Cambridge Assessment International Education

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BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

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

INFORMATION

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

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1	
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1 Yeast cells contain the enzyme catalase which catalyses the breakdown of hydrogen peroxide, releasing oxygen.

You will investigate the effect of pH on the activity of catalase in an extract from yeast cells.

You will need to immobilise the yeast cells in sodium alginate beads.

When a bead containing yeast cells is dropped into hydrogen peroxide solution the bead will sink. As oxygen is released the bead will rise. The more oxygen released, the faster the bead will rise.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast cell suspension	none	15
H	3.0% hydrogen peroxide solution	harmful irritant	30
S	sodium alginate solution	none	30
C	calcium chloride solution	none	30
B3	buffer pH 3	none	10
B4	buffer pH 4	none	10
B6	buffer pH 6	none	10
B7	buffer pH 7	none	10
B8	buffer pH 8	none	10

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

It is recommended that you wear suitable eye protection.

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[Turn over

Carry out step 1 to step 19.

step 1 Put 10 cm^3 of **C** into a large test-tube.

step 2 Put 5 cm^3 of **S** into a small beaker.

step 3 Stir **Y** and put 3 cm^3 of **Y** into the beaker used in step 2. Mix well.

step 4 Use a 5 cm^3 syringe to collect 2 cm^3 of the mixture of **S** and **Y** (prepared in step 3).

step 5 Position the 5 cm^3 syringe over the **large** test-tube containing **C** as shown in Fig. 1.1.

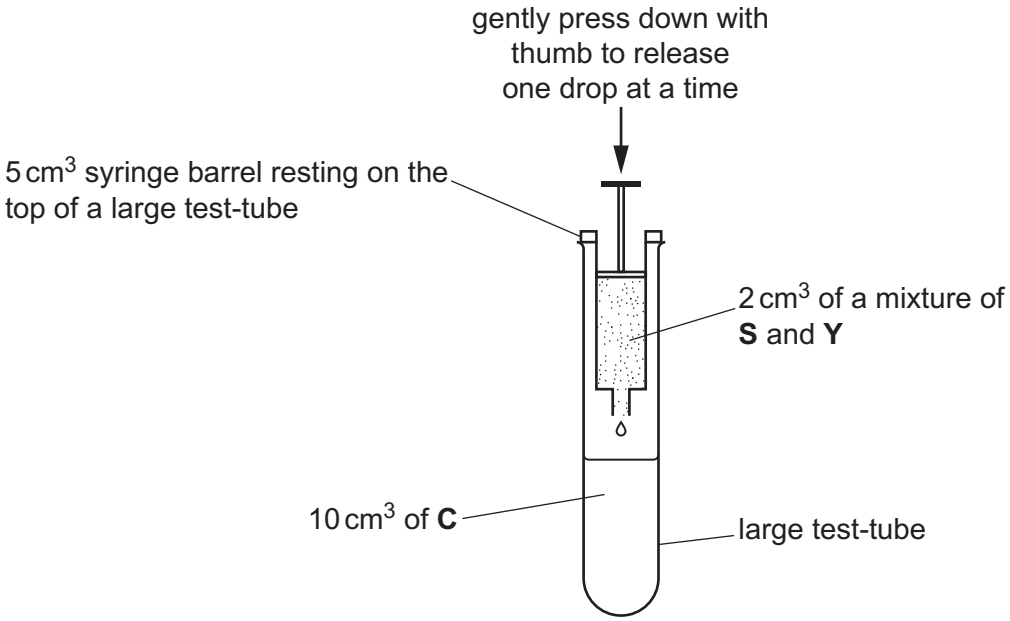


Fig. 1.1

step 6 Gently press down on the plunger of the 5 cm^3 syringe with your thumb to release **one** drop into solution **C**. The drop should form a bead.

step 7 Repeat step 6 until you have used all 2 cm^3 of the mixture.
Leave the beads in the solution **C** for 1 minute.

step 8 Tip the contents of the large test-tube from step 7 into a Petri dish.

step 9 Put **two** beads into each of the beakers containing pH buffers **B3**, **B4**, **B6**, **B7** and **B8**.

step 10 Label a **small** test-tube **B3**.

step 11 Put 3 cm^3 of the pH buffer **B3** into the test-tube labelled **B3**.

step 12 Put 3 cm^3 of hydrogen peroxide solution, **H**, into this test-tube and shake to mix. Leave this test-tube in a test-tube rack.

step 13 Pick up a bead from the pH buffer **B3** using blunt forceps.

step 14 Drop the bead into the test-tube from step 12. Start timing when the bead reaches the bottom of the test-tube.

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step 15 Time how long it takes for the bead to reach the surface of the liquid.
If the bead does not reach the surface after 60 seconds, stop timing and record as 'more than 60'.

step 16 Record the result from step 15 in **(a)(i)**.

step 17 Pick up the second bead from the pH buffer **B3** using blunt forceps.

step 18 Repeat step 14 to step 16.

step 19 Repeat step 10 to step 18 with the remaining pH buffers instead of **B3**.

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

[5]

(ii) State the independent variable in this investigation.

..... [1]

(iii) State **one** significant source of error in this investigation.

.....

.....

..... [1]

You will need to estimate the pH of the solution, **U**.

You are provided with **U**, as shown in Table 1.2.

Table 1.2

labelled	contents	hazard	volume / cm^3
U	solution of unknown pH	none	10

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

It is recommended that you wear suitable eye protection.

Carry out step 20 to step 27.

step 20 Put **one** bead into the beaker containing solution **U**.

step 21 Label a clean test-tube **U**.

step 22 Put 3 cm^3 of solution **U** into the test-tube labelled in step 21.

step 23 Put 3 cm^3 of hydrogen peroxide solution into this test-tube. Leave this test-tube in a test-tube rack.

step 24 Pick up the bead from the beaker containing solution **U**, using blunt forceps.

step 25 Drop the bead into the test-tube from step 23. Start timing when the bead reaches the bottom of the test-tube.

step 26 Time how long it takes for the bead to reach the surface of the liquid.
If the bead does not reach the surface after 60 seconds, stop timing and record as 'more than 60'.

step 27 Record the result from step 26 in **(a)(iv)**.

(iv) State the result for solution **U**.

result for solution **U** ..... [1]

(v) Using your results from **(a)(i)** and **(a)(iv)**, estimate the pH of solution **U**.

pH of solution **U** ..... [1]

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(vi) In the procedure described in step 1 to step 19, the effect of pH on catalase activity was investigated.

Describe how you would modify this procedure to investigate the effect of concentration of **substrate** on the time taken for the beads to rise.

.....

.....

.....

.....

..... [2]

(b) Immobilised enzymes are often used in industry. For example the enzyme lactase is used to produce lactose-free milk.

A student measured the initial rate of reaction of human lactase at different concentrations of lactose and plotted a graph, as shown in Fig. 1.2.

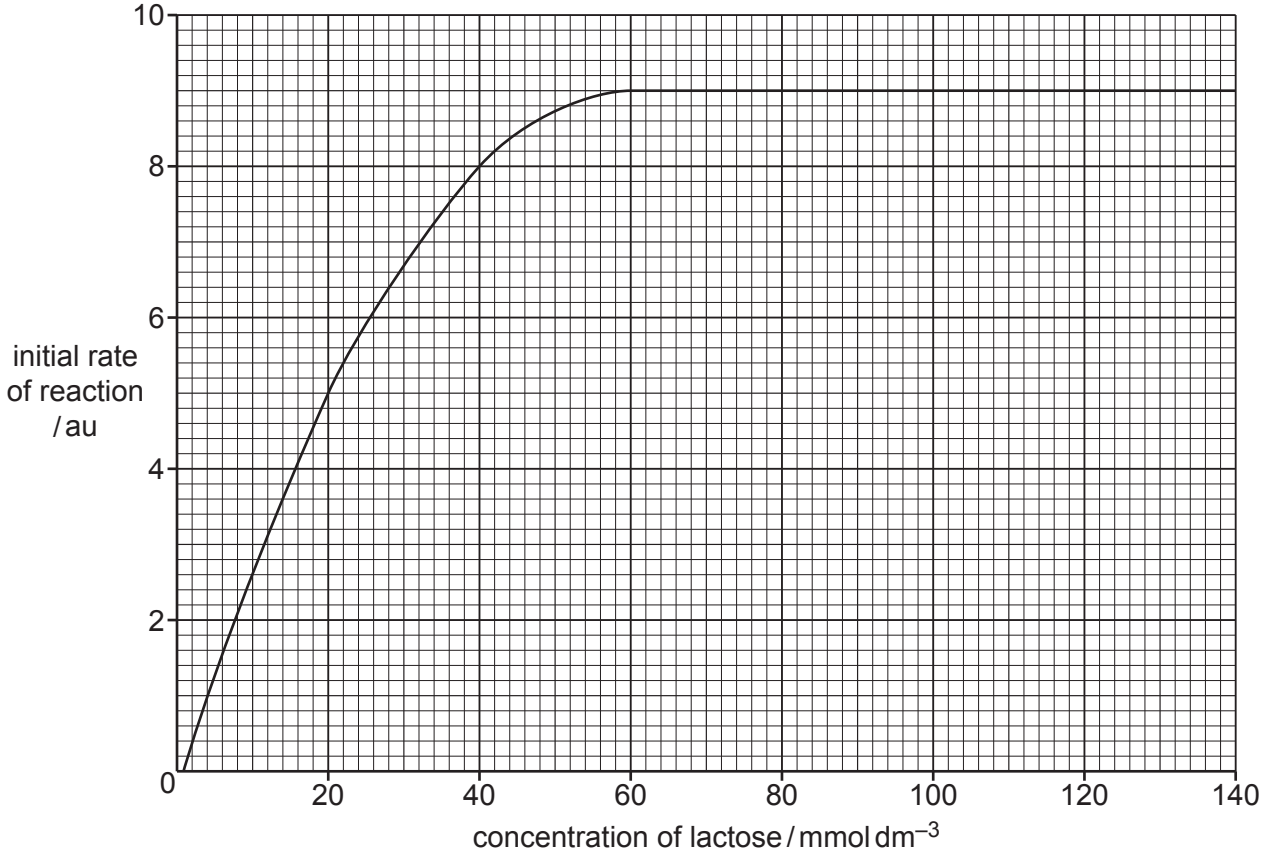


Fig. 1.2

(i) Explain the change in the initial rate of reaction between:

20 mmol dm^{-3} and 40 mmol dm^{-3} of lactose

.....

