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1376858227

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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Answer **all** questions.

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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 Beetroot is a root vegetable that contains a red pigment in its cells. When beetroot is put in ethanol, the red pigment is released from the beetroot tissue and the ethanol changes to a red colour.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	quantity
B	beetroot cylinders in distilled water	none	2
A	100% ethanol	flammable	100 cm^3
W	distilled water	none	300 cm^3

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

It is recommended that you wear suitable eye protection.

Beetroot tissue can stain clothing.

You will investigate the effect of different concentrations of ethanol on the release of red pigment from beetroot tissue.

You will need to:

- prepare different concentrations of ethanol, **A**
- put beetroot tissue into the different concentrations of ethanol
- record the intensity of colour for each concentration of ethanol.

You will make different concentrations of ethanol using proportional dilution of the 100% ethanol, **A**.

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

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(a) (i) Complete Table 1.2 for the other concentrations you will use.

Table 1.2

percentage concentration of ethanol	volume of **A** / cm^3	volume of **W** / cm^3
100	20.0	0.0
0	0.0	20.0

[2]

Carry out step 1 to step 14.

1. Prepare the concentrations of ethanol as shown in Table 1.2 in the beakers provided.
2. Label large test-tubes with the concentrations of ethanol stated in Table 1.2.
3. Put 10 cm^3 of each concentration of ethanol into the appropriately labelled large test-tube.
4. Cut the beetroot cylinders into 2 mm thick discs using a single-edged blade.
   You will need 5 discs for each concentration of ethanol.
5. Put the discs into a small beaker and cover with **W**.
6. Stir with a glass rod.
7. Pour the liquid into the beaker labelled **For waste**.
8. Put the discs on a paper towel and blot them to remove excess **W**.
9. Put 5 discs into each of the large test-tubes. Leave for 5 minutes.

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

10. Label **small** test-tubes with the ethanol concentrations stated in Table 1.2.
11. After 5 minutes stir the contents of each large test-tube.
12. Pour the liquid from each large test-tube into the appropriately labelled small test-tube.
    Make sure that the discs remain in the large test-tubes.

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Fig. 1.1 shows the key you need to use to record your results.

Key

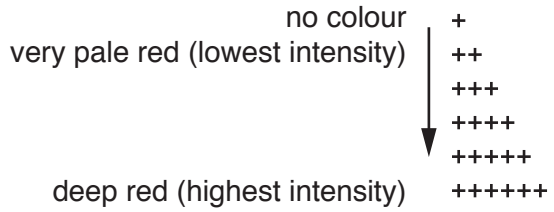


Fig. 1.1

13. Observe the colour of the liquid in each small test-tube.

It may help to observe the liquid with a piece of white card behind the test-tube.

You may observe the same intensity in more than one test-tube.

14. Record your observations in **(a)(ii)** using the symbols shown in the key in Fig. 1.1.

(ii) Prepare a table in the space below to record your observations.

[5]

(iii) State the independent variable in this investigation.

..... [1]

(iv) Use your results from **(a)(ii)** to explain the effect of different ethanol concentrations on the beetroot tissue.

.....

.....

.....

.....

.....

..... [3]

(v) Identify **two** significant sources of error in your investigation.

For each source of error, suggest an improvement.

source of error 1 .....

.....

improvement 1 .....

.....

.....

source of error 2 .....

.....

improvement 2 .....

.....

.....

[4]

(b) Scientists investigated the effect of water potential on the properties of potato tissue.
This was done by placing potato cylinders in solutions with different water potentials for 20 hours. All other variables were kept constant.

The tissue was then compressed. The scientists measured the sound that the potato tissue made as it was compressed using an acoustic emission meter.

The measurement of acoustic emission from compressed potato tissue can be used to judge the quality of the potato.

The results are shown in Table 1.3.

Table 1.3

water potential / MPa	acoustic emission / arbitrary units
–0.3	95
–0.5	76
–0.6	68
–0.9	50
–1.2	43
–1.5	24

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

The position of zero on the *x*-axis is shown.

Use a sharp pencil for drawing graphs.

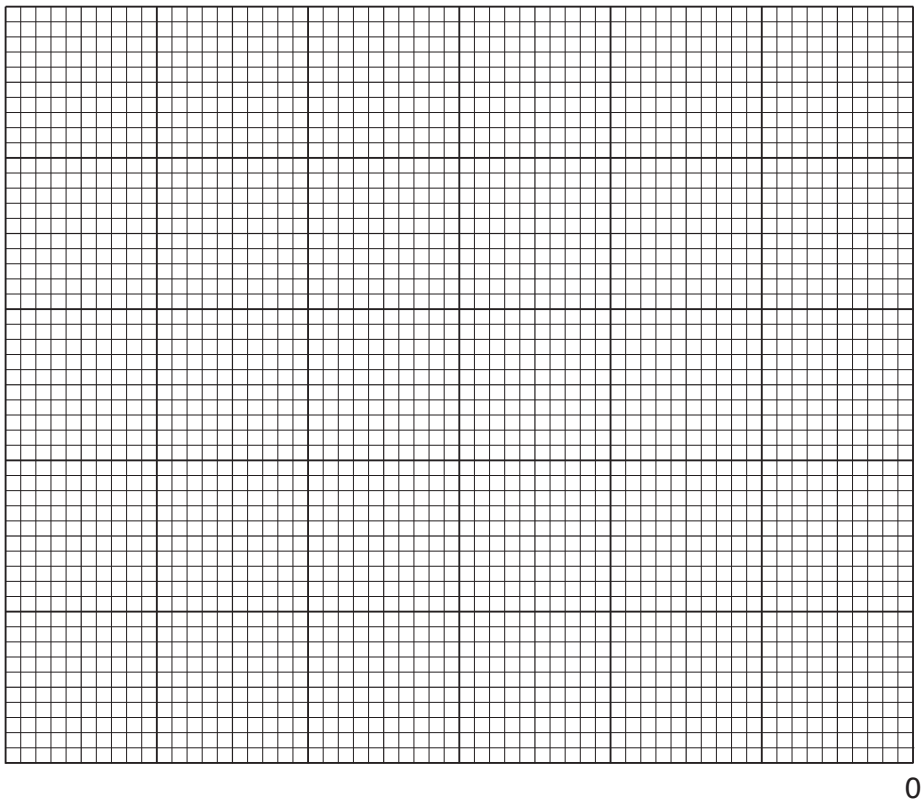


Fig. 1.2 [4]

(ii) Use your graph in **(b)(i)** to estimate the water potential of the potato tissue at an acoustic emission value of 80 arbitrary units.

water potential = ... [1]

(iii) Suggest how the scientists could make **one** improvement to the independent variable so that a more accurate estimate of the water potential at 80 arbitrary units can be obtained.

.....

.....

..... [1]

[Total: 21]

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

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

(a) (i) Draw a large plan diagram of the sector shown in Fig. 2.1.

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

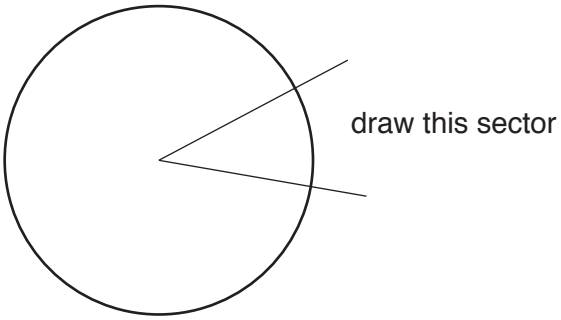


Fig. 2.1

[5]

(ii) Observe the cells from the central region (the pith) of the stem of **J1**.

