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BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2020**

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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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish the whole of Question 1 and Question 2.

1 Milk contains nutrients, including proteins, fats, carbohydrates, vitamins and minerals, that are essential for growth and development of young mammals.

When milk, **M**, is dropped into a test-tube containing copper sulfate solution, **CS**, the drop of milk sinks to the bottom of the test-tube. The rate at which the drop of milk sinks depends on the concentration of the milk.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
CS	copper sulfate solution	irritant	200
M	100% milk	none	50
W	distilled water	none	30
U	milk sample of unknown concentration	none	10

If **CS** comes into contact with your skin, wash off immediately under 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 syringe.

1. Put 2 cm^3 of **M** into the syringe labelled **M**.

2. Hold the syringe containing **M** over an empty test-tube, as shown in Fig. 1.1. Push the plunger slowly to release **one** drop.

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

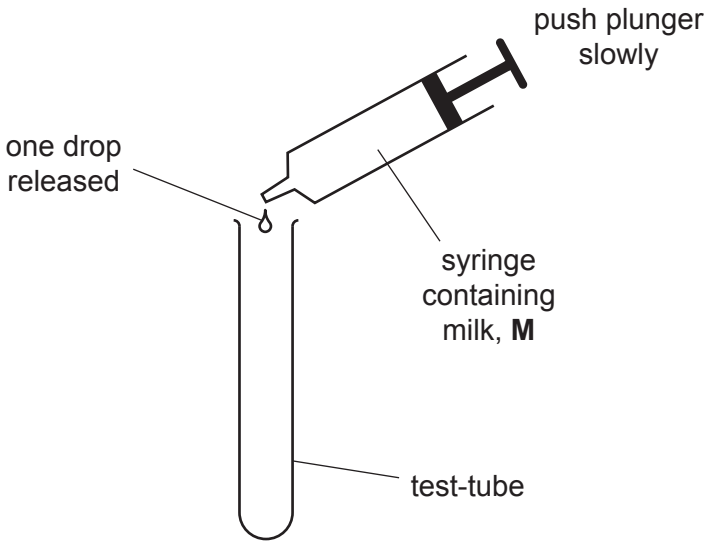


Fig. 1.1

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You will investigate the effect of changing the concentration 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, **CS**
- use your results to estimate the concentration of milk sample, **U**.

(a) You will need to use proportional dilution to make different concentrations of milk, **M**, between 90% and 50%.

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

Table 1.2 shows how to make up two of the concentrations of milk you will use.

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
90.0	9.0	1.0
50.0	5.0	5.0

[2]

Carry out step 4 to step 14.

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

5. Draw a line 2 cm from the top of a clean, dry test-tube, as shown in Fig. 1.2.

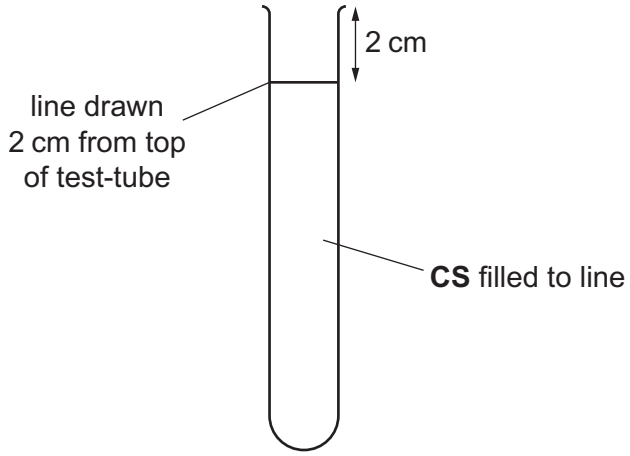


Fig. 1.2

6. Put **CS** into this test-tube up to the mark, as shown in Fig. 1.2.

7. Stir the 90% concentration of milk.

8. Put 2 cm^3 of the 90% milk into the syringe labelled **M**.

9. Put **one** drop of 90% milk into the test-tube containing **CS**, as shown in Fig. 1.3. Start timing.

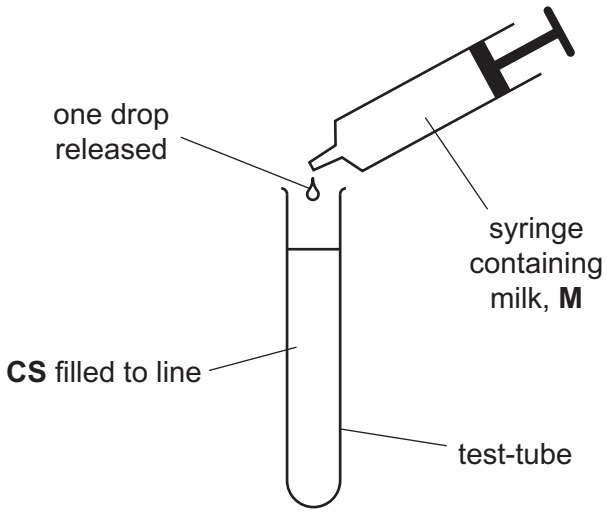


Fig. 1.3

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’.

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

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12. Repeat step 9 to step 11 two more times, with 90% milk. This will give you three results for 90% milk.

13. Empty the contents of the test-tube into the container labelled **For waste**.

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

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

[5]

(iii) Describe the trend in your results.

.....

.....

..... [1]

You are provided with a sample of milk labelled **U**.

15. Repeat step 6 to step 10 using **U**.

16. Record your result for **U** in **(a)(iv)**.

(iv) Record the time taken for the drop of **U** to reach the bottom of the test-tube.

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

(v) Using your results in **(a)(ii)** and **(a)(iv)** estimate the concentration of milk in **U**.

U = ...
[1]

Table 1.3 describes two sources of error when measuring the dependent variable in this investigation.

(vi) Complete Table 1.3 by:

- describing, for each error, an improvement to the procedure that reduces the effect of the error
- describing a third error and the improvement you would make to reduce its effect.

Table 1.3

error	improvement
1. Milk sometimes stays at the top of **CS** and may interfere with the movement of the next drop.	
2. The drop sometimes sticks to the side of the test-tube and changes the time taken for the drop to reach the bottom.	
3.	

[4]

(vii) Error 2 in Table 1.3 states that 'the drop sometimes sticks to the side of the test-tube and changes the time taken for the drop to reach the bottom.'

State whether error 2 is a random error or a systematic error.
Give a reason for your answer.

type of error .....

reason .....

.....

[1]

(b) The milk produced by mammals contains fat globules.

Table 1.4 shows the mean fat globule diameter for the milk produced by different types of mammal.

Table 1.4

type of mammal	mean fat globule diameter /μm
buffalo (B)	8.8
human (H)	4.3
camel (C)	2.9
goat (G)	3.2
sheep (S)	3.7

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

Use a sharp pencil for drawing bar charts.

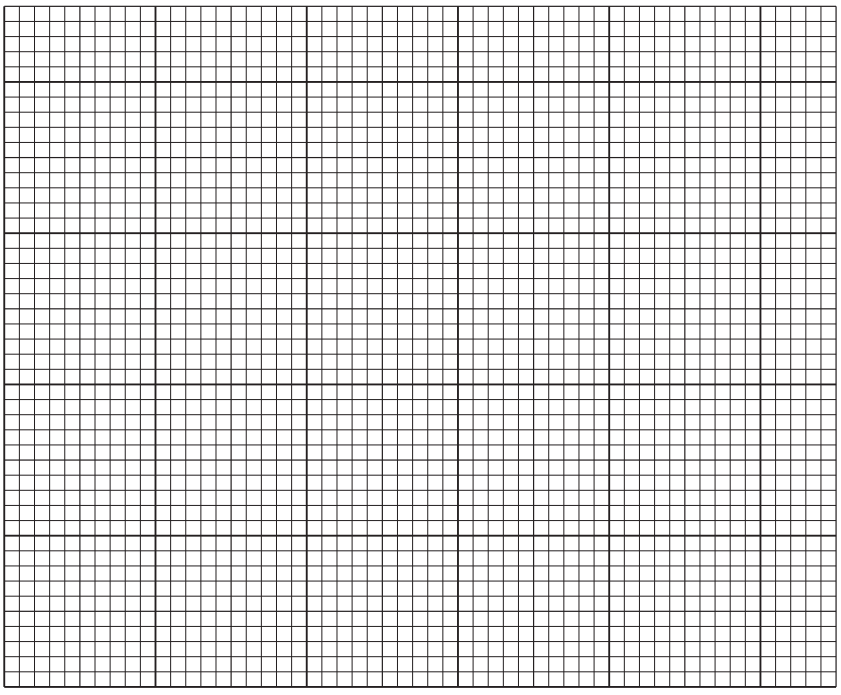


Fig. 1.4

[4]

(ii) Suggest which mammal milk in Table 1.4 contains fat that takes the longest time to be broken down by enzymes.

