Cambridge Assessment International Education

Cambridge International AS & A Level

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8835247060

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 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 Milk is sometimes contaminated with substances such as starch.

You will determine the concentration of starch in a sample of contaminated milk, using a range of starch standards.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
M	milk	none	50
SM	1.0% starch solution in milk (starch-milk)	none	20
CM	contaminated milk	none	20
iodine	iodine solution	irritant	20

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 1.0% starch-milk solution, **SM**, to reduce the concentration by **one fifth** between each successive dilution.

You will need to prepare **four** concentrations of starch-milk solution in addition to the 1.0% starch-milk solution, **SM**.

You must use the milk, **M**, to dilute the starch-milk solution. Do **not** use water for the dilution.

After the serial dilution is completed, you will need to have 8 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 starch-milk, **SM**, solution transferred
- a labelled arrow to show the volume of milk, **M**, added
- a label under the beaker to show the concentration of the starch-milk solution.

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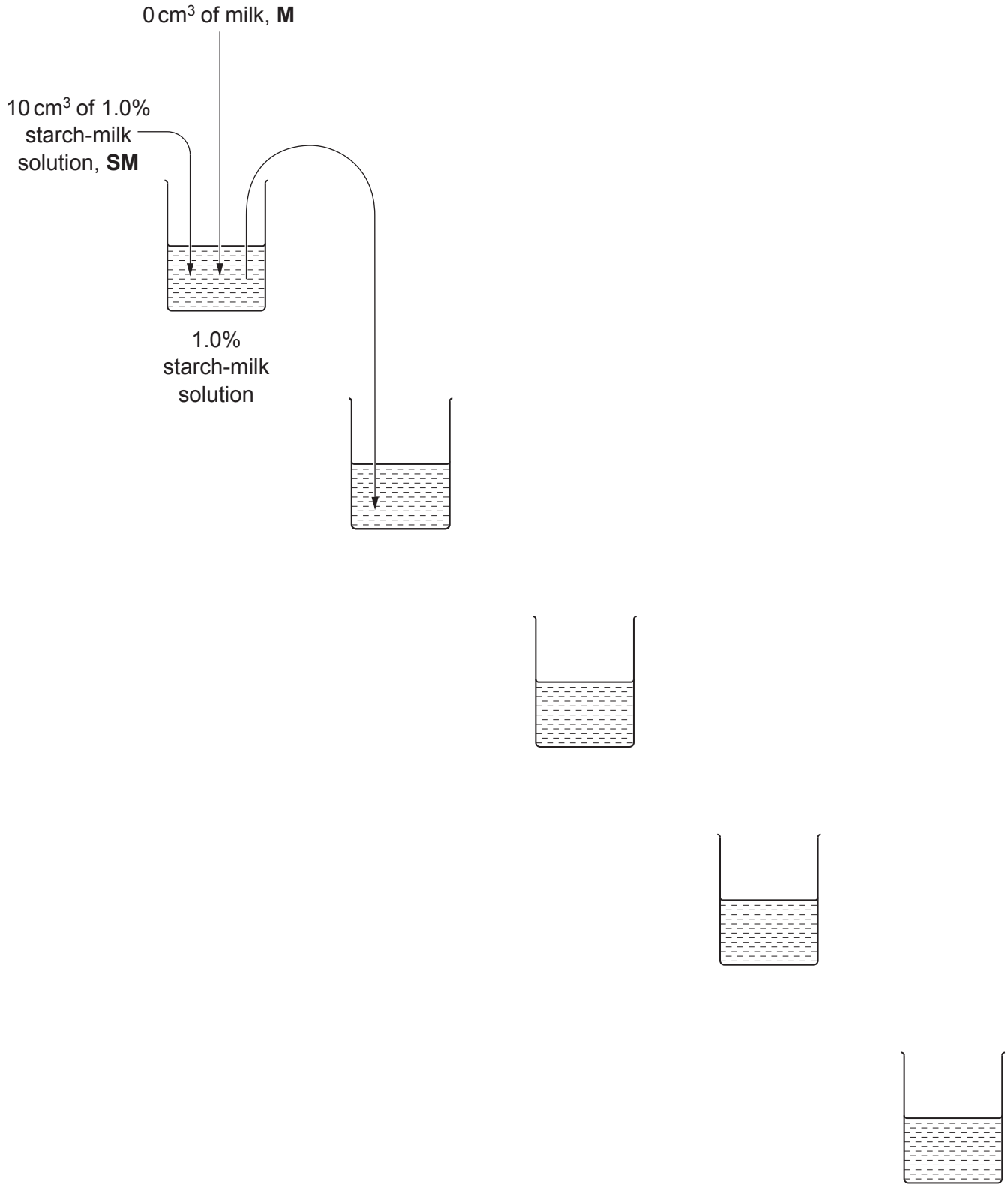

0 cm3 of milk, M
10 cm3 of 1.0% starch-milk solution, SM
1.0% starch-milk solution

Fig. 1.1

[3]

Carry out step 1 to step 11.

step 1 Prepare the concentrations of starch-milk solution as shown in Fig. 1.1.

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

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

step 4 Repeat step 3 with the remaining concentrations of starch-milk solution.

step 5 Add 1 cm^3 of iodine solution to each test-tube. Shake gently to mix.

step 6 Observe the colour in each test-tube and use the key in Fig. 1.2 to determine the colour score.

step 7 Record in **(a)(ii)** the colour score for each concentration of starch-milk solution.

colour of solution						
colour score	5	4	3	2	1	0

Fig. 1.2

(ii) Record your results in an appropriate table.

[5]

(iii) To determine the concentration of starch in the contaminated milk, **CM**, you will need to test a sample of **CM**.

State the volume of **CM** that you will use.

volume = ... [1]

step 8 Label a test-tube **CM**.

step 9 Transfer the volume of **CM** that you stated in **(a)(iii)** into test-tube **CM**.

step 10 Put 1 cm^3 of iodine solution into the test-tube. Shake gently to mix.

step 11 Observe the colour in the test-tube, and use the key in Fig. 1.2 to determine the colour score.

(iv) Record the colour score for test-tube **CM**.

colour score for **CM** ..... [1]

(v) Use your results in **(a)(ii)** and **(a)(iv)** to determine the concentration of starch in the contaminated milk, **CM**.

concentration of starch in **CM** ..... [1]

(vi) Identify **one** source of error in step 6.

.....

.....

..... [1]

(vii) Suggest why milk is used to dilute the starch-milk solution rather than water.

.....

.....

..... [1]

(viii) Milk is sometimes contaminated with glucose.

Suggest how you would modify this investigation to determine the concentration of glucose in a sample of contaminated milk.

.....

.....

.....

..... [2]

(b) Some people are intolerant to lactose in milk. The enzyme β-galactosidase is used to break down the lactose in milk.

In an investigation, equal quantities of β-galactosidase were added to different concentrations of lactose in milk. The rate of lactose breakdown was measured and recorded.

The results are shown in Table 1.2.

Table 1.2

concentration of lactose / mmol dm^{-3}	rate of reaction / arbitrary units
12	0.30
42	0.65
70	0.80
110	1.15
164	1.25
210	1.25

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

Use a sharp pencil.

