the concentration of protease in fruit extract **U**, you will need to test a sample of the extract.

State the volume of fruit extract **U** that you will use.

volume = …… cm^3 [1]

(vi) Record the time taken for clots to appear using fruit extract **U**.

time taken = ... [1]

(vii) Use your results from **(a)(ii)** and **(a)(vi)** to estimate the concentration of protease in fruit extract **U**.

concentration of protease in fruit extract **U** = ... % [1]

(viii) With reference to your estimate in **(a)(vii)**, suggest how you would modify this procedure to obtain a more accurate value for the concentration of protease in fruit extract **U**.

.....

.....

.....

..... [2]

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(b) The effect of pH on the activity of the protease enzyme actinidin in fruit extract was investigated.

Table 1.3 shows the results of the investigation.

Table 1.3

pH	protease activity / μmol min^{-1} mg^{-1}
1.8	0.00
4.0	20.25
5.1	24.00
6.1	28.25
7.4	22.50
8.5	6.75

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

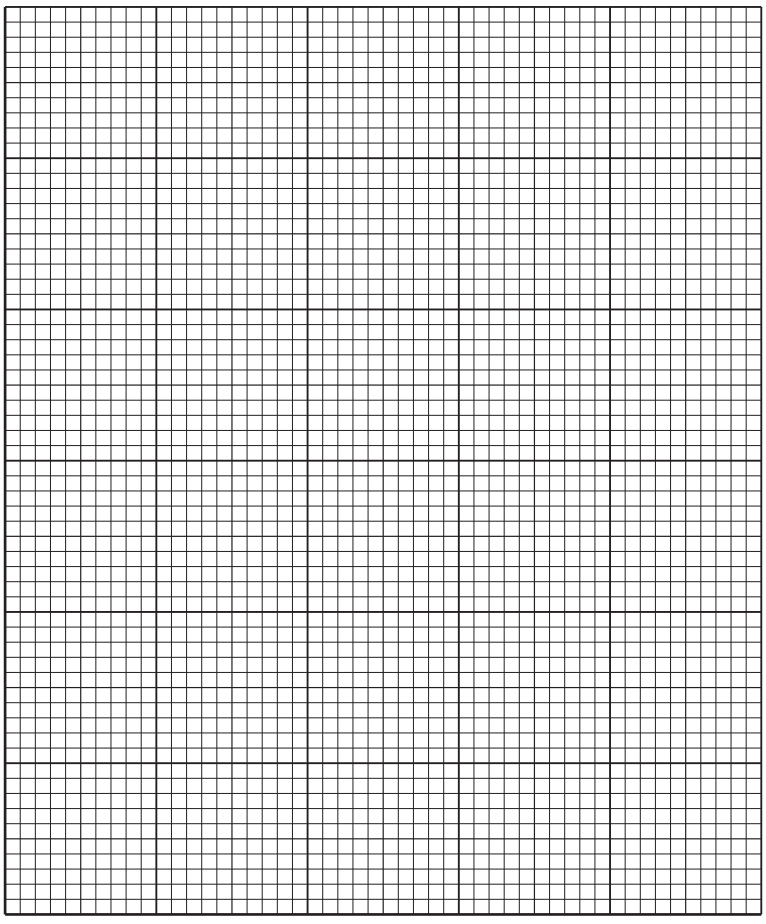


Fig. 1.2

[4]

(ii) Use the data in Table 1.3 and your graph in Fig. 1.2 to explain the effect of pH on the activity of protease.

.....

.....

.....

.....

.....

..... [3]

[Total: 21]

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

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

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

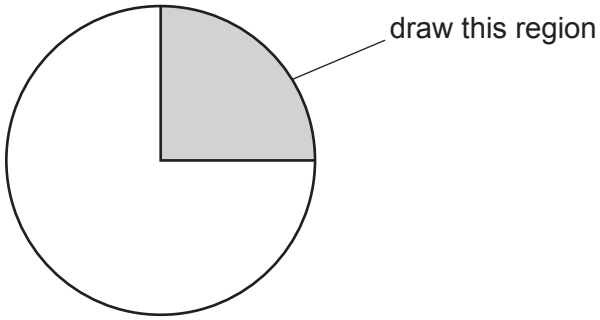


Fig. 2.1

[5]

(ii) Observe the trichomes on the leaf on **K1**.

Select a group of **four** adjacent cells that includes three epidermal cells **and** one trichome.

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

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

[5]

(iii) The presence of trichomes on **K1** suggests the leaf is from a plant that is a xerophyte.

State **one** other observable feature that suggests the leaf is from a plant that is a xerophyte.

.....

.....

..... [1]

(b) (i) Fig. 2.2 is a scanning electron micrograph of an open stoma.

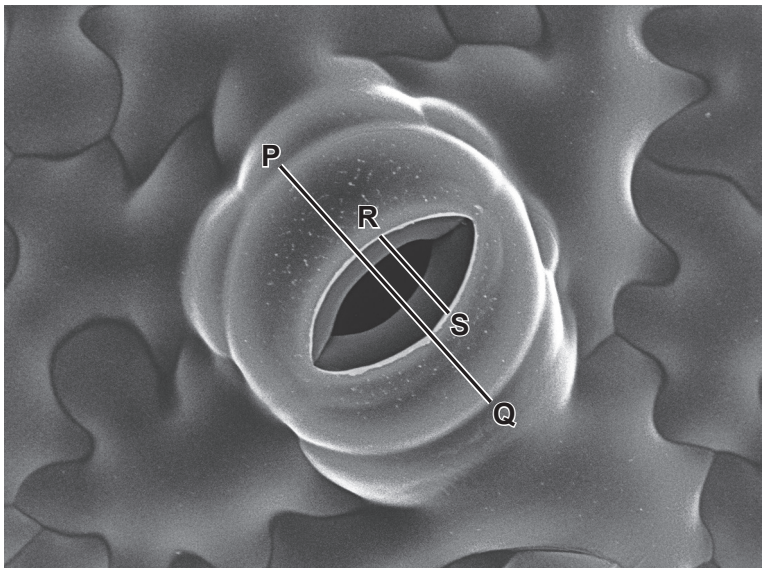


Fig. 2.2

Line **P**–**Q** represents the width of the paired guard cells that form the stoma.