Explain your answer.

mammal .....

explanation .....

.....

.....

.....

.....

[2]

[Total: 21]

Question 2 starts on page 10

2 Fig. 2.1 is a photomicrograph of a stained transverse section through a plant root.

You are not expected to be familiar with this specimen.



Fig. 2.1

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Use a sharp pencil for drawing.

You are expected to draw the correct shape and proportions of the different tissues.

(a) (i) Draw a large plan diagram of the region of the root section shown by the shaded area in Fig. 2.2.

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

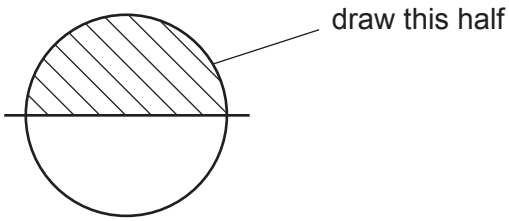


Fig. 2.2

[5]

(ii) **J1** is a stained transverse section through a root of a different type of plant.

You are not expected to be familiar with this specimen.

Observe the xylem vessel elements in the centre of the root section on **J1**.

Select **one** large xylem vessel element and **three** adjacent cells.

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 lumen in **one** cell.

[5]

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(b) Identify observable similarities **and** differences between the root section in Fig. 2.1 and the root section on **J1**.

Record the observable similarities **and** differences in Table 2.1.

Table 2.1

feature	Fig. 2.1	J1
similarities		
differences		

[4]

(c) Fig. 2.3 is a photomicrograph of the same root section as in Fig. 2.1.

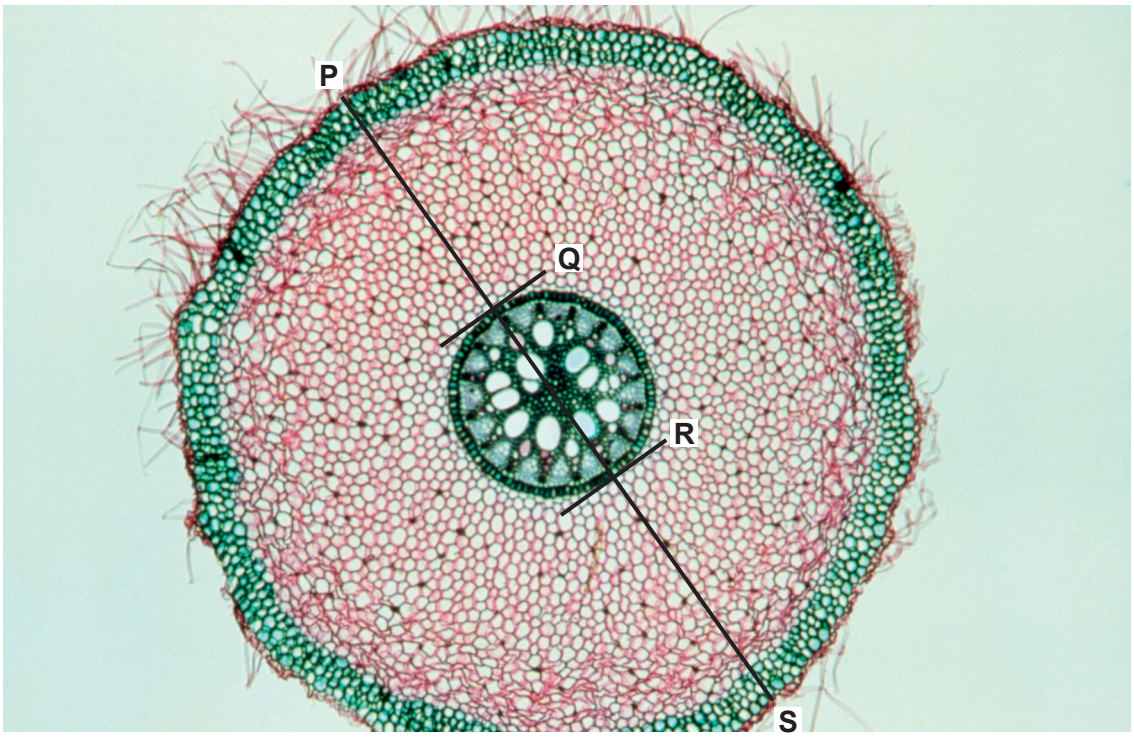


Fig. 2.3

The line **P**–**S** shows the diameter of the whole root section.

The line **Q**–**R** is the diameter of the vascular tissue.

Calculate the percentage of the diameter of the whole root section that is vascular tissue.

Show your working.

[5]

[Total: 19]

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Cambridge International AS & A Level

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2020**

2 hours

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1 Yeast cells contain enzymes that break down sugars to release energy. In these reactions carbon dioxide is released. Some of this carbon dioxide dissolves in water forming carbonic acid.

The progress of these enzyme-catalysed reactions can be followed by measuring the time taken for an indicator to change colour as carbonic acid is formed.

You will investigate the effect of changing the concentration of yeast suspension on the time taken for the indicator to change colour.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	10% yeast suspension	none	100
H	hydrogencarbonate indicator solution	none	50
W	distilled water	none	100

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

It is recommended that you wear suitable eye protection.

Read step 1 to step 4.

(a) (i) Using Table 1.1 **and** step 1 to step 4, assess the risk of this procedure as **low**, **medium** or **high**. Give **one** reason for your answer.

risk .....

reason .....

.....

[1]

The hydrogencarbonate indicator solution, **H**, will change colour from brown to yellow as carbon dioxide passes through it.

To help you identify the end-point (yellow) carry out step 1 to step 4.

1. Put 5 cm^3 of **H** into a small test-tube.
2. Put a drinking straw into this test-tube.
3. Gently breathe **out** through the straw so that you are blowing air bubbles through **H**.
4. Stop blowing when the colour changes from brown to yellow. This is the end-point.

You will need to use this test-tube for colour comparison in step 14.

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You will use proportional dilution to make different concentrations of yeast suspension, **Y**.

You will need to prepare 20 cm^3 of each concentration of yeast suspension.

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

Table 1.2

percentage concentration of yeast suspension	volume of **Y** / cm^3	volume of **W** / cm^3
10.0	20.0	0.0

[2]

Carry out step 5 to step 18.

5. Use a glass rod to stir the yeast suspension, **Y**.

6. Prepare the concentrations of yeast suspension as decided in **(a)(ii)** and shown in Table 1.2.

7. Label a small test-tube for each of the concentrations of yeast suspension you have prepared in step 6.

8. Put 5 cm^3 of **H** into each labelled test-tube.

9. Using the beakers labelled **water-bath**, **hot water** and **cold water**, set up and maintain a water-bath with water between 35 °C and 40 °C.

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Fig. 1.1 shows the apparatus you will set up for the investigation.

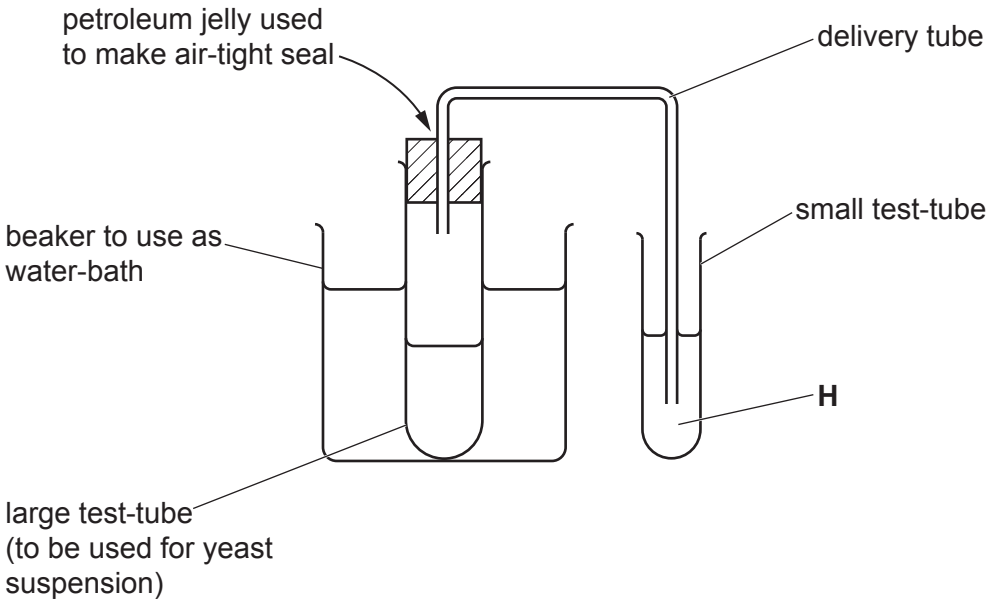


Fig. 1.1

10. Use a glass rod to stir the 10% yeast suspension, then put 20 cm^3 of the 10% yeast suspension into the large test-tube.

