Cambridge Assessment International Education

Cambridge International AS & A Level

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4531333156

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

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

When hydrogen peroxide solution and a sample of potato tissue are put into a syringe, some of the solution comes out of the syringe nozzle as the oxygen is released.

You are going to investigate the effect of surface area of potato tissue on the activity of catalase.

You are provided with the materials shown in Table 1.1 and Table 1.2.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	hydrogen peroxide solution	irritant	40

Table 1.2

labelled	material	details	quantity
P	potato cylinders	same diameter	4

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

It is recommended that you wear suitable eye protection.

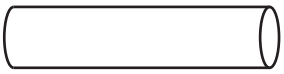
Wear gloves to protect your hands when using **H**.

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1. Cut the potato cylinders in the beaker labelled **P** to a length of 20 mm. Put the 20 mm cylinders back into the beaker labelled **P**.

   To investigate the effect of surface area, you will cut the cylinders into a different number of pieces as shown in Table 1.3.

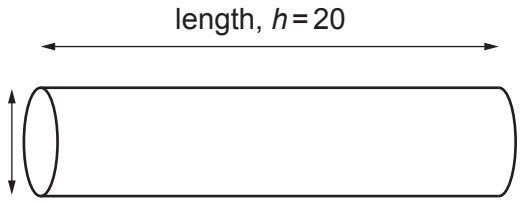
Table 1.3

length of original cylinder / mm	**number (n) of pieces to put into the syringe**	**length (h) of each small piece / mm**
20	1 	20
20	2 	10
20	4 	5
20	10 	2

You now need to calculate the total surface area of the potato tissue that will be put into the syringe. An example of how to do this is shown in Fig. 1.1 on page 4.

EXAMPLE:

One cylinder has length of 20 mm



surface area of one cylinder $= 2\pi r^2 + 2\pi rh$

$= (2 \times 3.14 \times 2^2) + (2 \times 3.14 \times 2 \times 20)$

$= 276.32\,\text{mm}^2$

where:
$\pi = 3.14$
r = radius of cylinder
h = height or length of cylinder

Fig. 1.1

The total surface area depends on the number of pieces, n.

Total surface area = surface area of one cylinder × number of pieces
$= (2\pi r^2 + 2\pi rh)n$

(a) (i) Measure the diameter of **one** of the cylinders **and** calculate the radius, r.

$r =$ ..... [1]

(ii) All of the cylinders have the same diameter (standardised).

State **one** other variable that should be standardised in this investigation.

.....

..... [1]

(iii) Complete Table 1.4 to calculate the total surface area of potato tissue to put in the syringe.

Show your working in the space provided in Table 1.4.

Table 1.4

n	***h*** **/ mm**	***r*** **/ mm**	**surface area of one piece / mm^2**	**show your working in this column**	**total surface area / mm^2**
1	20				
2	10				
4	5				
10	2				

[2]

Carry out step 2 to step 22.

2. Remove the plunger from a 10 cm^3 syringe.

3. Put one 20 mm potato cylinder into the barrel of the syringe.

4. Put the plunger back into the syringe and push it to the 4 cm^3 mark, as shown in Fig. 1.2.

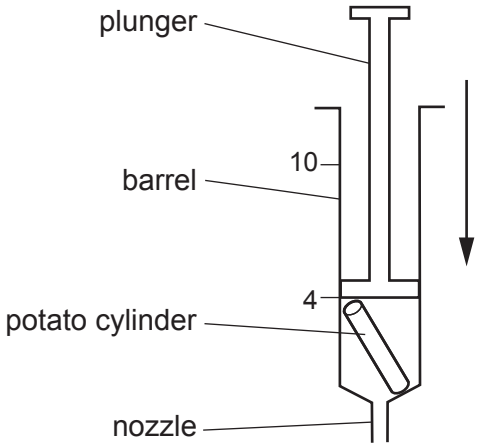


Fig. 1.2

5. Put the nozzle of the syringe into the beaker containing **H**.

6. Pull the plunger out to the 10 cm^3 mark so that **H** enters the syringe, as shown in Fig. 1.3.

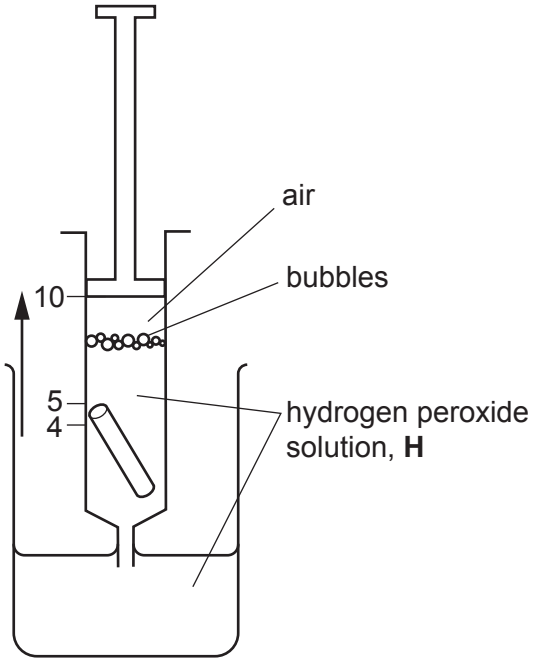


Fig. 1.3

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7. Hold the syringe above the beaker labelled **For waste**. Push the plunger so that the level of **H** is at the 5 cm^3 mark, as shown in Fig. 1.4.

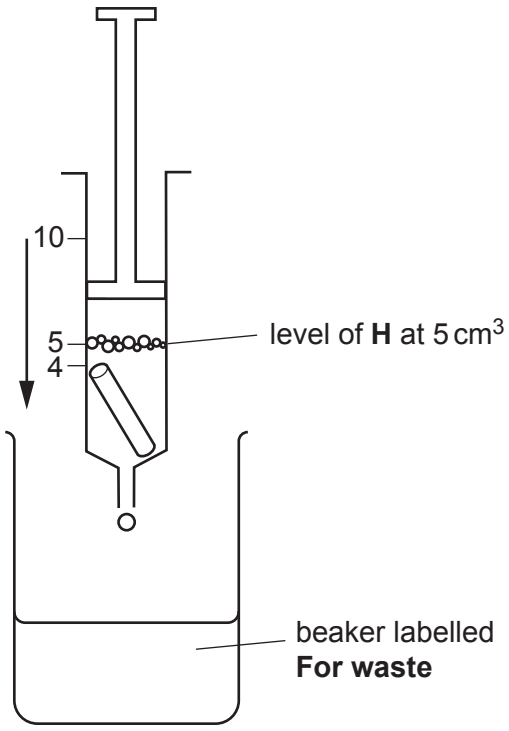


Fig. 1.4

8. Wipe the nozzle with a paper towel to remove excess **H**.

9. Hold the syringe above the beaker labelled **For waste**. Start timing.

   Count the number of drops released in 1 minute. Record the results in **(a)(iv)**.

10. Put the syringe into the beaker labelled **B**.

11. Cut a cylinder from step 1 into two pieces. Each piece should be 10 mm in length, as shown in Table 1.3 and Table 1.4.

12. Remove the plunger from an empty 10 cm^3 syringe.

13. Put the two 10 mm pieces from step 11 into the barrel of the syringe.

14. Repeat step 4 to step 10.

15. Cut a cylinder from step 1 into four pieces. Each piece should be 5 mm in length, as shown in Table 1.3 and Table 1.4.

16. Remove the plunger from an empty 10 cm^3 syringe.

17. Put the four 5 mm pieces from step 15 into the barrel of the syringe.

18. Repeat step 4 to step 10.

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19. Cut a cylinder from step 1 into 10 pieces. Each piece should be 2 mm in length, as shown in Table 1.3 and Table 1.4.

20. Remove the plunger from an empty 10 cm^3 syringe.

21. Put the ten 2 mm pieces from step 19 into the barrel of the syringe.

22. Repeat step 4 to step 10.

(iv) Record your results in an appropriate table.

[5]

(v) State the independent variable.

..... [1]

(vi) Suggest an appropriate control for this investigation.

..... [1]

(vii) Identify **two** sources of error in step 3 to step 22. For each source of error suggest an improvement to the method which will reduce the effect of the error.

error 1 .....

.....

improvement 1 .....

.....

.....

error 2 .....

.....

improvement 2 .....

.....

.....

[4]

(viii) The procedure described by step 1 to step 22 investigated the effect of surface area on catalase activity, by measuring the number of drops released in 1 minute.

Describe how you would modify the procedure to investigate the effect of changing temperature on the activity of catalase in the potato tissue.

.....

.....

..... [1]

(b) A student investigated the effect of hydrogen peroxide concentration on the activity of catalase. The student measured the distance the solution moved along a clear plastic tube attached to a syringe, as shown in Fig. 1.5.