Select **four** adjacent, touching cells.

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

Make a large drawing of this group of **four** touching cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

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

You are not expected to be familiar with this specimen.

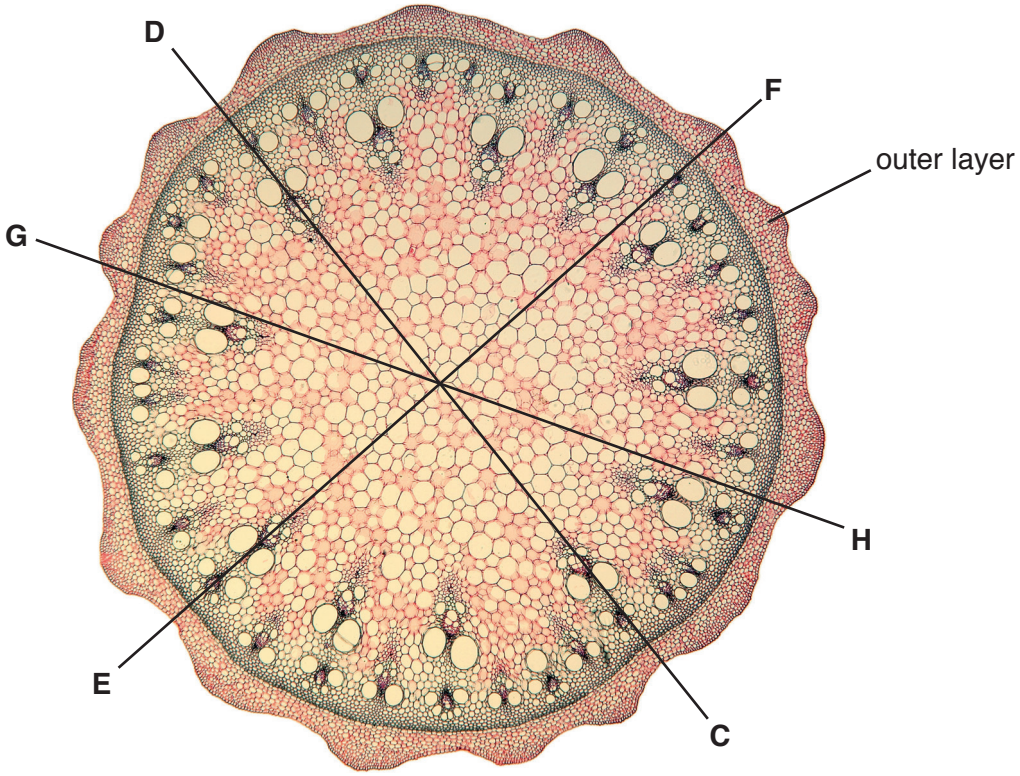


Fig. 2.2

(i) Use the lines **C**–**D**, **E**–**F** and **G**–**H** to determine:

- the mean diameter of the whole stem, as seen in the photomicrograph in Fig. 2.2.
- the mean depth of the outer layer, as seen in the photomicrograph in Fig. 2.2.

Show all the steps in your working.

mean diameter of whole stem .....mm

mean depth of outer layer .....mm

[4]

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

simplest whole number ratio = ... [1]

(c) Prepare an appropriate table so that it is suitable for you to record observable differences between the stem on **J1** and the stem in Fig. 2.2.

Record the observable differences in your table.

[4]

[Total: 19]

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

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

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1 Enzyme **E** catalyses the hydrolysis of starch to maltose.

The progress of this enzyme-catalysed reaction can be followed by measuring the time taken for the substrate, starch, to disappear.

You will investigate the effect of an inhibitor, **C**, on the hydrolysis of starch.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3	risk
E	1% amylase solution	irritant	10	
S	1% starch solution	none	50	
C	2% copper sulfate solution	harmful irritant	20	
W	distilled water	none	100	
iodine	iodine solution	irritant	25	
U	unknown concentration of copper sulfate solution	harmful irritant	10	

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

It is recommended that you wear suitable eye protection.

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

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

Complete Table 1.1, using the words **low**, **medium** or **high**, to state the risk of using **E**, **S** and **C**. You may use each word once, more than once or not at all. [1]

You will need to make a **serial** dilution of 2.0% copper sulfate solution, **C**, which reduces the concentration by a **factor of ten** between each successive dilution.

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

Decide which other concentrations of copper sulfate solution 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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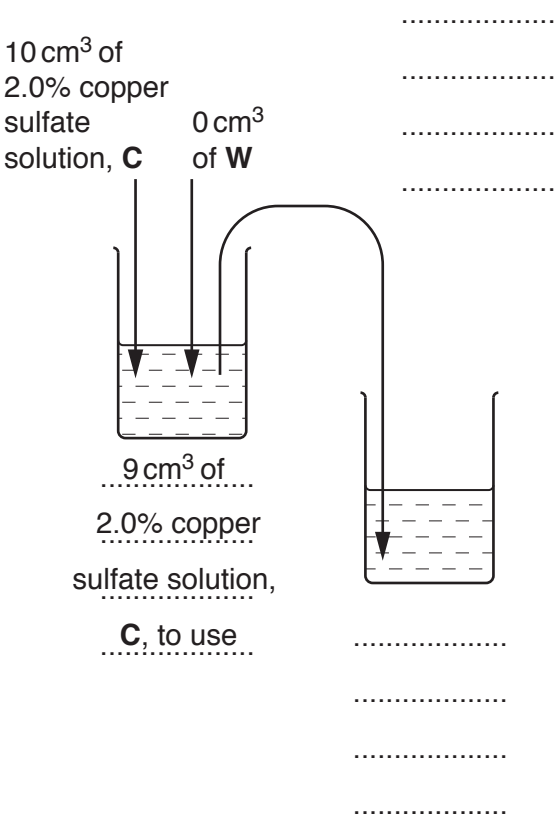

10 cm3 of 2.0% copper sulfate solution, C
0 cm3 of W
9 cm3 of 2.0% copper sulfate solution, C, to use
.....
.....
.....
.....
.....
.....
.....
.....

Fig. 1.1 [3]

Carry out step 1 to step 19.

1. Prepare the concentrations of copper sulfate solution as decided in **(a)(ii)** and shown in Fig. 1.1.

Use a glass rod to mix the copper sulfate solutions and water.

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

3. Label another test-tube **W**.

4. Wipe the white tile clean with a damp paper towel and then dry the white tile.

5. Label the white tile, as shown in Fig. 1.2.
The numbers indicate the sampling times in seconds.

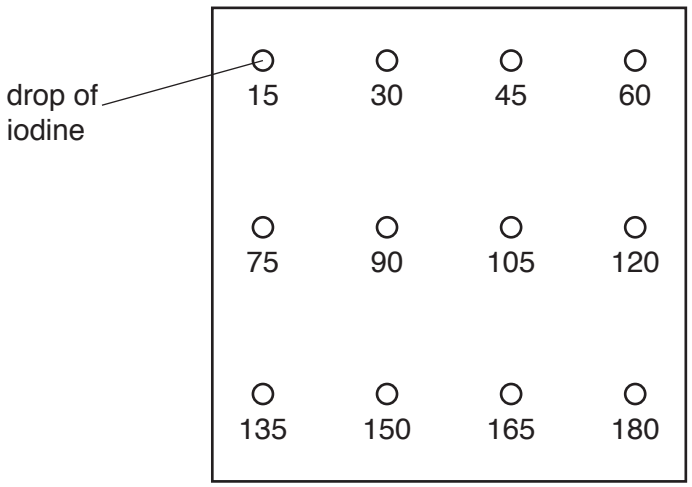


Fig. 1.2

6. Put one drop of iodine on the white tile at each sampling time, as shown in Fig. 1.2.

7. Put 1 cm^3 of **W** into the test-tube labelled **W**.

8. Put 3 cm^3 of **S** into the same test-tube. Mix well.

9. Put 0.5 cm^3 of **E** into the same test-tube. Use a glass rod to mix.

10. Start timing.

11. After 15 seconds, use the glass rod to transfer a drop of the mixture from the test-tube onto the **iodine** that is labelled **15**, on the white tile.

