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Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

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1559104802

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

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 all the work that you would like to do.

If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 You are required to estimate the water potential of potato tissue.

When a piece of potato is put into a sucrose solution, as shown in Fig. 1.1, water will move by osmosis into and out of the potato cells. The net direction of movement of water depends on the difference in water potential between the potato cells and the sucrose solution.

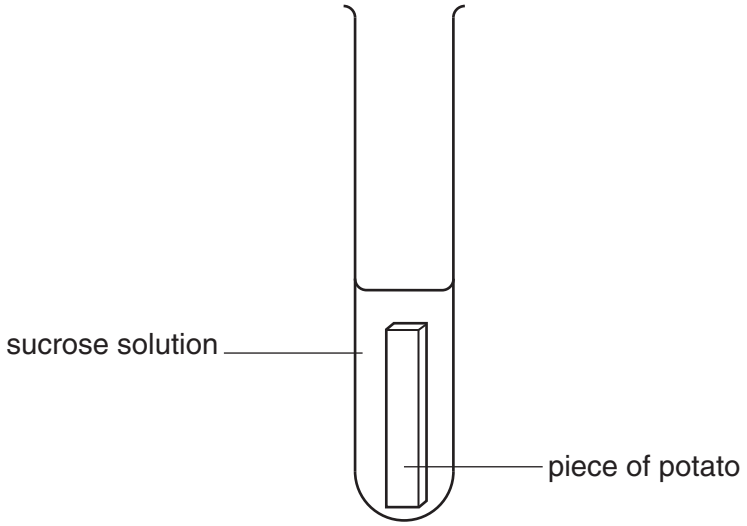


Fig. 1.1

(a) (i) Complete the sentences by using **two** of the following words.

gain **less** **lose** **more**

If the potato cells ..... water then the sucrose solution will become more dilute.

This will change the sucrose solution so that it becomes ..... dense.

[1]

A piece of potato is left in a sucrose solution for 15 minutes, to allow time for osmosis to take place.
The concentration of the sucrose solution after 15 minutes may be different from the original concentration.
After 15 minutes a blue dye is added to the sucrose solution to make a blue solution. The blue dye does not affect the concentration of the sucrose solution.

A small volume of this blue solution is then released into a known concentration of sucrose solution as shown in Fig. 1.2.

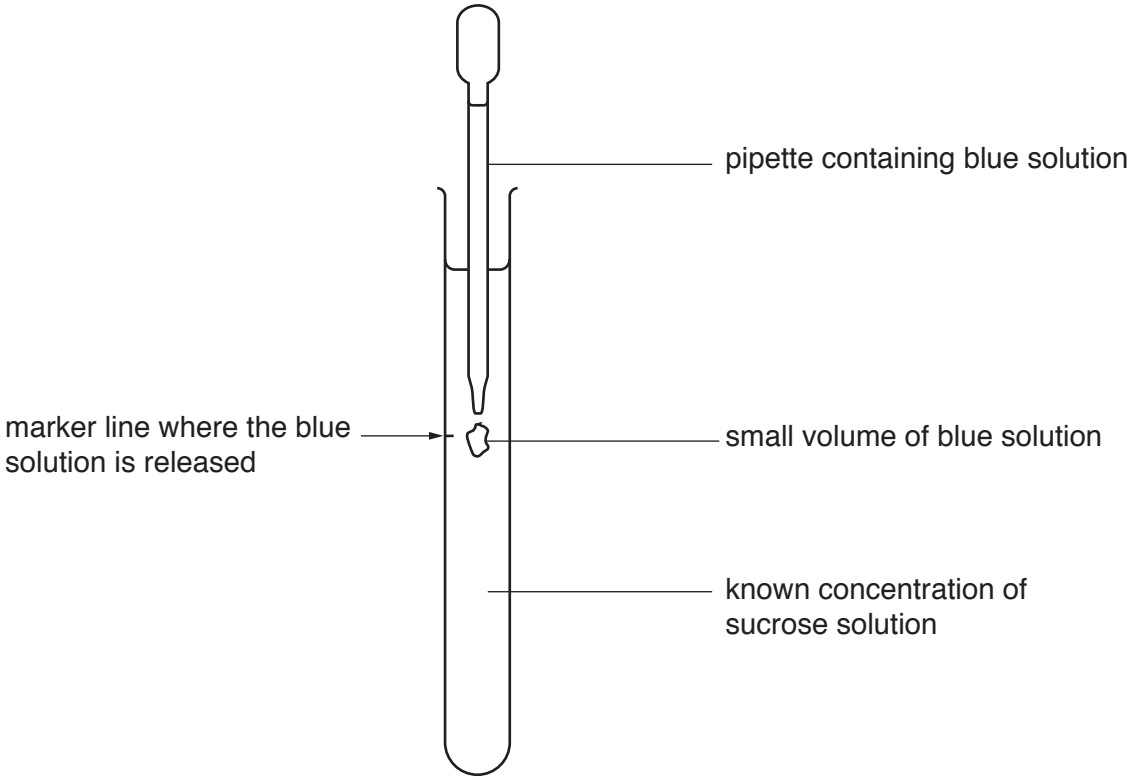


Fig. 1.2

The pipette is removed immediately after the blue solution is released.

The blue solution may move up, move down or remain at the same level depending on the difference in the concentration between the blue solution and the known concentration of sucrose solution.

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[Turn over

(ii) Think about how the blue solution will move in the known concentration of sucrose in the test-tubes shown in Fig. 1.3.

blue solution is **less** concentrated than the known sucrose solution	blue solution is the **same** concentration as the known sucrose solution	blue solution is **more** concentrated than the known sucrose solution

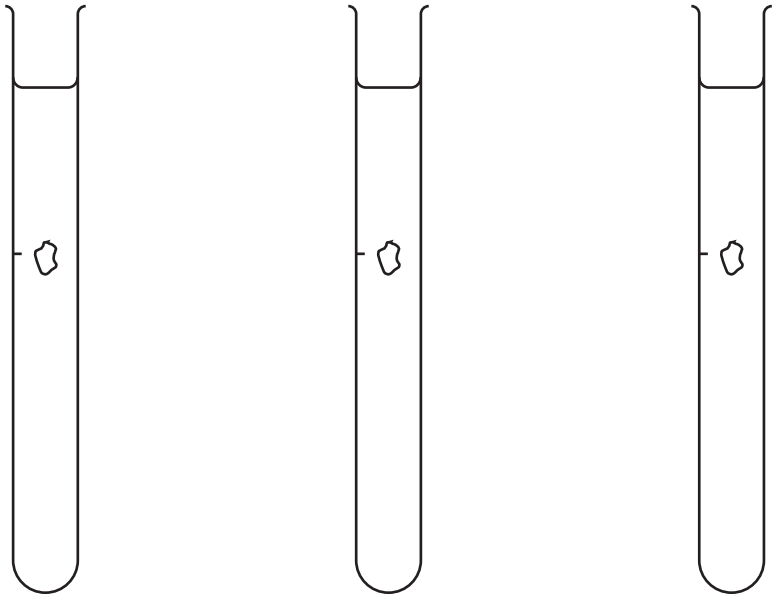


Fig. 1.3

Complete Fig. 1.3 by drawing an arrow on each test-tube, using the key, to show how you expect the blue solution to move.

key:

↑ blue solution moves up

↓ blue solution moves down

→ blue solution remains at the same level

[1]

(b) You are required to investigate osmosis in potato tissue so that you can estimate the water potential of the potato cells.

You are provided with:

labelled	contents	hazard	volume/cm^3
S	1.00 mol dm^{-3} sucrose solution	none	200
W	distilled water	none	200

labelled	details
P	7 pieces of potato, cross sectional area 1.5 cm × 1.0 cm of variable length

You are required to make simple dilutions of the 1.00 mol dm^{-3} sucrose solution, **S**, which reduces the concentration between each dilution.

You will need to prepare 40 cm^3 of each concentration.

Decide which concentrations of sucrose solution to prepare using simple dilutions of **S**.

(i) Complete Table 1.1 to show how you will prepare the other concentrations.

Table 1.1

final concentration of sucrose solution /mol dm^{-3}	volume of **S** /cm^3	volume of distilled water, **W**/cm^3
1.00	40	0

[3]

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[Turn over

Read step 1 to step 11 before proceeding.

Proceed as follows:

1. Prepare all the concentrations of sucrose solution as shown in Table 1.1 in the beakers provided.

2. Measure 4.5 cm from the bottom of each **large** test-tube and put a mark, as shown in Fig. 1.4.

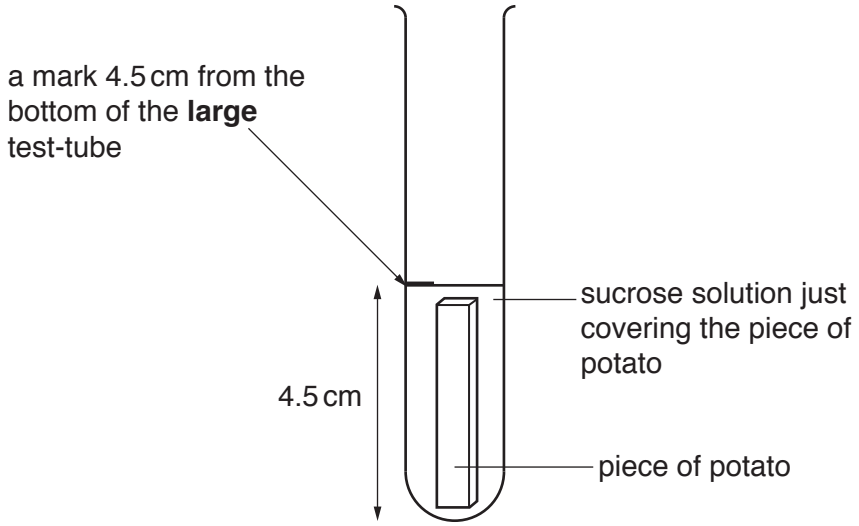


Fig. 1.4

(ii) Decide on the length of each piece of potato you will use, so that the volume of sucrose solution just covers the piece of potato, as shown in Fig. 1.4.