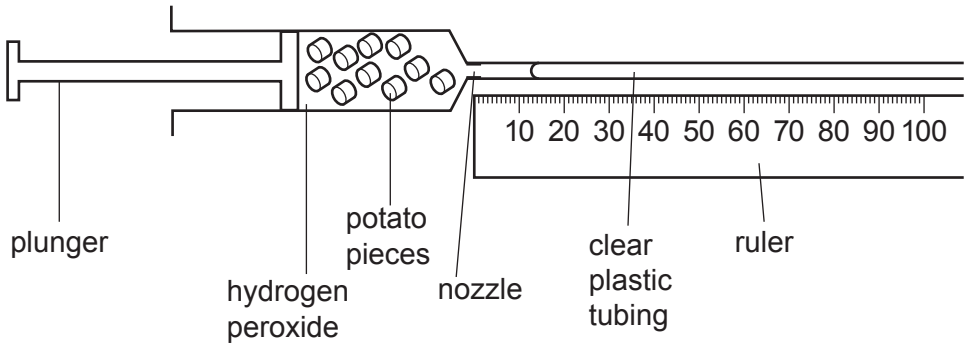


Fig. 1.5

The results are shown in Table 1.5.

Table 1.5

percentage concentration of hydrogen peroxide	distance moved in 1 minute / mm
0.2	11
0.4	18
0.8	50
1.5	69
3.0	73
6.0	73

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(i) Plot a graph of the data in Table 1.5 on the grid in Fig. 1.6.

Use a sharp pencil for drawing graphs.

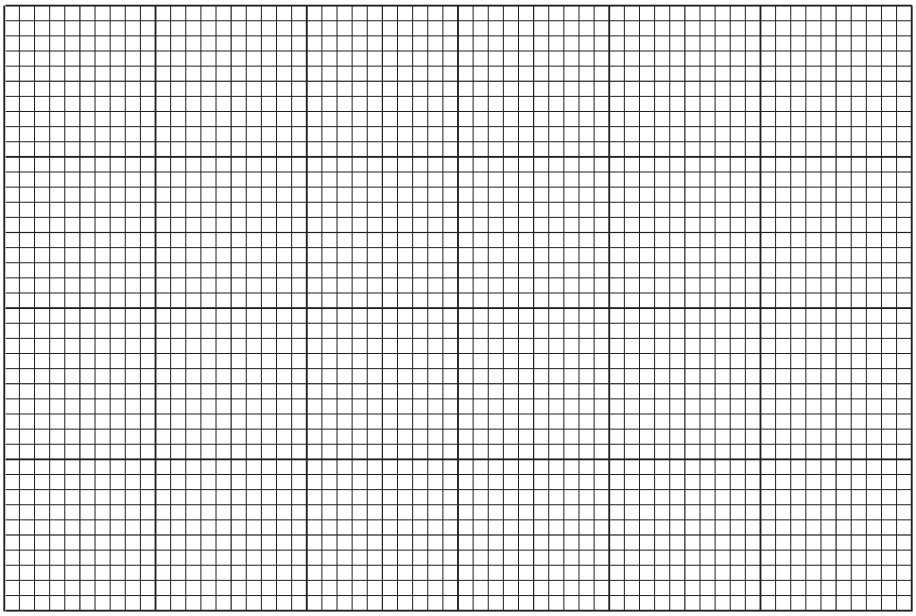


Fig. 1.6

[4]

(ii) Suggest an explanation for the results between 0.2% and 6.0% hydrogen peroxide.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 22]

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

(a) Set up the microscope so that you can observe the section on **J1**.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the whole section of the leaf on **J1**. Your drawing should show the correct shapes and proportions of different tissues.

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

[5]

(ii) Observe the ring of cells surrounding the vascular tissue in the centre of the section on **J1**.

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

Each cell that you draw must touch at least one of the other cells.

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

[5]

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



Fig. 2.1

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

Record the observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.1

[3]

(ii) The presence of a thick waxy cuticle in the leaf section in Fig. 2.1 supports the conclusion that the plant is adapted to live in a dry environment.

Observe the leaf section in Fig. 2.1.

Suggest **one** other observable feature in the section in Fig. 2.1 which supports this conclusion.

.....

Explain how this feature would prevent water loss.

.....

.....

..... [1]

(c) Fig. 2.2 is a photomicrograph of the same leaf section that is in Fig. 2.1.

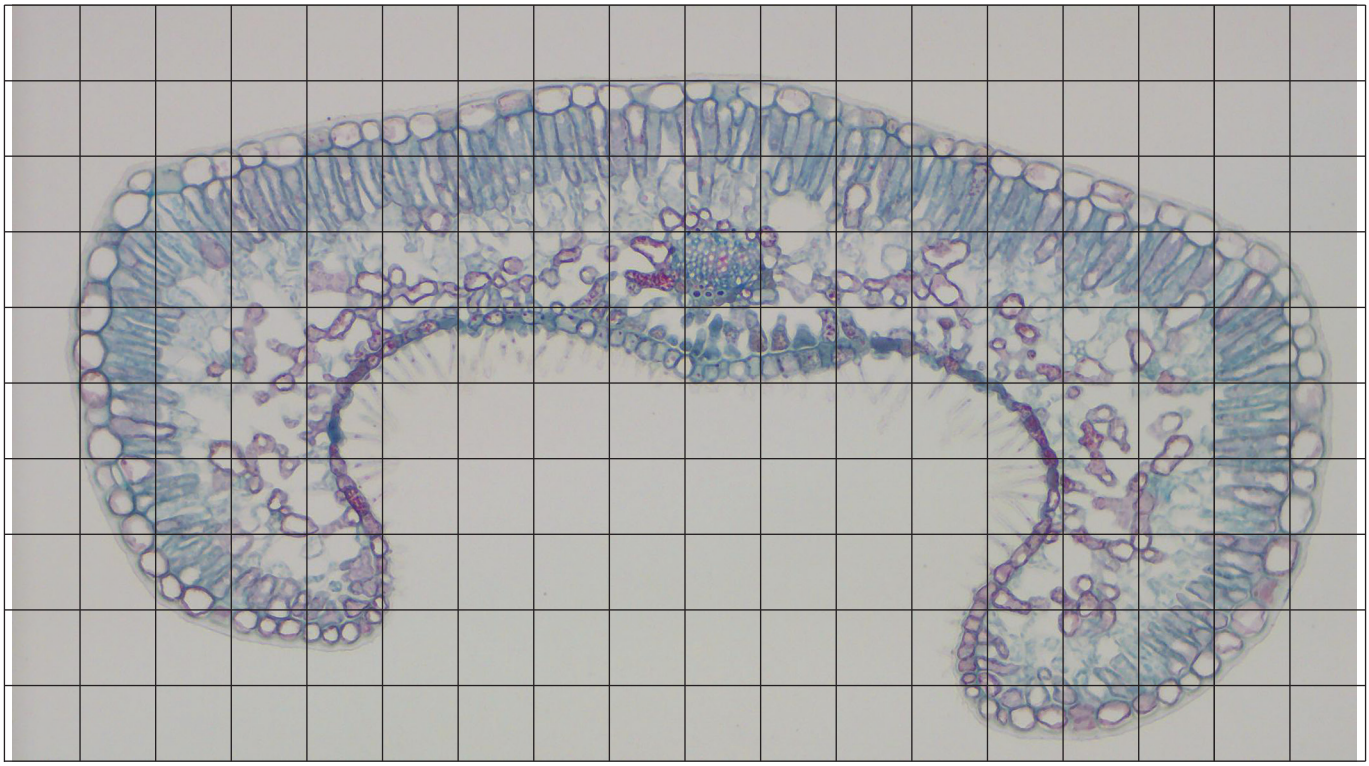


Fig. 2.2

You will need to use the grid to find the area of the palisade layer **and** the total area of the leaf section in Fig. 2.2.

Each square of the grid is 1 cm^2.

In some squares the palisade layer or the leaf section does not fill the whole square.

(i) Describe the method you will use to decide which of these squares to include.

.....

.....

..... [1]

(ii) State the area of the palisade layer and the total area of the leaf section in Fig. 2.2.

area of palisade layer = ... cm^2

total area of the leaf section = ... cm^2
[2]

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(iii) Calculate the area of the palisade layer as a percentage of the total area of the leaf section.

Show your working.

[1]

[Total: 18]

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Cambridge International AS & A Level

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6238188355

BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2021**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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INFORMATION

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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 The enzyme amylase breaks down starch to form reducing sugars.

It has been found that drinking tea affects the activity of amylase.

You will investigate the effect of different concentrations of tea extract on the breakdown of starch by amylase.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
E	amylase solution	harmful irritant	50
T	100% tea extract	none	20
S	starch solution	none	50
W	distilled water	none	150
iodine	iodine solution	irritant	20

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

It is recommended that you wear suitable eye protection.

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

Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

(a) (i) Complete Fig. 1.1 by drawing as many extra beakers as you need for your serial dilution of **T**.

For each beaker add labelled arrows to show:

- the volume of tea extract transferred
- the volume of water, **W**, added.

Under each beaker state the concentration of tea extract.

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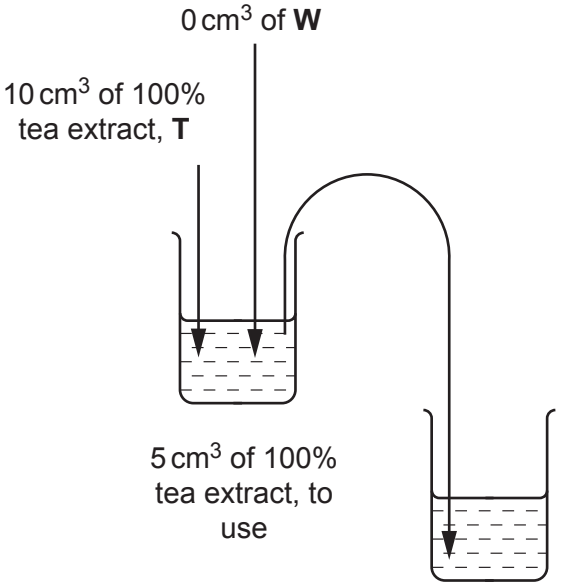

0 cm3 of W
10 cm3 of 100% tea extract, T
5 cm3 of 100% tea extract, to use

Fig. 1.1

[3]

Carry out step 1 to step 12.