12. Clean the glass rod with a paper towel.

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13. Repeat step 11 to step 12 at intervals of 15 seconds until the **iodine** does not change colour.

14. Record the time taken for the starch to disappear in an appropriate table in **(a)(iii)**.
If the starch has not disappeared at 180 seconds, record 'more than 180'.

15. Repeat step 4 to step 14 replacing the 1 cm^3 of **W** with 1 cm^3 of the **lowest** concentration of copper sulfate solution.

16. Repeat step 15 with the other concentrations of copper sulfate solution.

(iii) Record your results in an appropriate table.

[5]

17. Label a test-tube with the letter **U**.

18. Repeat step 4 to step 13 with **U** instead of **W**.

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

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

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

(v) Using your results in **(a)(iii)** and **(a)(iv)**, estimate the concentration of copper sulfate in **U**.

..... [1]

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[Turn over

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

Explain why this is a source of error.

source of error .....

explanation .....

.....

[1]

(vii) Suggest how you could make **one** improvement to the **independent** variable so that a more accurate estimate of the concentration of copper sulfate in **U** can be obtained.

.....

.....

.....

..... [1]

(viii) Suggest how you could make **two** improvements to the measuring of the **dependent** variable so that a more accurate estimate of the concentration of copper sulfate in **U** can be obtained.

.....

.....

.....

.....

.....

.....

..... [2]

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Question 1 continues on page 10

(b) A student carried out an investigation into the effect of temperature on the activity of enzyme **E**.

The results are shown in Table 1.2.

Table 1.2

temperature / °C	rate of reaction / arbitrary units
5.5	57.5
15.0	120.0
29.5	215.0
36.0	245.0
49.5	102.5

(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.

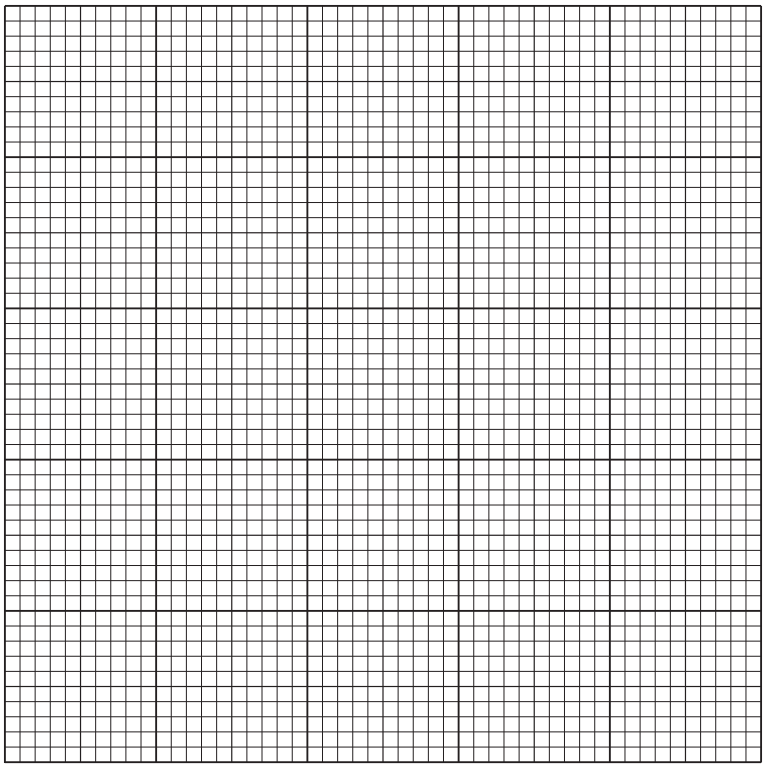


Fig. 1.3 [4]

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(ii) Use your graph in Fig. 1.3 to determine the rate of reaction when the temperature is 37.5 °C.

rate of reaction = ... arbitrary units [1]

(iii) Explain the shape of the graph:

between 5.5 °C and 36.0 °C

.....

.....

.....

.....

between 36.0 °C and 49.5 °C.

.....

.....

.....

.....

[3]

[Total: 23]

2 **K1** 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 leaf.

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

[5]

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

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

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. 2.1 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.

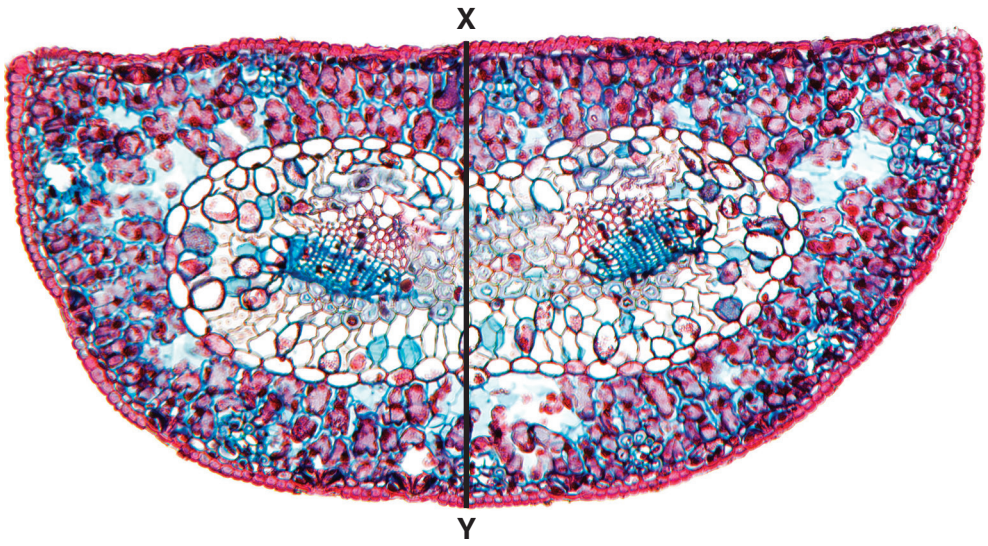


Fig. 2.1 magnification ×74

(i) Calculate the actual thickness of the leaf, shown by line **X**–**Y**.

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

actual thickness of the leaf = ... [3]

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A student calculated the actual length of five cells from the epidermis of this leaf.

The results are shown in Table 2.1.

Table 2.1

cell	1	2	3	4	5
length of cell / μm	28.0	26.0	27.5	26.5	27.0

(ii) Use the information in Table 2.1 to calculate the mean length of these cells.

Show all the steps in your working.

mean length = ... μm [1]

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

Record the observable differences in your table.