11. Put the large test-tube in the water-bath.

12. Put the bung in the large test-tube, and make sure the end of the delivery tube is in **H**, as shown in Fig. 1.1.

13. Start timing.

14. Stop timing when the end-point is reached.

    The test-tube from step 4 can be used to confirm the end-point.

    Record the result in **(a)(iii)**. If the time taken is more than 180 seconds, record the result as 'more than 180'.

15. Put the contents of the large test-tube into the container labelled **For waste**.

16. Rinse the large test-tube using water from the container labelled **For washing**.

17. Put another test-tube of **H**, prepared in step 7, into the apparatus shown in Fig. 1.1.

18. Repeat step 10 to step 17 for the other concentrations of yeast suspension you prepared in step 6.

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(iii) Record your results in an appropriate table.

[5]

(iv) Identify **one** significant source of error in this investigation. Give a reason for your answer.

source of error .....

reason .....

.....

[1]

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(v) A student suggested that collecting the carbon dioxide gas would be a better way to produce quantitative data.

Describe the apparatus and a suitable method the student could use to collect and measure the volume of carbon dioxide. You may use a labelled diagram in the space provided.

.....

.....

.....

space for diagram

[2]

(b) A student carried out an investigation into the effect of temperature on the activity of the enzymes in **Y**.

The student immobilised the yeast cells in alginate beads which were then dropped into a solution of the substrate at different temperatures.

As carbon dioxide collected in the beads they rose to the surface of the solution of the substrate as shown in Fig. 1.2.

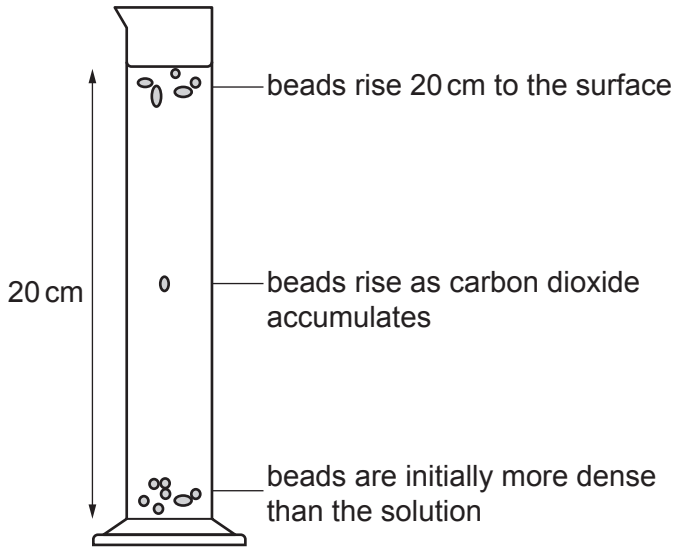


Fig. 1.2

The student measured the time taken for 5 beads to rise to the surface, a distance of 20 cm.

The processed results are shown in Table 1.3

Table 1.3

temperature / °C	**mean time to rise / seconds**
10	72
25	19
40	11
50	36
55	108

(i) Identify the temperature at which the beads rise the fastest. ..... °C

For this temperature calculate the rate at which these beads rise 20 cm.

rate = ...

[2]

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

Use a sharp pencil for drawing graphs.

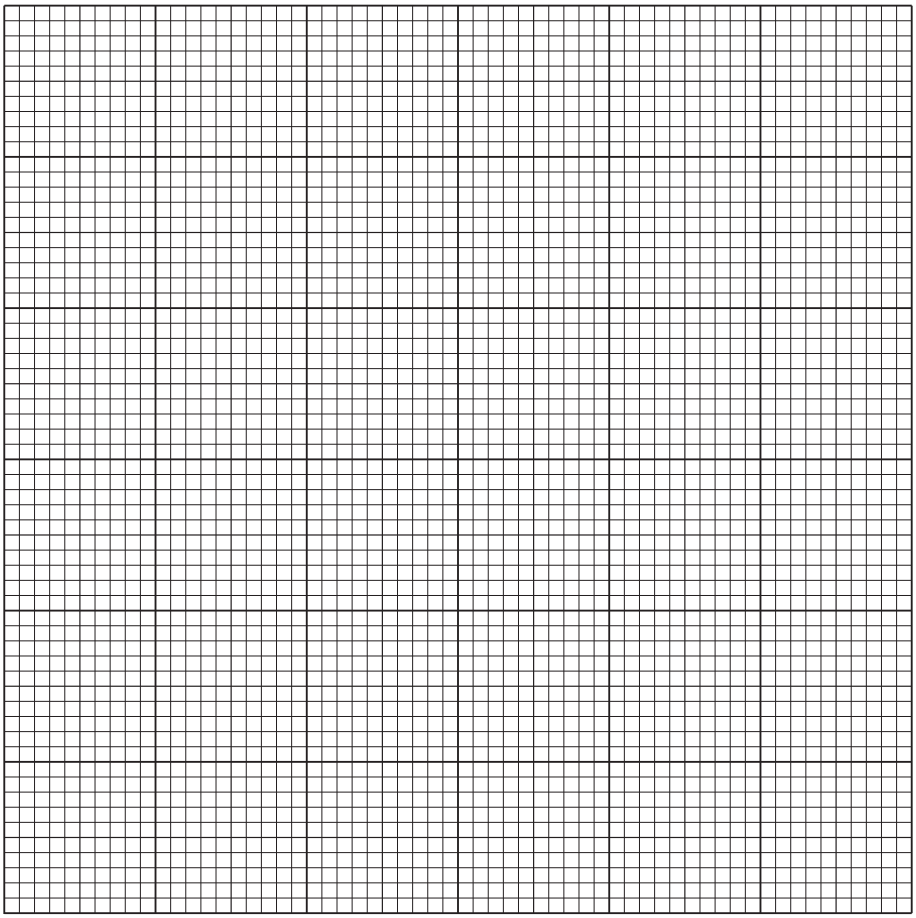


Fig. 1.3

[4]

(iii) Describe the trend shown by the graph in Fig. 1.3.

.....

.....

.....

..... [1]

(iv) Explain the shape of the graph:

between 10 °C and 40 °C

.....

.....

.....

.....

between 40 °C and 55 °C.

.....

.....

.....

.....

[3]

[Total: 21]

Question 2 starts on page 12

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

You are expected to draw the correct shape and proportions of the different tissues.

(a) **(i)** Draw a large plan diagram of the sector of the stem on **K1**, as shown by the shaded area in Fig. 2.1.

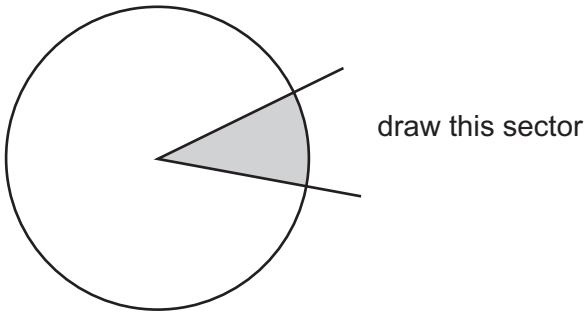


Fig. 2.1

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

[5]

(ii) Observe the central tissue of the stem on **K1**.

Select a **group** of **four** adjacent cells which show observable features of the central tissue.

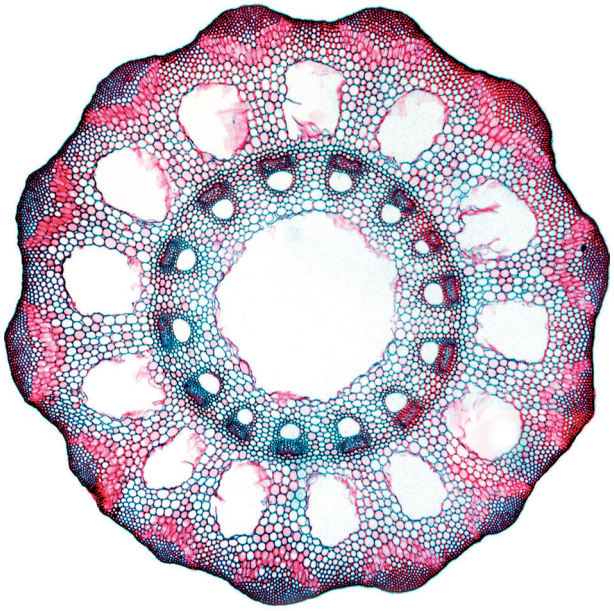
Each cell must touch at least two other cells.