Line **R**–**S** represents the width of the stoma.

Calculate the width of the stoma as a percentage of the width of line **P**–**Q**.

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

answer = ... %

[4]

(ii) Fig. 2.3 and Fig. 2.4 are photomicrographs of the leaf surface from different plants.

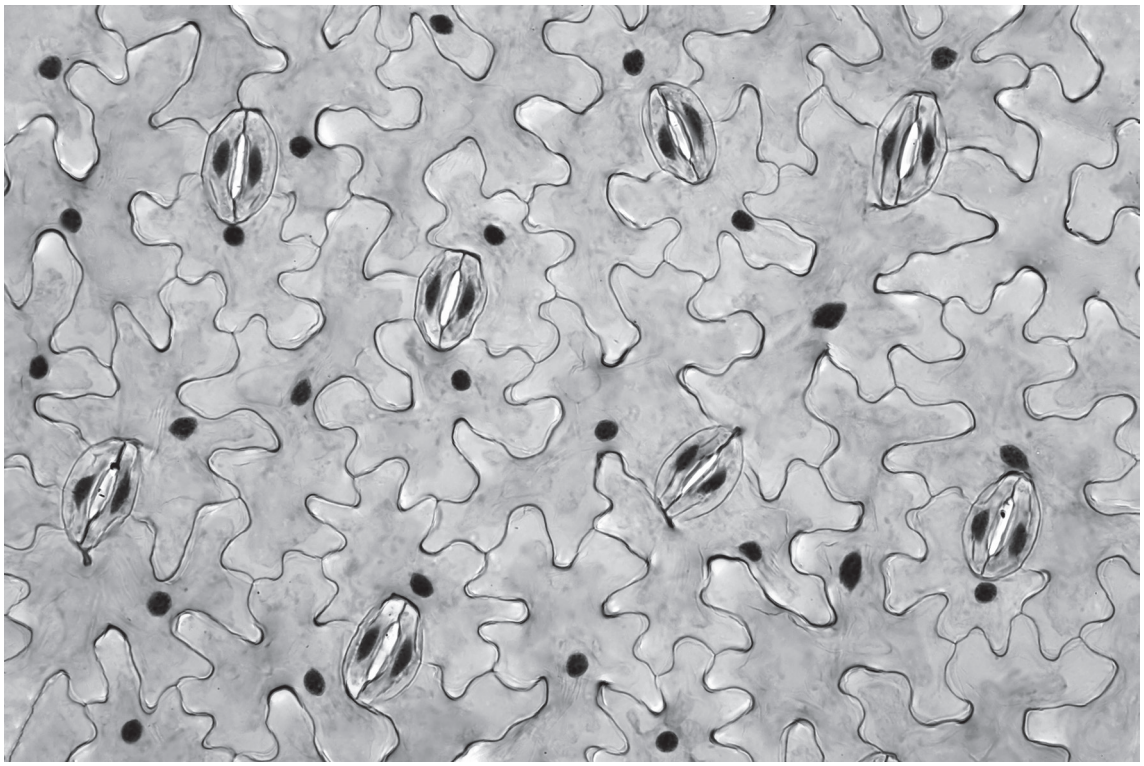


Fig. 2.3

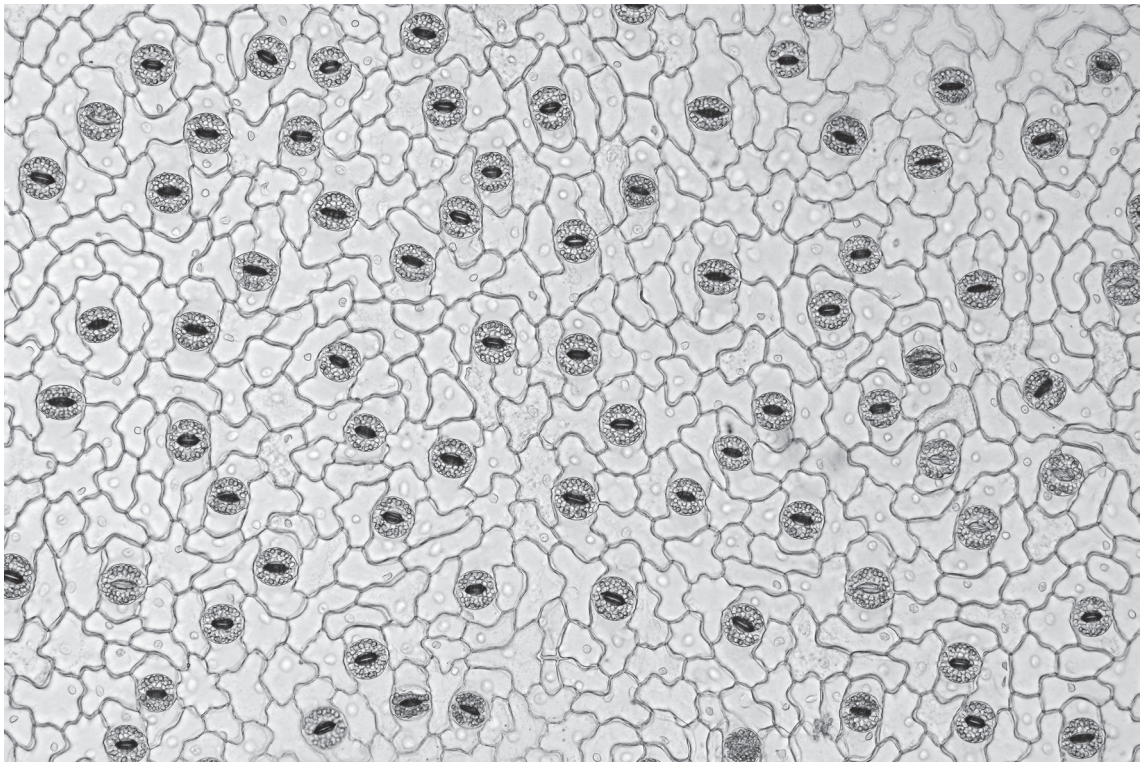


Fig. 2.4

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Identify **three** observable features that are different between the leaf surface in Fig. 2.3 and the leaf surface in Fig. 2.4.