[4]

[Total: 17]

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CANDIDATE NUMBER

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

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1 When plant tissue is soaked in methylene blue solution, the solution enters the tissue and stains it blue. When the stained plant tissue is placed into solutions of different pH, methylene blue is released from the plant cells.

A student investigated the effect of pH on the release of methylene blue from the cells of potato tissue.

The student suggested the following hypothesis:

The lower the pH of the solution surrounding the potato tissue, the more methylene blue will be released into the solution.

You will investigate this hypothesis by comparing the release of methylene blue from potato tissue at different pH values.

- The pH values will be changed using buffers, **P2**, **P3**, **P4**, **P5** and **P6**.
- Buffer **PU** has an unknown pH.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume/cm^3
P2	buffer solution pH 2	none	25
P3	buffer solution pH 3	none	25
P4	buffer solution pH 4	none	25
P5	buffer solution pH 5	none	25
P6	buffer solution pH 6	none	25
PU	buffer solution of unknown pH	none	25
W	distilled water	none	200
B	3 potato cylinders stained with methylene blue, in distilled water	none	–

Use the forceps to handle the potato cylinders.

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

It is recommended that you should wear suitable eye protection.

Methylene blue can stain skin and clothing.

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Carry out step 1 to step 17. Use forceps when handling potato cylinders.

1. Pour the water surrounding the potato cylinders in **B** into the container labelled **For waste**.

2. Pour distilled water from the beaker labelled **W** into **B** so that the potato cylinders are covered. Stir gently with the glass rod.

3. Put the potato cylinders onto the white tile using the forceps.

(a) (i) Measure the length of each potato cylinder in mm.

Record your measurements in Table 1.2.

Table 1.2

potato cylinder	length/mm
1	
2	
3	

[1]

(ii) The potato cylinders all have the same diameter.

Describe how you will standardise the surface area of each potato cylinder.

.....

..... [1]

4. Cut one potato cylinder into two pieces and then cut each piece into four smaller pieces, as shown in Fig. 1.1. Repeat for the other two potato cylinders.

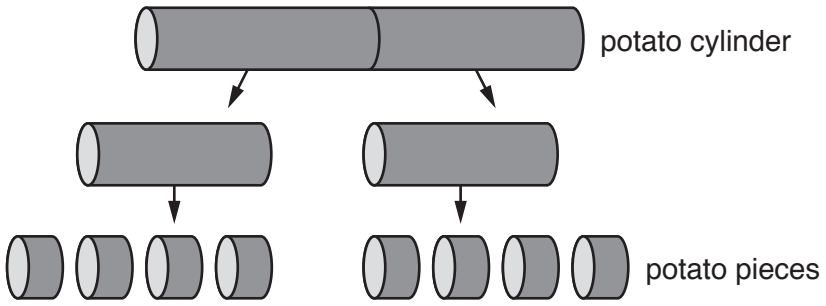


Fig. 1.1

5. Put the potato pieces into beaker **B**. Repeat step 2.

6. Put four potato pieces into each of six test-tubes.

7. Label the six test-tubes using the labels **P2**, **P3**, **P4**, **P5**, **P6** and **PU**.

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Buffer solution will be added to the pieces of potato in each test-tube.

The volume of buffer solution surrounding the plant tissue in the test-tube is a variable that must be standardised.

(iii) Think about how you will standardise the volume of buffer solution.

State the volume of buffer solution that you will use in each test-tube.

volume = ...cm^3 [1]

8. Put the volume of buffer solution **P2** stated in **(a)(iii)** into the appropriately labelled test-tube.

9. Repeat step 8 for each of the other buffer solutions **P3**, **P4**, **P5**, **P6** and **PU**.

10. Put a bung into the test-tube labelled **P2** and mix the contents.

11. Remove the bung from the test-tube and rinse the bung with water in the beaker labelled **For washing**.

12. Repeat step 10 and step 11 with the remaining test-tubes.

13. Leave the test-tubes in the test-tube rack for 10 minutes.

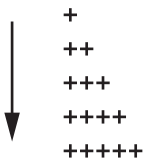
While you are waiting, use your time to continue with Question 1.

14. After 10 minutes, shake each test-tube and pour the liquid into six clean test-tubes.

Fig. 1.2 shows the key you need to use to record your results.

Key:

very pale colour: lowest intensity



deep colour: highest intensity

Fig. 1.2

15. Observe the liquid in each test-tube.

It may help to observe the liquid with a piece of white card behind the test-tube.

You may observe the same intensity in more than one test-tube.

16. Record your results for **P2**, **P3**, **P4**, **P5** and **P6** in **(a)(iv)** using the symbols shown in the key in Fig. 1.2.

17. Record your result for **PU** in **(a)(v)** using one of the symbols shown in the key in Fig. 1.2.

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(iv) Record your results in an appropriate table for **P2**, **P3**, **P4**, **P5** and **P6**.

[5]

(v) Record your result for **PU**.

result for **PU** ..... [1]

(vi) Using your results from **(a)(iv)** and **(a)(v)**, estimate the pH of **PU**.

pH of **PU** = ... [1]

(vii) Suggest **one** improvement to this investigation so that a more accurate estimate of the pH of **PU** can be made.

.....

..... [1]

(viii) Think about how you would modify this procedure to investigate the effect of temperature on the release of methylene blue from the cells of potato tissue.

Describe **how** the independent variable (temperature) will be changed to investigate the release of methylene blue from the cells of potato tissue.

.....

.....

.....

.....

.....

..... [2]

(b) A student investigated the effect of soil pH on grass growth.

Grass was grown in pots containing soil of different pH values for 90 days. The grass was then collected, dried and weighed. All other variables were kept constant.

The results are shown in Table 1.3.

Table 1.3

soil pH	mean mass of grass/g
4.5	7.5
5.0	9.5
5.5	11.1
6.0	12.5
6.5	13.4

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

Use a sharp pencil for drawing graphs.

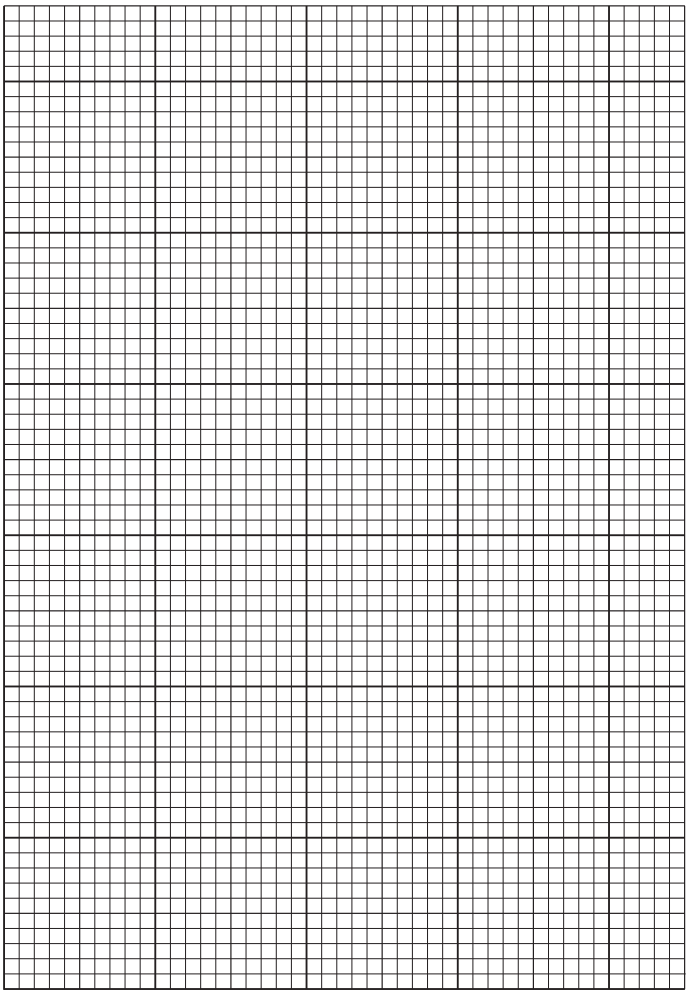


Fig. 1.3

[4]

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(ii) Use Table 1.3 and the graph in **(b)(i)** to describe the trend in the data.

