Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4769128693

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 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 Some plant cells contain vitamin C (ascorbic acid), which has many functions for maintaining human health.
To find the best source of vitamin C may require estimating its concentration in plant extracts.

You are required to estimate the concentration of vitamin C in a solution of plant extract, **X**, using the indicator DCPIP.

DCPIP (blue) reacts with vitamin C in a sample and becomes colourless. The end-point is when the DCPIP remains blue, so all the vitamin C has reacted with DCPIP.

The greater the volume of DCPIP added to reach the end-point, the higher the concentration of vitamin C in the sample.

You are required to:

- prepare different concentrations of vitamin C solution, **V**, using a serial dilution of a 0.05% solution of **V**
- record the volume of DCPIP required to reach the end-point for each of the concentrations of **V**.

You are provided with:

labelled	contents	hazard	volume/cm^3
V	0.05% vitamin C solution	none	50
W	distilled water	none	100
X	unknown concentration of vitamin C in a plant extract	none	20
DCPIP	indicator	none	50

It is recommended that you wear suitable eye protection.

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[Turn over

(a) You are required to prepare a **serial** dilution of the 0.05% vitamin C solution, **V**, which reduces the concentration of **V** by **half** between each successive dilution.

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

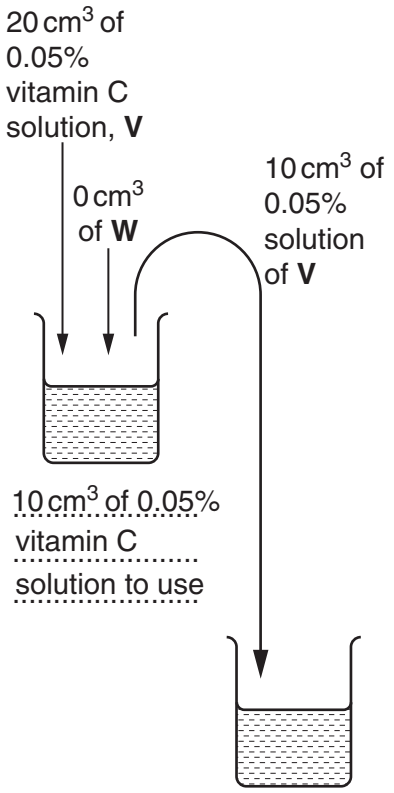
Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

(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 solution available for use in the investigation
- use one arrow, with a label above the beaker, to show the **volume** and **concentration** of vitamin C 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 0.05% vitamin C solution, V
0 cm3 of W
10 cm3 of 0.05% solution of V
10 cm3 of 0.05% vitamin C solution to use

.....

.....

.....

[3]

Fig. 1.1

Proceed as follows:

1. Prepare the concentrations of vitamin C solution as decided in **(a)(i)** and Fig. 1.1.

You are required to find the volume of DCPIP needed to reach the end-point for each of the concentrations of vitamin C solution prepared in **(a)(i)**.

2. Put 3 cm^3 of the lowest concentration of vitamin C solution into a test-tube.

3. Put 5 cm^3 of DCPIP into the syringe, labelled **D**.

4. Wipe off any drops of DCPIP from the outside of the syringe with a paper towel.

5. Hold the syringe over the test-tube and push the plunger gently to release one or two drops of DCPIP as shown in Fig. 1.2.

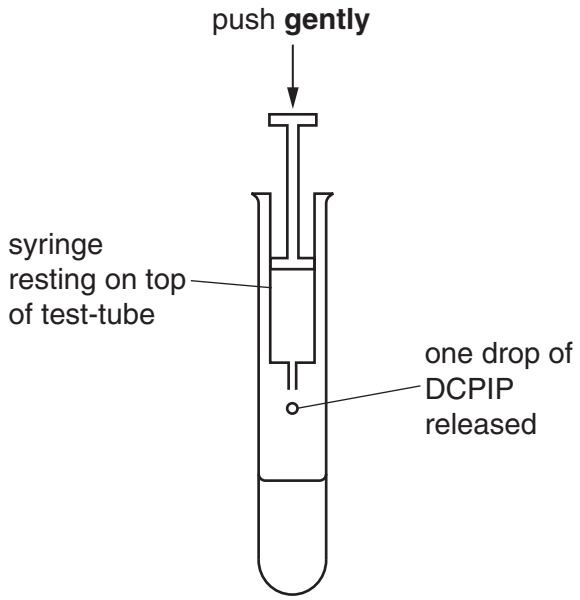


Fig. 1.2

6. Shake the test-tube to mix the contents.

7. Repeat step 5 and step 6 until the blue colour remains (does not disappear). This is the end-point.

8. Record in **(a)(ii)** the volume of DCPIP needed to reach the end-point.

   If the colour does not remain blue after adding 5 cm^3 of DCPIP, stop putting in DCPIP and record as 'more than 5'.

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9. Repeat step 2 to step 8 for each of the concentrations of vitamin C solution that you prepared in step 1.

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

[4]

(iii) Describe **one** significant source of error when carrying out steps 3 to 9.

.....

.....[1]

You are now required to estimate the concentration of vitamin C in a sample of plant extract, **X**, using DCPIP.

10. Repeat step 2 to step 8 with **X**. Record in **(a)(iv)** the volume of DCPIP needed to reach the end-point.

(iv) State the volume of DCPIP needed to reach the end-point for **X**. ..... cm^3 [1]

(v) Use your results in **(a)(ii)** and **(a)(iv)** to estimate the concentration of vitamin C in **X**.

.....[1]

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[Turn over

(vi) Describe how you could use this procedure to produce a more accurate estimate of the concentration of vitamin C in the sample of plant extract **X** than the one given in **(a)(v)**.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Vitamin C is important in the human diet. It is essential for the growth and repair of tissues in the body.
Some vegetables contain vitamin C and can be eaten either uncooked (raw) or cooked.
A scientist carried out an investigation to determine the effect of heating on the vitamin C content of selected vegetables. The scientist measured the vitamin C content in 100 g of each food sample when raw and after boiling for 10 minutes.

All other variables were kept constant.

The results are shown in Table 1.1.