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

Table 2.1

feature	Fig. 2.3	Fig. 2.4
1		
2		
3		

[4]

[Total: 19]

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CANDIDATE NUMBER

5014687108

BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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.
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INFORMATION

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[Turn over

1 Yeast cells contain enzymes that catalyse the breakdown of sugars, such as glucose and sucrose, to produce ethanol and carbon dioxide.

As the sugars are broken down, the yeast cells in a suspension will sink slowly to the bottom of the container, forming a sediment with a clear liquid above. This process is called sedimentation.

You will investigate the effect of different concentrations of ethanol on the sedimentation of yeast cells.

(a) Test-tube **R** in Fig. 1.1 shows how a test-tube will be set up at the start of the investigation.

(i) Decide what you expect the contents of the test-tube to look like after sedimentation.

On test-tube **S** in Fig. 1.1, draw:

- lines to show the layers that you expect to see after sedimentation
- a label line and label to identify the sediment.

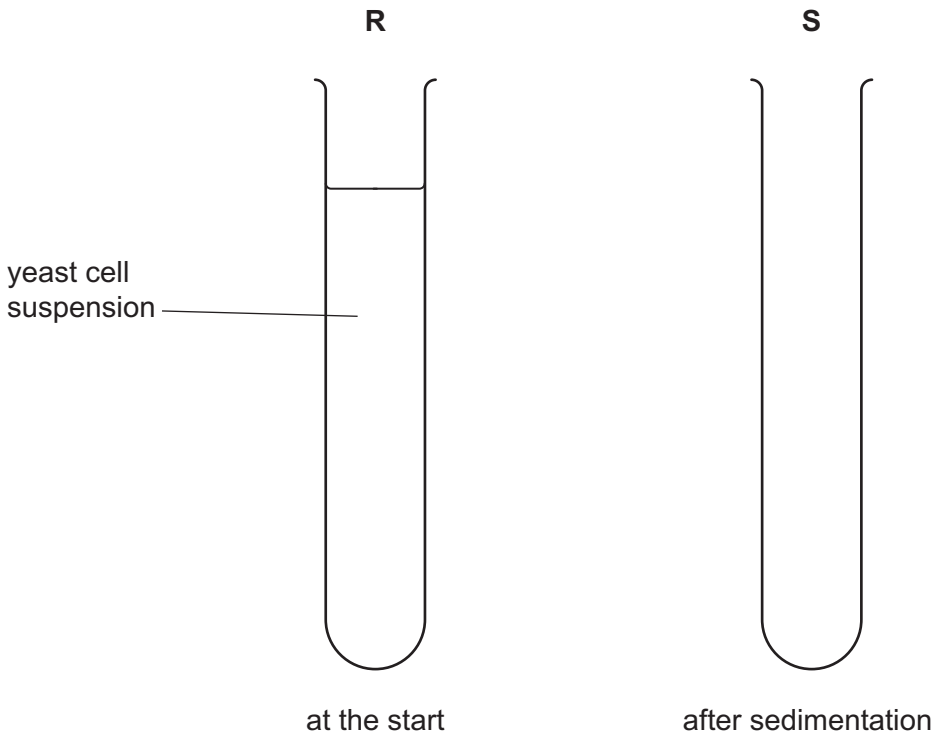


Fig. 1.1

[2]

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You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
E	100% ethanol	flammable harmful	50
A	calcium chloride solution	irritant	15
W	distilled water	none	150
Y	dried yeast	none	

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

You should wear suitable eye protection.

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You will investigate the effect of different concentrations of ethanol on the sedimentation of yeast cells.

You will need to:

- prepare different concentrations of ethanol
- measure the height of the yeast sediment in each concentration of ethanol every four minutes.

You will use proportional dilution to make different concentrations of ethanol.

You will prepare 10 cm^3 of each concentration, using **E** and **W**.

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

Decide which other concentrations of ethanol you will use.

(ii) Complete Table 1.2 to show how you will prepare the concentrations of ethanol you will use.

Table 1.2

percentage concentration of ethanol	volume of E / cm^3	volume of W / cm^3
100	10.0	0.0
60	6.0	4.0

[2]

Carry out step 1 to step 15.

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

step 2 Label **one** test-tube with the label **C**.

step 3 Label the other test-tubes with the concentrations of ethanol prepared in step 1.

step 4 Put 1 cm^3 of **A** into each of the test-tubes labelled in step 2 and step 3.

step 5 Put 7 cm^3 of **W** into the test-tube labelled **C**.

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step 6 Put 7 cm^3 of the 100% ethanol, **E**, into the test-tube labelled **100%**.

step 7 Repeat step 6 for each of the other concentrations you prepared in step 1.

step 8 Put 100 cm^3 of **W** into the beaker labelled **Y** and stir until all of the dried yeast forms a suspension.

step 9 Stir the yeast cell suspension and put 7 cm^3 of the yeast cell suspension into the test-tube labelled **100%**.

step 10 Repeat step 9 for each of the other labelled test-tubes, including **C**.

step 11 Put a clean bung into one of the test-tubes and invert the test-tube to mix the contents.

step 12 Repeat step 11 for all the other test-tubes.

step 13 Start timing and immediately measure the height of the sediment in each test-tube. These are the results at the start (0 minutes).
Record your results in **(a)(iii)**.

step 14 After 4 minutes, measure the height of the sediment in each test-tube.
Record your results in **(a)(iii)**.

step 15 Repeat step 14 so that results are recorded every 4 minutes until the final results are recorded at 20 minutes.

