Cambridge Assessment International Education

# Cambridge International AS & A Level

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*1744682233*

**BIOLOGY** **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2022**

**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** Some fruit contains large quantities of ascorbic acid (vitamin C). Ascorbic acid can be absorbed through the partially permeable wall of the gut.

You will investigate the rate at which ascorbic acid from a $2\,g\,dm^{-3}$ ascorbic acid solution diffuses across a partially permeable membrane. Dialysis (Visking) tubing acts as a partially permeable membrane.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | quantity |
|---|---|---|---|
| **A** | $2\,g\,dm^{-3}$ ascorbic acid solution | irritant | $80\,cm^3$ |
| **W** | distilled water | none | $200\,cm^3$ |
| **D** | dialysis tubing in distilled water | none | 20 cm |
| **I** | iodine solution | irritant | $25\,cm^3$ |
| **S** | starch solution | none | $20\,cm^3$ |

It is recommended that you wear suitable eye protection.

You will need to:
- allow ascorbic acid to diffuse out of the dialysis tubing into the distilled water surrounding the dialysis tubing
- estimate the concentration of ascorbic acid that has diffused out of the dialysis tubing.

Carry out step 1 to step 27.

step 1 Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

step 2 To open the other end, wet the dialysis tubing and rub the tubing gently between your fingers and thumb.

step 3 Put $10\,cm^3$ of ascorbic acid solution **A** into the open end of the dialysis tubing.

step 4 Rinse the outside of the dialysis tubing by dipping it in the container of water labelled **D**.

step 5 Carefully place the filled dialysis tubing bag into the large test-tube and secure in position using an elastic band, as shown in Fig. 1.1.

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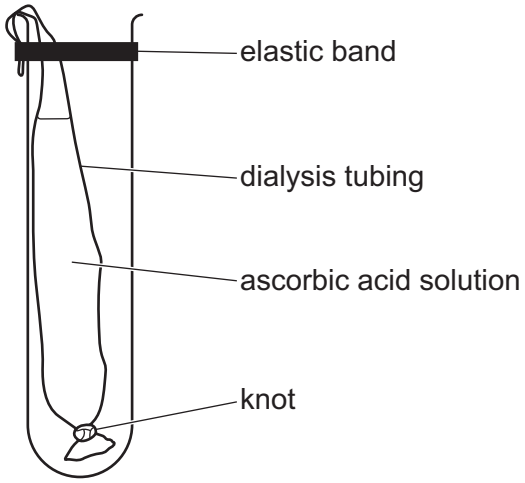



**Fig. 1.1**

You will need to fill the large test-tube with a known volume of distilled water so that it just covers the liquid in the dialysis tubing.

step 6 Use a syringe to add the distilled water to the large test-tube and record in **(a)(i)** the volume you added.

**(a) (i)** State the volume of distilled water you added.

volume of water ..... $cm^3$ [1]

step 7 Start timing and leave the dialysis tubing bag in the distilled water for at least 15 minutes.

While you are waiting continue with this question.

You will need to dilute the $2\,g\,dm^{-3}$ ascorbic acid solution, **A**, to provide a range of known concentrations.

You will need to make up $20\,cm^3$ of each concentration of ascorbic acid.

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

**(ii)** Decide which other concentrations of ascorbic acid to make and complete Table 1.2.

**Table 1.2**

| concentration of ascorbic acid / g dm$^{-3}$ | volume of ascorbic acid solution / cm$^3$ | volume of distilled water / cm$^3$ |
|---|---|---|
| 0.0 | 0.0 | 20.0 |
| | | |
| | | |
| | | |
| | | |
| 2.0 | 20.0 | 0.0 |

[2]

step 8 Using the beakers provided, make up the concentrations of ascorbic acid stated in Table 1.2.

step 9 Put 1 cm$^3$ of starch solution **S** into a clean test-tube.

step 10 Put 5 cm$^3$ of the 0 g dm$^{-3}$ ascorbic acid solution (distilled water) into the same test-tube. Shake gently to mix.

step 11 Fill a syringe with 2 cm$^3$ iodine solution **I**.

step 12 Add one drop of **I** to the mixture of **S** and ascorbic acid solution, as shown in Fig. 1.2. Mix gently.

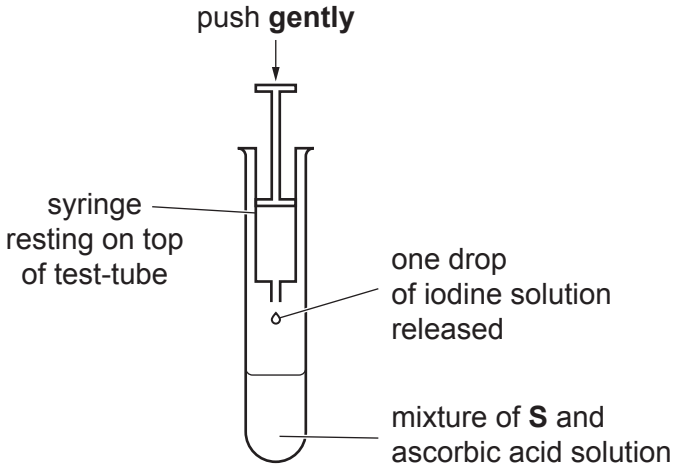



**Fig. 1.2**

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step 13 You should see a blue colour. This is the end-point you are looking for when you test the remaining ascorbic acid solutions (step 21).

step 14 Record the volume of iodine solution you have added.

step 15 Put 1 $cm^3$ of starch solution **S** into a clean test-tube.

step 16 Put 5 $cm^3$ of the lowest concentration of the remaining ascorbic acid solutions into the same test-tube. Shake gently to mix.

step 17 Fill the syringe containing iodine solution **I** to the 2 $cm^3$ level again.

step 18 Add one drop of **I** to the mixture of **S** and ascorbic acid solution as shown in Fig. 1.2. Mix well.

step 19 Continue adding drops one at a time, mixing after each drop, until you see a blue colour.

step 20 As soon as you see a blue colour, wait 10 seconds. If the blue colour disappears then add another drop.

step 21 Continue adding drops until the mixture stays blue for at least 10 seconds. This is the end-point.

step 22 Record the volume of iodine solution you have added.

step 23 Repeat step 15 to step 22 with the other concentrations of ascorbic acid you prepared in step 8.

Record your results in **(a)(iii)**.

**(iii)** Record your results in an appropriate table.

[5]

step 24 Remove the dialysis tubing from the large test-tube and place it in the beaker labelled **For waste**. Stop timing and record the time that the dialysis tubing has been left in the distilled water (time from step 7 to step 24).

time = .....

step 25 Pour the solution from the large test-tube into a small beaker.

step 26 Use a syringe to remove a 5 $cm^3$ sample of the solution from the small beaker.

step 27 Repeat step 15 to step 22 using this sample. Record your result in **(a)(iv)**.

**(iv)** Record the volume of iodine added. ..... [1]

**(v)** Use your results in **(a)(iii)** and **(a)(iv)** to estimate the concentration of ascorbic acid in the solution outside the dialysis tubing bag.

concentration of ascorbic acid ..... [1]

**(vi)** Calculate the **rate** of diffusion of ascorbic acid out of the dialysis tubing.

Show your working.

rate of diffusion ..... [2]

**(vii)** Identify **two** significant sources of error when finding the concentration of ascorbic acid in the sample from the large test-tube.

.....

.....

.....

.....

..... [2]

**(viii)** Suggest how you would make **two** improvements to this investigation.

.....

.....

.....

.....

.....

.....

..... [2]

**(b)** Fruit can be preserved by reducing its water content. This can be done by cutting the fruit into small cubes and soaking the cubes in concentrated sucrose solution.

Cubes of melon were soaked in 45% sucrose solution for 20 hours at a temperature of 25 °C.

The water content of the melon was determined every 4 hours.

The results are shown in Table 1.3.

**Table 1.3**

| time / hours | water content / g of water for each g of melon |
|---|---|
| 0 | 1.44 |
| 4 | 0.83 |
| 8 | 0.42 |
| 12 | 0.25 |
| 16 | 0.20 |
| 20 | 0.20 |

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

Use a sharp pencil.

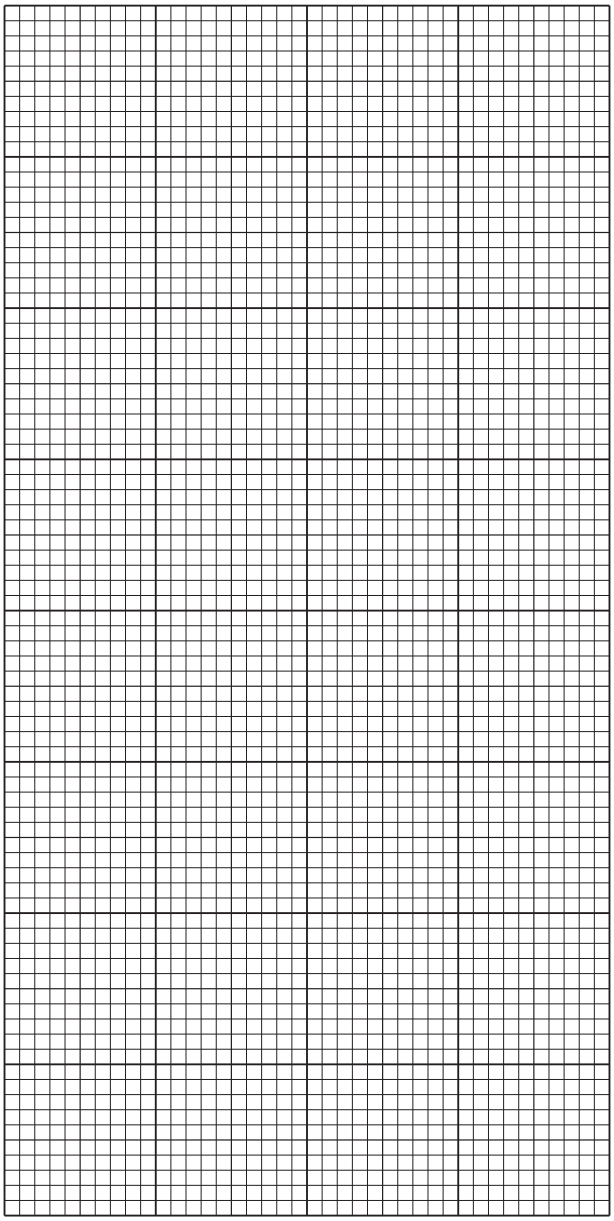


**Fig. 1.3**

[4]

**(ii)** Explain the change in water content of the melon cubes between 16 hours and 20 hours.

.....

.....

.....

.....

..... [2]

[Total: 22]

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

**(a)** **(i)** Draw a large plan diagram of the region of the stem on **J1** indicated by the shaded region in Fig. 2.1. Use a sharp pencil.