Table 1.1

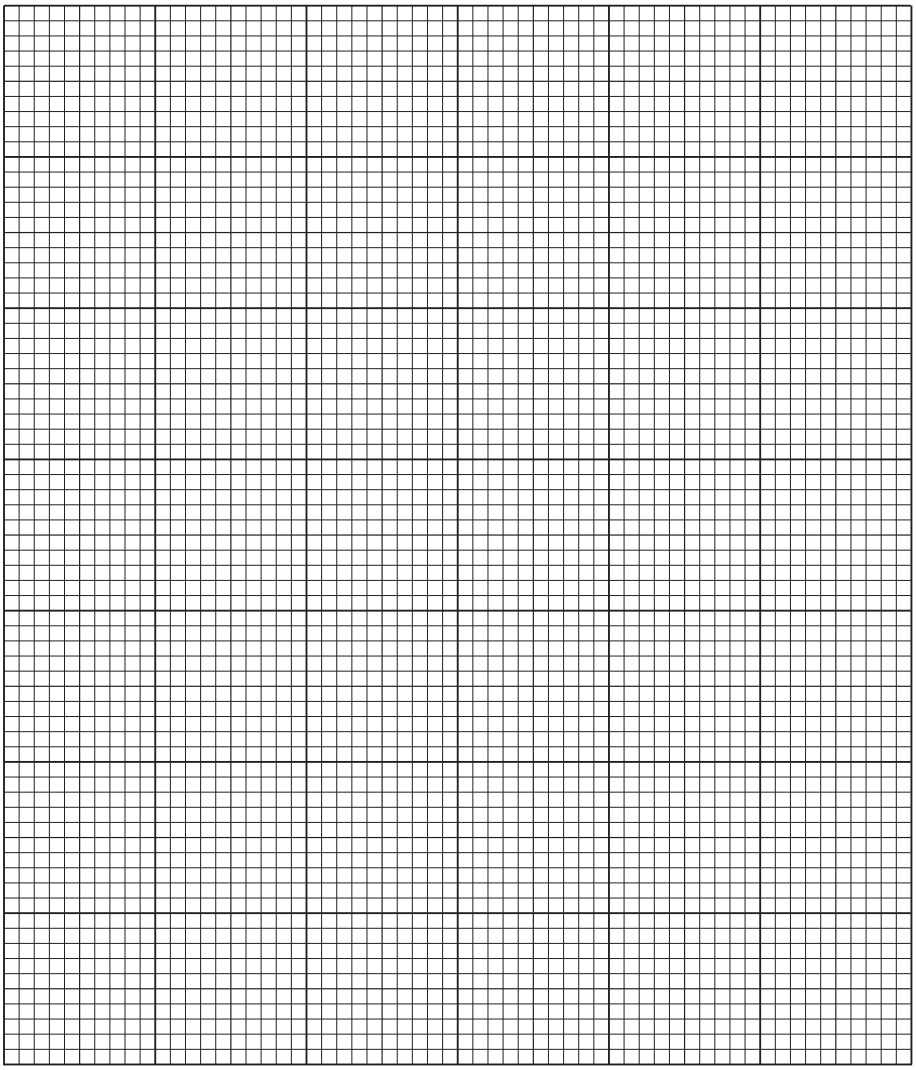
	vitamin C content /mg per 100 g	
vegetable	**raw**	**after boiling**
kale (K)	48	45
broccoli (B)	79	44
red pepper (R)	126	89

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Use a sharp pencil for charts.

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

Each pair of bars should be separated for each type of vegetable.



[4]

(ii) Calculate the percentage loss of vitamin C in broccoli as a result of boiling.

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

percentage loss = ...[2]

(iii) In raw vegetables vitamin C is contained within the cells of the tissues.
Suggest how boiling causes the loss of vitamin C in broccoli.

.....

.....

.....

.....

.....[2]

[Total: 21]

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

You are not expected to be familiar with this specimen.

(a) Observe the different tissues on **J1** and select a field of view that shows part of the epidermis and the vascular bundles.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram from the selected field of view which shows:

- part of the epidermis
- only **two** smaller outer vascular bundles
- only **one** larger inner vascular bundle
- any other observable tissues.

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

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

[5]

(ii) Observe the cells of the epidermis on **J1**.

Select one group of **four** adjacent (touching) cells in the epidermis. Do **not** select guard cells in the epidermis. Each cell must touch at least one of the other cells.

Use the eyepiece graticule in the microscope to measure, as shown in Fig. 2.1:
- the total length of the four cells, **L**
- the depth of one of the cells, **T**.

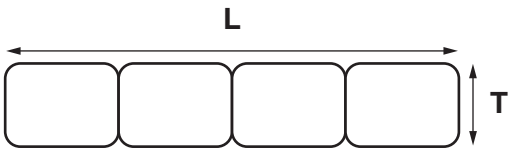


Fig. 2.1 (not drawn to scale)

L = …… eyepiece graticule units

T = …… eyepiece graticule units

[2]

(iii) Use the measurements from **(a)(ii)** to help you make a large drawing of this group of **four** cells on **J1**.

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

[5]

(iv) Suggest **one** observable feature of **J1** which supports the conclusion that this plant exchanges gases through its stem.

.....

.....

.....[1]

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

You are not expected to be familiar with this specimen.

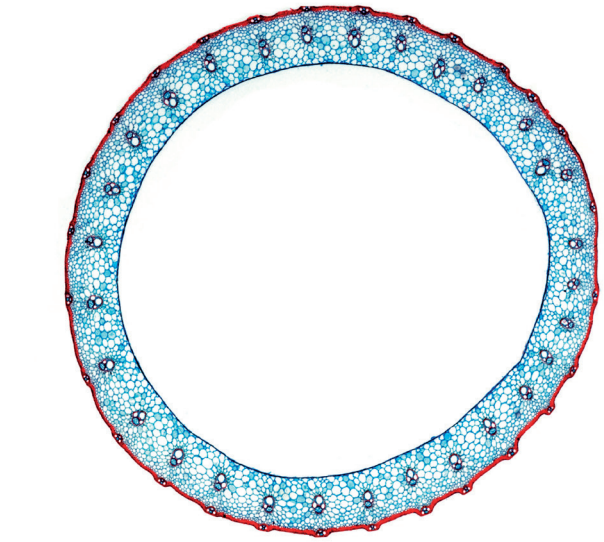


Fig. 2.2

(b) Calculate the magnification of Fig. 2.2 using the scale bar.

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

magnification × …….. [3]

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(c) Annotate Fig. 2.2 to describe **three** observable differences between the stem sections in Fig. 2.2 and on **J1** by:

- drawing label lines to **three** features in Fig. 2.2 that show these differences
- describing next to each line how each feature is different from the specimen **J1**.

[3]

[Total: 19]

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CENTRE NUMBER

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9873561300

BIOLOGY **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2017**

2 hours

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1 The enzyme, **E**, catalyses the reaction of urea with water to form ammonium carbonate.

Aqueous ammonium carbonate produces ammonium ions forming an alkaline solution. This solution causes red litmus paper to change to blue.

The end-point of the reaction is when **all of the surface** of the red litmus paper is blue.

Molecule **S** may affect the activity of the enzyme, **E**.

You are required to:

- prepare a serial dilution of a 0.3% solution of **S**
- prepare a control to show that the results for this investigation are due to the effects of **S**
- record the time taken to reach the end-point for each of the concentrations of **S** and the control.

You are provided with:

labelled	contents	hazard	volume/cm^3
S	0.3% solution of **S**	none	25
W	distilled water	none	100
U	10% urea solution	none	100
E	enzyme solution	harmful irritant	30

labelled	contents	hazard	quantity
R	red litmus paper	none	2 strips

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

It is recommended that you wear suitable eye protection.

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[Turn over

(a) You are required to prepare a **serial** dilution of the 0.3% solution of **S** which reduces the concentration by a **factor of 10** between each successive dilution.

You will need to prepare 9 cm^3 of each concentration.

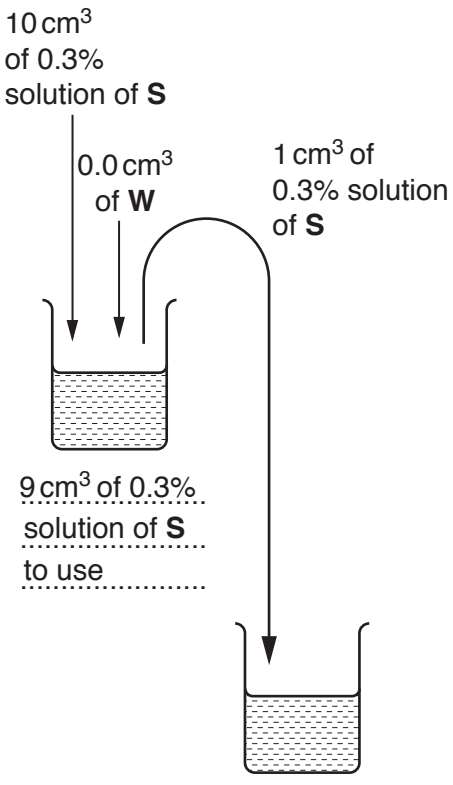
Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

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

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10 cm3 of 0.3% solution of S
0.0 cm3 of W
1 cm3 of 0.3% solution of S
9 cm3 of 0.3% solution of S to use

.....

