Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0822589752

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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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.

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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 Some people feel unwell after drinking animal milk. This is because they are unable to digest the reducing sugar lactose found in this milk. Other sources of milk, such as milk made from plant material, do not contain this reducing sugar and can be included in the diet instead.

You are required to:
- prepare different concentrations of reducing sugar solution, **R**, using serial dilution
- determine the concentration of reducing sugar in two samples of milk
- identify which milk would be the most suitable for a person who is unable to digest lactose.

You are provided with:

labelled	contents	hazard	volume / cm^3
R	1% reducing sugar solution	none	50
W	distilled water	none	50
Benedict's	Benedict's solution	none	50
M1	milk	none	40
M2	milk	none	40

(a) You are required to make a serial dilution of the 1% reducing sugar solution, **R**, which reduces the concentration **by half** between each successive dilution.

Decide how many different concentrations you will prepare for your serial dilution.

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

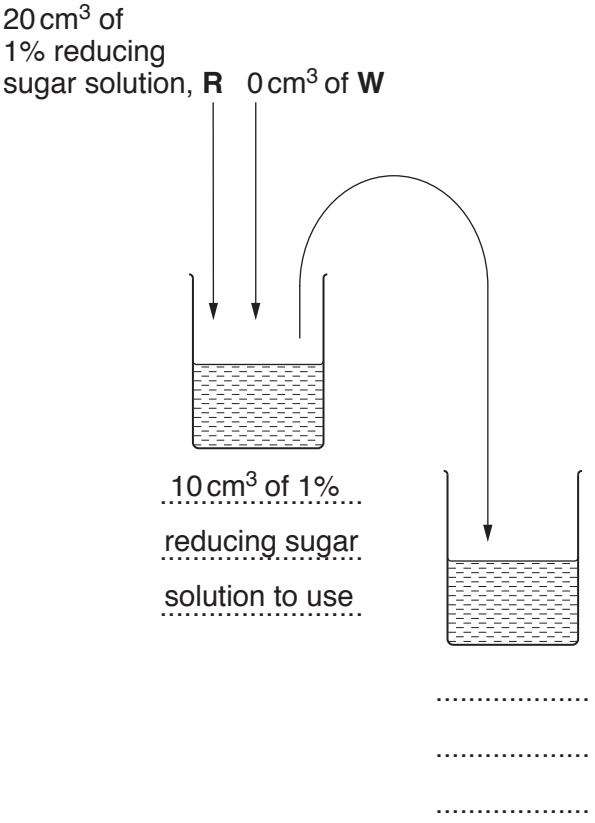
Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

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

For each beaker:

- state, under the beaker, the **volume** and **concentration** of the reducing sugar solution available for use in the investigation
- use one arrow, with a label above the beaker, to show the **volume** and **concentration** of reducing sugar solution added to prepare the concentration
- use another arrow, with a label above the beaker, to show the **volume** of **W** added to prepare the concentration.

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20 cm3 of
1% reducing
sugar solution, R
0 cm3 of W
10 cm3 of 1%
reducing sugar
solution to use
.....
.....
.....

[3]

Fig. 1.1

Proceed as follows:

1. Set up a water-bath and heat to boiling ready for step 6.

2. Prepare the concentrations of reducing sugar solution as decided in **(a)(i)** and in Fig. 1.1.

(ii) You will be required to carry out the Benedict's test on each of the reducing sugar solutions you have prepared. You will use 2 cm^3 of reducing sugar solution for each test.

State the volume of Benedict's solution you will use for each reducing sugar test.
Explain why you have selected this volume.

volume of Benedict's solution ..... cm^3

explanation .....

.....

[1]

3. Put 2 cm^3 of 1% reducing sugar solution into a test-tube.

4. Put the volume of Benedict's solution you stated in **(a)(ii)** into the same test-tube.

5. Shake the test-tube gently to mix the contents.

6. Put this test-tube into the boiling water-bath (prepared in step 1) and record in **(a)(iii)** the time taken for the first appearance of a colour change.

   If there is no colour change after 90 s, **stop timing** and record as 'more than 90'.

7. Repeat step 3 to step 6 for each of the other concentrations of reducing sugar that you prepared in step 2.

(iii) Prepare the space below and record your results.

[3]

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(iv) A student carried out step 1 to step 7 and recorded the result for one of the concentrations as 42 s.
Calculate the rate of this reaction.

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

..... s^{-1} [2]

You are required to find the concentration of reducing sugar in two samples of milk, **M1** and **M2**, using Benedict's solution.

(v) State the variables that you will need to standardise so that you can compare the results of the Benedict's test on **M1** and **M2** with those recorded in **(a)(iii)**.

.....

.....

.....

.....[2]

8. Repeat step 3 to step 6 for each of **M1** and **M2** and record your results in **(a)(vi)**.

(vi) Record your results for **M1** and **M2**.

M1 .....

M2 ..... [1]

(vii) Use your results in **(a)(iii)** to estimate the percentage concentration of reducing sugar in each of **M1** and **M2**.

M1 .....

M2 .....[2]

(viii) State which sample, **M1** or **M2**, would be most suitable for a person who is unable to digest lactose. Give a reason for your answer.

sample.....

reason .....[1]

(b) In most people the reducing sugar lactose is hydrolysed by an enzyme during digestion to produce monosaccharides which are absorbed into the blood.

Some people do not produce this enzyme. When they drink animal milk, the lactose is undigested.

Certain bacteria use the undigested lactose for respiration and produce hydrogen gas. This enters the bloodstream, and is transported to the lungs where it is breathed out (exhaled).

Scientists can measure the concentration of hydrogen in exhaled air.

A scientist gave a person who does not produce this enzyme a drink of animal milk. The effect of drinking milk containing lactose was investigated by measuring the concentration of hydrogen in exhaled air every 20 minutes for 80 minutes.

The results are shown in Table 1.1.

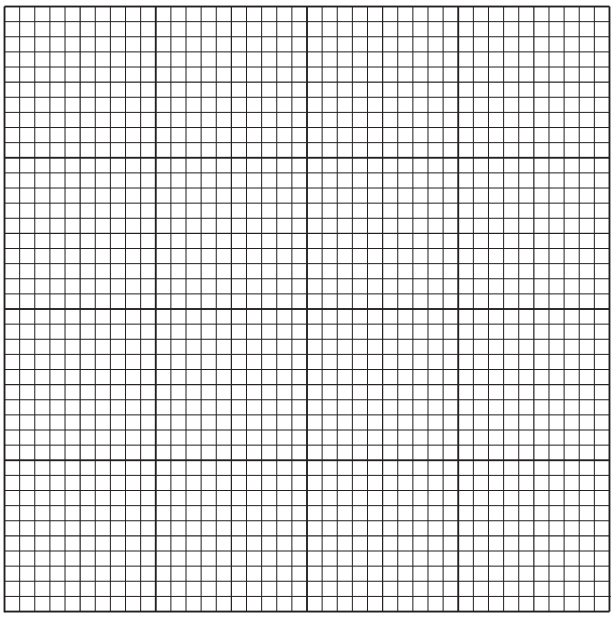
Table 1.1

time after drinking milk containing lactose /minutes	concentration of hydrogen in exhaled air /ppm
0	15
20	17
40	24
60	52
80	80

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You are required to use a sharp pencil for graphs.

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



[4]

Fig. 1.2 is a photomicrograph of a stained transverse section through an animal organ. The bacteria that use lactose may be found in the lumen of this organ.

You are not expected to be familiar with this specimen.

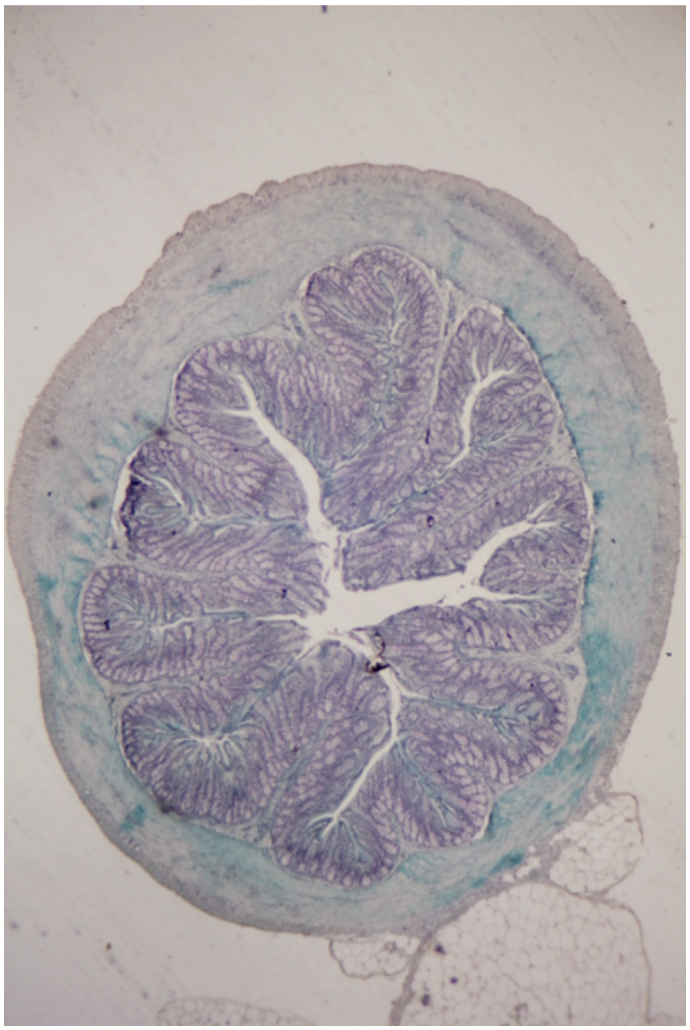


Fig. 1.2

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You are required to use a sharp pencil for drawings.