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

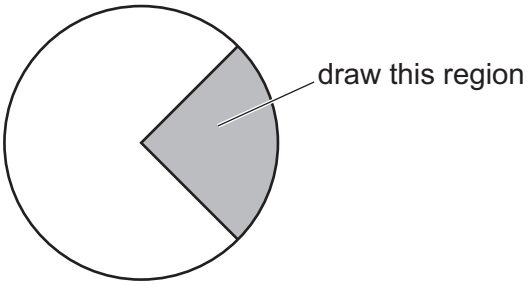



**Fig. 2.1**

[5]

**(ii)** Observe the xylem vessel elements of the section on **J1**.

Select **four** adjacent xylem vessel elements.

Each xylem vessel element must touch at least one other xylem vessel element.

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

[5]

**(b)** Fig. 2.2 is a scanning electron micrograph of trichomes on the surface of a leaf.

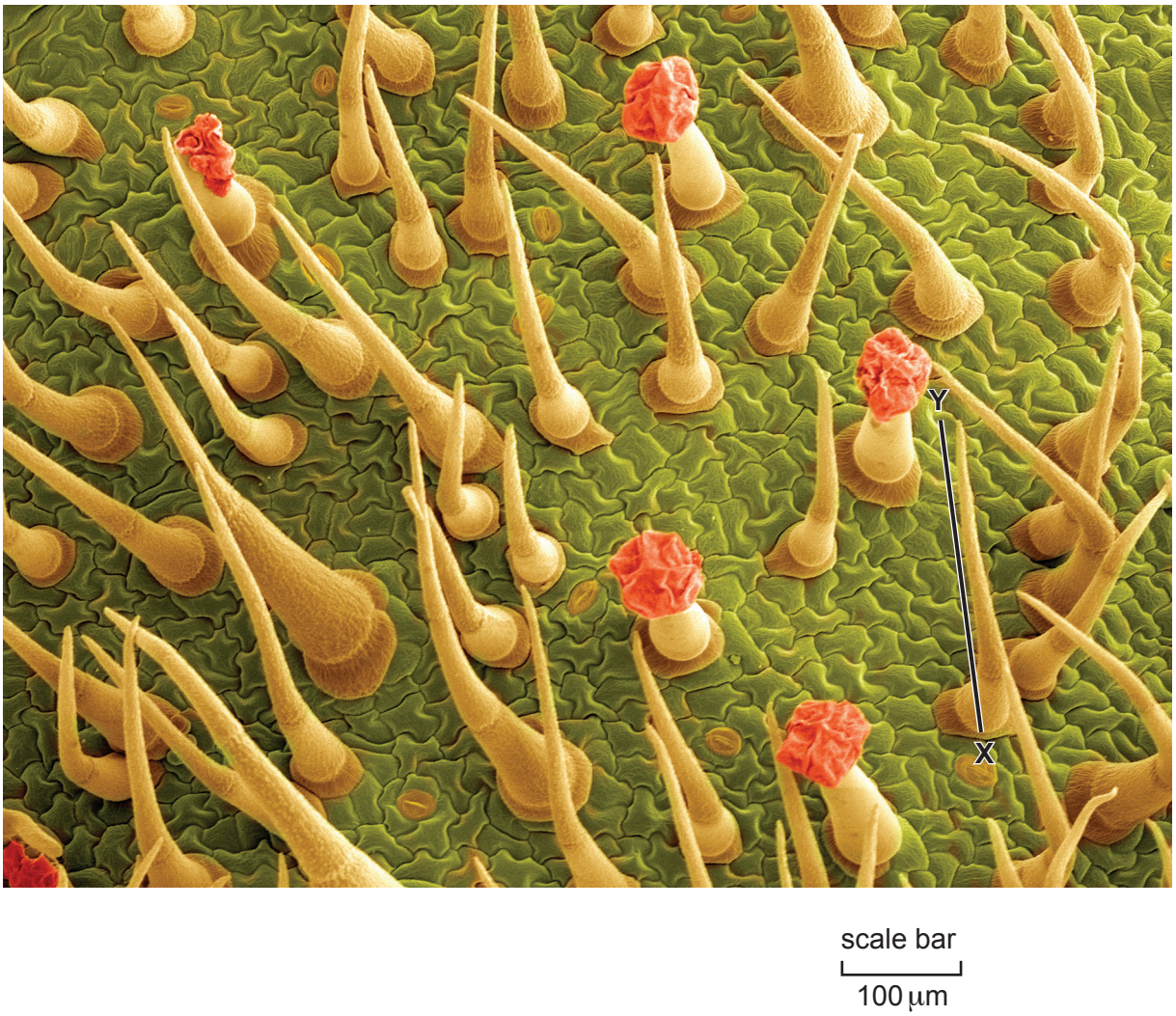



**Fig. 2.2**

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

Show your working and use appropriate units.

..... [3]

**(ii)** Add a labelled line to Fig. 2.2 to identify a stoma. [1]

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**(iii)** Fig. 2.3 is a scanning electron micrograph of trichomes on the leaf of a different plant.

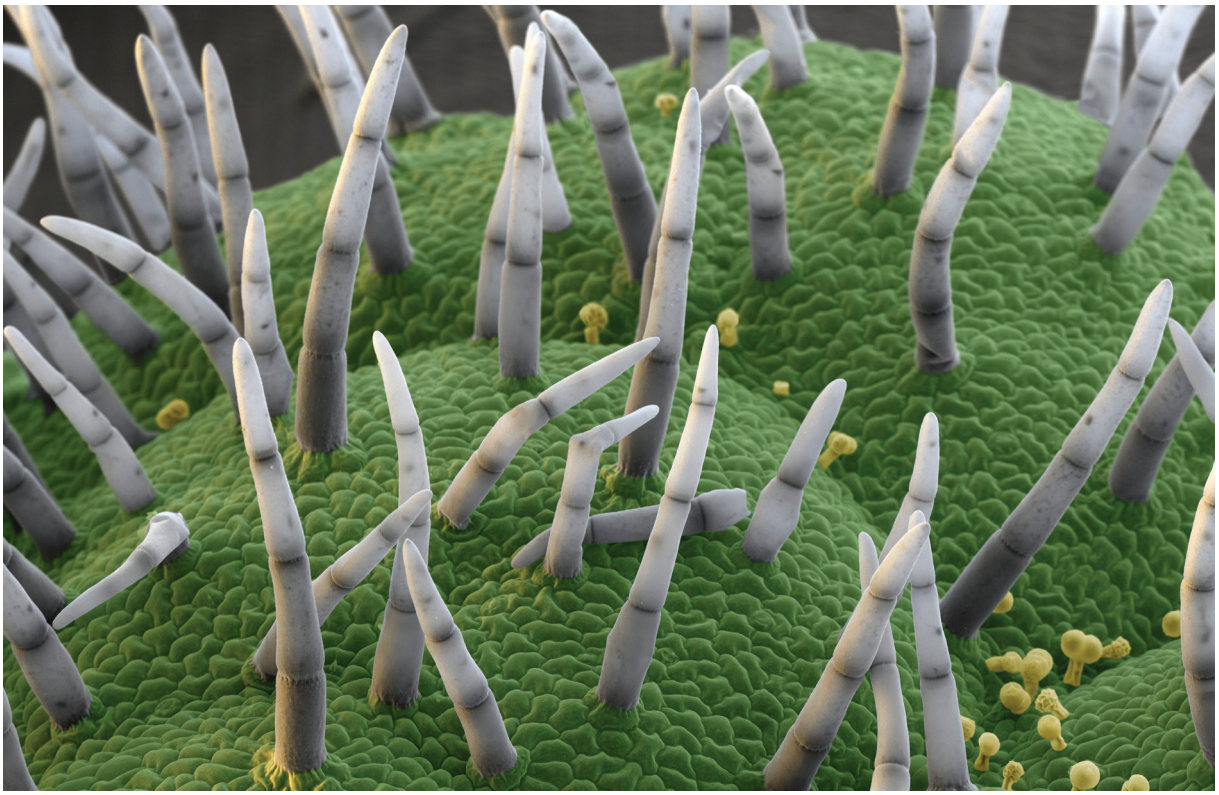


**Fig. 2.3**

Observe the trichomes in Fig. 2.2 **and** Fig. 2.3.

Identify **one** observable similarity and **two** observable differences, other than size and colour, between the trichomes in Fig. 2.2 and the trichomes in Fig. 2.3.

Record these observations in an appropriate table.

[4]

[Total: 18]

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# Cambridge International AS & A Level

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*9123732966*

**BIOLOGY** **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2022**

**2 hours**

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[Turn over

**1** You are provided with a solution labelled **E** containing an enzyme which coagulates (clots) milk.

Enzyme **E** hydrolyses (breaks) peptide bonds between certain amino acids in a protein found in milk and this results in the coagulation of the milk.
Calcium ions are needed for this coagulation.

When a mixture of milk, calcium chloride solution and **E** is gently turned in a test-tube, the milk will coagulate, producing lumps of a white solid in a liquid.

The end-point of the enzyme-catalysed coagulation is when all the milk coagulates, as shown in Fig. 1.1.

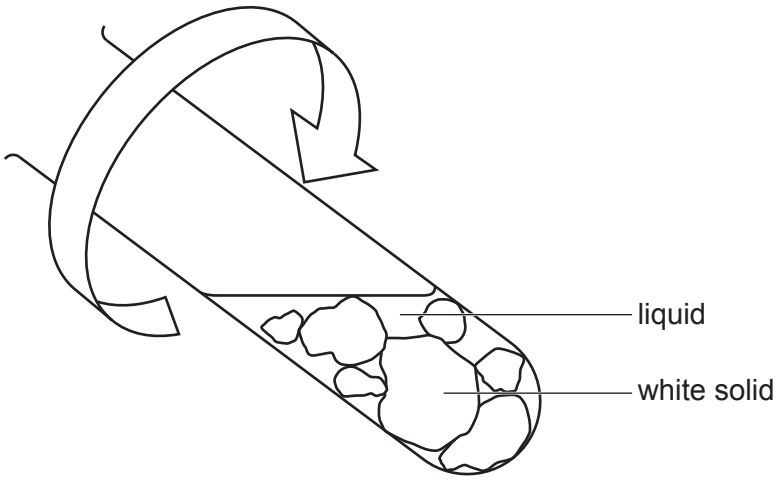



**Fig. 1.1**

You will investigate the effect of temperature on the time taken to reach the end-point.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **M** | 100% milk | none | 150 |
| **E** | enzyme solution | harmful irritant | 20 |
| **C** | calcium chloride solution | harmful irritant | 20 |

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

It is recommended that you wear suitable eye protection.