1. Prepare the concentrations of tea extract as shown in Fig. 1.1.

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

3. Put 1 cm^3 of each concentration of tea extract into the appropriately labelled test-tube.

4. Put 5 cm^3 of **E** into each of the labelled test-tubes. Shake gently to mix.

5. Using the beakers labelled **hot water** and **cold water**, set up and maintain a water-bath with water between 30 °C and 40 °C.

6. Put the test-tubes from step 4 into the water-bath.

7. Label a white tile, as shown in Fig. 1.2, with:

   - the times 2, 4, 6, 8 and 10 (minutes)
   - the percentage concentrations of tea extract you prepared in step 1.

8. Put drops of iodine solution onto the white tile as shown in Fig. 1.2.

You will need one row of drops of iodine solution for each of the concentrations of tea extract you prepared in step 1.

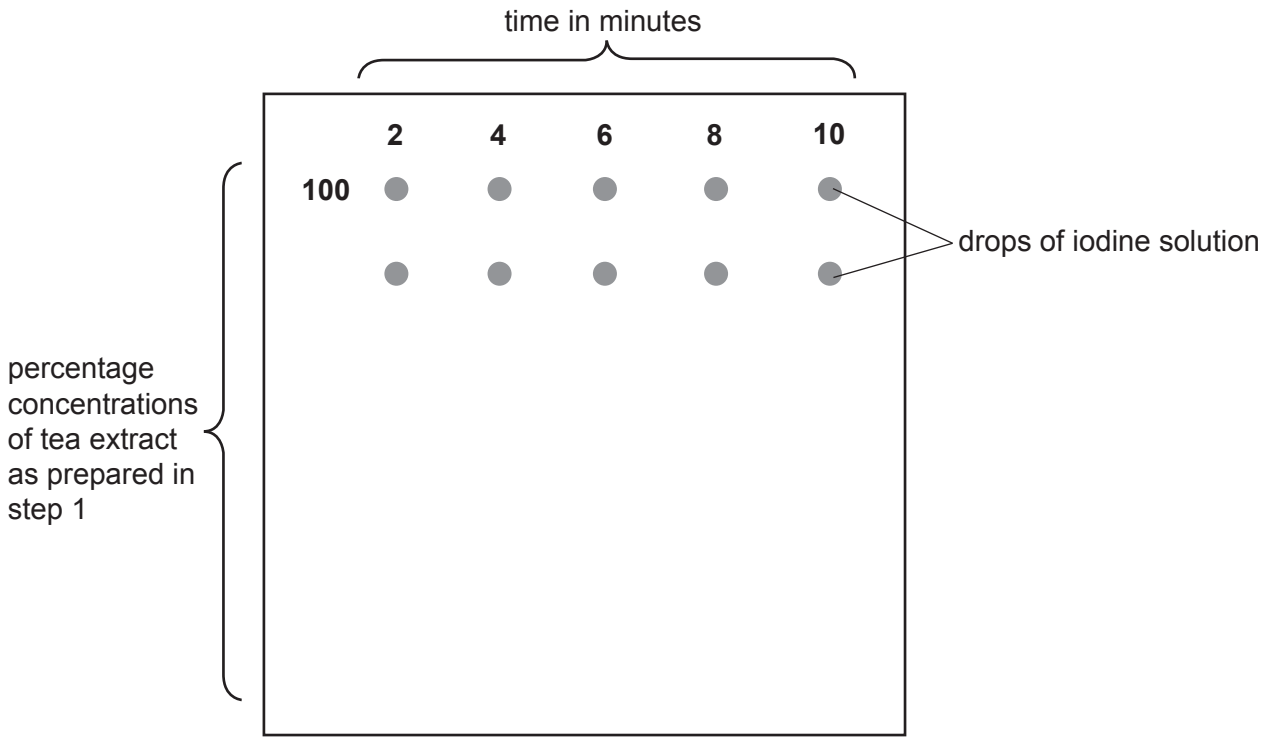


Fig. 1.2

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Read step 9 to step 12 before continuing.

9. Put 2 cm^3 of starch solution **S** into each test-tube (in the water-bath). Shake gently to mix. Start timing.

10. After 2 minutes:

    - use a pipette to remove a sample of the solution from the test-tube labelled 100%
    - put 1 drop of the solution onto the spot of iodine solution labelled 2 (minutes) on the row labelled 100 (%)
    - put 1 drop of the next solution onto the spot of iodine solution labelled 2 (minutes) on the row labelled with your next concentration of tea extract
    - repeat for the other concentrations of tea extract you prepared in step 1, so that all of the drops of iodine solution in the 2 minute column have been used.

11. Repeat step 10 at intervals of 2 minutes until there is no blue-black colour. This is the end-point.

Note: you will not see the original colour of the iodine due to the presence of the tea.

If the iodine continues to turn blue-black at 10 minutes, stop sampling and record this as 'more than 10'.

12. Record in **(a)(ii)** the time taken to reach the end-point.

(ii) Record your results in an appropriate table.

[5]

(iii) State the trend for your results.

.....

..... [1]

(iv) Tea is a competitive inhibitor of amylase.

Explain how tea can act as a competitive inhibitor of amylase.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(v) The volume of the drops of iodine solution in step 8 was not standardised.

Suggest **one** improvement to step 8.

.....

.....

..... [1]

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(vi) Identify **two** possible sources of error in step 9 **and** suggest improvements to reduce the effect of these errors.

error .....

.....

improvement .....

.....

.....

error .....

.....

improvement .....

.....

.....

[4]

(b) Caffeine is a chemical found in tea and many other drinks.

A student investigated the concentration of caffeine in different types of drink.

Table 1.2 shows the student's raw data and processed data.

Table 1.2

type of drink	raw data		processed data
	volume of one serving / cm^3	mass of caffeine per serving / mg	concentration of caffeine / mg cm^{-3}
black tea (BT)	220	40	0.18
filter coffee (FC)	350	195	
decaffeinated tea (DT)	220	5	0.02
cola light (CL)	330	33	0.10
espresso coffee (EC)	30	48	1.60
green tea (GT)	220	18	0.08

(i) Complete Table 1.2 by calculating the concentration of caffeine in filter coffee.

[1]

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(ii) Plot a bar chart on the grid in Fig. 1.3 to show the concentration of caffeine (processed results) in the different types of drink shown in Table 1.2.

Use a sharp pencil for drawing bar charts.

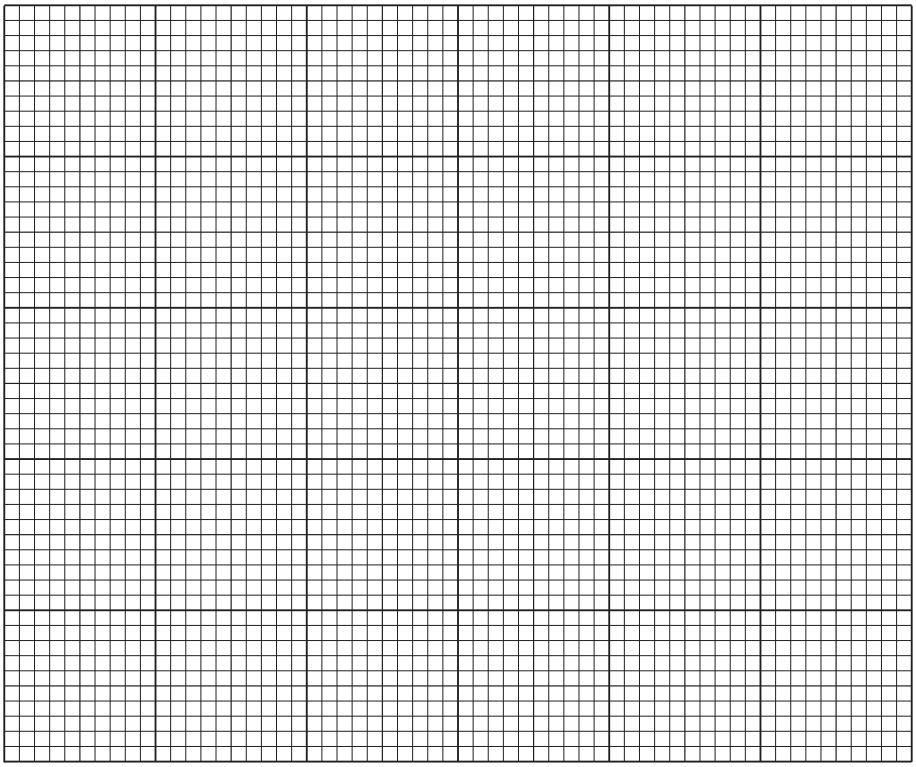


Fig. 1.3

[4]

(c) An energy drink contains a mixture of caffeine and reducing sugars.

State the reagent you would use to determine the concentration of reducing sugar in the energy drink.

..... [1]

[Total: 23]

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

(a) Set up the microscope so that you can observe the section on **K1**.