.....

.....

[3]

Fig. 1.1

Proceed as follows:

1. Prepare the concentrations of molecule **S**, as decided in **(a)(i)**, in the containers provided.

   *Note: syringe labelled **S** should be used for solutions of **S only**.*

   You are required to set up a control to show that the results for this investigation are due to the effects of molecule **S**.
   The control uses water, **W**, instead of molecule **S**.

2. Label one test-tube **W** for the control and label as many test-tubes as you require for all the concentrations of molecule **S** prepared in step 1.

3. Put one piece of red litmus paper, approximately 0.5 cm in length, into the bottom of each test-tube.

4. Put 10 cm^3 of **U** into each test-tube.

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

*The reaction will start when **E** is added in step 6.*

6. Put 2 cm^3 of **E** into the test-tube labelled **W**. Shake gently to mix.

7. Start timing and record the time taken for **all of the surface** of the red litmus paper to change to blue (the end-point).
   Shake the test-tube during this time to mix the contents.
   If the piece of red litmus paper does not reach the end-point after 240 seconds (4 minutes), stop the experiment and record 'more than 240'.

   Record your result in **(a)(ii)**.

   You are now required to investigate the effect of different concentrations of molecule **S** on the activity of the enzyme, **E**.

8. Put 1 cm^3 of the **lowest** concentration of molecule **S** into the appropriately labelled test-tube. Shake gently to mix.

9. Repeat step 6 and step 7 with the appropriately labelled test-tube.

10. Repeat with all the other concentrations of molecule **S**. Record your results in **(a)(ii)**.

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(ii) Prepare the space below and record your results for:

- **W**, the control
- all the concentrations of molecule **S**.

[5]

(iii) Using your knowledge of enzymes, suggest how molecule **S** may have reduced the activity of the enzyme.

.....

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.....

.....

.....[3]

This procedure could be used to estimate the concentration of molecule **S** in an unknown solution, **X**.

You are provided with:

labelled	contents	hazard	volume/cm^3
X	solution with unknown concentration of molecule **S**	none	20

11. Repeat step 3 to step 7, using 1 cm^3 of solution **X** instead of 1 cm^3 of **W**. Record the time taken to reach the end-point in **(a)(iv)**.

(iv) State the time taken to reach the end-point for solution **X**. ..... s [1]

(v) Use your results in **(a)(ii)** and **(a)(iv)** to estimate the concentration of molecule **S** in solution **X**.

.....[1]

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

.....

.....

.....[1]

(vii) Describe how you could use this procedure to produce a more accurate estimate of the concentration of molecule **S** in solution **X** than the one given in **(a)(v)**.

.....

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.....

.....[3]

(b) Scientists studied the effect of mercury entering water where fish and other organisms were living. It was thought that the mercury may have been taken up by these organisms.

The scientists investigated the mercury concentration in tissue samples from five different organisms living in the contaminated water. The concentration of mercury was measured in parts per million (ppm).

The results are shown in Table 1.1.

Table 1.1

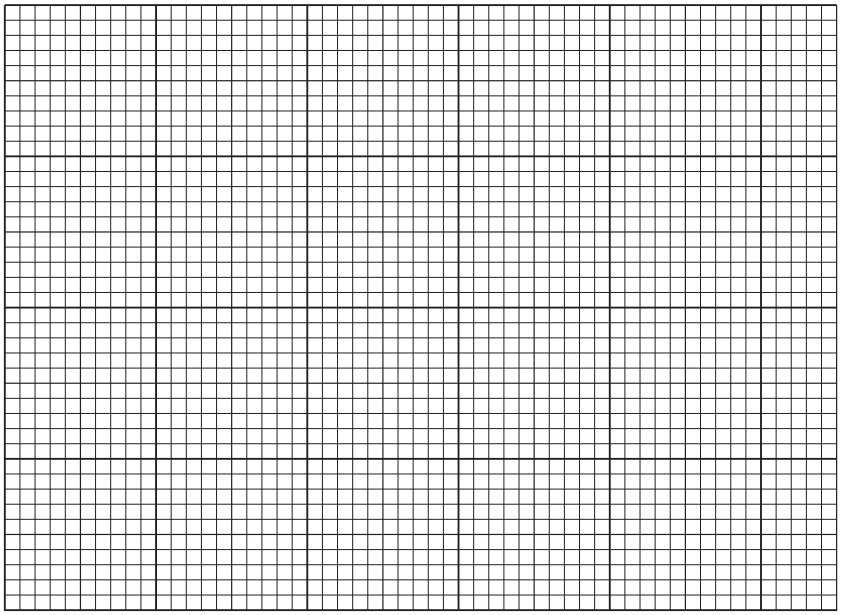
organism	**mercury concentration in tissue samples /ppm**
china fish (F)	24.0
clam (C)	20.0
crab (B)	35.5
oyster (O)	5.5
red mullet (R)	10.5

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Use a sharp pencil for charts.

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

The bars should be separated for each type of organism.



[4]

(ii) A scientist wanted to compare the mercury concentration in the contaminated water with the mean mercury concentration of the five organisms.

Calculate the mean mercury concentration in the five organisms.

answer = ... ppm [1]

[Total: 22]

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

You are not expected to be familiar with this specimen.

(a) Observe the different tissues on **M1** and select a field of view that shows part of the epidermis and the vascular bundles.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram from the selected field of view which shows:

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

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

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

[5]

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(ii) Observe the central tissue in the stem on **M1**. 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. 2.1 is a photomicrograph of a stained transverse section through a stem of a different type of plant.

You are not expected to be familiar with this specimen.

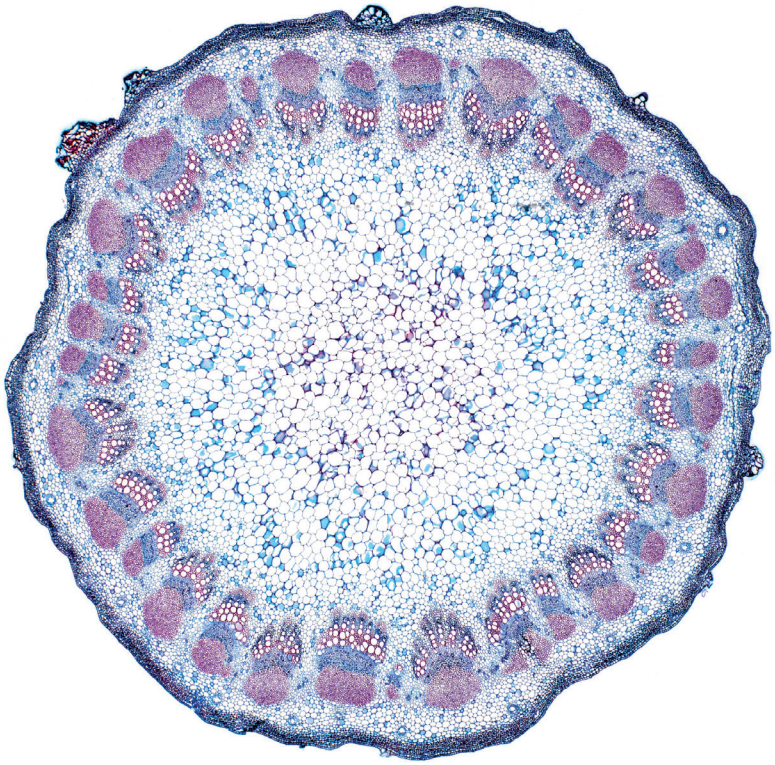


Fig. 2.1

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(i) Prepare the space below so that it is suitable for you to record the observable differences between the stem on **M1** and the stem in Fig. 2.1.

