Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

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4531585503

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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Answer **all** questions.

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

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

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

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

1 Yeast cells contain enzymes which catalyse the breakdown of glucose to produce ethanol and carbon dioxide. This process is used to make beer. After the beer has been made, the yeast is no longer needed and is removed.

The yeast cells are removed by allowing the cells to sink slowly to the bottom of the container, forming a sediment. This process is called sedimentation.

You will need to follow the progress of sedimentation of yeast cells in a test-tube. You will need to measure the height of the sediment at different times, for a total of 10 minutes.

You will use a graph paper scale to measure the sediment.

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

(i) Decide what you would expect the contents of the test-tube to look like after 10 minutes of sedimentation.

Draw on test-tube **B** in Fig. 1.1:

- the layers that you expect to see after 10 minutes of sedimentation
- label lines and labels for the layers.

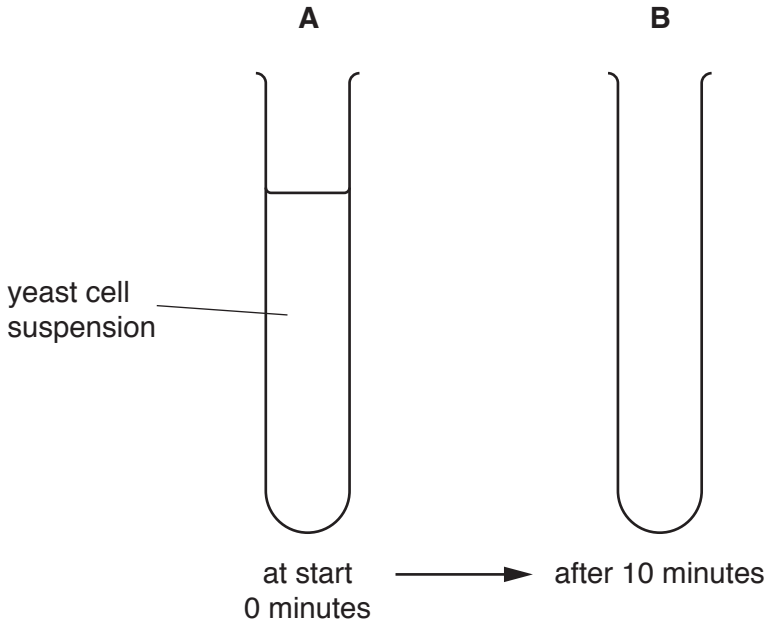


Fig. 1.1

[2]

(ii) Describe how you will use the graph paper scale to measure the sediment.
You may draw on test-tube **B** to help you with your answer.

.....

.....

..... [1]

(iii) Decide how often you will take these measurements, including measuring the sediment at 10 minutes.

State the times you will use for measuring the sediment.

..... [1]

There are molecules on the surface of yeast cells which cause the yeast cells to stick together.

The more cells that stick together, the faster the rate of sedimentation. This process may be affected by the pH of the yeast cell suspension.

You will need to:

- investigate the effect of the independent variable, pH, on the sedimentation of a yeast cell suspension
- use the results to estimate the pH of buffer **BU**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast cell suspension	none	50
B3	buffer pH3	none	25
B4	buffer pH4	none	25
B5	buffer pH5	none	25
B6	buffer pH6	none	25
BU	buffer (pH unknown)	none	25
C	calcium chloride solution	irritant	25

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

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[Turn over

Read step 1 to step 9 before proceeding.

1. Put 7 cm^3 of **B3** into a test-tube.
2. Put 1 cm^3 of **C** into the same test-tube.
3. Stir **Y** in the beaker, then put 7 cm^3 of **Y** into the same test-tube.
4. Repeat step 1 to step 3 for **B4**, **B5**, **B6** and **BU**.
5. Put a bung into one of the test-tubes and invert the test-tube three times to mix the contents.
6. Repeat step 5 for all the other test-tubes.
7. Immediately start timing.
8. At your selected times, as stated in **(a)(iii)**, measure the sediment in each test-tube, as you described in **(a)(ii)**. Do not disturb the contents of the test-tubes.
9. Record your results for **B3**, **B4**, **B5** and **B6** in **(a)(iv)** and record the results for **BU** in **(a)(v)**.

(iv) Record your results for **B3**, **B4**, **B5** and **B6** in an appropriate table.