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

[5]

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

You are not expected to be familiar with this specimen.



magnification ×14

Fig. 2.2

(i) Calculate the ratio of the total width of the stem compared to the width of the central air space.

Show all the steps in your working and use appropriate units.

ratio ..... [5]

(ii) Describe how to improve the accuracy of this ratio.

.....

..... [1]

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(iii) Identify observable differences between the stem on **K1** and the stem in Fig. 2.2.

Record the observable differences in Table 2.1.

Table 2.1

feature	K1	Fig. 2.2

[3]

[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 2020**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

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1 Amylase is an enzyme which hydrolyses starch into reducing sugars, as shown in Fig. 1.1.

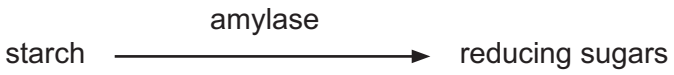


Fig. 1.1

The progress of this reaction can be followed by measuring the concentration of starch remaining using iodine solution.

You will need to:

- prepare a serial dilution of a 1.0% starch solution, **S**
- estimate the concentration of starch remaining after hydrolysis with amylase at two different pH values.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	**contents**	**hazard**	**volume / cm^3**
S	1.0% starch solution	none	50
iodine	0.01 mol dm^{-3} iodine solution	none	20
W	distilled water	none	150
X	a sample of 1.0% starch solution which has been incubated with amylase and pH2 buffer	harmful irritant	20
Y	a sample of 1.0% starch solution which has been incubated with amylase and pH7 buffer	harmful irritant	20

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

It is recommended that you wear suitable eye protection.

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[Turn over

(a) You need to carry out a **serial** dilution of the 1.0% starch solution, **S**, which reduces the concentration of the starch solution by a factor of 10 between each successive dilution.

Fig. 1.2 shows you the first two beakers you will use to make your serial dilution.

(i) Complete Fig. 1.2 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the volume and concentration of starch solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of starch solution added to prepare the concentration
- use another arrow with a label, above the beaker, to show the volume of **W** added to prepare the concentration.

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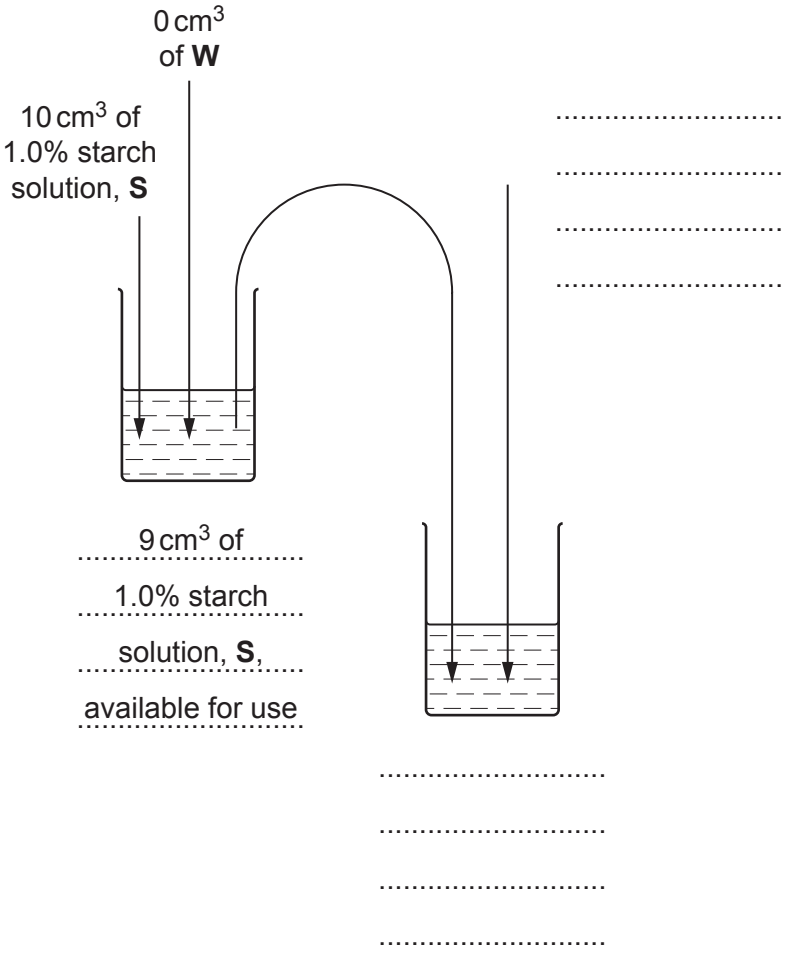

0 cm3 of W
10 cm3 of 1.0% starch solution, S
9 cm3 of 1.0% starch solution, S, available for use

Fig. 1.2

[3]

Carry out step 1 to step 6.

1. Prepare the concentrations of starch solution as decided in **(a)(i)** and shown in Fig. 1.2.

   Use a glass rod to mix the starch solutions and water.

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

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

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

5. After step 4, observe the colour of the liquid in each test-tube. You may see the same colour in more than one test-tube.

It may help to hold a piece of white card behind the test-tube to see the colour more clearly.

Fig. 1.3 shows the key you need to use to record your results.

Key

colour	**symbol**
blue/black or purple	+++++
blue	++++
dark brown	+++
brown	++
yellow/orange	+

Fig. 1.3

6. Record your results in **(a)(ii)** using the symbols shown in the key in Fig. 1.3.

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(ii) Record your results in an appropriate table.

[5]

Carry out step 7 to step 10.

7. Label a test-tube **X**.

8. Put 5 cm^3 of **X** into this test-tube.

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

10. Observe the colour of the liquid and record the result in **(a)(iii)** using the symbols shown in Fig. 1.3.

11. Repeat step 7 to step 10, using **Y** instead of **X**.

(iii) Record your result for **X** and **Y** using the symbols shown in the key in Fig. 1.3.

result for **X** .....

result for **Y** .....

[1]

(iv) Using your results in **(a)(ii)** and **(a)(iii)**, estimate the concentration of starch in **X** and **Y**.

X = ...

Y = ...

[1]

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[Turn over

(v) A student investigated the hydrolysis of starch by amylase.

The student decided to use a semi-quantitative method to measure the products.

These products are reducing sugars.

Suggest how the student would use a semi-quantitative method to measure the concentration of reducing sugars produced.

.....

.....

.....

.....

.....

.....

..... [3]

(b) One of the reducing sugars produced by the hydrolysis of starch is maltose.

Maltose is a disaccharide that can be hydrolysed to glucose by the enzyme maltase.

A student investigated the effect of maltose concentration on the initial rate of reaction of maltase.

The results are shown in Table 1.2.

Table 1.2

concentration of maltose / mol dm^{-3}	initial rate of reaction of maltase / arbitrary units
0.00	0
0.60	90
1.30	175
1.85	225
2.45	255
3.55	260
3.95	260

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

Use a sharp pencil for drawing graphs.

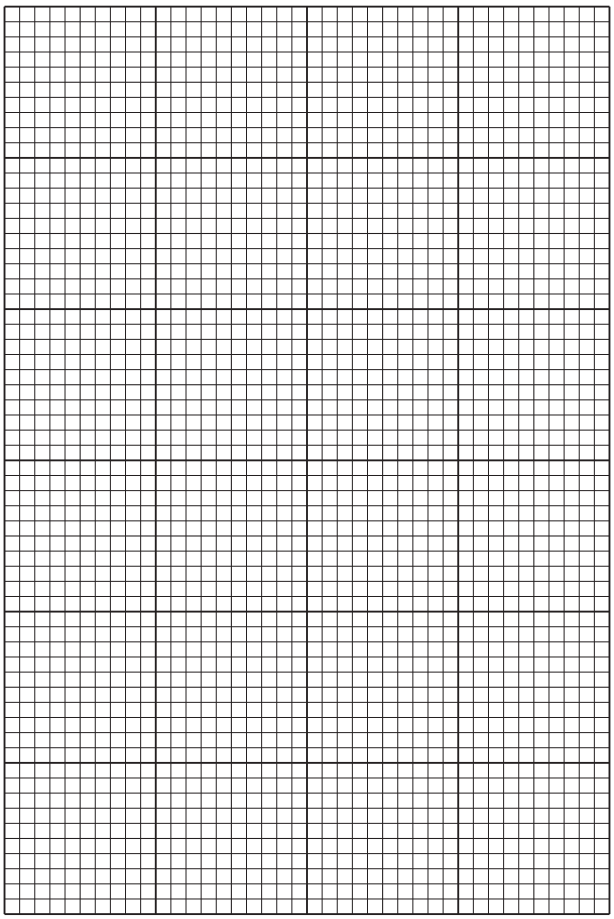


Fig. 1.4

[4]

(ii) Use the graph in Fig. 1.4 to estimate the Michaelis–Menten constant, K_m.