Record your observations in the space you have prepared.

[4]

Fig. 2.2 is a photomicrograph of a stained transverse section through a vascular bundle from Fig. 2.1.
A grid has been placed over the photomicrograph to help you answer **(b)(ii)** and **(b)(iii)**.

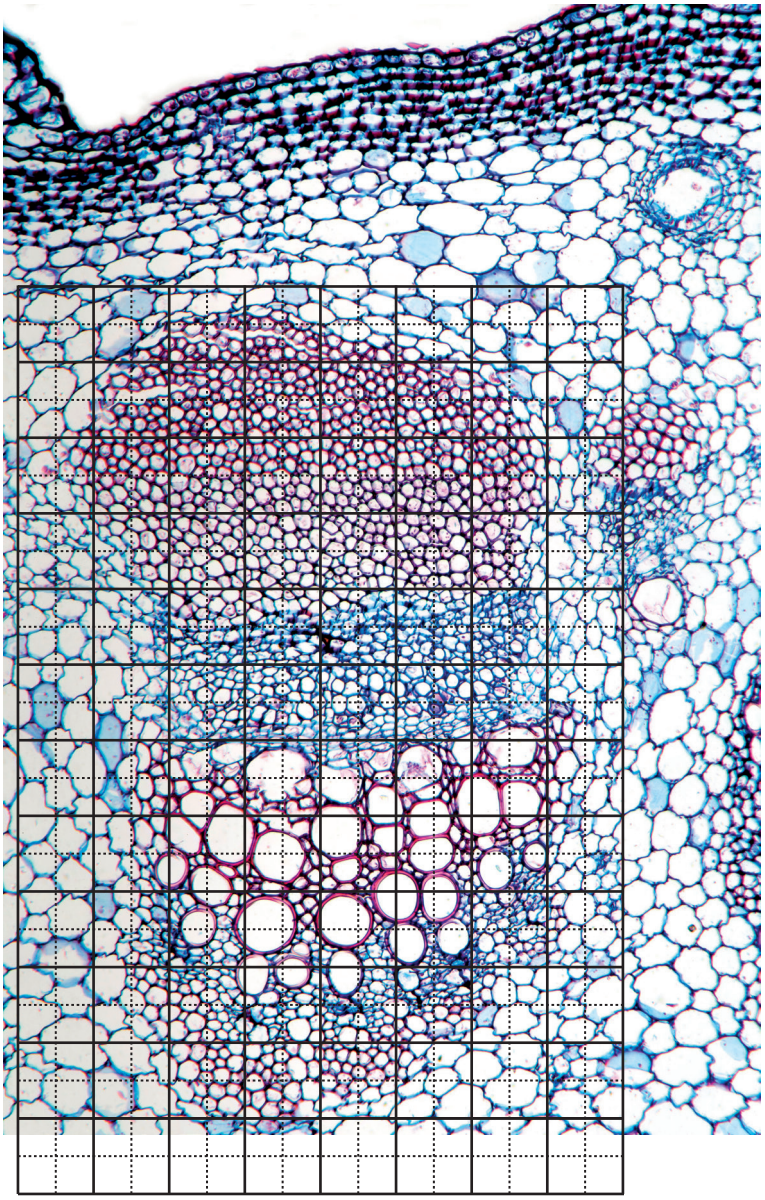


Fig. 2.2

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(ii) You are required to find the area of the xylem tissue and the area of the vascular bundle.

- Draw on Fig. 2.2 an outline around the xylem tissue.
- Draw on Fig. 2.2 an outline around the vascular bundle.
- Count the number of 1 cm × 1 cm squares within each outline.
  Count any 'half square' or 'more than half square' as one square.
  Do **not** count any square that is 'less than half a square'.
- Show on your grid all of the 1 cm × 1 cm squares that you have counted.

State the area of the xylem tissue **and** the area of the vascular bundle.

area of xylem tissue .....

area of vascular bundle .....
[2]

(iii) Calculate the area of the xylem tissue as a percentage of the area of the vascular bundle.

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

answer = ... % [2]

[Total: 18]

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

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1 When a person eats food containing starch, the enzyme amylase is released to hydrolyse (break down) the starch into reducing sugar.

As the food passes from the mouth to the stomach and then to the small intestine, amylase is released in the mouth and in the small intestine but is not released in the stomach.

(a) Fig. 1.1 shows a sketch of the changes in the concentration of the biological molecule, starch, as it enters the mouth and passes to the small intestine.

Sketch **another** line on the graph to show the changes in the concentration of **reducing sugar** as the starch enters the mouth and passes to the small intestine.

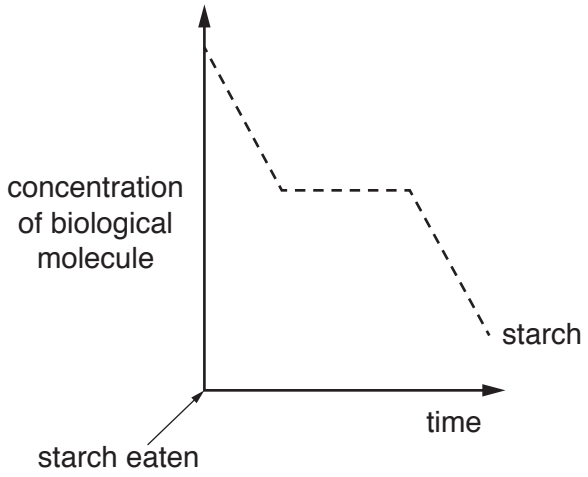


Fig. 1.1 [2]

(b) You are provided with four samples, **S1**, **S2**, **S3** and **S4**.

One of these samples contains starch suspension which a person is about to eat.

The other three represent samples taken from:

- the mouth 2 minutes after being eaten
- the stomach 10 minutes after being eaten
- the small intestine 2 hours (120 minutes) after being eaten.

You are required to identify the samples **S1**, **S2**, **S3** and **S4** by testing the samples for starch and for reducing sugar, using only the apparatus and reagents provided.

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You are provided with:

labelled	contents	hazard	volume/cm^3
Benedict's	Benedict's solution	irritant	50
iodine	iodine solution	stains	30

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

You will need to think about how you will carry out the tests so that you can determine the relative concentrations of the starch and reducing sugar.

(i) Decide how you will test each solution to show the relative concentration of starch present.

State the reagent you will use ..... .

Describe how you will carry out the test for starch.

.....

.....

State what you will record.

.....

Describe how you will determine which solution has the **highest concentration** of starch present.

.....
[2]

(ii) Decide how you will test each solution to show the relative concentration of reducing sugar present. You may measure the time taken to the first colour change.

State the reagent you will use ..... .

When testing for reducing sugar the volume of the reagent should be equal to or more than the volume of the sample.

Describe how you will carry out the test to measure the reducing sugar concentration.

.....

.....

.....

State how you will determine which solution has the **highest concentration** of reducing sugar present.