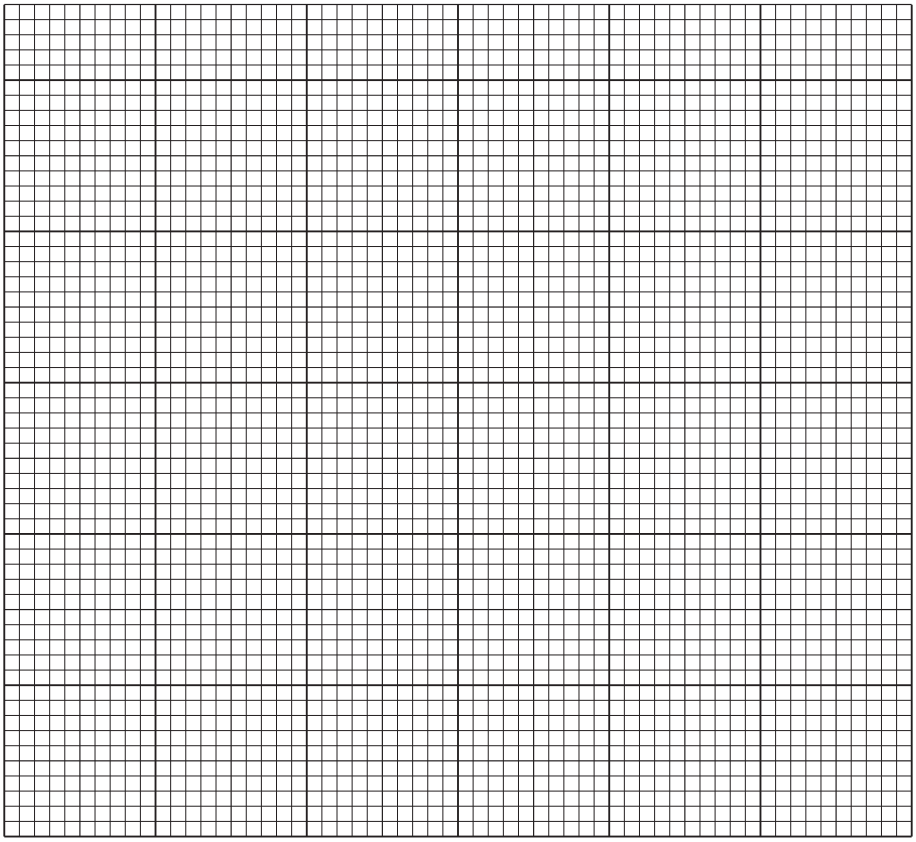


Fig. 1.3

[4]

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(ii) Describe **and** explain the shape of the graph in Fig. 1.3.

description .....

.....

.....

explanation .....

.....

.....

.....

.....

.....

[3]

[Total: 22]

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

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

Use a sharp pencil.

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

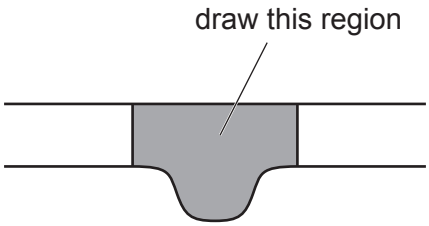


Fig. 2.1

[5]

(ii) Observe the xylem vessel elements in the leaf on **J1**.

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]

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

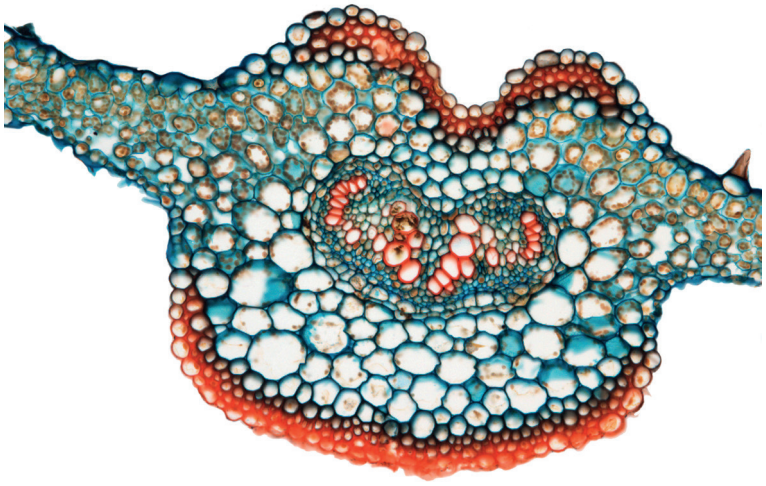


Fig. 2.2

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

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

Table 2.1

feature	J1	Fig. 2.2

[3]

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(ii) Fig. 2.3 shows a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

The length of one division on this stage micrometer is 0.2 mm.

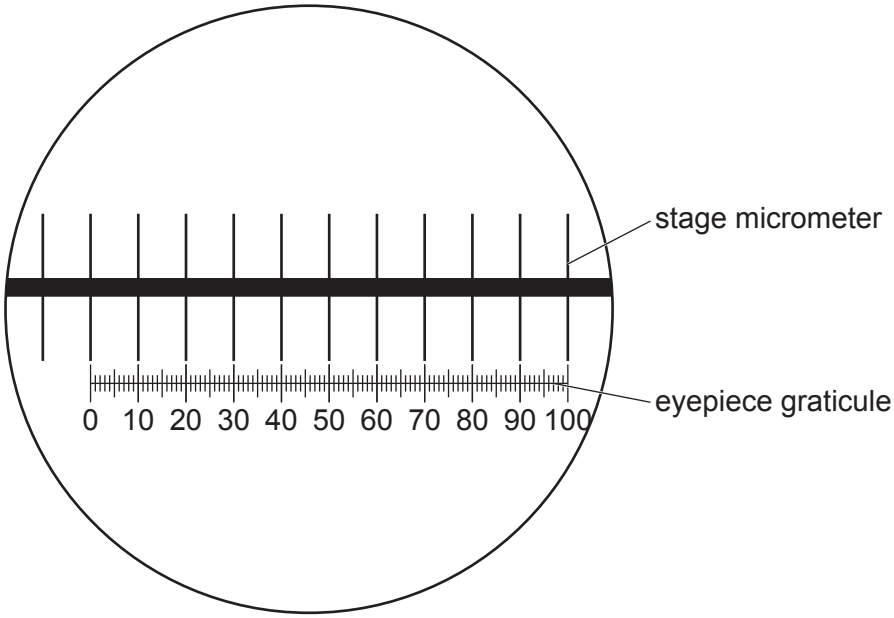


Fig. 2.3

Use Fig. 2.3 to calculate the length of **one** eyepiece graticule unit.

Show your working.

Include the unit in your answer.

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

(iii) Fig. 2.4 shows the same eyepiece graticule and same lenses being used to measure the width of the section shown in Fig. 2.2.

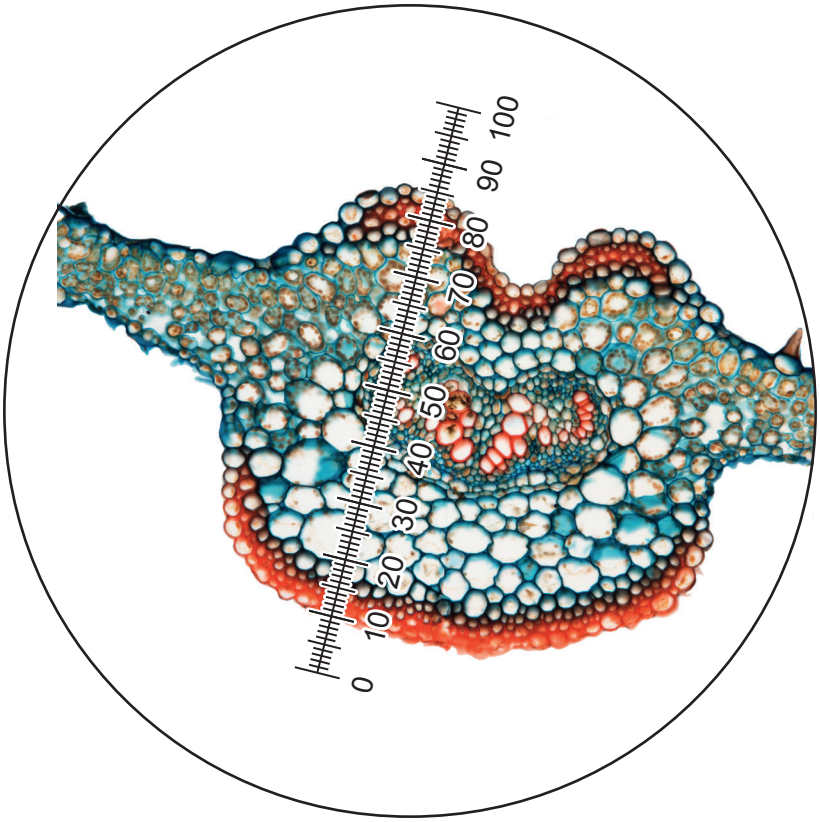


Fig. 2.4

Use your answer in **(b)(ii)** to calculate the actual width of the section shown in Fig. 2.4.

Show your working.

actual width of the section ..... [2]

[Total: 18]

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2024**

2 hours

You must answer on the question paper.