Observe the different tissues in the area on **K1** shown by the shaded region in Fig. 2.1.

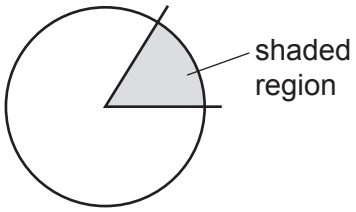


Fig. 2.1

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the area of the section on **K1** shown by the shaded region in Fig. 2.1, to include **two** large vascular bundles.

Your drawing should show the correct shapes and proportions of the different tissues.

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

[5]

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(ii) Observe the epidermis of the section on **K1**.

Select a line of **four** adjacent epidermal cells. Each cell in the line 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]

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

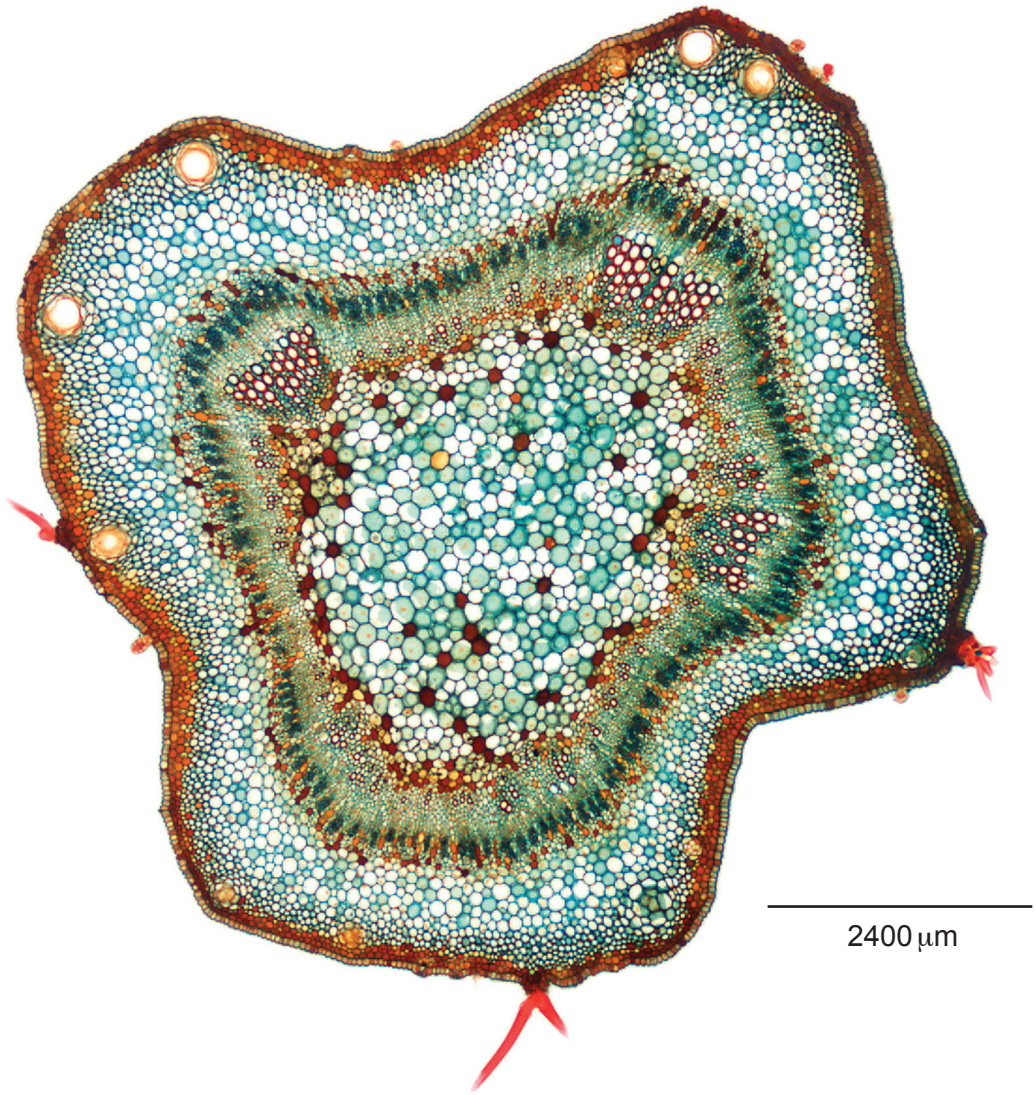


Fig. 2.2

(i) Use the scale bar on Fig. 2.2 to calculate the magnification of Fig. 2.2.

Show your working.

magnification = ... [3]

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(ii) Identify the observable differences between the section on **K1** and the section in Fig. 2.2.

Record the observable differences in Table 2.1.

Table 2.1

feature	K1	Fig. 2.2

[4]

[Total: 17]

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CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

5669683721

BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

2 hours

You must answer on the question paper.

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

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INFORMATION

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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 Some biological molecules produce a colour change when tested with a specific reagent.

You will investigate which biological molecules are present in four solutions, **S1**, **S2**, **S3**, and **S4**. Each solution contains **one** or **none** of the biological molecules: protein, starch, reducing sugar.

You will also investigate the contents of solution **U** which contains a mixture of biological molecules.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
C	0.15% copper sulfate solution	none	10
P	5% potassium hydroxide solution	harmful irritant	10
iodine	iodine solution	irritant	5
B	Benedict's solution	harmful irritant	20
S1	unknown solution	none	10
S2	unknown solution	none	10
S3	unknown solution	none	10
S4	unknown solution	none	10
U	unknown mixture of biological molecules	none	10

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

It is recommended that you wear suitable eye protection.

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Carry out the test for protein on **S1**, **S2**, **S3**, and **S4**, using step 1 to step 9.

1. Label four test-tubes, **S1**, **S2**, **S3**, and **S4**.
2. Put 1 cm^3 of **S1** into the test-tube labelled **S1**.
3. Repeat step 2 for **S2**, **S3**, and **S4**.
4. Put 1 cm^3 of **P** into each test-tube. Shake gently to mix.
5. Put 1 cm^3 of **C** into each test-tube. Shake gently to mix.
6. Leave the test-tubes for at least 1 minute. Shake gently to mix.
7. Observe the colour in each test-tube and record your observations in **(a)(iii)**.
8. Identify the solution or solutions (**S1**, **S2**, **S3**, **S4**) that contain protein and record this in **(a)(iv)**.
9. Keep any test-tubes from step 8 that contain protein. Empty the test-tubes that do **not** contain protein into the container labelled '**For waste**'. Rinse the empty test-tubes for use in step 10.

(a) **(i)** State the reagent that is used to test for reducing sugar **and** the colour or colours produced if a reducing sugar is present.

reagent .....

colour or colours .....

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

.....

.....

.....

.....

.....

.....

[3]

10. Carry out the test for reducing sugar on each of the solutions using the labelled test-tubes from step 9. You do **not** need to test any solutions identified as containing protein in step 8.
11. Observe the colour in each test-tube and record your observations in **(a)(iii)**.
12. Identify the solution or solutions (**S1**, **S2**, **S3**, **S4**) that contain reducing sugar and record this in **(a)(iv)**.

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13. Keep any test-tubes from step 12 that contain reducing sugar. Empty the test-tubes that do **not** contain reducing sugar into the container labelled '**For waste**'. Rinse the empty test-tubes for use in step 14.

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

reagent .....

colour .....

[1]

14. Carry out the test for starch on each of the solutions using the labelled test-tubes from step 13. You do **not** need to test any solutions identified as containing protein or reducing sugar in step 8 and step 12.

15. Observe the colour in each test-tube and record your observations in **(a)(iii)**.

16. Identify the solution or solutions (**S1**, **S2**, **S3**, **S4**) that contain starch and record this in **(a)(iv)**.

17. Identify the solution or solutions, if any, that do **not** contain protein, reducing sugar or starch. Record this as 'none' in **(a)(iv)**.

(iii) Record your observations in an appropriate table.

[4]

(iv) Identify the biological molecules present in solutions **S1**, **S2**, **S3** and **S4**. If any solution does **not** contain protein, reducing sugar or starch write the answer as 'none'.

S1 .....

S2 .....

S3 .....

S4 .....

[3]

18. Carry out the tests for protein, reducing sugar and starch using solution **U**.

19. Observe the colour from each test and record your observations in **(a)(v)**.

(v) Record the colours observed for each test for **U**.

protein test .....

reducing sugar test .....

starch test .....

[1]

(vi) Identify the biological molecules present in **U**.

.....

.....

.....

[1]

(b) A student carries out the same tests for protein, reducing sugar and starch on two unknown solutions, **Y** and **Z**. The student also carries out the test for the presence of lipid.

(i) Describe the test for lipid and the expected observation if a lipid is present.

.....

.....

.....

.....

observation if a lipid is present .....

[2]

From the observations for each test, the student concludes:

- solution **Y** contains protein and reducing sugar
- solution **Z** contains protein and lipid.

The student also carries out the test for non-reducing sugar on solution **Y** and on solution **Z**.

The student observes a positive result for the presence of a non-reducing sugar in solution **Y** and in solution **Z**.

The student concludes that a non-reducing sugar is present in solution **Y** and in solution **Z**.

(ii) Suggest why the student's conclusion may **not** be correct for solution **Y**.

.....

.....

.....

[1]

(iii) The student thought that the protein in solution **Z** could be the enzyme amylase.