Show your working on the graph and in the space below.

K_m = ... mol dm^{-3} [2]

(iii) A student investigated a different enzyme, **Z**, and found the K_m value to be 0.50 mol dm^{-3}.

State which enzyme, **Z** or maltase, has a **lower affinity** for its substrate. Give a reason for your answer.

enzyme .....

reason .....

.....

[1]

(iv) Using the graph in Fig. 1.4, explain the change in the rate of reaction between 0.00 mol dm^{-3} of maltose and 3.95 mol dm^{-3} of maltose.

.....

.....

.....

.....

.....

..... [2]

[Total: 22]

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

You are not expected to be familiar with this specimen.

(a) Select a field of view so that you can observe the different tissues as shown by the shaded area in Fig. 2.1.

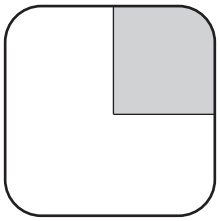


Fig. 2.1

Use a sharp pencil for drawing.

You are expected to draw the correct shape and proportions of the different tissues.

(i) Draw a large plan diagram of the region of the stem on **L1** shown by the shaded area in Fig. 2.1.

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

[5]

(ii) Observe the cells in the central tissue (pith) of the stem section on **L1**.

Select **four** adjacent, touching cells which show observable features of the central tissue.

Each cell must touch at least two other cells.

- Make a large drawing of this group of **four** touching 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 through a stem of a different type of plant.

You are not expected to be familiar with this specimen.

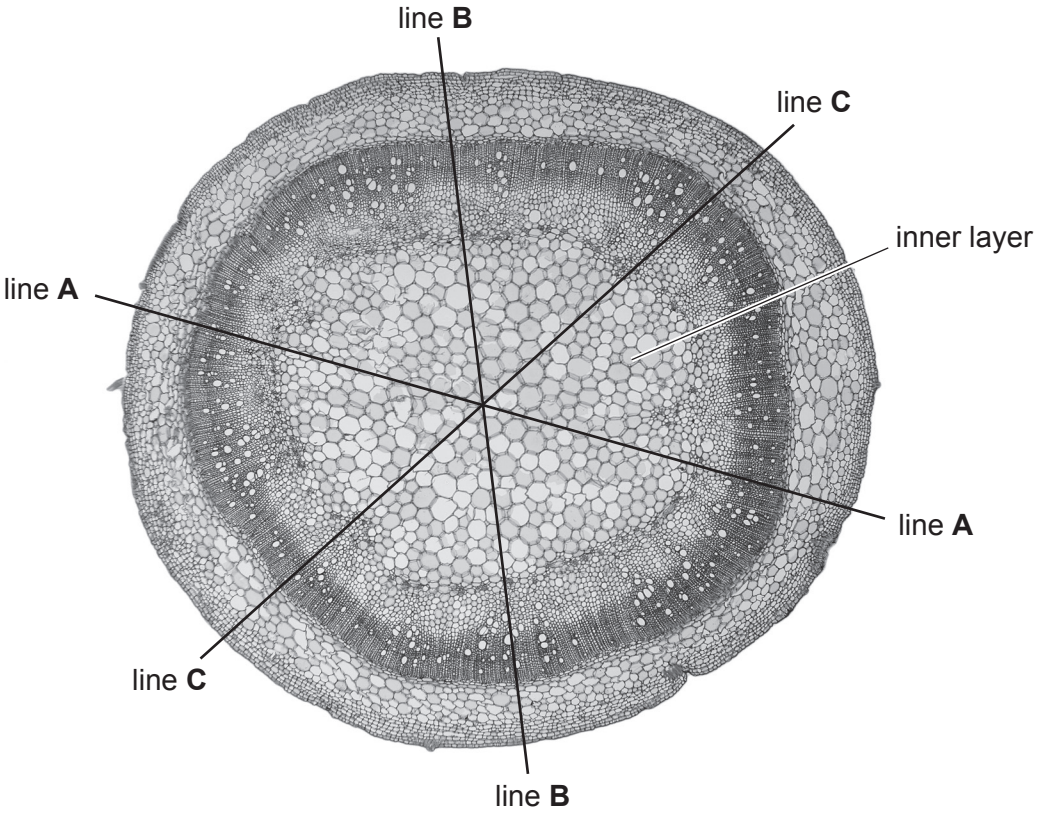


Fig. 2.2

(i) The magnification of the stem section in Fig. 2.2 is ×32.
Use line **A**, line **B** and line **C** to determine:

- the mean actual diameter of the whole stem section
- the mean actual diameter of the inner layer.

Show all the steps in your working.

mean actual diameter of whole stem section .....

mean actual diameter of inner layer .....

[4]

(ii) Use your answers to **(b)(i)** to determine the simplest whole number ratio of the mean actual diameter of the whole stem section to the mean actual diameter of the inner layer.

simplest whole number ratio = ... [1]

(c) Fig. 2.3 is a photomicrograph of the same stem section that is in Fig. 2.2.

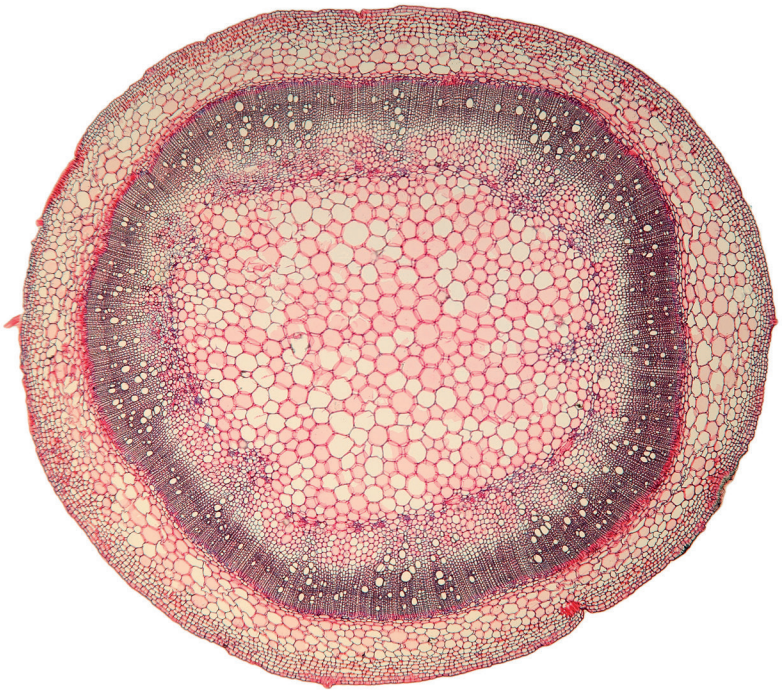


Fig. 2.3

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Identify the observable differences between the stem section in Fig. 2.3 and the stem section on **L1**.

Record the observable differences in Table 2.1.

Table 2.1

feature	Fig. 2.3	L1

[3]

[Total: 18]

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CANDIDATE NUMBER

1801403233

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2020**

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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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish the whole of Question 1 and Question 2.

1 Sucrase is an enzyme which hydrolyses the disaccharide sucrose into reducing sugars, as shown in Fig. 1.1.

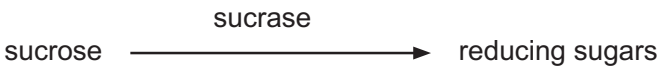


Fig. 1.1

The progress of this reaction can be followed by measuring the concentration of reducing sugar produced. To do this, samples can be taken at time intervals and the action of sucrase stopped in the sample.

The concentration of reducing sugar in the sample can then be tested using Benedict's solution and compared to 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
R	2.0% reducing sugar solution	none	50
B	Benedict's solution	harmful irritant	25
W	distilled water	none	150
U	unknown concentration of reducing sugar, sampled at 2 minutes	harmful irritant	2

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

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(a) You need to carry out a serial dilution of the 2.0% reducing sugar solution, **R**, to reduce the concentration by **half** between each successive dilution.