You will test the activity of enzyme **E** at 30 °C and other temperatures up to a maximum of 50 °C.

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**(a) (i)** Complete Table 1.2 to show three other temperatures that you will use to show the effect of temperature on the activity of enzyme **E**.

**Table 1.2**

| temperature / °C | | | | |
|---|---|---|---|---|
| 30 | ..... | ..... | ..... | 50 |

[1]

Carry out step 1 to step 14.

step 1 Set up a water-bath ready for step 6. The starting temperature of the water-bath should be 30 °C, as shown in Table 1.2.

step 2 Put 10 $cm^3$ of **M** into a test-tube.

step 3 Repeat step 2 so that you have **two** test-tubes containing **M**.

step 4 Put 1 $cm^3$ of **C** into each test-tube.

step 5 Gently shake the test-tubes to mix **M** and **C**.

step 6 Put the test-tubes into the water-bath and leave for 3 minutes.

**(ii)** Explain why the test-tubes are left in the water-bath for 3 minutes in step 6.

.....

..... [1]

step 7 Remove **one** of the test-tubes from the water-bath.

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The process of coagulation will start when **E** is added to the test-tube.

step 8 Put 1 $cm^3$ of **E** into the test-tube, so that it runs down the side of the test-tube and forms a layer on the surface of the mixture, as shown in Fig. 1.2.

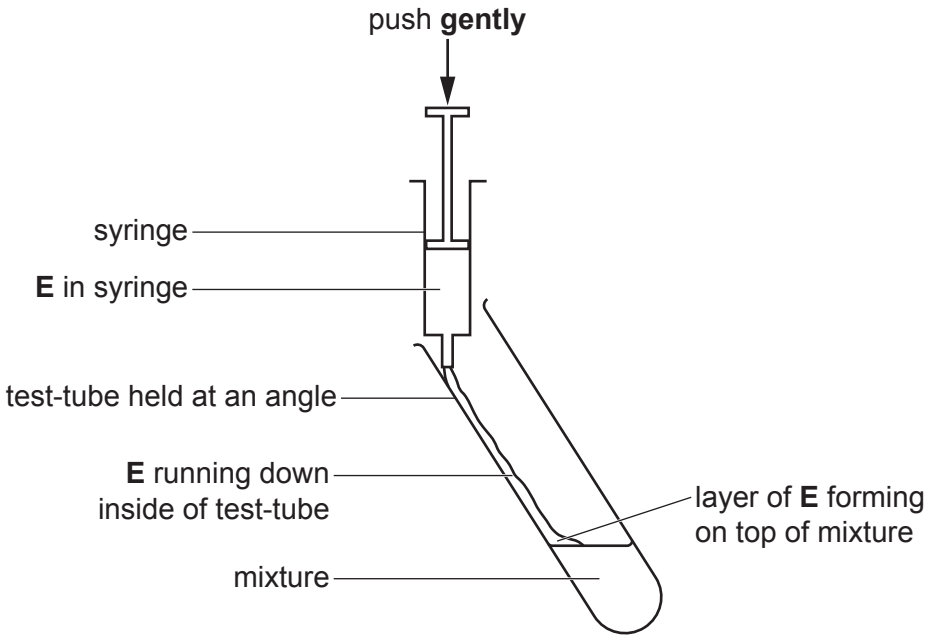



**Fig. 1.2**

step 9 Gently shake the test-tube to mix the solutions and start timing.

step 10 Rotate the test-tube and continue to rotate it while observing the mixture until the end-point is reached. Stop timing when the end-point is reached.

If the end-point has not been reached by 180 seconds, stop timing and record this as 'more than 180'.

step 11 Record in **(a)(iii)** the time to reach the end-point.

step 12 Repeat step 7 to step 11 with the other test-tube in the water-bath.

step 13 Set up the water-bath at the next temperature after 30 °C stated in Table 1.2.

step 14 Repeat step 2 to step 13 for each temperature 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 experiment.

.....

..... [1]

**(v)** Suggest a suitable control for this investigation to show that it is the enzyme **E** that coagulates the milk.

.....

.....

..... [1]

**(vi)** The procedure described by step 1 to step 14 investigated the effect of temperature on the activity of enzyme **E**, using the time taken to reach the end-point.

Describe how you would modify the procedure to investigate the effect of changing the concentration of milk on the time taken to reach the end-point.

.....

.....

.....

.....

.....

.....

.....

..... [3]

**(b)** A scientist carried out an investigation into the effect of enzyme concentration on the coagulation of milk. The scientist calculated the activity of the enzyme for each concentration of enzyme.

The results are shown in Table 1.3.

**Table 1.3**

| **% enzyme concentration** | **activity of enzyme / arbitrary units (au)** |
|---|---|
| 0.05 | 19 |
| 0.10 | 34 |
| 0.15 | 50 |
| 0.20 | 65 |
| 0.30 | 96 |

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

Use a sharp pencil.

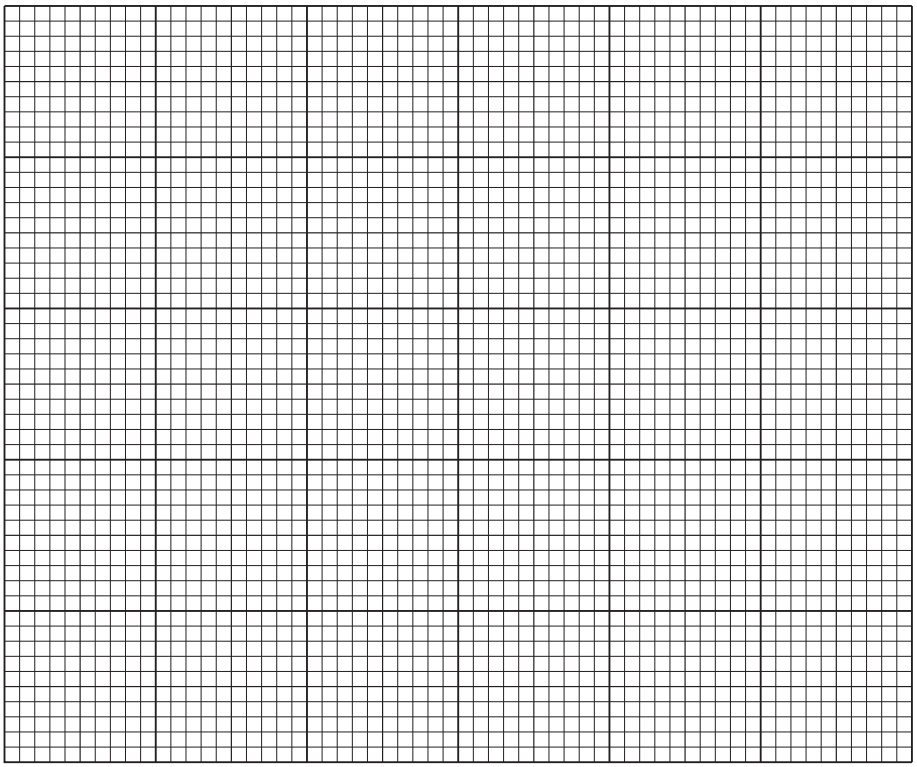


**Fig. 1.3**

[4]

**(ii)** Use your graph to determine the activity of the enzyme when the enzyme concentration is 0.25%.

Show on your graph how you determined this value.

activity of the enzyme = ..... au
[2]

**(iii)** Describe the trend in the results shown by your graph.

.....

.....

..... [1]

**(iv)** Suggest an explanation for the trend you described in **(b)(iii)**.

.....

.....

.....

.....

..... [2]

[Total: 21]

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

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

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

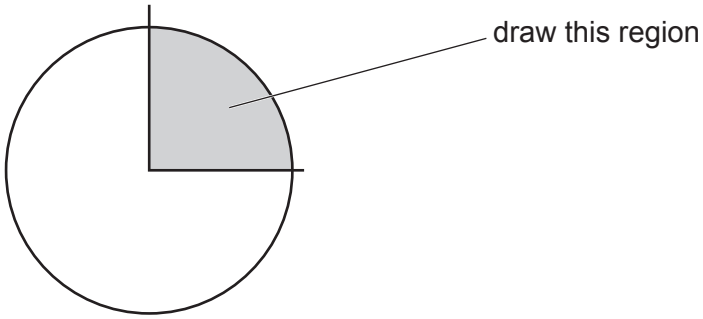



**Fig. 2.1**

[5]

**(ii)** Observe the epidermis of the stem on **K1** and the layer of cells beneath.

Select a group of four adjacent cells. This group must include **two** cells from the epidermis and **two** cells from below the epidermis.

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

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

[5]

Fig. 2.2 is a photomicrograph of a stained transverse section of a stem from a different type of plant.

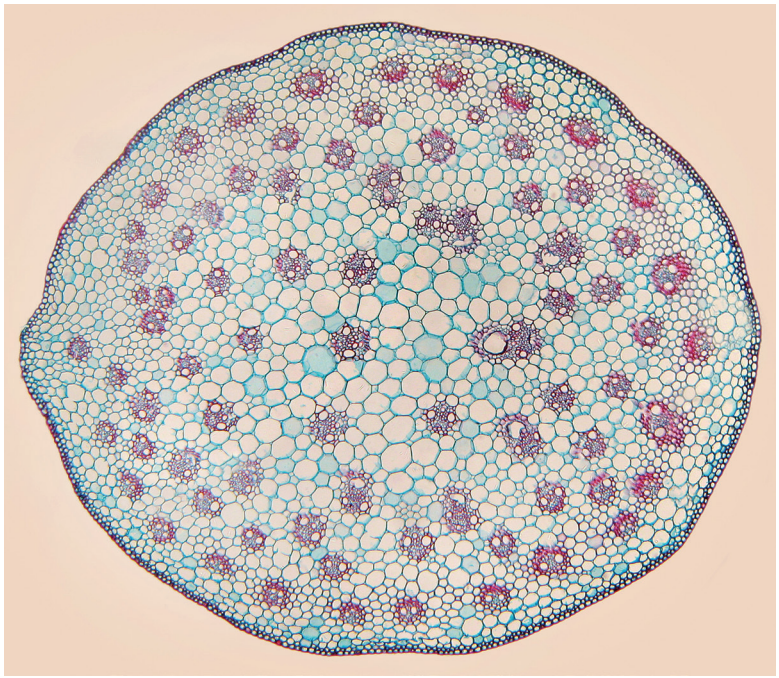


**Fig. 2.2**

**(b)** Identify **three** observable differences, other than size and colour, between the stem in Fig. 2.2 and the stem on **K1**.

Record these **three** observable differences in an appropriate table.

