Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8146767288

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 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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1	
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 Invertase is an enzyme found in honey.

Invertase breaks down sucrose into reducing sugars, as shown in Fig. 1.1.

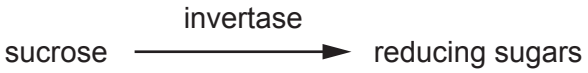


Fig. 1.1

You will carry out an investigation to determine the concentration of invertase in a sample of honey.

The presence of the reducing sugars can be detected by using Benedict's solution. The time taken for the Benedict's solution to first show a colour change can be used to estimate the concentration of invertase in the honey extract, **H**.

You will need to prepare a serial dilution of 1.0% invertase solution, **E**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	honey extract	none	10
E	1.0% invertase solution	harmful irritant	10
B	Benedict's solution	harmful irritant	30
S	5% sucrose solution	none	25
W	distilled water	none	150

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

It is recommended that you wear suitable eye protection.

(a) (i) Think about the hazards of using the invertase solution, **E**, as shown in Table 1.1.

State whether the risk of using the invertase solution, **E**, is **low**, **medium** or **high**. Give a reason for your answer.

risk .....

reason .....

.....

[1]

You need to carry out a **serial** dilution of the invertase solution, **E**, to reduce the concentration of invertase by a factor of 10 between each successive dilution.

Fig. 1.2 shows how to prepare the 1.0% and 0.1% concentrations of invertase solution.

(ii) Complete Fig. 1.2 by drawing as many extra beakers as you need for your serial dilution of invertase solution.

For each beaker:

- state, under the beaker, the volume and concentration of invertase solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of invertase 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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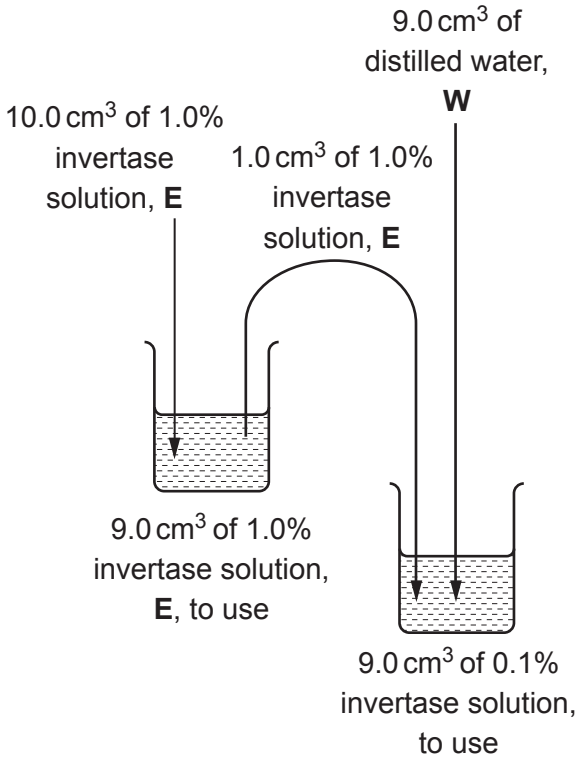

9.0 cm3 of distilled water, W
10.0 cm3 of 1.0% invertase solution, E
1.0 cm3 of 1.0% invertase solution, E
9.0 cm3 of 1.0% invertase solution, E, to use
9.0 cm3 of 0.1% invertase solution, to use

Fig. 1.2

[3]

Carry out step 1 to step 14 to determine the concentration of invertase in the honey extract, **H**.

1. Prepare the concentrations of invertase solution as you decided in **(a)(ii)** and shown in Fig. 1.2. Use a glass rod to mix the invertase solutions and water.

2. Set up a water-bath and heat the water to approximately 30 °C.

3. Label test-tubes with the concentrations of invertase solution prepared in step 1.

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

5. Label another test-tube **H**.

6. Put 2 cm^3 of honey extract, **H**, into the test-tube labelled **H**.

7. Put 2 cm^3 of **S** into each labelled test-tube, including the test-tube labelled **H**.

8. Put all of the test-tubes into the water-bath at approximately 30 °C. Leave the test-tubes in the water-bath for 10 minutes. You do **not** need to keep the water-bath at 30 °C.

   While you are waiting, use your time to continue with question 1.

9. After the 10 minutes remove the test-tubes from the water-bath and put them in a test-tube rack.

10. Put 4 cm^3 of Benedict's solution, **B**, into each of the test-tubes.

11. Heat the water-bath to boiling and then stop heating.

12. Put the test-tube labelled **H** into the water-bath. Start timing.

13. Measure the time taken to the first colour change. Record the result in **(a)(iii)**.
    If there is no colour change after 180 seconds, record as 'more than 180'.

14. Repeat step 12 and step 13 using each of the concentrations of invertase solution you prepared in step 1, instead of **H**. Record your results in **(a)(iv)**.

(iii) State the result for **H**.

..... seconds [1]

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(iv) Record your results in an appropriate table for the concentrations of invertase solution you prepared in step 1.

[5]

(v) Use your results from **(a)(iii)** and **(a)(iv)** to estimate the concentration of invertase in **H**.

concentration of invertase in **H** = ... % [1]

(vi) Suggest how you would make improvements to this investigation in order to obtain a more accurate estimate of the invertase concentration in **H**.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Honey contains a mixture of sugars. The percentage concentration of these sugars changes over time.

The percentage concentration of sucrose in honey was measured for a period of 25 weeks. The results are shown in Table 1.2.

Table 1.2

storage time /weeks	percentage concentration of sucrose
0	2.3
3	1.8
6	1.3
12	0.9
25	0.5

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

Use a sharp pencil for drawing graphs.

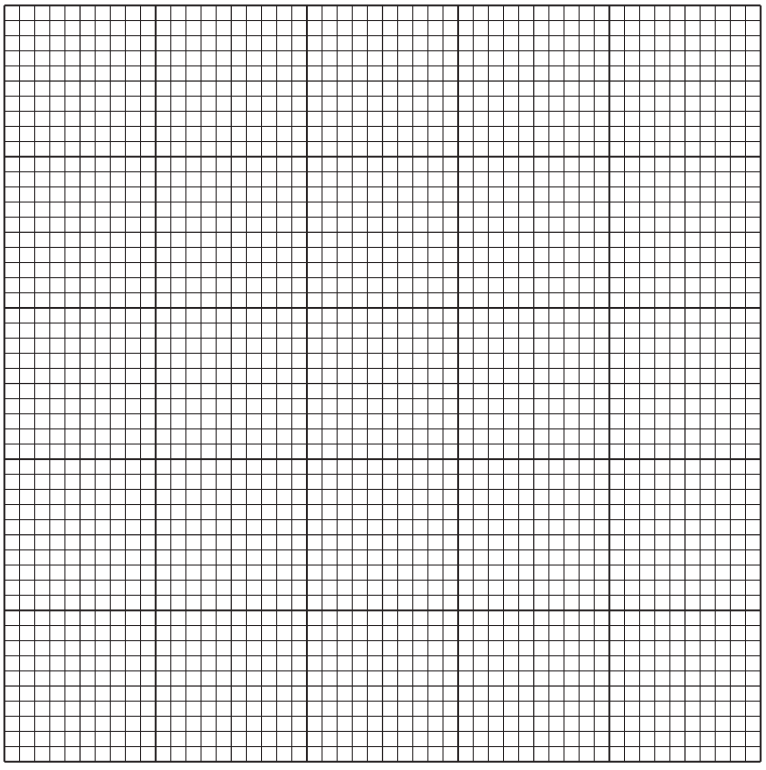


Fig. 1.3

[4]

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(ii) Describe the change in percentage concentration of sucrose shown by your graph in Fig. 1.3.

.....

.....

.....

.....

.....

..... [2]

(iii) State which sugars, other than sucrose, will be present in the honey after 25 weeks. Explain your answer.

sugars present .....

explanation .....

.....

.....

.....

.....

[2]

[Total: 22]

2 **J1** 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 in the sector shown by the shaded area in Fig. 2.1.

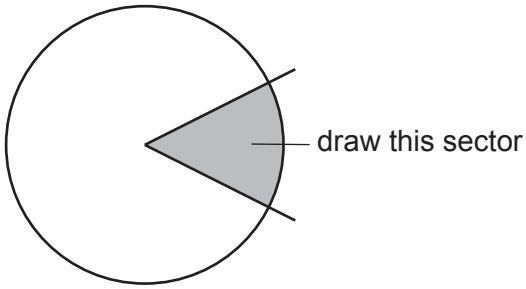


Fig. 2.1

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 sector of the stem on **J1** shown by the shaded area in Fig. 2.1.

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

[5]

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(ii) Observe one vascular bundle in the stem on **J1**.

The xylem within the vascular bundle is made up of rows of xylem vessel elements.

Select a row of at least three adjacent, touching, xylem vessel elements.

Make a large drawing of **three** adjacent, touching xylem vessel elements in this line.

On your drawing use a ruled label line and label to identify **one** lumen.

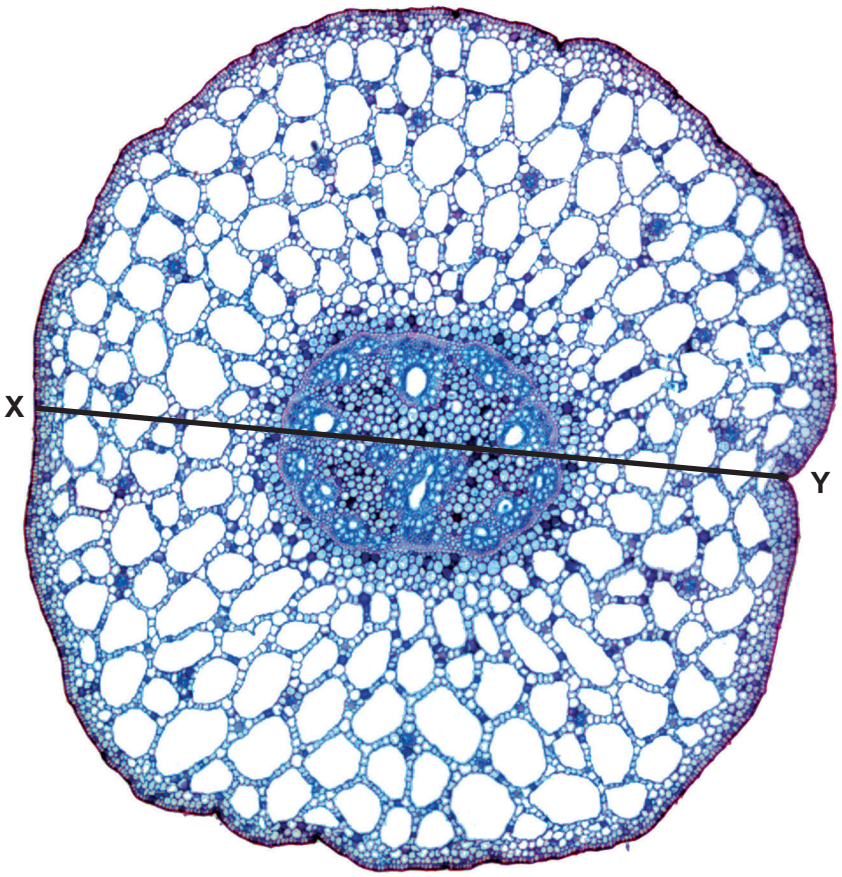
[5]

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[Turn over

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

You are not expected to be familiar with this specimen.



scale bar

1.5 mm

Fig. 2.2

(i) Use the scale bar on Fig. 2.2 to calculate the actual diameter of the stem indicated by line **X**–**Y**.