.....
[3]

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[Turn over

1. Carry out the test for starch and the test for reducing sugar on each of the solutions, **S1**, **S2**, **S3** and **S4**.

   If the time taken to the first colour change for the reducing sugar test is longer than 180 seconds then record 'more than 180'.

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

[5]

(iv) Using your results in **(b)(iii) and** using the information on page 2, complete Table 1.1 to show the identification of the samples, **S1**, **S2**, **S3** and **S4**.

Table 1.1

sample	identification of sample
contains starch suspension which a person is about to eat	
from the mouth 2 minutes after being eaten	
from the stomach 10 minutes after being eaten	
from the small intestine 2 hours (120 minutes) after being eaten	

[2]

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(v) Explain how you decided which sample was taken from the small intestine.

.....

.....

.....[1]

(c) A student wanted to obtain a **quantitative** estimate of the reducing sugar concentration in a sample.

Describe **how** the student could obtain a quantitative estimate of the concentration of reducing sugar in a sample.

.....

.....

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.....

.....

.....

.....

.....[3]

[Total: 18]

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[Turn over

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 the eyepiece graticule to measure across the root
- use these measurements to calculate the length of the cortex as a percentage of the diameter of the root
- draw a plan diagram of half of the root.

(a) The eyepiece graticule in the microscope can be used to measure different tissues.

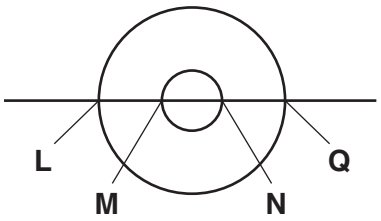


Fig. 2.1

(i) Use the eyepiece graticule in the microscope to measure across the diameter of the root as shown in Fig. 2.1:

L to **Q** = ... eyepiece graticule units

L to **M** = ... eyepiece graticule units

M to **N** = ... eyepiece graticule units

N to **Q** = ... eyepiece graticule units.

[3]

(ii) Use the measurements from **(a)(i)** to state:

the length across the diameter of the root (**L** to **Q**) ..... eyepiece graticule units

the length of cortex across the diameter ..... eyepiece graticule units

Calculate the length of cortex as a percentage of the diameter of the root.

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

answer = ...% [3]

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Use a sharp pencil for drawing.

(iii) Use the measurements from **(a)(i)** to help you draw a large plan diagram of **half of the root** on **K1**, shown by the shaded area in Fig. 2.2.

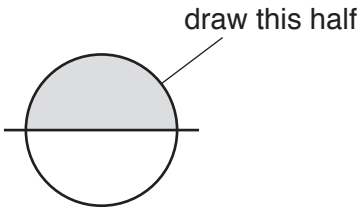


Fig. 2.2

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

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

[5]

(iv) 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) The xylem vessel elements transport water and minerals from the roots to the leaves. This transport depends on the negative pressure in the xylem being greater than the force of gravity.

Scientists measured the xylem pressure at different heights in a tree. This was repeated for a number of trees of the same species.

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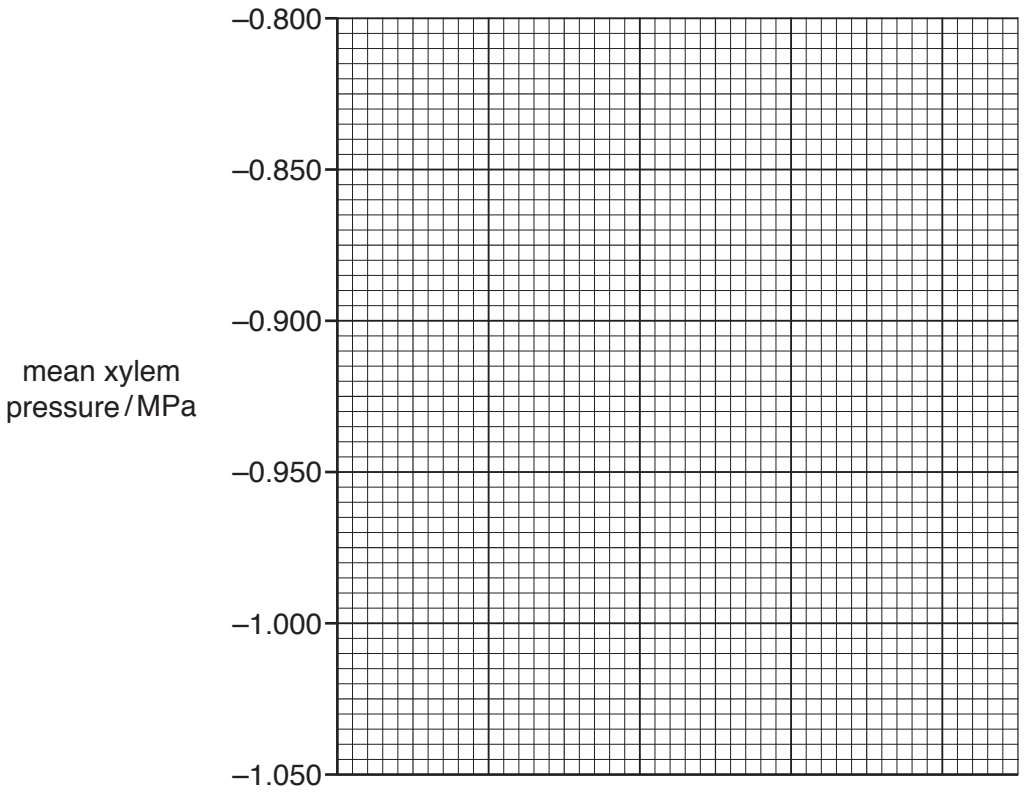
The scientist's mean results are shown in Table 2.1.

Table 2.1

height/m	mean xylem pressure /MPa
50.5	–0.800
62.5	–0.875
74.0	–0.950
82.0	–1.000
89.5	–1.045

Use a sharp pencil for graphs.

(i) Complete **and** plot the graph of the data shown in Table 2.1.



[4]

(ii) Explain, using your knowledge of adhesion and cohesion, how water is transported through the xylem vessel elements in a tree with transpiring leaves.

.....

.....

.....

.....

.....[2]

[Total: 22]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5906213048

BIOLOGY **9700/34**

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

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

Plan the use of the **two hours** to make sure that you finish 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 plants contain types of molecules which can be useful, for example in an industrial process.

To find the best source of one of these molecules may require estimating the concentration of a useful molecule in plant extracts.

You are required to estimate the concentration of molecule **M** in a sample of plant extract, **U**.

Molecule **M** changes the colour of potassium manganate(VII) solution, **K**, from pink to colourless.

The rate of the colour change depends on the concentration of molecule **M** in the sample. The greater the concentration of molecule **M**, the faster the end-point is reached.

You are required to:

- prepare a simple dilution of a 10% solution of molecule **M**, labelled **10M**
- record the time taken for the pink colour of **K** to change to the end-point for each of the concentrations of molecule **M**.

You are provided with:

labelled	contents	hazard	volume/cm^3
10M	10% solution of molecule **M**	none	100
W	distilled water	none	100
U	unknown concentration of molecule **M** in a plant extract	none	40
A	sulfuric acid	harmful irritant	20
K	potassium manganate(VII) solution	none	20

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

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(a) You are required to make simple dilutions of the **10M** solution which reduce the concentration between each successive dilution.

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

(i) Table 1.1 shows how to make up one of the concentrations of molecule **M** you will use.

Decide which concentrations of molecule **M** to prepare using simple dilutions of the **10M** solution.