(ii) Draw a large plan diagram of the half of the organ shown by the shaded area in Fig 1.3 .

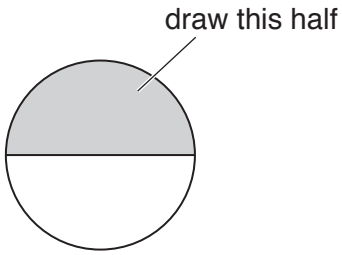


Fig. 1.3

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

[4]

[Total: 23]

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

You are not expected to be familiar with this specimen.

You are required to use a sharp pencil for drawings.

(a) (i) Observe the upper epidermis at the top of the leaf on **J1**.
Select one group of **three** cells with:

- two cells from the upper epidermis
- one adjacent (touching) cell from the tissue below.

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

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

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

[4]

(ii) State the function of the cell you have drawn from the tissue below the epidermis.
Identify **one** observable feature of this cell that supports your answer.

function of cell .....

observable feature .....[2]

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

You are not expected to be familiar with this specimen.

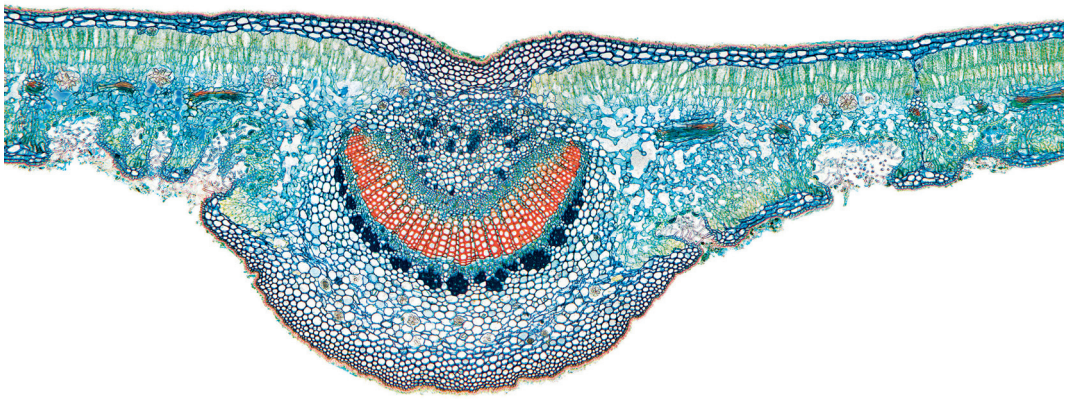


Fig. 2.1

(b) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **J1** and the leaf in Fig. 2.1.

Record your observations in the space you have prepared.

[4]

(c) You are required to measure the diameter of the field of view using the clear plastic ruler.

Proceed as follows:

1. Put the clear plastic ruler on the stage of the microscope and view the scale lines using low power (×100).
2. Measure the diameter of the field of view and record this in **(c)(i)**.

(i) Diameter of the field of view ..... mm [1]

Fig. 2.2 is the same photomicrograph as in Fig. 2.1 showing the field of view at the same magnification as the field of view you have just measured.

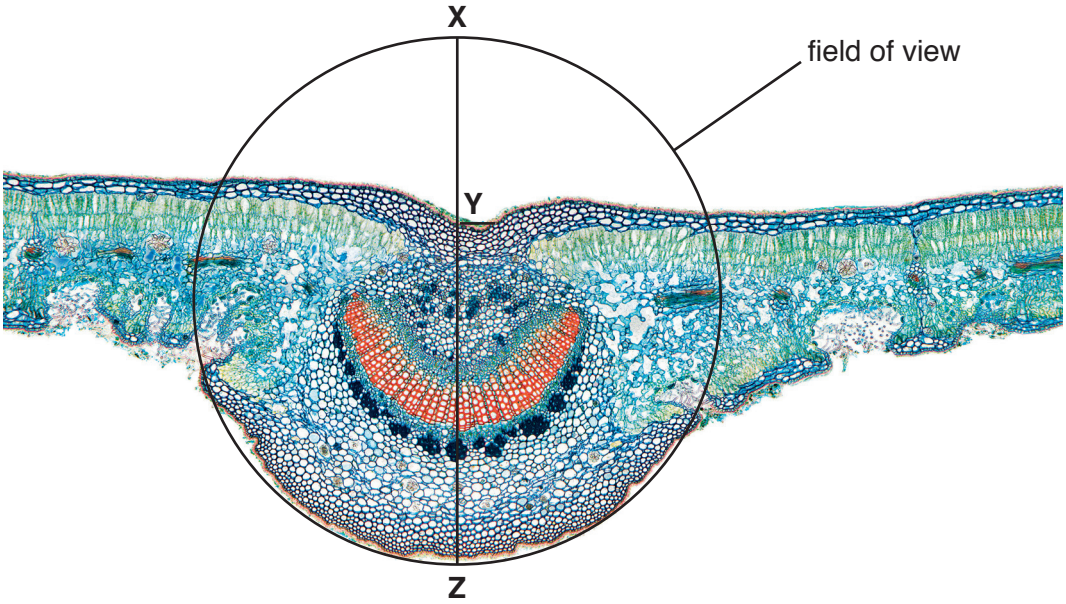


Fig. 2.2

(ii) Using appropriate measurements, calculate the fraction of the diameter of the field of view occupied by the leaf in Fig. 2.2 along the line **X–Z**.

fraction of diameter of field of view .....[1]

(iii) Using your answers to **(c)(i)** and **(c)(ii)** calculate the depth of the midrib, as shown by line **Y–Z**. Give your answer to the nearest μm.
You may lose marks if you do not show your working.

.....μm [2]

(iv) A student used a clear plastic ruler to measure the field of view of a microscope. The student replaced the ruler with a slide of a leaf and estimated the diameter of the midrib. Using these results the student calculated the actual diameter of the midrib.

State how this student could have modified their method to obtain a more accurate result. State the apparatus the student would use and describe the method.

apparatus .....

.....

method .....

.....

.....

.....

.....[3]

[Total: 17]

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CANDIDATE NAME

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CANDIDATE NUMBER

1747536260

BIOLOGY **9700/33**

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[Turn over

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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.

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

1 You are provided with one sample of onion epidermis which has been kept in a sucrose solution, **U**.

You are required to:

- make a slide of the epidermis that has been kept in **U**
- observe and draw a cell from the epidermis.

Proceed as follows:

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

2. Put a few drops of **U** onto the slide.

3. Remove a piece of the onion epidermis from **U** and, using forceps or fingers, peel off the inner epidermis, as shown in Fig. 1.1.

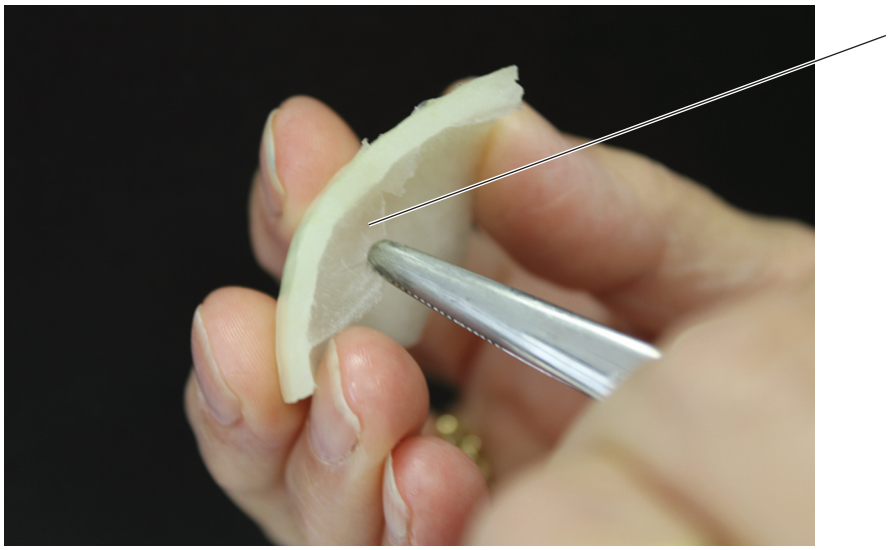


Fig. 1.1

4. Cut one piece of the epidermis that will fit under a coverslip. Put the remaining epidermis back into **U**.

5. Place the epidermis on the slide as shown in Fig. 1.2. If the epidermis is folded, you may need to add more drops of **U** so that it floats and uncurls.

   *Note: it is important to prevent the epidermis from drying out so add more drops of **U** if needed.*

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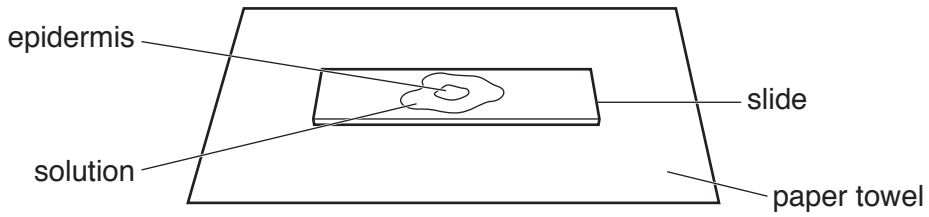


Fig. 1.2

6. Cover the epidermis with a coverslip and use a paper towel to remove any excess liquid that is outside the coverslip.

(a) Use the microscope to select an area of cells on the slide which shows the effect of keeping the epidermis in **U**. Adjust the amount of light entering the microscope to observe cells clearly.

You are required to use a sharp pencil for drawings.

Draw **one** cell from the slide which shows the effect of the sucrose solution **U**.

Use **one** ruled label line and label to identify the cell surface membrane in the cell.

[4]

Your answer to **(a)** shows the effects of the water potential of this concentration of sucrose solution on the onion cells.
To estimate the water potential of the sucrose solution in **U**, the concentration of sucrose in **U** needs to be estimated.