[4]

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

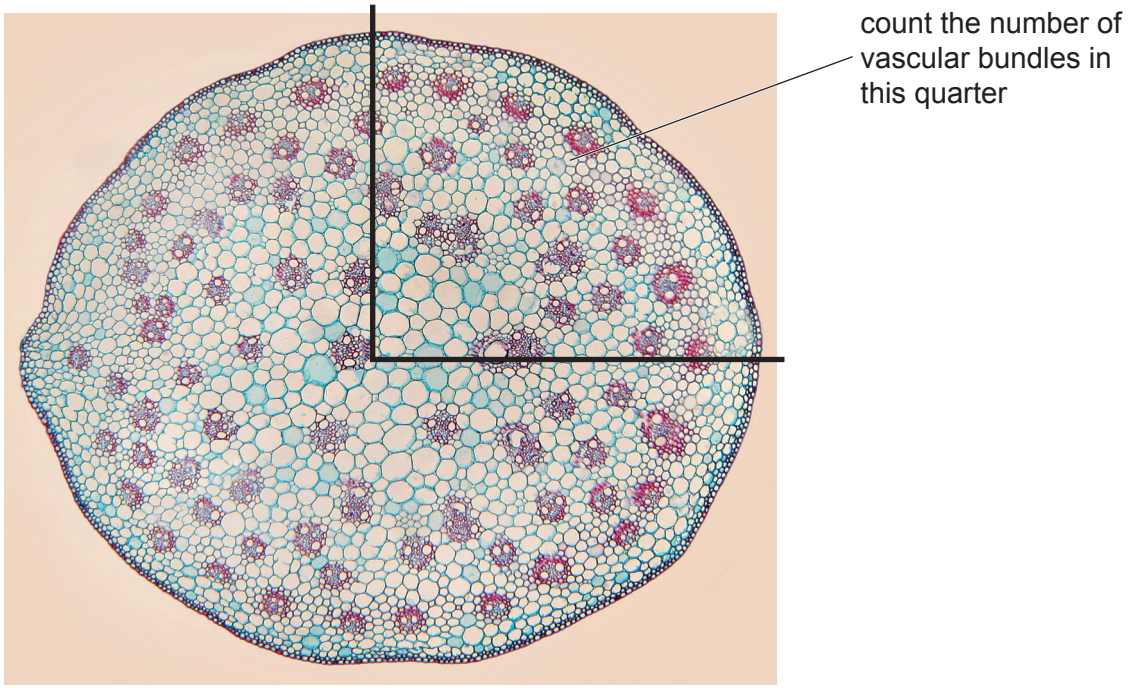



**Fig. 2.3**

Fig. 2.3 shows many vascular bundles within the photomicrograph. A sampling technique may be used to estimate the number of vascular bundles present in the whole photomicrograph.

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**(i)** The region shown in Fig. 2.3 is one quarter of the stem section.

Count and record the number of vascular bundles in the region shown in Fig. 2.3.

If half or more of a vascular bundle is within the region, count it as a whole vascular bundle.
Do not count any vascular bundle if less than half of the vascular bundle is within the region.

Mark clearly, using a pen (not a pencil), on Fig. 2.3 each of the vascular bundles you have counted.

Estimate the total number of vascular bundles in the whole photomicrograph.

Show your working.

estimated number of vascular bundles in the whole photomicrograph .....
[4]

**(ii)** The plant shown in Fig. 2.3 has many vascular bundles.

Suggest why it is an advantage to the plant to have many vascular bundles in its stem.

.....

.....

..... [1]

[Total: 19]

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Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*0686762061*

**BIOLOGY** **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 2022**

**2 hours**

You must answer on the question paper.

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[Turn over

**1** Ascorbic acid is important in the diet for maintaining health. Ascorbic acid can be found in many vegetables.

You will investigate the effect of heating on the concentration of ascorbic acid in a vegetable extract. You will be carrying out a test to estimate the concentration of ascorbic acid in a vegetable extract.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **A** | 0.1% ascorbic acid solution | none | 50 |
| **W** | distilled water | none | 100 |
| **iodine** | iodine solution | none | 20 |
| **S** | starch solution | none | 20 |
| **U** | vegetable extract before cooking | none | 20 |
| **C** | vegetable extract after cooking | none | 20 |

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

It is recommended that you wear suitable eye protection.

To estimate the concentration of ascorbic acid in the vegetable extract you will use iodine solution. The higher the concentration of ascorbic acid in the vegetable extract, the greater the volume of iodine solution needed to reach the end-point.

The end-point is when the blue colour remains for at least 10 seconds.

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**(a)** To find the volume of iodine solution needed to reach the end-point, iodine solution will be added to the vegetable extract, one drop at a time, using a syringe.

To practise releasing drops from a syringe, carry out step 1 to step 3.

step 1 Fill a 1.0 $cm^3$ syringe with distilled water, **W**.

step 2 Hold the syringe over an empty test-tube, as shown in Fig. 1.1, and push the plunger slowly to release one drop.

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

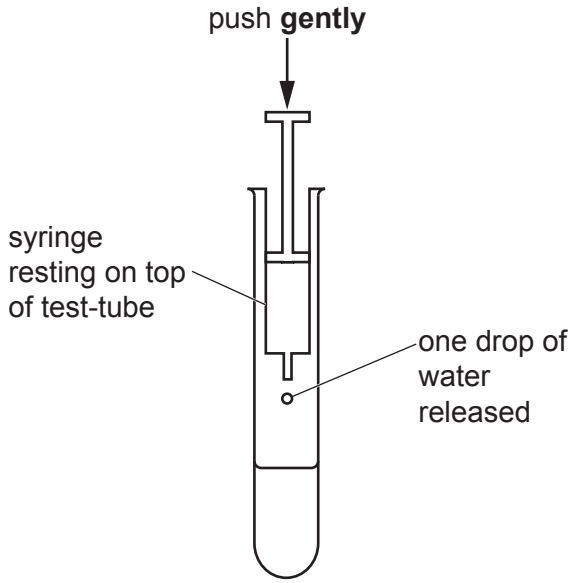



**Fig. 1.1**

You will need to carry out a **serial** dilution of the 0.1% solution of ascorbic acid, **A**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of ascorbic acid in addition to the 0.1% solution, **A**.

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

**(i)** Complete Fig. 1.2 to show how you will prepare your serial dilution.

Fig. 1.2 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker add labelled arrows to show:

- The volume of **A** transferred
- The volume of distilled water, **W**, added.

Under each beaker, state the concentration of ascorbic acid solution.

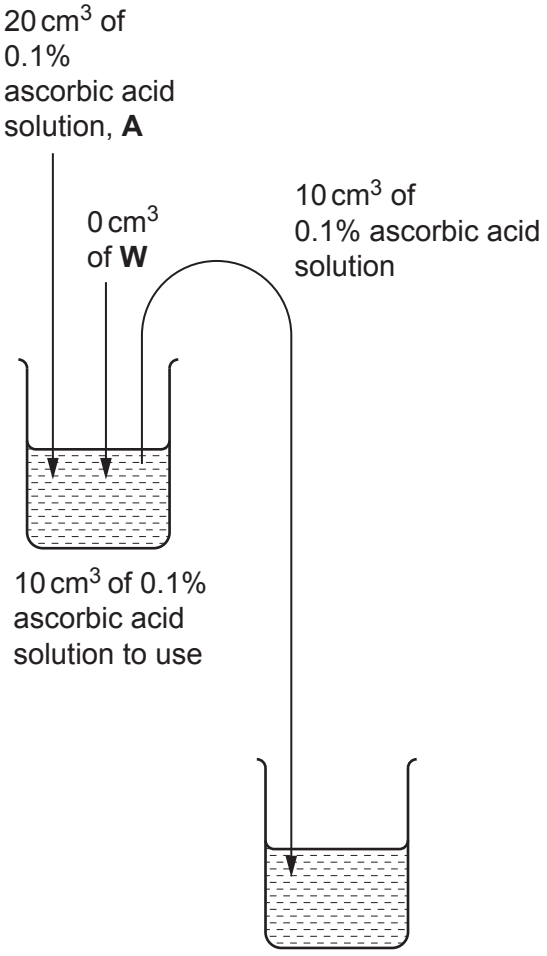

20 cm3 of 0.1% ascorbic acid solution, A
0 cm3 of W
10 cm3 of 0.1% ascorbic acid solution
10 cm3 of 0.1% ascorbic acid solution to use

**Fig. 1.2**

[3]

Carry out step 4 to step 17.

step 4 Prepare the concentrations of ascorbic acid solution, as decided in **(a)(i)**, in the beakers provided.

step 5 Put 1.0 $cm^3$ of **S** into a test-tube.

step 6 Put 5.0 $cm^3$ of 0.1% ascorbic acid solution, **A**, into the same test-tube.

step 7 Shake the test-tube gently to mix the contents.

step 8 Put the nozzle of a 1.0 $cm^3$ syringe into the beaker containing **iodine**.

step 9 Pull the plunger out so that 1.0 $cm^3$ of **iodine** enters the syringe.

step 10 Wipe off any excess **iodine** from the outside of the syringe with a paper towel.

In step 11 to step 15, you will be finding the volume of iodine solution needed to reach the end-point.

step 11 Put one drop of **iodine**, as shown in Fig. 1.1, into the mixture of **S** and **A** in the test-tube.

step 12 Mix gently and observe any colour change.

step 13 Repeat step 11 to step 12 until a blue colour appears. You may need to refill the 1.0 $cm^3$ syringe with **iodine** as in step 8 to step 10.

step 14 When the blue colour appears, shake the test-tube gently for 10 seconds and see if the end-point has been reached.

step 15 If the blue colour disappears then repeat step 11 to step 14 until the mixture stays blue for at least 10 seconds. This is the end-point.

If the colour does **not** stay blue after adding 5.0 $cm^3$ of iodine solution, stop adding iodine solution.

step 16 Record in **(a)(ii)** the volume of iodine solution added to reach the end-point. If the colour does **not** stay blue after adding 5.0 $cm^3$ of iodine solution, record as 'more than 5.0'.

step 17 Repeat step 5 to step 16 for each of the concentrations of ascorbic acid solution prepared in step 4.

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**(ii)** Record your results in an appropriate table.

[4]

**(iii)** Describe **one** significant source of error when carrying out steps 8 to 17.

.....

.....

..... [1]

You will now estimate the concentration of ascorbic acid in vegetable extracts **U** and **C**.

step 18 Repeat step 5 to step 15 with **U**, instead of **A**.

step 19 Record in **(a)(iv)** the volume of iodine solution added to reach the end-point.

step 20 Repeat step 5 to step 15 with **C**, instead of **A**.

step 21 Record in **(a)(iv)** the volume of iodine solution added to reach the end-point.

If the colour does **not** stay blue after adding 5.0 $cm^3$ of iodine solution, record as 'more than 5.0'.