(iii) Record your results in an appropriate table.

[5]

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(iv) Using your results in **(a)(iii)**, state **one** conclusion that can be made about the effect of the concentration of ethanol on the sedimentation of yeast cells.

.....

.....

.....

..... [1]

(v) A student suggested the hypothesis:

ethanol is needed for sedimentation of yeast cells to occur.

Using your results in **(a)(iii)**, state whether you support **or** reject this hypothesis.

Explain how your results provide evidence for this decision.

support **or** reject .....

explanation .....

.....

.....

[1]

(vi) Using the results at 20 minutes, state the concentration, or concentrations, of ethanol that caused the most sedimentation.

.....

Suggest how you could modify this procedure to obtain a more accurate estimate of the concentration that causes the most sedimentation.

modification .....

.....

.....

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.....

.....

[3]

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(vii) Identify the main source of error in the investigation into the effect of different concentrations of ethanol on the sedimentation of yeast cells.

.....

..... [1]

(viii) Another possible source of error, when carrying out step 6 of the investigation, is shown in Table 1.3.

Complete Table 1.3 by stating whether the type of error is systematic **or** random **and** the effect the error may have on the trend seen in the results.

Table 1.3

source of error	systematic error or random error	effect on the trend
the 7 cm^3 mark on the syringe used to measure the volume of ethanol actually measured 7.1 cm^3		

[1]

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(b) In fermentation, the action of yeast converts some of the carbohydrates in plants to ethanol and carbon dioxide.

A scientist investigated the production of ethanol during the fermentation of carbohydrates from different sources.

The investigation was carried out at 30 °C and at pH 5, using the yeast *Saccharomyces cerevisiae*. All other variables were kept constant.

The results are shown in Table 1.4.

Table 1.4

source of carbohydrate	**percentage ethanol produced per 100 g of carbohydrate**
molasses	3.80
oranges	1.05
grapes	2.65
beetroot	3.35
rice	4.70

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(i) Draw a bar chart of the data in Table 1.4 on the grid in Fig. 1.2.

Use a sharp pencil.

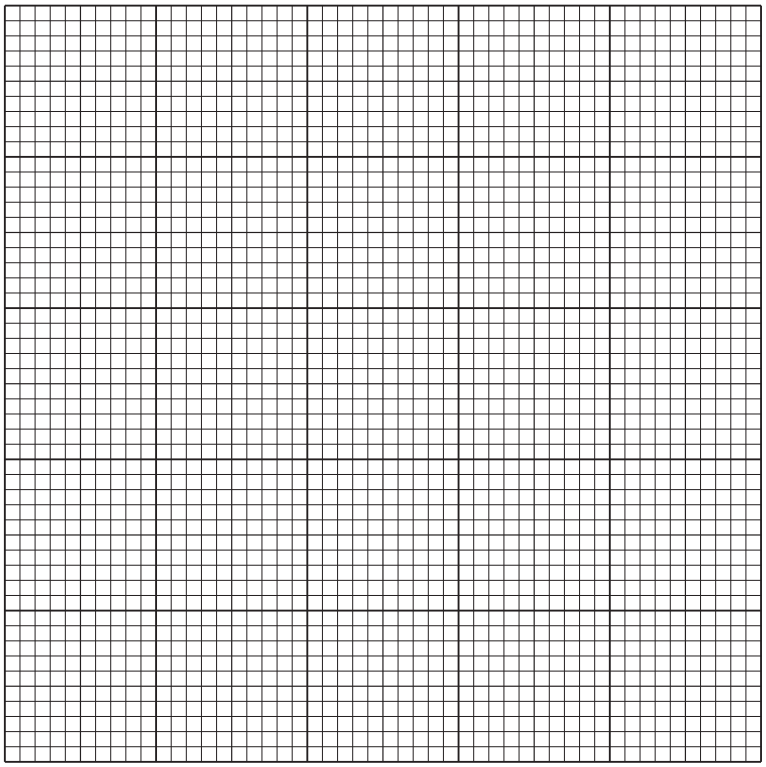


Fig. 1.2

[4]

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The investigation was repeated using a different yeast, *Schizosaccharomyces pombe*.

All the variables were kept the same as in the first investigation.

The percentage of ethanol produced using *Schizosaccharomyces pombe* was found to be lower with all of the sources of carbohydrate.

The results are shown in Table 1.5.

Table 1.5

source of carbohydrate	**percentage ethanol produced per 100 g of carbohydrate**	
	Saccharomyces cerevisiae	*Schizosaccharomyces pombe*
molasses	3.80	3.68
oranges	1.05	1.00
grapes	2.65	2.57
beetroot	3.35	3.29
rice	4.70	4.34

(ii) Suggest why the percentage of ethanol produced by *Schizosaccharomyces pombe* is lower than the percentage of ethanol produced by *Saccharomyces cerevisiae* for all sources of carbohydrate.

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..... [2]

[Total: 22]

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

(a) **(i)** Draw a large plan diagram of the whole section on **L1**. Use a sharp pencil.

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

[5]

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(ii) Observe the cells in the cortex on the section of the stem on **L1**.

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

Each cell must touch at least **two** other 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 through a different plant.