You are required to:

- prepare different concentrations of sucrose solution, **S**, using serial dilution
- carry out the non-reducing sugar test on these concentrations
- carry out the non-reducing sugar test on the solution in **U**
- use the results to estimate the concentration of sucrose solution in **U**.

You are provided with:

labelled	contents	hazard	volume /cm^3
S	1.0 mol dm^{-3} sucrose solution	none	50
W	distilled water	none	100
U	unknown concentration of sucrose solution containing onion epidermis	none	100
H	dilute hydrochloric acid	none	50
A	sodium hydrogencarbonate powder	none	–
Benedict's	Benedict's solution	none	25

7. Set up a water-bath and heat to boiling ready for step 12 and step 16.

(b) You are required to make a **serial** dilution of the 1.0 mol dm^{-3} sucrose solution, **S**, which reduces the concentration **by half** between each successive dilution.

Decide how many different concentrations you will prepare for your serial dilution.

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

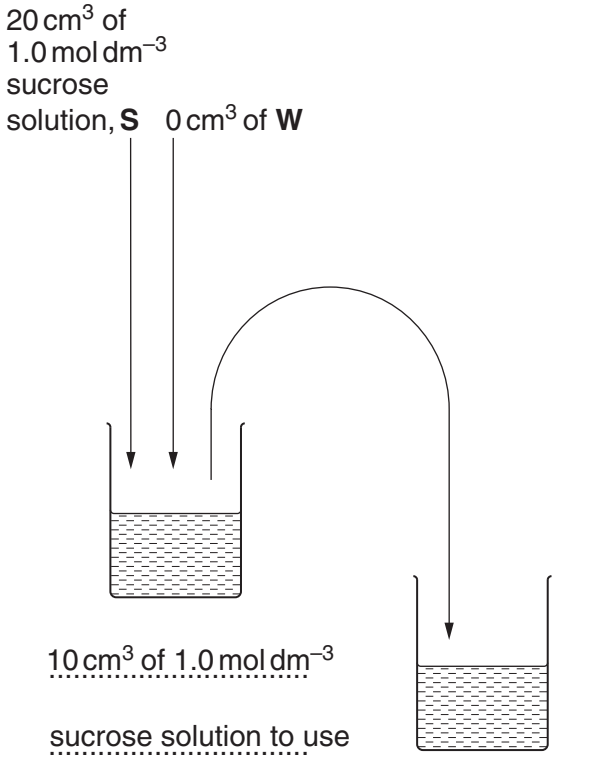
Fig. 1.3 shows the first two beakers you will use to make your serial dilution.

(i) Complete Fig. 1.3 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the **volume** and **concentration** of the sucrose solution available for use in the investigation
- use one arrow, with a label above the beaker, to show the **volume** and **concentration** of sucrose solution added to prepare the concentration
- use another arrow, with a label above the beaker, to show the **volume** of **W** added to prepare the concentration.

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20 cm3 of
1.0 mol dm–3
sucrose
solution, S
0 cm3 of W
10 cm3 of 1.0 mol dm–3
sucrose solution to use

....

.....

.....

Fig. 1.3

[3]

8. Prepare the concentrations of sucrose solution as decided in **(b)(i)** and in Fig. 1.3.

The sucrose concentration can be estimated by using the non-reducing sugar test.

To test for the presence of a non-reducing sugar, any non-reducing sugars must be hydrolysed (broken down) into the reducing sugars.

For example, boiling sucrose with dilute hydrochloric acid hydrolyses sucrose into glucose and fructose, which are both reducing sugars.

The Benedict's test can then be used to show the presence of these reducing sugars.

S and **U** contain only non-reducing sugars so a reducing sugar test would give a blue colour after boiling. You are required to carry out **only** the non-reducing sugar test **not** the reducing sugar test.

9. Put 2 cm^3 of **S** (1.0 mol dm^{-3} sucrose solution) into a labelled test-tube.

10. Repeat step 9 with each of the other concentrations prepared in step 8 and with a sample from **U**.

11. Put 2 cm^3 of **H** into each of the test-tubes.

12. Put all the test-tubes into the boiling water-bath (set up in step 7). Leave for 2 minutes.

13. After 2 minutes, remove the test-tubes and put them into the beaker labelled **C** and leave for a further 2 minutes to cool. *You will need the boiling water-bath for step 16.*

14. After 2 minutes, put a small amount of **A** into each test-tube and repeat until there is no more fizzing. This neutralises the acid so that the Benedict's solution can work.

*Note: there may be a residue of **A** in the bottom of some of the test-tubes. This will not affect the results.*

15. Put 3 cm^3 of Benedict's solution into the test-tube containing 1.0 mol dm^{-3} sucrose solution (**S**).

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

17. Measure the time taken to the first appearance of a colour change in the test-tube.
If there is no colour change after 120 s, **stop timing** and record as 'more than 120'.

18. Record the result in **(b)(ii)**.

19. Repeat step 15 to step 18 with each of the other concentrations of sucrose solution.

20. Repeat step 15 to step 17 with the sample from **U**. Record the result for **U** in **(b)(iii)**.

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(ii) Prepare the space below and record your results for the known concentrations of sucrose solution.

[5]

(iii) State the time taken for the appearance of the first colour change for **U** .....[1]

(iv) Use your results in **(b)(ii)** and **(b)(iii)** to estimate the concentration of sucrose in **U**.

*estimated concentration in **U***.....[1]

(v) Suggest how you would improve this procedure to obtain a more accurate estimate of the concentration of sucrose in **U**.

.....

.....

.....

.....

.....

.....[3]

(c) Using a more accurate procedure a student estimated the concentration of sucrose in a solution which had contained onion epidermis. The student's estimate was 0.66 mol dm^{-3}.

To find the water potential for this concentration of sucrose solution a graph needs to be plotted for known water potentials of different concentrations of sucrose solution as shown in Table 1.1.

Table 1.1

concentration of sucrose solution / mol dm^{-3}	water potential / kPa
1.0	–3.25
0.8	–2.60
0.6	–1.95
0.4	–1.30
0.2	–0.65

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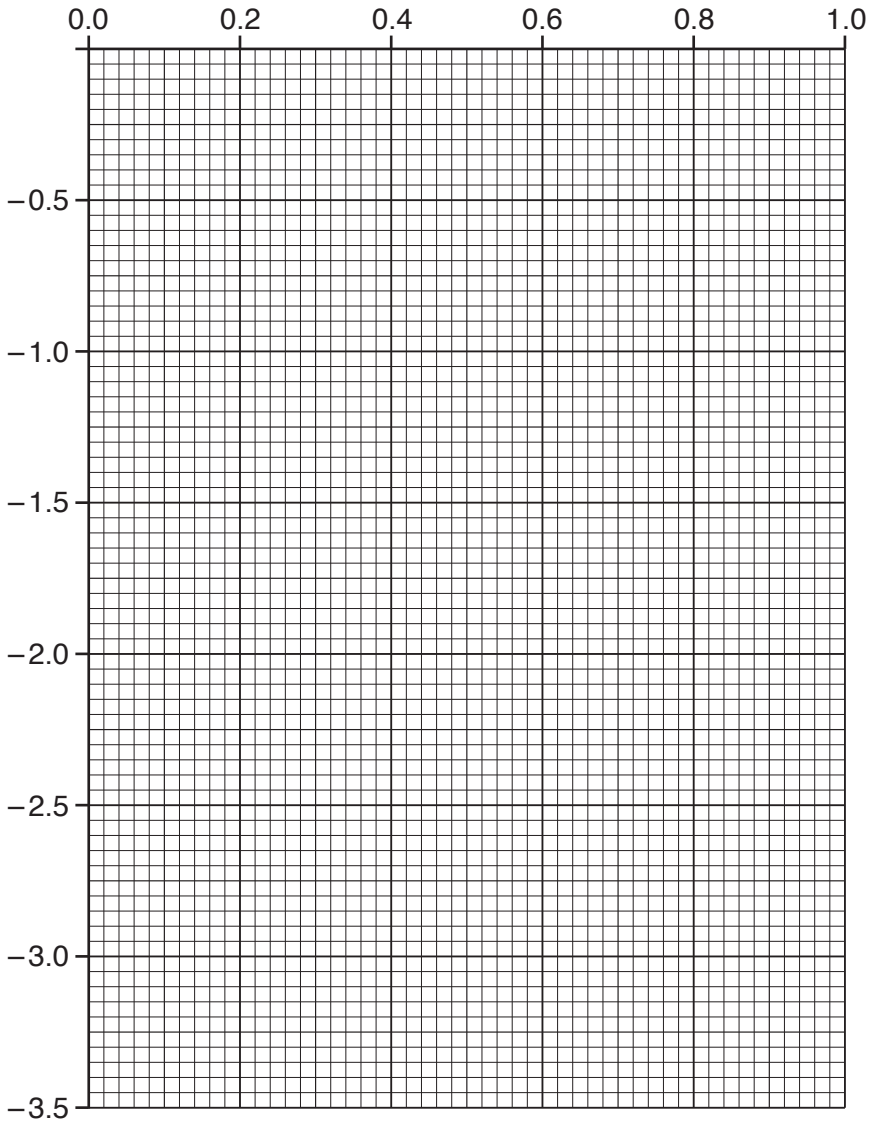
You are required to use a sharp pencil for graphs.

(i) Complete the graph, including axes labels, using the scale provided and using the data in Table 1.1.

.....

.....

.....



[3]

(ii) Use your graph to estimate the water potential of the concentration of sucrose solution recorded by the student (0.66 mol dm^{-3}).

Show on your graph how you estimated the water potential.

water potential .....kPa [1]

(iii) Assuming the water potential in **(c)(ii)** produced the observations of the onion cells in your drawing in **(a)**, explain the effect of the sucrose solution on the onion cells.

.....

.....

.....

.....