.....

.....

.....

.....[2]

(iii) Minerals from the soil enter a plant with the help of membrane-bound protein molecules. Suggest how a low pH could affect the growth of grass.

.....

.....

.....

.....[2]

[Total: 21]

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

You are not expected to be familiar with this specimen.

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

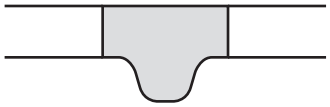


Fig. 2.1

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 **M1** shown by the shaded area in Fig. 2.1.

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

[5]

(ii) Observe the vascular bundle of the leaf on **M1**.

Select one group of **four** cells from the xylem tissue.

Each cell in the group should touch at least one 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) State **one** feature that identifies the cells you have drawn in **(a)(ii)** as xylem.

.....

..... [1]

(c) A student investigated the structure of a different leaf to that on **M1**.

The student calibrated the eyepiece graticule in a light microscope using a stage micrometer scale so that the actual width of the leaf could be found.

The calibration was: one eyepiece graticule division equal to 15 μm.

Fig. 2.2 shows the field of view and eyepiece graticule using the same microscope with the same lenses as those used by the student.

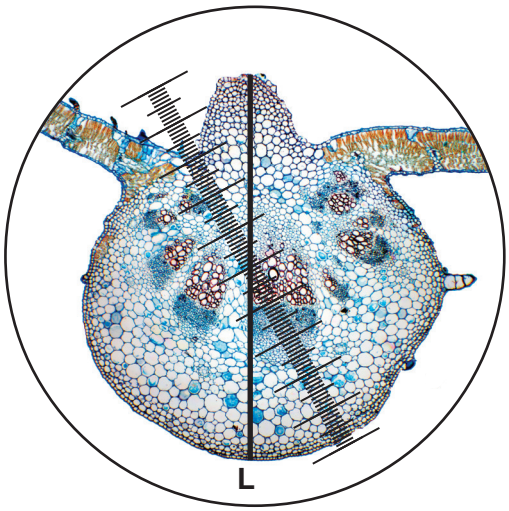


Fig. 2.2

(i) Use the calibration of the eyepiece graticule scale and line **L** on Fig. 2.2 to calculate the actual depth of the leaf.

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

actual depth of the leaf = ... [4]

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Fig. 2.3 is a photomicrograph of the same leaf section that is in Fig. 2.2.

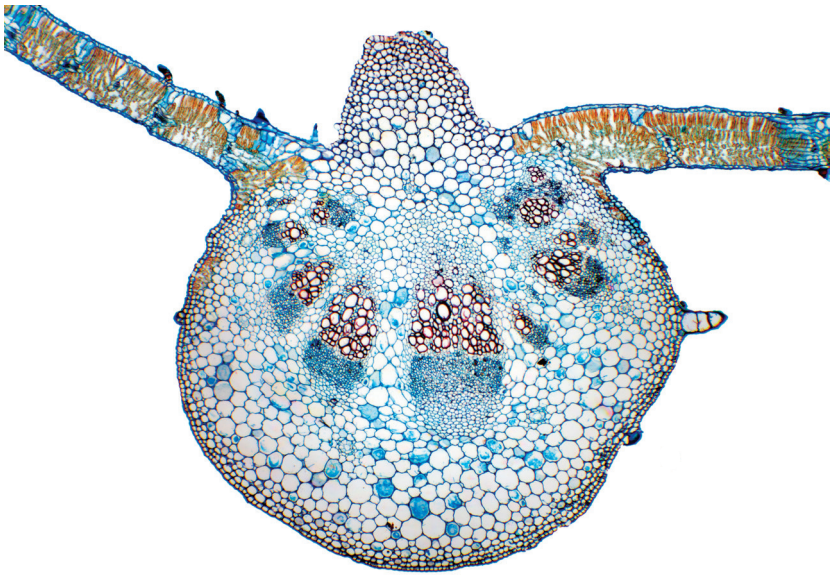


Fig. 2.3

(ii) Use your answer to **(c)(i)** to calculate the magnification of the leaf shown in Fig. 2.3.

Show all the steps in your working.

Space for working

magnification of leaf in Fig. 2.3 ..... [1]

(iii) Annotate Fig. 2.3 to describe **three** observable differences between the leaf in Fig. 2.3 and on **M1**.

- Draw label lines to **three** different features on the leaf in Fig. 2.3 **and** use only the labels **R**, **S** and **T**.
- Next to each letter, describe how each feature on the leaf differs from the leaf on **M1**.

[3]

[Total: 19]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4619373025

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paperclips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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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 Agar cubes that have been stained with a blue indicator can be used to investigate diffusion.

When ascorbic acid, **A**, diffuses into a stained agar cube, it causes the cube to decolourise (the blue colour disappears).

The end-point is reached when the cube has decolourised.

You will investigate the effect of changing the surface area to volume ratio of agar cubes on the diffusion of ascorbic acid by:

- cutting a block of stained agar, **B**, into cubes of different sizes
- putting cubes of different sizes into ascorbic acid, **A**
- recording the time taken for each size of agar cube to reach the end-point.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume /cm^3
A	10% ascorbic acid solution	none	120
B	one stained agar block	none	–

Use the blunt forceps and paper towel to handle the agar block.

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

It is recommended that you wear suitable eye protection.

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(a) You will need to cut agar cubes of different sizes from the agar block, **B**.

The **largest** cube you will cut is 10 mm × 10 mm × 10 mm, as shown in Fig. 1.1.

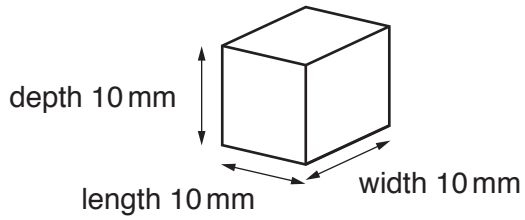


Fig. 1.1

Decide on the sizes of the other agar cubes you will investigate.

(i) Complete Table 1.2 to show the sizes of agar cubes you will investigate.

The first row, for the largest cube, has been completed for you.

Table 1.2

length × width × depth of cube /mm	surface area /mm^2	volume /mm^3	surface area: volume
10 × 10 × 10	600	1000	0.6 : 1

[3]

Carry out step 1 to step 13.

Use the blunt forceps and paper towel to handle the pieces of agar.

1. Draw a grid on the graph paper as shown in Fig. 1.2.

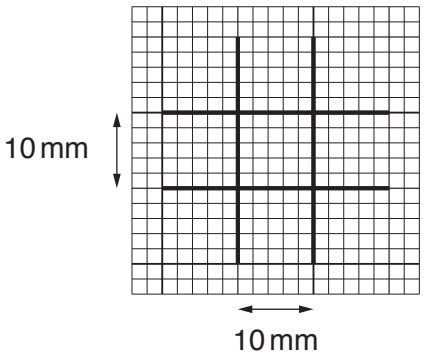


Fig. 1.2

2. Put the graph paper into the plastic wallet and put it on the white tile.

3. Cut a small piece of agar from block **B**. Put the small piece of agar on the plastic wallet so that it is on top of the grid (drawn in step 1).