Describe how the student could determine whether the protein in solution **Z** is amylase.

.....

.....

.....

.....

.....

.....

.....

[3]

[Total: 19]

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

(a) Set up the microscope so that you can observe the section on **L1**.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the whole section of the leaf on **L1**. Your drawing should show the correct shapes and proportions of the different tissues.

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

[5]

(ii) Observe the cells in the layer just below the epidermis of the section on **L1**.

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

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

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

[5]

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



Fig. 2.1

The leaf sections on **L1** and in Fig. 2.1 are from plants that are adapted to grow in dry environments (xerophytic plants).

(i) Observe the leaf sections on **L1** and in Fig. 2.1.

- State **one** xerophytic feature that is visible on **L1**.

.....

- State **one** xerophytic feature visible in Fig. 2.1 that is a **different** feature from the one you have identified for **L1**.

.....

[2]

(ii) Observe the vascular tissue on **L1** and in Fig. 2.1.

Identify **one** observable difference between the vascular tissue on **L1** and in Fig. 2.1.

Record the observable difference in Table 2.1.

Table 2.1

feature	L1	Fig. 2.1
vascular tissue		

[1]

(c) A scientist identifies five different types of tree in a forest, as shown in Table 2.2.

Table 2.2

type of tree	percentage of total trees in the forest
Juniperus excelsa (E)	10.5
Pinus pinea (P)	37.0
Cedrus libani (L)	5.0
Juniperus drupacea (D)	3.0
Pinus brutia (B)	44.5

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(i) Plot a bar chart of the data in Table 2.2 on the grid in Fig. 2.2.

Use a sharp pencil for drawing bar charts.

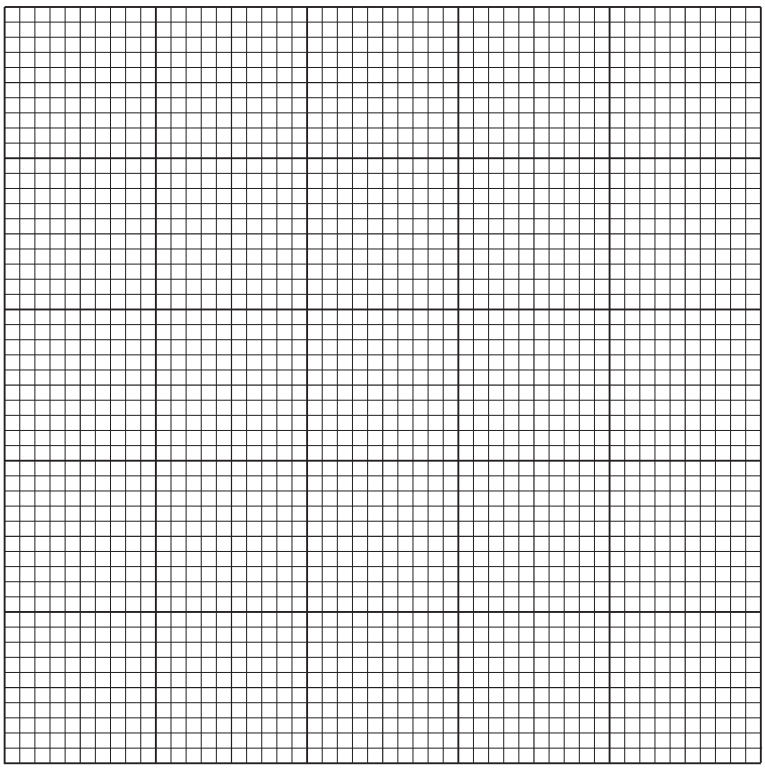


Fig. 2.2

[4]

(ii) The forest has a total of 2344 trees.

Calculate the total number of *Juniperus* trees in the forest using the data in Table 2.2.

Show your working.

total number of *Juniperus* trees = ...

[4]

[Total: 21]

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1746388050

BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 2021**

2 hours

You must answer on the question paper.

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

INSTRUCTIONS

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

INFORMATION

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

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1	
2	
Total	

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[Turn over

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

When a mixture of hydrogen peroxide and yeast cells is put into a syringe, some of the mixture comes out of the syringe nozzle as the oxygen is released.

You are going to investigate the effect of pH on the activity of catalase.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	3% hydrogen peroxide solution	irritant	25
Y	yeast cell suspension	none	40
B3	buffer pH 3	none	10
B4	buffer pH 4	none	10
B5	buffer pH 5	none	10
B6	buffer pH 6	none	10
B7	buffer pH 7	none	10
U	unknown pH buffer	none	10

If any of the solutions come into contact with your skin, wash off immediately with cold water.

It is recommended that you wear suitable eye protection.

Wear gloves to protect your hands when using **H**.

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Carry out step 1 to step 22.

1. Put clear plastic tubing onto the nozzle of a 10 cm^3 syringe, as shown in Fig. 1.1.

2. Put two marks on the (plastic) tubing so that one mark is at a distance of 5 cm from the nozzle and the other mark is at a distance of 15 cm from the nozzle, as shown in Fig. 1.1.

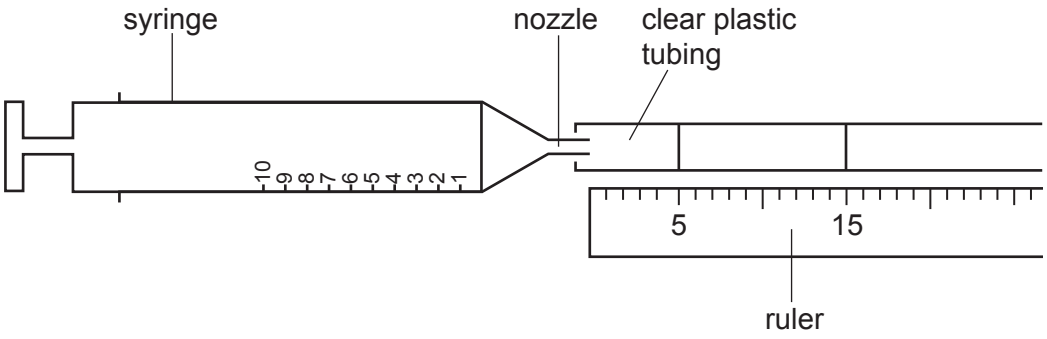


Fig. 1.1

3. Remove the tubing from the nozzle of the syringe.

4. Use the glass rod to stir the yeast cell suspension, **Y**.

5. Put the nozzle of the syringe into the beaker containing **Y**.

6. Pull the plunger out to the 3 cm^3 mark so that **Y** enters the syringe, as shown in Fig. 1.2.

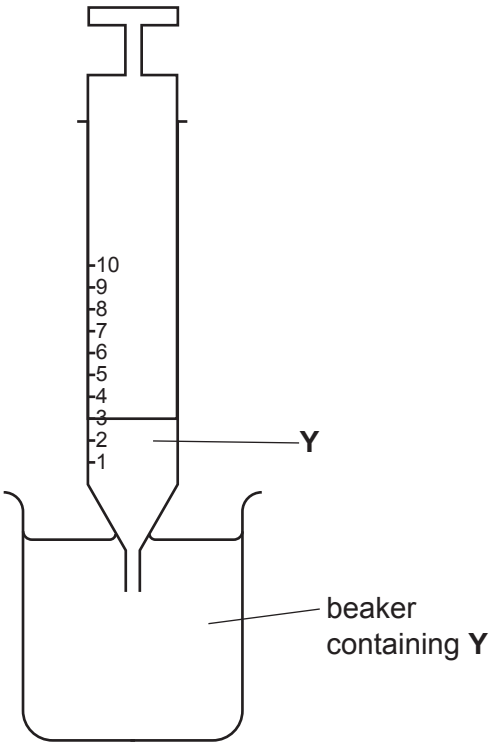


Fig. 1.2

7. Remove the syringe from the beaker containing **Y** and wipe the nozzle with a paper towel.

8. Put the nozzle of the same syringe into the beaker containing the pH 3 buffer, **B3**.

9. Pull the plunger out to the 5 cm^3 mark so that approximately 2 cm^3 of the buffer enters the syringe, as shown in Fig. 1.3.

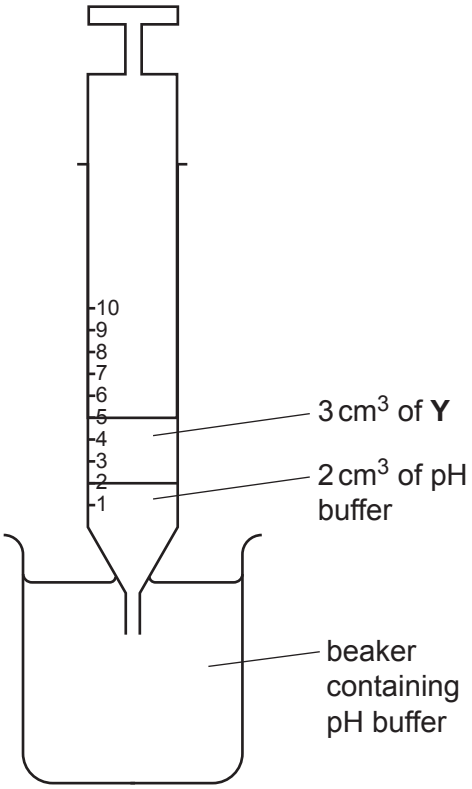


Fig. 1.3

10. Remove the syringe from the beaker containing pH buffer and wipe the nozzle with a paper towel.

11. Put the nozzle of the same syringe into the beaker containing hydrogen peroxide solution, **H**.

12. Pull the plunger out to the 6 cm^3 mark so that approximately 1 cm^3 of **H** enters the syringe, as shown in Fig. 1.4.