.....[2]

[Total: 23]

2 **(a)** Some plants store starch in cells in the roots. As a plant grows more sucrose may be transported to the roots to be stored as starch.

You are provided with three samples which represent cell extracts from roots of different ages, **P1**, **P2** and **P3**.

You are required to test each sample for starch.

(i) Describe how you will test the samples so that you can compare the quantity of starch in each sample.

.....

.....

.....

.....

.....[2]

1. Test each of the samples, **P1**, **P2** and **P3** for starch using the method described in **(a)(i)**.
2. Record your observations in **(a)(ii)**.

(ii) Prepare the space below and record your observations.

[3]

(iii) Use your observations recorded in **(a)(ii)** to state which of the samples **P1**, **P2** or **P3** may represent the oldest root.

.....[1]

(b) Fig. 2.1 is a photomicrograph of a stained longitudinal section of part of a root.

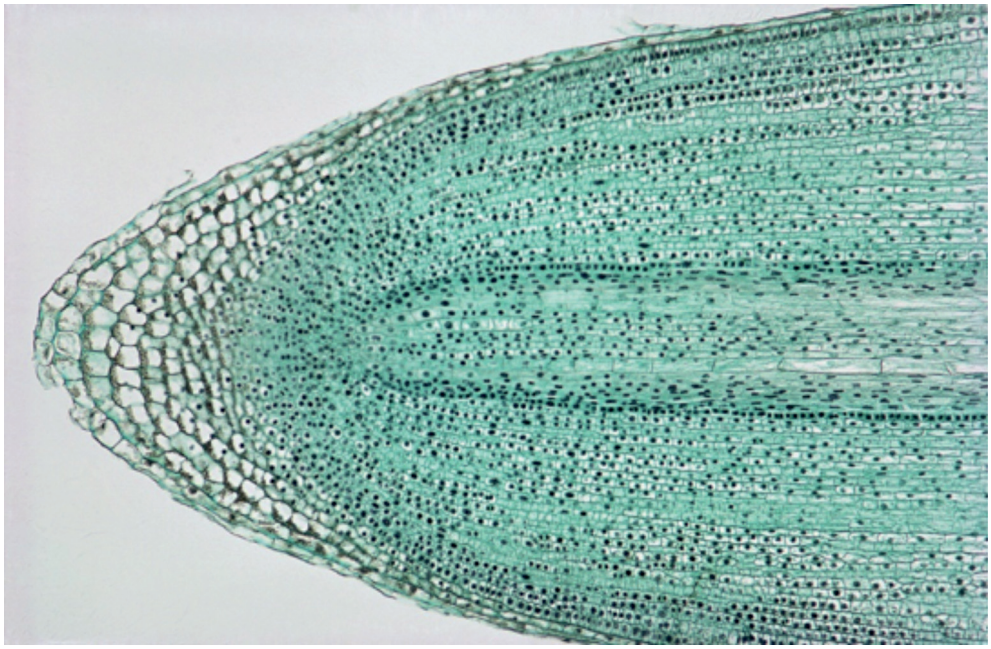


Fig. 2.1

You are required to use a sharp pencil for drawings.

Draw a large plan diagram of the part of the root shown in Fig. 2.1.

Use **one** ruled label line and the letter **T** to identify a tissue containing cells which may store starch in the root.

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

[5]

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(c) Fig. 2.2 is a photomicrograph of starch grains inside plant root cells.

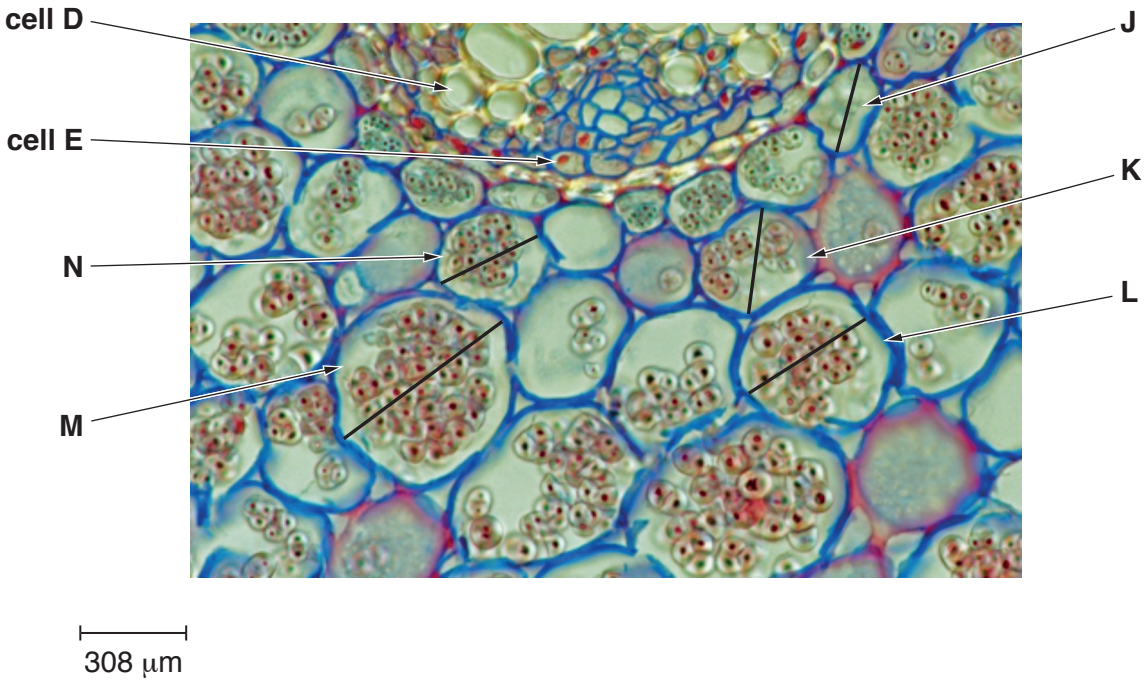


Fig. 2.2

(i) Use the scale bar and the lines in Fig. 2.2 to find the actual width, in μm, of the cells labelled **J**, **K**, **L**, **M** and **N**.

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

J..... μm, **K**..... μm, **L**..... μm, **M**..... μm, **N**..... μm [3]

(ii) Using the actual widths calculated in **(c)(i)**, calculate the **mean** actual width of a cell.

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

mean actual width .....[2]

(iii) State **one** observable difference between the two cells labelled **D** and **E** on Fig. 2.2.

.....

.....[1]

[Total: 17]

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Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 2016**

2 hours

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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 When plant cells are placed into different concentrations of sodium chloride solution, water moves between the cells and the solutions. This will affect how much a piece of plant tissue can bend.

Fig. 1.1, Fig. 1.2 and Fig. 1.3 show the method you will use to measure the angle of bend of a piece of plant tissue (potato).

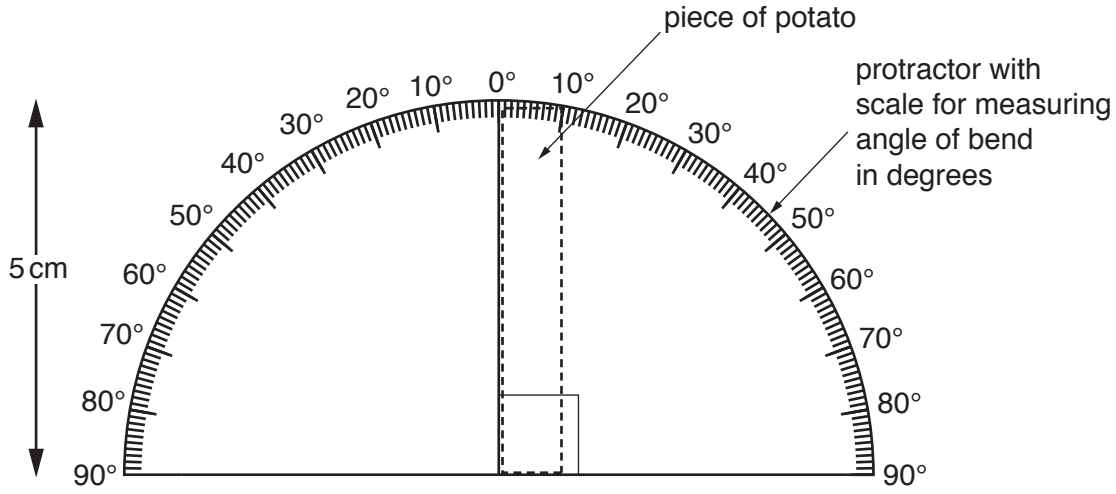


Fig. 1.1

Note: you are provided with a sheet showing 4 protractors.
*Do **not** cut these into separate protractors. Do **not** remove from the plastic covering.*
You may use one or more of these to obtain your results.