.....

.....

60 mmol dm^{-3} and 140 mmol dm^{-3} of lactose.

.....

.....

.....

.....

.....

[2]

(ii) Use the graph in Fig. 1.2 to estimate the Michaelis-Menten constant (K_m) of lactase.

Show your working **on the graph** in Fig. 1.2.

K_m = ... $mmol\,dm^{-3}$ [3]

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[Turn over

(c) Lactose is found in the milk of many mammals.

A scientist investigated the concentration of lactose in the milk of different mammals.

Table 1.3 shows the results of this investigation.

Table 1.3

type of mammal	concentration of lactose / mmol dm^{-3}
rabbit (RA)	60.0
seal (SE)	2.5
goat (GO)	137.5
sheep (SH)	150.0
horse (HO)	222.5

Plot a bar chart of the data shown in Table 1.3 on the grid in Fig. 1.3.

Use a sharp pencil.

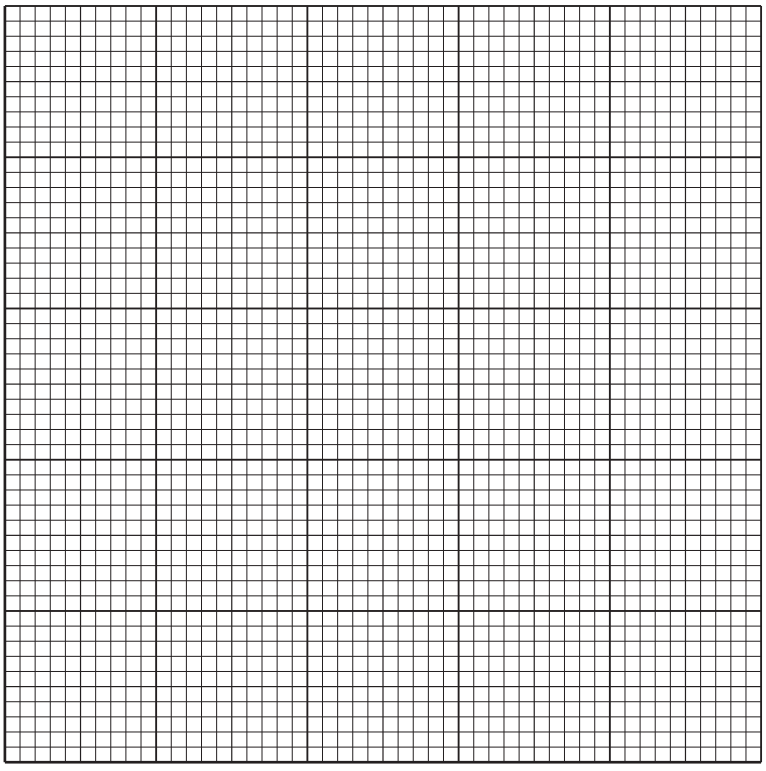


Fig. 1.3

[4]

[Total: 20]

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2 **J1** 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 **J1**, indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

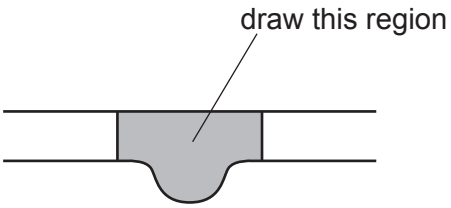


Fig. 2.1

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

[5]

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(ii) Observe the vascular tissue in the midrib on the section of the leaf on **J1**.

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

Each xylem vessel element must touch at least **two** other xylem vessel elements.

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

[5]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a different leaf.

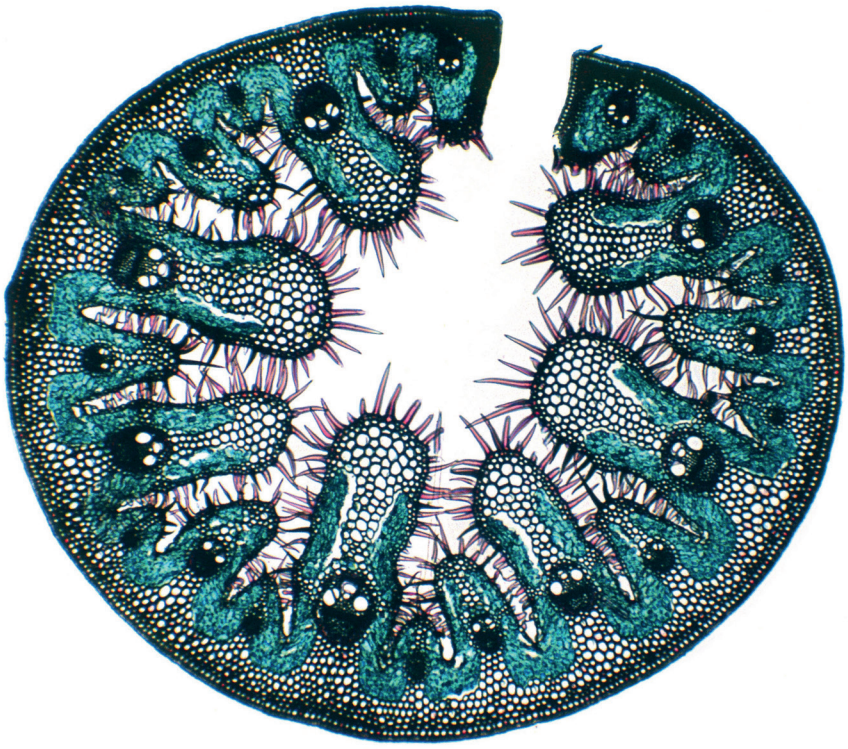


Fig. 2.2

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

Record these three observable differences in Table 2.1.

Table 2.1

feature	Fig. 2.2	J1

[4]

(ii) The leaf section shown in Fig. 2.2 is from a xerophytic plant which grows in sand dunes where there is very little water.

State **two** observable features of the leaf section shown in Fig. 2.2 which help the plant to survive in dry conditions. Explain how each feature allows the plant to survive in dry conditions.

feature 1 .....

explanation

.....

feature 2 .....

explanation

.....

[2]

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

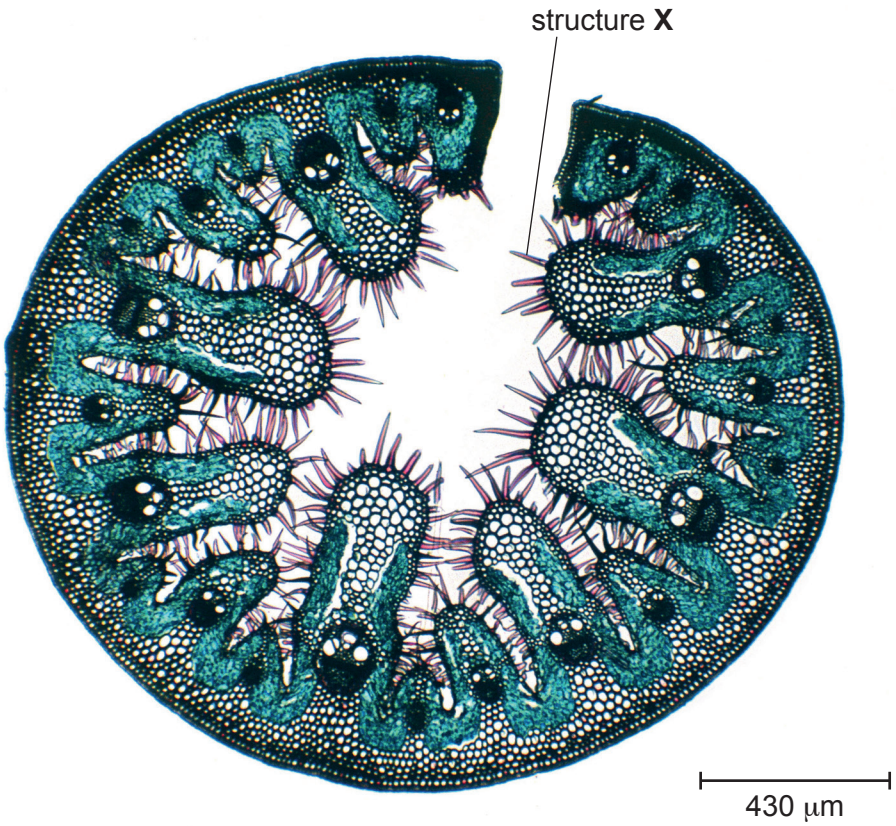


Fig. 2.3

Use the scale bar to calculate the actual length of structure **X**.

Show your working and use appropriate units.

actual length of structure **X** = ... [4]

[Total: 20]

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BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2023**

2 hours

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1 Grapes are fruit that contain high concentrations of soluble sugars such as sucrose, fructose and glucose.

The proportions of these sugars change as the grapes mature.

You will determine the concentration of reducing sugars in a sample of grape extract by using known concentrations of reducing sugar.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
G	grape extract	none	20
W	distilled water	none	100
B	Benedict's solution	harmful irritant	40
R	8.0% reducing sugar solution	none	40

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 carry out a serial dilution of the 8.0% reducing sugar solution, **R**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of reducing sugar in addition to 8.0% reducing sugar solution, **R**.

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

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

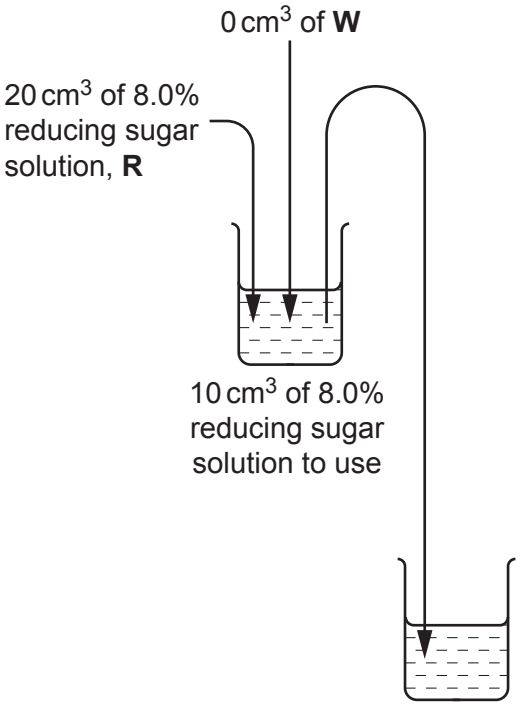
Fig. 1.1 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker, add labelled arrows to show:

- the volume of reducing sugar solution transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of reducing sugar solution.