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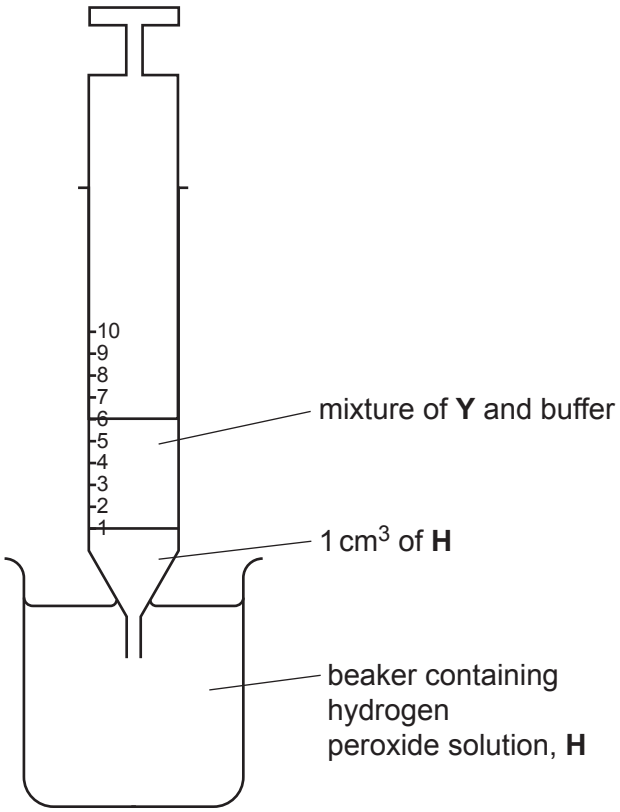


Fig. 1.4

13. Remove the syringe from the beaker containing hydrogen peroxide solution, **H**, and carefully wipe the nozzle with a paper towel to remove excess **H**.

14. Put the tubing onto the nozzle.

15. Put the syringe and tubing on a flat surface, as shown in Fig. 1.5.

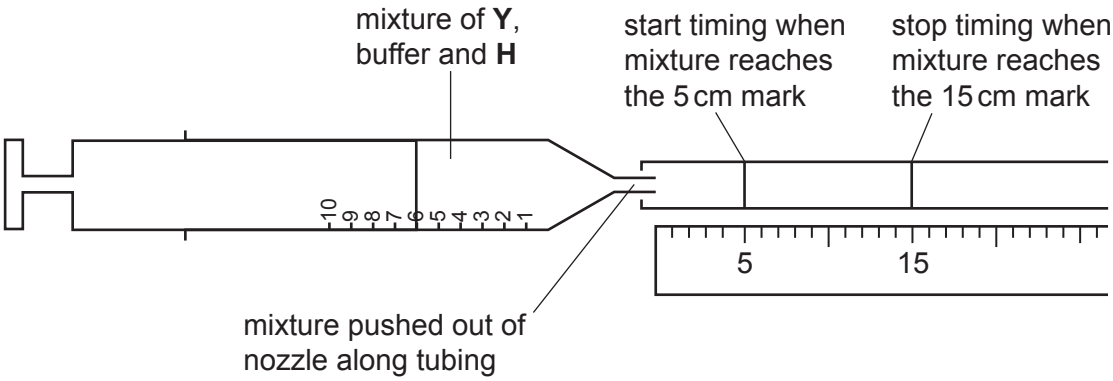


Fig. 1.5

16. Start timing when the mixture reaches the mark at 5 cm.

17. Stop timing when the mixture reaches the mark at 15 cm. Record the time in **(a)(i)**.

    If the mixture does not reach the 5 cm mark or if it takes more than 4 minutes to reach the 15 cm mark, record as 'more than 240'.

18. Hold the syringe with the nozzle up and remove the tubing from the syringe. Put the tubing onto a paper towel.

19. Hold the syringe with the nozzle pointing downwards over the container labelled '**For waste**' and empty the syringe.

20. Fill the syringe with water from the container labelled '**For washing**'. Put the tubing onto the syringe nozzle and empty the syringe into the container labelled '**For waste**'.

21. Repeat step 3 to step 20 with each of the other pH buffers, **B4**, **B5**, **B6** and **B7**.

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

[5]

(ii) State the dependent variable for this investigation.

..... [1]

(iii) Suggest an appropriate control for this investigation.

.....

.....

..... [1]

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22. Repeat step 3 to step 20 with the unknown pH buffer, **U**. Record the time in **(a)(iv)**.

(iv) State the time for **U**. .....

Using your results from **(a)(i)** estimate the pH of **U**. .....

[2]

(v) Identify **one** source of error in step 4 to step 17.

Suggest an improvement to the method which will reduce the effect of this error.

error .....

.....

improvement .....

.....

.....

.....

[2]

(vi) The procedure described by step 1 to step 21 investigated the effect of pH on catalase activity, by measuring the time taken for the mixture to move a set distance.

Describe how you would modify the procedure to investigate the effect of changing the concentration of hydrogen peroxide on the time taken for the mixture to move a set distance.

.....

.....

.....

.....

.....

..... [2]

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(b) A student investigated the effect of temperature on the activity of catalase, by measuring the concentration of hydrogen peroxide remaining in the mixture after a set time.

The student used potassium manganate(VII) solution to determine the concentration of hydrogen peroxide remaining in the mixture.

The greater the volume of potassium manganate(VII) used, the higher the concentration of hydrogen peroxide remaining.

The results are shown in Table 1.2.

Table 1.2

temperature / °C	**volume of potassium manganate(VII) used / cm^3**
10.0	11.0
23.0	7.0
32.0	4.5
38.5	3.2
49.0	7.4
58.5	10.8

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(i) Plot a graph of the data in Table 1.2 on the grid in Fig. 1.6.

Use a sharp pencil for drawing graphs.

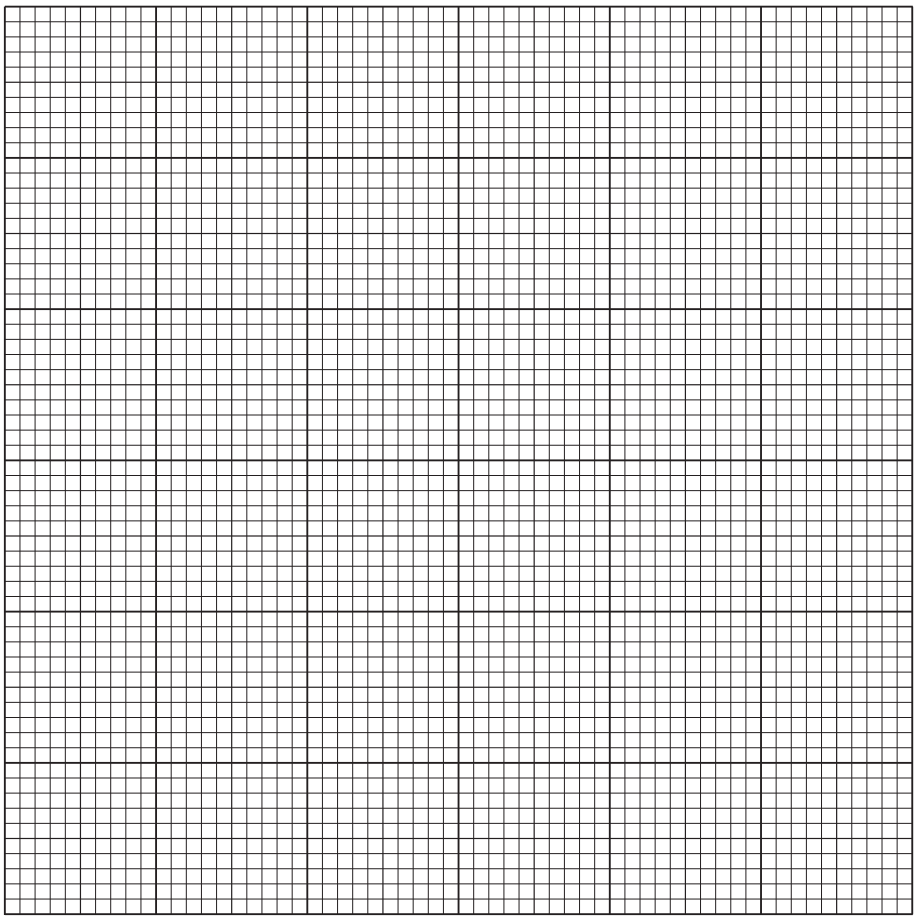


Fig. 1.6

[4]

(ii) Use your graph to find the volume of potassium manganate(VII) needed when the temperature was 45 °C.

volume of potassium manganate(VII) = ... cm^3 [1]

(iii) Suggest an explanation for the difference in concentration of hydrogen peroxide remaining at 38.5 °C and at 58.5 °C.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 20]

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

(a) Set up the microscope so that you can observe the section on **M1**.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the whole section on **M1**. Your drawing should show the correct shapes and proportions of the different tissues.