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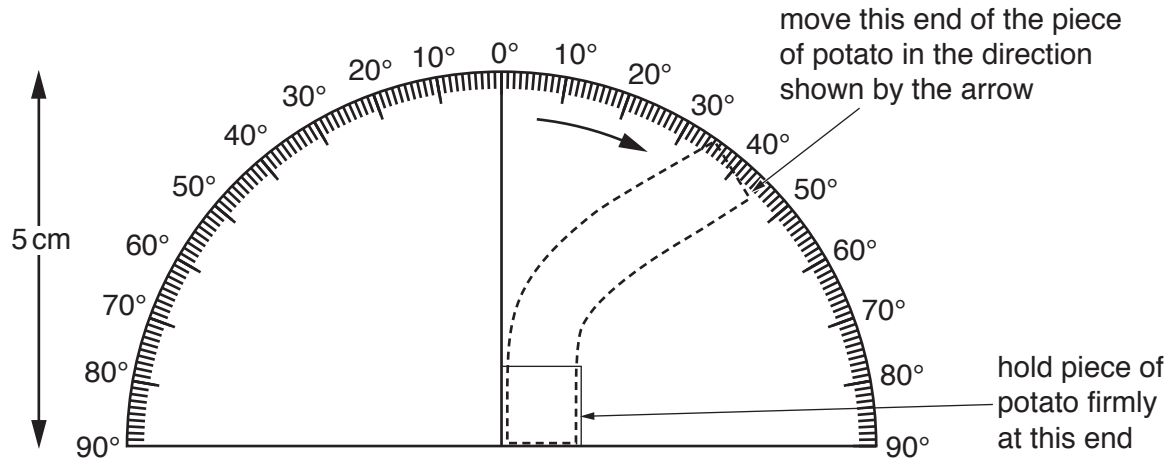


Fig. 1.2

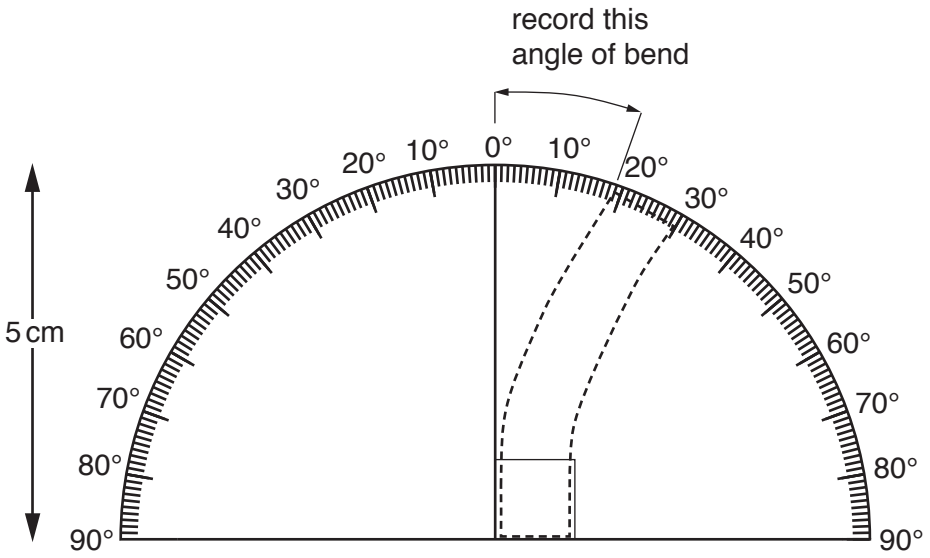


Fig. 1.3

Method of measuring the angle of bend

- Put the piece of potato in the starting position on one of the protractors provided, as shown in Fig. 1.1.
- Hold the bottom of the piece of potato **firmly** as shown in Fig. 1.2.
- Move the top of the piece of potato until there is some resistance.
- Release the top of the piece of potato.
- Measure the angle of bend, after releasing the top of the piece of potato, as shown in Fig. 1.3. The maximum angle of bend is 90°.

Note: before measuring, remove excess liquid from the piece of potato and make sure the plastic covering on the page of protractors is dry.

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You are provided with four different concentrations of sodium chloride solution labelled **S1**, **S2**, **S3** and **S4**. Each concentration of sodium chloride solution contains two pieces of potato.

S1, **S2** and **S3** each contain one of the concentrations of sodium chloride solution, 1.00 mol dm^{-3}, 0.50 mol dm^{-3} and 0.25 mol dm^{-3} but not necessarily in that order.

S4 has an unknown concentration of sodium chloride solution.

(a) (i) Complete the sentence by selecting the correct word from: **least** or **most** or **same**.

The piece of potato soaked in the lowest concentration of sodium chloride solution will have the ..... angle of bend when compared to the other concentrations of sodium chloride solution. [1]

You are required to:
- measure the angle of bend for each of the pieces of potato from **S1**, **S2** and **S3**
- use these results to identify the concentrations of the sodium chloride solutions, **S1**, **S2** and **S3**.

The size of the pieces of potato is a variable which needs to be standardised.

(ii) Decide how you will make sure that the pieces of potato are a standard size.

State the size you will use.

.....

.....[1]

(iii) Describe how you will obtain accurate results to record the angle of bend.

.....

.....[1]

Proceed as follows:

1. Cut the pieces of potato as stated in **(a)(ii)** and return to the appropriate solution.

2. Before measuring the angle of bend, remove excess liquid from the piece of potato using the paper towel.

3. Measure the angle of bend of the pieces of potato from **S1**, **S2** and **S3** using the **Method of measuring the angle of bend** as described on page 3.

Note: before measuring, remove excess liquid from the piece of potato and make sure the plastic covering on the page of protractors is dry.

4. Record your results in **(a)(iv)**.

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[Turn over

(iv) Prepare the space below and record your results.

[5]

(v) Using your results in **(a)(iv)** state the concentration of sodium chloride solution in **S1**, **S2** and **S3**.

S1 …….. mol dm^{-3}

S2 …….. mol dm^{-3}

S3 …….. mol dm^{-3}

[1]

5. Repeat step 3 using the pieces of potato from **S4** and record your result in **(a)(vi)**.

(vi) Record the angle of bend for the pieces of potato from **S4**.

.....

.....

.....[1]

(vii) Estimate the concentration of the sodium chloride solution in **S4** using your results in **(a)(iv)**, **(a)(v)** and **(a)(vi)**.

.....[1]

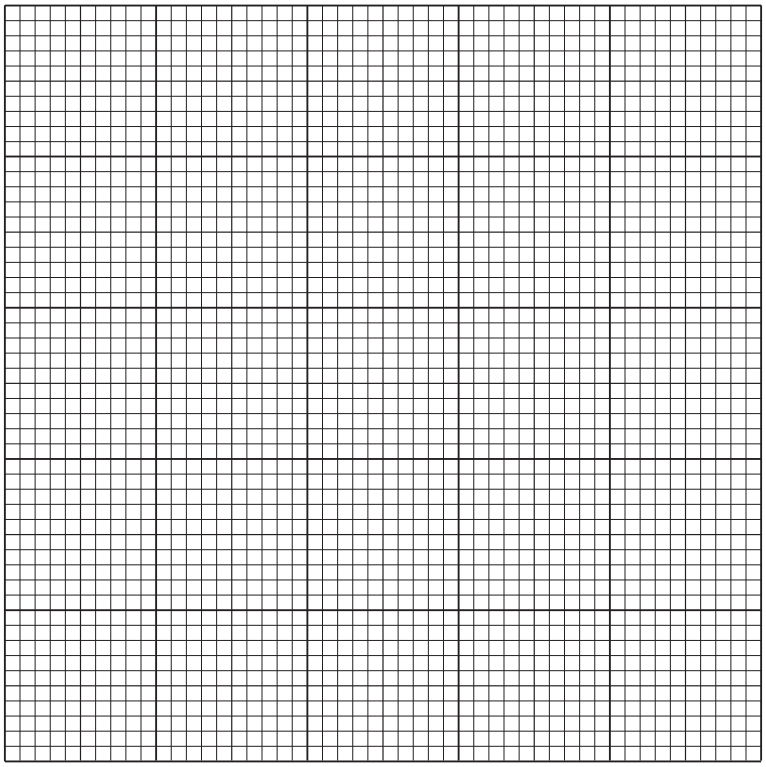
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You are expected to use a sharp pencil to draw graphs.

A student recorded angles of bend of 0° for pure water (0 mol dm^{-3} sodium chloride solution) and 2° for 0.15 mol dm^{-3} sodium chloride solution.

(viii) Plot a graph to show the relationship between the concentration of sodium chloride solution and the angle of bend using:

- the results recorded by the student
- your results as recorded in **(a)(iv)**
- the concentrations of sodium chloride solution stated in **(a)(v)**.



[3]

(ix) A more accurate estimate for the concentration of sodium chloride solution in **S4** can be found by using this graph.

Use your graph to estimate the concentration of sodium chloride solution in **S4** using your answer to **(a)(vi)**.
Show on the graph how you estimated the concentration of sodium chloride solution.

concentration in **S4** .....[2]

(b) Suggest how you would improve this procedure to have more confidence in your estimate of **S4**.

.....

.....

.....

.....

.....[3]

(c) A student puts a piece of the potato from **S1** into water.
Explain, in terms of water potential, the effect this would have on the potato cells.

.....

.....

.....

.....

.....[2]

[Total: 21]

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Question 2 starts on page 10

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

You are not expected to be familiar with this specimen.

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

You are required to use a sharp pencil for drawings.

(i) Draw a large plan diagram of the part of the leaf observed in the field of view.

Use **one** ruled label line and label to identify one layer of epidermis.



Fig. 2.1

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

[6]

(ii) Observe the cells in the ring around the vascular bundle on **L1**.
These cells are not identical.