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0 cm3 of W
20 cm3 of 8.0% reducing sugar solution, R
10 cm3 of 8.0% reducing sugar solution to use

.....

.....

.....

Fig. 1.1

[3]

Carry out step 1 to step 16.

step 1 Set up a water-bath and heat to boiling ready for step 6 and step 14.

step 2 Prepare the concentrations of reducing sugar solution as shown in Fig 1.1.

step 3 Label test-tubes with the concentrations shown in Fig. 1.1.

step 4 Put 2 cm^3 of the 8.0% reducing sugar solution into the appropriately labelled test-tube.

step 5 Put 2 cm^3 of Benedict's solution, **B**, into the same test-tube. Shake gently to mix.

step 6 Put this test-tube in the boiling water-bath. Start timing.

step 7 Measure the time taken to the first appearance of a colour change in the test-tube.

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

step 8 Record the result from step 7 in **1(a)(ii)**.

step 9 Remove the test-tube from the water-bath. Put the test-tube in the test-tube rack.

step 10 Repeat step 4 to step 9 with the remaining concentrations of reducing sugar solution.

(ii) Record your results in an appropriate table for the known concentrations of reducing sugar.

[5]

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(iii) Identify **one** source of error in step 7.

.....

.....

..... [1]

(iv) To determine the concentration of reducing sugar in grape extract **G**, you will need to test a sample of the extract.

State the volume of grape extract **G** that you will use to test for reducing sugars.

volume = ...

[1]

step 11 Label a test-tube **G**.

step 12 Transfer the volume of grape extract **G** that you stated in **(a)(iv)** into test-tube **G**.

step 13 Put $2\,cm^3$ of Benedict's solution, **B**, into the same test-tube. Shake gently to mix.

step 14 Put this test-tube in the boiling water-bath. Start timing.

step 15 Measure the time taken to the first appearance of a colour change in the test-tube.

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

step 16 Record the result from step 15 in **(a)(v)**.

(v) Record the time taken for the first colour change in test-tube **G**.

time taken = ... [1]

(vi) The concentration of reducing sugars in **G** can be estimated from a graph of your results.

Draw a graph of the results you recorded in **(a)(ii)** on the grid in Fig. 1.2, using a line of best fit.

The axes have been labelled for you.

Use a sharp pencil.

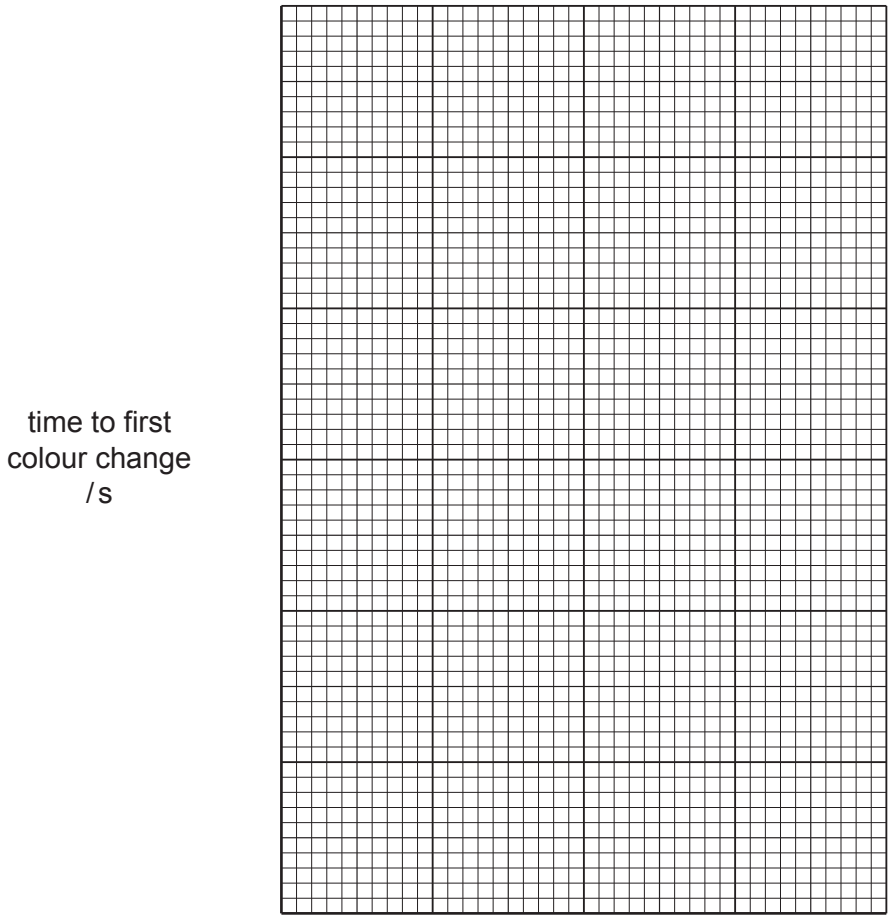


Fig. 1.2

[2]

(vii) Use your graph to estimate the percentage concentration of reducing sugars in **G**.

Show **on your graph** how you determined your answer.

percentage concentration of reducing sugars in **G** .....

[2]

(viii) Suggest how you would modify this investigation to obtain a more accurate estimate for the concentration of reducing sugars in sample **G**.

.....

.....

.....

..... [2]

(b) The concentration of reducing sugars in grapes changes as the grapes age (get older).

Table 1.2 shows the concentration of reducing sugars for grapes of different ages.

Table 1.2

age of grapes / days	percentage concentration of reducing sugars
14	1.1
28	1.9
42	2.6
56	3.9
70	7.5
84	11.3

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

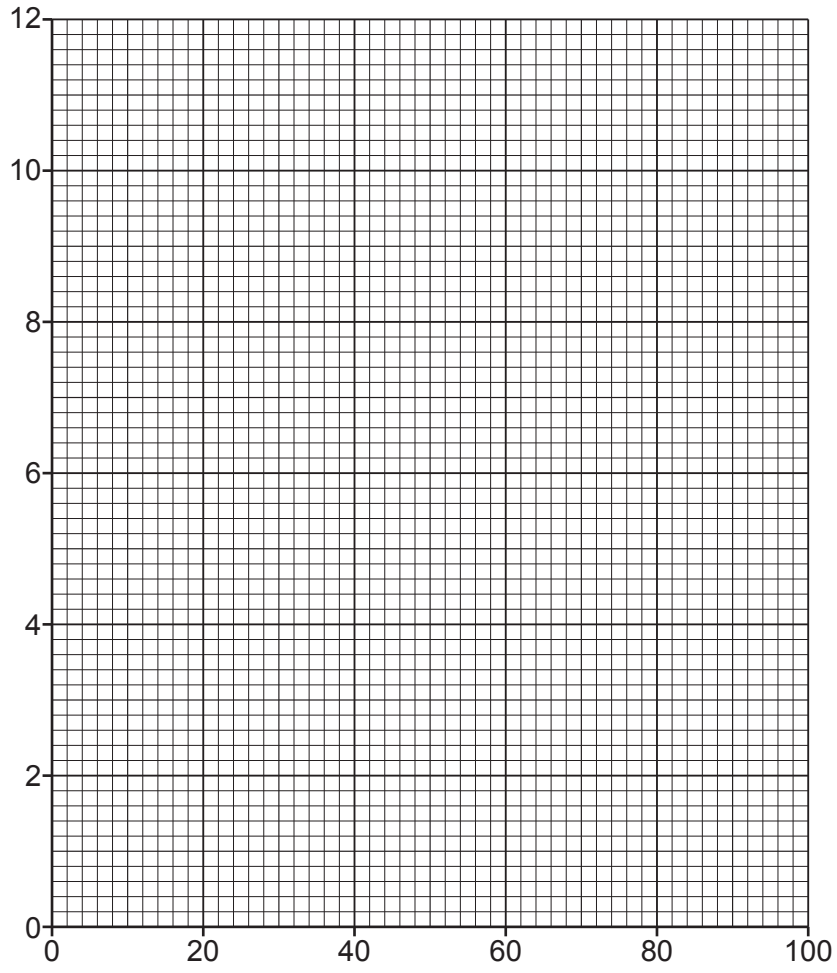


Fig. 1.3

[2]

(ii) Use your estimate from **(a)(vii)** and your graph in **(b)(i)** to estimate the age of the grapes that were used to make grape extract **G**.

age of grapes ..... days [1]

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(c) Grapes contain starch as well as reducing sugars. In a study, the concentration of amylase in grapes was measured as the grapes aged.

The results of the study are shown in Fig. 1.4.

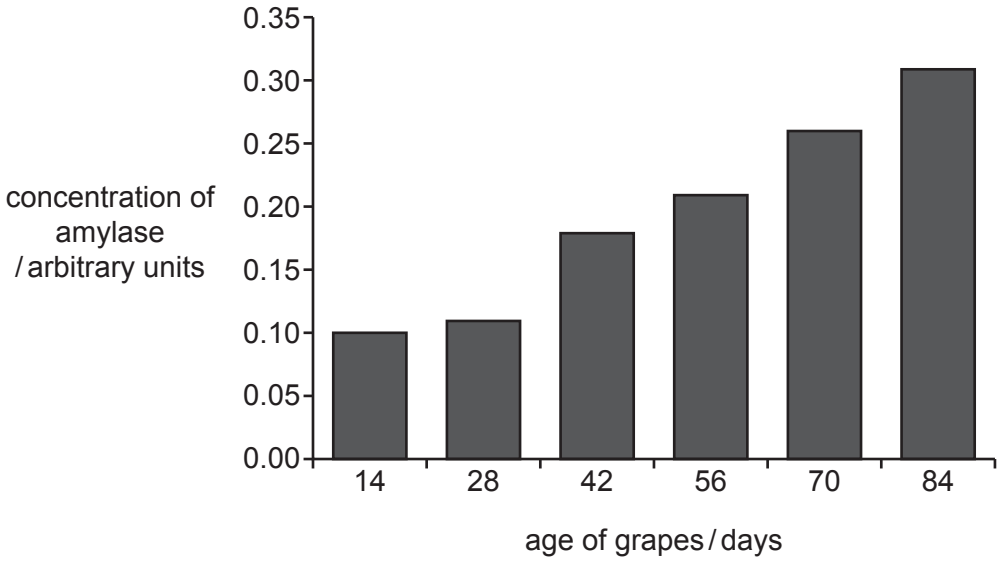


Fig. 1.4

Use the data in Fig. 1.3 and Fig. 1.4 to suggest a possible explanation for the change in the concentration of reducing sugars in grapes as they age.