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

[6]

(ii) Observe the xylem vessel elements in the centre of the section of the root on **M1**.

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

Each smaller cell that you draw must touch the larger xylem vessel element and at least **one** of the other smaller cells.

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

[5]

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

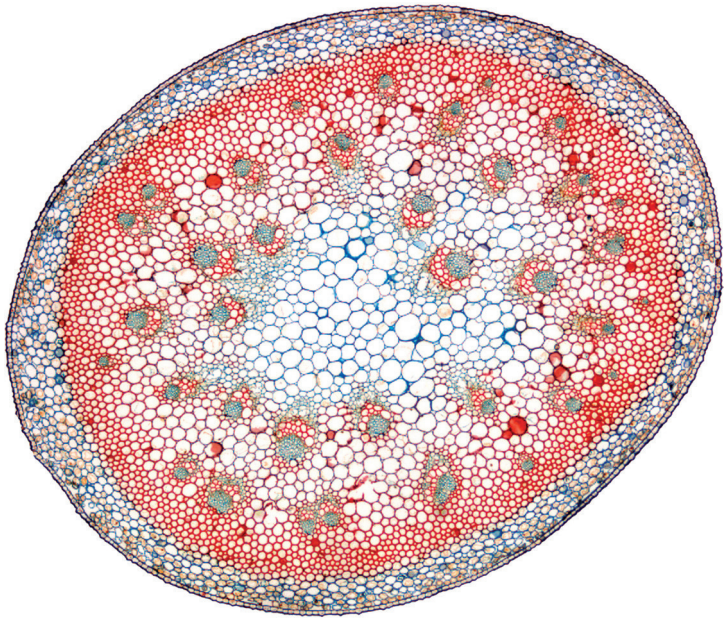


Fig. 2.1

(i) Identify **one** similarity between the section on **M1** and the section shown in Fig. 2.1.

.....

..... [1]

(ii) Identify the observable **differences** between the section on **M1** and the section shown in Fig. 2.1.

Record the observable differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.1

[3]

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

The length of one division on this stage micrometer is **0.8 mm**.

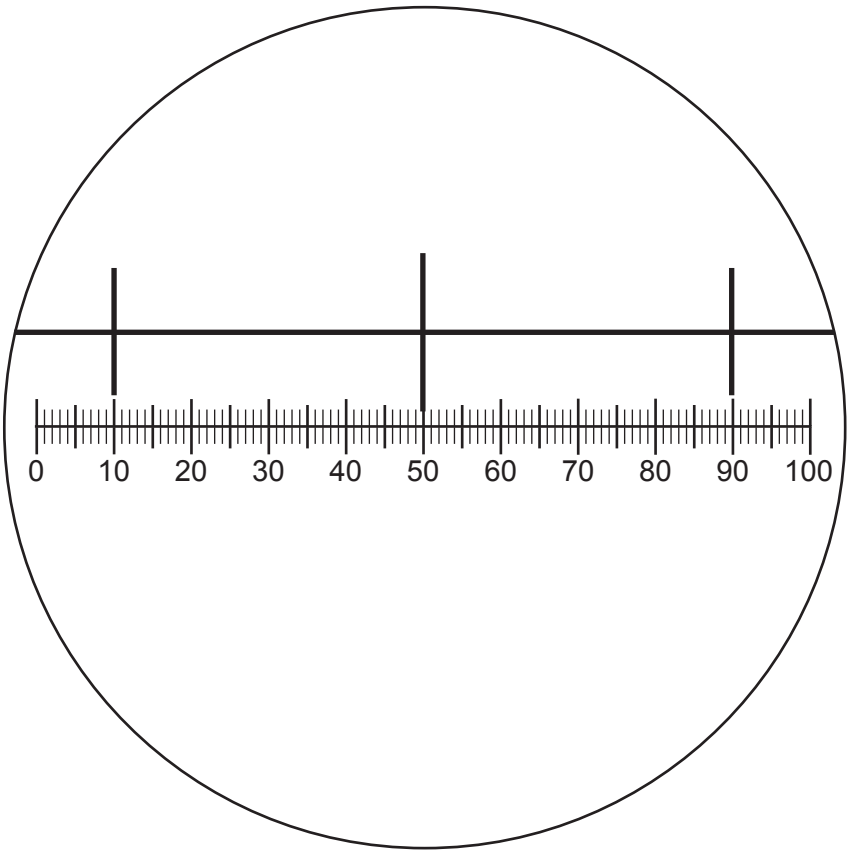


Fig. 2.2

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

[3]

Fig. 2.3 shows a photomicrograph of a section of a stem, viewed using a microscope with an eyepiece graticule.

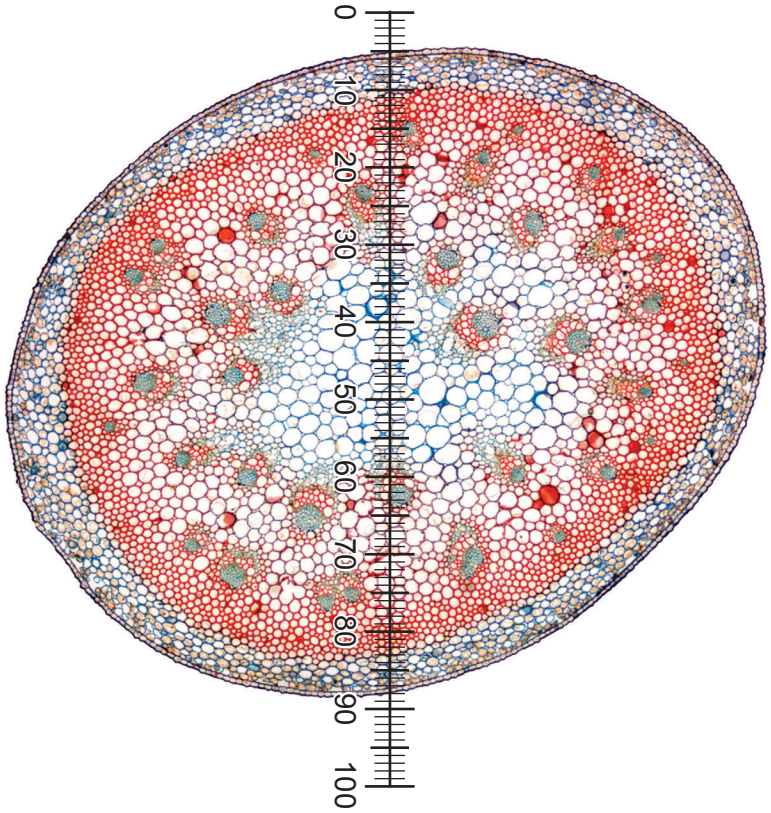


Fig. 2.3

(ii) The eyepiece graticule shown in Fig. 2.3 has been placed across the diameter of the section.

Use the calibration of the eyepiece graticule unit from **(c)(i)** to calculate the actual diameter of the section in Fig. 2.3.

Show your working.

[2]

[Total: 20]

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

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 A farmer who grows grapes needs to pick them when they have the highest reducing sugar content.

You will be using the Benedict's test to determine the concentration of reducing sugars in different samples of grape juice, **U1**, **U2** and **U3**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
U1	unknown concentration of reducing sugars	none	20
U2	unknown concentration of reducing sugars	none	20
U3	unknown concentration of reducing sugars	none	20
W	distilled water	none	100
B	Benedict's solution	harmful irritant	50
R	2% reducing sugar solution	none	50

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

It is recommended that you wear suitable eye protection.

(a) The Benedict's test requires you to heat test-tubes containing some of the above solutions in a boiling water-bath.

Read step 1 to step 5 on page 3 and then assess the risk of using a boiling water-bath in these steps as **low**, **medium** or **high**.

State the level of risk. .....

(i) State **one** reason for your answer.

.....

..... [1]

Carry out step 1 to step 9.

1. Set up a water-bath and heat to boiling ready for step 5, step 15 and step 22.
2. Label 3 test-tubes **U1**, **U2** and **U3**.
3. Put 2 cm^3 of **U1** in the test-tube labelled **U1**.
4. Put 2 cm^3 of **B** into the test-tube containing **U1**. Shake gently to mix.
5. Put this test-tube into the boiling water-bath. Start timing.
6. Measure the time taken for the first appearance of a colour change in the test-tube.
   If there is no colour change after 120 seconds, stop timing.
7. Record the result in **(a)(ii)**. If there is no colour change after 120 seconds, record as 'more than 120'.
8. Remove the test-tube from the water-bath and put it in the test-tube rack.
9. Repeat step 3 to step 8 for **U2** and **U3**.

(ii) Record your results for **U1**, **U2** and **U3** in an appropriate table.

[3]

(iii) Using your results in **(a)(ii)**, state which sample, **U1**, **U2** or **U3**, has the highest concentration of reducing sugars.

..... [1]

You will need to carry out a **serial** dilution of the 2% reducing sugar solution, **R**, to reduce the concentration by **half** between each successive dilution.

Fig. 1.1 shows the first 2 beakers you will use to make your serial dilution.

(iv) Complete Fig. 1.1 by drawing as many extra beakers as you need for your serial dilution of reducing sugar solution.

For each beaker add labelled arrows to show:

- The volume of reducing sugar solution transferred
- The volume of water added.