State the length of the pieces of potato you will use.

length = ... [1]

3. Cut enough pieces of potato to put into the sucrose concentrations that you prepared in step 1.

4. Put the pieces of potato on a paper towel to remove any excess fluid.

5. Put one piece of potato into each of the large test-tubes from step 2.

6. Put 1.00 mol dm^{-3} sucrose solution, **S**, into a large test-tube up to the mark made in step 2.

7. Repeat step 6 with each of the other concentrations of sucrose solution.

8. Start timing and leave for 15 minutes.

While you are waiting for 15 minutes continue with step 9 to step 11 and continue with the other questions.

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9. Measure 6 cm from the **top** of each of the **small** test-tubes and put a mark, as shown in Fig. 1.5.

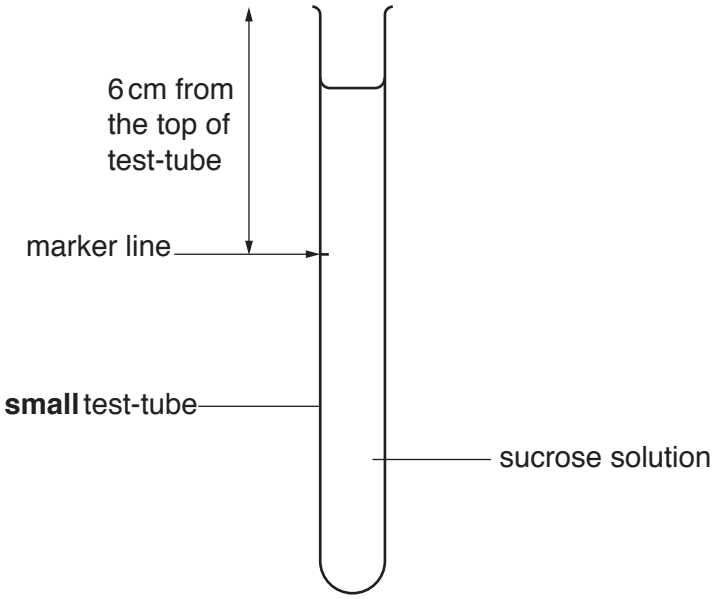


Fig. 1.5

10. Put 15 cm^3 of 1.00 mol dm^{-3} sucrose solution, **S**, into one of the **small** test-tubes from step 9.

11. Repeat step 10 with each of the other sucrose solutions that you prepared in step 1.

You are provided with:

labelled	contents	hazard	volume /cm^3
M	methylene blue solution	none	15

12. After leaving the pieces of potato for 15 minutes, put a drop of **M** into the **large** test-tube containing 1.00 mol dm^{-3} sucrose solution, **S**, and a piece of potato.

13. Gently shake the **large** test-tube to mix **M** with the sucrose solution.

14. Repeat step 12 and step 13 with each of the other concentrations of sucrose solution.

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[Turn over

Read step 15 to step 19 before proceeding.

15. Use a pipette to remove a sample of the blue solution from the **large** test-tube containing 1.00 mol dm^{-3} sucrose solution, **S**.

*You will now use the **small** test-tubes as in Fig. 1.5.*

16. Put the end of the pipette into the **small** test-tube containing 1.00 mol dm^{-3} concentration of sucrose solution, **S**. This should be level with the marker line on the test-tube as shown in Fig. 1.2 on page 3.

17. Release a small volume of the blue solution, then immediately remove the pipette from the test-tube.
It is possible to repeat step 17 without having to replace this sucrose solution.

18. Immediately observe the direction **and** the speed of movement of the blue solution.
*You are **not** required to measure the speed.*
Record these observations in **(b)(iii)**.

19. Repeat step 15 to step 18 using the other concentrations of sucrose solution.
Make sure that the small volume of the blue solution from the **large** test-tube is put into the **small** test-tube labelled with the same concentration.

(iii) Record your observations of direction and speed of movement in an appropriate table.

[6]

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(iv) Using your results in **(b)(iii)** estimate the concentration of sucrose solution with a water potential equal to the water potential of the potato tissue.

.....

.....[1]

(v) Identify **one** significant source of error in this investigation.

.....

.....

.....[1]

(vi) Describe how you would use this procedure to produce a more accurate estimate of the concentration of sucrose solution with a water potential equal to the water potential of the potato tissue.

.....

.....

.....

.....

.....

.....

.....[3]

(vii) Describe the movement of water when the concentration of the sucrose solution surrounding the piece of potato has a water potential equal to the water potential in the potato tissue.

.....

.....[1]

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[Turn over

(viii) Using the same procedure a student observed that the blue solution stayed in the same position (did not move up or down) in a concentration of sucrose solution of 0.3 mol dm^{-3}.

Fig. 1.6 shows the relationship between the concentration of sucrose solution and the water potential of the sucrose solution.

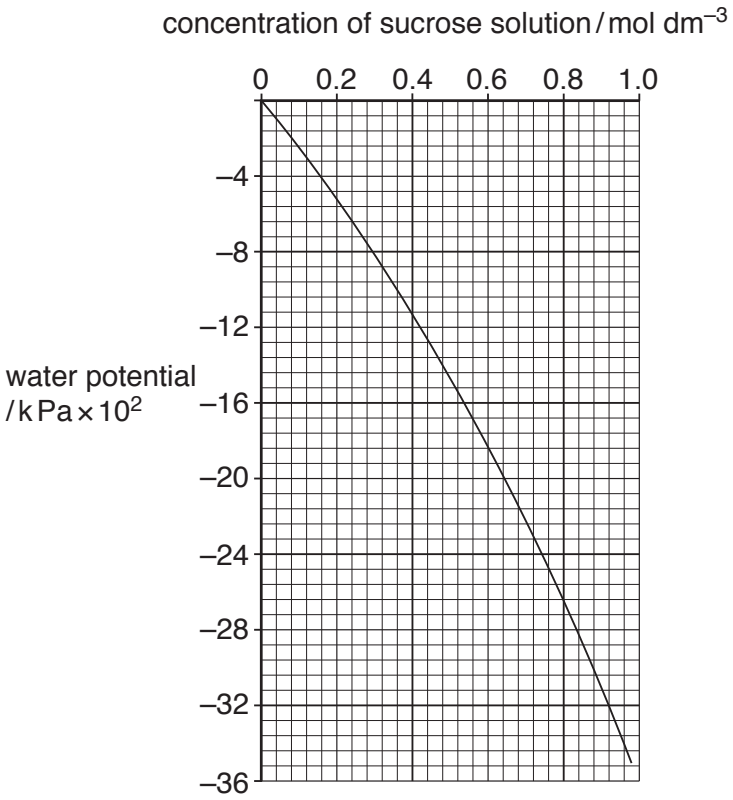


Fig. 1.6

Use the graph in Fig. 1.6 to estimate the water potential of a 0.3 mol dm^{-3} sucrose solution. Show on the graph how you estimated the water potential.

water potential ..... [2]

[Total: 20]

Question 2 starts on page 12

2 Some plants store starch as grains.

Some starch grains have rings on the surface and the grains from different plant types differ in size and shape.

You are required to:

- observe and draw starch grains from two different types of plant
- compare the starch grains from these two different types of plant.

You are provided with starch grains, in water, from two different types of plant, labelled **F** and **G**.

1. Put one **clean and dry** microscope slide on a piece of black card with a paper towel underneath as shown in Fig. 2.1.

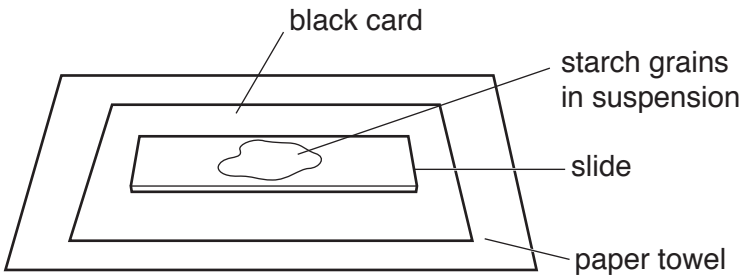


Fig. 2.1

2. Using a pipette put a few drops of **F** containing starch grains onto the slide.

3. Cover the starch grains with a coverslip and use a paper towel to remove any excess liquid that is outside the coverslip.

4. View the slide to observe the starch grains using the microscope. Select an area of starch grains on the slide.

You may need to reduce the amount of light entering the microscope to observe the grains clearly.

You must adjust the fine focus to observe the starch grains.

5. Select **three** starch grains which show the different sizes and features of the grains.

6. Make a large drawing in **(a)(i)** of the three starch grains that you have selected.

7. Remove the slide from the microscope and place on a paper towel.

8. Repeat step 1 to step 7 with **G**.

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Use a sharp pencil for drawing.

(a) (i) Make a large drawing of the three starch grains from **F** and the three starch grains from **G**.

Use **one** ruled label line and label **X** to identify the surface markings of **one** starch grain.

*starch grains from **F***

*starch grains from **G***

[5]

(ii) Annotate your drawings in **(a)(i)** to describe **three** observable differences between the starch grains from **F** and **G** by:

- drawing label lines to each of the features on the starch grains that show these differences
- describing next to each line how each feature is different.

[3]

(b) A student investigated the effect of human salivary amylase on starch.
1 cm^3 of salivary amylase was mixed with 10 cm^3 of a known concentration of starch and kept at 25 °C. The concentration of reducing sugar was measured at intervals for 60 minutes.

All other variables were standardised.

The results are shown in Table 2.1.