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

Table 1.1

volume of **10M** / cm^3	volume of distilled water, **W** / cm^3	percentage concentration of molecule **M**
10	0	10

[3]

Proceed as follows:

1. Prepare the concentrations of molecule **M** as shown in Table 1.1.
2. Put 1 cm^3 of **A** into a test-tube.
3. Put 1 cm^3 of **K** into the same test-tube and mix well.
4. Put 1 cm^3 of **10M** into the same test-tube and mix well. Start timing.
5. Record the time taken to reach the end-point in **(a)(ii)**.

   If the end-point is not reached in 4 minutes (240 seconds) record 'more than 240' **and** record the colour of the solution.
6. Repeat step 2 to step 5 for each of the concentrations of molecule **M** prepared in step 1.

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

[5]

You are now required to estimate the concentration of molecule **M** in a sample of plant extract, **U**.

7. Repeat step 2 to step 4 with **U**. Record the time taken to reach the end-point in **(a)(iii)**.

(iii) State the time taken to reach the end-point for sample **U**. ..... [1]

(iv) Use your results in **(a)(ii)** and **(a)(iii)** to estimate the concentration of molecule **M** in sample **U**.

concentration = ... [1]

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(v) Describe how you could use this procedure to produce a more accurate estimate of the concentration of molecule **M** in the sample of plant extract **U** than the one given in **(a)(iv)**.

.....

.....

.....

.....

.....

.....

..... [3]

(b) A student suggested that molecule **M** might act as an antibiotic.

In order to test this suggestion the student carried out the following investigation:

- bacteria were spread over the surface of a strip of agar gel containing nutrients
- bacteria were allowed to grow, shown by the shaded area in Fig. 1.1
- small drops ($2\,\mu m^3$) of different concentrations of molecule **M** were put onto the surface of the agar gel strip
- after 24 hours, the inhibition area (where the bacteria were no longer observed) was measured for each concentration of molecule **M**.

Fig. 1.1 shows a diagram of the strip of agar gel after 24 hours. This is not to scale.

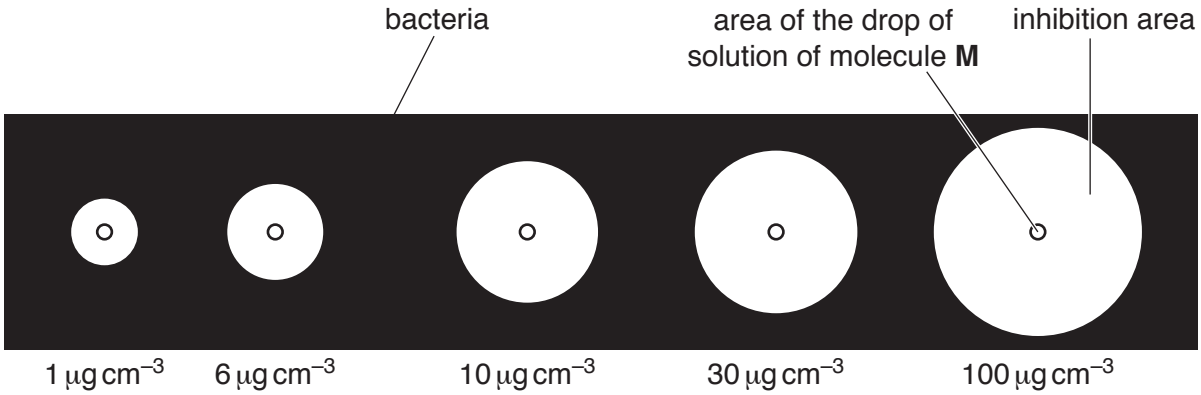


Fig. 1.1

The results are shown in Table 1.2.

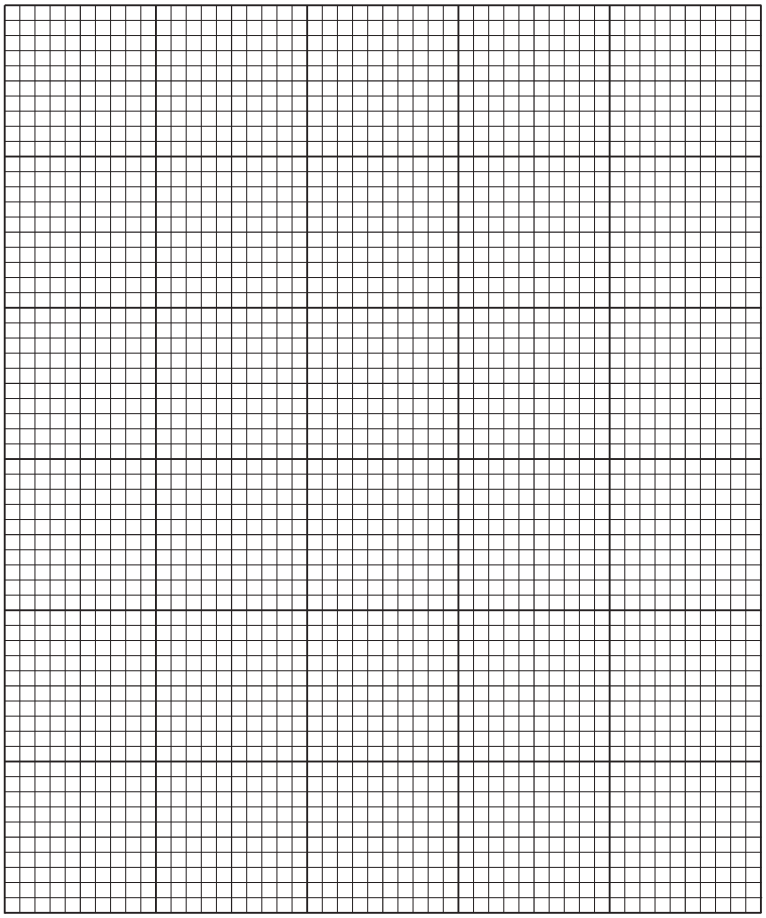
Table 1.2

concentration of solution of molecule M / $\mu g\,cm^{-3}$	inhibition area / mm^2
0	0
1	30
6	50
10	70
30	106
100	120

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Use a sharp pencil for graphs.

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



[4]

(ii) Use your graph to estimate the inhibition area for a concentration of molecule **M** of $46\,\mu g\,cm^{-3}$.

inhibition area = ... [1]

(iii) Explain how the data support the statement that molecule **M** might act as an antibiotic.

.....

.....

..... [1]

(iv) Suggest how molecule **M** may act as an antibiotic.

.....

.....

.....

.....

..... [2]

[Total: 21]

Question 2 starts on page 10

2 **N1** 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 the eyepiece graticule to measure depths of different tissues across the leaf
- use these measurements to find the simplest ratio of the depth of the leaf to the depth of the palisade layer
- draw a plan diagram of part of the leaf.

(a) Select a part of the leaf on **N1** which shows the four tissue layers **L** (**L1** and **L2**), **P** and **Q**.

Do **not** include a vascular bundle.

(i) Use the eyepiece graticule in the microscope to measure:
- the depth of the whole leaf, **T**
- the depth of each of the tissues, **L** (**L1** and **L2**), **P** and **Q**, as shown in Fig. 2.1.