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

actual diameter = ... [4]

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(ii) Identify **three** observable differences between the stem on **J1** and the stem shown in Fig. 2.2.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

[3]

(iii) Suggest **one** observable feature shown by the stem in Fig. 2.2 that allows the plant to live in water. Give a reason for your answer.

feature .....

reason .....

.....

[1]

[Total: 18]

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BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2020**

2 hours

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1 When plant cells are placed into sodium chloride solution, osmosis occurs and water will enter or leave the vacuoles. Some cells may become plasmolysed. A cell is described as being plasmolysed when the cell surface membrane detaches from the cell wall.

You will investigate the effect of different concentrations of sodium chloride solution on onion tissue.

You will need to:

- prepare different concentrations of sodium chloride solution using proportional dilution of 4.0% sodium chloride solution
- observe and record the effect of adding these concentrations of sodium chloride solution to the onion tissue.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
X	2 pieces of onion tissue in distilled water	none	–
S	4.0% sodium chloride solution	none	50
W	distilled water	none	50

It is recommended that you wear suitable eye protection.

You will need to prepare different concentrations of sodium chloride solution, **S**, using **proportional** dilution. You will need to prepare 10 cm^3 of each concentration.

(a) (i) Table 1.2 shows how to make up two of the concentrations of **S** you will use.
Decide which **three** other concentrations of **S** you will use.

Complete Table 1.2 for the other concentrations you will use.

Table 1.2

percentage concentration of sodium chloride solution	volume of S / cm^3	volume of W / cm^3
4.0	10.0	0.0
0.0	0.0	10.0

[2]

Carry out step 1 to step 14.

1. Prepare the concentrations of sodium chloride solution, as shown in Table 1.2, in the beakers provided.

2. Put one **clean and dry** microscope slide on a paper towel.

3. Put a few drops of **W** onto the microscope slide.

4. Remove one piece of onion tissue from beaker **X**. Peel off the inner epidermis as shown in Fig. 1.1.

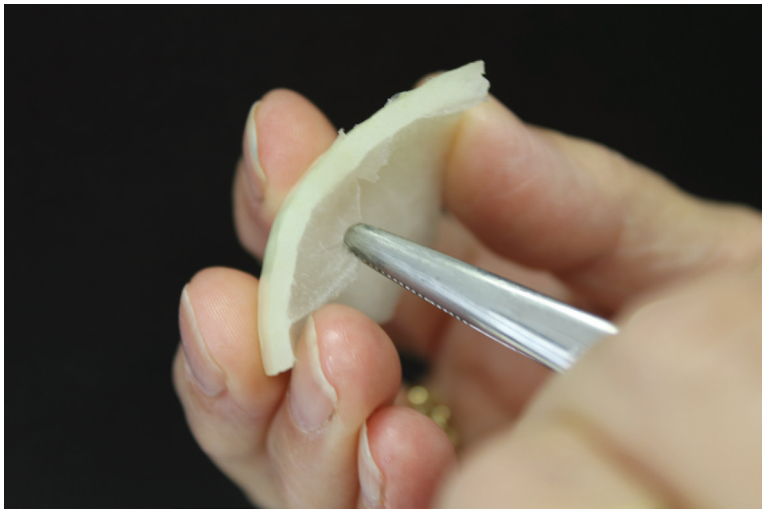


Fig. 1.1

5. Cut one piece of the inner epidermis so that it will fit under a coverslip. Put any remaining epidermis into the beaker labelled **For waste**.

6. Put the epidermis into **W** on the microscope slide, as shown in Fig. 1.2. If the epidermis is folded, you may need to add more drops of **W** so that it floats and uncurls. It is important to stop the epidermis from drying out.

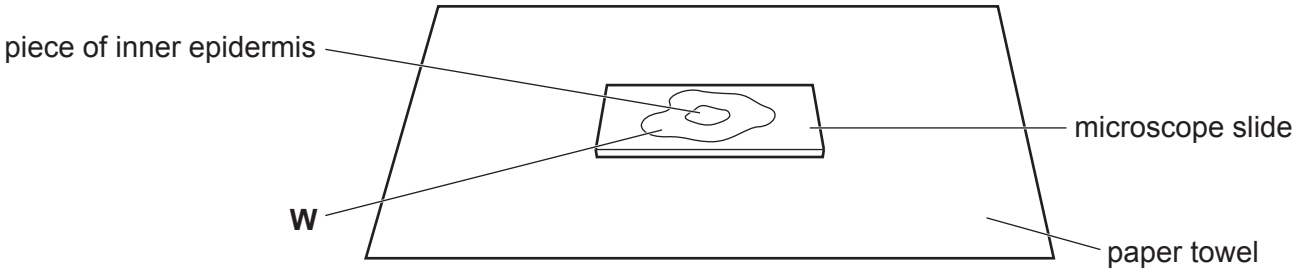


Fig. 1.2

7. Put a coverslip over the piece of epidermis on the microscope slide. Use a paper towel to remove any excess **W** that is outside the coverslip.

8. Observe the epidermis using the low power lens of the microscope. You may need to reduce the amount of light entering the microscope to observe the cells clearly.

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You will need to observe and record the effect of adding **W** and the different concentrations of sodium chloride solution on the onion tissue. You will do this by counting the number of plasmolysed cells within a sample of cells.

(ii) Decide the total number of cells in your sample.

State the total number of cells in your sample ..... [1]

9. Count the number of plasmolysed cells observed in your sample for **W**. Record your results in **(a)(iii)**.

10. Take the microscope slide off the microscope and remove the coverslip.

11. Use a paper towel to remove **W** from around the epidermis.

12. Put a few drops of the **lowest concentration** of sodium chloride solution you prepared in step 1 onto the epidermis.

13. Repeat step 7 to step 11 using the lowest concentration of sodium chloride solution instead of **W**.

14. Repeat step 12 to step 13 using the remaining concentrations of sodium chloride solution. The 4.0% sodium chloride solution is used last.

(iii) Record your results in an appropriate table.

[3]

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(iv) Using the **high power** lens, select three adjacent, touching cells that show the effect of adding 4.0% sodium chloride solution.

Make a large drawing of these **three** adjacent, touching cells. Use a sharp pencil for drawing.

Use **one** ruled label line and label to identify a cell surface membrane of **one** cell.

[4]

(v) Use your knowledge of water potential to explain the appearance of the inner epidermal cells in 4.0% sodium chloride solution.

.....

.....

.....

.....

.....

.....

..... [2]

(vi) Suggest how you could modify the procedure to have more confidence in your results.

.....

.....

.....

.....

.....

.....

..... [2]

(b) A student investigated the effect of different concentrations of sucrose solution on pieces of potato tissue. The student used the results to determine the mean percentage change in length of the pieces of potato tissue.

- Pieces of potato tissue were cut to exactly the same length and cross-sectional area.
- Each piece of potato tissue was put into a different concentration of sucrose solution for 1 hour.
- After 1 hour the length of each piece of potato tissue was measured and the percentage change in length was calculated.
- Five replicates were done for each concentration.

The student then calculated the mean percentage change in length of potato tissue for each concentration of sucrose solution.

The processed data are shown in Table 1.3.

Table 1.3

concentration of sucrose solution / mol dm^{-3}	**percentage change in length**					**mean percentage change in length**
0.0	+2.60	+1.90	+2.80	+2.60	+2.80	+2.70
0.2	+0.25	+0.35	+0.35	+0.30	+0.25	+0.30
0.4	–1.40	–1.40	–1.35	–1.40	–1.45	–1.40
0.6	–2.20	–2.25	–2.20	–2.15	–2.20	–2.20
0.8	–2.60	–2.50	–1.60	–2.60	–2.70	
1.0	–2.90	–3.00	–2.85	–3.15	–3.10	–3.00

(i) Complete Table 1.3 by calculating the mean percentage change in length of the potato tissue in 0.8 mol dm^{-3} sucrose solution.

[1]

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[Turn over

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

Use a sharp pencil for drawing graphs.

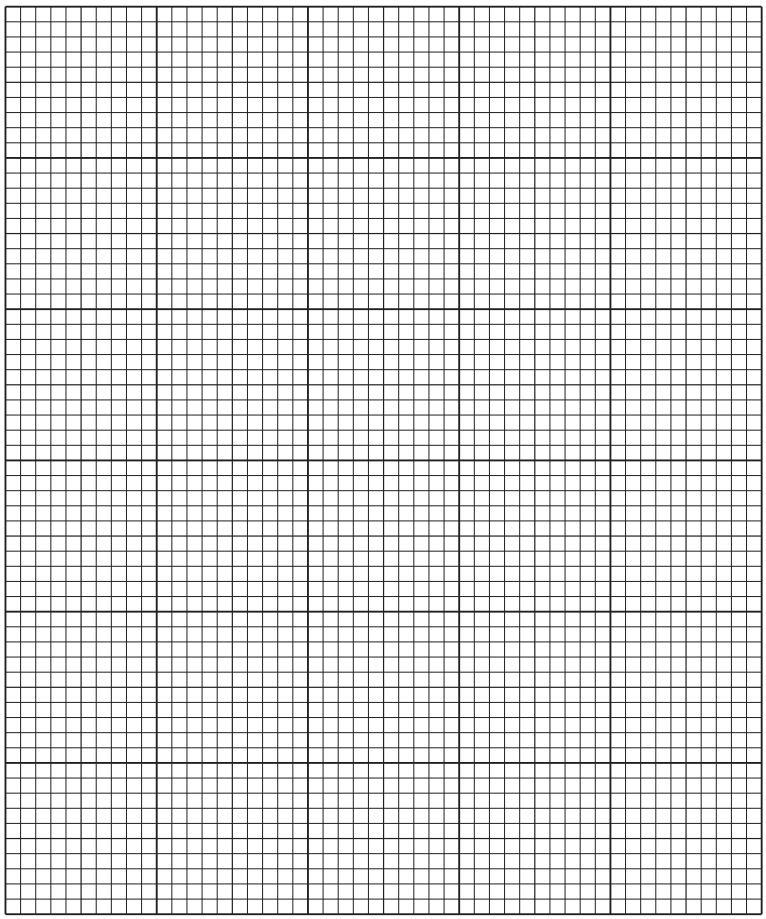


Fig. 1.3

[4]

(iii) Fig. 1.4 is a calibration curve of sucrose concentration against water potential.