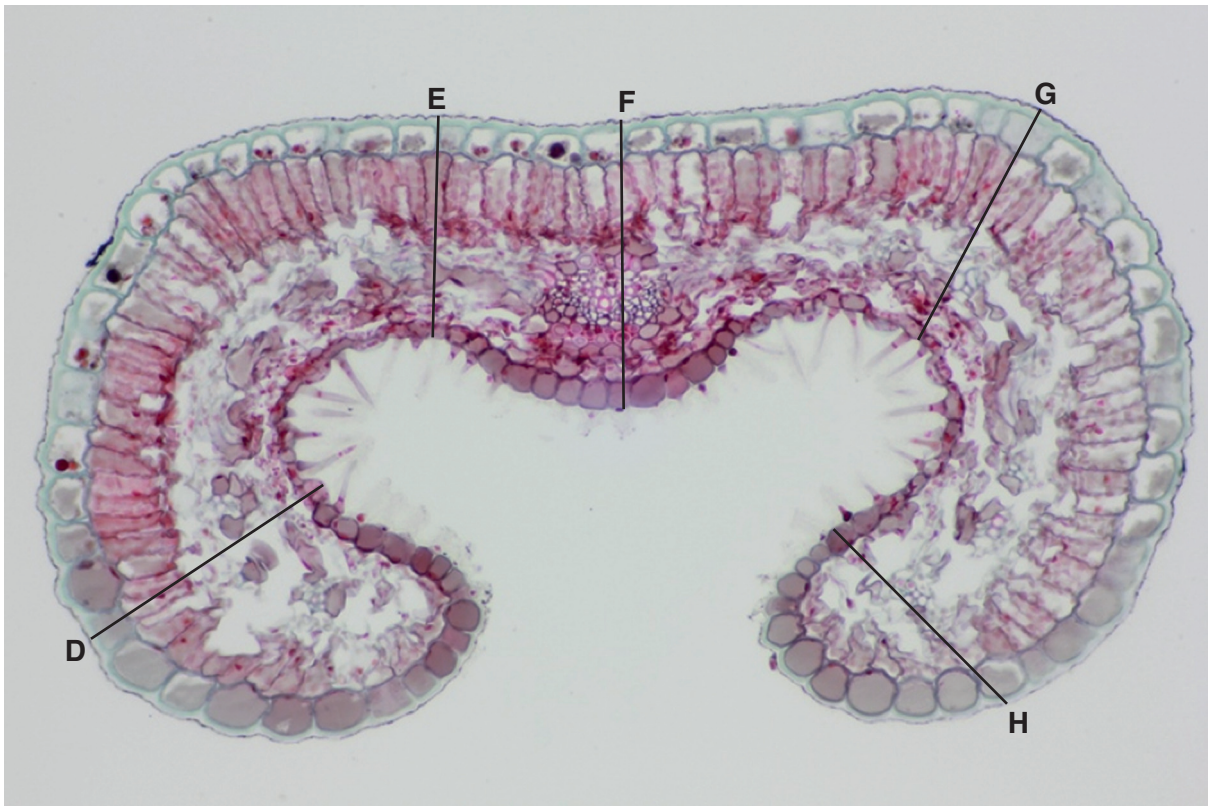
Select one group of **four** adjacent (touching) cells which show some of the differences between these cells.
Each cell of the group must touch at least one of the other cells.

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

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

[6]

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



magnification ×75

Fig. 2.2

(i) Use the magnification and the lines in Fig. 2.2 to find the actual thickness of the leaf, in μm, at the positions labelled **D**, **E**, **F**, **G** and **H**.

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

D …….. μm, **E** …… μm, **F** …….. μm, **G** …… μm, **H** ……. μm [2]

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(ii) Using the actual thicknesses calculated in **(b)(i)**, calculate the **mean** actual thickness of the leaf.

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

mean actual thickness .....[2]

(c) The leaf on slide **L1** and the leaf in Fig 2.2 are adapted to living in dry conditions.

Prepare the space below so that it is suitable for you to record observable differences in xerophytic adaptations between these two specimens.

Record your observations in the space you have prepared.

[3]

[Total: 19]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4948069759

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

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 When plant tissue is soaked in methylene blue solution, the stain enters the tissue and colours it blue.
When the stained plant tissue is placed into ethanol the stain moves out of the cells and is released.

You will investigate the effect of concentration of ethanol (independent variable) on the release of methylene blue solution from pieces of stained plant tissue.

You are required to:

- prepare different concentrations of ethanol, **E**, using simple dilution
- record the colours for the known concentrations of ethanol
- record the colour for an unknown concentration of ethanol, **U**
- use the results to estimate the concentration of ethanol in **U**.

You are provided with:

labelled	contents	hazard	volume/cm^3
E	1.0% ethanol	flammable	40
W	distilled water	none	250
U	unknown concentration of ethanol	flammable	15

labelled	contents	hazard	quantity
P	plant tissue stained with methylene blue	methylene blue solution will stain your skin	3 pieces

You should wear suitable eye protection especially when handling the ethanol.

If any methylene blue solution comes into contact with your skin wash off immediately with water.

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(a) You are required to make concentrations of ethanol using simple dilution of the 1.0% ethanol, **E**, which reduces the concentration by 0.25% between each successive dilution.

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

Table 1.1 shows how to make up two of the concentrations of ethanol you will use.

(i) Complete Table 1.1 by showing as many extra concentrations as you need.

For each concentration state:

- the volume of 1.0% ethanol, **E**, you will use
- the volume of distilled water, **W**, you will use
- the resulting percentage concentration of ethanol.

Table 1.1

volume of 1.0% ethanol, **E** /cm^3	volume of distilled water, **W** /cm^3	percentage concentration of ethanol
10.0	0.0	1.00
0.0	10.0	0.00

[3]

Proceed as follows:

1. Prepare the concentrations of ethanol as shown in Table 1.1 in the beakers provided.
2. Label the test-tubes with the concentrations of ethanol.
3. Put 5 cm^3 of each dilution of ethanol into the labelled test-tubes.
4. Label one test-tube **U** and put 5 cm^3 of **U** into this test-tube.

Always use blunt forceps when handling the plant tissue to avoid contact with the methylene blue solution.

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5. Remove the pieces of plant tissue from the container labelled **P** and put them on the white tile. Cut the ends off each piece of plant tissue.

6. Cut the plant tissue into **equal** lengths of approximately 2 cm.

7. Empty the coloured water from **P** into the container labelled **For Waste**.

8. Put the pieces of plant tissue back into **P** and cover the pieces with tap water from the container labelled **T**.

9. Change the tap water five times to remove excess methylene blue solution, either using a syringe or by pouring off the water into the container labelled **For Waste**.

Fig. 1.1 shows how you will set up the apparatus for each concentration of ethanol.

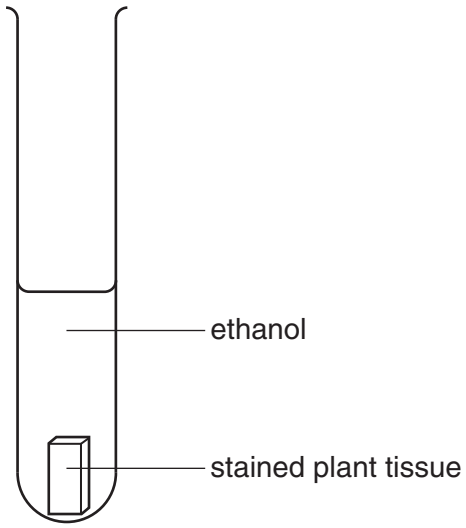


Fig. 1.1

10. Remove the pieces of plant tissue from **P** and put them on a paper towel.

11. Put one piece of plant tissue into each test-tube, including **U** and start timing. Leave for 10 minutes.

    While you are waiting continue with Question 1.

    After 10 minutes you will need to remove the plant tissue from each test-tube so that the colour of each solution can be recorded.

12. After 10 minutes pour the solution **and** the piece of plant tissue from **one** of the test-tubes into the beaker labelled **R**.

13. Put the piece of plant tissue into the container labelled **For waste**. Pour the solution back into the test-tube.

14. Rinse beaker **R** with water from the container labelled **For washing**.

15. Repeat step 12 to step 14 with each of the remaining test-tubes, including **U**.

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16. Arrange the test-tubes in the order of intensity of blue colour from lowest intensity to highest intensity.

17. Observe the colour in the test-tubes and match the intensity of colour in each test-tube to the key shown in Fig. 1.2.
You may observe the same intensity of colour for more than one test-tube.

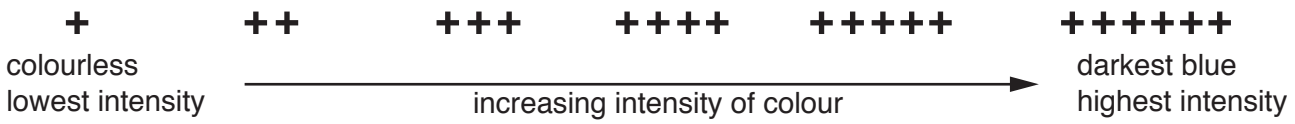


Fig. 1.2

18. Record your results for the known concentrations of ethanol in **(a)(ii)** and record the result for **U** in **(a)(iii)**.

(ii) Prepare the space below and record your results for the known concentrations of ethanol.

[4]

(iii) Record your result for **U** and use this and your results in **(a)(ii)** to estimate the concentration of ethanol in **U.**

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

*estimated concentration of ethanol in **U*** .....[2]

(iv) Explain how the ethanol affected the release of methylene blue from the plant cells.

.....

.....

.....

.....

.....

.....

.....[3]

(v) This procedure investigated the effect of the concentration of ethanol on the release of methylene blue solution from pieces of stained plant tissue.

To modify this procedure for investigating another variable, the independent variable (concentration of ethanol) would need to be standardised.
Describe how the concentration of ethanol could be standardised.

.....

.....

Consider how you would modify this procedure to investigate the effect of **temperature** on the release of methylene blue solution from pieces of stained plant tissue.

Describe how this independent variable, **temperature**, could be investigated.

.....

.....

.....

.....[3]

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Question 1 continues on page 8

(b) A student investigated the effect of placing pieces of tissue from a potato in sucrose solutions of different concentrations. At the start, each sample of potato tissue was weighed and the initial mass was recorded. Then each sample of potato tissue was placed into a different concentration of sucrose solution.

After a set time the potato tissue was removed and the final mass of the potato tissue was recorded.
The percentage change in mass for each sample of potato tissue was calculated.

The results of the student's investigation are shown in Table 1.2. Note: the percentage change in mass is shown to the nearest 0.5%.