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INFORMATION

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1 Plant cells produce the enzyme catalase that catalyses the hydrolysis (breakdown) of hydrogen peroxide into water and oxygen, as shown in Fig. 1.1.

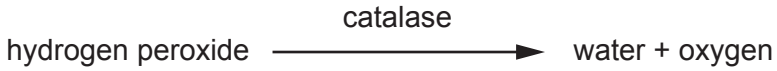


Fig. 1.1

A cylinder of potato tissue will have catalase molecules on its surface.

When potato tissue is put into hydrogen peroxide solution, oxygen bubbles are released and a foam forms at the surface of the hydrogen peroxide solution.

You will investigate the effect of ethanol concentration on the activity of catalase by measuring the height of the foam.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	hydrogen peroxide solution	harmful irritant	40
W	water	none	200
E	100% ethanol	flammable	80
P	5 potato cylinders	none	–

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

It is recommended that you wear suitable eye protection.

Carry out step 1 to step 7.

step 1 Put the five potato cylinders onto a white tile or cutting surface and cut each cylinder to a length of 4 cm.

step 2 Label a beaker **0** and put 30 cm^3 of **W** into this beaker.

step 3 Put **one** potato cylinder into the beaker labelled **0**. Start timing and leave for 5 minutes.

step 4 Label **one** test-tube **0**.

step 5 After 5 minutes (step 3), remove the potato cylinder from the beaker labelled **0** and put it into the test-tube labelled **0**.

step 6 Put 5 cm^3 of hydrogen peroxide solution into this test-tube. Immediately start timing.

step 7 Measure and record the height of the foam at 1 minute **and** at 2 minutes.

height of foam at 1 minute .....

height of foam at 2 minutes .....

(a) (i) The length of the potato cylinders may not be precisely 4 cm.

Identify **one** other source of error in the procedure you have carried out.

.....

.....

..... [1]

You will investigate the effect of different concentrations of ethanol on catalase activity.

You will need to carry out a **serial** dilution of the 100% ethanol, **E**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **three** concentrations of ethanol in addition to the 100% ethanol, **E**.

After the serial dilution is completed, you will need to have 30 cm^3 of each concentration available to use.

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

Each beaker should have:

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

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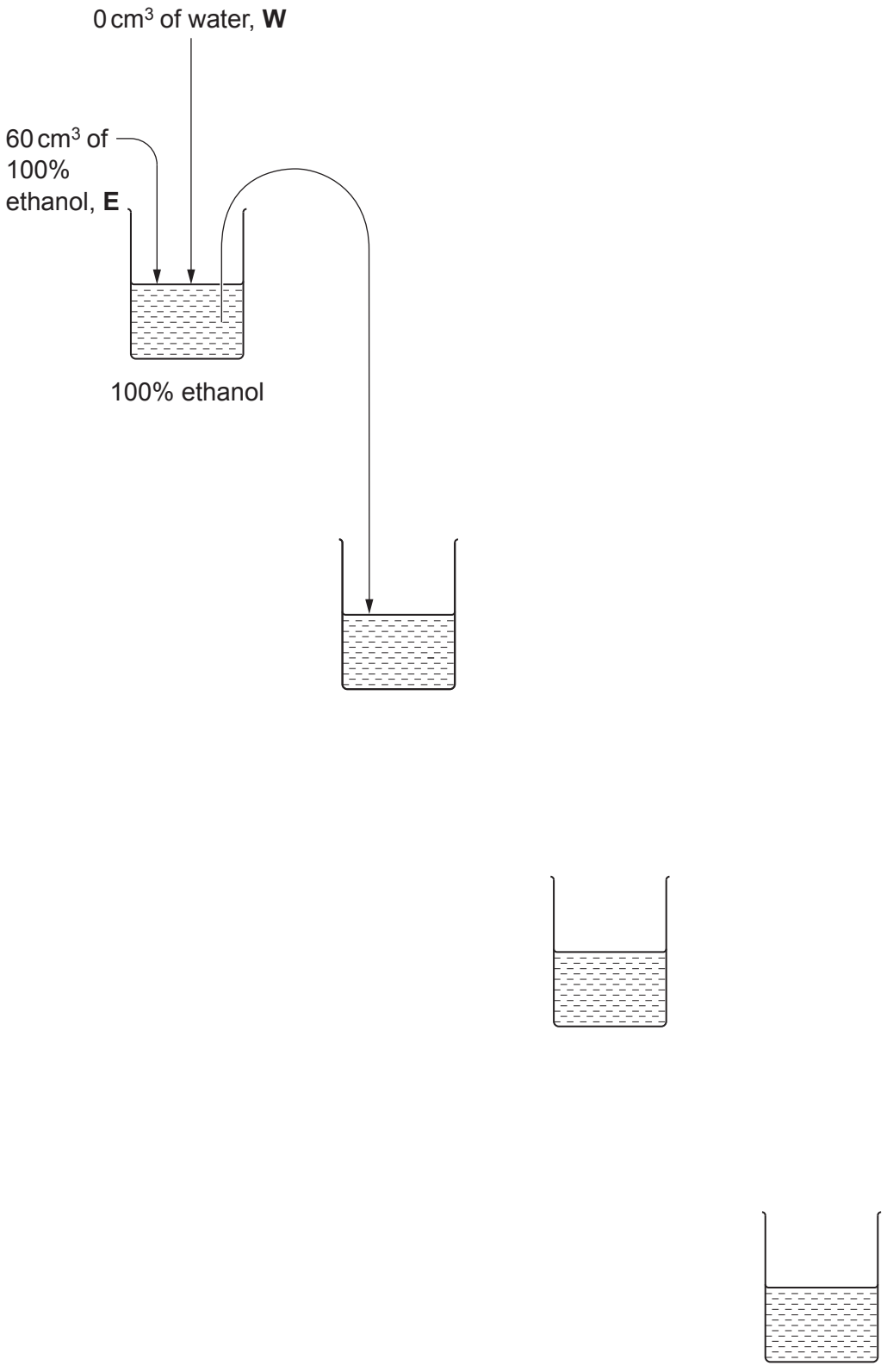


Fig. 1.2

[3]

Carry out step 8 to step 14.

step 8 Prepare the concentrations of ethanol as shown in Fig. 1.2.

step 9 Put **one** potato cylinder into each beaker. Start timing and leave for 5 minutes.

step 10 Label test-tubes with the ethanol concentrations prepared in step 8.

step 11 After 5 minutes (step 9), remove the potato cylinders from the beakers and put them into the appropriately labelled test-tubes.

step 12 Put 5 cm^3 of hydrogen peroxide solution into the test-tube labelled **100**. Immediately start timing.

step 13 Measure the height of the foam after 1 minute **and** after 2 minutes. Record the results in **(a)(iii)**.

step 14 Repeat step 12 and step 13 with the potato cylinders in each of the other test-tubes.

(iii) Record your results in an appropriate table. Include the results recorded in step 7.

[5]

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(iv) Calculate the rate at which the foam was produced at 1 minute **and** at 2 minutes for **100%** ethanol, **E**.

Show your working.

Include the unit in your answer.

rate at 1 minute = ...

rate at 2 minutes = ...
[1]

(v) Use your results in **(a)(iv)** to describe how the rate changes with time.

.....

.....

..... [1]

(vi) With reference to the activity of catalase, explain why the results of **0** (step 7) were important in this investigation.

.....

.....

..... [1]

(vii) State the dependent variable in this investigation.

..... [1]

(viii) Suggest **two** improvements to the investigation you have carried out to increase the confidence in your results.

1 .....

.....

.....

2 .....

.....

.....

[2]

(b) Some fruits turn brown when they are cut into slices for eating. This browning can make the fruit less appealing to eat and difficult to sell.

The enzyme polyphenol oxidase (PPO) catalyses an oxidation reaction when fruit is cut, causing the fruit tissue to turn brown.

Scientists carried out an investigation to see how exposing wampee fruits to different concentrations of ethanol affected the activity of PPO in the fruit tissue.

A large sample of wampee fruits was divided into five equal groups. Each group of fruit was sealed in a plastic container and treated with a different concentration of ethanol.

After a short time in storage, the activity of the enzyme PPO in the wampee fruit tissue was recorded.

The results are shown in Table 1.2.