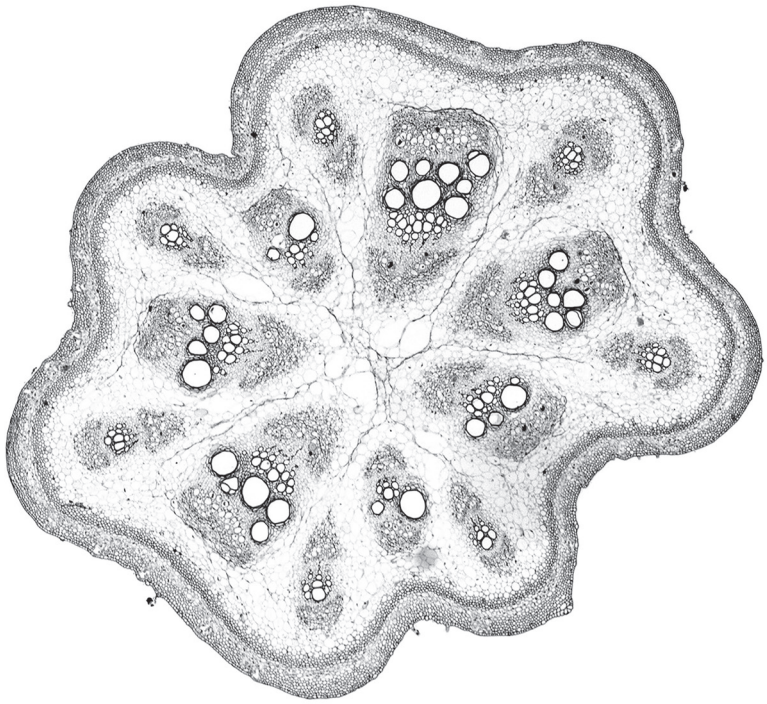


Fig. 2.1

Identify **three** observable features, other than colour, that are different between the section on **L1** and the section in Fig. 2.1.

Record the differences between these **three** observable features in Table 2.1.

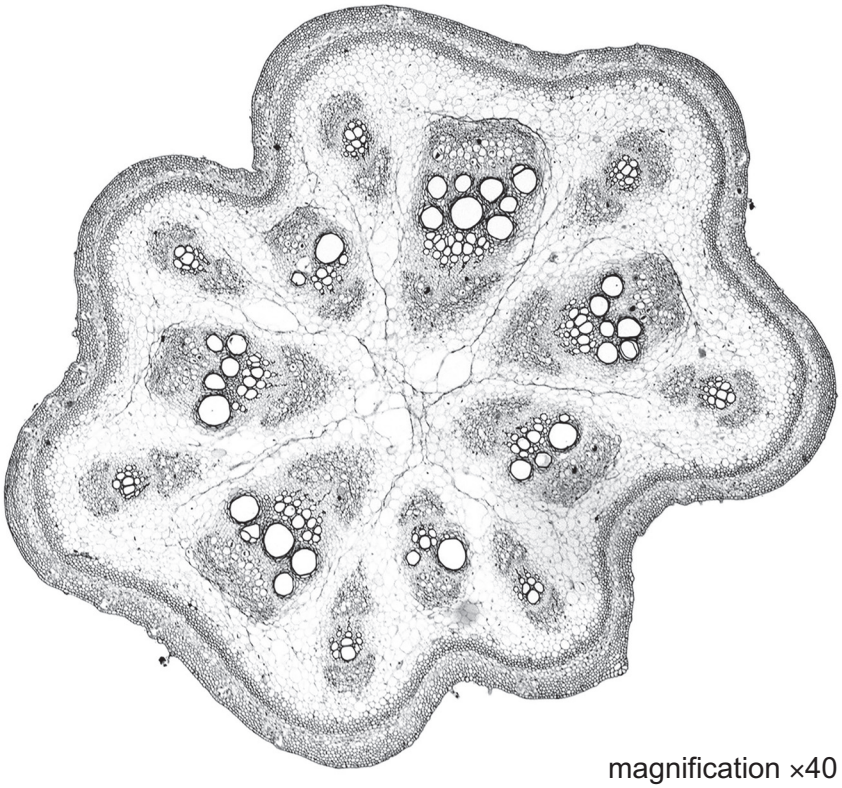
Table 2.1

feature	L1	Fig. 2.1

[4]

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



magnification ×40

Fig. 2.2

Determine the **mean** actual diameter of the stem in Fig. 2.2.

Show your working.

mean actual diameter .....
[4]

[Total: 18]

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 2024**

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 Salicylic acid acts as a painkiller and is the active ingredient in aspirin.

When a person ingests a dose of aspirin, the salicylic acid enters the blood and circulates in the bloodstream. Most of the salicylic acid is metabolised by the body. Some of the salicylic acid is excreted by the kidneys into the urine.

You will estimate the concentration of salicylic acid in two solutions, **S1** and **S2**. These solutions represent samples of blood and urine taken from a person who has ingested aspirin.

Note: you will **not** be working with real blood or real urine.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
A	1.0% salicylic acid	harmful	50
C	iron(III) chloride solution	harmful	30
S1	sample with unknown concentration of salicylic acid	harmful	20
S2	sample with unknown concentration of salicylic acid	harmful	20
W	distilled water	none	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.

The concentration of salicylic acid can be determined by using iron(III) chloride, **C**, which forms a purple solution when mixed with salicylic acid. The greater the concentration of salicylic acid, the more intense the purple colour formed.

You will need to:

- prepare different concentrations of salicylic acid
- record the intensity of purple colour for each concentration
- estimate the concentration of salicylic acid in **S1** and **S2**.

You will use proportional dilution to make different concentrations of salicylic acid.

You will prepare 10 cm^3 of each concentration, using **A** and **W**.

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

Decide which other concentrations of salicylic acid you will use.

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(a) (i) Complete Table 1.2 to show how you will prepare the concentrations of salicylic acid you will use.

Table 1.2

percentage concentration of salicylic acid	volume of A / cm^3	volume of W / cm^3
1.0	10.0	0.0
0.0	0.0	10.0

[3]

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Carry out step 1 to step 7.

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

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

step 3 Put 2 cm^3 of **C** into each of the test-tubes labelled in step 2.

step 4 Put 5 cm^3 of **A** into the test-tube labelled 1.0%. Use a glass rod to mix.

step 5 Repeat step 4 for each of the other concentrations you prepared in step 1.

step 6 Place the white card behind the test-tubes and observe the intensity of colour in each test-tube. You may see the same intensity in more than one test-tube.

step 7 Compare the intensity of colour in each test-tube with the key in Fig. 1.1. Record your observations in **(a)(ii)** using only the symbols shown in the key in Fig. 1.1.