[5]

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(v) Complete Table 1.2 by recording your results for **BU**.

Table 1.2

time / minutes		10
height of sediment / mm		

Use your results in **(a)(iv)** and **(a)(v)** at 10 minutes to estimate the pH for **BU**.

estimated pH of **BU** = ... [2]

(vi) Suggest how to modify this procedure to obtain a more accurate estimate of the pH for **BU**.

.....

.....

.....

..... [2]

(vii) Suggest an explanation for the effect of pH on the sedimentation of yeast cells.

.....

.....

..... [1]

(viii) Identify **one** significant source of error in this investigation.
Explain why this is a source of error.

source of error .....

explanation .....

.....
[1]

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[Turn over

(b) At the end of beer making, the yeast is no longer needed and is separated from the beer by sedimentation.
The progress of sedimentation can be monitored by removing samples of beer at intervals over a period of 30 hours and counting the number of yeast cells remaining in the beer, as shown in Table 1.3.

Table 1.3

time / hours	number of yeast cells / arbitrary units cm^{-3}
0	1180
10	720
20	250
25	190
30	180

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

Use a sharp pencil for drawing graphs.

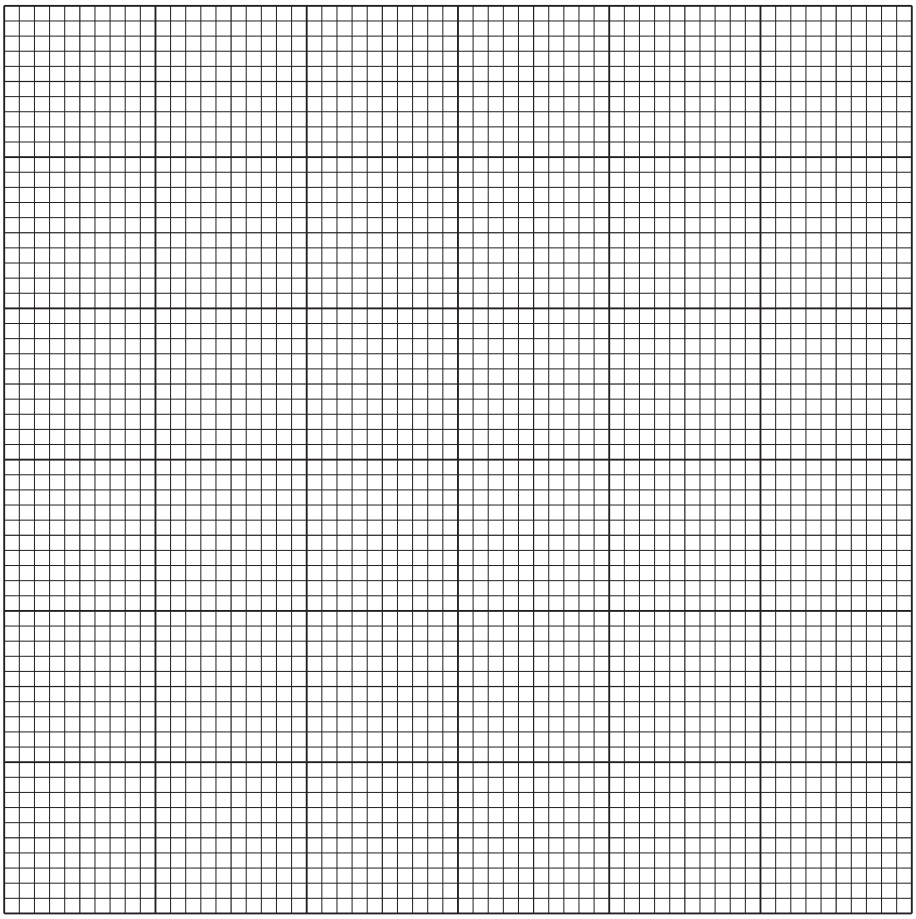


Fig. 1.2

[4]

(ii) Use your graph to find the number of yeast cells at 18 hours.

Show **on the graph** how you determined your answer.

number of yeast cells ..... arbitrary units cm^{-3} [2]

[Total: 21]

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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 all the different tissues in the stem on **J1**.

(i) Draw a large plan diagram of a quarter of the stem on **J1**, shown by the shaded area in Fig. 2.1.
Use **one** ruled label line and label to identify the xylem.