**(iv)** Record the volume of iodine solution needed to reach the end-point for **U** and **C**.

volume for **U** ..... $cm^3$

volume for **C** ..... $cm^3$

[1]

**(v)** Complete Fig. 1.3 to show the positions of each of the percentage concentrations of ascorbic acid, recorded in **(a)(ii)**.




percentage concentration of ascorbic acid

**Fig. 1.3**

[1]

**(vi)** Use your results in **(a)(ii)** and **(a)(iv)** to estimate the concentration of ascorbic acid in **U** and **C**.

Show these estimates on Fig. 1.3 by placing the letters **U** and **C** in the correct positions along the line. [1]

**(vii)** Describe how you could modify this procedure to obtain a more accurate estimate of the concentration of ascorbic acid in the vegetable extract **U** and **C**.

Do **not** include the use of a colorimeter in your answer.

.....

..... [1]

**(viii)** **U** is a vegetable extract before heating and **C** is the same vegetable extract after heating.

Suggest an explanation for the effect of heating on the concentration of ascorbic acid in the vegetable extract.

.....

.....

..... [1]

**(ix)** In the investigation you have carried out, vegetable extract, **C**, was heated for 60 minutes.

Outline how you could investigate the effect of different heating times on the concentration of ascorbic acid in a vegetable extract.

.....

.....

.....

.....

.....

.....

..... [3]

**(b)** Some chemicals, such as ascorbic acid, have antimicrobial properties. A scientist carried out an investigation to determine the effect of ascorbic acid on the growth of a species of bacterium, *B. subtilis*.

The growth of bacteria was investigated by measuring the mass of the bacteria when grown on agar containing different concentrations of ascorbic acid.

All other variables were kept constant.

The results are shown in Table 1.2.

**Table 1.2**

| ascorbic acid concentration / mM | mass of *B. subtilis* / mg |
|---|---|
| 2.5 | 9.7 |
| 10.0 | 7.2 |
| 20.0 | 4.7 |
| 30.0 | 3.1 |
| 40.0 | 2.4 |

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

Use a sharp pencil.

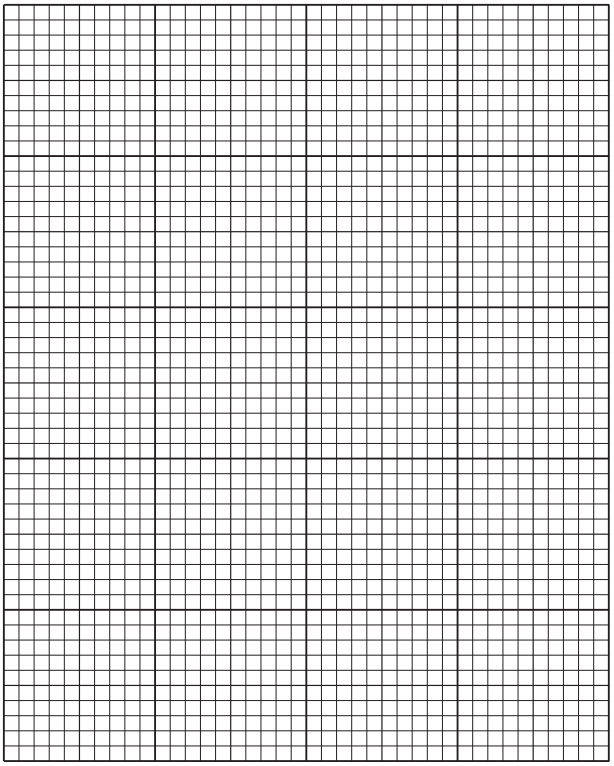


**Fig. 1.4**

[4]

**(ii)** Use your graph to calculate the percentage decrease in the mass of the bacteria between 10.0 mM and 35.0 mM ascorbic acid.

Show your working.

percentage decrease = ..... [2]

[Total: 22]

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

**(a)** **(i)** Draw a large plan diagram of the region of the root on **L1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

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

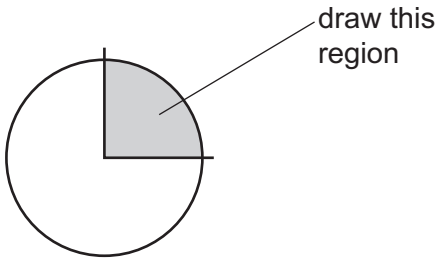



**Fig. 2.1**

[5]

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

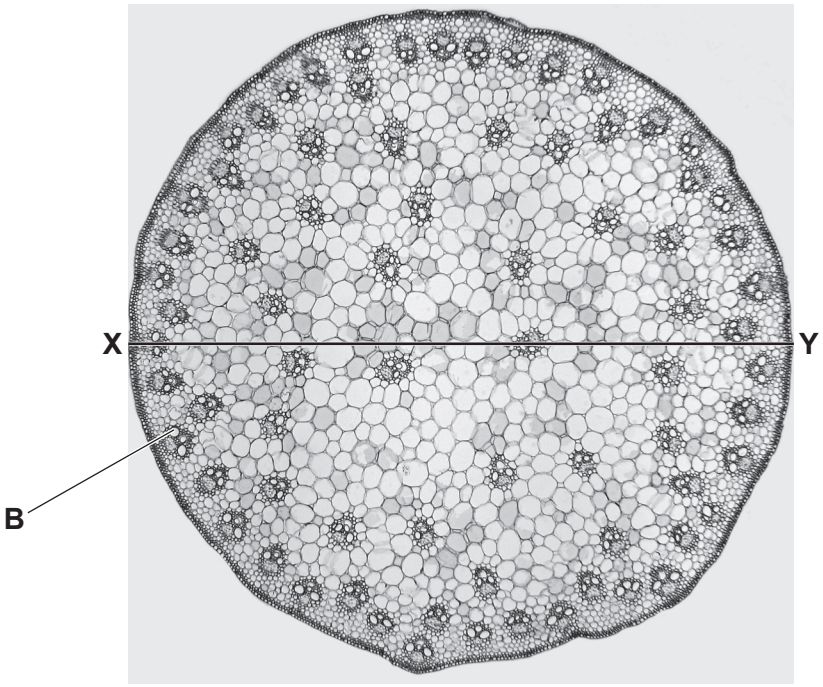
Select a group of four adjacent cells that make up this tissue.

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

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

[5]

**(b)** Fig. 2.2 is a photomicrograph of a stained transverse section of a stem from the same plant species as the root on **L1**.




Magnification ×22

**Fig. 2.2**

**(i)** In Fig. 2.2 the line **X**–**Y** is drawn across the diameter of the root.

Use the magnification and the line **X**–**Y** to calculate the actual diameter of the root.

Show your working and use appropriate units.

actual diameter = ..... [3]

**(ii)** In Fig. 2.2, the structure labelled **B** forms part of the vascular bundle.

Identify structure **B** and explain how you identified this structure.

structure **B** .....

explanation .....

.....

[1]

**(iii)** Identify **three** observable **differences**, other than size and colour, between the root on **L1** and the stem in Fig. 2.2.

Record these three observable differences in Table 2.1.

**Table 2.1**

| feature | L1 | Fig. 2.2 |
|---|---|---|
| | | |

[4]

[Total: 18]

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# Cambridge International AS & A Level

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CENTRE NUMBER

CANDIDATE NUMBER

*2780300147*

**BIOLOGY** **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2022**

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

You will investigate the effect of substrate concentration on the activity of catalase in yeast.

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

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

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **Y** | 7.0% yeast cell suspension | none | 15 |
| **H** | 6.0% hydrogen peroxide solution | harmful irritant | 30 |
| **S** | 2.0% sodium alginate solution | none | 30 |
| **W** | distilled water | none | 100 |
| **C** | 1.5% calcium chloride solution | none | 30 |

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

It is recommended that you wear suitable eye protection.

Carry out step 1 to step 7 to immobilise the yeast.

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

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

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

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

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

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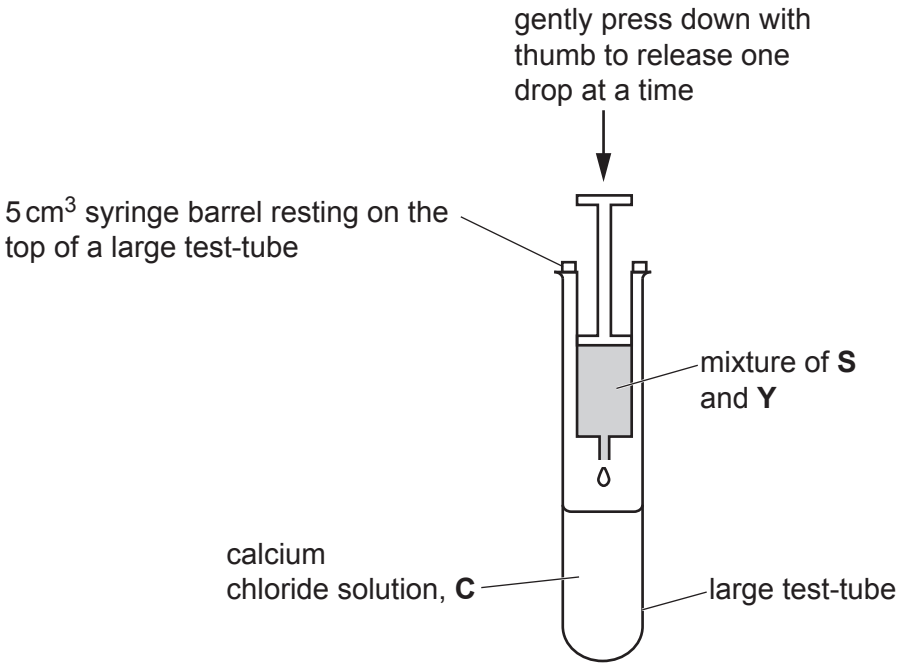



**Fig. 1.1**

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

step 7 Repeat step 6 until you have used all 2 $cm^3$ of the mixture.

You will use these beads in step 11.

You will need to carry out a **serial** dilution of the 6.0% hydrogen peroxide solution, **H**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of solution in addition to the 6.0% hydrogen peroxide solution, **H**.

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

**(a) (i)** Complete Fig. 1.2 to show how you will prepare your serial dilution.

Fig. 1.2 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker add labelled arrows to show:

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

Under each beaker, state the concentration of hydrogen peroxide solution.