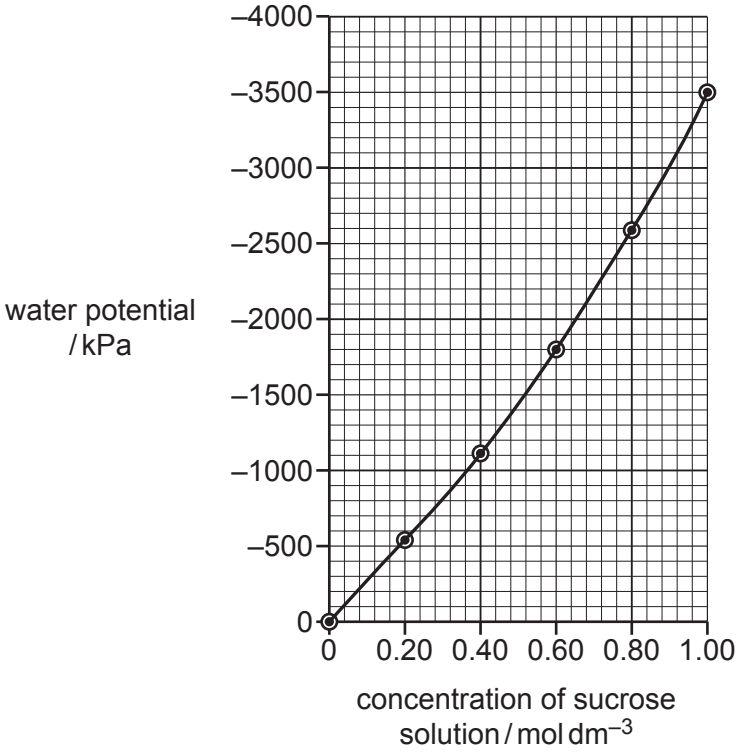


Fig. 1.4

Use the graphs in Fig. 1.3 **and** Fig. 1.4 to determine the water potential of the cells in potato tissue.

Show on the graphs how you determined your answer.

water potential of cells in potato = ... [3]

[Total: 22]

2 Water moves through xylem vessel elements in plants. The diameter of xylem vessel elements varies between different species of plant.

You will measure how quickly coloured water moves through xylem vessel elements of different diameters. You will use microscope slides to represent xylem vessel elements of different diameters.

You are provided with the materials shown in Table 2.1.

Table 2.1

labelled	description	hazard
P	container with 6 pieces of paper	none
R	beaker containing coloured water	none

Carry out step 1 to step 9.

1. Put one clean, dry microscope slide on the bench.
2. Put **two** pieces of paper from the container labelled **P** on top of the microscope slide.
3. Put another microscope slide on top of the paper.
4. Put tape around the two microscope slides to hold them together as shown in Fig. 2.1**A**.
5. Label this pair of microscope slides, **A**.
6. Repeat step 1 to step 4 using **four** pieces of paper instead of **two** pieces of paper, as shown in Fig. 2.1**B**.
7. Label this pair of microscope slides, **B**.

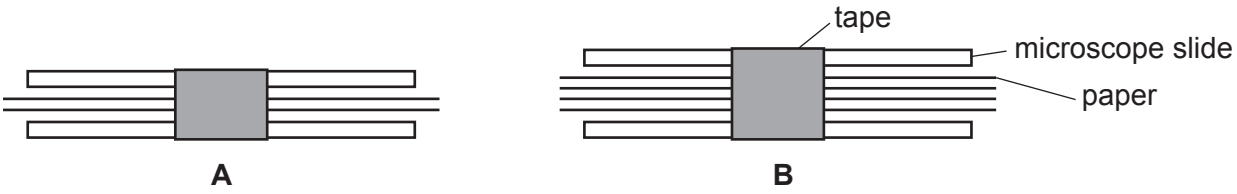


Fig. 2.1

8. Hold **A** by the side edges and remove the paper.
   You should be left with a gap as shown in Fig. 2.2.
9. Repeat step 8 for **B**.

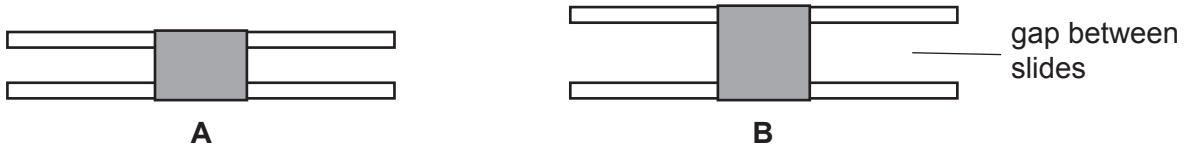


Fig. 2.2

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10. Put **A** into the beaker labelled **R**, as shown in Fig. 2.3. Start timing **immediately** and record in Table 2.2 the time it takes for the coloured water to reach the top of the pair of microscope slides. If the time taken is longer than 60 seconds record the result as 'more than 60'.

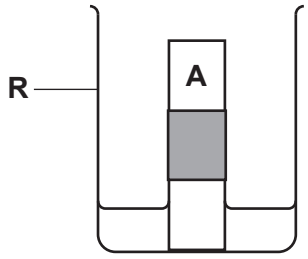


Fig. 2.3

11. Repeat step 10 using **B** instead of **A**.

(a) (i) Record your results in Table 2.2.

Table 2.2

pair of microscope slides	number of pieces of paper used to make gap	time for coloured water to reach the top of the microscope slides / s
A	2	
B	4	

[1]

(ii) Identify **one** significant source of error when measuring the dependent variable.

.....

.....

..... [1]

(iii) Using your results in Table 2.2 suggest how the diameter of xylem vessels affects the transport of water in a plant.

.....

..... [1]

(b) Fig. 2.4 is a photomicrograph of a stained transverse section through a leaf.

You are not expected to be familiar with this specimen.

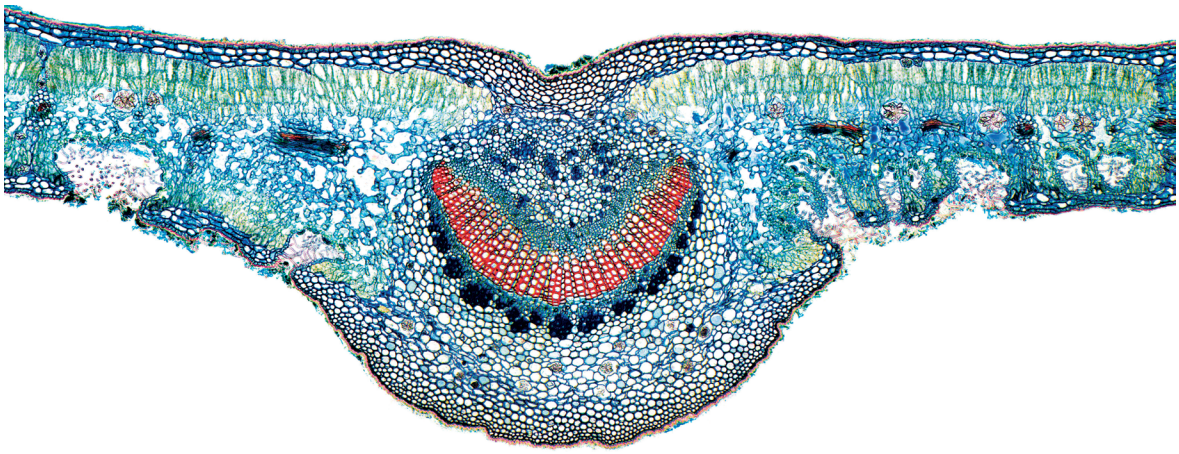


Fig. 2.4

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 section shown in Fig. 2.4.

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

[6]

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Fig. 2.5 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.

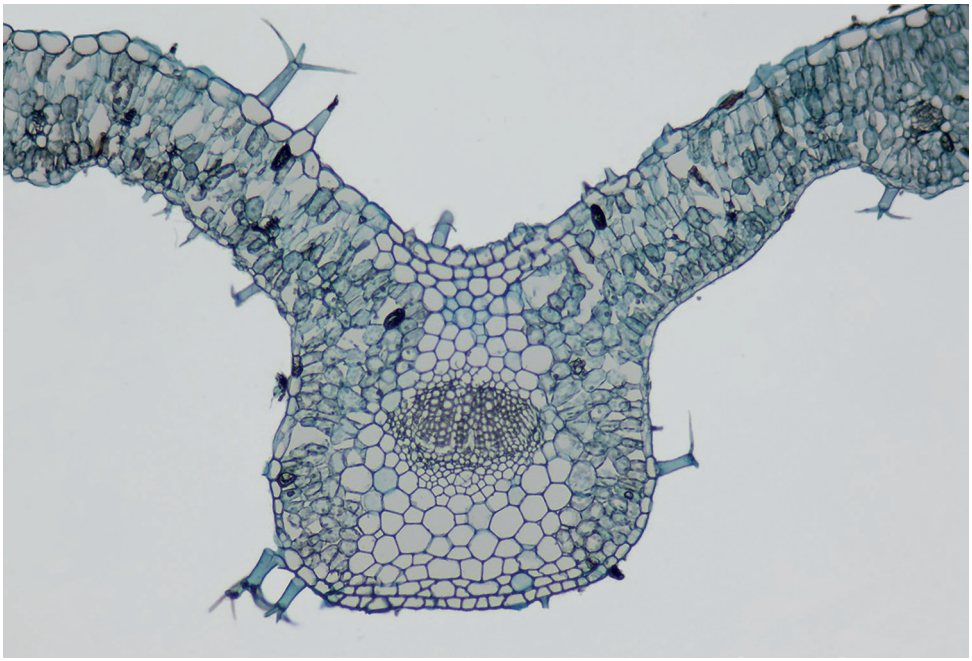


Fig. 2.5

(ii) Identify the observable differences between the leaf in Fig. 2.4 and the leaf in Fig 2.5.