Use a sharp pencil for drawing.

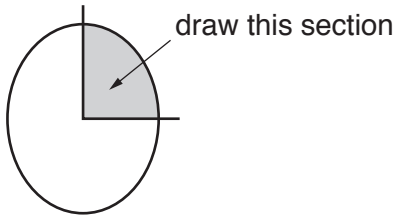


Fig. 2.1

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

[5]

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(ii) Observe the tissues close to the epidermis of the stem on **J1**.
Near to the epidermis there are cells which are larger than any other cells in the stem.

Select **one** group of **four** adjacent, touching cells that make up this tissue.
Each cell must touch at least two of the other cells.

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

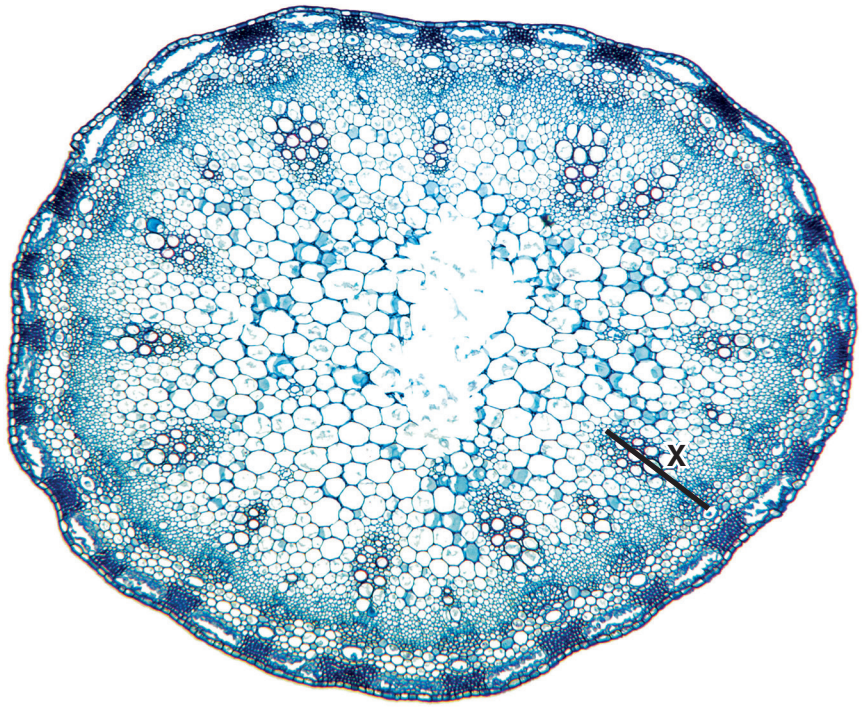
Use **one** ruled label line and label to identify the cell wall of **one** cell.

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

[5]

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

You are not expected to be familiar with this specimen.



magnification ×13

Fig. 2.2

(b) (i) Use the magnification on Fig. 2.2 to calculate the actual length, in μm, of line **X** (length of a vascular bundle).

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

actual length of **X** = ... μm [4]

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(ii) A student used a light microscope to observe a slide of the section shown in Fig. 2.2.

State how the student would use an eyepiece graticule scale to measure the actual length of a vascular bundle.

.....

.....

..... [1]

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

Record your observations in the space you have prepared.

[4]

[Total: 19]

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

A cylinder of potato tissue will have these enzymes on the surface.
When hydrogen peroxide solution and a cylinder of potato tissue are mixed, oxygen bubbles are released.

You will need to investigate the effect of surface area by:

- changing the surface area
- counting the number of bubbles of oxygen released in a set time (dependent variable).

You are provided with the materials shown in Table 1.1 and Table 1.2.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	hydrogen peroxide solution	moderate	40
W	water	none	100

If any of **H** comes into contact with your skin, wash off immediately under cold water.
It is recommended that you wear suitable eye protection and gloves.

Table 1.2

labelled	contents	details	quantity
P	potato cylinders	same cross-sectional area	4

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(a) To investigate the effect of surface area, other variables need to be standardised.