Table 1.2

concentration of ethanol / $\mu dm^3\ dm^{-3}$	**PPO activity / arbitrary units**
0	2.20
100	1.40
200	0.95
400	0.70
500	0.60

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

Use a sharp pencil.

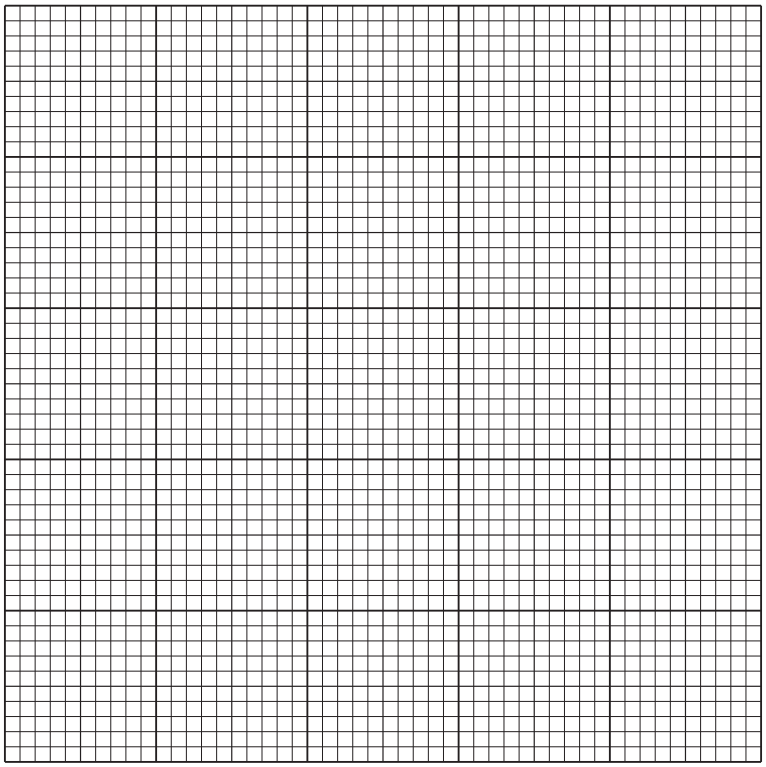


Fig. 1.3

[4]

(ii) Suggest an explanation for the pattern shown in the data.

.....

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 21]

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

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

Use a sharp pencil.

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

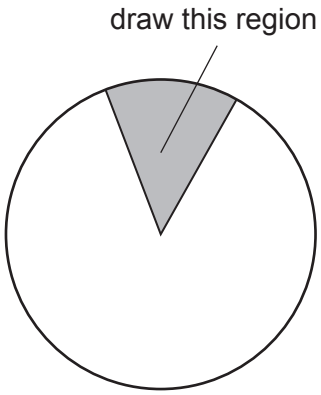


Fig. 2.1

[5]

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

Select a group of four adjacent cells.

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

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

[5]

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

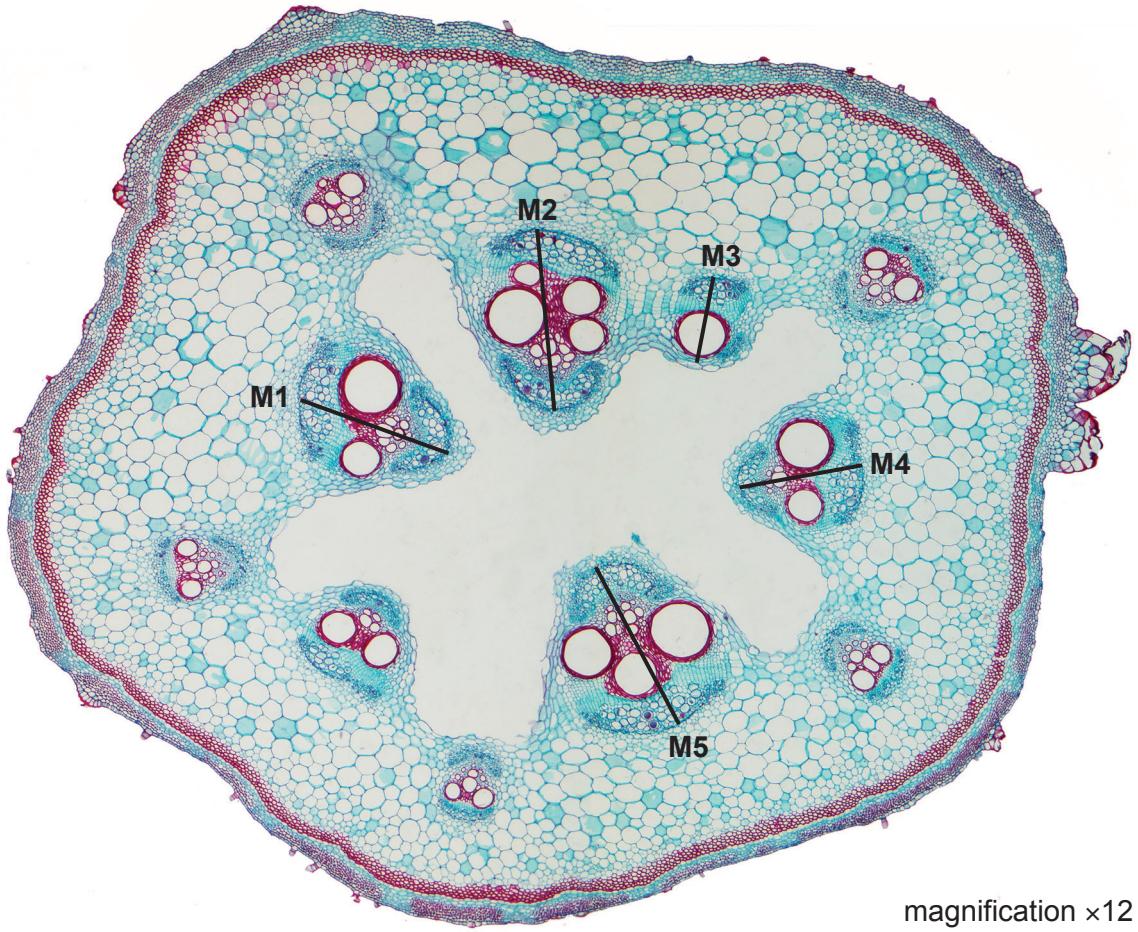


Fig. 2.2

(i) Measure the length of the vascular bundles using the lines **M1**, **M2**, **M3**, **M4** and **M5** in Fig. 2.2 **and** calculate the mean actual length of the vascular bundles.

Show your working.

M1 = **M2 =** **M3 =** **M4 =** **M5 =**

mean actual length ..... [4]

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(ii) A student suggested that the mean actual length of the vascular bundles calculated in **(b)(i)** was not accurate for the whole plant.

Describe **two** modifications to the method used in **(b)(i)** that would allow a more accurate mean length of the vascular bundles for the whole plant to be calculated.

1 .....

.....

.....

2 .....

.....

.....

[1]

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



Fig. 2.3

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Identify **three** observable differences, other than colour, between the stem section on **K1** and the stem section in Fig. 2.3.

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

[4]

[Total: 19]

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Cambridge International AS & A Level

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 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.
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1 Vegetables, such as carrots, contain sugars.

Potassium manganate(VII) solution can be used to identify the presence of sugars.

The sugars change the colour of the potassium manganate(VII) solution from purple to colourless.

You will measure the time taken for potassium manganate(VII) solution to turn colourless with sugar solutions of known concentration. You will use the results to estimate the concentration of sugars in a carrot extract.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
S	1.0 mol dm^{-3} sugar solution	none	40
W	distilled water	none	40
A	sulfuric acid	harmful irritant	20
K	potassium manganate(VII) solution	irritant	20
C	carrot extract	none	10

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

It is recommended that you wear suitable eye protection and wear gloves to protect your hands when using **A** and **K**.

You will need to:

- prepare different concentrations of sugar solution
- record the time taken for **K** to become colourless (end-point) for each of the different concentrations of sugar solution **and** for the carrot extract, **C**
- use your results to estimate the concentration of sugars in the carrot extract, **C**.

You will need to use **proportional** dilution to make five different concentrations of sugar solution.

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

Table 1.2 shows **two** of the concentrations of sugar solution you will use and how to prepare them.

Decide which **three** other concentrations of sugar solution you will use.