Key

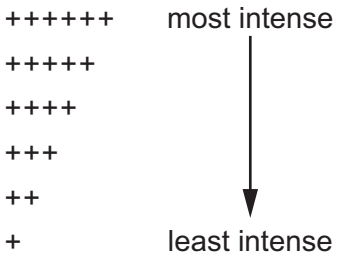


Fig. 1.1

(ii) Record your results in an appropriate table.

[4]

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Carry out step 8 to step 12.

step 8 Label one test-tube **S1** and label another test-tube **S2**.

step 9 Put 2 cm^3 of **C** into each of the test-tubes labelled in step 8.

step 10 Put 5 cm^3 of **S1** into the appropriately labelled test-tube. Use a glass rod to mix.

step 11 Put 5 cm^3 of **S2** into the appropriately labelled test-tube. Use a glass rod to mix.

step 12 Observe the intensity of colour in each test-tube.

(iii) Record your observations for **S1** and **S2** using the symbols shown in the key in Fig. 1.1.

intensity of colour for **S1** .....

intensity of colour for **S2** .....

[1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the concentration of salicylic acid in **S1** and **S2**.

concentration in **S1** .....%

concentration in **S2** .....%

[1]

(v) When a person ingests a dose of aspirin, some of the salicylic acid is excreted by the kidneys into the urine.

State which sample, **S1** or **S2**, is from the person's blood. Explain your answer.

sample ……

explanation .....

.....

.....

[1]

(vi) State the independent variable in this investigation.

..... [1]

(vii) Describe **one** significant source of error when carrying out step 6 and step 7 **and** suggest an improvement to reduce this error.

source of error .....

improvement .....

.....

[2]

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(b) A person was given an oral dose of aspirin and the concentration of salicylic acid in their urine was measured at intervals over a period of four hours.

The results are shown in Table 1.3.

Table 1.3

time / minutes	concentration of salicylic acid in urine / $\mu g\,mL^{-1}$
30	36.0
60	65.5
120	42.5
180	33.0
240	31.5

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

Use a sharp pencil.



Fig. 1.2

[4]

(ii) Use your graph in Fig. 1.2 to estimate the concentration of salicylic acid in the urine at 105 minutes.

Show on your graph how you obtained your answer.

concentration of salicylic acid = ... $\mu g\,mL^{-1}$ [2]

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(iii) The highest concentration of salicylic acid in the urine is detected at 60 minutes.

Using the data in Table 1.3 and your graph in Fig. 1.2, describe the change in concentration of salicylic acid between 60 minutes and 240 minutes.

.....

.....

..... [1]

(iv) Aspirin is also taken to reduce inflammation and blood clotting. Inflammation and blood clotting involve enzyme-controlled reactions.

Suggest how aspirin reduces these enzyme-controlled reactions.

.....

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..... [2]

[Total: 22]

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2 **M1** is a slide of a stained transverse section through a plant structure made up of leaves wrapped around a central area.

(a) (i) Observe the region of the section on **M1** indicated by the shaded area in Fig. 2.1.

- Draw a large plan diagram of this region. Use a sharp pencil.
- Include **four** vascular bundles in your drawing.
- Use **one** ruled label line and label to identify **one** vascular bundle.

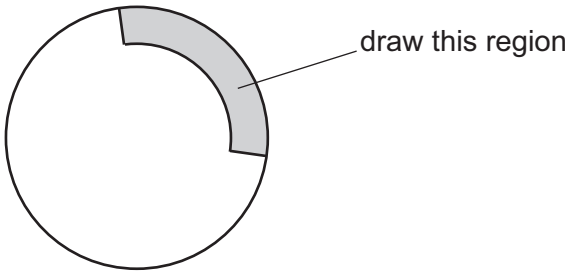


Fig. 2.1

[5]

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(ii) Observe the cells in the lower epidermis of the region indicated by the shaded area in Fig. 2.1.

Select a line of four adjacent cells.

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

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

[5]

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Fig. 2.2 is a photomicrograph of a stained transverse section of a stem from a different plant.

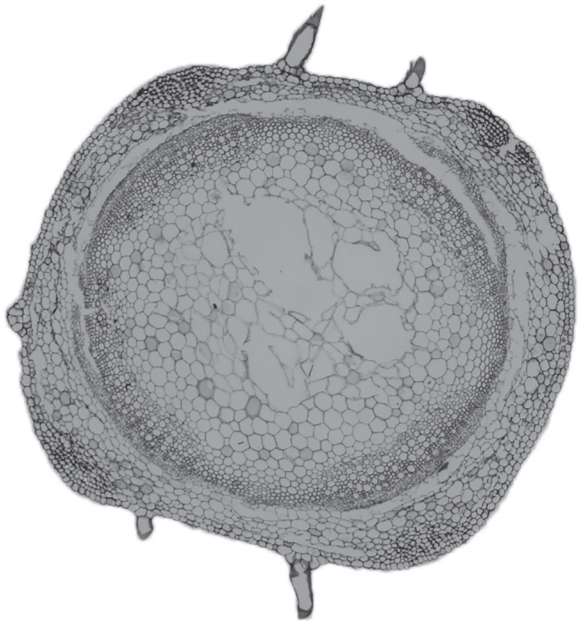


Fig. 2.2

(b) Identify **three** observable features, other than colour, that are different between the section on **M1** and the section in Fig. 2.2.

Record the differences between these **three** observable features in Table 2.1.

Table 2.1

feature	slide M1	Fig. 2.2

[4]

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(c) Fig. 2.3 is the same photomicrograph as that shown in Fig 2.2, with line **X**–**Y** drawn across the section.