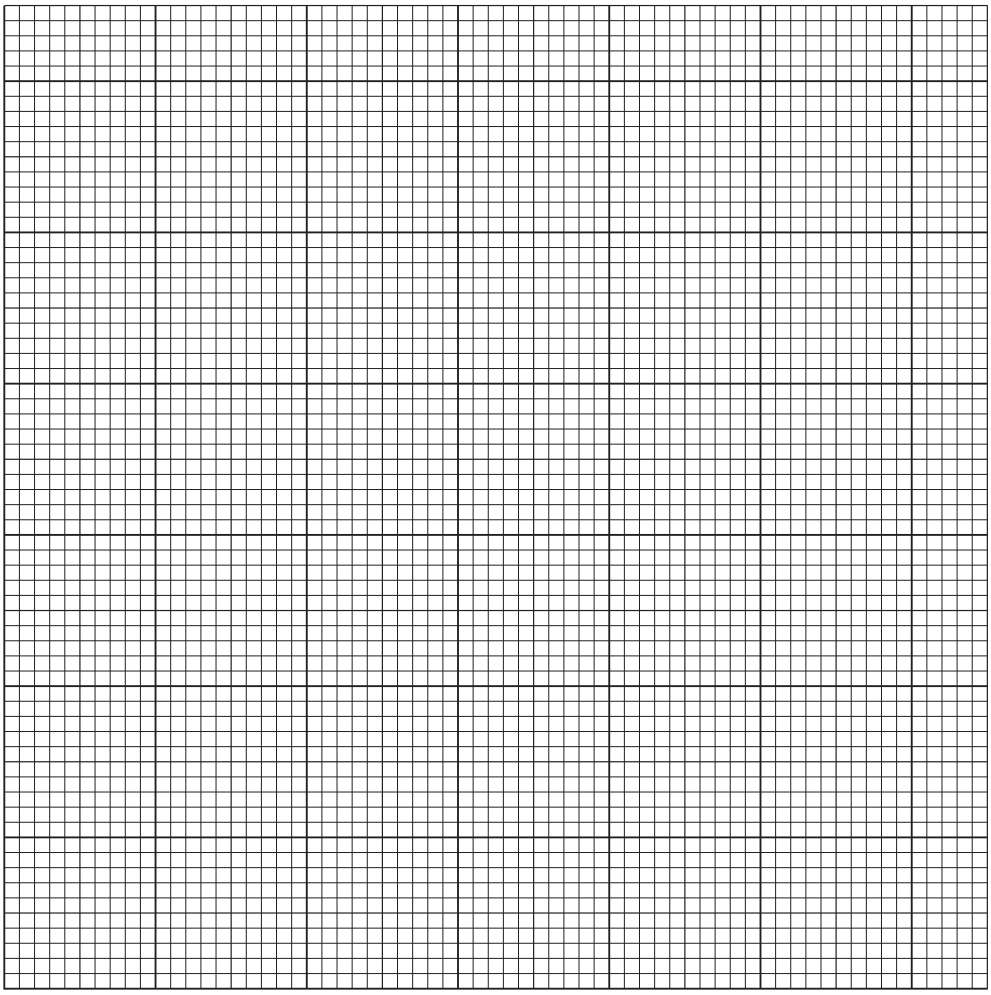
Table 2.1

time /minutes	reducing sugar concentration/μM
0	0.0
10	4.2
20	7.3
30	9.6
50	10.4
60	10.5

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Use a sharp pencil for drawing graphs.

(i) Plot a graph of the data shown in Table 2.1.



[4]

(ii) Use your graph to calculate the **percentage** increase in concentration of reducing sugar between 15 minutes and 35 minutes.

You may lose marks if you do not show all your working.

% increase ..... [3]

Fig. 2.2 is a photomicrograph of a stained transverse section through a stem.
You are not expected to be familiar with this specimen.

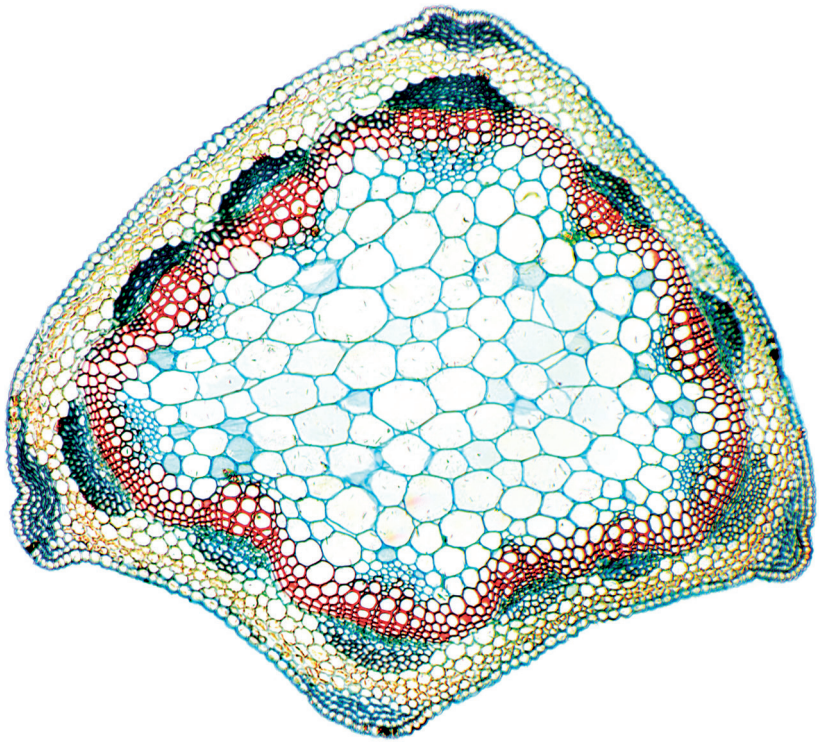


Fig. 2.2

Observe the different tissues in Fig. 2.2 and select an area that shows part of the epidermis and the vascular bundles.

Use a sharp pencil for drawing.

(c) Draw **one** large plan diagram from the selected area which shows:

- part of the epidermis
- only **three** vascular bundles
- any other observable tissues.

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

[5]

[Total: 20]

Note:
For those candidates who started with Question 2, start Question 1 as soon as you have completed Question 2. Questions **1(a)(i)**, **1(a)(ii)**, **1(b)(i)** and **1(b)(viii)** do not need apparatus.

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2361525521

BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

2 hours

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If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

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1 Plant cells contain enzymes that catalyse metabolic reactions. Some of these enzymes catalyse the release of oxygen from hydrogen peroxide.

A plant extract solution can be produced which will contain these enzymes.

When hydrogen peroxide and a plant extract solution are mixed oxygen is released. The oxygen forms bubbles that make a foam on the surface.

You are required to investigate the effect of pH on the progress of the enzyme-catalysed reactions by:

- changing the pH (independent variable) using buffers
- measuring the height of the foam (dependent variable) produced by the release of oxygen.

To follow the progress of this reaction you will need to measure the height of foam at different times for a total of 3 minutes.

(a) (i) Decide how often you will take these measurements including the final height of foam at 3 minutes.

State the times when you will measure the height of foam.

.....[1]

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(ii) Fig. 1.1**A** shows how a test-tube will be set up at the start (0 minutes).

Fig. 1.1**B** shows the test-tube after 3 minutes.

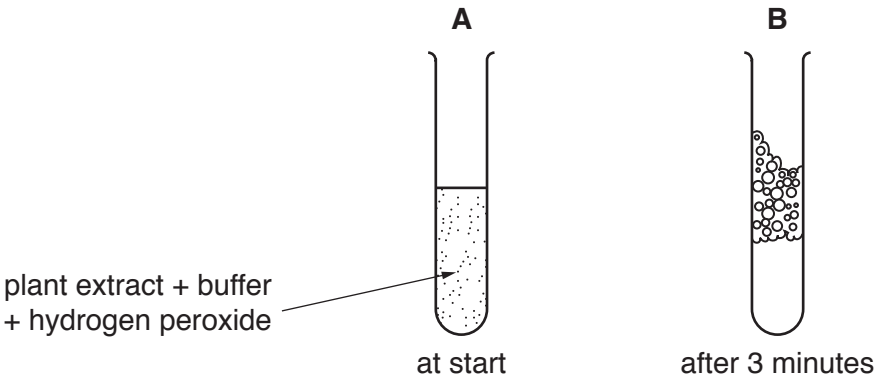


Fig. 1.1

The top of the foam may not form an even layer, so you will need to decide where to measure the layer of the foam.

Draw a double-headed arrow ↕ on Fig. 1.1**B** to show where you will measure this layer of foam. [2]

You are provided with:

labelled	contents	hazard	volume / cm^3
E	plant extract solution	harmful irritant	40
H	hydrogen peroxide solution	harmful irritant	70
B4	buffer pH4	none	10
B5	buffer pH5	none	10
B7	buffer pH7	none	10
B9	buffer pH9	none	10
B10	buffer pH10	none	10
U	unknown buffer	none	10
D	liquid detergent	none	10

If any of these liquids 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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Temperature affects the rate of an enzyme-catalysed reaction and may be a significant source of error.
You are required to measure the temperature of the room before the start of the investigation **and** when all the measurements have been recorded.

Proceed as follows:

Read step 1 to step 9.

1. Measure the temperature of the room and record this measurement in **(b)(iii)** on page 5.

2. Put 1 cm^3 of each buffer into separate test-tubes.

3. Put 2 cm^3 of **E** into each test-tube. Gently shake to mix well.

4. Put 1 drop of **D** into each test-tube. Do **not** mix.

*The reaction will start as soon as **H** is added to the mixture of **E** and buffer.*

5. Put 5 cm^3 of **H** into **one** of the test-tubes.

6. Immediately start timing.

7. Using the strip of graph paper provided, measure the height of the foam as decided in **(a)(ii)**, at each of your sampling times as stated in **(a)(i)**, until you have recorded the final measurement at 3 minutes. Record your measurements in **(b)(i)**.

If the foam flows over the top of the test-tube, **stop timing**. Record the measurement of the height of the foam to the top of the test-tube **and** add an asterisk (*) to show that the foam has flowed over.

8. Repeat step 5 to step 7 with each of the other buffer solutions.

9. Measure the temperature of the room now that all the measurements have been recorded. Record the temperature in **(b)(iii)**.

(b) (i) Record your results for the height of foam (**raw** results) in an appropriate table.

[4]

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(ii) Using your raw results for **pH 5**:

- State the highest height of foam ..... mm.
- State the first time when this height was reached ..... seconds.

Using these measurements, calculate the rate of production of oxygen, as millimetres per second ($mm\,s^{-1}$).

You may lose marks if you do not show your working.

rate of oxygen production = ... $mm\,s^{-1}$ [2]

(iii) State the temperature of the room before the start of the investigation.