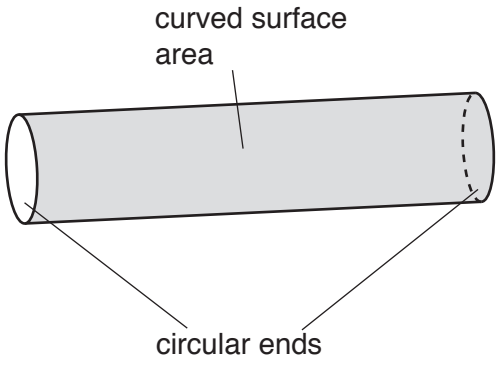
Each potato cylinder has been provided with the same diameter but with **different** lengths.

Each cylinder of potato tissue must be cut to the **same** length.

1. Cut each of the four potato cylinders in the beaker labelled **P**, to a length of 20 mm.

To investigate the effect of surface area, the surface area can be changed by cutting each of these four cylinders into a different number of pieces.

The formula for calculating the total surface area of a cylinder is shown in Fig. 1.1.



Total surface area of a cylinder = curved surface area + surface area of all the circular ends.

Fig. 1.1

The curved surface area of a cylinder can be calculated by using the formula:

$$\text{curved surface area} = 2\pi rl$$

$\pi = 3.14$
r = radius of cylinder
l = length of cylinder

All the cylinders start with the same length (20 mm) and have the same radius, so the curved surface area is standard.

The total curved surface area is the same for all four cylinders, even when a cylinder is cut into several pieces, as shown in the example on page 4.

To change the total surface area, each cylinder is cut into a different number of pieces.

The change in surface area depends on the number of the circular ends, n.

$$\text{surface area of all the ends} = \pi r^2 n$$

EXAMPLE
One cylinder has 2 circular ends as shown in Fig. 1.2.

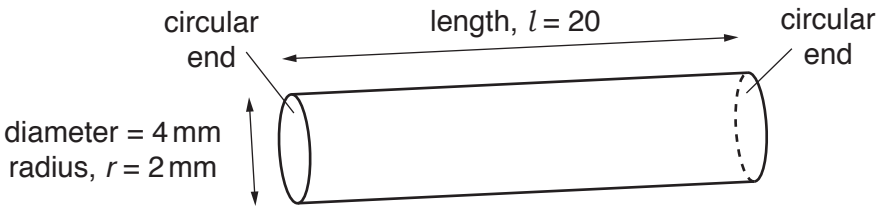


Fig. 1.2

- number of circular ends, $n = 2$
- area of one circular end = $\pi r^2 = 3.14 \times 2^2 = 12.56 = 13\,\text{mm}^2$ (to the nearest whole number)
- surface area of all the circular ends = $\pi r^2 n$
  $= 13 \times 2$
  $= 26\,\text{mm}^2$

Fig. 1.3 shows another cylinder with the same radius and length, which is cut into two pieces. There are then 4 circular ends.

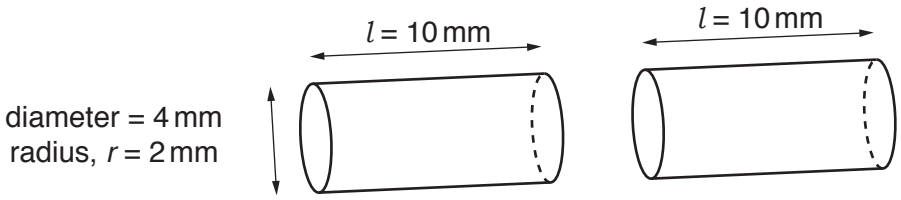


Fig. 1.3

- total number of circular ends, $n = 4$
- area of circular end = $13\,\text{mm}^2$ to the nearest whole number
- surface area of all the circular ends = $\pi r^2 n$
  $= 13 \times 4$
  $= 52\,\text{mm}^2$ (to the nearest whole number)

(i) Measure the diameter of **one** of the cylinders in **P** and calculate the radius, r.

r = ... [1]

(ii) Calculate the curved surface area, to the nearest whole number, using $2 \times 3.14 \times r \times 20$.

curved surface area = ... [2]

(iii) For the potato cylinders in **P**, use πr^2 to calculate the area of one circular end to the nearest whole number.
Use π as 3.14 and use r as recorded in **(a)(i)**.

area of one circular end = ... [1]

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(iv) Complete Table 1.3 to calculate the total surface area when using different numbers of pieces to include:

- one whole cylinder
- one cylinder cut into two pieces
- two other cylinders cut into two different numbers of pieces.