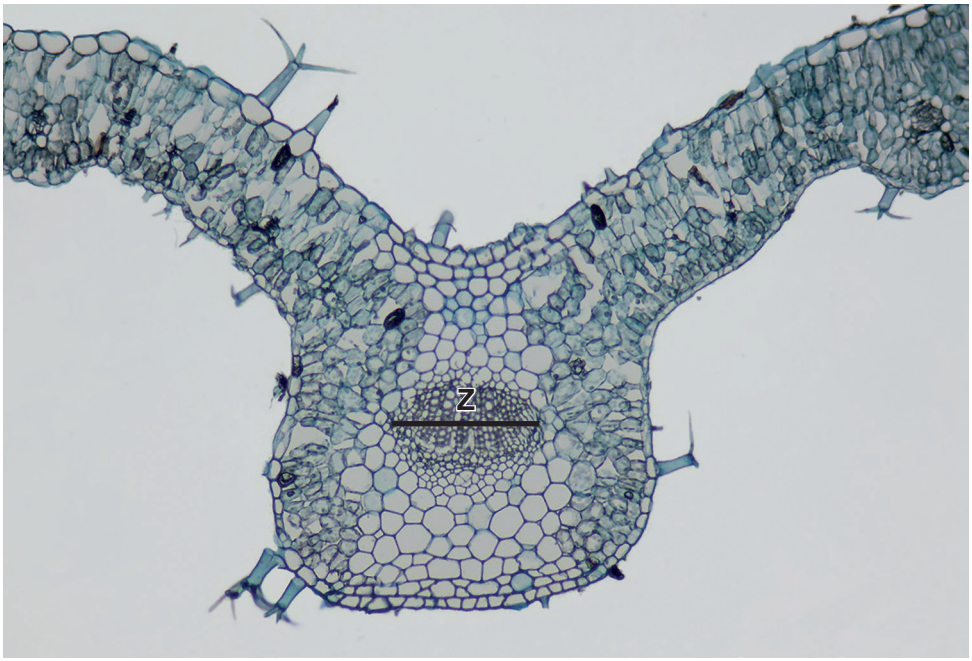
Record the observable differences in Table 2.3.

Table 2.3

feature	Fig. 2.4	Fig 2.5

[4]

(c) Fig. 2.6 is the same photomicrograph as in Fig. 2.5 but with line **Z** added to show the diameter of the vascular bundle.



magnification x200

Fig. 2.6

(i) Use the magnification and the line **Z** on Fig. 2.6 to calculate the actual diameter of the vascular bundle.

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

actual diameter of vascular bundle = ... [4]

(ii) State **one** piece of apparatus you would use to measure a specimen on a slide using a microscope fitted with an eyepiece graticule.

..... [1]

[Total: 18]

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2020**

2 hours

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

1 Energy drinks contain a high concentration of carbohydrates, such as glucose, as a source of energy.

Glucose is a monosaccharide which can be quickly metabolised by body cells, releasing energy during exercise.

Glucose changes the colour of potassium manganate(VII) solution, **P**, from purple to colourless. The end-point is when **P** is completely colourless.

You will need to:
- prepare different concentrations of glucose solution
- record the time taken to reach the end-point for the known glucose concentrations
- use your results to estimate the concentration of glucose in an energy drink, **U**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	risk	volume / cm^3
G	20% glucose solution	none	50
W	distilled water	none	20
A	dilute sulfuric acid	irritant	20
P	potassium manganate(VII) solution	low risk irritant	20
U	energy drink	none	10

It is recommended that you wear suitable eye protection.

If **A** or **P** come into contact with your skin, wash off immediately under cold water.

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(a) You will need to prepare different concentrations of glucose solution.

The lowest concentration you will prepare is 12%.

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

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

Decide which other concentrations of glucose solution you will use.

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

Table 1.2

percentage concentration of glucose	volume of **G** / cm^3	volume of **W** / cm^3
20	10	0
12	6	4

[2]

Carry out step 1 to step 8.

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

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

3. Put 1 cm^3 of 20% glucose solution into the appropriately labelled test-tube.

4. Repeat step 3 with each of the other concentrations of glucose.

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

   The reaction will start as soon as you put **P** into the test-tubes (step 6).

   Do **not** stop the timer – keep it running continuously.

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

7. Measure the time taken for each test-tube to reach the end-point. As each end-point is reached, record the time taken in the space provided for raw results. Do **not** stop the timer.

8. Record in **(a)(ii)** the time taken for each test-tube to reach the end-point.

   If the end-point has not been reached after 600 seconds (10 minutes) record the time as 'more than 600'.

Use this space for raw results.

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(ii) Record your results in an appropriate table.

[5]

9. Label a test-tube **U** and put 1 cm^3 of **U** into this test-tube.

10. Repeat step 5 to step 7 using the test-tube labelled **U**.

(iii) Record the time taken to reach the end-point for **U**.

time for **U** = ... s [1]

(iv) Estimate the percentage concentration of glucose in **U**.

concentration in **U** = ... % [1]

(v) Describe how you would modify this procedure to give a more accurate estimate of **U**.

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..... [3]

(vi) State **two** significant sources of error when carrying out step 7.

.....

.....

.....

.....

..... [2]

(vii) Describe how you would modify this procedure to reduce **one** source of error as stated in **(a)(vi)**.

.....

.....

..... [1]

(b) An investigation was carried out into the effect of drinking an energy drink on blood glucose concentration over a period of 3 hours.

The results are shown in Table 1.3.

Table 1.3

time / hours	glucose concentration / mmol dm^{-3}
0.0	5.2
0.5	7.5
1.0	9.1
2.0	8.4
3.0	7.9

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

Use a sharp pencil for drawing graphs.

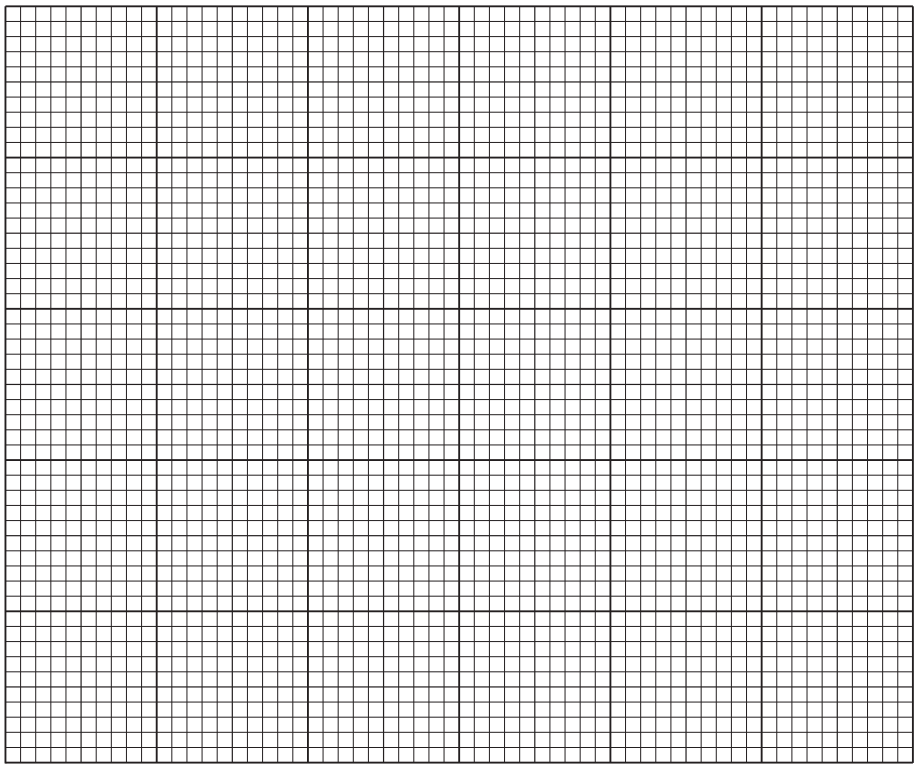


Fig. 1.1

[4]

[Total: 19]

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

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 root.

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

[5]

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

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

Each smaller cell must touch the 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]

(b) Fig. 2.1 is a photomicrograph of a stained transverse section through a root of a different plant species. You are not expected to be familiar with this specimen.

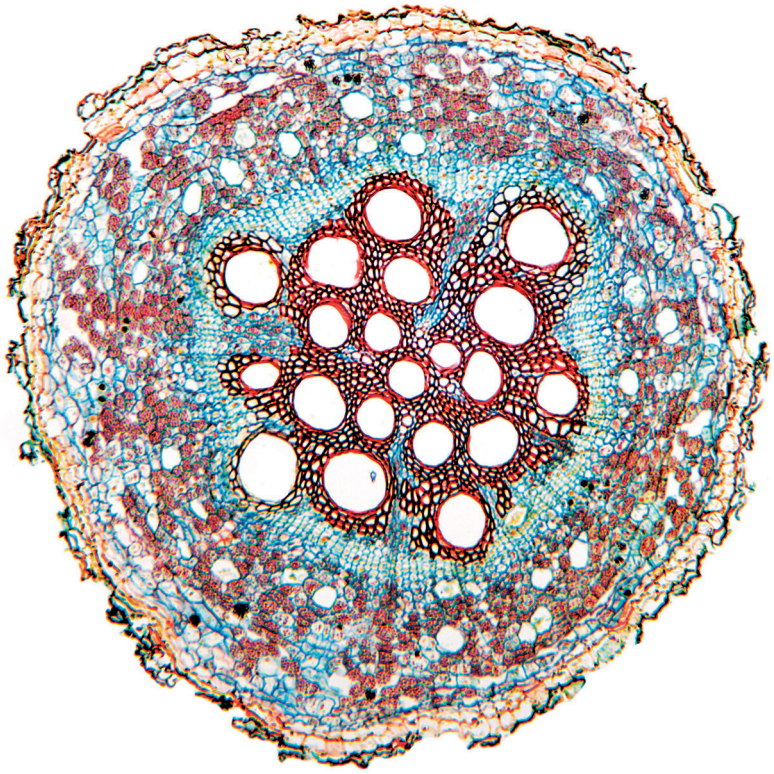


Fig. 2.1

Prepare an appropriate table so that it is suitable for you to record the observable differences between the root on **K1** and the root in **Fig. 2.1**.

Record the observable differences in your table.

[4]

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(c) Fig. 2.2 is a photomicrograph of the same root section as in Fig. 2.1, with the central area enlarged.