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

Table 1.2

concentration of sugar solution / mol dm^{-3}	volume of S / cm^3	volume of W / cm^3
1.0	10.0	0.0
0.0	0.0	10.0

[2]

Carry out step 1 to step 11.

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

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

step 3 Put 1 cm^3 of 1.0 mol dm^{-3} sugar solution into the appropriately labelled test-tube.

step 4 Repeat step 3 with each of the other concentrations of sugar solution.

step 5 Put 1 cm^3 of **A** into each of the test-tubes. Shake gently to mix.

The reaction will start as soon as you put **K** into the test-tubes (step 6). Keep the timer running continuously until the end of step 7.

step 6 Put 1 cm^3 of **K** into each of the test-tubes and start timing. Shake gently to mix.

step 7 Measure the time taken for each concentration to reach the end-point. As each end-point is reached record the time taken in **(a)(ii)**.

If an end-point has not been reached after 600 seconds, record the time as 'more than 600'.

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(ii) Record your results in an appropriate table.

[5]

step 8 Label a test-tube **C** and put 1 cm^3 of **C** into this test-tube.

step 9 Put 1 cm^3 of **A** into the test-tube. Shake gently to mix.

step 10 Put 1 cm^3 of **K** into the test-tube and start timing. Shake gently to mix.

step 11 Measure the time taken to reach the end-point. Record the time taken in **(a)(iii)**.

(iii) State the time taken to reach the end-point for **C**.

time taken ..... [1]

(iv) Estimate the concentration of sugars in **C**.

concentration of sugars in **C** ..... $mol\,dm^{-3}$ [1]

(v) Suggest how the procedure could be modified to improve the accuracy of your estimate in **(a)(iv)**.

.....

.....

.....

.....

.....

.....

..... [3]

DO NOT WRITE IN THIS MARGIN

(vi) A student used the same procedure to compare the concentration of sugars in three vegetables: carrot, potato and onion.

State **one** variable that needs to be standardised in the procedure.

.....

..... [1]

(vii) Suggest how the student could extend this investigation to estimate the concentration of **starch** in a vegetable extract.

.....

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.....

.....

..... [2]

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(b) Bananas produce ethylene gas which causes them to ripen. The production of ethylene gas continues after the bananas are removed from the plant (harvested).

The ethylene gas decreases the post-harvest life of the bananas. The post-harvest life is the time after harvesting when the bananas are suitable to eat.

Potassium manganate(VII) can be used to increase the post-harvest life of the bananas by oxidising the ethylene gas to form water and carbon dioxide.

An experiment was carried out to determine the effect of different quantities of potassium manganate(VII) on the post-harvest life of bananas.

The results are shown in Table 1.3.

Table 1.3

mass of potassium manganate(VII) / g	mean post-harvest life / days
0	9.30
2	11.25
4	12.60
6	13.65
8	11.45

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

Use a sharp pencil.

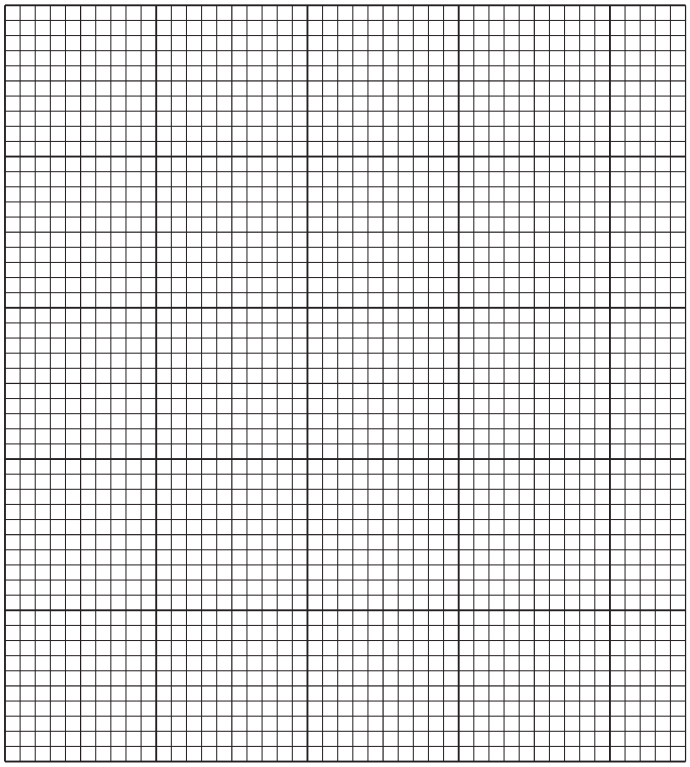


Fig. 1.1

[4]

(ii) Use your graph in Fig. 1.1 to predict the post-harvest life of bananas if the mass of potassium manganate(VII) is 6.8 g.

Show on your graph how you obtained your answer.

post-harvest life of bananas = ... days [2]

(iii) Suggest why the post-harvest life of bananas decreases when more than 6 g of potassium manganate(VII) is used.

.....

..... [1]

[Total: 22]

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

(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 endodermis.

[5]

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(ii) Observe the epidermis of the root on **L1** and the layer of cells beneath.

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

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

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

[5]

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(b) Fig. 2.1 is a photomicrograph of a stained transverse section through a different plant.

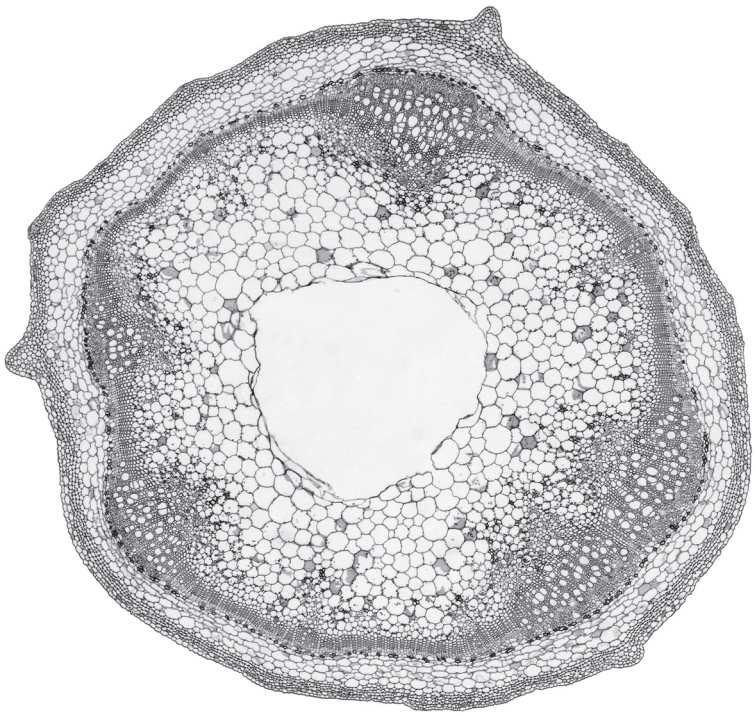


Fig. 2.1

Identify **three** observable differences, other than colour, between the section on **L1** and the section in Fig. 2.1.

Record these **three** observable differences 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.

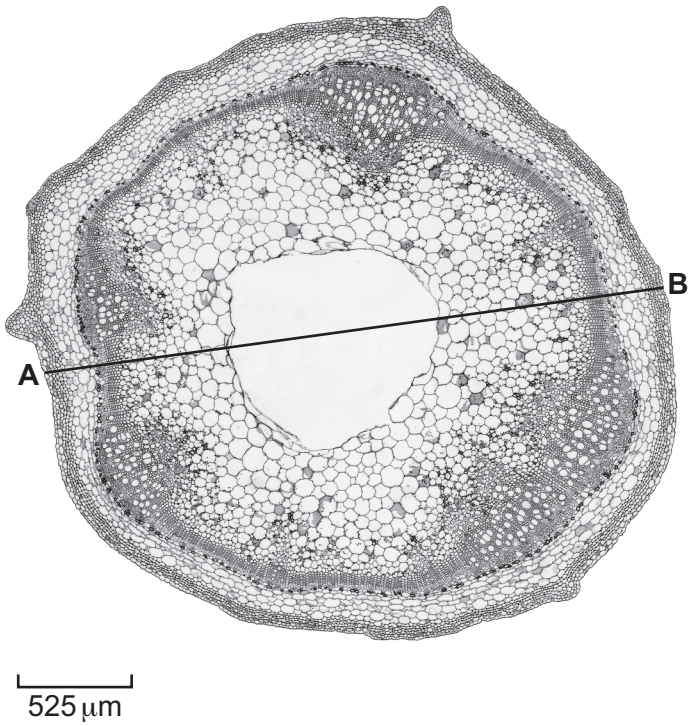


Fig. 2.2

Use the scale bar on Fig. 2.2 and the line **A–B** to calculate the actual diameter of the section in Fig. 2.2.