Table 1.2

sucrose concentration / mol dm^{-3}	initial mass / g	final mass / g	percentage change in mass
0.0	1.84	2.15	17.0
0.2	1.65	1.80	
0.4	1.43	1.48	3.5
0.6	1.62	1.31	–19.0
0.8	1.43	1.08	–24.5
1.0	1.68	1.19	–29.0

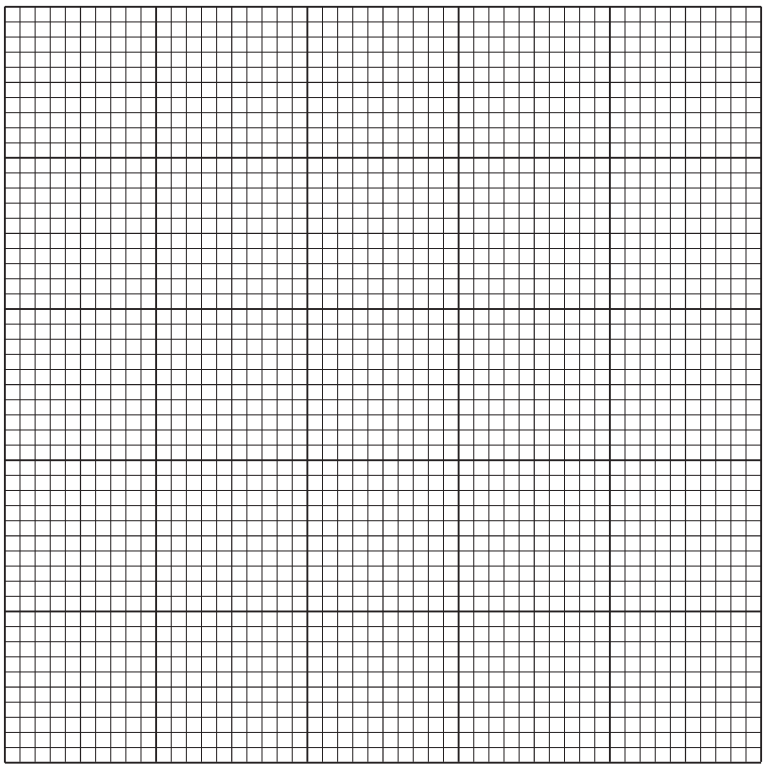
(i) Complete Table 1.2 by calculating the percentage change in mass for the 0.2 mol dm^{-3} sucrose solution.

[1]

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You are required to use a sharp pencil for graphs.

(ii) Plot a graph of the data shown in Table 1.2.



[4]

(iii) Use your graph to estimate the percentage change in mass of the potato tissue for a sucrose concentration of 0.7 mol dm^{-3}.

Show on your graph how you estimated the percentage change in mass.

percentage change in mass .....[2]

[Total: 22]

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

You are not expected to be familiar with this specimen.

You are required to use a sharp pencil for drawings.

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

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

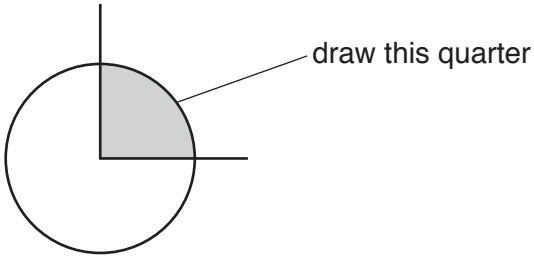


Fig. 2.1

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

[4]

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(ii) Observe the central tissue in the root on **K1**. These cells are not identical.

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

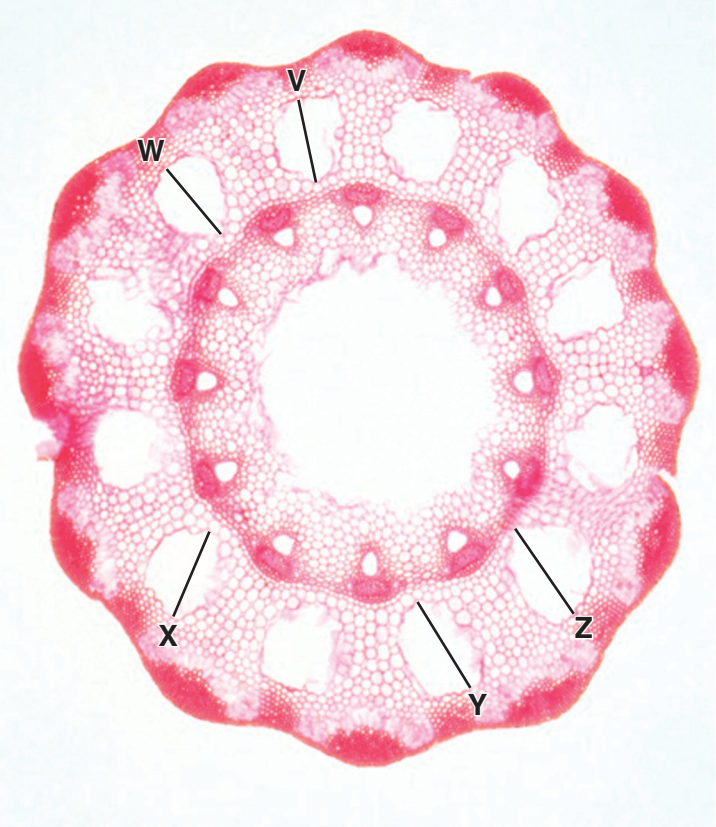
Make a large drawing of this group of **four** cells.

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 through a stem of a different plant.

You are not expected to be familiar with this specimen.



magnification × 36

Fig. 2.2

(i) Use the magnification and the lines in Fig. 2.2 to find the actual diameter, in μm, of the air spaces labelled **V**, **W**, **X**, **Y** and **Z**.

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

V ..... μm, **W** ..... μm, **X** ..... μm, **Y** ..... μm, **Z** ..... μm [3]

(ii) Using the actual diameters calculated in **(b)(i)**, calculate the **mean** actual diameter of an air space.
You may lose marks if you do not show your working or if you do not use appropriate units.

mean actual diameter .....[2]

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(c) Prepare the space below so that it is suitable for you to record the observable differences between the root on **K1** and the stem in Fig. 2.2.

Record your observations in the space you have prepared.

[4]

[Total: 18]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2225442478

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2016**

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 Antibiotics are tested by observing how effective the antibiotics are at killing bacteria or preventing their growth.
Agar blocks can be used to set up a model for antibiotic testing.
In this model an acid represents the antibiotic solution and the blue stain in the agar block represents the bacteria.

You will investigate the effect of the antibiotic solution (independent variable) on 'killing the bacteria', shown by the blue colour changing to yellow as the end-point.

You are required to:
- prepare different concentrations of the antibiotic solution, **A**, using serial dilution
- record the time taken to reach the end-point (yellow) for each of the concentrations of **A**
- record the time taken to reach the end-point for an unknown concentration of antibiotic solution, **U**
- use the results to estimate the concentration of antibiotic in **U**.

You are provided with:

labelled	contents	hazard	volume/cm^3
A	1% acid (antibiotic solution)	irritant	50
W	distilled water	none	100
U	unknown concentration of acid (antibiotic solution)	irritant	30
B	agar block containing a blue stain	none	–

You are advised to wear suitable eye protection, especially when using the antibiotic solution, **A**.
If **A** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard .....

level of risk .....[1]

(b) You are required to make a **serial** dilution of the 1% antibiotic solution, **A**, which reduces the concentration **by half** between each successive dilution.

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

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

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

For each beaker:

- state, under the beaker, the **volume** and **concentration** of the antibiotic solution available for use in the investigation
- use one arrow, with a label above the beaker, to show the **volume** and **concentration** of antibiotic solution added to prepare the concentration
- use another arrow, with a label above the beaker, to show the **volume** of **W** added to prepare the concentration.

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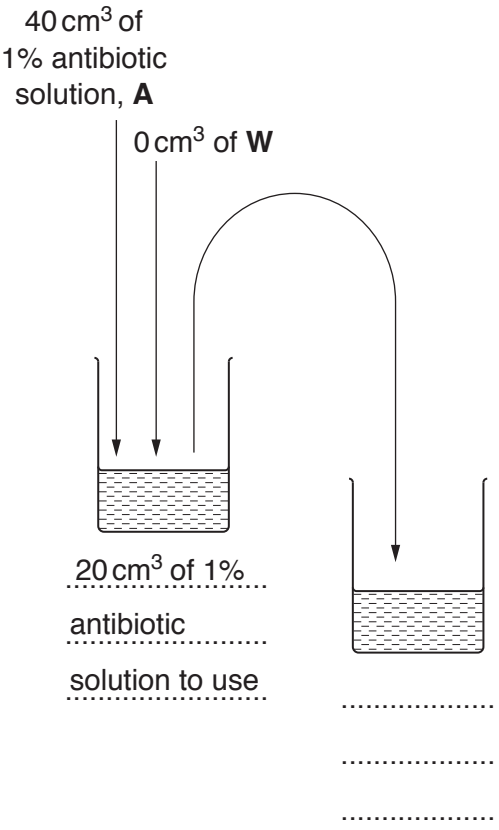

40 cm3 of
1% antibiotic
solution, A
0 cm3 of W
20 cm3 of 1%
antibiotic
solution to use

Fig. 1.1

[3]

Proceed as follows:

1. Prepare the concentrations of antibiotic solution as decided in **(b)(i)** and as shown in Fig. 1.1.

2. Adjust the volumes so that there is 20 cm^3 of antibiotic solution in each beaker.

3. Label a beaker as **U** and put 20 cm^3 of **U** into this beaker.

You will need to cut the agar block, **B**, into smaller pieces as shown in Fig. 1.2.

To avoid staining your skin, try not to touch the agar. You may use the blunt forceps and paper towels to handle the agar.