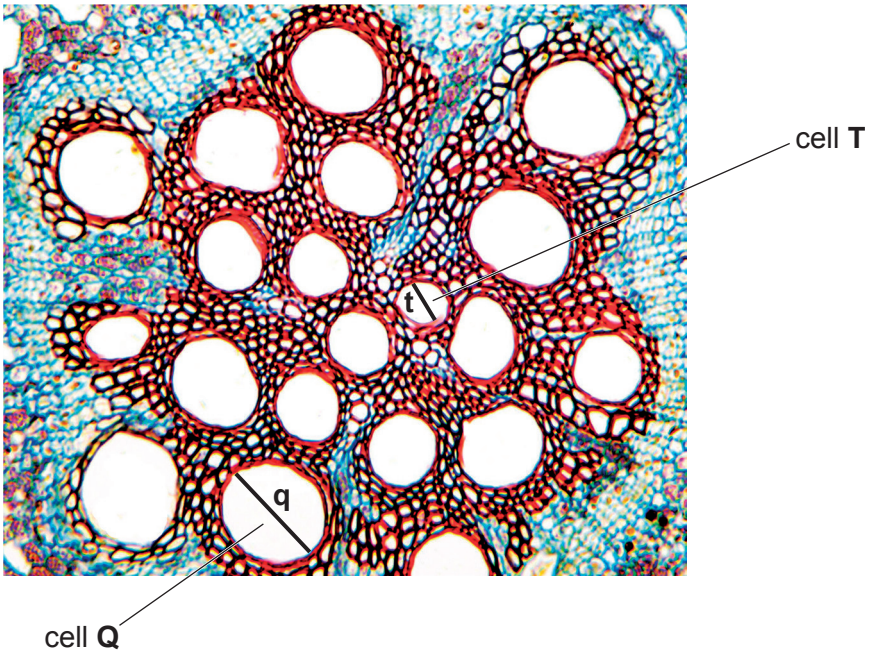


Fig. 2.2

(i) Measure line **q** and line **t** to find the diameter of cell **Q** and cell **T** as shown in Fig. 2.2.

diameter of cell **Q** = ...

diameter of cell **T** = ...
[2]

(ii) Calculate the percentage difference in diameter between cell **Q** and cell **T**.

Show all the steps in your working.

percentage difference = ... % [3]

(iii) Using your knowledge of adhesion and cohesion, suggest why the difference in diameter of cell **Q** and cell **T** may affect the movement of water in xylem.

.....

.....

.....

.....

.....

..... [2]

[Total: 21]

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7316657622

BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 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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1	
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 When potato cells are placed into different concentrations of sodium chloride solution, water moves between the sodium chloride solution and the potato cells.

You will investigate the effect of different concentrations of sodium chloride solution on potato tissue.

You will need to:

- prepare different concentrations of sodium chloride solution, **S**
- put potato tissue into the different concentrations of sodium chloride solution
- record the distance the potato tissue bends
- use your results to estimate the concentration of an unknown concentration of sodium chloride solution, **U**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	7 pieces of potato tissue	none	–
S	10% sodium chloride solution	none	200
U	unknown concentration of sodium chloride	none	50
W	distilled water	none	200

It is recommended that you wear suitable eye protection.

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(a) You will need to prepare different concentrations of sodium chloride solution, using proportional dilution.

You will need to prepare 50 cm^3 of each concentration, using **S** and **W**.

Table 1.2 shows how to make up two of the concentrations of sodium chloride solution you will use.

Decide which other concentrations of sodium chloride solution you will use.

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

Table 1.2

percentage concentration of sodium chloride	volume of **S** / cm^3	volume of **W** / cm^3
10	50	0
0	0	50

[2]

1. Prepare the concentrations of sodium chloride solution as shown in Table 1.2, in the beakers provided. Mix well.
2. Label the Petri dishes with the concentrations of sodium chloride solution prepared in step 1.
3. Label another Petri dish **U**.
4. Put a piece of potato tissue into each of the Petri dishes you have labelled.

You will need to cover the piece of potato tissue in each Petri dish with the appropriate sodium chloride solution prepared in step 1, as shown in Fig. 1.1.

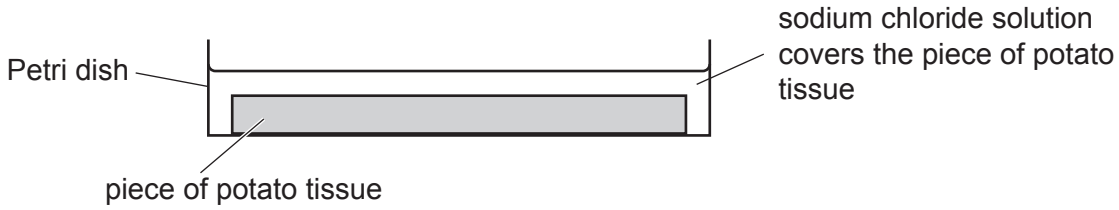


Fig. 1.1

(ii) Decide the volume of sodium chloride solution you will use to cover the piece of potato tissue.

State the volume of sodium chloride solution you will use.

volume ..... [1]

5. Put the volume of each concentration of sodium chloride solution you have decided in **(a)(ii)** into the appropriately labelled Petri dish.

6. Repeat step 5 using **U**.

7. Leave the pieces of potato tissue in the sodium chloride solutions for 20 minutes.

   While you are waiting, use your time to continue with Question 1.

   You will use graph paper to measure how far the pieces of potato tissue bend after being left for 20 minutes in the sodium chloride solutions.

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Fig. 1.2 shows how you will prepare the graph paper, as described in step 8 and step 9.

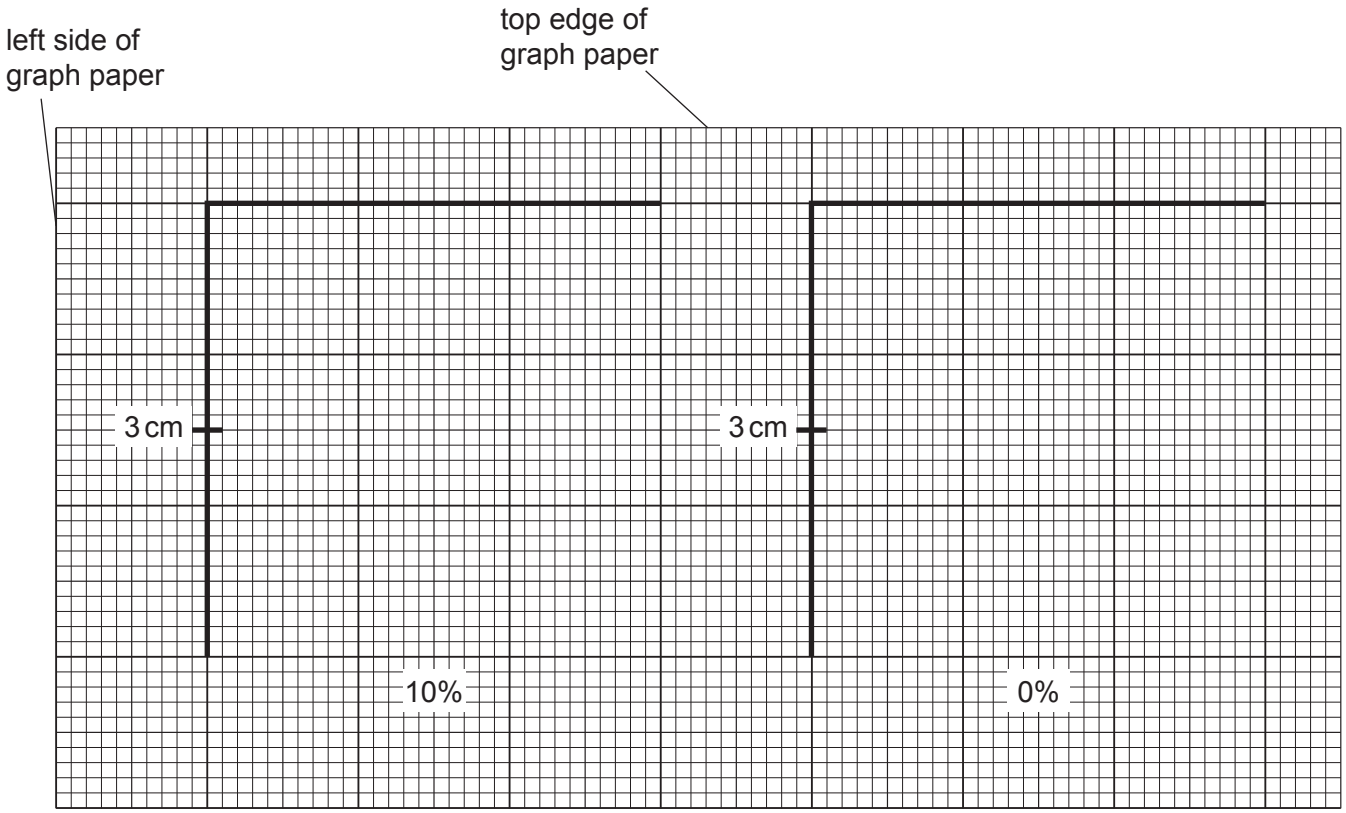


Fig. 1.2

8. On the graph paper provided, draw two lines at right angles to each other, as shown in Fig. 1.2. Each line should be approximately 6 cm long.
   Draw a mark on the vertical line 3 cm below where the vertical line meets the horizontal line, as shown in Fig. 1.2.

9. On the same piece of graph paper repeat step 8 for each of the other concentrations of sodium chloride solution and for **U**.

10. After 20 minutes (step 7) remove the piece of potato tissue from the 10% sodium chloride solution and put it onto a paper towel to remove the excess liquid.

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11. Put the piece of potato tissue on the vertical line of the graph paper, as shown in Fig. 1.3.