.....

.....

.....

.....

.....

..... [3]

[Total 23]

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

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

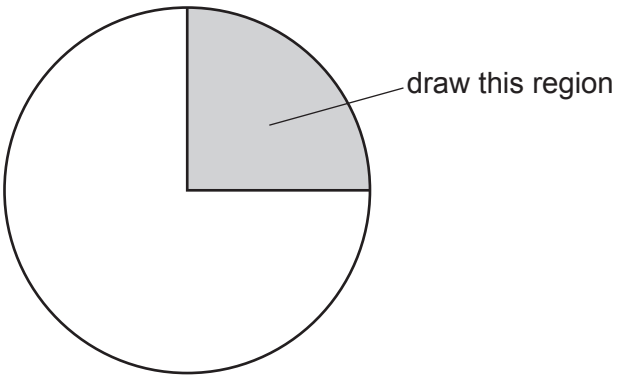


Fig. 2.1

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

[5]

(ii) Observe the xylem vessel elements in the root on **K1**.

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

Each xylem vessel element must touch at least **two** other xylem vessel elements.

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

[5]

(b) Fig. 2.2 shows a photomicrograph of a transverse section through a different root.

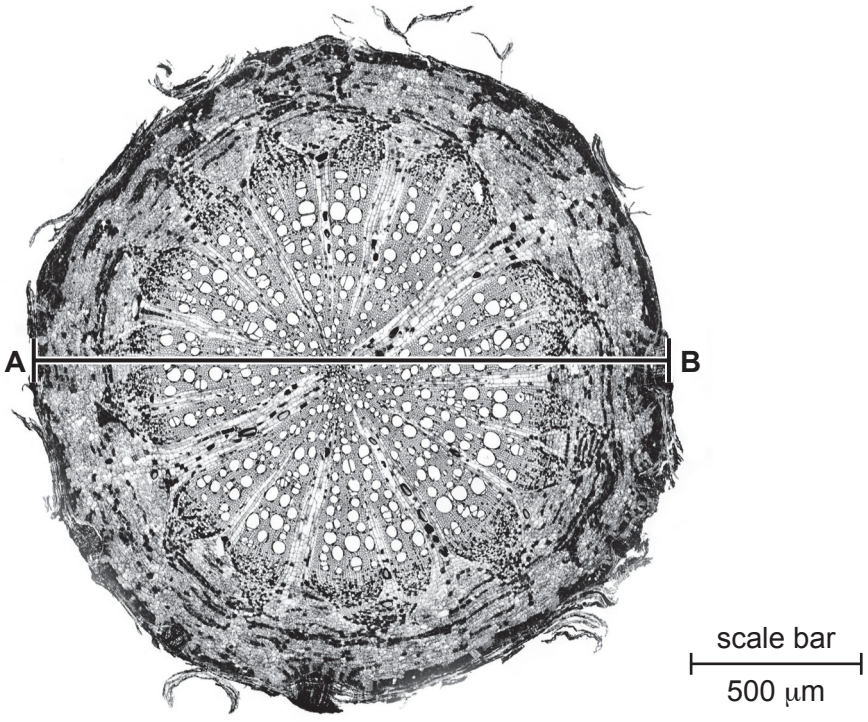


Fig. 2.2

(i) Identify **three** observable differences, other than colour, between the root section on **K1** and the root section in Fig. 2.2.

Record these observable differences in Table 2.1.

Table 2.1

feature	K1	Fig. 2.2
1		
2		
3		

[3]

(ii) Line **A**–**B** represents the diameter of the root in Fig. 2.2.

Use the scale bar on Fig. 2.2 to calculate the **actual diameter** of the root.

Show your working.

Include the unit in your answer.

actual diameter = ...
[3]

(iii) Use your value from **(b)(ii)** to calculate the magnification of Fig. 2.2.

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

magnification = × .....
[1]

[Total 17]

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Cambridge International AS & A Level

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

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1 When milk is dropped into a test-tube containing copper sulfate solution, the drop of milk sinks to the bottom of the test-tube. The speed at which the drop of milk sinks will depend on the amount of protein, fat and other solids that are present in the milk.

You will investigate the effect of different concentrations of milk on the time taken for the drop to sink to the bottom of the test-tube.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
C	copper sulfate solution	irritant	200
M	100% milk	none	50
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.

Carry out step 1 to step 3 to practise releasing one drop of **M** from a pipette.

step 1 Put some of **M** into a pipette.

step 2 Hold the pipette containing **M** over an empty test-tube, as shown in Fig. 1.1.
Squeeze the pipette gently to release **one** drop. It is important that the drop does **not** contain air bubbles.

step 3 Repeat step 2 until you can release **one** drop at a time.

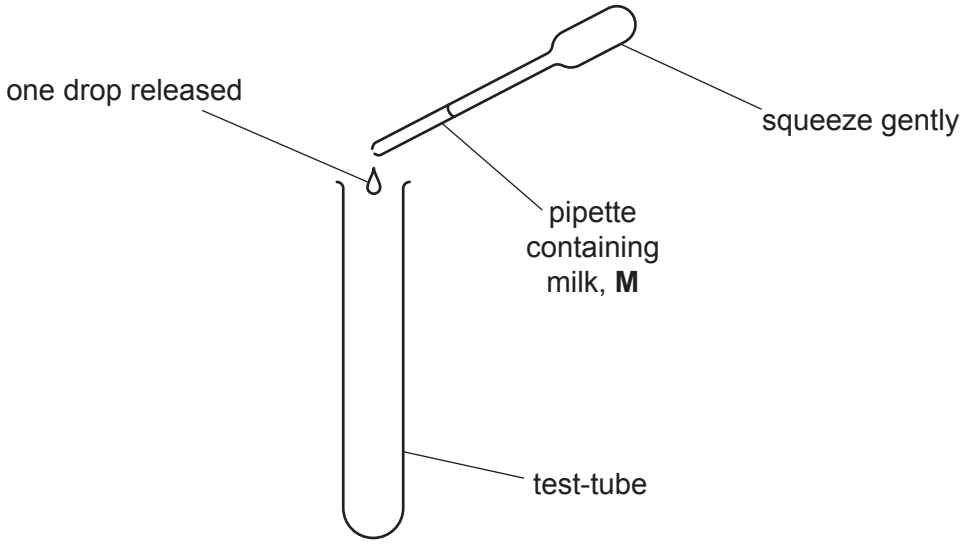


Fig. 1.1

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You will investigate the effect of different concentrations of milk on the time taken for **one** drop of milk to sink through copper sulfate solution.

You will need to:
- prepare different concentrations of milk
- record the time taken for **one** drop of each concentration of milk to sink through copper sulfate solution.

(a) You will need to use proportional dilution to make different concentrations of milk, **M**, between 95% and 55%.

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

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

Decide which other concentrations of milk you will use.

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

Table 1.2

percentage concentration of milk	volume of **M** / cm^3	volume of **W** / cm^3
95.0		
55.0	5.5	4.5

[2]

Carry out step 4 to step 14.

step 4 Prepare the concentrations of milk, shown in Table 1.2, in the beakers provided.

step 5 Draw a line 2 cm from the top of a clean, dry test-tube, as shown in Fig. 1.2.
You will start timing from this line in your investigation.

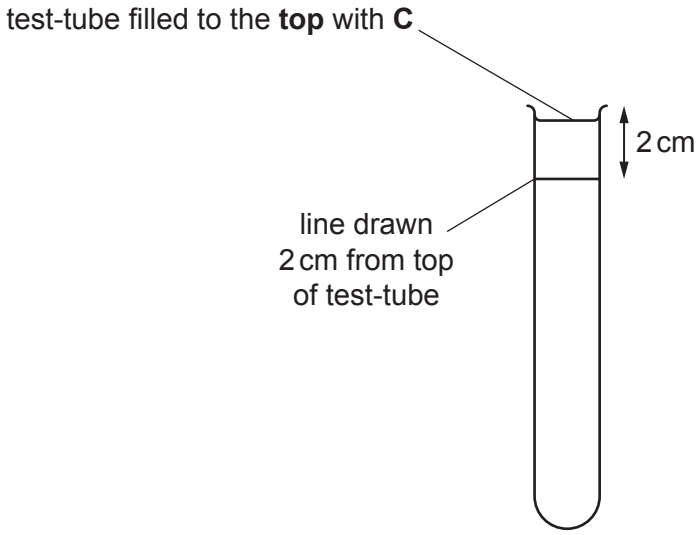


Fig. 1.2

step 6 Fill this test-tube with **C**, up to the top, as shown in Fig. 1.2.

step 7 Stir the 95% concentration of milk.

step 8 Put some of the 95% milk into a pipette.

step 9 Put **one** drop of 95% milk into the test-tube containing **C**, as shown in Fig. 1.3.
Start timing when the drop passes the line you have drawn.

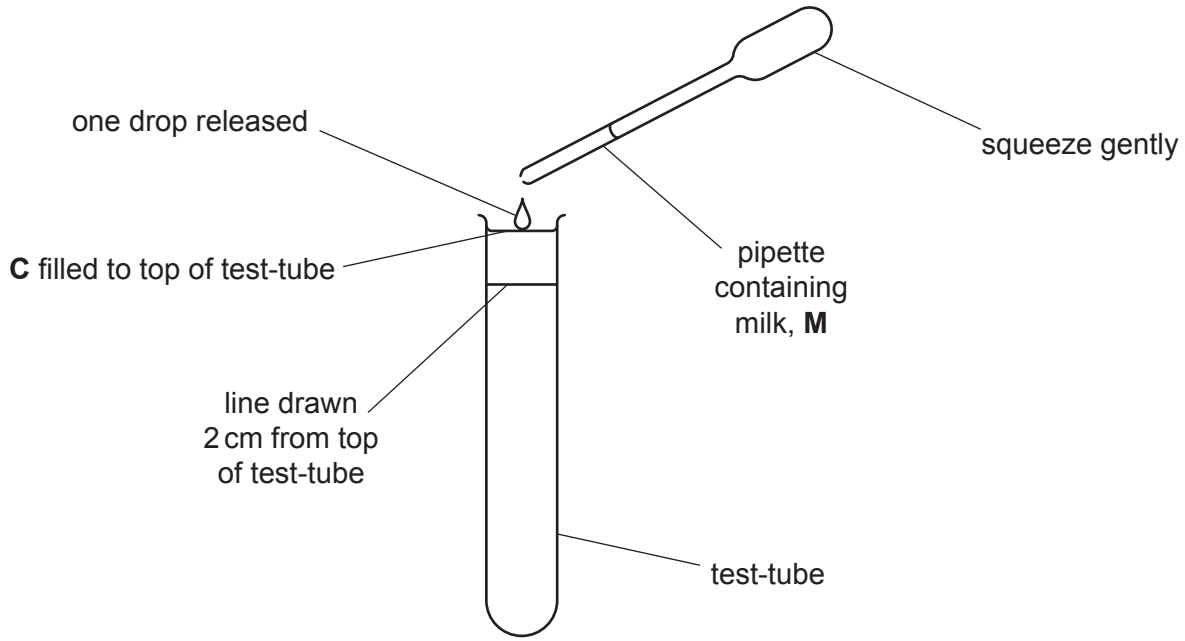


Fig. 1.3

step 10 Stop timing when the drop reaches the bottom of the test-tube.