Show your working, including units.

actual diameter = ... [4]

[Total: 18]

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7798341146

BIOLOGY **9700/35**

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

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1 The enzyme amylase catalyses the hydrolysis (breakdown) of starch to reducing sugars, as shown in Fig. 1.1.



Fig. 1.1

A student investigated the effect of temperature on the hydrolysis of starch by the enzyme amylase.

The student:

- put 2 cm^3 of amylase into a test-tube
- put 18 cm^3 of starch solution into a different test-tube
- put the test-tubes into a water-bath at 0 °C
- left the test-tubes for 3 minutes
- put the starch solution into the test-tube containing the amylase
- left the test-tube for 2 minutes
- immediately determined the relative amount of reducing sugars in the test-tube
- repeated this procedure at 40 °C and at 100 °C.

You are provided with three beakers, **S1**, **S2** and **S3**. These three beakers contain the same products of the reaction between starch and amylase as the test-tubes prepared by the student.

You will determine:

- the relative amount of reducing sugar present in each beaker
- the presence or absence of starch in each beaker.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	**contents**	**hazard**	**volume / cm^3**
S1	products of the reaction between starch and amylase at 0 °C	none	20
S2	products of the reaction between starch and amylase at 40 °C	none	20
S3	products of the reaction between starch and amylase at 100 °C	none	20
U	products of the reaction between starch and amylase at an unknown temperature	none	20
B	Benedict's solution	irritant	30
iodine	iodine solution	irritant	15

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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To investigate the effect of temperature on the hydrolysis of starch by the enzyme amylase you will need to:

- carry out the test for reducing sugars on **S1**, **S2** and **S3**
- determine the relative amount of reducing sugar in each solution
- carry out the test for starch on **S1**, **S2**, and **S3**
- determine the presence or absence of starch in each solution.

(a) (i) Explain why the student left the test-tubes in the water-bath for 3 minutes before adding the starch solution.

.....

..... [1]

To determine the relative amount of reducing sugar in each solution, the time to the first colour change will be measured using 5 cm^3 of each solution.

(ii) Decide how you will test each solution to show the relative amount of reducing sugar present.

State the reagent you will use.

reagent .....

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

.....

.....

.....

State how you will determine which solution has the **highest amount** of reducing sugar present.

.....
[2]

Carry out step 1 to step 5.

step 1 Label one test-tube, **S1**.

step 2 Put 5 cm^3 of **S1** into the test-tube.

step 3 Repeat step 1 and step 2 for **S2** and **S3**.

step 4 Carry out the test for reducing sugars as you described in **(a)(ii)**.

If the time taken to the first colour change is longer than 120 seconds then record as 'more than 120'.

step 5 Record in **(a)(iv)** the time taken to the first colour change for each solution.

Carry out step 6 to step 11 to test for the presence of starch.

step 6 Label a clean test-tube, **S1**.

step 7 Put 5 cm^3 of **S1** into the test-tube.

step 8 Repeat step 6 and step 7 for **S2** and **S3**.

step 9 Put 2 drops of iodine solution into each test-tube. Shake gently to mix.

If any starch is present the solution will change to a blue colour.

step 10 Observe the colour in each test-tube.

step 11 Record in **(a)(iv)** the colour for each solution.

(iii) State the independent variable in this investigation.

..... [1]

(iv) Record your results in an appropriate table.

[4]

(v) Complete Table 1.2 using your results in **(a)(iv)**.

For reducing sugar content use only the words: **none**, **low**, **medium** or **high**.

For presence of starch use only the words: **present** or **absent**.

You may use each word once, more than once or not at all.

Table 1.2

	reducing sugar content	**presence of starch**
S1	.....	.....
S2	.....	.....
S3	.....	.....

[2]

(vi) Explain the results for **S1**, **S2** and **S3**.

.....

.....

.....

.....

.....

..... [3]

U contains the products of the reaction between starch and amylase solution in a water-bath at an unknown temperature.

You need to:

- carry out the test for reducing sugars and the test for starch on **U**
- compare the results for **U** with the results for **S1**, **S2** and **S3**
- estimate the temperature of the water-bath used for **U**.

Carry out step 12 and step 13.

step 12 Repeat the test for reducing sugars and the test for starch on **U**.

step 13 Record your results in **(a)(vii)**.

(vii) Record the result of the test for reducing sugars for **U**.

time taken to first colour change ..... s

Record the result of the test for starch for **U**.

colour .....
[1]

(viii) Use your results in **(a)(iv)** and **(a)(vii)** to estimate the temperature of the water-bath used for **U**.

temperature of water-bath ..... °C [1]

(ix) Describe how the student could obtain a **quantitative** estimate of the concentration of reducing sugar in a solution.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) A student investigated the effect of temperature on the action of an enzyme that digests protein.

The results are shown in Table 1.3.

Table 1.3

temperature / °C	rate of reaction / arbitrary units
20	8
25	46
30	74
40	59
45	42

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

Use a sharp pencil.

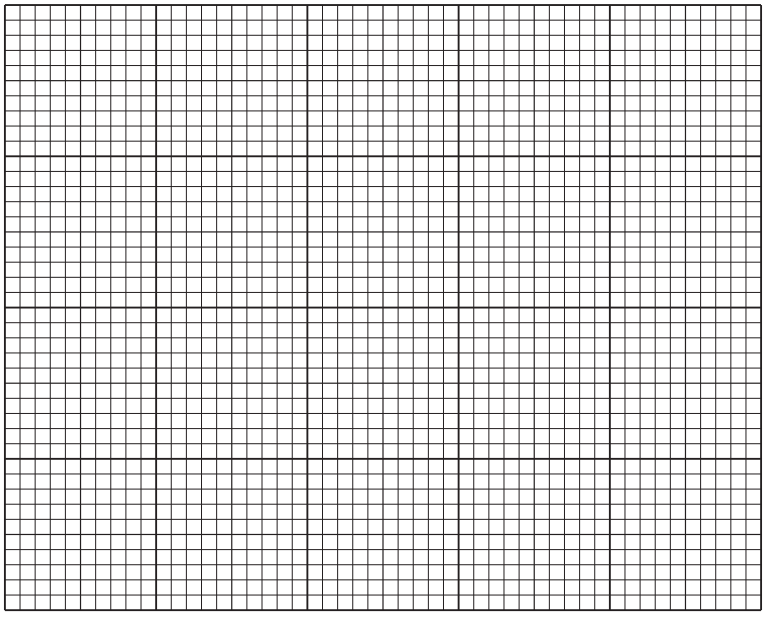


Fig. 1.2

[4]

[Total: 23]

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

(a) **(i)** Draw a large plan diagram of the whole section on **M1**.

Use a sharp pencil.

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

[5]

(ii) Observe the upper epidermis of the leaf on **M1** and the layer of cells beneath it. The large bulge on the mid-rib is located on the upper epidermis.

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

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

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

Use a sharp pencil.

[6]

(b) Fig. 2.1 is a photomicrograph of a stained transverse section of a different leaf from **M1**.