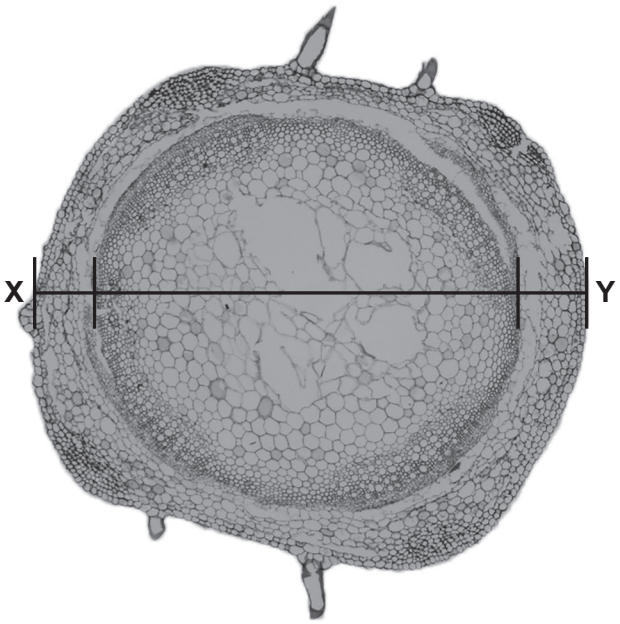


Fig. 2.3

(i) Using the line **X**–**Y,** measure the width of the stem section and the width of the central region.

Use appropriate units.

width of stem section .....

width of central region .....

[2]

(ii) State the ratio of the width of the stem section to the width of the central region.

ratio ..... [1]

(iii) Describe how to determine the mean width of the central region of the stem in Fig. 2.3.

.....

.....

..... [1]

[Total: 18]

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CENTRE NUMBER						CANDIDATE NUMBER				

4101582432

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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 Beetroot is a root vegetable that contains a red pigment in its cells. When beetroot is put in ethanol, the red pigment is released from the beetroot tissue and the ethanol changes to a red colour.

You will investigate the effect of different concentrations of ethanol on the release of red pigment from beetroot tissue.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
B	4 beetroot cylinders in distilled water	none	-
E	50% ethanol	flammable harmful	100
W	distilled water	none	300

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 ethanol, using proportional dilution of the 50% ethanol, **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 ethanol you will use.

Decide which other concentrations of ethanol you will use.

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

Table 1.2

percentage concentration of ethanol	volume of E / cm^3	volume of W / cm^3
50	20.0	0.0
0	0.0	20.0

[2]

Carry out step 1 to step 14.

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

step 2 Label large test-tubes with the concentrations of ethanol stated in Table 1.2.

step 3 Put 10 cm^3 of each concentration of ethanol into the appropriately labelled large test-tubes.

step 4 Cut the beetroot cylinders into 2 mm thick discs, using a single-edged blade.
You will need 10 discs for each concentration of ethanol.

step 5 Put the discs into a small beaker and cover with distilled water, **W**.

step 6 Stir with a glass rod.

step 7 Pour the surrounding liquid into the beaker labelled **For waste**.

step 8 Blot the discs on a paper towel to remove excess water.

step 9 Put 10 discs into each of the large test-tubes. Start timing and leave for 10 minutes.

While you are waiting use your time to continue with other parts of Question 1.

step 10 Label small test-tubes with the ethanol concentrations shown in Table 1.2.

step 11 After 10 minutes (at the end of step 9) stir the contents of each large test-tube.

step 12 Pour the liquid from each large test-tube into the appropriately labelled small test-tube.
The discs should remain in the large test-tubes.

Fig. 1.1 shows the key you need to use to record your results.

Key

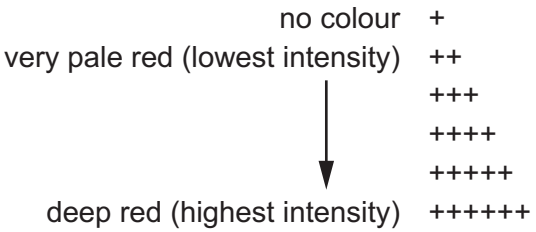


Fig. 1.1

step 13 Observe the colour of the liquid in each small test-tube.

step 14 Record your observations in **(a)(ii)** using the symbols shown in the key in Fig. 1.1.

(ii) Record your observations in an appropriate table.

[5]

(iii) Describe the trend in your results.

.....

.....

..... [1]

(iv) With reference to your results in **(a)(ii)**, explain the effect of ethanol on cell membranes.

.....

.....

.....

.....

.....

..... [3]

(v) State the dependent variable in this investigation.

..... [1]

(vi) State **one** variable that was standardised **and** describe how it was standardised.

.....

.....

..... [1]

(vii) Identify **one** source of error in this investigation.

.....

.....

..... [1]

(viii) Describe how you would modify the procedure to investigate the effect of temperature on the permeability of beetroot cell membranes.

.....

.....

.....

.....

..... [2]

(b) Researchers investigated the effect of drinking beetroot juice on blood pressure.

Two groups of people were used in the investigation.

- One group was given 500 cm^3 of beetroot juice to drink.
- A control group was given 500 cm^3 of water to drink.
- The mean blood pressure of each group was measured at intervals.
- The difference in mean blood pressure between the two groups was calculated.

Table 1.3 shows the results of the investigation.

Table 1.3

time after drinking / minutes	**difference in mean blood pressure compared to control group / kPa**
0	0.0
25	–0.28
80	–0.57
125	–0.92
160	–1.33
220	–0.87