If the drop has **not** reached the bottom of the test-tube after 120 seconds, stop timing and record 'more than 120'.

step 11 Record your result in **(a)(ii)**.

step 12 Carry out step 7 to step 10 as many times as you need, so that you are confident in your results for 95% milk. Remove any milk remaining at the surface of **C** with a pipette between each trial **and** add fresh **C** up to the top of the test-tube.

Record all your results in **(a)(ii)**.

step 13 When you are confident in your results for 95% milk, empty the contents of the test-tube into the container labelled **For waste** and rinse out the test-tube.

step 14 Repeat step 6 to step 13 for the other concentrations of milk you prepared in step 4.

(ii) Record your results in an appropriate table.

[5]

(iii) Describe the trend in your results in **(a)(ii)**.

.....

.....

..... [1]

(iv) Using Table 1.1 **and** step 4 to step 13, assess the risk of this procedure as **low**, **medium** or **high**. Give **one** reason for your answer.

risk .....

reason .....

.....

.....

[1]

(v) Complete Table 1.3 to identify **two** possible sources of error in this investigation **and** describe how you could improve the procedure to reduce the effect of each source of error.

Table 1.3

error	improvement

[4]

Turn over for Question **1(b)**.

(b) A student investigated the effect of temperature on the density of a milk sample.

The results from the investigation are shown in Table 1.4. The density of milk is shown in arbitrary units (au).

Table 1.4

temperature / °C	density of milk / au
5	34
10	33
20	31
25	26
30	24
35	21

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

Use a sharp pencil.

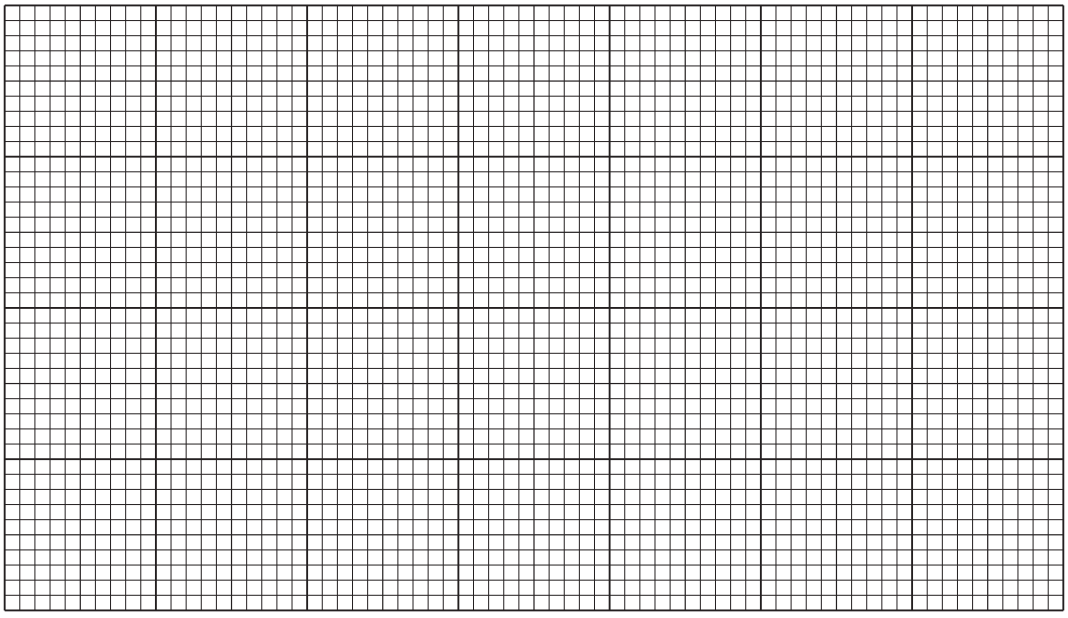


Fig. 1.4

[4]

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(ii) The student measured the temperature of the laboratory as 23 °C. Use your graph to determine the density of milk at 23 °C.

density of milk = ... au [1]

(iii) A student suggested the hypothesis:

As the temperature increases by 10 °C the density of the milk decreases by 2 au.

Explain whether or not the data provides evidence to support the hypothesis.

.....

.....

.....

.....

..... [2]

[Total: 20]

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 cortex.

[5]

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

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

Each xylem vessel element must touch at least **two** other xylem vessel elements.

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

[5]

(iii) Describe **one** observable feature that you used to identify the cells on **L1** as xylem vessel elements.

..... [1]

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

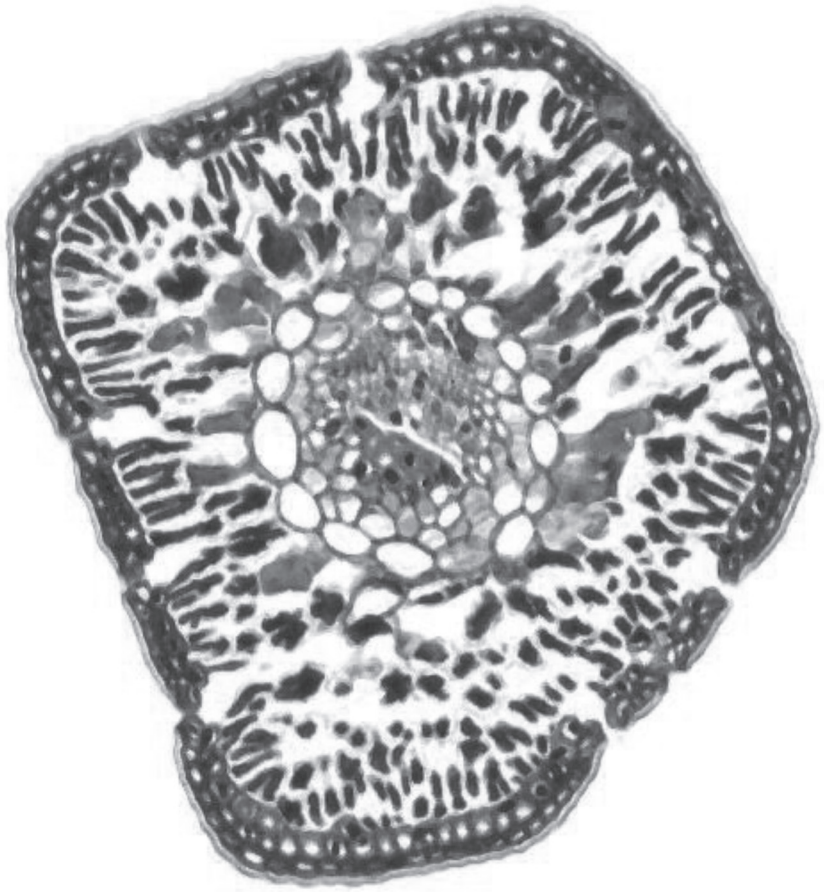


Fig. 2.1

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

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

Table 2.1

feature	L1	Fig. 2.1

[4]

(ii) Describe **one** observable **similarity** between the vascular bundle on **L1** and the vascular bundle in Fig. 2.1, other than that they both contain xylem and phloem.

.....

.....

..... [1]

(c) Fig. 2.2 is the same photomicrograph as that shown in Fig. 2.1 with the line **P**–**Q** added.

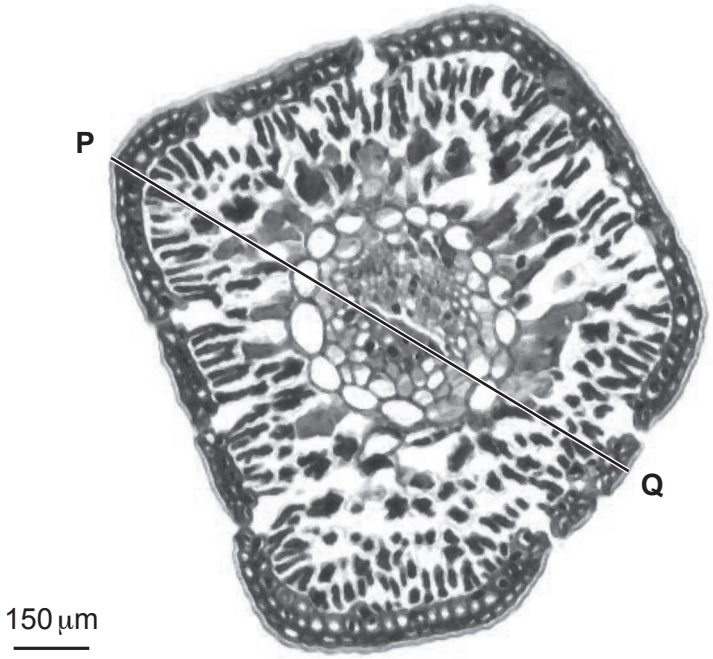


Fig. 2.2

Use the scale bar to calculate the actual length of line **P**–**Q**.

Show your working and use appropriate units.

actual length of **P**–**Q** = ... [4]

[Total: 20]

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 2023**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

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

INFORMATION

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

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1	
2	
Total	

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

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1 Milk is a source of protein and reducing sugars. Different types of milk contain different concentrations of protein. The concentration of protein in milk can be measured using potassium hydroxide solution and copper sulfate solution.