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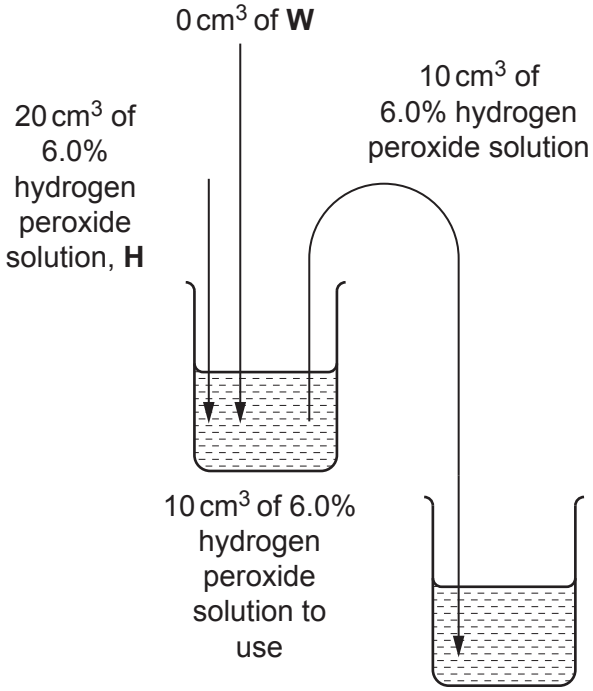

0 cm3 of W
10 cm3 of 6.0% hydrogen peroxide solution
20 cm3 of 6.0% hydrogen peroxide solution, H
10 cm3 of 6.0% hydrogen peroxide solution to use

**Fig. 1.2**

[3]

Carry out step 8 to step 16.

step 8 Prepare the concentrations of hydrogen peroxide solution, as decided in **(a)(i)**, in the beakers provided.

step 9 Label the **small** test-tubes with the concentrations you prepared in step 8.

step 10 Put 10 $cm^3$ of each hydrogen peroxide concentration into the appropriately labelled test-tube. Leave these test-tubes in a test-tube rack.

step 11 Tip the contents of the large test-tube from step 7 into a Petri dish.

step 12 Pick up a bead using blunt forceps.

step 13 Drop the bead into the test-tube containing 6.0% hydrogen peroxide solution, **H**. Start timing when the bead reaches the bottom of the test-tube. If the bead does **not** sink to the bottom of the test-tube, record the time as zero.

step 14 Time how long it takes for the bead to reach the surface of the hydrogen peroxide solution.
If the bead does not reach the surface after 180 seconds, stop timing and record as 'more than 180'.

step 15 Record the result from step 14 in **(a)(ii)**.

step 16 Repeat step 12 to step 15 with the remaining concentrations of hydrogen peroxide solution.

**(ii)** Record your results in an appropriate table.

[5]

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

.....

.....

..... [1]

**(iv)** Suggest how you could make an improvement to this investigation to reduce the error stated in **(a)(iii)**.

.....

.....

..... [1]

You will need to estimate the concentration of hydrogen peroxide in **U**.

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

**Table 1.2**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **U** | unknown concentration of hydrogen peroxide solution | harmful irritant | 30 |

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

It is recommended that you wear suitable eye protection.

Carry out step 17 to step 22.

step 17 Label a clean test-tube **U**.

step 18 Put 10 $cm^3$ of **U** into the test-tube labelled **U**.

step 19 Pick up a bead using blunt forceps.

step 20 Drop the bead into the test-tube containing **U**. Start timing when the bead reaches the bottom of the test-tube.

step 21 Time how long it takes for the bead to reach the surface of solution **U**.
If the bead does not reach the surface after 180 seconds, stop timing and record as 'more than 180'.

step 22 Record the result from step 21 in **(a)(v)**.

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

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

**(vi)** Using your results from **(a)(ii)** and **(a)(v)**, estimate the concentration of hydrogen peroxide in **U**.

concentration of hydrogen peroxide in **U** ..... % [1]

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**(vii)** In the procedure described in step 1 to step 16, the effect of the concentration of hydrogen peroxide on catalase activity was investigated.

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

.....

.....

.....

..... [2]

**(b)** Immobilised enzymes are often used in industry, for example in the production of lactose-free milk. This can increase productivity and reduce costs, as the enzyme is easy to reuse and the product is not contaminated by the enzyme.

A student investigated the effect of bead diameter on the hydrolysis of lactose. The beads contained the enzyme lactase. Lactase catalyses the hydrolysis of lactose into glucose and galactose.

The student:
- put beads with a diameter of 2 mm into a syringe, up to the 5 $cm^3$ line
- put 5 $cm^3$ of milk containing lactose into this syringe
- left the syringe for 5 minutes
- measured the concentration of lactose in the milk after 5 minutes.

The student used this method with the bead diameters shown in Fig. 1.3.

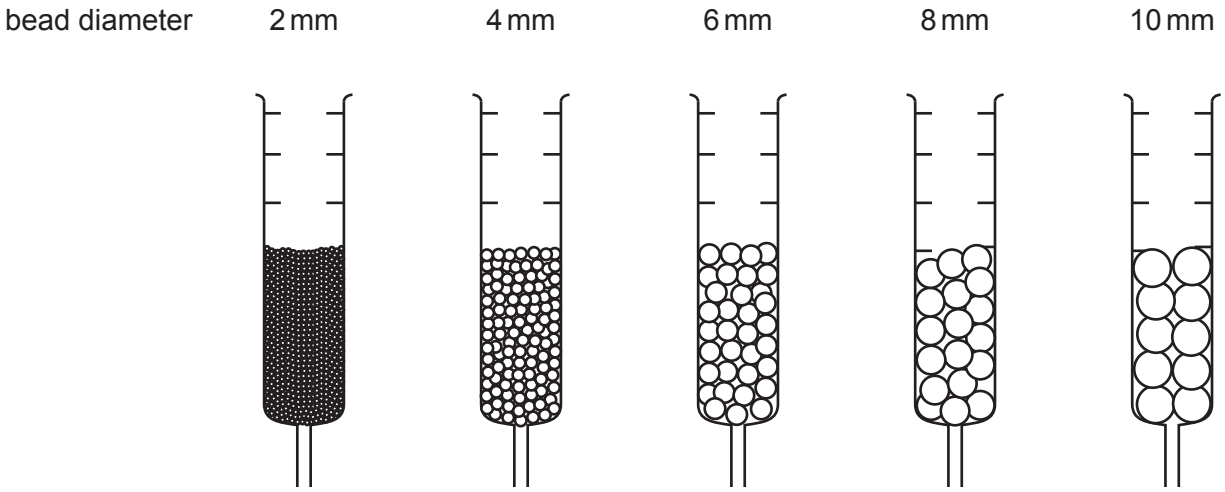



**Fig. 1.3**

Table 1.3 shows the results of this investigation.

**Table 1.3**

| bead diameter / mm | percentage concentration of lactose after 5 minutes |
|---|---|
| 2 | 20.5 |
| 4 | 21.0 |
| 6 | 29.5 |
| 8 | 40.5 |
| 10 | 69.0 |

**(i)** Plot a graph of the data shown in Table 1.3 on the grid in Fig. 1.4.

Use a sharp pencil.

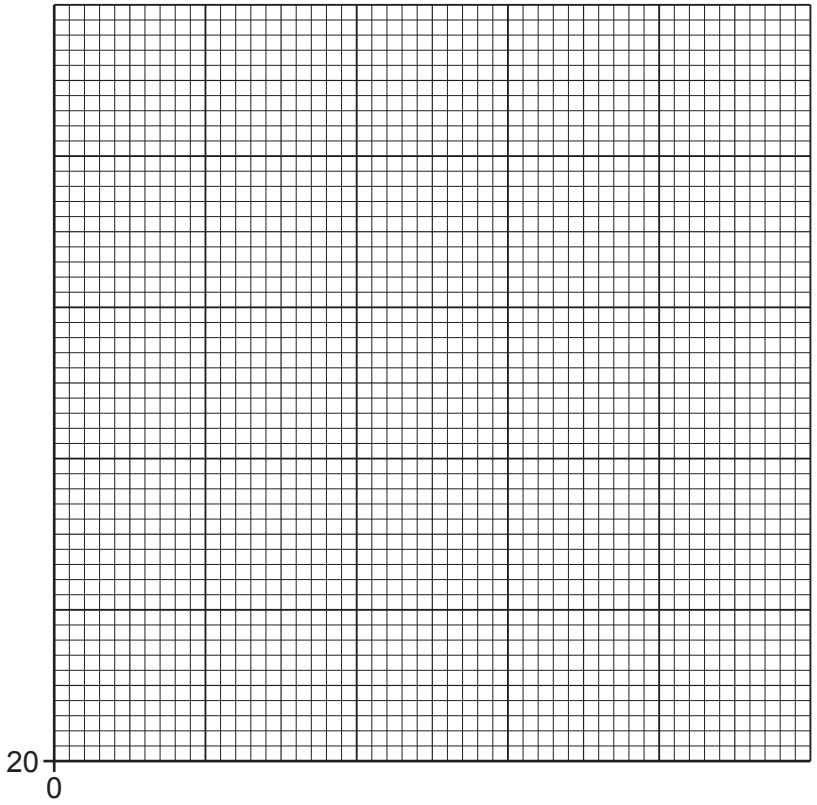



**Fig. 1.4**

[4]

**(ii)** Use your graph to find the concentration of lactose in the milk after 5 minutes, when the bead diameter was 5 mm.

concentration of lactose = ..... % [1]

**(iii)** Explain why the percentage concentration of lactose in the milk after 5 minutes increases as the bead diameter increases.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 22]

**Question 2 starts on page 12.**

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

**(a)** **(i)** Draw a large plan diagram of the region of the stem on **M1**, indicated by the shaded area in Fig. 2.1.
Use a sharp pencil.
Your drawing should include three vascular bundles.

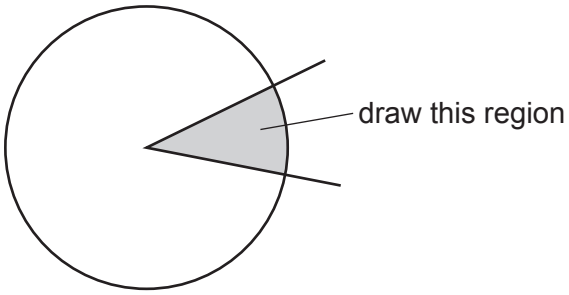



**Fig. 2.1**

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

[5]

**(ii)** Observe the central tissue on the section of the stem on **M1**.

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

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

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

[5]

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

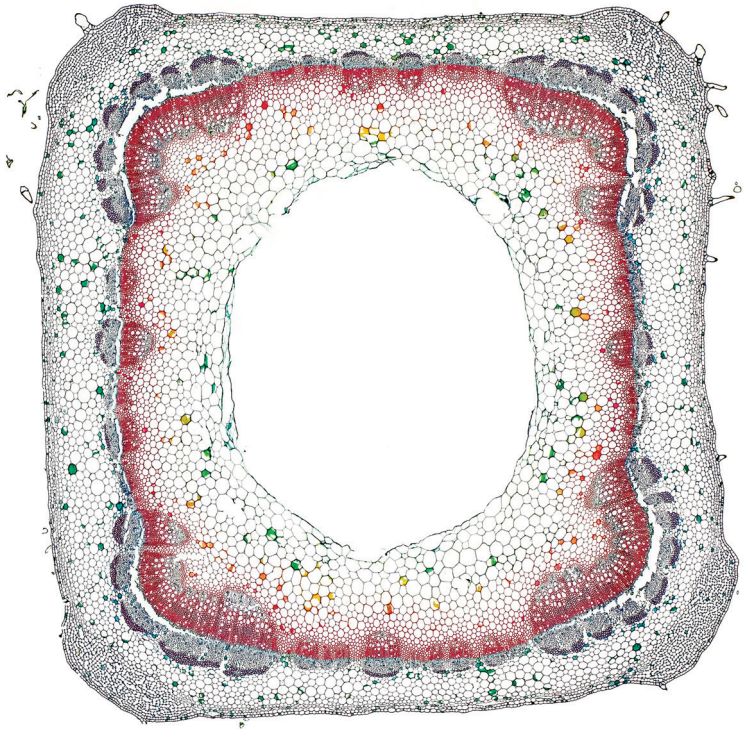


**Fig. 2.2**

Identify **three** observable **differences** between the stem in Fig. 2.2 and the stem on **M1**.