..... °C

State the temperature of the room after all the measurements have been recorded.

..... °C

State the difference between this temperature and the temperature of the room at the start of the investigation.

difference = ... °C

Explain whether temperature is a significant source of error in this investigation.

.....

..... [1]

You are provided with a sample **U** which contains a buffer.

You are now required to estimate the pH of the buffer in **U** using the same procedure.

10. Repeat step 2 to step 7 using **U** and record your results in **(b)(iv)**.

(iv) Record the maximum height of foam using **U**. ..... mm [1]

(v) Using the result in **(b)(iv)** and the results in **(b)(i)** estimate the pH of **U**.

pH ..... [1]

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(vi) This procedure investigated the effect of pH on the activity of the enzymes in a plant extract solution.

To modify this procedure for investigating a different variable, the pH should be kept the same.

Think about how you could modify this procedure to investigate the effect of **substrate concentration**, using 6% hydrogen peroxide solution, on the activity of enzymes in the plant extract solution.

Describe how the independent variable, **substrate concentration**, would be changed in an investigation.

.....

.....

.....

.....

Describe how the dependent variable could be measured more accurately than measuring the height of foam. You may use a labelled diagram in the space provided.

.....

.....

.....

space for diagram

[3]

(c) A student investigated the effect of temperature on the rate of enzyme activity in a plant extract solution. All the other variables were standardised.

The results are shown in Table 1.1.

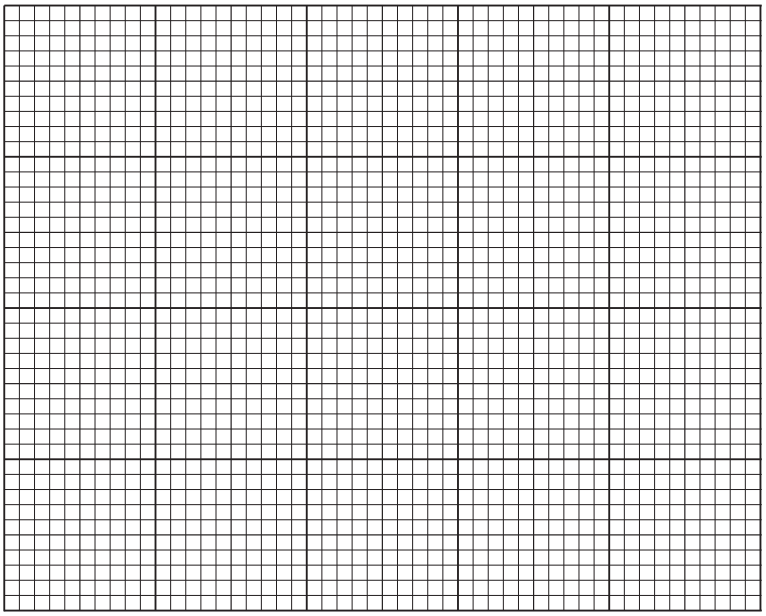
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Table 1.1

temperature /°C	rate of enzyme activity /arbitrary units (au)
5	6.5
16	39.0
27	31.0
38	9.5
49	1.0

Use a sharp pencil for drawing graphs.

(i) Plot a graph of the data shown in Table 1.1.



[4]

(ii) Use your knowledge of enzymes and the data to explain the effect of temperature on the enzyme activity in the plant extract solution.

.....

.....

.....

.....

.....

.....[3]

[Total: 22]

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

(a) **(i)** The specimen on **J1** has an irregular shape.

Select a field of view so that you can observe a sector that includes:

- a structure as shown by the shaded area and labelled **R** in Fig. 2.1
- part of the ring of vascular tissue.

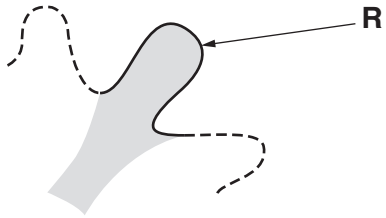


Fig. 2.1

Draw **one** large plan diagram of the different tissues shown in the field of view to show:

- the tissues making up **R**
- the tissues in the part of the vascular ring below **R**
- any other observable tissues.

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

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

[6]

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(ii) Observe the cells in the centre of the stem (pith) in the specimen on **J1**.
These cells are not identical.

Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells.
Each cell of the group must touch at least two of the other cells.

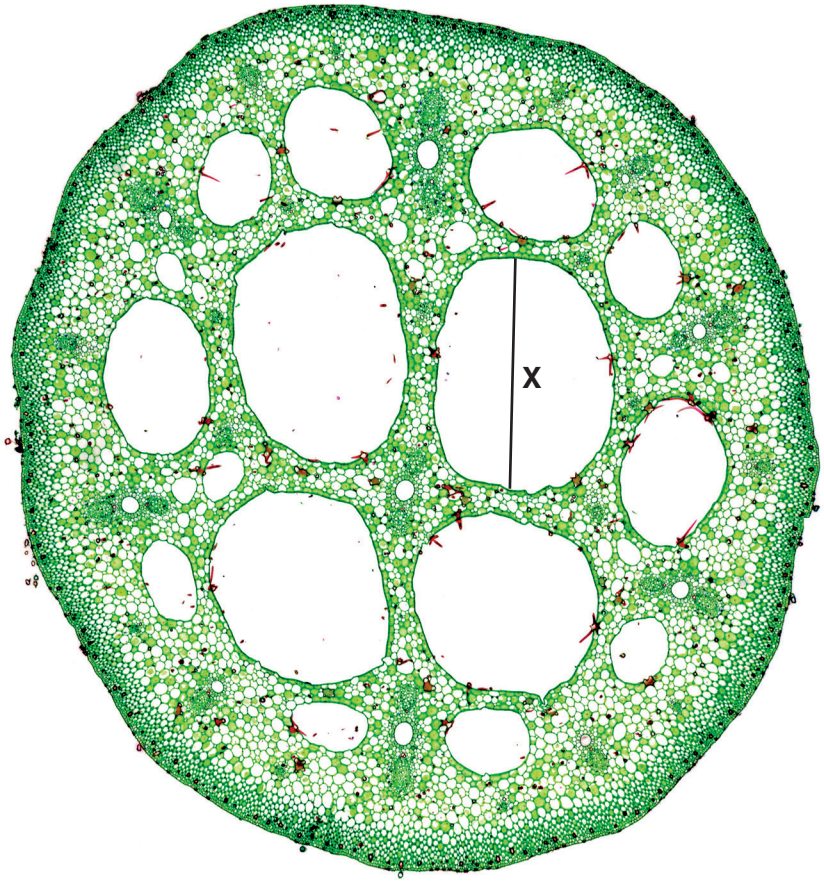
Make a large drawing of this group of **four** cells.

Use **one** ruled label line and the label **C** to identify a structure made of cellulose.

[5]

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

You are not expected to be familiar with this specimen.



magnification ×16

Fig. 2.2

(i) In Fig. 2.2 the line **X** is drawn across the length of an air space.

Use the line **X** and the magnification to calculate the actual length of the air space, in μm.

You may lose marks if you do not show your working.

actual length = ... μm [3]

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(ii) Observe the stem on **J1** and the stem in Fig. 2.2 and identify the differences between them.

Record the observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.2

[4]

[Total: 18]

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CANDIDATE NAME

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3601194050

BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

2 hours

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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 all the work that you would like to do.

If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

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

You are required to investigate the progress of enzyme-catalysed reactions by testing for the release of carbon dioxide.

A sample of yeast cells in sucrose solution, **Y**, will be put into a piece of Visking tubing, **V**, as shown in Fig. 1.1.

The Visking tubing membrane is selectively permeable. The carbon dioxide molecules produced by the yeast cells will diffuse through the membrane of the tubing into the water surrounding the Visking tubing.

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

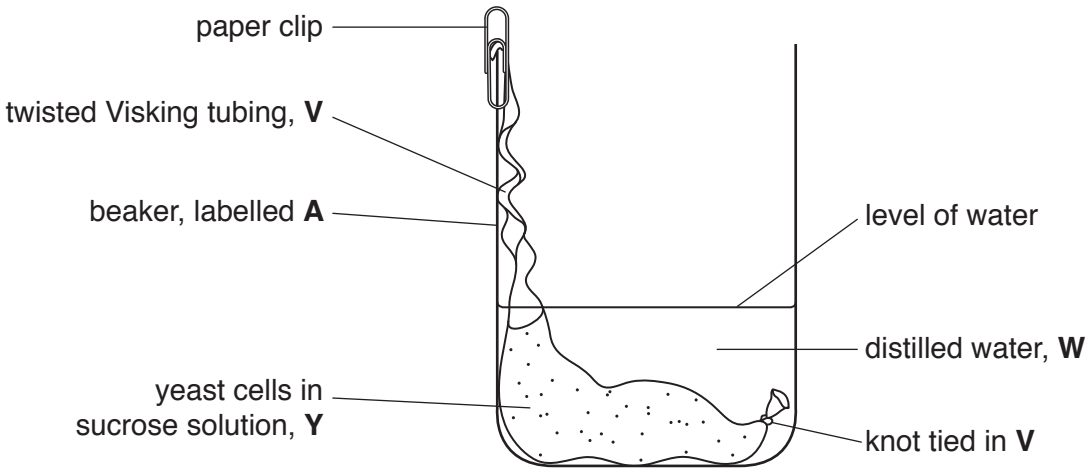


Fig. 1.1

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

As the concentration of carbon dioxide increases, **B** changes from blue to green to yellow.

BLUE → GREEN → YELLOW

no carbon dioxide — increasing concentration — highest concentration of carbon dioxide

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To follow the progress of this reaction you will need to take samples from the water surrounding the Visking tubing at different times for a total of 10 minutes.

(a) (i) Decide how often you will take these samples, including a final sample at 10 minutes.

State the times when you will remove the samples.

..... [1]

You are provided with:

labelled	contents	hazard	volume / cm^3
Y	yeast cells in sucrose solution	none	20
B	bromothymol blue indicator solution	harmful	10
W	distilled water	none	100

labelled	details
V	15 cm length of Visking tubing in a beaker containing distilled water

If any liquids come into contact with your skin, wash off immediately under cold water.
It is recommended that you wear suitable eye protection.