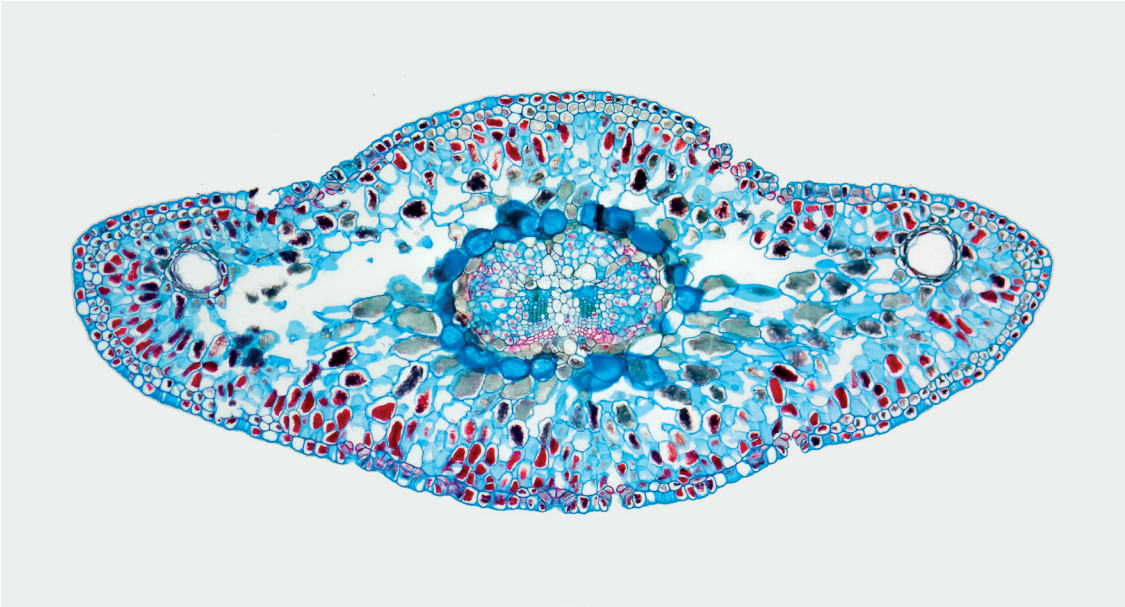


Fig. 2.1

Identify **three** observable differences, other than colour, between the leaf section on **M1** and the leaf section in Fig. 2.1.

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

Table 2.1

feature	M1	Fig. 2.1

[3]

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

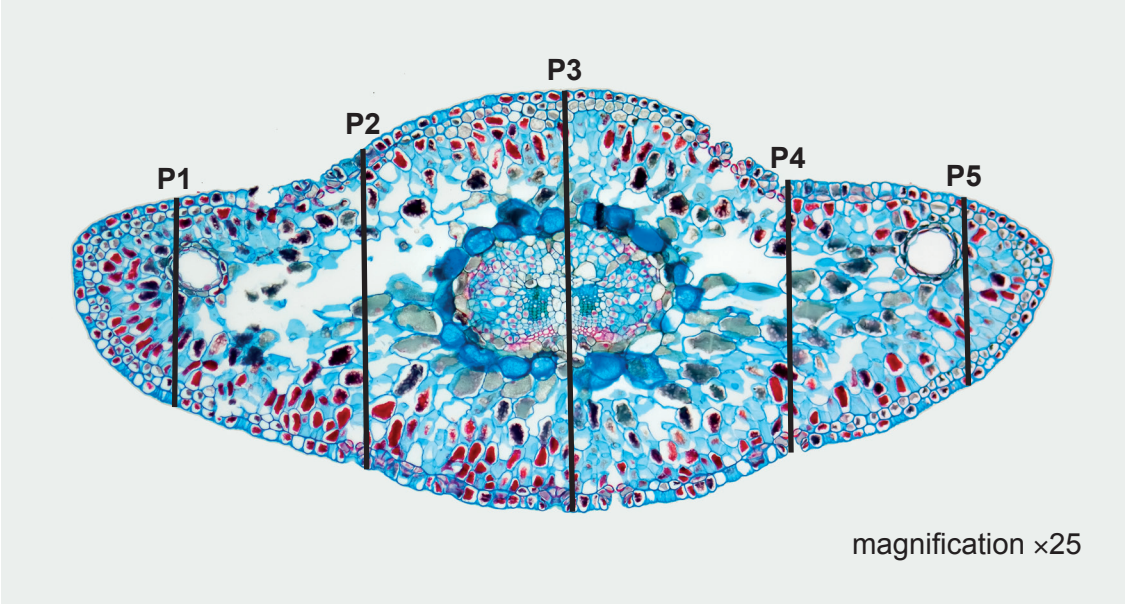


Fig. 2.2

Measure the thickness of the leaf using the lines **P1**, **P2**, **P3**, **P4** and **P5** in Fig. 2.2 and calculate the mean length of the lines.

Show your working, including units.

P1 = **P2 =** **P3 =** **P4 =** **P5 =**

mean length of lines = ...

Using the magnification and the mean length of lines, calculate the actual mean thickness of the leaf.

actual mean thickness = ...

[3]

[Total: 17]

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BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 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 Blood plasma contains soluble proteins such as albumin.

Albumin can be separated from blood plasma and used in medical treatments.

When the pH changes, soluble proteins become insoluble and form large clumps. This is known as precipitation.

You will investigate the effect of different concentrations of hydrochloric acid on the precipitation of proteins.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	2.0 mol dm^{-3} hydrochloric acid	irritant	30
P	protein solution	none	15
W	distilled water	none	30

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:

- prepare different concentrations of hydrochloric acid
- observe the effect of the different concentrations of hydrochloric acid on the precipitation of a protein solution at 0, 5 and 10 minutes.

You will need to use **proportional** dilution to make five different concentrations of hydrochloric acid.

You will need to prepare 5 cm^3 of each concentration, using **H** and **W**.

Table 1.2 shows two of the concentrations of hydrochloric acid you will use and how to prepare **one** of the concentrations.

Decide which **three** other concentrations of hydrochloric acid you will use.

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

Table 1.2

concentration of hydrochloric acid / mol dm^{-3}	volume of H / cm^3	volume of W / cm^3
2.0	5.0	0.0
0.4		

[3]

Carry out step 1 to step 8.

step 1 Label five test-tubes with the concentrations of hydrochloric acid solution decided in **(a)(i)**.

step 2 Prepare the concentrations of hydrochloric acid as shown in Table 1.2, in the appropriately labelled test-tubes. Mix well.

You will be adding **P** to the different concentrations of hydrochloric acid to form a white precipitate.

The solution becomes cloudier as more proteins precipitate, as shown in Fig. 1.1.

clear ⟶ cloudy

soluble proteins precipitated proteins

Fig. 1.1

You will need to record how cloudy each solution appears.

(ii) Decide on a key you will use to record your observations.

Complete Table 1.3 to show the key you will use.

Table 1.3

appearance	key
most cloudy	
clear	

[1]

You will be observing the appearance of the solutions in the test-tubes. You may use a piece of black card behind the test-tubes to help you to decide on the amount of precipitation of the solutions.

You may observe the same amount of precipitation in more than one test-tube.

step 3 Put 1 cm^3 of **P** into each of the test-tubes. Shake gently to mix.

step 4 Observe the appearance of the solutions in the test-tubes.

step 5 Record in **(a)(iii)** your observations using the key decided in **(a)(ii)**. This is your observation at 0 minutes.

step 6 Start timing.

step 7 Record in **(a)(iii)** your observations after 5 minutes.

step 8 Record in (**a)(iii)** your observations after 10 minutes.

(iii) Record your results in an appropriate table.

[5]

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(iv) State the trend in your results at 0 minutes.

.....

..... [1]

(v) With reference to your observations at 0, 5 and 10 minutes, describe the effect of concentration of hydrochloric acid on the **rate** of protein precipitation.

.....

.....

.....

.....

..... [2]

(vi) A possible source of error when adding **P** in step 3 is shown in Table 1.4.

Complete Table 1.4 by stating the type of error (systematic or random) **and** by stating the effect on the trend seen in the results at 0 minutes.

Table 1.4

source of error	systematic error or random error	effect on the trend
the 1.0 cm^3 mark on the syringe actually measured 1.05 cm^3		

[1]

(vii) Identify **one** source of error in the investigation other than the error stated in Table 1.4.

Suggest **one** modification to the procedure to reduce the effect of this error.

error .....

.....

modification .....

.....

.....

[2]

(b) A scientist identified the proteins present in a sample of blood plasma.

The quantity of each protein as a percentage of the total protein in the blood plasma is shown in Table 1.5.

Table 1.5

protein in blood plasma	percentage of total protein
albumin (A)	55.0
alpha globulin (AG)	12.5
beta globulin (BG)	16.5
gamma globulin (GG)	8.5
fibrinogen (F)	7.0

(i) Draw a bar chart of the data in Table 1.5 on the grid in Fig. 1.2.