Fig. 1.2 shows the first two beakers you will use to make your serial dilution.

(i) Complete Fig. 1.2 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the volume and concentration of reducing sugar solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of reducing sugar solution added to prepare the concentration
- use another arrow with a label, above the beaker, to show the volume of **W** added to prepare the concentration.

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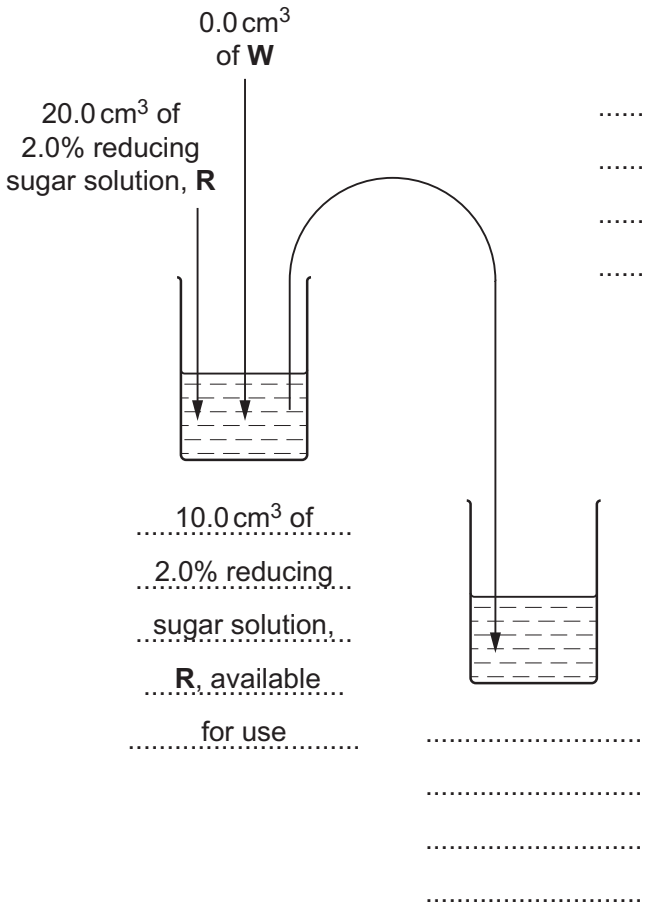


Fig. 1.2

[3]

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Carry out step 1 to step 8.

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

2. Prepare the concentrations of reducing sugar solution decided in **(a)(i)** and shown in Fig. 1.2.

   Use a glass rod to mix the reducing sugar solutions and water.

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

4. Put 2 cm^3 of each concentration of reducing sugar solution into an appropriately labelled test-tube.

5. Put 2 cm^3 of Benedict's solution, **B**, into each of these test-tubes. Shake gently to mix.

6. Put the test-tube labelled 2.0% into the boiling water-bath. Start timing.

7. Measure the time taken to the first colour change. Record the result in **(a)(ii)**.
   If there is no colour change after 90 seconds, record as 'more than 90'.

8. Repeat step 6 and step 7 using each of the concentrations of reducing sugar solution you prepared in step 2, instead of 2.0%. Record your results in **(a)(ii)**.

(ii) Record your results in an appropriate table.

[5]

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You are provided with an unknown concentration of reducing sugar solution in the test-tube labelled **U**.

9. Put 2 cm^3 of **B** into the test-tube labelled **U**.

10. Repeat step 6 to step 7, using the test-tube labelled **U** instead of 2.0%. Record your result for **U** in **(a)(iii)**.

(iii) Record your result for **U**.

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

(iv) Using your results in **(a)(ii)** and **(a)(iii)**, estimate the concentration of reducing sugars in **U**.

U = ... [1]

(v) Suggest how you would make improvements to this investigation to obtain a more accurate estimate of the concentration of reducing sugars in **U**.

.....

.....

.....

.....

.....

..... [2]

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[Turn over

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(b) A student wanted to determine the Michaelis-Menten constant (K_m) for sucrase during the hydrolysis of sucrose, as shown in Fig. 1.1.

The student measured the initial rate of reaction at different concentrations of sucrose.

The results are shown in Fig. 1.3.

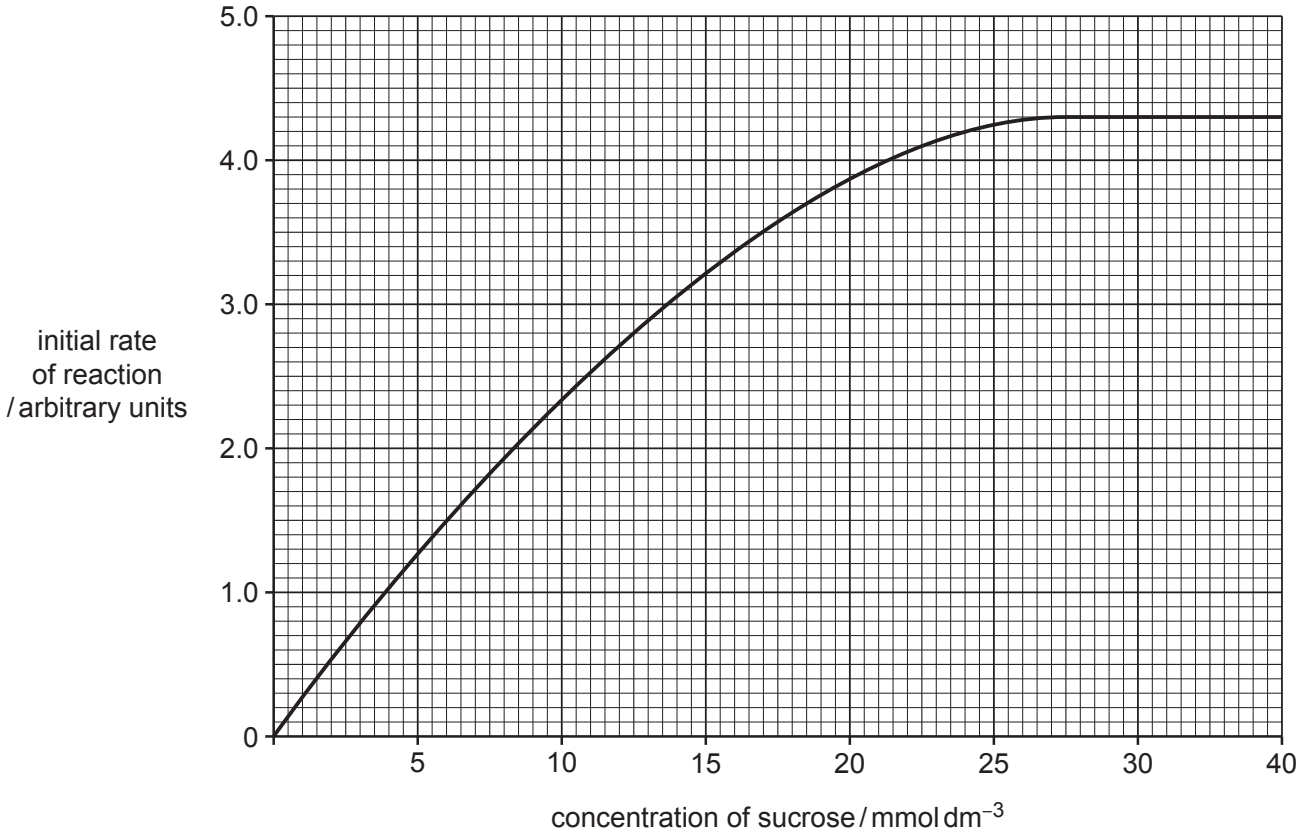


Fig. 1.3

(i) Use the graph in Fig. 1.3 to estimate the Michaelis-Menten constant (K_m).

Show your working on the graph and in the space below.

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

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(ii) The K_m value for another enzyme, **Z**, is 0.95 mmol dm^{-3}.

State which enzyme, **Z or** sucrase, has a **lower affinity** for its substrate.

Give a reason for your answer.

enzyme .....

reason .....

..... [1]

(iii) Explain why the initial rate of reaction does not increase between 30 mmol dm^{-3} and 40 mmol dm^{-3} of sucrose.

.....

.....

..... [1]

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(c) A scientist carried out some research into the sugar content of five different fruit juices.

The results are shown in Table 1.2.

Table 1.2

type of fruit juice	concentration of sugar / arbitrary units
red grape (RG)	21.25
white grape (WG)	18.50
orange (OR)	11.75
pineapple (PA)	10.25
grapefruit (GF)	14.00

Plot a bar chart of the data in Table 1.2 on the grid in Fig. 1.4.