Proceed as follows:

Read step 1 to step 18.

1. Label the tile with the sampling times you decided in **(a)(i)** and 0 (zero) for a sample removed at the start of timing.

2. Put one drop of **B** onto the tile for each of the sampling times.

3. Tie a knot in the Visking tubing as close as possible to one end so that it seals the end.

4. To open the other end, wet the Visking tubing and rub the tubing gently between your fingers.

5. Stir **Y** and put approximately 6 cm^3 of **Y** into the open end of the Visking tubing.

*note: remove the liquid **not** the froth.*

6. Rinse the outside of the Visking tubing by dipping it into the water in the container labelled **V**.

7. Hold the Visking tubing close to the liquid so there is as little air in the tubing as possible. Twist the open end of the Visking tubing.

Look carefully at Fig. 1.1. This has been set up so that the volume of water is as small as possible to cover the Visking tubing. The part of the Visking tubing containing **Y** is on the bottom of the beaker.

8. Put the Visking tubing into the beaker, labelled **A**, as shown in Fig. 1.1.

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9. Make sure the twisted end of the Visking tubing is held in place by a paperclip.

10. Put **W** into the beaker up to the level shown on Fig. 1.1, using a syringe so that you can measure the volume of **W**.

(ii) State the volume of **W** you have decided to use.

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

11. Start timing.

12. Immediately remove a sample of the water with a glass rod.

13. Mix the sample on the glass rod into the drop of **B** labelled 0 and record the colour in **(a)(iii)**.

14. Gently shake the beaker to mix the water. Repeat step 12 and step 13 at each of the sampling times, gently shaking the beaker before step 12 each time. Continue until the final sample is removed at 10 minutes.

15. After the final sample at 10 minutes, clean off the tile and dry it. Repeat step 1 and step 2.

16. Holding the twisted end of the Visking tubing, pour the water from the beaker into the container labelled **for waste**.

17. Put the volume of fresh water stated in **(a)(ii)** into the beaker with the Visking tubing.

18. Repeat step 11 to step 14.

(iii) Record your results in an appropriate table.

[6]

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(iv) Describe **and compare** the results for the first 10 minutes with the results for the second 10 minutes.

.....

.....

.....

.....

.....

.....[2]

(b) A student set up the apparatus as in Fig. 1.1 to investigate the hydrolysis (breakdown) of sucrose into reducing sugar by yeast cells.

These reducing sugar molecules are able to pass through the Visking tubing into the surrounding water.

The student removed a sample of the surrounding water after 20 minutes and carried out a Benedict's test on the sample. The time taken to the first colour change was measured.

(i) Think about how the student would estimate the concentration of reducing sugar in this sample.

Describe how to prepare a range of concentrations of reducing sugar, using a 4% reducing sugar solution.

.....

.....

.....

.....[2]

(ii) The student tested a range of concentrations of reducing sugar with Benedict's solution and measured the time taken to the first colour change for each test.

Using the results the student collected, describe how you would estimate the concentration of reducing sugar in the sample removed after 20 minutes.

.....

.....

.....

.....

.....[1]

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[Turn over

(c) A student investigated the effect of different sugars on the metabolic reactions in yeast.

Yeast cells in different types of sugar solution were prepared. All other variables were standardised.

The rate of metabolic reactions was measured by a sensor which recorded the concentration of carbon dioxide released in 5 minutes.

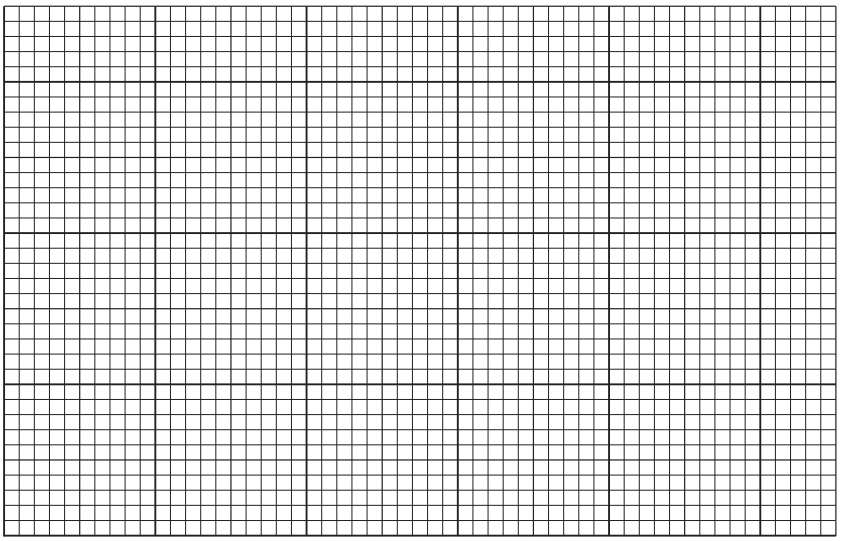
Table 1.1 shows the results for this investigation.

Table 1.1

type of sugar	rate of metabolic reactions /arbitrary units (au)
fructose (**F**)	0.16
glucose (**G**)	0.31
lactose (**L**)	0.01
maltose (**M**)	0.17
sucrose (**S**)	0.20

Use a sharp pencil for drawing charts.

(i) Draw a chart of the data shown in Table 1.1.



[4]

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(ii) Describe the difference in the rate of metabolic reactions in yeast between sucrose and glucose. Using your knowledge of enzymes and carbohydrates, suggest an explanation for this difference.

description .....

.....

explanation .....

.....

.....

.....

.....

.....[4]

[Total: 21]

2 **L1** 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.

(a) **(i)** The transverse section of this stem has an irregular shape.

Select a field of view so that you can observe a sector that includes:
- a structure as shown by the shaded area, labelled **R** in Fig. 2.1
- at least one large vascular bundle.

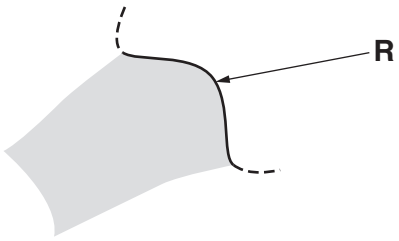


Fig. 2.1

Draw **one** large plan diagram of the different tissues shown in the field of view to show:
- the tissues making up **R**
- the tissues in the vascular bundle
- any other observable tissues.

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

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

[5]

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(ii) Observe the cells in the epidermis of the stem on **L1** and the cells touching these cells. These cells are not identical.

Select **one** group of **four** adjacent (touching) cells made up of:

- two epidermis cells
- two cells which touch these epidermis cells in the layer underneath.

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

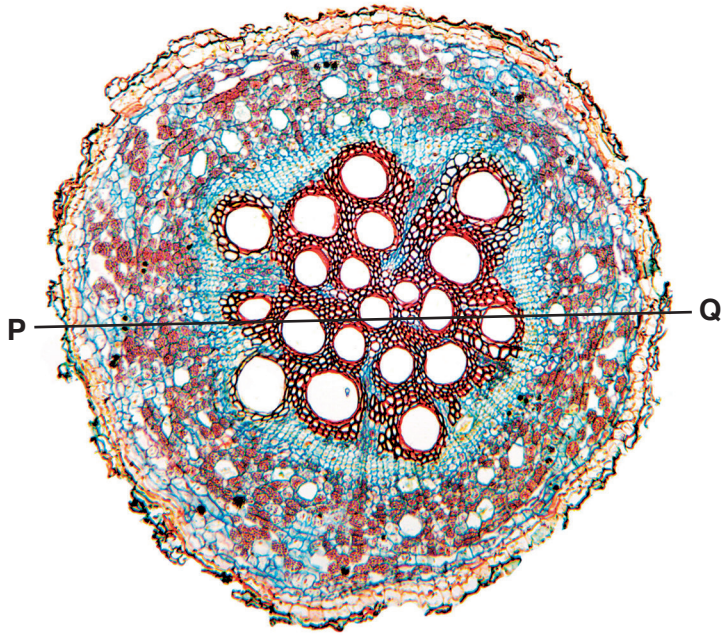
Make a large drawing of this group of **four** cells.

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

[6]

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

You are not expected to be familiar with this specimen.



magnification ×14

Fig. 2.2

(i) Use the line **P**–**Q** to determine the simplest whole number ratio of the diameter of the root to the diameter of the vascular tissue (stele).

You may lose marks if you do not show your working.

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

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(ii) Observe the stem on **L1** and the root in Fig. 2.2 and identify the differences between them.

Record the observable differences in Table 2.1.

Table 2.1

feature	L1	Fig. 2.2

[4]

[Total: 19]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7841959405

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

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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Total	

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

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

1 In humans, the kidneys are the organs that remove waste products from the blood and produce urine. Small, useful molecules such as glucose are also removed from the blood in the kidney. Glucose must be reabsorbed into the blood so that very little is lost in the urine.

The concentration of glucose in urine can be estimated in order to check that the kidneys are working.

You will not be testing real urine. You will be testing solutions that represent urine and will be referred to as 'mock urine'.

You are required to test each of three samples of mock urine for the presence of glucose. These represent samples taken at different times from the same person.

You are provided with:

labelled	contents	hazard	volume / cm^3
U1	mock urine	none	20
U2	mock urine	none	20
U3	mock urine	none	20
Benedict's	Benedict's solution	none	20
G	2% glucose solution	none	20
W	distilled water	none	20

If **Benedict's** comes into contact with your skin, wash off immediately under cold water.
It is recommended that you wear suitable eye protection.

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Read step 1 to step 7 before proceeding.

Proceed as follows:

1. Set up a water-bath and heat to boiling for use in step 6.
2. Put 2 cm^3 of **U1** into a test-tube.
3. Put 2 cm^3 of Benedict's solution into the same test-tube.
4. Shake the test-tube gently to mix the contents.
5. Repeat step 2 to step 4 for **U2** and **U3**.
6. Put all three test-tubes into the water-bath you prepared in step 1 and immediately start timing.
7. Record in **(a)(i)** the time taken to the first colour change **and** record the final colour at 90 s. After 90 s, remove each of the test-tubes from the water-bath.