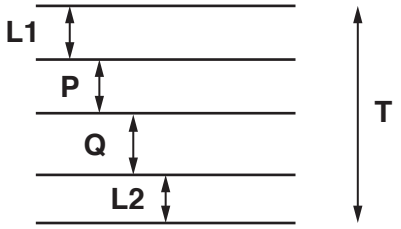


Fig. 2.1 (not drawn to scale)

T = ……. eyepiece graticule units

L1 = ……. eyepiece graticule units

P = ……. eyepiece graticule units

Q = ……. eyepiece graticule units

L2 = ……. eyepiece graticule units

[3]

(ii) Use the measurements from **(a)(i)** to determine the simplest ratio of the depth of the leaf (**T**) to the depth of the palisade layer.

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

simplest ratio ..... [3]

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Use a sharp pencil for drawing.

(iii) Use the measurements from **(a)(i)** to help you draw a large plan diagram of the part of the leaf on **N1**, as shown by the shaded area in Fig. 2.2.

This must include at least **one** vascular bundle.

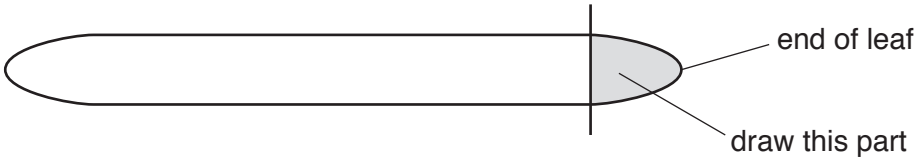


Fig. 2.2

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

Use **one** ruled label line and label to identify the palisade layer.

[5]

(iv) Observe the cells of the epidermis at the end of the leaf on **N1** as shown in Fig. 2.2. 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 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. 2.3 is a photomicrograph of a stained transverse section through a different type of leaf.

You are not expected to be familiar with this specimen.



Fig. 2.3

Annotate Fig. 2.3 to describe **three** observable differences between the leaf sections in Fig. 2.3 and on **N1** by:

- drawing label lines to **three** features in Fig. 2.3 that show these differences
- describing next to each line how each feature is different from the specimen **N1**. [3]

[Total: 19]

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CENTRE NUMBER

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 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 The enzyme amylase, **E**, hydrolyses (breaks down) starch, to a reducing sugar.
You are required to investigate how much reducing sugar diffuses from a mixture of starch and amylase through a partially permeable wall of Visking tubing.

You are provided with:

labelled	contents	hazard	volume /cm^3
E	2.0% amylase solution	irritant	20
S	1.0% starch suspension	none	20
W	distilled water	none	150

labelled	contents	hazard	details	quantity
V	Visking tubing	none	15 cm length in distilled water	1

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

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

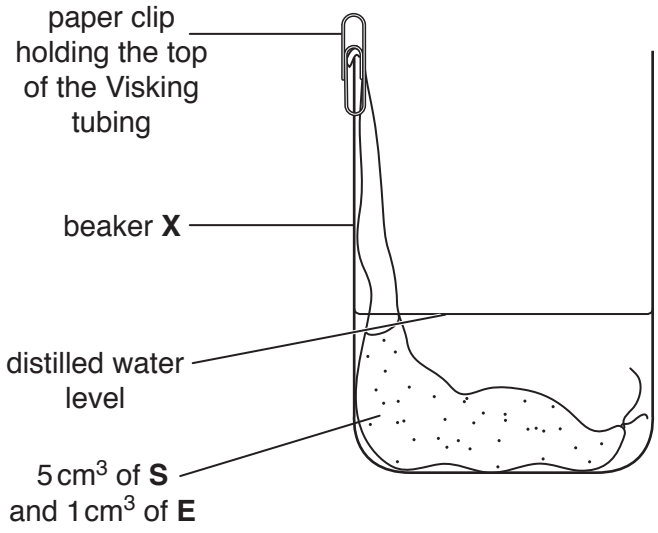


Fig. 1.1

Proceed as follows:

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

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

3. Put 5 cm^3 of **S** into the Visking tubing.

4. Put 1 cm^3 of **E** into the Visking tubing.

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

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 the mixture is on the bottom of the beaker.

6. Put the Visking tubing into the beaker, labelled **X**, as shown in Fig. 1.1.

7. 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**.

(a) (i) State the volume of **W** needed to reach the water level as shown in Fig. 1.1.

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

8. Leave the apparatus for 20 minutes.

While you are waiting, continue with Question 1.

9. After 20 minutes, remove the Visking tubing and put it into the container labelled '**For waste**'.

You are required to:

- prepare a serial dilution of the 1.0% reducing sugar solution, **R**
- carry out the Benedict's test for the known concentrations of reducing sugar and the water surrounding the Visking tubing
- use the results to estimate the concentration of reducing sugar in the water surrounding the Visking tubing.

You are provided with:

labelled	contents	hazard	volume / cm^3
W	distilled water	none	150
R	1.0% reducing sugar solution	none	25
Benedict's	Benedict's solution	irritant	30

It is recommended that you wear suitable eye protection.

If **Benedict's** comes into contact with your skin, wash it off immediately with cold water.

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(ii) You are required to make a **serial** dilution of the 1.0% reducing sugar solution, **R**, which reduces the concentration of **R** by **half** between each successive dilution.

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

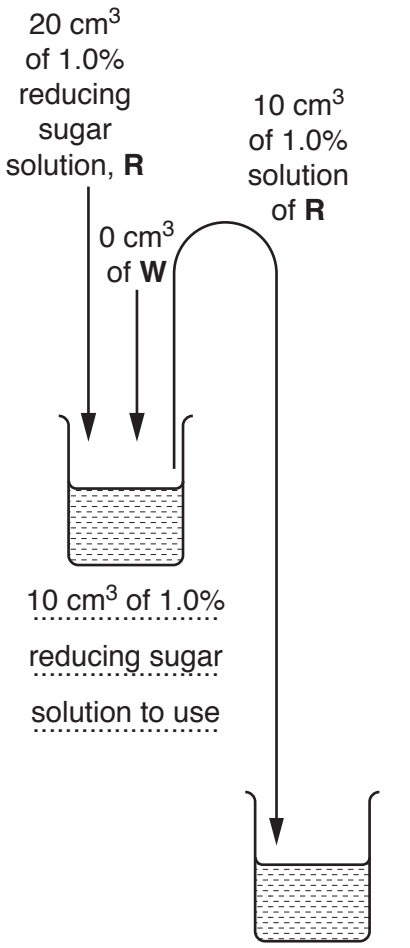
Fig. 1.2 shows the first two beakers you will use to make your serial dilution.

Complete Fig. 1.2 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the **concentration** and the **volume** of the solution available for use in this investigation
- use one arrow, with a label above the beaker, to show the **concentration** and **volume** of the 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 1.0% reducing sugar solution, R
10 cm3 of 1.0% solution of R
0 cm3 of W
10 cm3 of 1.0% reducing sugar solution to use

.....

.....

.....

[3]

Fig. 1.2

10. Set up a boiling water-bath ready for step 12.

11. Prepare the concentrations of reducing sugar solution, as decided in **(a)(ii)**, in the containers provided.

12. Carry out the Benedict's test on each of the concentrations of reducing sugar solution and record your results in **(a)(iii)**.

    You will need to use 2 cm^3 of each of the concentrations of reducing sugar solution with 2 cm^3 of Benedict's solution.

13. Test each solution separately and record in **(a)(iii)** the time taken for the first appearance of any colour change. If there is no colour change after 180 seconds record as 'more than 180'.

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

[5]

(iv) Describe **one** significant source of error when carrying out steps 12 and 13.

.....

.....

.....[1]

Before proceeding, check that you have carried out step 9 on page 3.