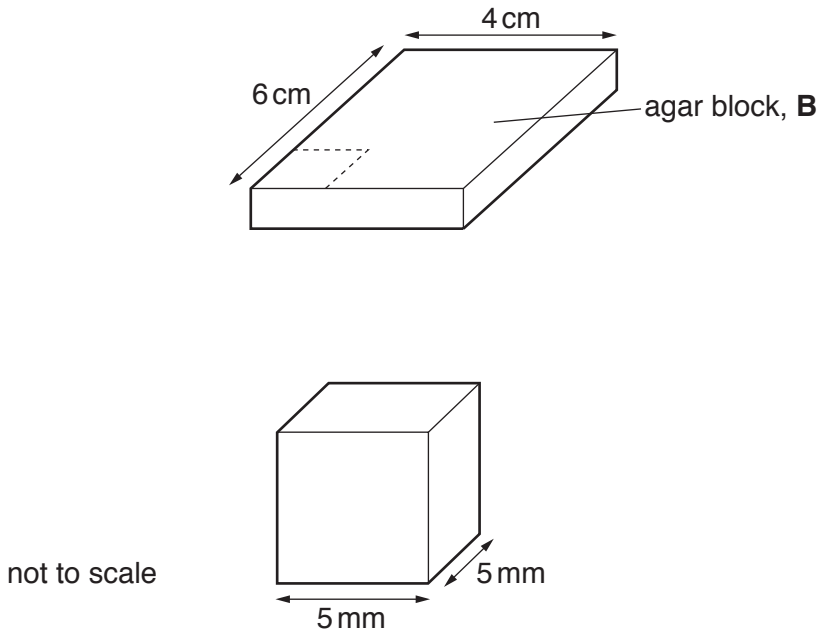


Fig. 1.2

4. Place the agar block, **B**, onto a white tile and cut into identical pieces, each 5 mm × 5 mm as shown in Fig. 1.2. You do not need to adjust the depth.

5. Put one piece of agar into each beaker containing the concentrations prepared in step 1 and start timing.

6. Gently stir the contents of each beaker at intervals.

7. Record in **(b)(ii)** the time taken for the pieces of agar to reach the end-point.

   Note that the colour of the agar may change from blue to green and then to yellow.

   If any piece of agar has not changed to yellow after 240 s, **stop timing** and record as 'more than 240'.

   Note that the same concentrations of antibiotic solution can be used again.

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(ii) Prepare the space below and record your results for the **known** concentrations of antibiotic solution.

[5]

8. Put one piece of agar into the beaker labelled **U** and start timing.

(iii) Record the time taken for the piece of agar in **U** to change to reach the end-point.

time taken ..... [1]

(iv) Use your results in **(b)(ii)** and **(b)(iii)** to estimate the concentration of antibiotic solution in **U**.

.....[1]

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

.....

.....[1]

(vi) This procedure investigated the effect of the concentration of the antibiotic solution (the independent variable) on its diffusion into stained agar blocks.

To modify this procedure for investigating the effect of another independent variable, the concentration of antibiotic solution would need to be standardised.

Describe how the concentration of antibiotic solution could be standardised.

.....

.....

Describe how you would modify this procedure to investigate the effect of the independent variable, **temperature**, on diffusion into stained agar blocks.

.....

.....

.....

.....

.....[3]

(c) In your investigation the antibiotic solution entered the agar blocks by diffusion.

In animals, some substances cross cell surface membranes either by simple diffusion or by facilitated diffusion.

A student investigated the rate of glucose uptake into animal cells.

These animal cells were placed into different concentrations of glucose and the rate of glucose uptake into the cells was measured.

All the other variables were standardised.

The results are shown in Table 1.1.

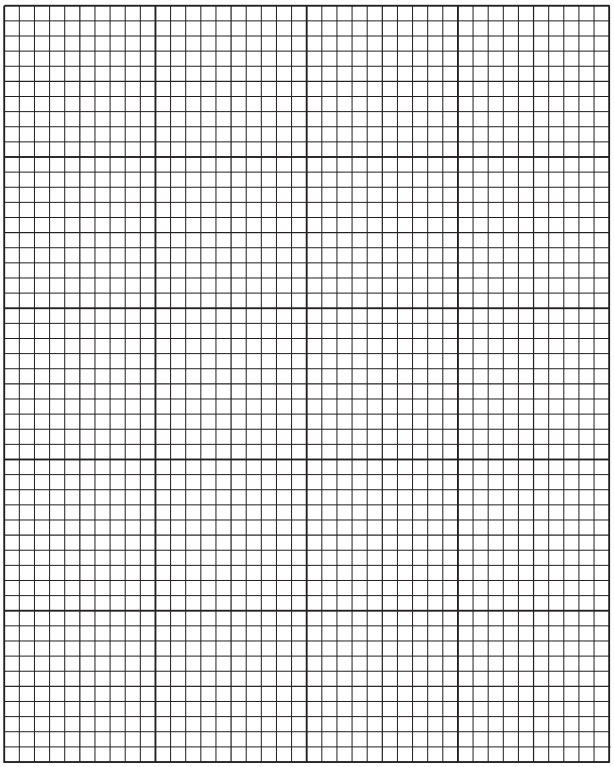
Table 1.1

external concentration of glucose /mmol dm^{-3}	rate of glucose uptake by cells /mmol cm^{-3} h^{-1}
0	0
1	205
3	320
5	395
10	450
20	455

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You are required to use a sharp pencil for graphs.

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



[4]

(ii) Use your graph to estimate the rate of glucose uptake by cells for an external concentration of glucose of 7 mmol dm^{-3}.

Show on your graph how you estimated the rate of glucose uptake.

rate of glucose uptake ..... mmol cm^{-3} h^{-1} [1]

(iii) Using the graph, explain how the results of the investigation support the idea that glucose enters cells by facilitated diffusion.

.....

.....

.....

.....

.....[2]

[Total: 22]

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

You are not expected to be familiar with this specimen.

This leaf has several vascular bundles along its length.

(a) Select the central vascular bundle which is larger than the others.

You are required to use a sharp pencil for drawings.

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

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

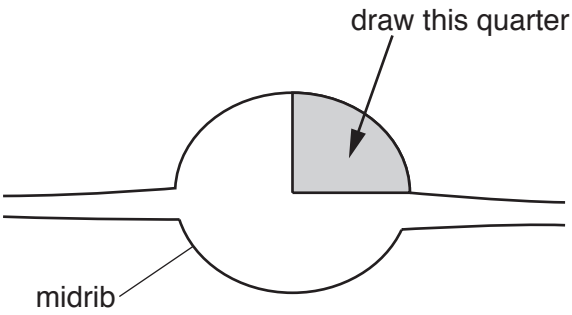


Fig. 2.1

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

[4]

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(ii) Observe the xylem tissue in the vascular bundle of the midrib on **M1**.

Select one group of **four** adjacent (touching) cells in a chain.

Each cell of the chain 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 label to identify the cell wall of **one** cell.

[5]

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

You are not expected to be familiar with this specimen.

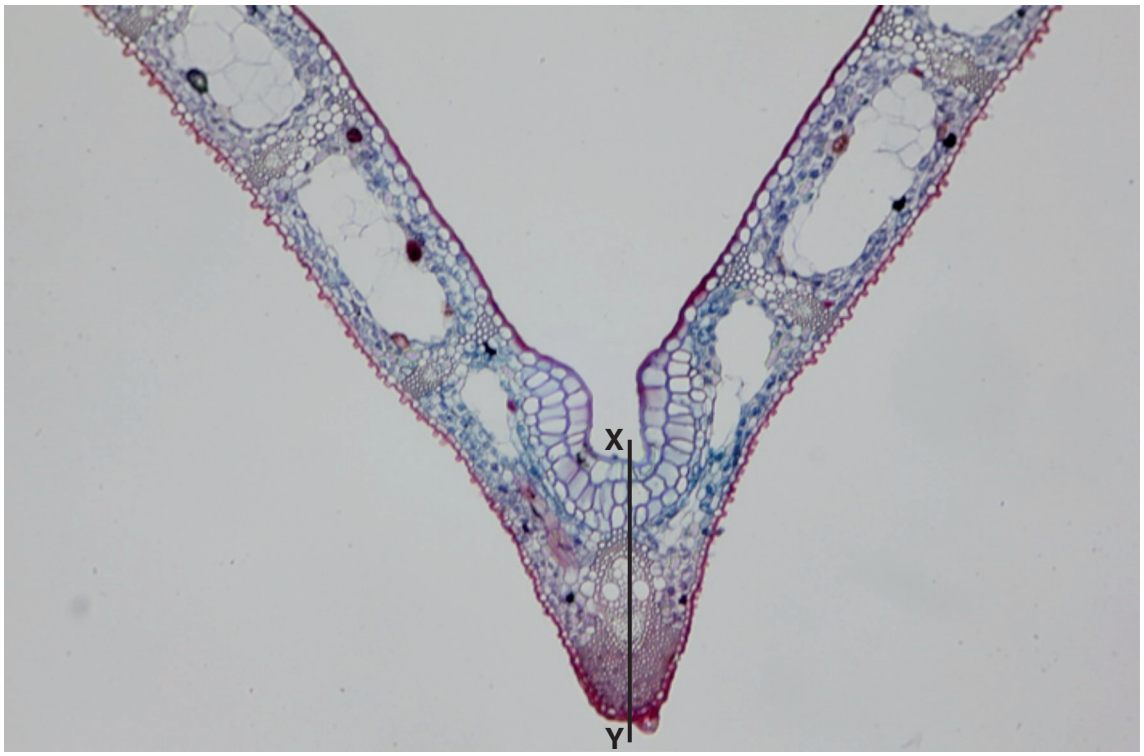


Fig. 2.2

(i) Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the length of the vascular bundle.

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

simplest ratio ..... [4]

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(ii) Suggest **one** observable feature, shown in Fig. 2.2, which supports the conclusion that this plant may grow in an aquatic habitat.

.....

.....[1]

(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf midrib on **M1** and the leaf midrib in Fig. 2.2.

Record your observations in the space you have prepared.

[4]

[Total: 18]

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