   If there has been no colour change during the 90 s, record the time to the first colour change as 'more than 90'. You should still record the final colour at 90 s.

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

[4]

(ii) Use your results in **(a)(i)** to state which of **U1**, **U2**, and **U3** do **not** contain glucose.

.....[1]

(iii) State how you will use your results in **(a)(i)** to identify which of **U1**, **U2**, and **U3** has the highest concentration of glucose.

.....

.....[1]

(iv) State which of **U1**, **U2**, and **U3** has the highest concentration of glucose. .....[1]

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[Turn over

If the sample with the highest concentration of glucose is more than 0.5%, then this may mean that a kidney is not working.

You are required to estimate the concentration of glucose in the sample stated in **(a)(iv)** by:

- preparing 10 cm^3 of a 0.5% glucose solution
- carrying out a Benedict's test on the 0.5% glucose solution
- using your results to estimate the concentration of glucose in the sample stated in **(a)(iv)**.

(v) You are provided with a 2% glucose solution, **G**.
Complete Table 1.1 to describe how **G** could be diluted to produce 10 cm^3 of a 0.5% glucose solution.

Table 1.1

final percentage concentration of glucose	volume of 2% glucose solution / cm^3	volume of distilled water, **W** / cm^3
0.5		

[2]

(vi) State **one** variable that must be standardised when carrying out the Benedict's test, to allow you to make a valid comparison between the results collected in **(a)(i)** and the result you will collect for the 0.5% glucose solution you have prepared.

.....

.....

.....[1]

8. Prepare the 0.5% glucose solution as shown in Table 1.1 in the beaker provided.

9. Repeat the Benedict's test with the 0.5% glucose solution and the sample stated in **(a)(iv)**.

10. Record in **(a)(vii)** the time taken to the first colour change. After 90 s, remove the test-tubes from the water-bath.
If there has been no colour change during the 90 s record the time to the first colour change as 'more than 90'.

(vii) Record your results in an appropriate table.

[2]

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(viii) Use your results from **(a)(vii)** to complete Table 1.2 by using **one** tick (✓) to show your estimate of the concentration of glucose in the sample stated in **(a)(iv)**.

Table 1.2

percentage concentration of glucose in mock urine sample	estimate tick (✓)
below 0.5	
0.5	
above 0.5	

[1]

(ix) This procedure enabled you to estimate the concentration of glucose in the mock urine sample.

Suggest how you would improve this procedure to find a more accurate estimate of this concentration.

.....

.....

.....

.....

.....

.....[3]

Question 1 continues on page 6

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(b) Fig. 1.1 is a photomicrograph of a stained transverse section through an animal organ. This organ is used to transport urine from the kidney to the bladder.

You are not expected to be familiar with this specimen.

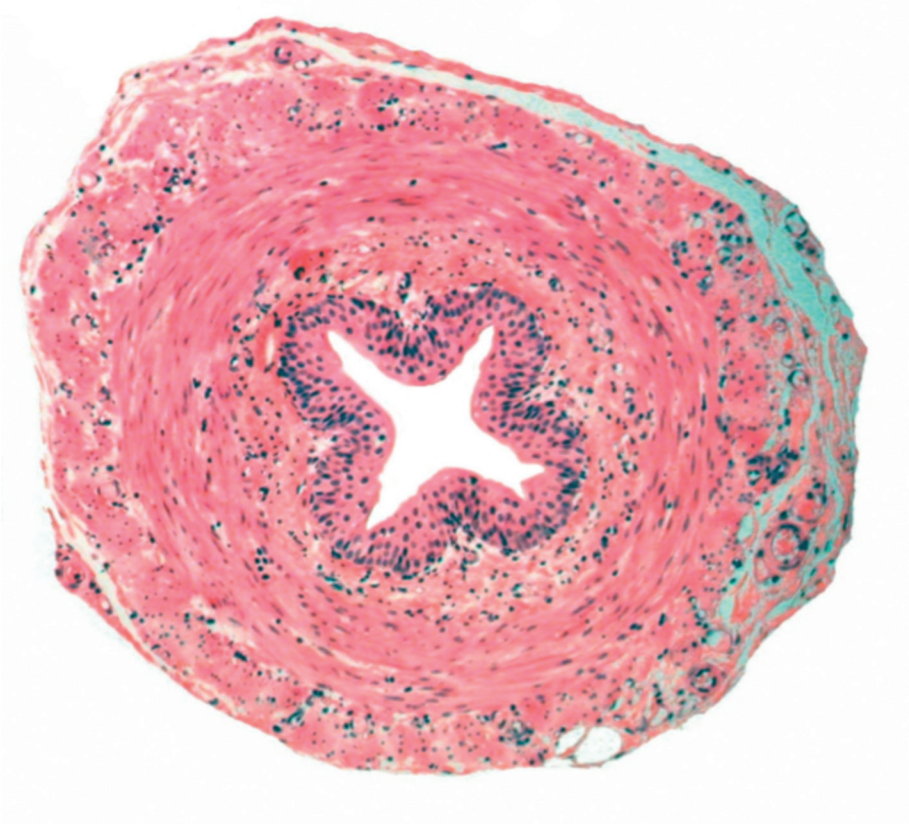


Fig. 1.1

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Use a sharp pencil for drawing.

Draw a large plan diagram of half of the organ in Fig. 1.1, shown by the shaded area in Fig. 1.2.

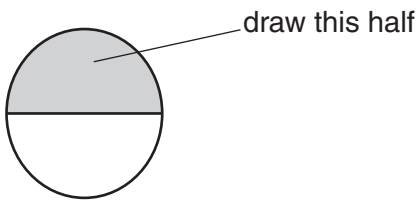


Fig. 1.2

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

[4]

[Total: 20]

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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.

(a) Observe the upper epidermis of the leaf on **K1**. The upper epidermis has no guard cells.

Select one group of **four** adjacent (touching) cells from the upper epidermis.
Each cell must touch at least one of the other cells.

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

Use **one** ruled label line and the label **C** to identify a structure made of cellulose.

[5]

(b) A scientist investigated the rate of transpiration from the leaves of a plant adapted to growing in a dry, hot habitat.

The rate of transpiration was measured in arbitrary units (au) and recorded at intervals from 08:00 to 17:00.

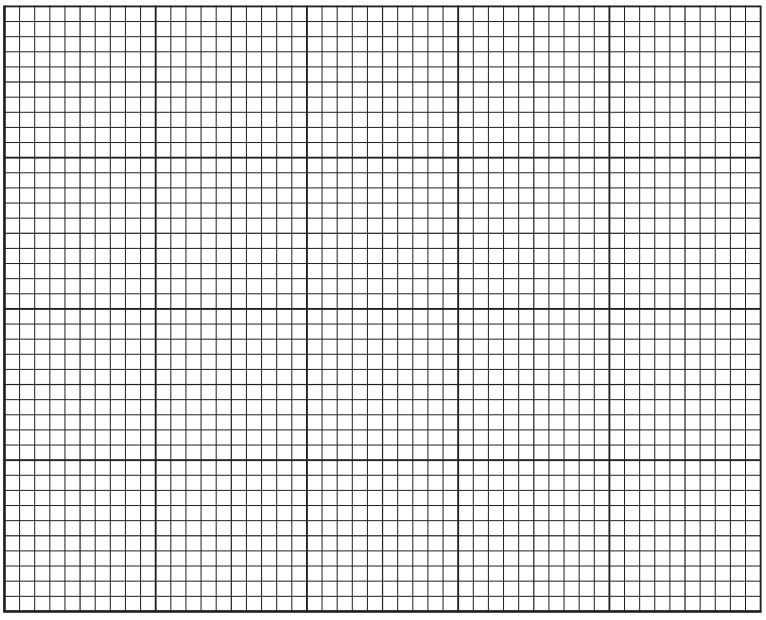
The results are shown in Table 2.1.

Table 2.1

time of day	mean rate of transpiration / au
08:00	0.30
10:30	1.00
12:00	1.55
15:30	1.15
17:00	0.40

Use a sharp pencil for drawing graphs.

(i) Plot a graph of the data shown in Table 2.1.



[4]

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(ii) Calculate the difference in the mean rate of transpiration between 08:30 and 11:30. Show your working.

difference = ...[2]

(iii) Suggest an explanation for the difference in the mean rates of transpiration between 08:30 and 11:30.

.....

.....

.....

.....

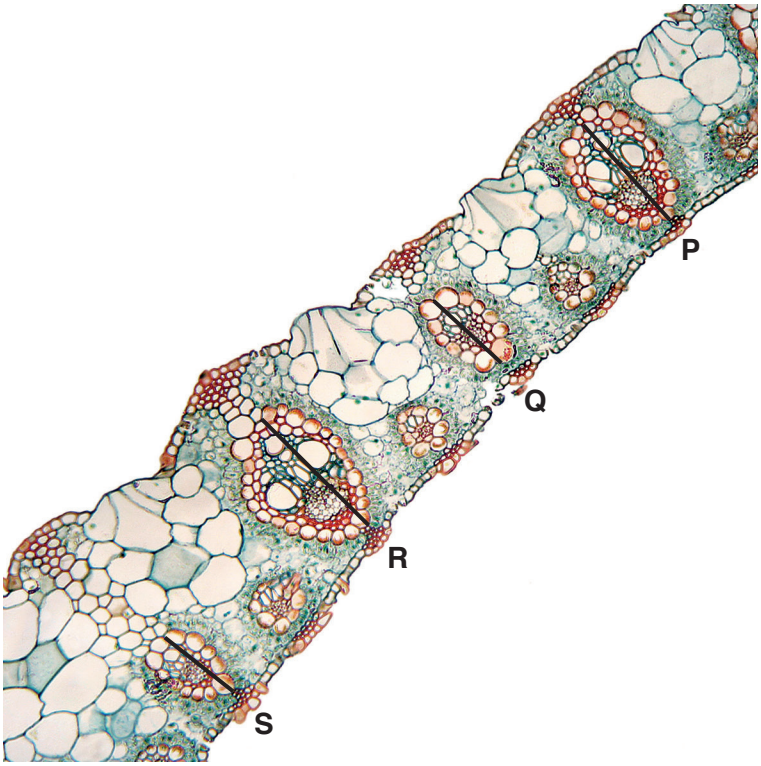
.....