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

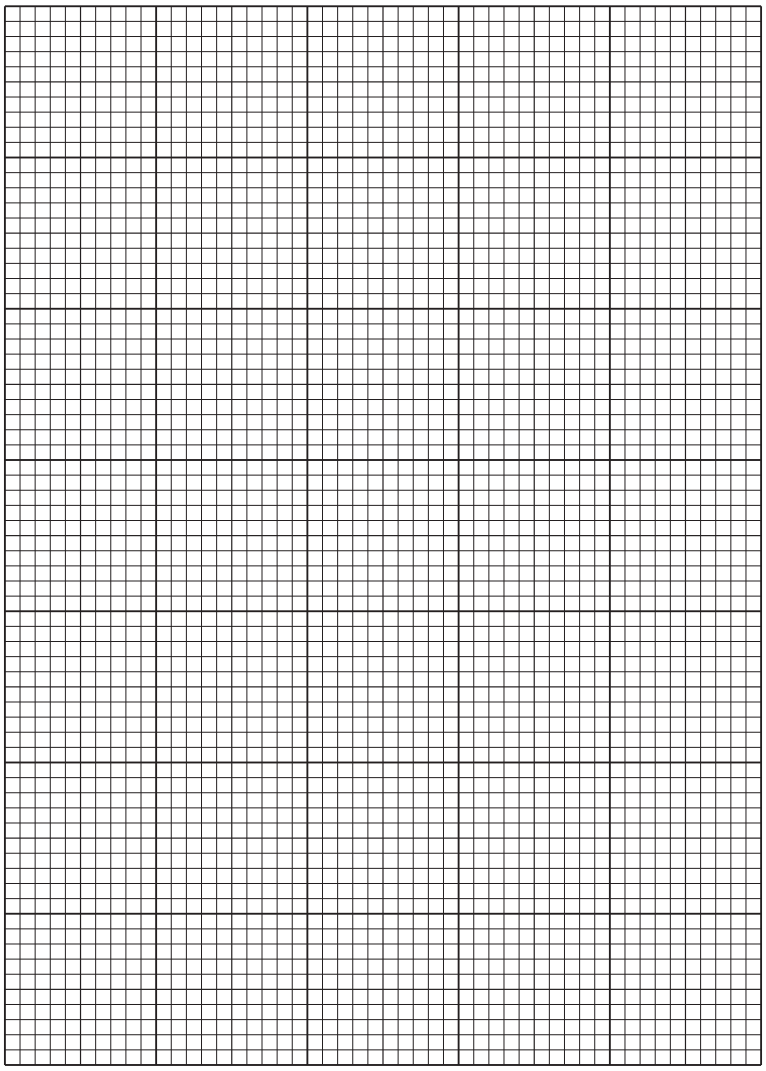


Fig. 1.2

[4]

(ii) After 100 minutes, the mean blood pressure for the control group was 15.79 kPa.

Use your graph in Fig. 1.2 to calculate the mean blood pressure after 100 minutes for the group that was given beetroot juice.

Show your working.

mean blood pressure after 100 minutes = ... kPa [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 part of the leaf section on **N1** to show the different tissues.

The section that you choose to draw should include **four** vascular bundles.

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

[5]

(ii) Observe the cells in the epidermis of the leaf on **N1**.

Select **two** guard cells **and two** adjacent epidermal cells.
Each cell must touch at least **one** other cell.

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

[5]

(b) Fig. 2.1 is a photomicrograph of a transverse section of a leaf from a different type of plant.

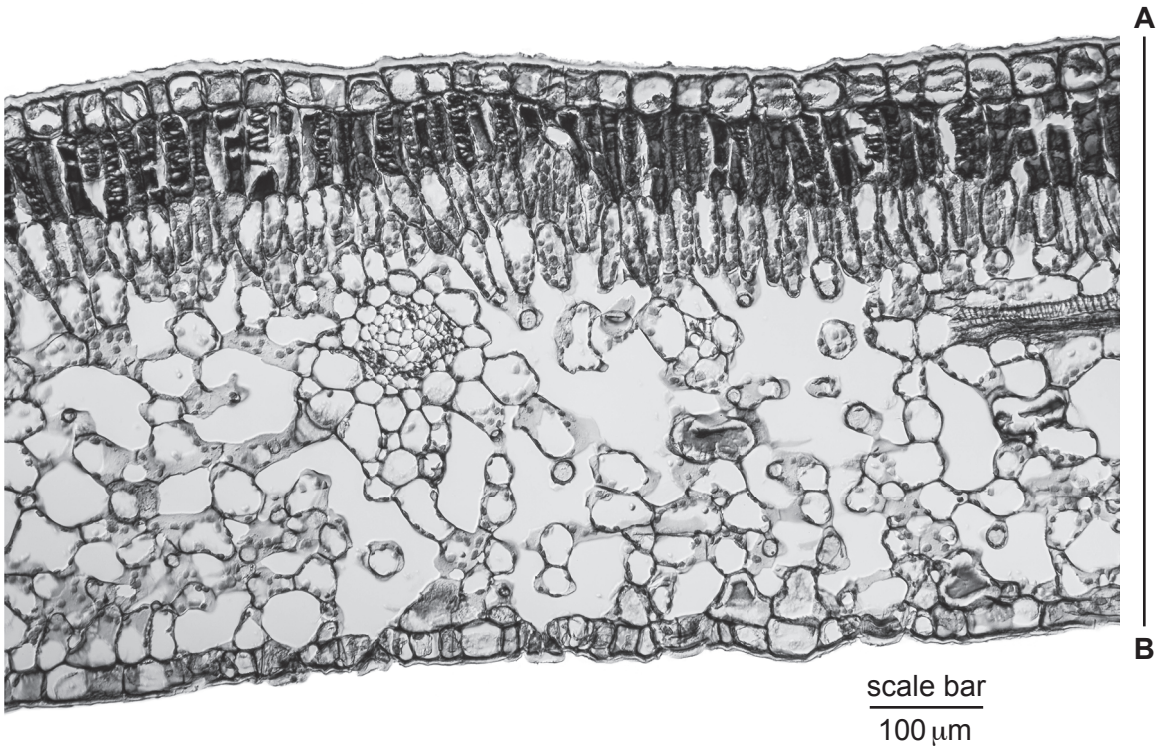


Fig. 2.1

(i) Identify **three** observable features, other than colour, that are different between the leaf section on **N1** and the leaf section in Fig. 2.1.

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

[4]

(ii) Line **A**–**B** represents the thickness of the leaf in Fig. 2.1.

Use the scale bar in Fig. 2.1 to calculate the actual thickness of the leaf.

Show your working.

Include the unit in your answer.

actual thickness = ... [3]

(iii) Use your value from **(b)(ii)** to calculate the magnification of Fig. 2.1.

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

magnification = × ..... [1]

[Total: 18]

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