You will investigate the protein content of milk.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
M	milk containing a 5.0% concentration of protein	none	50
W	distilled water	none	100
K	potassium hydroxide solution	harmful irritant	20
C	copper sulfate solution	none	20
U	milk containing an unknown concentration of protein	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 prepare a range of known concentrations of protein, using the milk containing a 5.0% concentration of protein, **M**.

You will need to carry out a serial dilution of the milk containing 5% protein, **M**, to reduce the concentration of protein by **half** between each successive dilution.

You will need to prepare **four** concentrations of protein in addition to 5.0% protein, **M**.

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

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

Fig. 1.1 shows the beakers you will use.

For each beaker, add labelled arrows to show:

- the volume of protein solution transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of protein solution.

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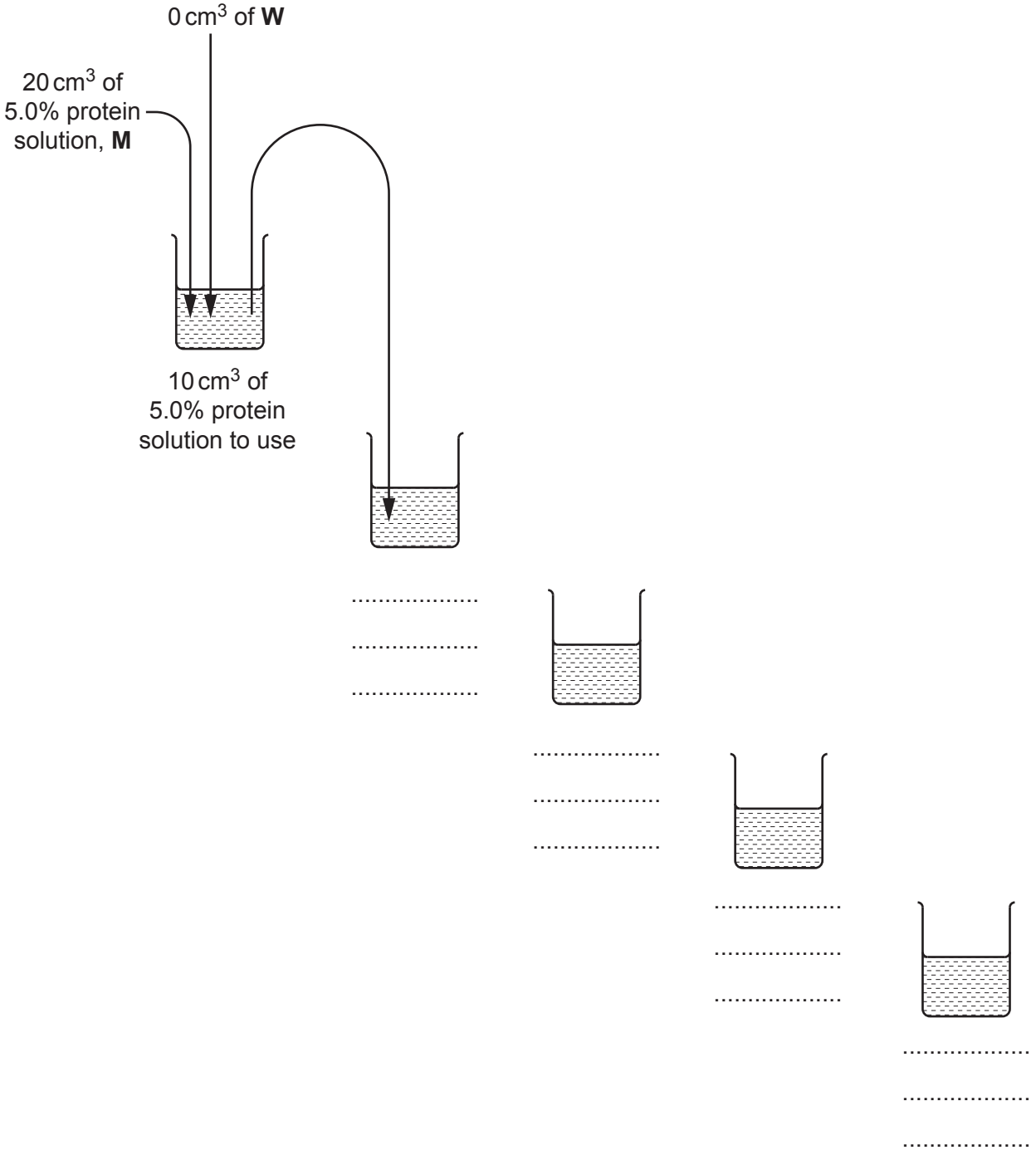

0 cm3 of W
20 cm3 of 5.0% protein solution, M
10 cm3 of 5.0% protein solution to use
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Fig. 1.1

[3]

Carry out step 1 to step 7.

step 1 Prepare the concentrations of protein, as shown in Fig. 1.1, in the beakers provided. Mix well.

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

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

step 4 Put 2 cm^3 of **K** into each of the labelled test-tubes. Shake gently to mix.

step 5 Put 2 cm^3 of **C** into each of the labelled test-tubes. Shake gently to mix.

step 6 Leave for 2 minutes for the colour to change.

step 7 Observe the colour in each test-tube and compare with the colours in Fig. 1.2.
You will see the same colour in more than one test-tube. Record your observations in **(a)(ii)** using **only** the colours shown in Fig. 1.2.

dark purple	purple	light purple	blue

Fig. 1.2

(ii) Record your observations in an appropriate table.

You may record the same colour for more than one test-tube.

[3]

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Carry out step 8 to step 9.

step 8 Stir **U** and put 2 cm^3 of **U** into a test-tube.

step 9 Repeat step 4 to step 7 with **U**. Record the colour in **(a)(iii)**.

(iii) State the colour for sample **U** ..... [1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the protein concentration in **U**.

..... [1]

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

source of error .....

.....

improvement .....

.....

[2]

(vi) Suggest how you would modify the experiment to determine the concentration of reducing sugars in a sample of milk.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Milk can be made from plant sources.

A scientist compared the protein content in milk from cows with milk produced from different plants.

The results are shown in Table 1.2.

Table 1.2

type of milk	protein content / g per 100 cm^3
cow (C)	3.400
almond (A)	0.575
cashew (H)	2.250
oat (O)	0.400
soya (S)	3.325

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Plot a bar chart of the data shown in Table 1.2 on the grid in Fig. 1.3.

Use a sharp pencil.

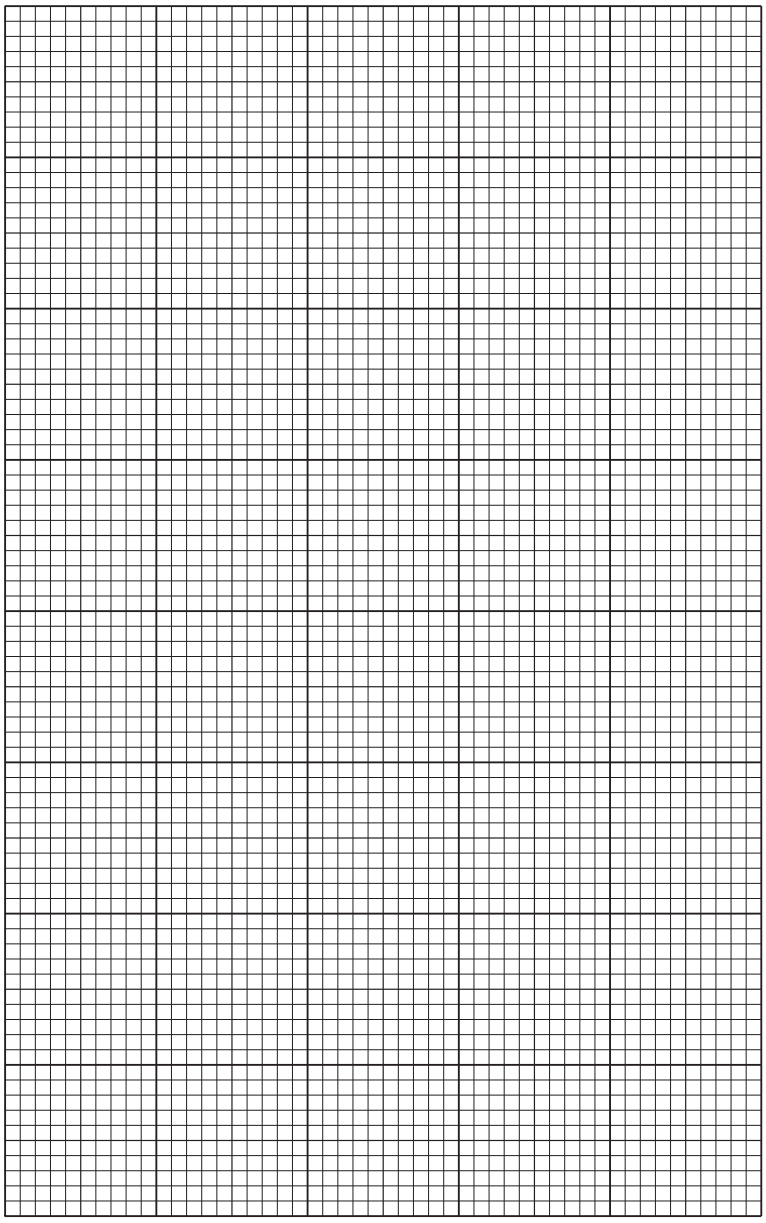


Fig. 1.3

[4]

(c) One of the reducing sugars found in cow's milk is lactose. Some people are intolerant to lactose and cannot digest it. A method of producing lactose-free milk is to treat cow's milk with the enzyme lactase.

Lactase hydrolyses lactose to produce glucose and galactose.

A scientist investigated the effect of different lactase concentrations on the mass of lactose converted to glucose and galactose in 10 minutes.

The scientist plotted a graph of the results, shown in Fig. 1.4.