.....

.....[3]

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

You are not expected to be familiar with this specimen.



magnification ×59

Fig. 2.1

(i) In Fig. 2.1 the lines **P**, **Q**, **R** and **S** are drawn across the length of four vascular bundles.

Use the lines **P**, **Q**, **R** and **S** and the magnification to find the actual length of each of the vascular bundles in μm.

You may lose marks if you do not show your working.

P..... μm, **Q**..... μm, **R**..... μm, **S**..... μm [2]

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(ii) Using the actual lengths in **(c)(i)**, calculate the **mean** actual length of these four vascular bundles.

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

mean actual length = ... μm [2]

(d) Observe the leaf on **K1** and the leaf in Fig. 2.1 and identify the differences between them.

Record the observable differences in Table 2.2.

Table 2.2

feature	K1	Fig. 2.1

[2]

[Total: 20]

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BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

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 all the work that you would like to do.

If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

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 required for this coagulation.

You are required to:

- carry out a trial test to think about sources of error
- investigate the effect of substrate concentration on this enzyme-catalysed coagulation.

When a mixture of milk, calcium chloride solution and **E** is gently rotated in a test-tube the coagulation goes through the stages shown in Fig. 1.1.

Stage **3** is the end-point of the enzyme-catalysed coagulation.

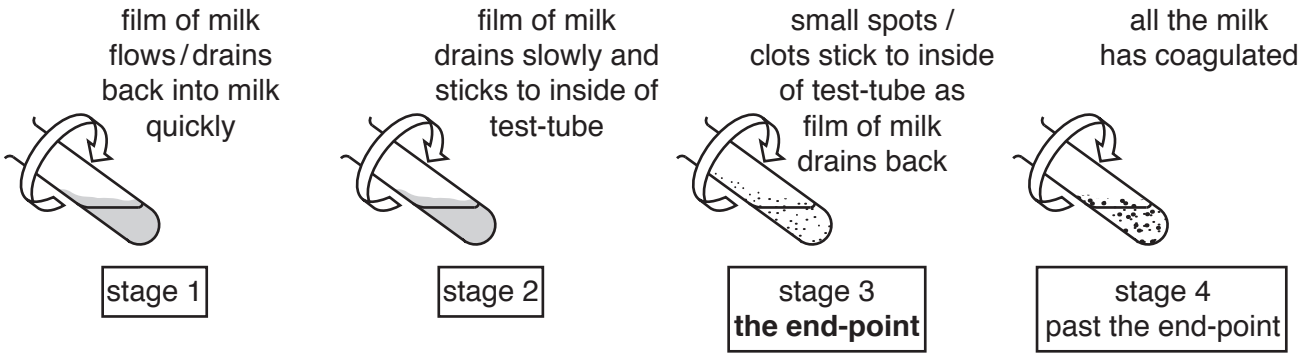


Fig. 1.1

You are provided with:

labelled	contents	hazard	volume / cm^3
C	10% calcium chloride solution	harmful irritant	20
W	distilled water	none	100
M	milk	none	100
E	1% enzyme 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.

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You are required to carry out a trial test (step 1 to step 16) before you start your investigation.

Read step 1 to step 16 before proceeding.

Proceed as follows:

1. You are provided with a beaker labelled **water-bath**. Use the hot and cold water to set up a water-bath in this beaker. The starting temperature of the water-bath should be between 35 °C and 40 °C.

   You will **not** need to maintain this temperature during steps 2 to 15.

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

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

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

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

6. Take the temperature of the water-bath and record this temperature in **(a)(ii)** on page 5.

7. Put the test-tubes into the water-bath and leave for at least 3 minutes.

(a) (i) Explain why the test-tubes are left in the water-bath for at least 3 minutes in step 7.

.....

.....[1]

8. Remove one of the test-tubes from the water-bath.

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

9. 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.

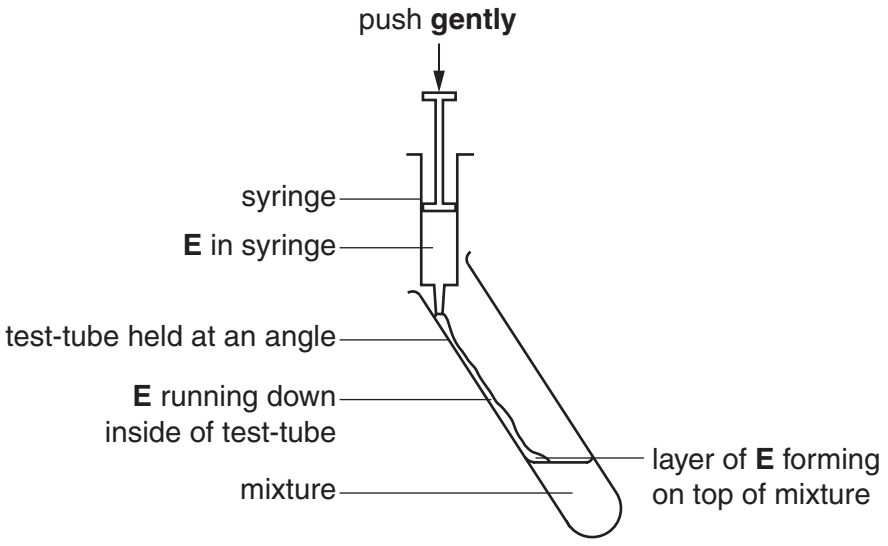


Fig. 1.2

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

11. Hold the test-tube over a piece of black card on the table as shown in Fig. 1.3.

12. Gently rotate the test-tube to form a film of milk on the inside of the test-tube.

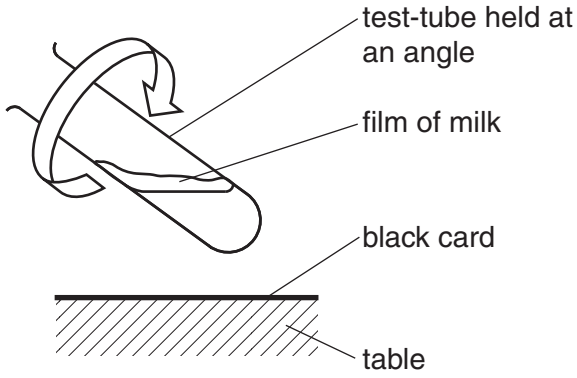


Fig. 1.3

13. Observe the film until the end-point is reached (stage 3 in Fig. 1.1). Ignore any small bubbles on the inside of the test-tube. Stop timing.

14. Record in **(a)(iii)** the time taken to reach the end-point.

    If the end-point has not been reached in 4 minutes, stop the experiment and record 'more than 240'.

15. Repeat step 8 to step 14 with each of the other two test-tubes in the water-bath.

16. Take the temperature of the water-bath when the final test-tube has been removed and record this in **(a)(ii)**.

(ii) Temperature may be a source of error in this investigation.

State the temperatures of the water-bath.

temperature of water-bath taken in step 6 ..... °C

temperature of water-bath taken in step 16 ..... °C

Explain whether the temperature of the water-bath is a significant source of error in this investigation.

.....

.....

.....[1]

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(iii) Record your results in an appropriate table.

[2]

(iv) A significant source of error for this investigation is deciding when the end-point is reached.
Suggest **one** advantage of carrying out this trial test **before** investigating the effect of substrate concentration on this enzyme-catalysed reaction.

.....

.....

.....[1]

You are required to investigate the effect of substrate concentration on this enzyme-catalysed coagulation.

(v) Identify the dependent variable in this investigation.

.....[1]

(vi) You are required to prepare different concentrations of milk, using **M**.

M is undiluted milk and is to be referred to as 100% milk.

You are required to make a serial dilution of **M**, which reduces the concentration of **M by half** between each successive dilution. You will need to prepare 3 further concentrations of milk.

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

Complete Fig. 1.4 to show how you will dilute **M** by:

- stating, under each beaker, the volume and concentration of the milk available for use in the investigation
- using one arrow, with a label above the beaker, to show the volume and concentration of milk added to prepare the concentration
- using another arrow, with a label above the beaker, to show the volume of distilled water, **W**, added to prepare the concentration.