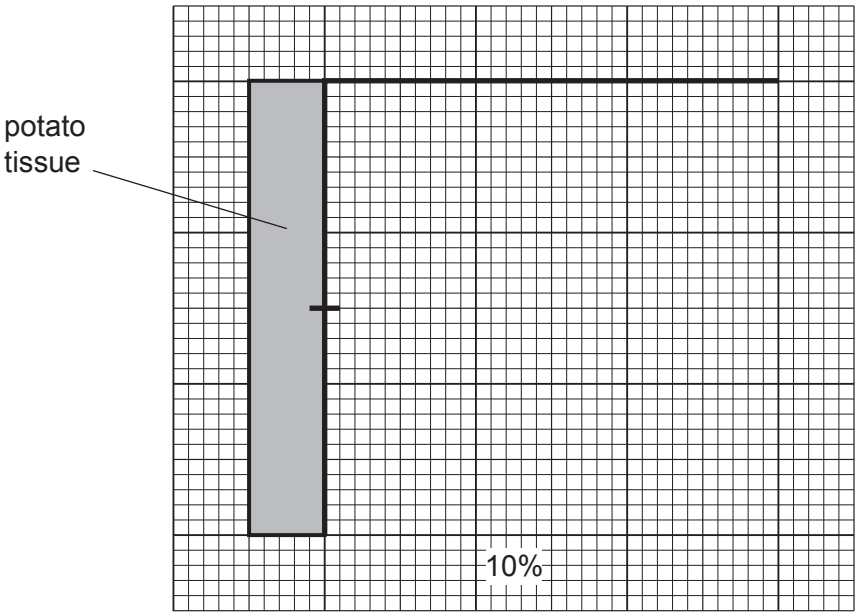


Fig. 1.3

12. Put your finger on the middle of the potato tissue at the 3 cm mark and press firmly, as shown in Fig. 1.4.

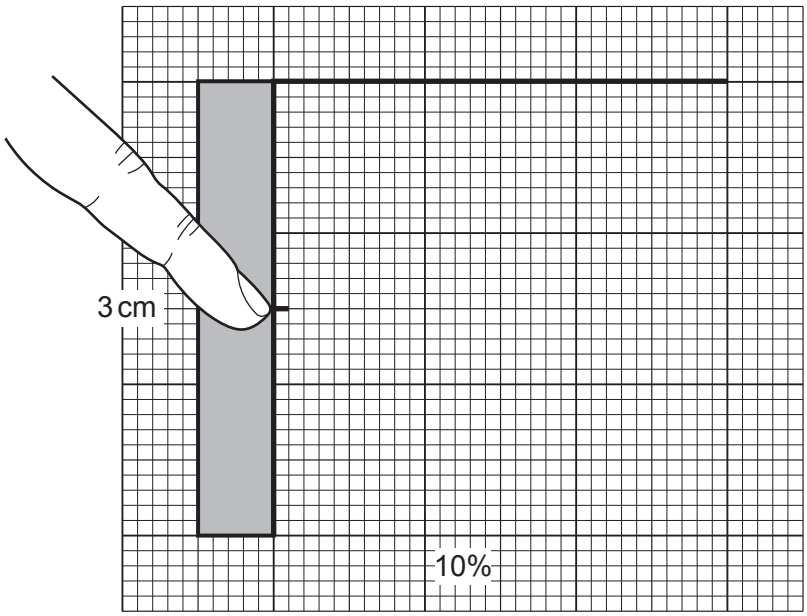


Fig. 1.4

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13. Hold the potato tissue firmly in this position. Move the top of the potato tissue, as shown in Fig. 1.5, until there is some resistance.

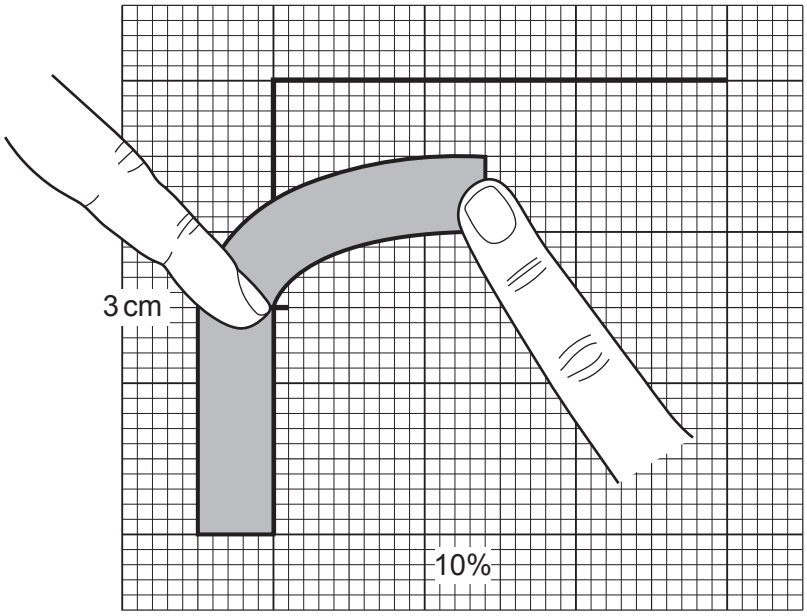


Fig. 1.5

14. Mark the position of the top of the potato tissue on the graph paper, as shown in Fig. 1.6.

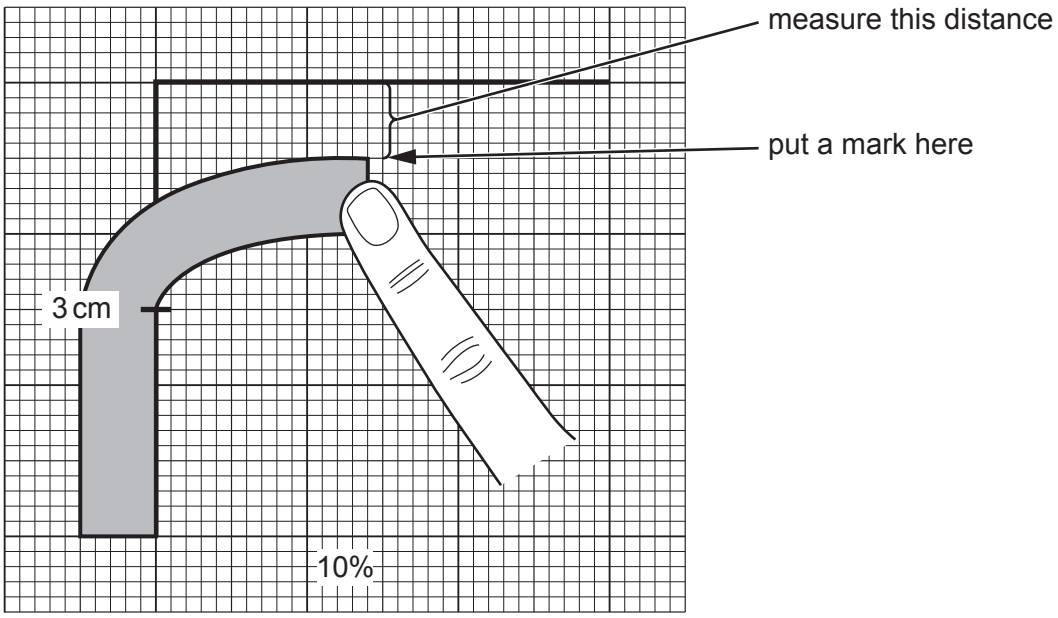


Fig. 1.6

15. Remove the potato tissue and put it in the container labelled **For waste.**

16. Measure the distance between the mark and the horizontal line on the graph paper, as shown in Fig. 1.6.

17. Record your result in **(a)(iii)**.

18. Repeat step 10 to step 17 using the potato tissue from the other concentrations of sodium chloride solution.

19. Repeat step 10 to step 16 using the potato tissue from **U**. Record your result for **U** in **(a)(iv)**.

(iii) Record your results in an appropriate table.

[5]

(iv) State the result for **U**. Use your results in **(a)(iii)** to estimate the concentration of sodium chloride in **U**.

result for **U** .....

estimate ..... % [1]

(v) Explain, in terms of water potential, the difference between the result for 10% sodium chloride solution and the result for 0% sodium chloride solution.

.....

.....

.....

.....

.....

.....

..... [2]

(vi) State the dependent variable.

..... [1]

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(vii) Suggest how you could make improvements to the procedure so that a more accurate estimate of the concentration of sodium chloride in **U** can be obtained.

.....

.....

.....

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.....

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.....

.....

..... [3]

(viii) A systematic error may occur when a piece of apparatus with a scale is used.

State **one** piece of apparatus used in this investigation that may have a systematic error.

.....

Suggest whether this affected your results **and** give a reason for your answer.

.....

.....

..... [1]

(b) A scientist carried out an investigation into the effect of temperature on the number of molecules of a substance diffusing through a cell membrane in a set time.

The results are shown in Table 1.3.

Table 1.3

temperature / °C	number of molecules per mm^2
5	2
15	4
40	9
63	18
92	30

(i) Plot a graph of the data in Table 1.3 on the grid in Fig. 1.7.

Use a sharp pencil for drawing graphs.

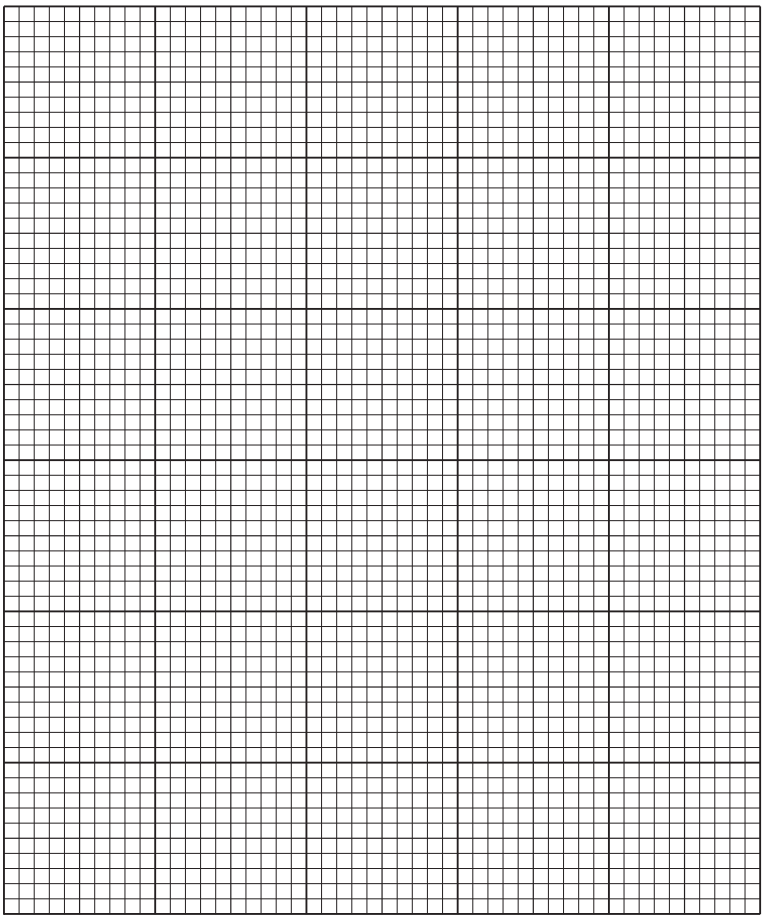


Fig. 1.7 [4]

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(ii) Describe and explain the trend in your graph.

description .....

.....

.....

explanation .....

.....

.....

[2]

[Total: 22]

Question 2 starts on page 12

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**.

On your diagram:

- ignore the trichomes (hair-like structures)
- use **one** ruled label line and label to identify the epidermis.