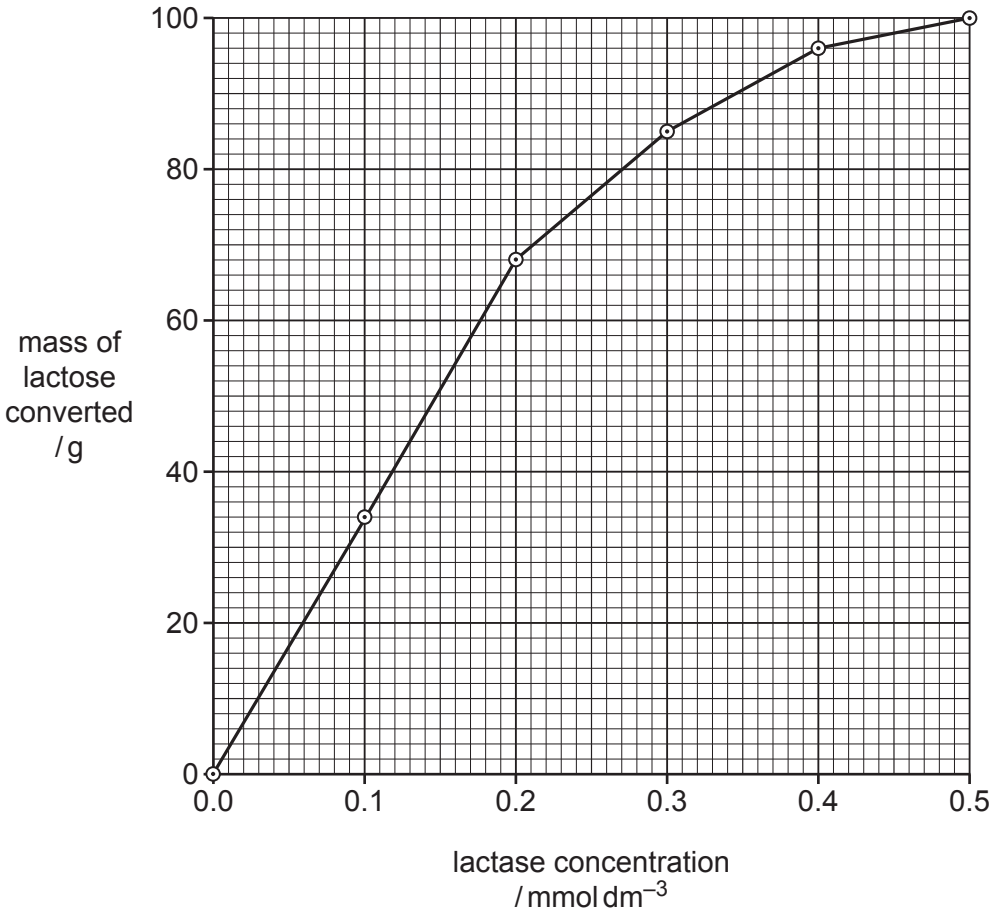


Fig. 1.4

(i) Use the graph in Fig. 1.4 to determine the mass of lactose converted when 0.16 mmol dm^{-3} of lactase is used.

Show your working on the graph.

mass of lactose = ... g [1]

(ii) Calculate the **rate** of lactose conversion when 0.16 mmol dm^{-3} of lactase is used.

..... g min^{-1} [1]

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(iii) Explain the shape of the graph between 0.1 mmol dm^{-3} and 0.2 mmol dm^{-3} of lactase.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 22]

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

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

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

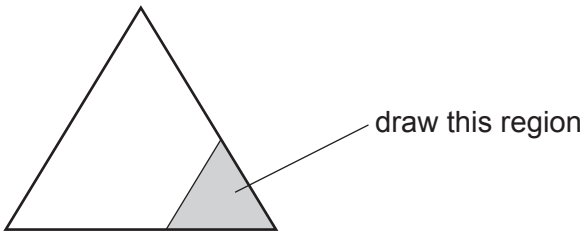


Fig. 2.1

[5]

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(ii) Observe the cells in the central tissue of the stem on **N1**.

Select a group of **four** adjacent cells that make up this tissue.

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 species to the stem on **N1**.

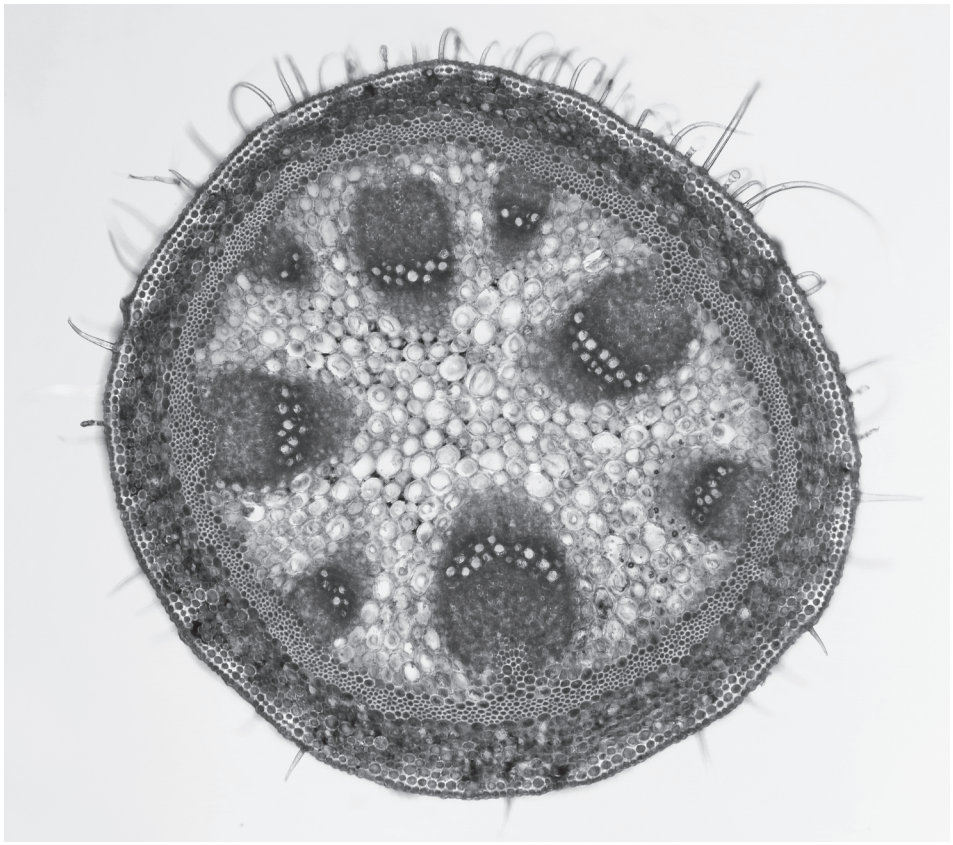


Fig. 2.2

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

Record these three observable differences in Table 2.1.

Table 2.1

feature	N1	Fig. 2.2

[4]

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

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

The length of one division on the stage micrometer in Fig. 2.3 is 0.50 mm.

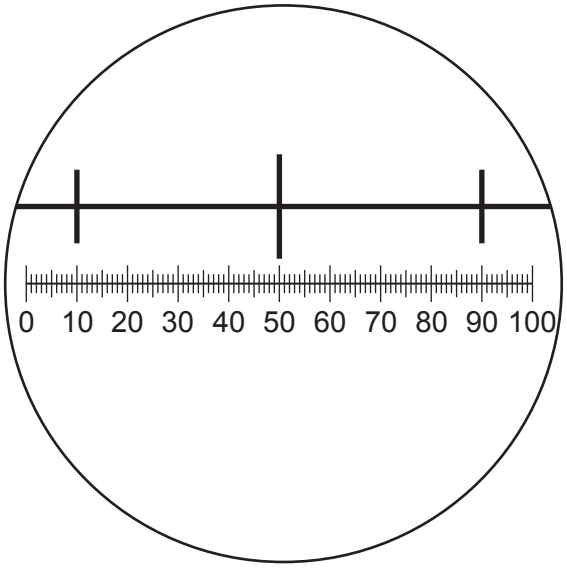


Fig. 2.3

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

Give your answer in micrometres (μm).

Show your working.

actual length = ... μm [2]

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Fig. 2.4 shows a magnified section of the stem shown in Fig. 2.2. This was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.3.

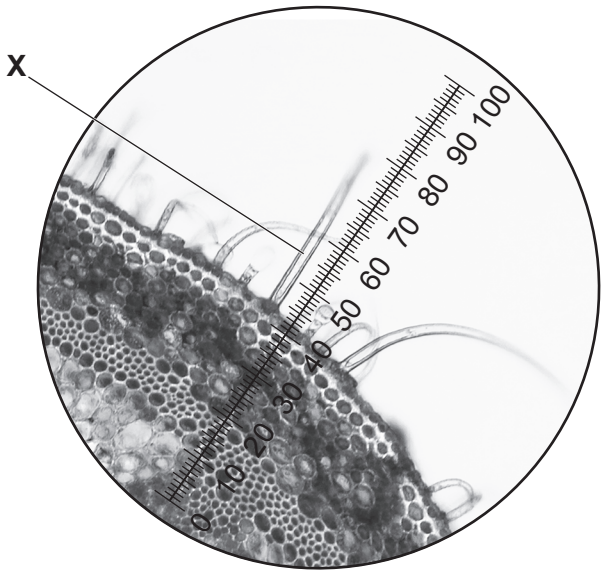


Fig. 2.4

(ii) Use the calibration of the eyepiece graticule unit from **(c)(i)** to calculate the actual length of the trichome labelled **X** in Fig. 2.4.

Show your working.

actual length = ... [2]

[Total : 18]

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

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

INFORMATION

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

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2	
Total	

This document has **12** pages.

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1 You will be investigating the effect of salt concentration on the movement of water in potatoes.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	5 lengths of potato	none	–
W	distilled water	none	150
S	1 mol dm^{-3} salt solution	none	150

It is recommended that you wear suitable eye protection.

(a) You will need to make different concentrations of salt solution using proportional dilution of the 1.00 mol dm^{-3} salt solution, **S**.

You will need to prepare 40 cm^3 of each concentration.

Table 1.2 shows two of the concentrations you will use.

Decide which other concentrations of salt solution you will use.

(i) Complete Table 1.2 to show how you will prepare the other concentrations.

Table 1.2

final concentration of salt solution / mol dm^{-3}	volume of **S** / cm^3	volume of distilled water, **W** / cm^3
1.00	40	0
0.00	0	40

[2]

Carry out step 1 to step 11.

step 1 Prepare the concentrations of salt solution, as shown in Table 1.2, in the beakers provided.

step 2 Cut 10 discs of potato for each of the concentrations prepared in step 1.

Each disc should be approximately 3 mm thick.

step 3 Place 10 discs in a line as shown in Fig. 1.1.