Use a sharp pencil for drawing bar charts.

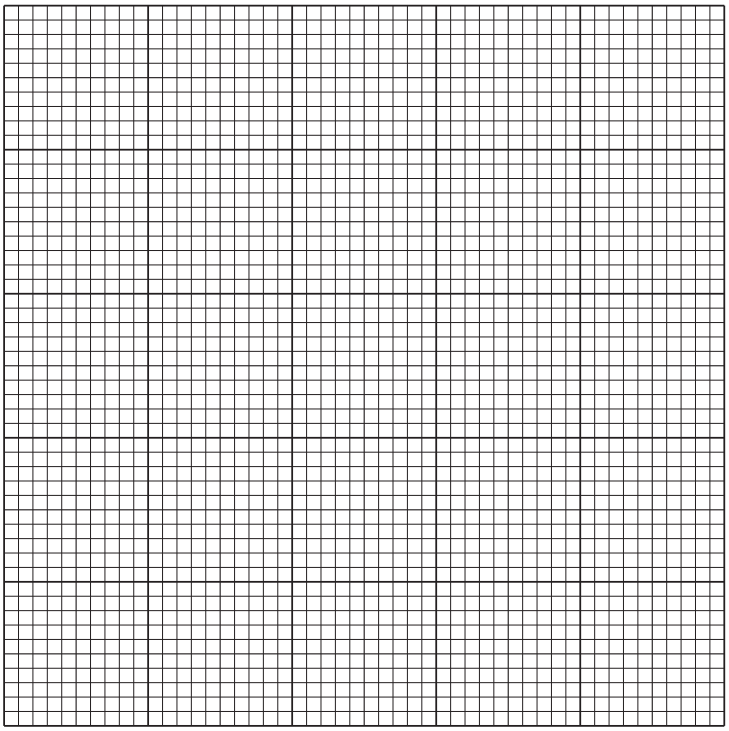


Fig. 1.4

[4]

[Total: 21]

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

You are not expected to be familiar with this specimen.

(a) Select a field of view so that you can observe the different tissues as shown by the shaded area in Fig. 2.1.

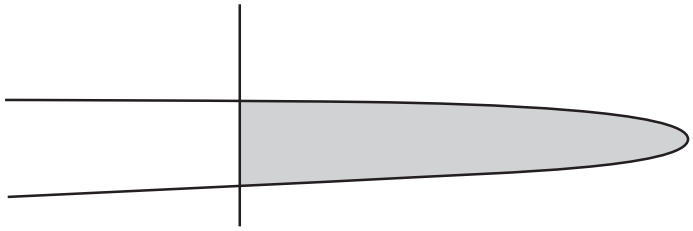


Fig. 2.1

Use a sharp pencil for drawing.

You are expected to draw the correct shape and proportions of the different tissues.

(i) Draw a large plan diagram of the region of the leaf on **M1** shown by the shaded area in Fig. 2.1 to include:

- the epidermis
- only **two** vascular bundles
- any other observable tissues.

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

[5]

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(ii) Observe the cells in the epidermis of the leaf on **M1**.

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

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** cell.

[5]

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You need to estimate the average width of an epidermal cell of the leaf on slide **M1**.

(iii) Put the clear plastic ruler on the stage of the microscope and view the scale lines on it using low power (×10 objective lens).

Measure the diameter of the field of view to the nearest 0.5 mm.

diameter of the field of view = ... mm

View the leaf on slide **M1**.

Estimate the number of epidermal cells across the diameter of the field of view.

number of cells across the field of view = ...

Use your answers to calculate the mean width of an epidermal cell, using appropriate units.

Show all the steps in your working.

mean width of an epidermal cell = ...
[3]

(iv) State **two** pieces of apparatus you would need to use to obtain a more accurate estimate of the width of an epidermal cell on slide **M1**.

1 .....

2 .....
[1]

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[Turn over

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

You are not expected to be familiar with this specimen.

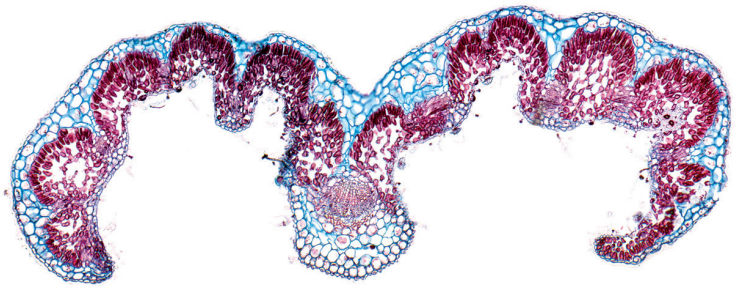


Fig. 2.2

(i) Suggest **one** observable feature shown by the plant in Fig. 2.2 that allows it to live in a dry habitat. Give a reason for your answer.

feature .....

reason .....

.....

[1]

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(ii) Identify observable similarities **and** differences between the leaf on **M1** and the leaf shown in Fig. 2.2.

Record the observable similarities **and** differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.2
similarities		
differences		

[4]

[Total: 19]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4343786601

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2020**

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	

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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish the whole of Question 1 and Question 2.

1 Urease is an enzyme that catalyses the breakdown of urea as shown in Fig. 1.1.

$$\text{urea + water} \xrightarrow{\text{urease}} \text{ammonium carbonate + carbon dioxide}$$

Fig. 1.1

The ammonium carbonate forms an alkaline solution that causes red litmus paper to change to blue.

The change in colour of the litmus paper can be used to determine the rate of reaction.

Urease can be extracted from germinating beans.

- You will investigate the effect of different concentrations of urease on the breakdown of urea.
- You will use your results to estimate the concentration of urease in a bean extract.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	**contents**	**hazard**	**volume / cm^3**
E	10% urease solution	harmful irritant	10
U	5% urea solution	none	10
W	distilled water	none	100
B	bean extract	harmful irritant	10
–	red litmus paper	none	–

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

It is recommended that you wear suitable eye protection.

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[Turn over

(a) You will need to carry out a serial dilution of the 10% urease solution, **E**, to reduce the concentration by **half** between each successive dilution.

Fig. 1.2 shows the first two beakers you will use to make your serial dilution.

(i) Complete Fig. 1.2 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the volume and concentration of urease solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of urease solution added to prepare the concentration
- use another arrow with a label, above the beaker, to show the volume of **W** added to prepare the concentration.

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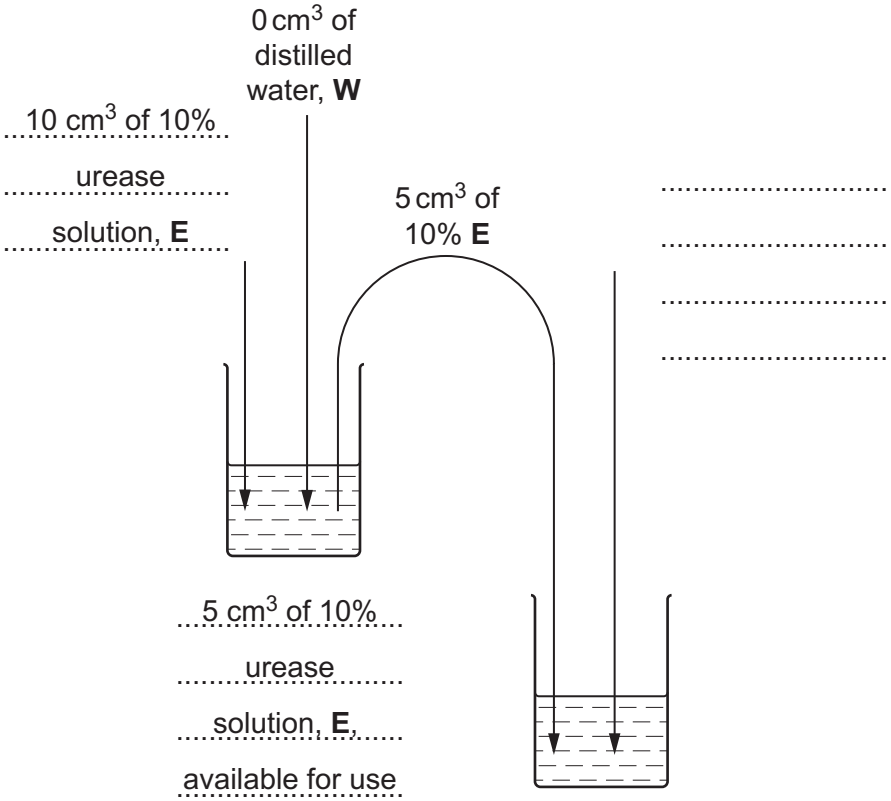

0 cm3 of distilled water, W
10 cm3 of 10% urease solution, E
5 cm3 of 10% E
5 cm3 of 10% urease solution, E, available for use

Fig. 1.2

[3]

Carry out step 1 to step 10.