[5]

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

Select **three** adjacent, touching, epidermal cells where only one cell has a trichome attached.

Make a large drawing of these three epidermal cells **and** the attached trichome.

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

You are not expected to be familiar with this specimen.

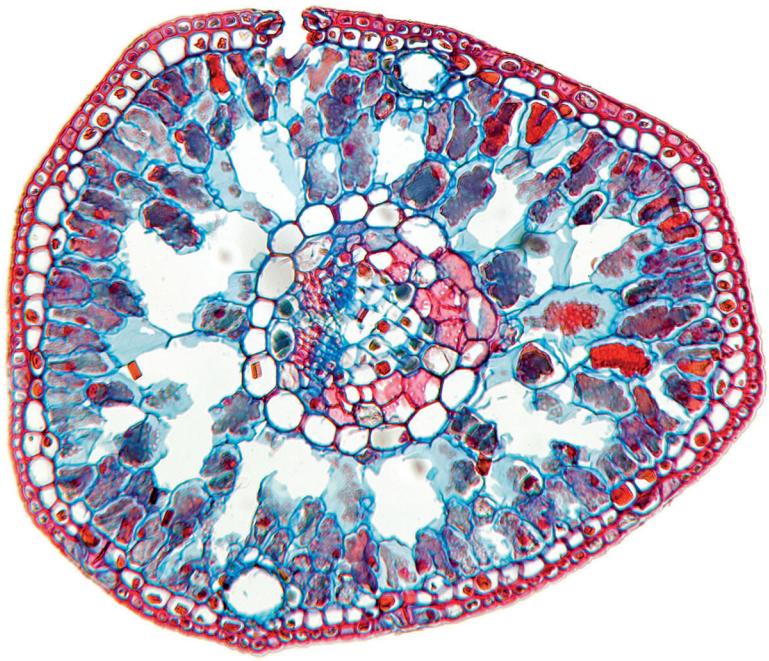


Fig. 2.1

Prepare an appropriate table so that it is suitable for you to record the observable differences between the leaf on **N1** and the leaf in Fig. 2.1.

Record the observable differences in your table.

[4]

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

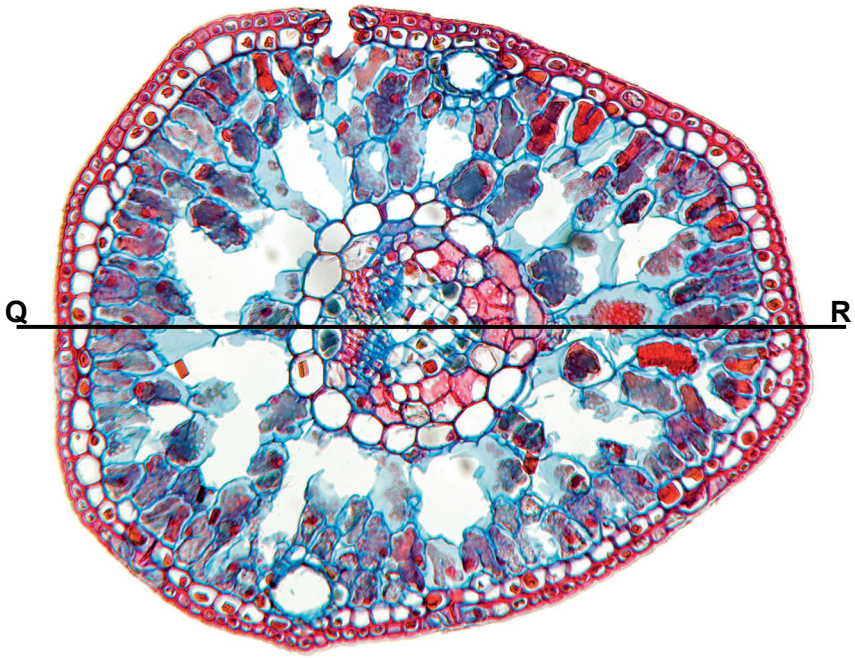


Fig. 2.2

Use the line **Q**–**R** to determine the simplest whole number ratio of the total diameter of the leaf to the diameter of the central vascular tissue.

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

simplest whole number ratio ..... [4]

[Total: 18]

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 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 Yeast contains an enzyme that will break down hydrogen peroxide into oxygen and water. The oxygen can be collected.

You will investigate the effect of the inhibitor copper sulfate on the breakdown of hydrogen peroxide and the volume of oxygen collected.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3	risk
Y	yeast suspension	none	40	
H	hydrogen peroxide solution	harmful irritant	50	
C	1.0% copper sulfate solution	harmful irritant	40	
W	distilled water	none	100	low

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

It is recommended that you wear suitable eye protection.

(a) (i) Think about the hazards of using the materials in Table 1.1.

Decide whether the risk of using **Y**, **H** and **C** is **low**, **medium** or **high**.

Complete Table 1.1, using the words **low**, **medium** or **high**, to state the risk of using **Y**, **H** and **C**. You may use each word once, more than once or not at all.

The risk for **W** has been completed for you.

[1]

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[Turn over

You will need to make a **serial** dilution of 1.0% copper sulfate solution, **C**, which reduces the concentration by half between each successive dilution.

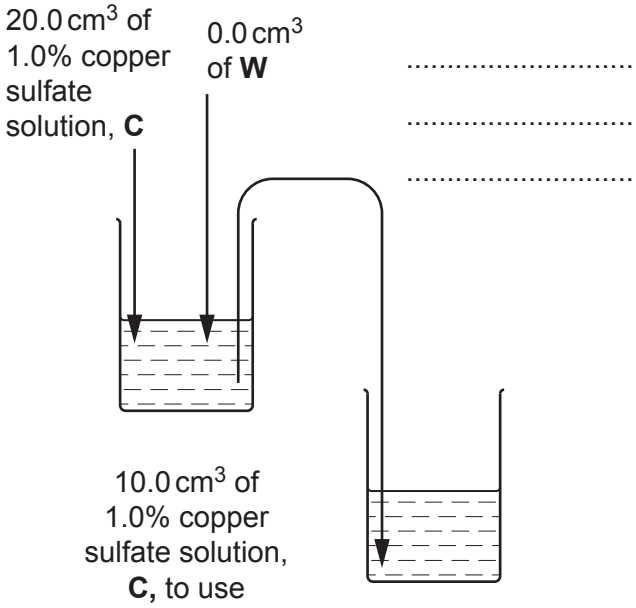
Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

(ii) Complete Fig. 1.1 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 copper sulfate solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of copper sulfate 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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20.0 cm3 of 1.0% copper sulfate solution, C
0.0 cm3 of W
10.0 cm3 of 1.0% copper sulfate solution, C, to use

.....

.....

.....

.....

.....

.....

[3]

Fig. 1.1

Carry out step 1 to step 14.

1. Prepare the concentrations of copper sulfate solution as you decided in **(a)(ii)** and as shown in Fig. 1.1.
   Use a glass rod to mix the copper sulfate solutions and water.

2. Label the large test-tubes with the concentrations of copper sulfate solution prepared in step 1.

3. Put 5 cm^3 of 1.0% copper sulfate solution into the appropriately labelled test-tube.

4. Repeat step 3 with the other concentrations you prepared in step 1.

5. Label another large test-tube **W**. Put 5 cm^3 of **W** into this test-tube using a clean syringe.

6. Use the marker pen to draw one line on the **small** test-tube 8 cm from the bottom, as shown in Fig. 1.2.

   This test-tube will be used to collect the oxygen from the reaction.

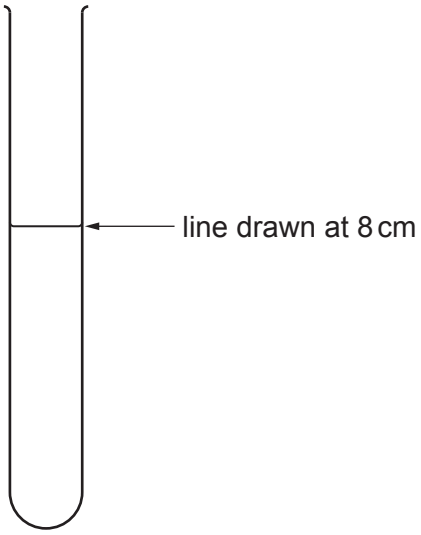


Fig. 1.2

7. Use the beakers labelled **hot water** and **cold water** to set up and maintain a water-bath with water between 30 °C and 35 °C.

8. Stir **Y** and put 5 cm^3 of **Y** into the test-tube labelled **W**. Mix thoroughly with a glass rod.

   Put this test-tube into the water-bath.

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9. Put the test-tube you prepared in step 6 into the container of water labelled **T**. Make sure that the test-tube is fully immersed and that there is no air in it, as shown in Fig. 1.3.

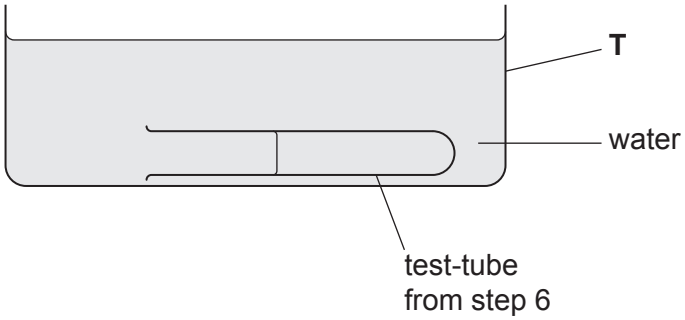


Fig. 1.3

Fig. 1.4 shows the apparatus you will set up for collecting the oxygen from the reaction.

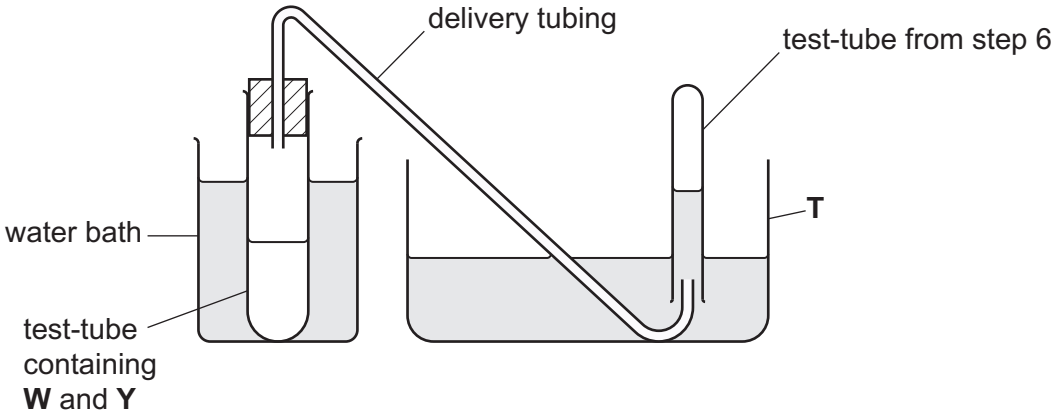


Fig. 1.4

10. Set up the apparatus as shown in Fig. 1.4.

    The reaction will start as soon as you add **H** in step 12. The oxygen produced in this reaction will collect in the small test-tube, displacing the water from this test-tube. The water level in this test-tube will start to fall.