4. Cut the small piece of agar so that each side is 10 mm, using the grid as a guide, as shown in Fig. 1.3.

   You will need to turn the piece of agar to make sure that each side is cut to 10 mm.

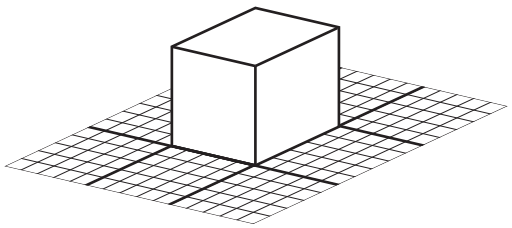


Fig. 1.3

5. Label a beaker **10 × 10 × 10** and put the agar cube you have cut into this beaker.

6. Put any waste pieces of agar into the container labelled **For waste**.

7. Remove the graph paper from the plastic wallet.

8. Draw on the graph paper a grid for each of the sizes of agar cube as stated in Table 1.2.

9. Repeat step 2 to step 6 with each of the sizes of agar cube as stated in Table 1.2.

10. Put 20 cm^3 of **A** into the beaker labelled **10 × 10 × 10**.

11. Repeat step 10 with each of the other beakers you have labelled.

12. Start timing.

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13. Record the time taken for each agar cube to reach the end-point (the agar cube has decolourised).

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

If any agar cube remains blue after 900 seconds, **stop timing** and record 'more than 900'.

You may use this space for raw results.

(ii) Record your results in an appropriate table.

[4]

(iii) Describe the trend in your results.

.....

.....

..... [1]

(iv) State **one** way in which you could improve the confidence in your results.

.....

.....

..... [1]

(v) Describe a suitable control for this investigation.

.....

.....

..... [1]

(vi) Using your knowledge of diffusion and your answers in **(a)(ii)** and **(a)(iii)**, suggest reasons why a **low** surface area to volume ratio could be a disadvantage to an organism.

.....

.....

.....

.....

..... [2]

(b) Table 1.3 shows three possible sources of error when carrying out the investigation described by step 1 to step 13.

(i) Complete Table 1.3 by stating the type of error as systematic or random and the effect on the trend seen in the results. The first one has been completed for you.

Table 1.3

source of error	type of error	effect on trend
the 10 cm^3 mark on the syringe used to measure the volume of **A** actually measured 10.2 cm^3	systematic	no effect as the same syringe was used each time
the agar block, **B**, had lumps in it where it was not dissolved properly		
it was difficult to judge the end-point		

[2]

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The procedure, described by step 1 to step 13, investigated the effect of surface area to volume ratio on diffusion, using the time taken to reach the end-point.

Think about how you could modify this procedure to investigate the effect of **ascorbic acid concentration** on the time taken to reach the end-point.

(ii) The size of the agar cube should be standardised.
Look at your results in **(a)(ii)** and state a size of agar cube that is appropriate to use.

size of agar cube ..... [1]

(iii) Describe how you would modify the procedure to investigate the effect of **ascorbic acid concentration** on the time taken to reach the end-point.

.....

.....

.....

.....

.....

.....

.....

..... [2]

(c) Ascorbic acid is found in plants.

Iodine solution can be used to determine the concentration of ascorbic acid in a plant extract.

Fig. 1.4 shows a calibration graph that can be used to estimate the concentration of ascorbic acid in a plant extract.

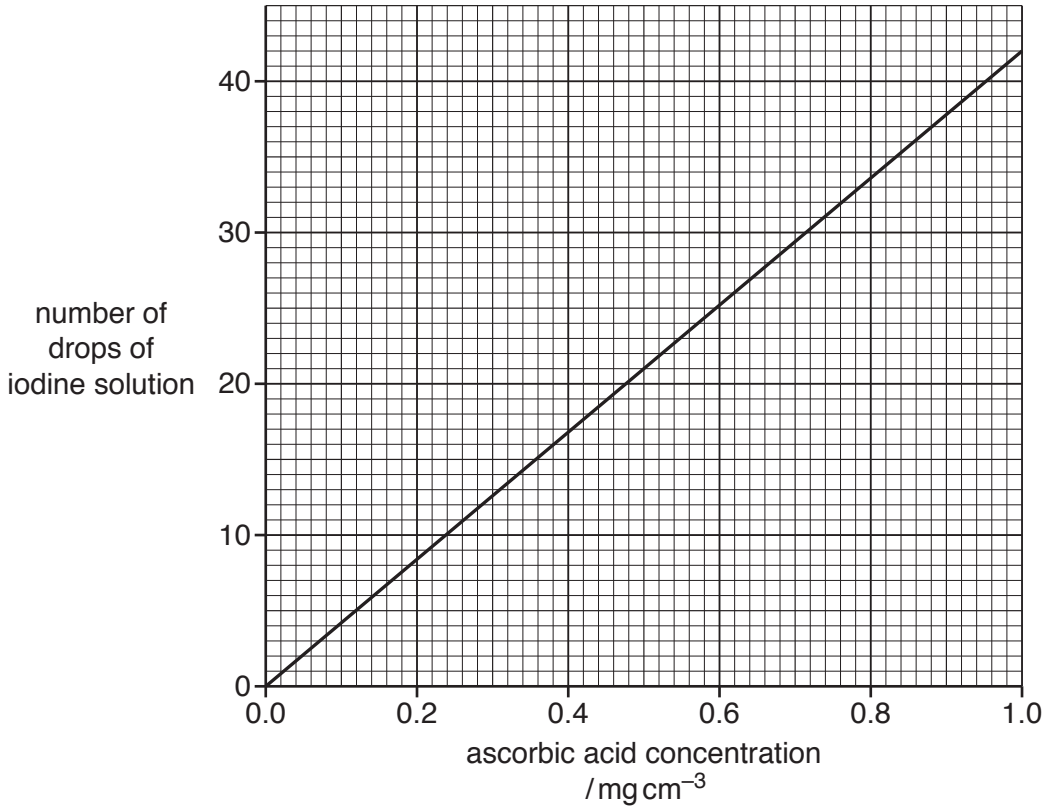


Fig. 1.4

A student carried out an investigation to compare the concentration of ascorbic acid in different plant extracts.

The results are shown in Table 1.4.

Table 1.4

plant extract	number of drops of iodine solution	ascorbic acid concentration / mg cm^{-3}
C	40	0.95
D	8	0.19
E	26	0.62
F	13	
G	2	0.04

(i) Using the graph in Fig. 1.4, complete Table 1.4 for plant extract **F**. [1]

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(ii) Plot a bar chart of the data in Table 1.4 on the grid in Fig. 1.5.

Use a sharp pencil for drawing graphs.