1. Prepare the concentrations of urease solution, as decided in **(a)(i)** and shown in Fig. 1.2.

2. Prepare a clean, dry spotting tile by labelling the wells with the concentrations of urease solution, as decided in **(a)(i)**. Label one well **W**, for water.

3. Put 5 drops of urea solution, **U**, into each labelled well.

4. Put 3 drops of 10% urease solution into the appropriately labelled well. Mix gently.

5. Repeat step 4 with the other concentrations of urease solution you prepared in step 1.

6. Put 3 drops of water, **W**, into the appropriately labelled well. Mix gently.

7. Cut the red litmus paper into lengths of approximately 0.5 cm. Put one piece of litmus paper into each labelled solution on the spotting tile.

8. Start timing and leave for 2 minutes.

9. After 2 minutes, observe the colour of the litmus paper in each well.
You may see the same colour in more than one well.

Fig. 1.3 shows the key you need to use to record your results.

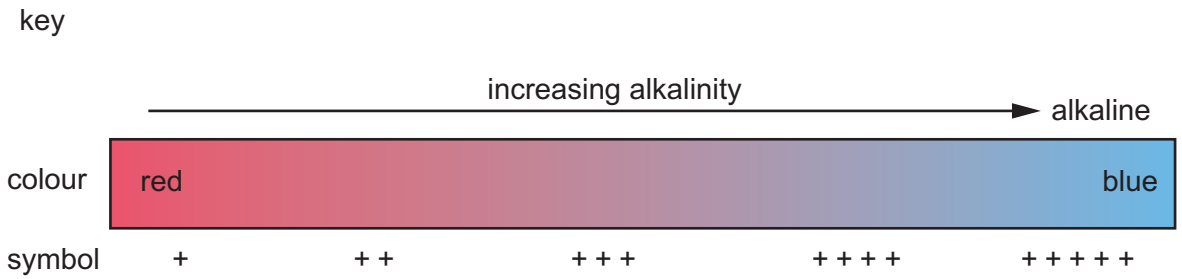


Fig. 1.3

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10. Record your results in **(a)(ii)** using the symbols shown in Fig. 1.3.

(ii) Record your results in an appropriate table.

[4]

(iii) Describe the trend in your results.

.....

..... [1]

11. Choose a clean, dry well on the spotting tile, and label it **B**.

12. Put 5 drops of **U** into this well.

13. Put 3 drops of **B** into the same well. Mix gently.

14. Put one 0.5 cm length of litmus paper into the well.

15. Start timing and leave for 2 minutes.

16. After 2 minutes, observe the colour of the litmus paper in the well.

(iv) Record your result for **B** using the symbols shown in the key in Fig. 1.3.

result for **B** ..... [1]

(v) Use your results in **(a)(ii)** and **(a)(iv)** to estimate the concentration of urease in bean extract, **B**.

concentration = ... %
[1]

(vi) Describe how you could modify this procedure to produce a more accurate estimate of the concentration of urease in bean extract, **B**.

.....

.....

..... [1]

(vii) Identify **two** sources of error in step 3 to step 8. For each error suggest an improvement to the method that will reduce the effect of the error.

error 1 .....

improvement .....

.....

error 2 .....

improvement .....

.....
[2]

(b) The enzyme urease is also produced by soil bacteria.

The effect of soil temperature on urease activity was investigated. The results are shown in Table 1.2.

Table 1.2

soil temperature / °C	urease activity / arbitrary units
5	2.5
15	5.0
25	7.5
35	15.0
45	32.5
55	31.0

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

Use a sharp pencil for drawing graphs.

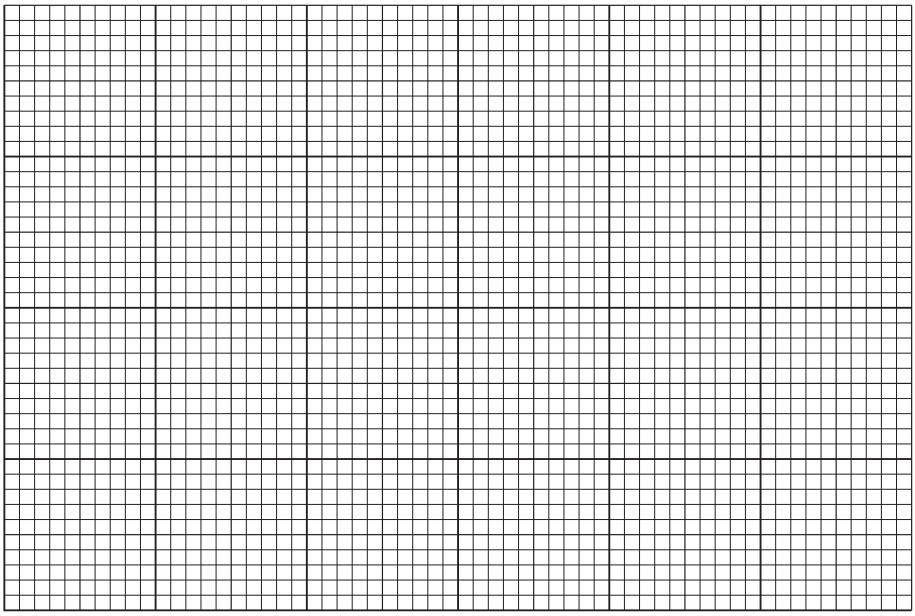


Fig. 1.4

[4]

(ii) The average soil temperature recorded in a woodland was 21°C.

Use your graph in **(b)(i)** to estimate the urease activity in the soil at 21°C.

Show on your graph how you obtained your answer.

urease activity at 21°C = ... [2]

(iii) Explain the effect of soil temperature on urease activity as shown in your graph in **(b)(i)**.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total 22]

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

You are expected to draw the correct shape and proportions of the different tissues.

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

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

[5]

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

Select a **line** of **four** adjacent cells that make up the epidermis. 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** cell.

[5]

(iii) Prepare the space below so that it is suitable for you to record observable differences between the upper epidermis and the lower epidermis of the leaf section on **N1**.

Record your observations in the space you have prepared.

[3]

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

You are not expected to be familiar with this specimen.

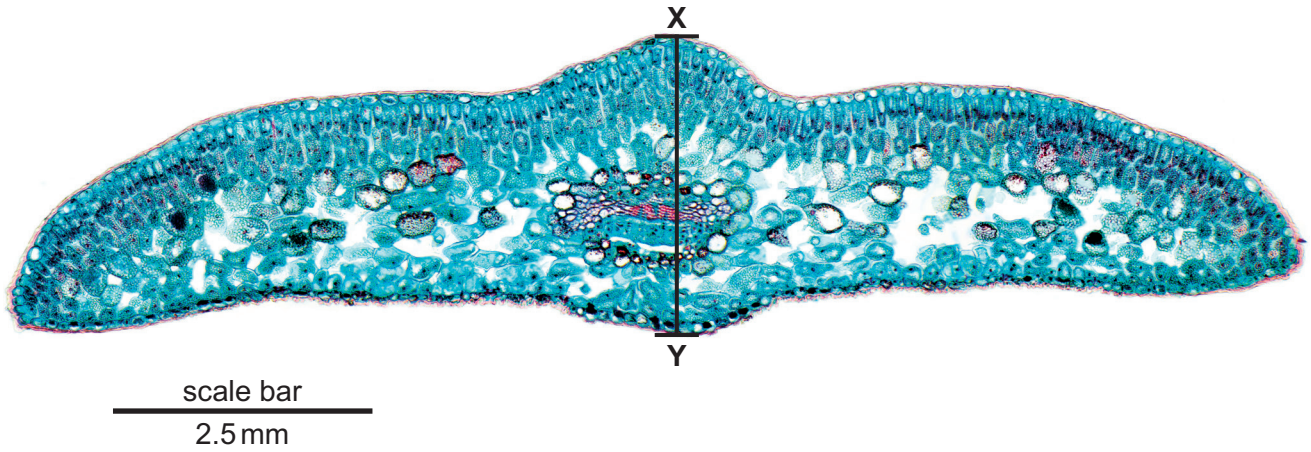


Fig. 2.1

Use the scale bar on Fig. 2.1 to calculate the actual depth of the leaf section indicated by line **X**–**Y**.

Show your working and use appropriate units.

actual depth = ... [5]

[Total 18]

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