Use a sharp pencil.

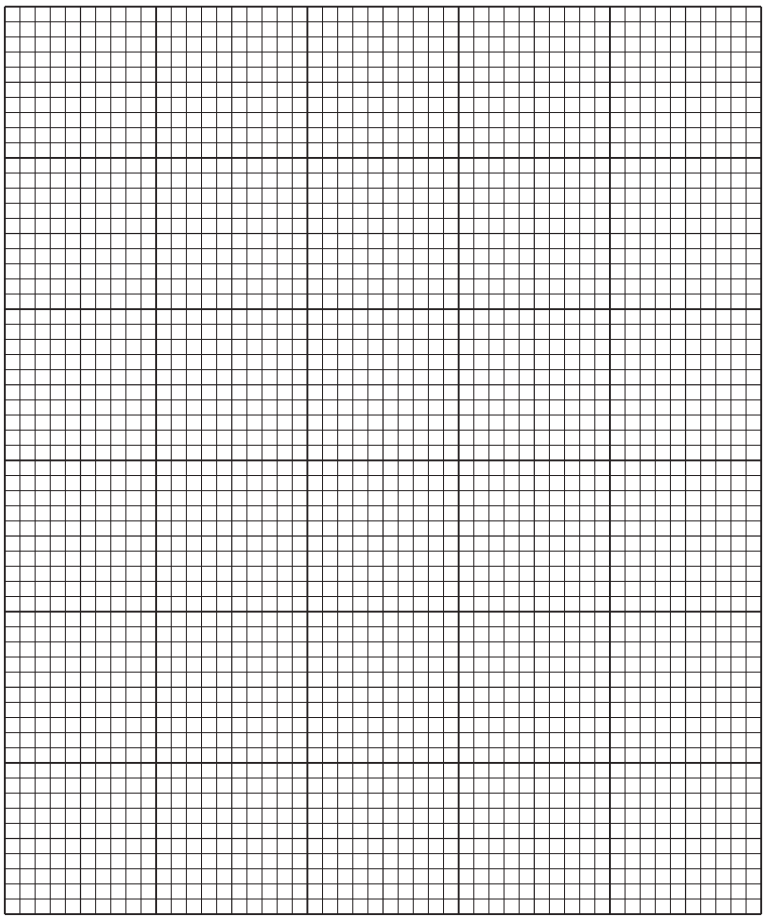


Fig. 1.2

[4]

(ii) The total protein concentration in the blood plasma is 70 mg cm^{-3}.

Calculate the concentration of globulin proteins in the blood plasma.

Show your working and give your answer to the appropriate number of significant figures.

concentration of globulin proteins = ...mg cm^{-3} [2]

[Total: 21]

2 Starch grains are present in plant cells. The starch grains have different sizes and shapes depending on the type of plant.

As the starch grains get larger, patterns form on the surface of the starch grains. These patterns can be observed using a microscope.

You are provided with samples from two different plants, **C** and **D**.

You will need to:

- prepare a microscope slide of starch grains from **C** and **D**
- observe the starch grains present on each microscope slide
- draw **two** starch grains from each sample.

Carry out step 1 to step 13.

step 1 Label one clean and dry microscope slide, **C**. Put the slide onto a paper towel.

step 2 Put sample **C** onto a white tile.

step 3 Cut a thin slice (approximately 1 mm) from the end of sample **C**.

step 4 Cut this slice into smaller pieces.

step 5 Put two drops of distilled water onto these small pieces.

step 6 Use a teat pipette to transfer drops of the liquid from around the small pieces prepared in step 5 onto the slide labelled **C**.

step 7 Put a coverslip over the liquid on slide **C**.

step 8 Use the microscope to observe the starch grains on slide **C**.

You may need to reduce the amount of light entering the microscope and will need to adjust the fine focus to observe the surface of the starch grains clearly.

step 9 Select **two** starch grains on slide **C** that show distinct circular patterns on their surface.

step 10 Make a large drawing of these **two** starch grains in **(a)(i)**.

step 11 Repeat step 1 to step 8 to carry out the same procedure for sample **D**.

step 12 Select **two** starch grains on slide **D** that show patterns on their surface that are **different** from those observed on slide **C**.

step 13 Make a large drawing of these **two** starch grains in **(a)(i)**.

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(a) (i) Make a large drawing of:

- **two** starch grains from slide **C**
- **two** starch grains from slide **D**.

Use a sharp pencil.

Slide **C**

Slide **D**

[5]

(ii) State the reagent that is used to test for starch and the colour that is produced if starch is present.

reagent .....

colour .....

[1]

(iii) Suggest why the starch grains get smaller as plants germinate.

.....

.....

..... [1]

(b) (i) **N1** is a slide of a stained transverse section through a leaf.

Draw a large plan diagram of the region of the leaf on **N1** indicated by the shaded area in Fig. 2.1. This region must include **two** vascular bundles.

Use a sharp pencil.

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

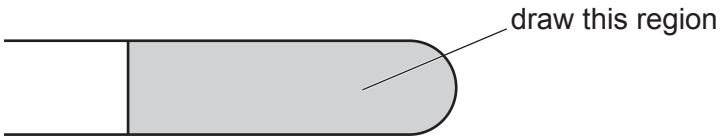


Fig. 2.1

[5]

(ii) Fig. 2.2 is a photomicrograph of part of a stained transverse section of a different leaf from **N1**.

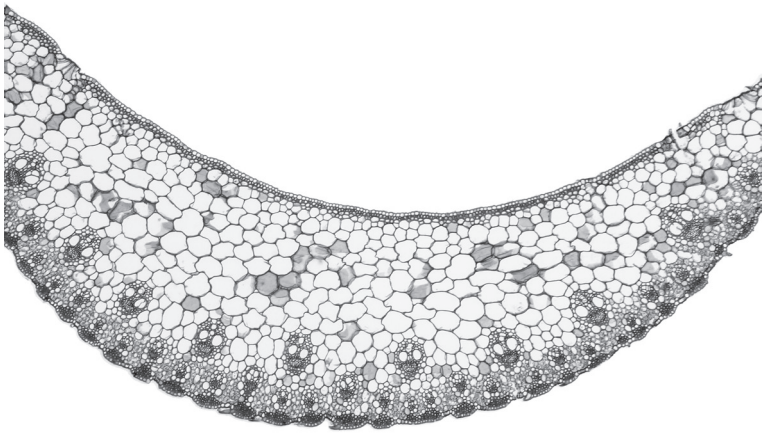


Fig. 2.2

Identify **three** observable differences, other than colour, between the section on **N1** and the section in Fig. 2.2.

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

Table 2.1

feature	N1	Fig. 2.2

[4]

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

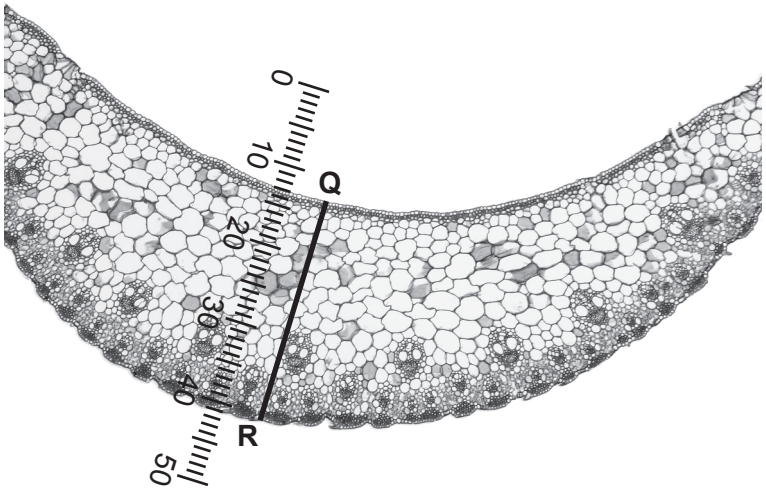


Fig. 2.3

An eyepiece graticule scale is shown on Fig. 2.3.

The calibration of the eyepiece graticule scale is:

1 eyepiece graticule division = 34 μm

Use the calibration of the eyepiece graticule to calculate the actual width of the section in Fig. 2.3 shown by the line **Q–R**.

Show your working.

actual width of leaf ..... [3]

[Total: 19]

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