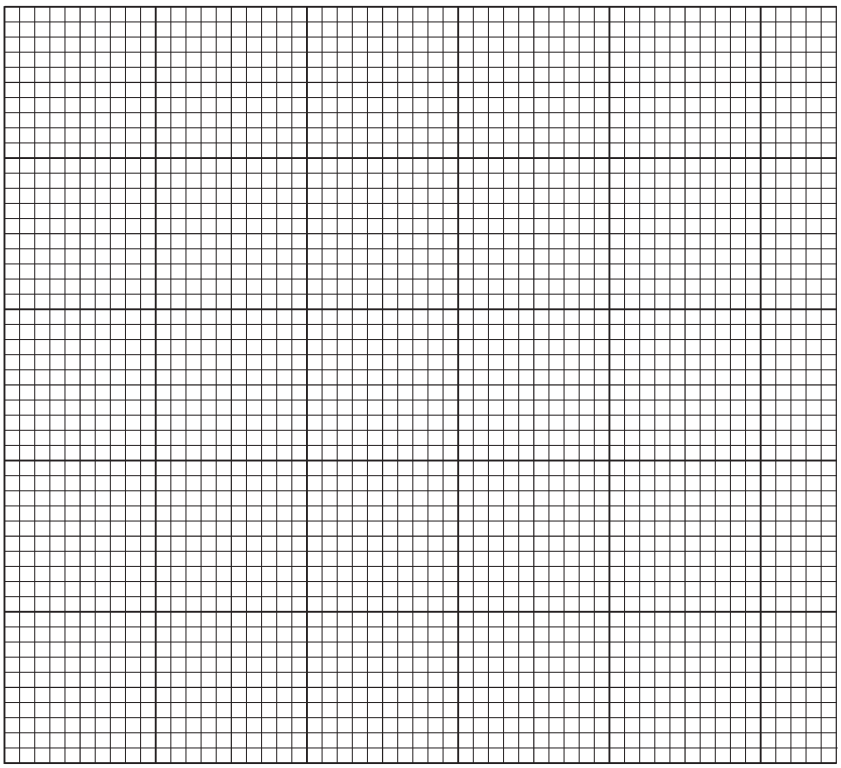


Fig. 1.5

[4]

[Total: 22]

2 **L1** 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 epidermis.

[5]

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

Select **one** large xylem vessel and **three** adjacent, touching vessels which show observable features of the xylem.

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

Make a large drawing of this group of **four** touching cells.

Use **one** ruled label line and label to identify the lumen in one of the cells.

[6]

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

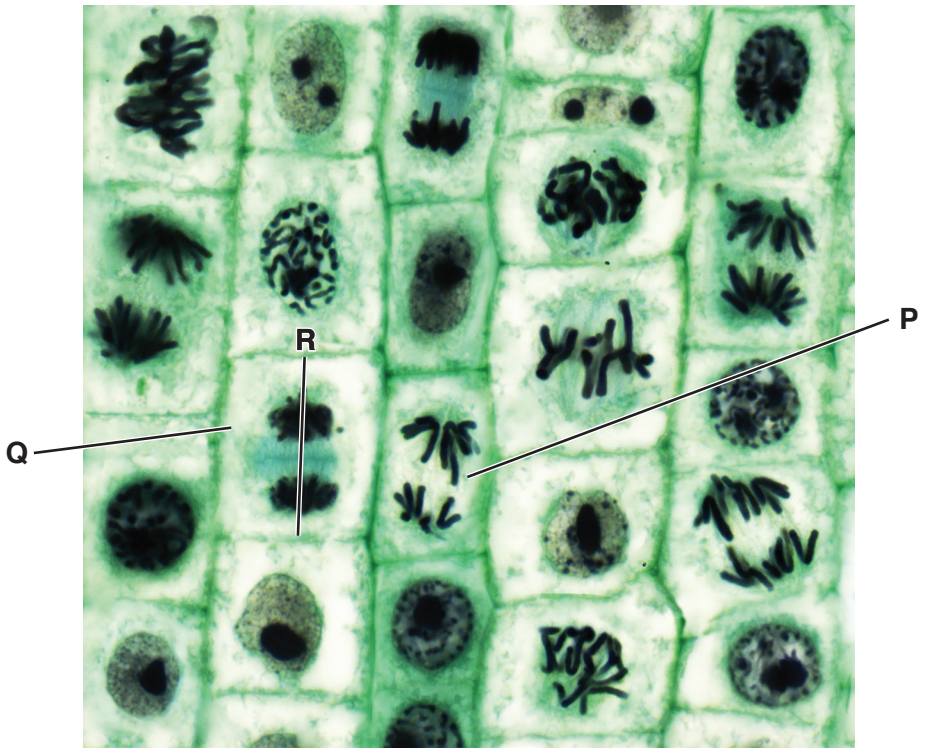


Fig. 2.1

(i) Cell **P** in Fig. 2.1 is in a stage of mitosis.

State the stage of mitosis shown in cell **P**.

Give a reason for your answer.

stage .....

reason .....

.....

.....

[2]

(ii) State the total number of cells in Fig. 2.1 that are in the same stage as cell **P**.

..... [1]

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(iii) The actual length of cell **Q** is 41.6 μm, as shown by line **R**.

Calculate the magnification of the photomicrograph in Fig. 2.1.

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

magnification = ... [4]

[Total: 18]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5583857315

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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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 Catalase is an enzyme that catalyses the break down of hydrogen peroxide, as shown in Fig. 1.1.

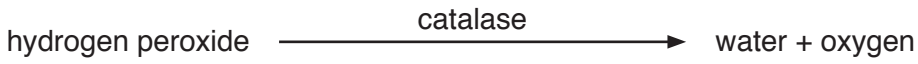


Fig. 1.1

You will investigate the progress of this reaction by measuring the production of oxygen at different concentrations of catalase. Catalase can be found in plant extract.

You will need to prepare different concentrations of plant extract, **P**, using proportional dilution.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume /cm^3	risk
H	hydrogen peroxide solution	harmful irritant	60	
W	distilled water	none	80	
P	100% plant extract solution	harmful irritant	50	

If **H** or **P** 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 **H**, **W** and **P** is **low**, **medium** or **high**.

Complete Table 1.1, using the words **low**, **medium** or **high**, to state the risk of using **H**, **W** and **P**. You may use each word once, more than once or not at all. [1]

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You will need to prepare different concentrations of plant extract, **P**, using proportional dilution.

You will need to prepare 10 cm^3 of each concentration.

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

Decide which other concentrations of **P** you will use.

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

Table 1.2

percentage concentration of **P**	volume of **P** / cm^3	volume of **W** / cm^3
100	10.0	0.0
0	0.0	10.0

[2]

When discs of filter paper that have been soaked in **P** are put into hydrogen peroxide solution, the discs rise to the surface as oxygen bubbles are produced. The higher the rate of oxygen production the faster the discs will rise to the surface.

Carry out step 1 to step 8.

1. Prepare the concentrations of **P** as stated in Table 1.2.

2. Pick up one disc of filter paper using forceps.

3. Continue to hold the disc in the forceps **and**:

    - dip the disc in 100% **P**
    - remove excess **P** by briefly blotting the disc on a paper towel
    - put the disc at the bottom of the liquid in the beaker labelled **H**.

4. Immediately release the disc from the forceps and start timing.

5. Record in **(a)(iii)** the time taken for the disc to reach the surface of **H** and then remove the disc using the forceps. If the time taken for the disc to rise back to the surface is longer than 180 seconds then record 'more than 180'.

6. Dip the forceps in the water in the beaker labelled **For washing**. Dry the forceps with a paper towel.

7. Repeat step 2 to step 6 **two more** times, using 100% **P**.

8. Repeat step 2 to step 7 using the other concentrations of **P** as stated in Table 1.2.

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(iii) Record your results in an appropriate table.

[5]

(iv) State the independent variable in this investigation.