Record the three observable differences in Table 2.1.

**Table 2.1**

| feature | Fig. 2.2 | M1 |
|---|---|---|
| | | |

[4]

**(c)** Fig. 2.3 is the same photomicrograph as that shown in Fig. 2.2. The line **X**–**Y** is drawn across the width of the stem.

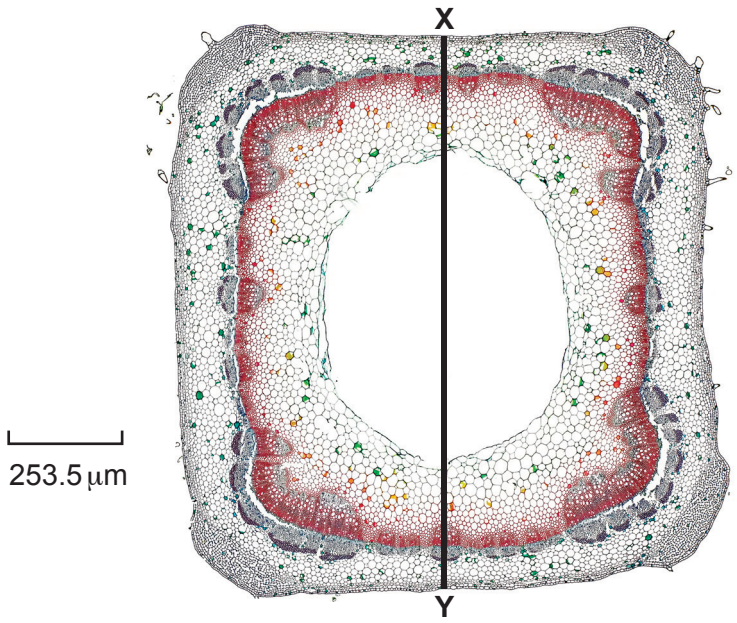



**Fig. 2.3**

Use the line **X**–**Y** and the scale bar to calculate the actual width of the stem.

Show your working and use appropriate units.

actual width of stem = ..... [4]

[Total: 18]

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# Cambridge International AS & A Level

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*9045134674*

**BIOLOGY** **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2022**

**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 [ ].

| For Examiner's use | |
|---|---|
| 1 | |
| 2 | |
| Total | |

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**1** Yeast cells contain enzymes that catalyse metabolic reactions. Some of these reactions release carbon dioxide.

You will investigate the release of carbon dioxide from a mixture of yeast and carbohydrate. The mixture is put into dialysis (Visking) tubing.

The dialysis tubing acts as a partially permeable membrane, allowing the carbon dioxide to diffuse out of the dialysis tubing.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **Y** | 1g dried yeast | none | - |
| **G** | 10.0% warm glucose solution | none | 20 |
| **W** | distilled water | none | 50 |
| **B** | bromothymol blue indicator solution | harmful | 10 |
| **D** | 20 cm length of dialysis tubing in a beaker of distilled water | none | – |

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

It is recommended that you wear suitable eye protection.

To test for the release of carbon dioxide, a sample of the water surrounding the dialysis tubing is added to drops of an indicator, **B**.

Fig. 1.1 shows the effect of increasing concentration of carbon dioxide on the colour of **B**. Yellow is the end-point.




**Fig. 1.1**

Carry out step 1 to step 21.

step 1 Using the beakers labelled **hot water** and **cold water**, adjust the water in the beaker labelled **water-bath** to 45 °C. You will **not** need to maintain this temperature.

step 2 Put 15 $cm^3$ of **G** into the test-tube labelled **Y**. Mix well.

Between step 3 and step 4, you will be leaving the apparatus for 15 minutes. Use this time to continue with other parts of Question 1.

step 3 Put test-tube **Y** into the water-bath for 15 minutes.

step 4 After 15 minutes, remove test-tube **Y** from the water-bath.

step 5 Stir the mixture in test-tube **Y** and pour it into a beaker.

step 6 Label the spotting tile (dimple tile) with the sample times in minutes, as shown in Fig. 1.2.

step 7 Put 3 drops of **B** onto the spotting tile at each sample time, as shown in Fig. 1.2.

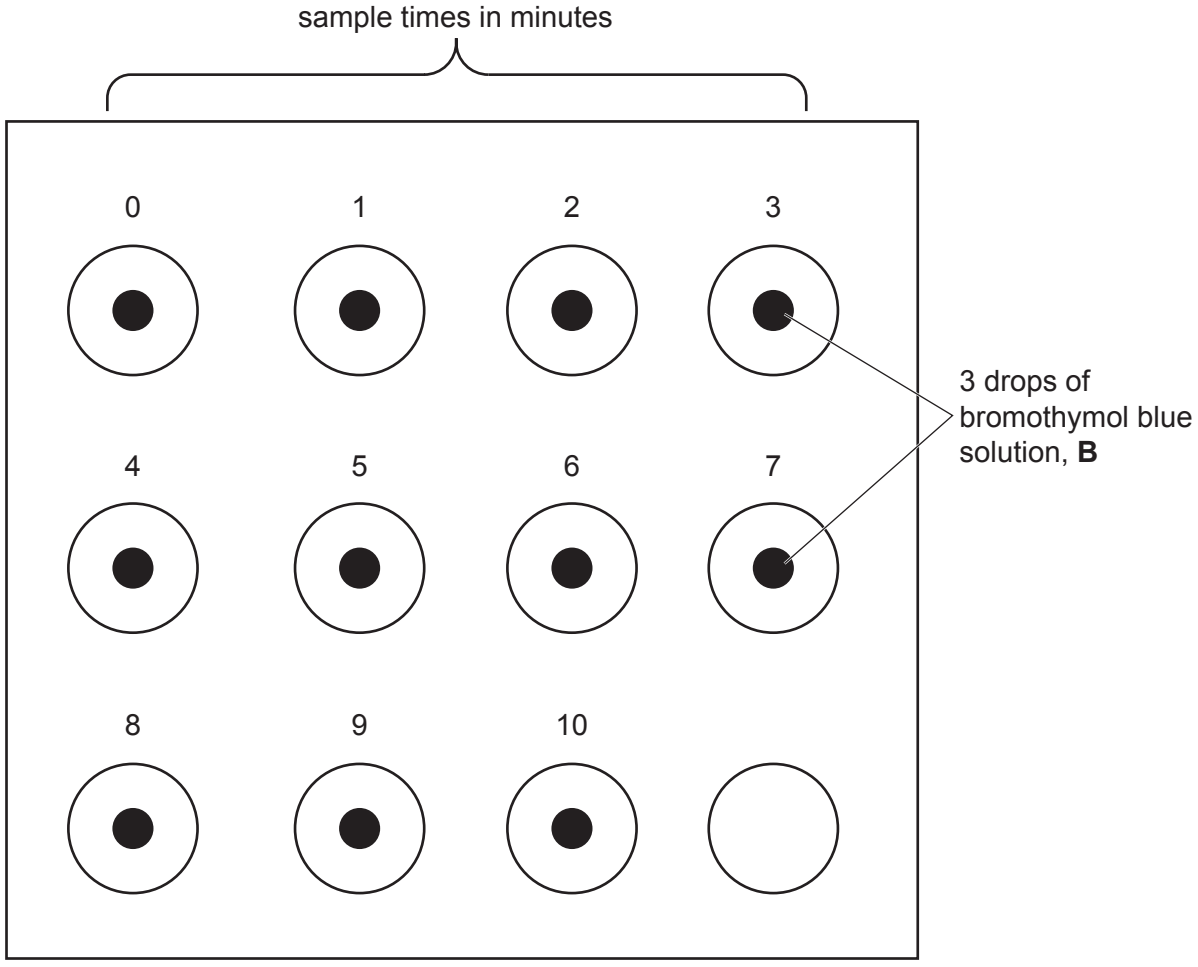



**Fig. 1.2**

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Fig. 1.3 shows the apparatus you will set up for this investigation.

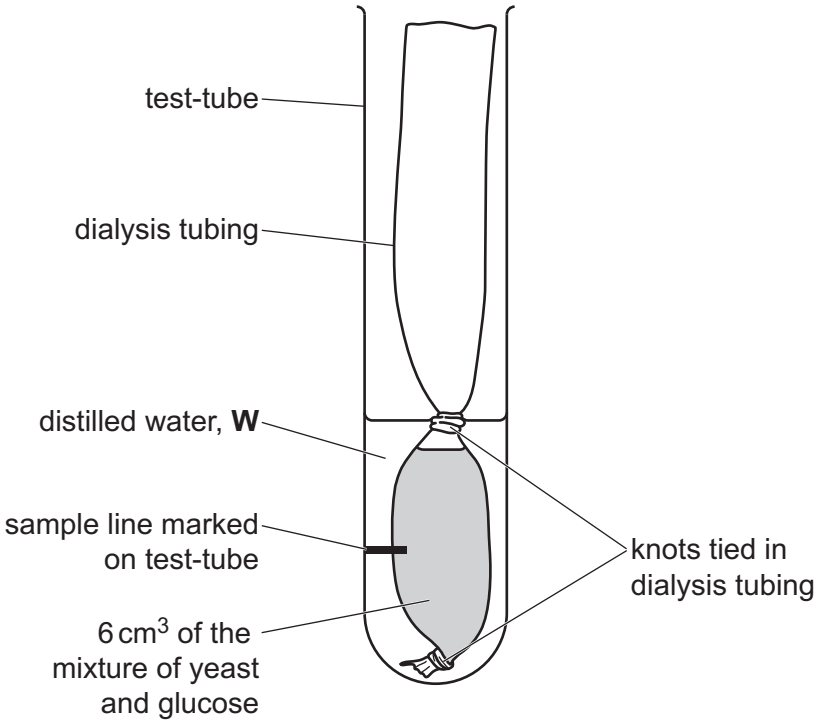



**Fig. 1.3**

step 8 Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.

step 9 To open the other end, rub the tubing gently between your fingers and thumb.

step 10 Stir the mixture in the beaker from step 5 and put 6.0 cm$^3$ of this mixture into a syringe.

step 11 Wipe the outside of the syringe and put the mixture from the syringe into the dialysis tubing.

step 12 Rinse the outside of the dialysis tubing by dipping it into the water in the container labelled **D**.