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

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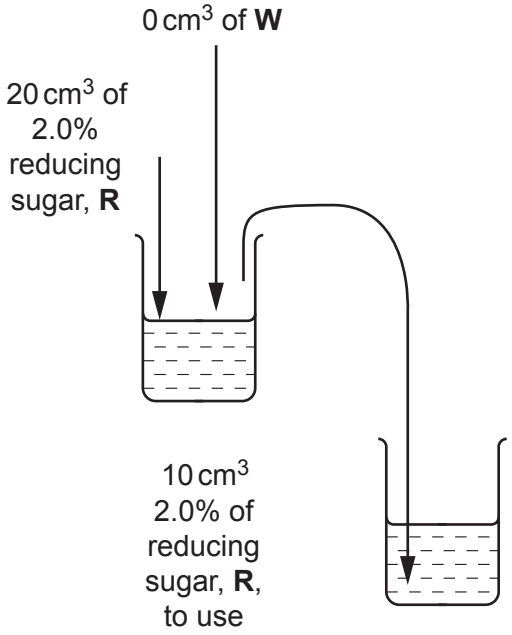

0 cm3 of W
20 cm3 of 2.0% reducing sugar, R
10 cm3 2.0% of reducing sugar, R, to use

Fig. 1.1

[3]

Carry out step 10 to step 19.

10. Prepare the concentrations of reducing sugar solution as shown in Fig. 1.1.
11. Label test-tubes with the concentrations you prepared in step 10.
12. Put 2 cm^3 of 2% reducing sugar solution into the appropriately labelled test-tube.
13. Put 2 cm^3 of **B** into the same test-tube. Shake gently to mix.
14. Repeat step 12 to step 13 with the other concentrations you prepared in step 10.
15. Put all the test-tubes into the boiling water-bath. Start timing.
16. Leave the test-tubes in the boiling water-bath for 1 minute.
17. Remove the test-tubes with a test-tube holder and put them into a test-tube rack.
18. Observe the colour in each test-tube. You may see the same colour in more than one test-tube.
19. Record the colours in **(a)(v)** using the words:

red **orange** **brown** **green** **blue**

(v) Record your results in an appropriate table.

[4]

In **(a)(iii)** you identified the solution with the highest concentration of reducing sugars as either **U1**, **U2** or **U3**.

20. Put 2 cm^3 of the solution you identified in **(a)(iii)** into a test-tube.

21. Put 2 cm^3 of **B** into the same test-tube. Shake gently to mix.

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

23. Leave the test-tube in the boiling water-bath for 1 minute.

24. Remove the test-tube with a test-tube holder and put it into a test-tube rack.

25. Observe the colour in the test-tube. Record the colour in **(a)(vi)**, using one of the words:

red **orange** **brown** **green** **blue**

(vi) State the colour observed in step 25 .....

Using your results in **(a)(v)**, estimate the concentration of reducing sugars in this sample.

..... [1]

A student carries out the same procedure and finds that one of the unknown samples gives a negative result for reducing sugars. The student thinks that the sample may contain non-reducing sugars.

(vii) Describe how you would modify the procedure to test for non-reducing sugars.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) As grapes ripen, the concentrations of the different reducing sugars change.
A scientist measured the concentration of glucose and fructose at different stages of ripening.

The results are shown in Table 1.2.

Table 1.2

stage of ripening	percentage concentration of reducing sugar	
	glucose	fructose
unripe	9	1
ripening	7.5	9.5
ripe	3	22

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

Use a sharp pencil for drawing bar charts.

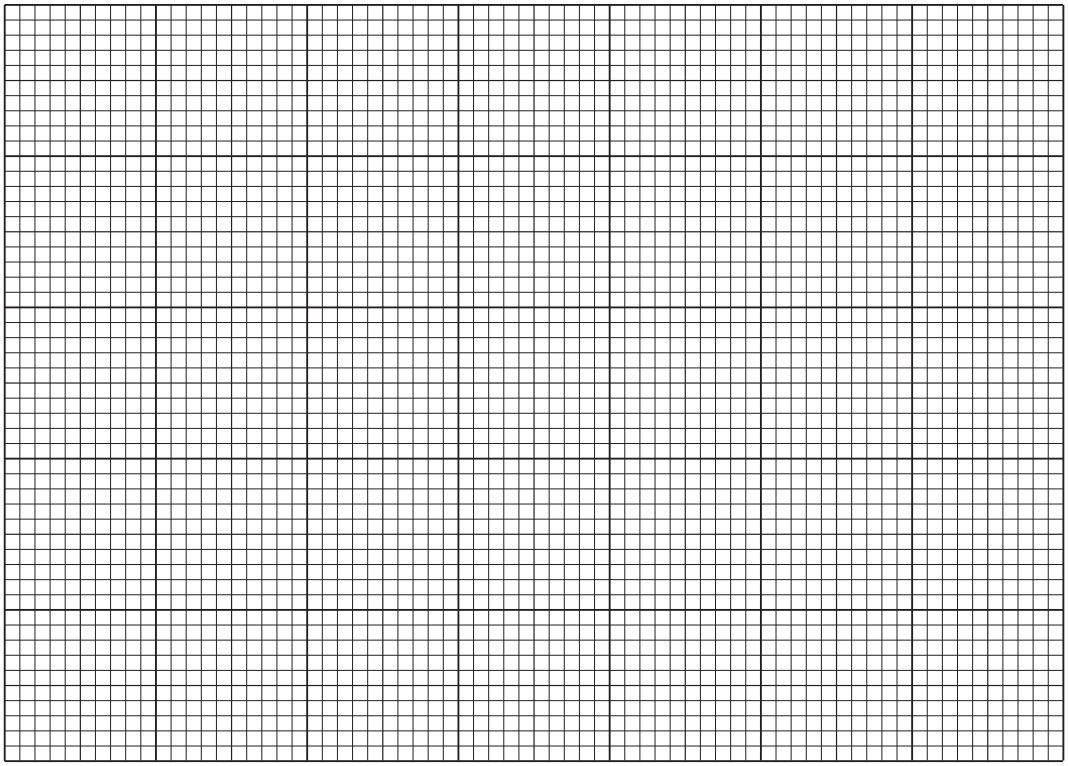


Fig. 1.2

[4]

[Total: 20]

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Question 2 starts on page 10.

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

(a) Set up the microscope so that you can observe the section on **N1**.

Observe the different tissues in the area on **N1** shown by the shaded region in Fig. 2.1.

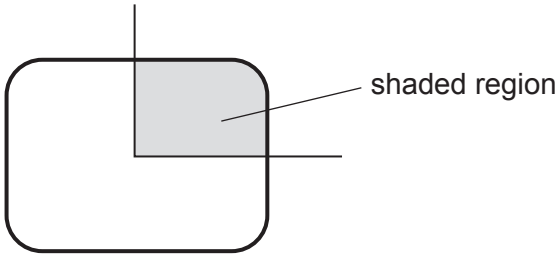


Fig. 2.1

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the area of the section on **N1** as shown by the shaded region in Fig. 2.1. Your drawing should show the correct shapes and proportions of the different tissues.

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

[5]

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

Select **four** adjacent, touching cells of the central 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 different type of plant.

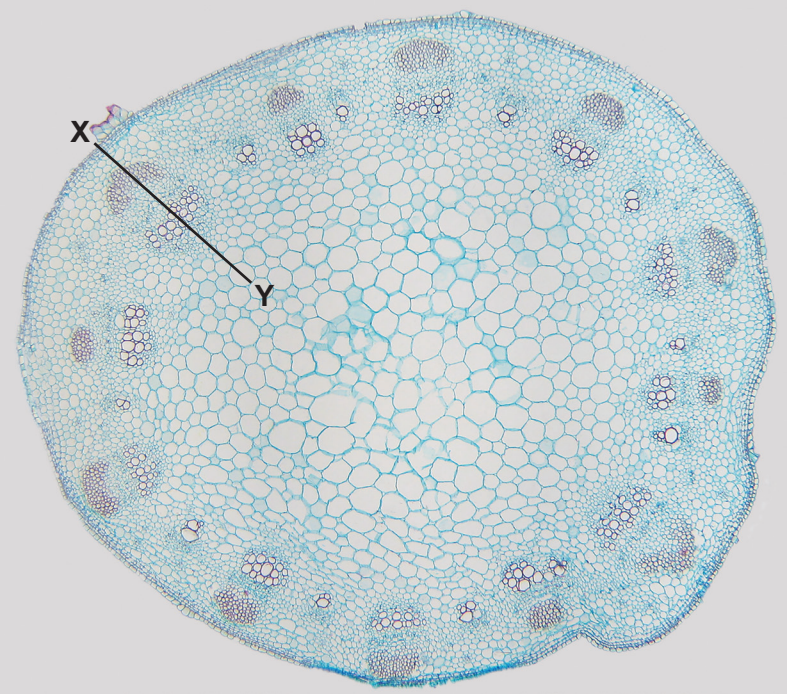


Fig. 2.2

(i) Use the scale bar and line **X**–**Y** on Fig. 2.2 to calculate the actual length of the vascular bundle.

Show your working and use appropriate units.

..... [3]

(ii) Identify the organ shown in Fig. 2.2.

.....

Give reasons for your answer.

.....

.....

.....

.....

..... [3]

(iii) Identify the observable differences between the section on **N1** and Fig. 2.2.

Record the observable differences in Table 2.1.

Table 2.1

feature	N1	Fig. 2.2

[4]

[Total: 20]

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