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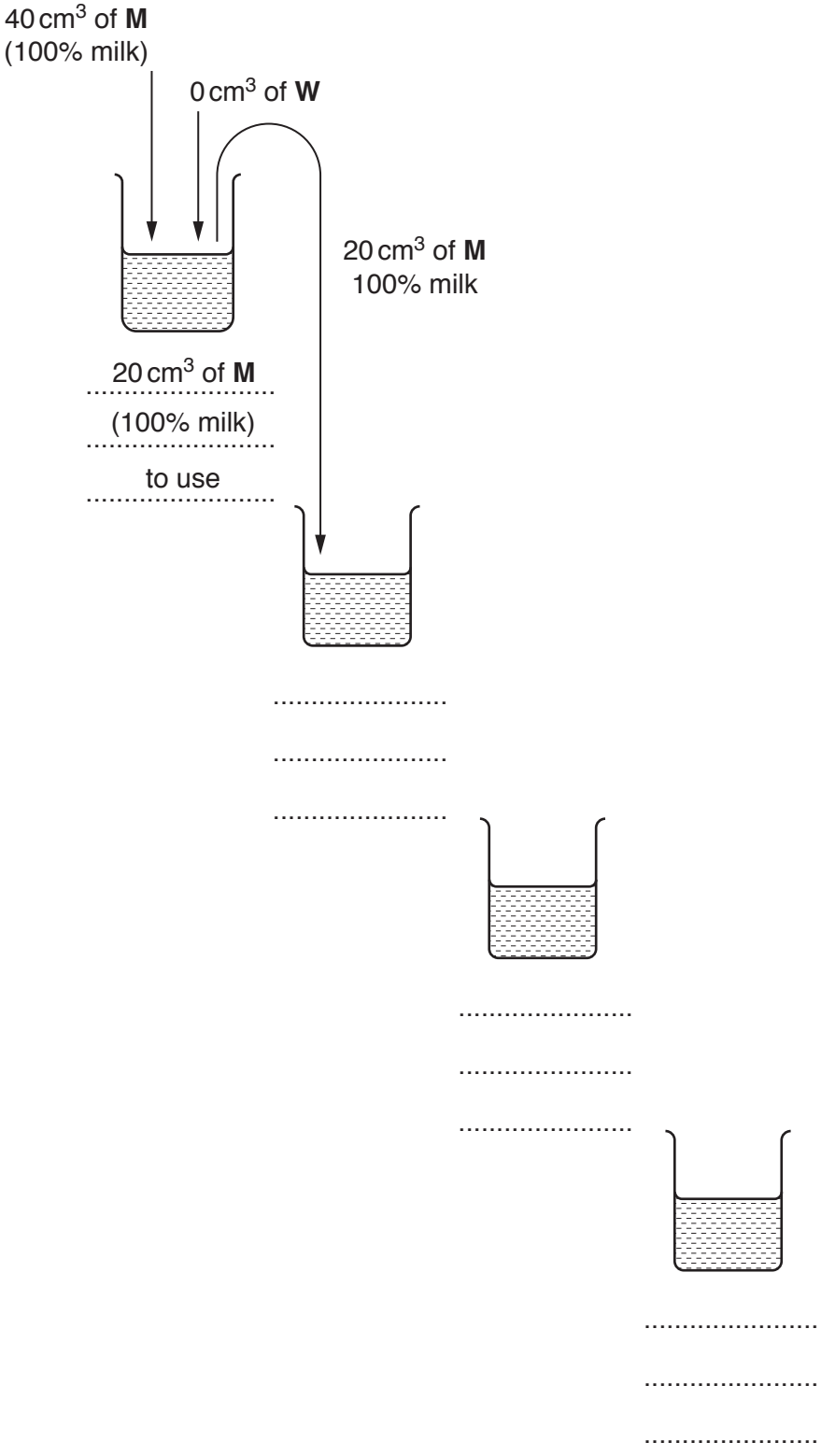


Fig. 1.4 [3]

17. Prepare the concentrations of milk as decided in **(a)(vi)** and in Fig. 1.4.

18. Adjust the temperature of the water-bath so that it is between 35 °C and 40 °C.
    You will **not** need to maintain this temperature during step 19 to step 24.

19. Put 10 cm^3 of the lowest concentration of milk into a test-tube.

20. Repeat step 19 with each of the other concentrations of milk that you have prepared and with 100% milk.

21. Put 1 cm^3 of **C** into each test-tube.

22. Gently shake each of the test-tubes to mix the milk and **C**.

23. Put the test-tubes in the water-bath and leave for at least 3 minutes.

While you are waiting read step 8 to step 13.

24. After 3 minutes remove one of the test-tubes from the water-bath. Add 1 cm^3 of **E** as in step 9, then repeat step 10 to step 13 and record in **(a)(vii)** the time taken to reach the end-point.

25. Repeat step 24 with each of the other test-tubes.

(vii) Record your results in an appropriate table.

[4]

(viii) Describe a control that could be carried out as part of your investigation.

.....

.....

.....[1]

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(ix) This procedure investigated the effect of substrate concentration on the activity of enzyme **E**, using the time taken to reach the end-point.

To modify this procedure for investigating another variable, the substrate concentration would need to be standardised.

Describe how the substrate concentration could be standardised.

.....

.....

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

Describe the modifications needed to investigate the effect of **temperature**.

.....

.....

.....

.....

.....

.....

.....

[3]

Question 1 continues on page 10

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(b) A scientist investigated the percentage mass of protein in milk produced by different animals.

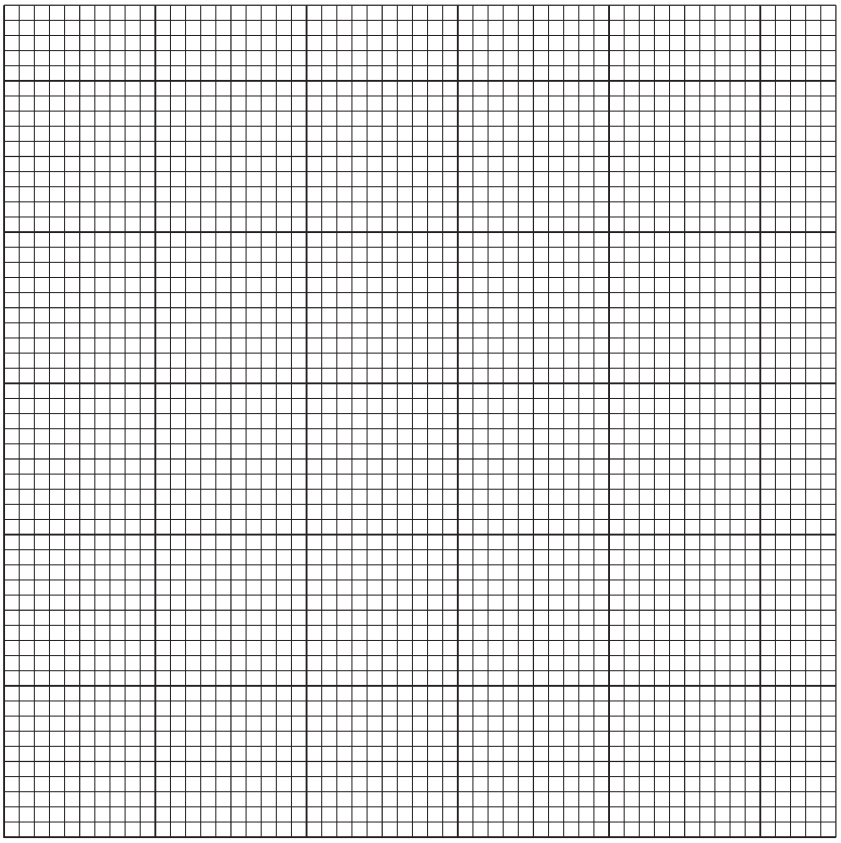
The results are shown in Table 1.1.

Table 1.1

source of milk	percentage mass of protein in milk
cow (co)	3.5
elephant (el)	4.0
sheep (sh)	5.4
seal (se)	10.2
mouse (mo)	9.0

Use a sharp pencil for drawing charts.

(i) Draw a chart of the data shown in Table 1.1.



[4]

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(ii) A scientist investigated enzyme-catalysed coagulation of milk using enzyme **E**. This enzyme hydrolyses (breaks) peptide bonds between certain amino acids in a protein found in milk and this results in the coagulation of the milk.

The scientist recorded the time taken to reach the end-point with each of the types of milk shown in Table 1.1. The shortest time to reach the end-point was recorded when seal milk was investigated.

Use your knowledge of enzymes and the data in Table 1.1 to suggest an explanation for this result.

.....

.....

.....

.....

.....[2]

[Total: 23]

2 **(a)** **M1** 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.

(i) Draw a large plan diagram of a quarter of the root on **M1**, shown by the shaded area in Fig. 2.1.

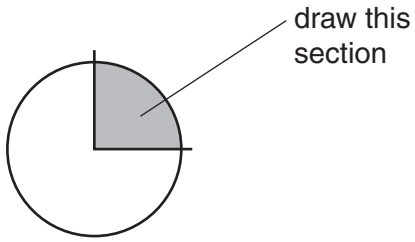


Fig. 2.1

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

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

[5]

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(ii) Observe the central tissue in the root on **M1**.

Select **one** large xylem vessel and **three** adjacent (touching) smaller xylem vessels from the tissue at the centre of the root. The large xylem vessel must touch each of the three smaller xylem vessels.

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

[4]

(iii) Annotate your drawing in **(a)(ii)** to describe **one** observable feature of the xylem vessels that adapts them for their function by:

- drawing a label line to the feature
- describing next to the line how the feature adapts the xylem vessel for its function.

[1]

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

You are not expected to be familiar with this specimen.

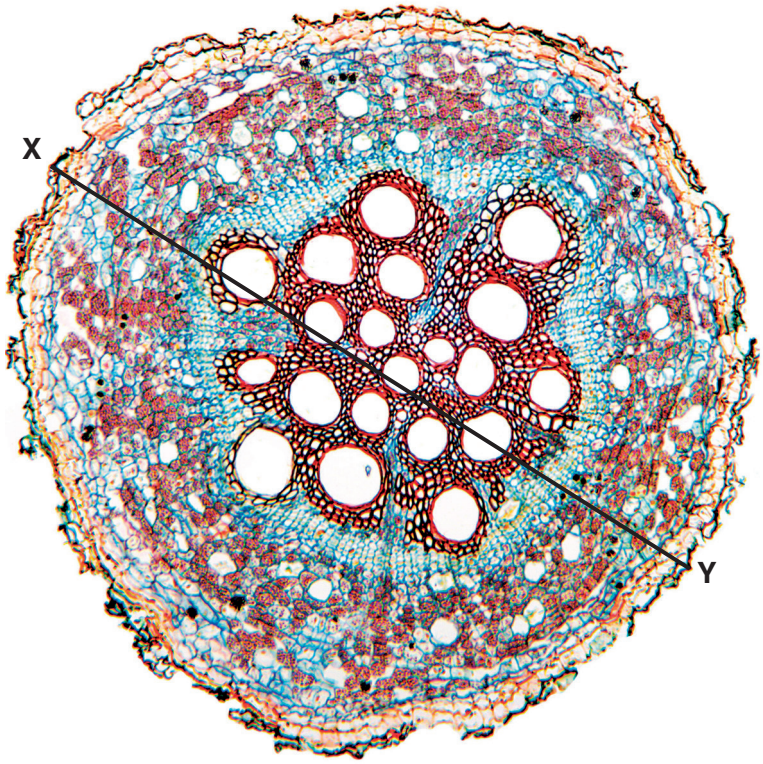


Fig. 2.2

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

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

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

actual diameter = ...[4]

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(c) Observe the root on **M1** and the root in Fig. 2.2 and identify the differences between them.

Record the observable differences in Table 2.1.

Table 2.1

feature	M1	Fig. 2.2

[3]

[Total: 17]

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