Look carefully at Fig. 1.3 to help you with step 13 to step 15.

step 13 Tie a knot just above the level of the mixture in the dialysis tubing, as shown in Fig. 1.3.

step 14 Put the dialysis tubing into a clean test-tube so that it is resting on the bottom of the test-tube, as shown in Fig. 1.3.

step 15 Draw a line on the test-tube so that it is half-way between the two knots, as shown in Fig. 1.3. This is where you will take your samples from.

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step 16 In this step, you will use a syringe to measure the volume of distilled water, **W**, needed to cover the section of dialysis tubing containing the mixture.

Use a syringe to put **W** into the test-tube to cover the section of dialysis tubing containing the mixture.

**(a) (i)** State the volume of **W** that you added to the test-tube in step 16.

volume of **W** = ..... $cm^3$ [1]

step 17 Take a sample of **W** from the test-tube at the point you marked in step 15, using a pipette.

step 18 Put 3 drops of **W** onto **B** at time 0 on the white tile. Put the remaining **W** in the pipette back into the test-tube.

step 19 Start timing and put the test-tube containing the dialysis tubing into the beaker labelled **water-bath**.

step 20 Mix the sample of **W** and **B** on the white tile and immediately record the colour in **(a)(ii)**, using the colours stated in Fig. 1.1.

step 21 Repeat step 17, step 18 and step 20 for each of the sampling times until the end-point (yellow) is reached for **two** consecutive samples. If the end-point is not reached at 10 minutes, stop timing.

**(ii)** Record your results in an appropriate table.

[4]

**(iii)** This investigation used colour to indicate the concentration of carbon dioxide in the sample.

Suggest **three** improvements to this investigation that would increase the accuracy of the results.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

**(iv)** A student repeated the investigation using the same procedure but with starch as the substrate instead of glucose.

Suggest why it took much longer to reach the end-point when starch was used as the substrate.

.....

.....

.....

.....

.....

.....

..... [3]

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**[Turn over**

**(b)** A student measured the rate of carbon dioxide production when yeast was incubated with a substrate at different temperatures.

**(i)** State the independent variable in this investigation.

..... [1]

The results from the investigation at **35 °C** are shown in Table 1.2.

The rate of carbon dioxide production is shown in arbitrary units (au).

**Table 1.2**

| time / min | rate of carbon dioxide production / au |
|---|---|
| 0 | 0.00 |
| 14 | 0.15 |
| 22 | 0.30 |
| 27 | 0.60 |
| 53 | 2.75 |
| 66 | 3.05 |

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

Use a sharp pencil.

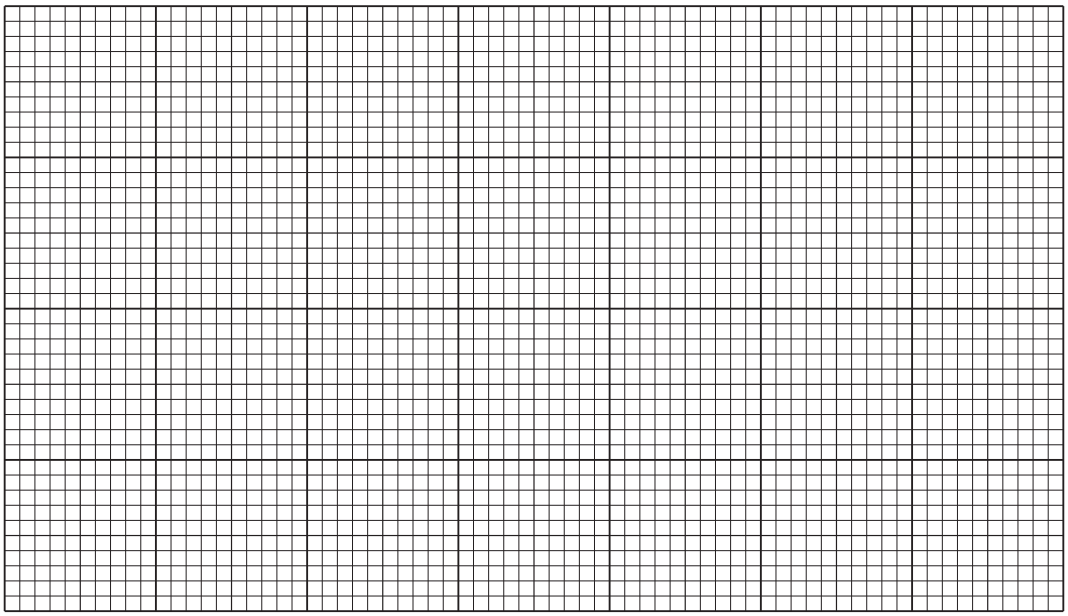


**Fig. 1.4**

[4]

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**(iii)** Describe the trend shown by the graph in Fig. 1.4.

.....

.....

.....

.....

.....

.....

.....

..... [3]

**(iv)** Use the graph in Fig. 1.4 to find the time required for the rate of carbon dioxide production to be 1.75 au when the yeast was incubated at 35 °C.

..... [1]

[Total: 20]

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

**(a)** **(i)** Draw a large plan diagram of the whole section of the root on **N1**.
Use a sharp pencil.

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

[5]

**(ii)** Observe the cells in the cortex of the root on **N1**.

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

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

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

[5]

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

Observe the photomicrograph in Fig. 2.1 and the section on **N1** to identify differences between them.

Fig. 2.1 has been annotated to describe **one** of these differences. A label line has been used to indicate the feature that is different.

Complete Fig. 2.1 by:

- identifying **and** annotating **three** more differences between the photomicrograph in Fig. 2.1 and the section on **N1**
- using a label line to identify the feature that is different.

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Fig. 2.1 .....

.....

**N1** .....

.....

Fig. 2.1 has flattened cells
**N1** has rounded cells

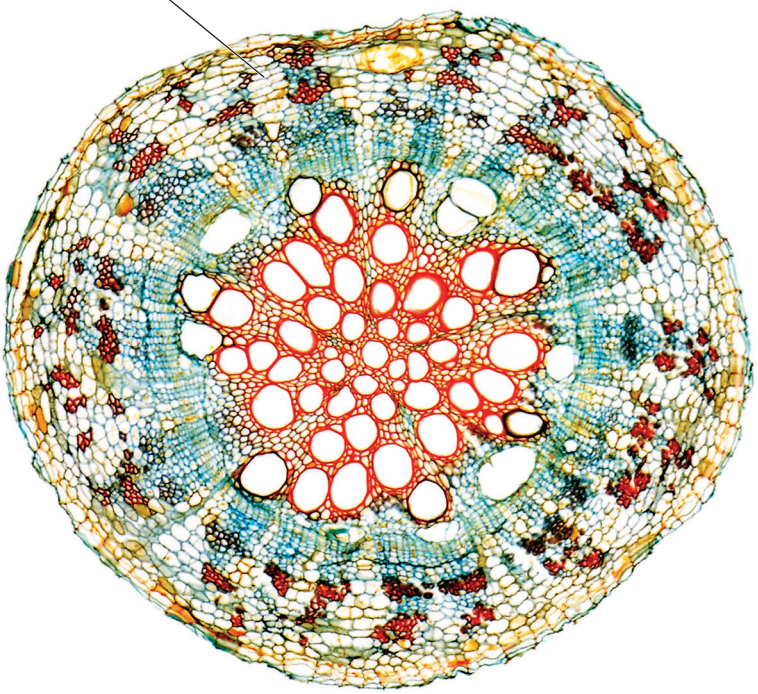


Fig. 2.1 .....

.....

**N1** .....

.....

Fig. 2.1 .....

.....

**N1** .....

.....

**Fig. 2.1**

[4]

**(c)** Fig 2.2 is the same photomicrograph as that shown in Fig. 2.1.

A black dot has been placed at the centre of the section.

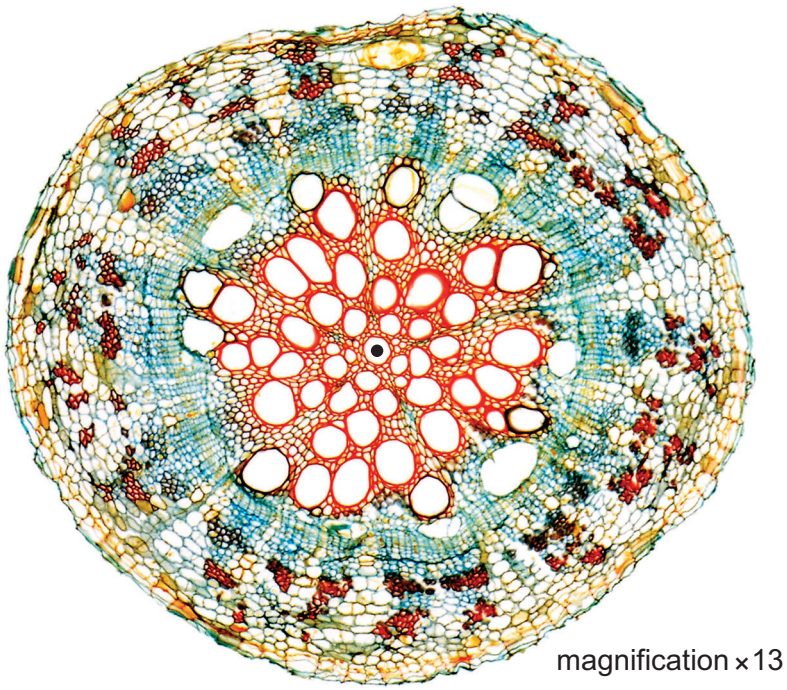



**Fig. 2.2**

**(i)** Determine the mean actual diameter of the section in Fig. 2.2.

- draw lines across the diameter of Fig. 2.2
- use your lines to measure the diameter of the section
- calculate the mean actual diameter of the section.

mean actual diameter = ..... mm
[3]

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**(ii)** Calculate the actual area of the section using your answer in **(c)(i)** and the formula: actual area = $\pi r^2$, where $\pi = 3.14$.

State your answer to the nearest whole number and use appropriate units.

actual area of the section = .....
[3]

[Total: 20]

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