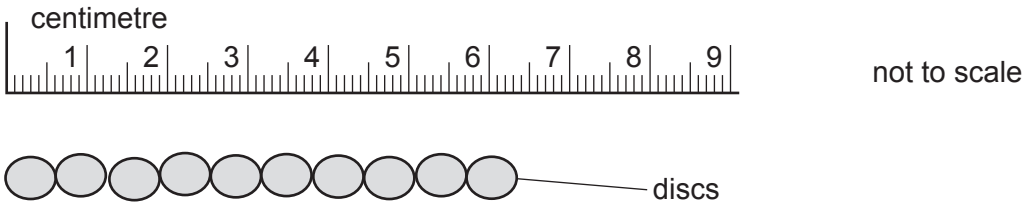


Fig. 1.1

step 4 Measure the total length of the 10 discs and record this value in **1(a)(ii)**.

step 5 Put the 10 discs into the beaker containing 1 mol dm^{-3} salt solution.

step 6 Repeat step 3 to step 5 with the other discs and the salt solutions you prepared in step 1.

step 7 Start timing and leave for 30 minutes.

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

step 8 After 30 minutes (step 7), discard the 1 mol dm^{-3} salt solution from around the discs and tip the discs onto some paper towel.

step 9 Place the 10 discs in a line as in Fig. 1.1 and measure their total length. Record this value in **1(a)(ii)**.

step 10 Repeat step 8 and step 9 for the other salt concentrations.

step 11 Calculate the **change** in length for each line of 10 discs.

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(ii) Record your results in an appropriate table, including raw results **and** processed results.

[5]

(iii) Explain your results for the 0.0 mol dm^{-3} salt solution (distilled water).

.....

.....

.....

.....

..... [2]

(iv) Suggest why a line of 10 discs was measured instead of a single disc.

.....

.....

..... [1]

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

.....

.....

..... [1]

(vi) Use your results to estimate a salt concentration where there is **no net movement** of water into or out of the potato.

salt concentration ..... $mol\,dm^{-3}$ [1]

(vii) Describe **two** improvements to your procedure that would make the estimate in **1(a)(vi)** more accurate.

1 .....

.....

.....

2 .....

.....

.....

[2]

(b) The salt content of unprocessed food was measured.

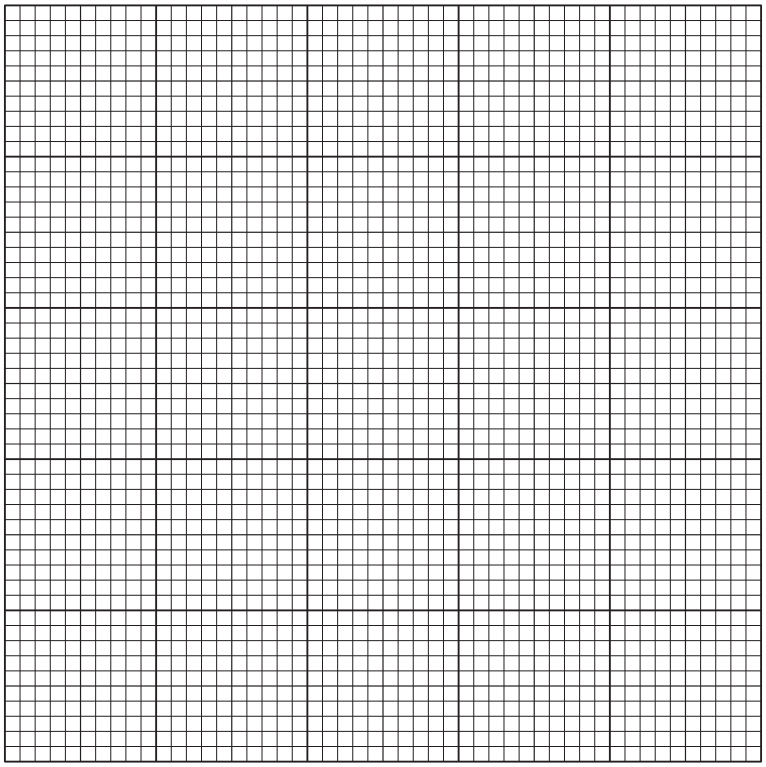
The values are shown in Table 1.3.

Table 1.3

food type	salt content of unprocessed food / mg per 100 g food
potatoes (P)	10.0
tuna (T)	40.0
bran (B)	25.0
chicken (C)	50.0
salmon (S)	95.0

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

Use a sharp pencil.



[4]

Fig. 1.2

The salt content of the same foods that had been processed was also measured.

The values are shown in Table 1.4.

Table 1.4

food type	salt content of processed food / mg per 100 g food
potatoes (P)	200.0
tuna (T)	300.0
bran (B)	1000.5
chicken (C)	350.5
salmon (S)	1800.0

(ii) Calculate the percentage increase in salt content when salmon is processed.

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

increase in salt content ..... % [2]

(iii) State the independent variable in this study.

.....

..... [1]

[Total: 21]

2 **M1** 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 **M1** indicated by the shaded region in Fig. 2.1. Use a sharp pencil.

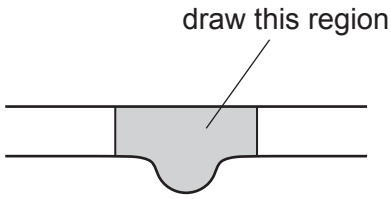


Fig. 2.1

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

[5]

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(ii) Observe one of the central vascular bundles of the leaf on **M1**.

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

Each xylem vessel element must touch at least **two** other xylem vessel elements.

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

[5]

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

The length of one division on this stage micrometer is 1 mm.

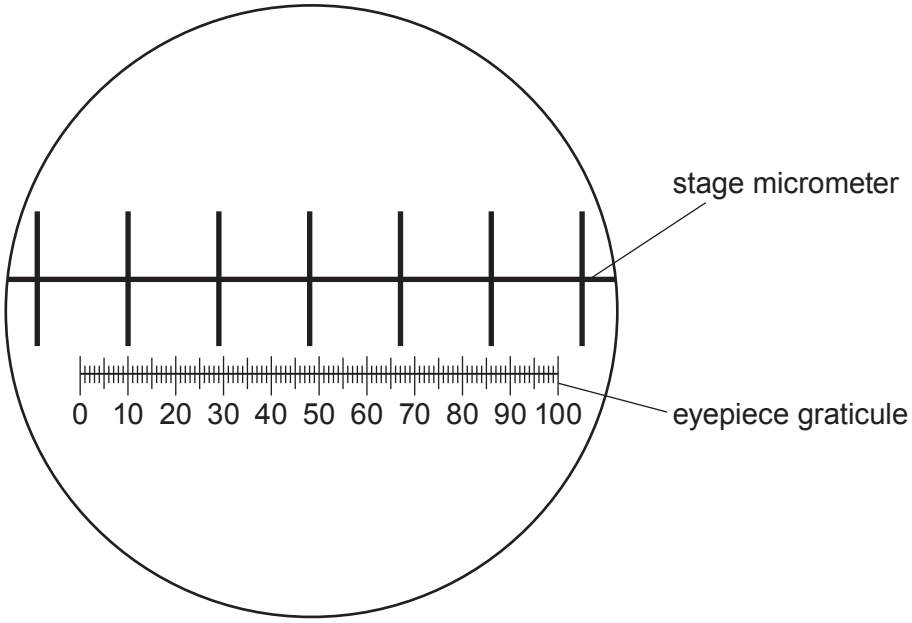


Fig. 2.2

(i) Use Fig. 2.2 to calculate the actual length of one eyepiece graticule unit.

Show your working and include appropriate units.

actual length = ... [3]

Fig. 2.3 shows a photomicrograph of a transverse section through a different leaf. This was taken with the same microscope and the same lenses used to take the photomicrograph in Fig. 2.2.

The eyepiece graticule has been placed across the leaf section to measure its thickness.

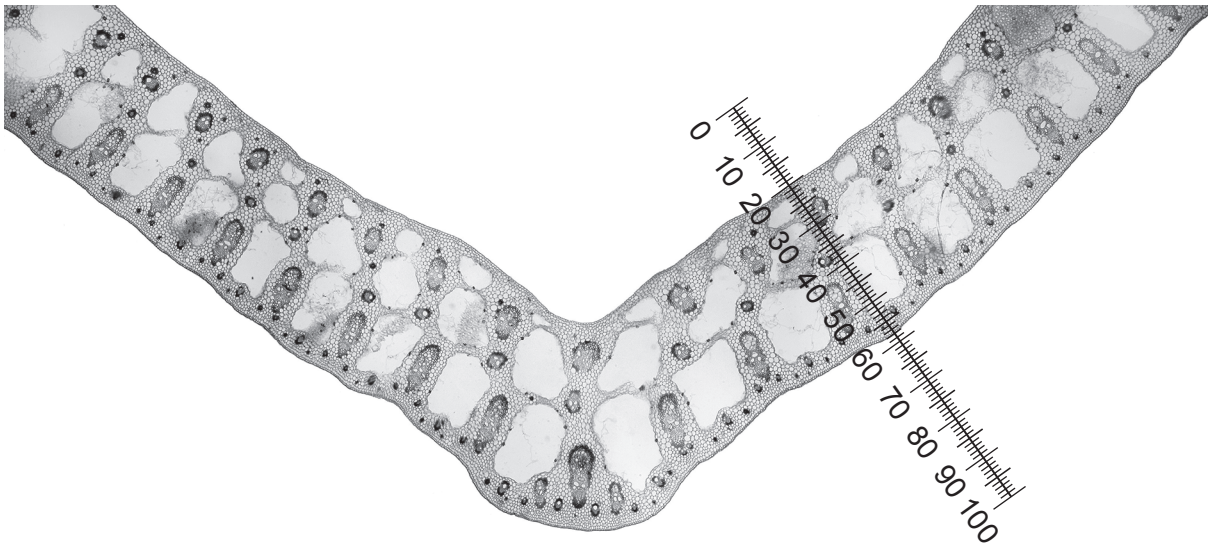


Fig. 2.3

(ii) Use the calibration of the eyepiece graticule from **2(b)(i)** to calculate the actual thickness of the leaf section in Fig. 2.3.

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

actual thickness = ... [2]

(iii) The presence of large air spaces in the leaf shown in Fig. 2.3 is one adaptation of the plant for living in water.

Suggest a function of these air spaces.

.....

.....

..... [1]

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(iv) Identify **three** observable differences, other than colour and the presence of air spaces, between the leaf section on **M1** and the leaf section in Fig. 2.3.

Record these observable differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.3

[3]

[Total: 19]

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