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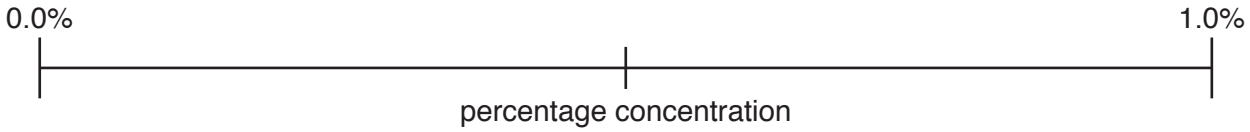
14. Carry out the Benedict's test on a sample taken from beaker **X** (sample **X**) and record the time taken for the first colour change to appear.

(v) State the time taken for the first colour change for sample **X**.

time taken = ... [1]

(vi) Complete Fig. 1.3 to show:

- the positions of each of the percentage concentrations of reducing sugar solution
- an estimate of the concentration of reducing sugar in the sample **X**, using a letter **X**.



[2]

Fig. 1.3

(vii) Describe how you could use this procedure to produce a more accurate estimate of the concentration of reducing sugar in the sample **X** than the one given in **(a)(vi)**.
Do **not** include the use of a colorimeter in your answer.

.....

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.....[3]

(b) A scientist investigated the effect of temperature (independent variable) on the activity of the enzyme in the Visking tubing.

All other variables were kept constant.

The quantity of reducing sugar diffusing through the wall of the Visking tubing was measured by a dye in the surrounding solution. The dye reacted with the reducing sugar. The more reducing sugar present the more intense the colour.

A colorimeter was used to measure the absorbance of light by the coloured solution. The absorbance of light by pure water is 0.00 arbitrary units.

The results are shown in Table 1.1.

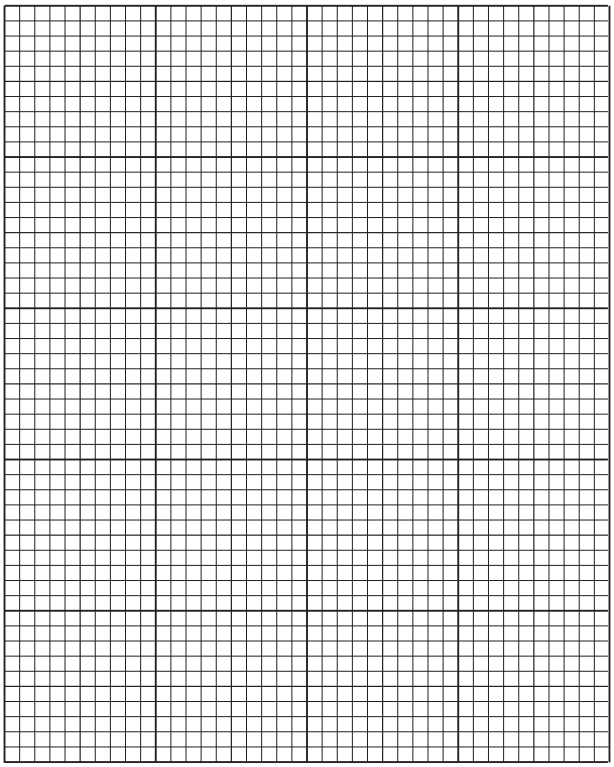
Table 1.1

temperature /°C	**absorbance of light by the coloured solution /arbitrary units**
30	0.90
41	1.46
49	1.58
59	1.10
70	0.65

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Use a sharp pencil for graphs.

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



[4]

(ii) Explain the difference in the absorbance of light between 49 °C and 70 °C.

.....

.....

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.....

.....

.....[3]

[Total: 23]

2 **L1** 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 the eyepiece graticule to measure part of a leaf and a vascular bundle
- use these measurements to calculate the depth of the vascular bundle as a percentage of the depth of the leaf
- draw a plan diagram of part of the leaf.

(a) The eyepiece graticule in the microscope can be used to measure different tissues.
Select a part of the leaf on **L1** which shows the widest part of the leaf (mid-rib) shown by **Y** in Fig. 2.1.

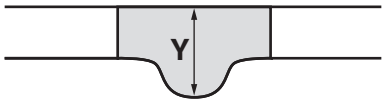


Fig. 2.1

(i) Use the eyepiece graticule in the microscope to measure:

- the depth of the leaf at **Y**
- the depth of the vascular bundle at **Y**.

depth of leaf ..... eyepiece graticule units

depth of vascular bundle ..... eyepiece graticule units [1]

(ii) Use the measurements from **(a)(i)** to calculate the depth of the vascular bundle as a percentage of the depth of the leaf.

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

answer = ...% [2]

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Use a sharp pencil for drawing.

(iii) Use the measurements from **(a)(i)** to help you draw a large plan diagram of the section of the leaf shown by the shaded area in Fig. 2.2.

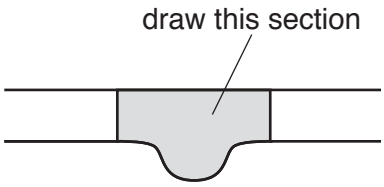


Fig. 2.2

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

Use **one** ruled label line and label to identify the vascular bundle.

[5]

(iv) Observe the vascular bundle in the central part of the leaf on **L1**.
Select one group of **four** adjacent (touching) xylem vessel elements. Each element must touch at least one of the other elements.

Make a large drawing of this group of **four** xylem vessel elements.

Use **one** ruled label line and label to identify the lumen of **one** xylem vessel element.

[5]

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(b) Fig. 2.3 is a photomicrograph of a stained transverse section through a different type of leaf.

You are not expected to be familiar with this specimen.

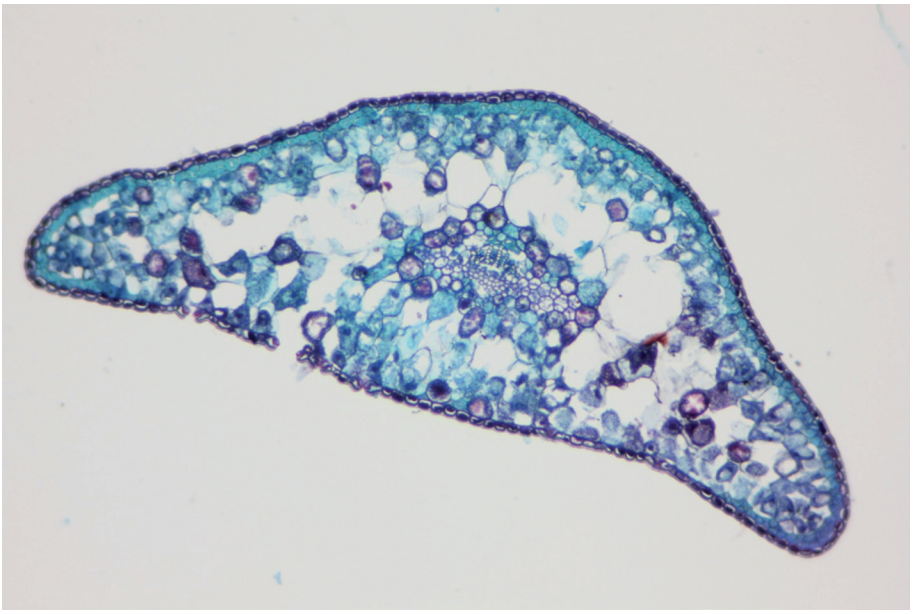


Fig. 2.3

Prepare the space below so that it is suitable for you to record the observable differences between the leaf sections on **L1** and in Fig. 2.3.

Record your observations in the space you have prepared.

[4]

[Total: 17]

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