..... [1]

(v) Identify **three** sources of error in this investigation. Suggest an improvement to the procedure for each source of error that would improve the confidence in your results.

1. *source of error* .....

   improvement .....

   .....

2. *source of error* .....

   improvement .....

   .....

3. *source of error* .....

   improvement .....

   .....

[3]

(b) Another way of measuring the activity of catalase from plant tissue would be to measure the volume of oxygen produced when it reacts with hydrogen peroxide.

A student decided to investigate the effect of changing the concentration of hydrogen peroxide on the volume of oxygen produced in 30 seconds.

Table 1.3 shows the results of the student's investigation.

Table 1.3

percentage concentration of hydrogen peroxide	**volume of oxygen produced in 30 seconds/cm^3**					
	test 1	**test 2**	**test 3**	**test 4**	**test 5**	**mean**
0.5	4.0	4.4	5.2	3.9	3.7	4.0
1.0	6.4	6.6	6.0	6.2	6.8	6.4
1.5	7.5	7.8	8.2	8.0	7.5	7.8
2.0	8.7	10.5	8.5	8.3	8.8	
2.5	9.2	9.5	9.6	9.9	8.8	9.4
3.0	9.6	9.5	9.2	9.9	10.3	9.7

(i) Complete Table 1.3 by calculating the mean value at 2.0% hydrogen peroxide.

Space for working.

[2]

(ii) Plot a graph of the mean values shown in Table 1.3 on the grid in Fig. 1.2.

Use a sharp pencil for drawing graphs.

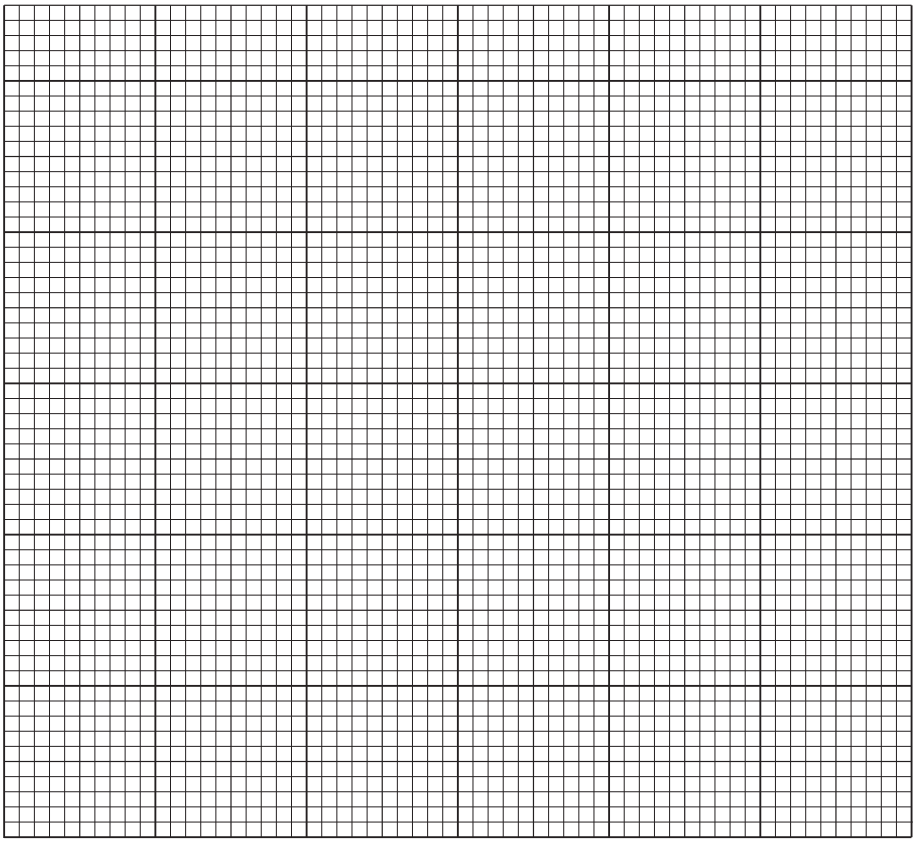


Fig. 1.2 [4]

(iii) Use your graph in Fig. 1.2 to determine the percentage concentration of hydrogen peroxide that produces 7.0 cm^3 of oxygen in 30 seconds.

percentage concentration = ...% [1]

(iv) Explain why the volume of oxygen production increases as the concentration of hydrogen peroxide increases.

.....

.....

.....

.....

.....

..... [3]

[Total: 22]

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[Turn over

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

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

(a) **(i)** Draw a large plan diagram of the sector of the stem on **N1**, shown by the shaded area in Fig. 2.1.

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

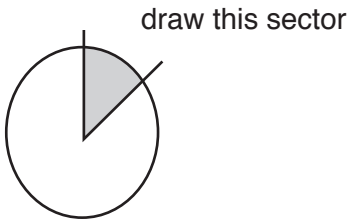


Fig. 2.1

[5]

(ii) Select **four** adjacent, touching xylem vessels.

Each vessel must touch at least **two** other cells.

Make a large drawing of this group of **four** touching xylem vessels.

Use **one** ruled label line and label to identify the cell wall of **one** vessel.

[5]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through the root 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 = 24.6 μm

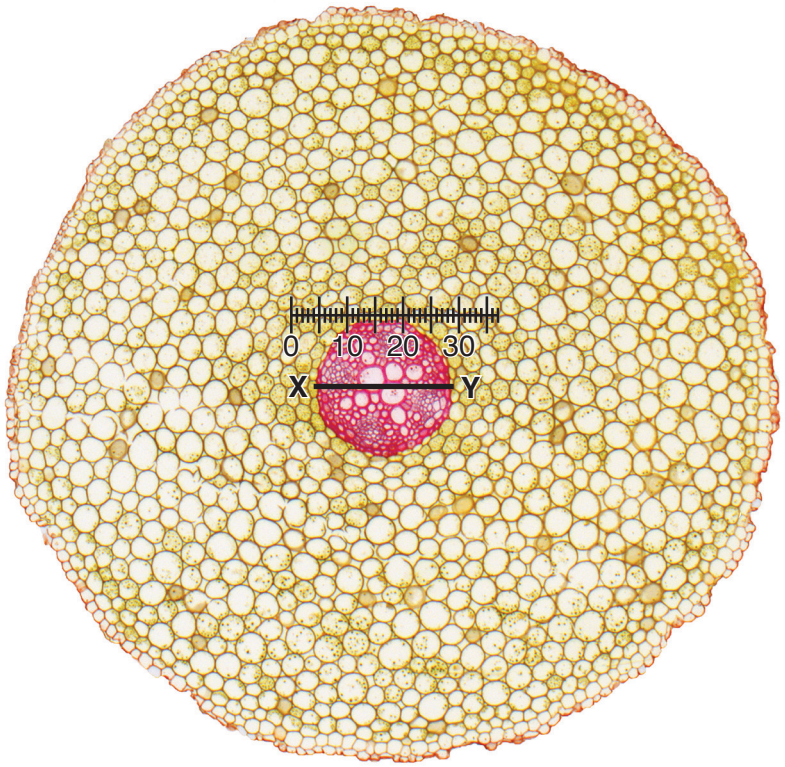


Fig. 2.2

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(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 = ... [4]

(ii) Prepare an appropriate table so that it is suitable for you to record the observable differences between the stem on **N1** and the root in Fig. 2.2.

Record the observable differences in your table.

[4]

[Total: 18]

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