11. Take the bung out of test-tube **W**.

12. Put 2 cm^3 of **H** into this test-tube and replace the bung and immediately start timing.

13. When the level of water in the small test-tube reaches the line, stop timing and record the result in **(a)(iii)**. If the time taken is more than 180 seconds, record the result as 'more than 180'.

14. Repeat step 8 to step 13 using the test-tubes of copper sulfate solution prepared in step 3 and in step 4, instead of test-tube **W**. Start with the test-tube with the lowest concentration of copper sulfate.

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(iii) Record your results in an appropriate table.

[5]

(iv) State the independent variable in this experiment.

..... [1]

(v) Think about how you would modify this procedure to investigate the effect of temperature on the breakdown of hydrogen peroxide.

Describe how the independent variable will be changed to investigate temperature.

.....

.....

..... [2]

(b) A student used a different method to measure the loss of oxygen from the breakdown of hydrogen peroxide.

The student measured the loss of mass after 5 minutes using the apparatus shown in Fig. 1.5.

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Fig. 1.5

Table 1.2 shows the student's results.

Table 1.2

initial mass of reaction mixture / g	final mass of reaction mixture / g	change in mass of reaction mixture / g	percentage change in mass of reaction mixture
249.55	243.31		

(i) Complete Table 1.2 by calculating the percentage change in mass of the reaction mixture.

You may use the space below for your working.

[2]

(ii) State how the student can increase the confidence in the result for percentage change in mass.

..... [1]

(c) A scientist carried out an investigation into the effect of several different inhibitors on the breakdown of hydrogen peroxide.

All other variables were kept constant.

The results are shown in Table 1.3.

Table 1.3

inhibitor	volume of oxygen after 5 minutes / cm^3
N	8.6
P	8.2
Q	4.3
R	7.8
S	3.9

(i) Draw a bar chart of the data in Table 1.3 on the grid in Fig. 1.6.

Use a sharp pencil for drawing graphs.

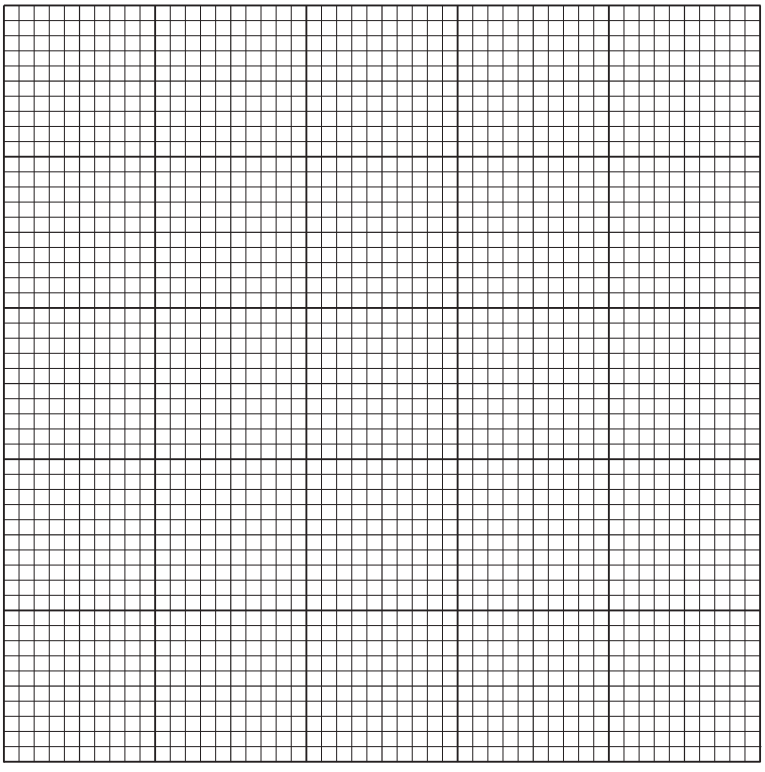


Fig. 1.6

[4]

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(ii) One of the inhibitors in Table 1.3 is a competitive inhibitor.

Explain how competitive inhibitors affect an enzyme-controlled reaction.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 22]

2 **L1** 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.

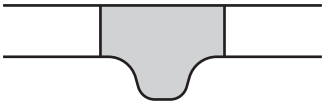


Fig. 2.1

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 part of the leaf on **L1** shown by the shaded area in Fig. 2.1.

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

[5]

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(ii) Observe the upper epidermis of the leaf on **L1**.

Select a **line** of **four** adjacent, touching cells in the upper epidermis.

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.

[4]

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

You are not expected to be familiar with this specimen.

An eyepiece graticule scale is shown on Fig. 2.2.

The calibration of the eyepiece graticule scale is:

1 eyepiece graticule division = 22.7 μm

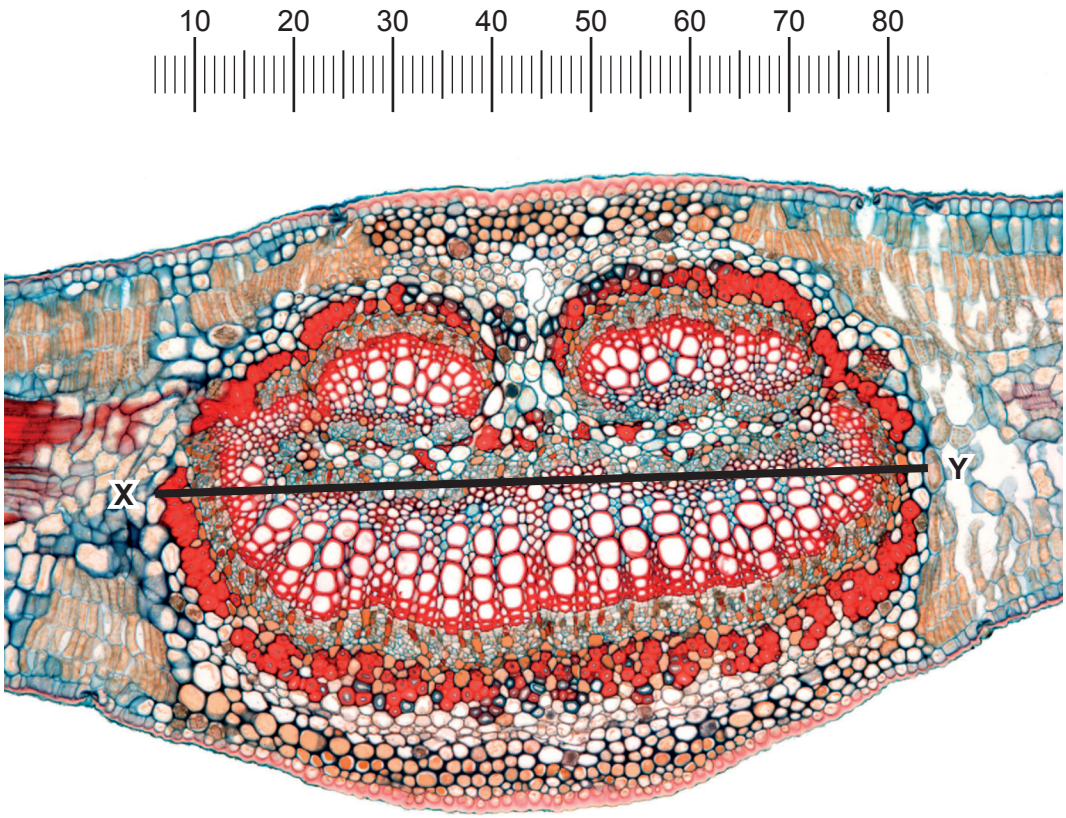


Fig. 2.2

(i) Use the calibration of the eyepiece graticule on Fig. 2.2 to calculate the actual width of the vascular tissue, shown by line **X**–**Y**.

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

actual width of vascular tissue = ... [3]

A student calculated the actual width of five xylem vessel elements in the vascular bundle of this leaf.

The results are shown in Table 2.1.

Table 2.1

xylem vessel element	width / μm
1	70.8
2	72.4
3	69.1
4	71.3
5	65.7

(ii) Use the information in Table 2.1 to calculate the mean width of these xylem vessel elements.

Show all the steps in your working.

mean width = ... [2]

(c) Fig. 2.3 is the same photomicrograph as in Fig. 2.2 but without line **X**–**Y** and the eyepiece graticule scale.

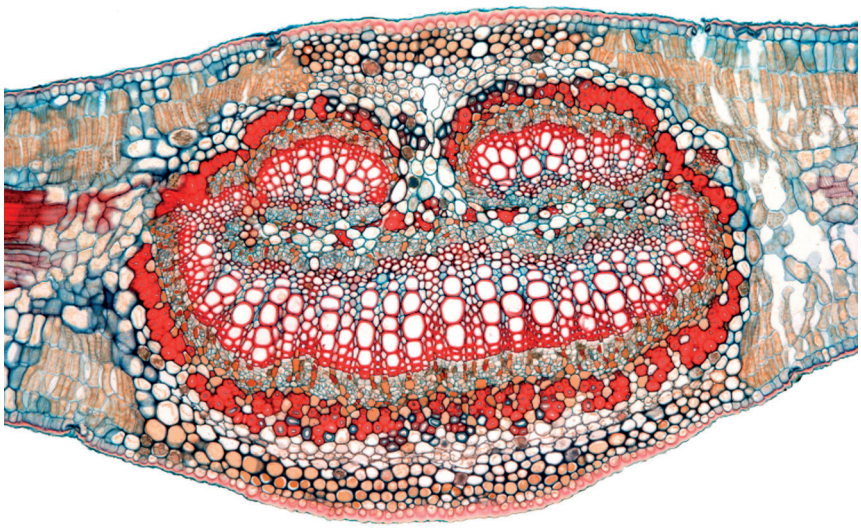


Fig. 2.3

Prepare an appropriate table so that it is suitable for you to record the observable differences between the midrib of the leaf on **L1** and Fig. 2.3.

Record the observable differences in your table.

[4]

[Total: 18]

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