Table 1.3

number of pieces cut from one cylinder	number of circular ends, *n*	area of one circular end from **(a)(iii)** /mm^2	surface area of all the ends /mm^2	curved surface area from **(a)(ii)** /mm^2	total surface area /mm^2
1	2				
2	4				

[2]

2. Cut each of the four cylinders into the number of pieces, as shown in Table 1.3.

3. Put the pieces into the shallow dish labelled **C**.
Cover with a damp paper towel to prevent the pieces from drying out.

You will use the apparatus as shown in Fig. 1.4.

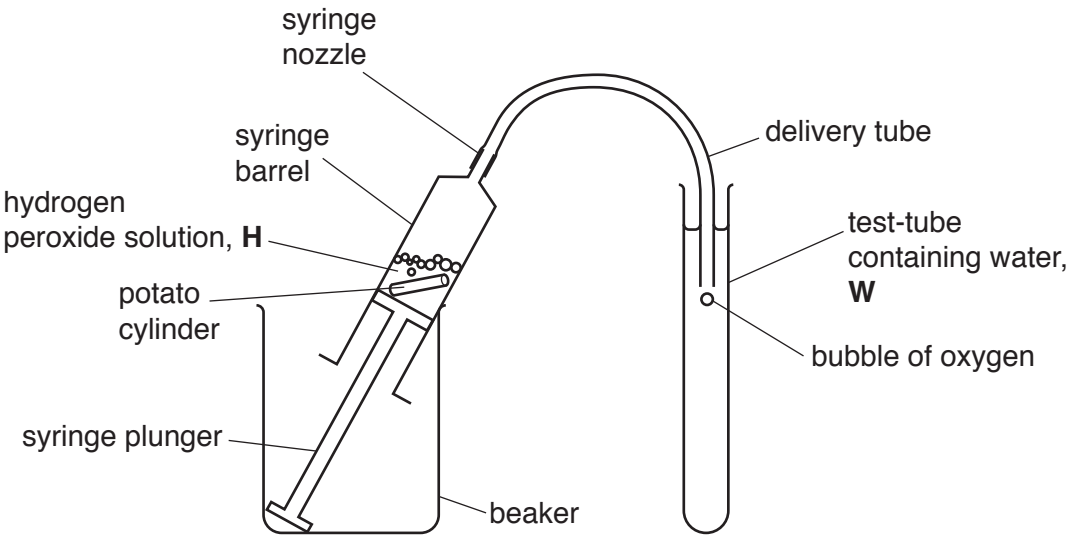


Fig. 1.4

The position of the delivery tube in the test-tube of water should be standardised to have confidence in the results.

(v) Describe how you will standardise the position of the delivery tube in the test-tube of water, as shown in Fig. 1.4.

.....

.....

..... [1]

4. Set up the test-tube with **W** and the delivery tube, as shown in Fig. 1.4 and described in **(a)(v)**. Do **not** attach the tubing to the syringe. You may stand the test-tube in the test-tube rack provided.

5. Remove the plunger from the 10 cm^3 syringe.

6. Put potato tissue into the barrel of the syringe, for example the whole cylinder in one piece.

7. Replace the plunger and push it to the 4 cm^3 mark, as shown in Fig. 1.5.

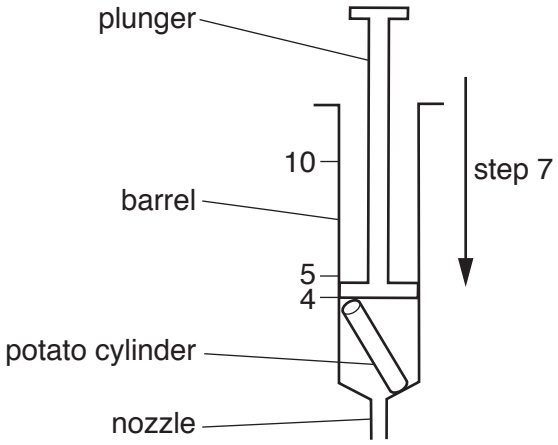


Fig. 1.5

8. Put the nozzle of the syringe into the beaker containing **H**.

9. Pull the plunger out to the 10 cm^3 mark so that **H** enters the syringe, as shown in Fig. 1.6.

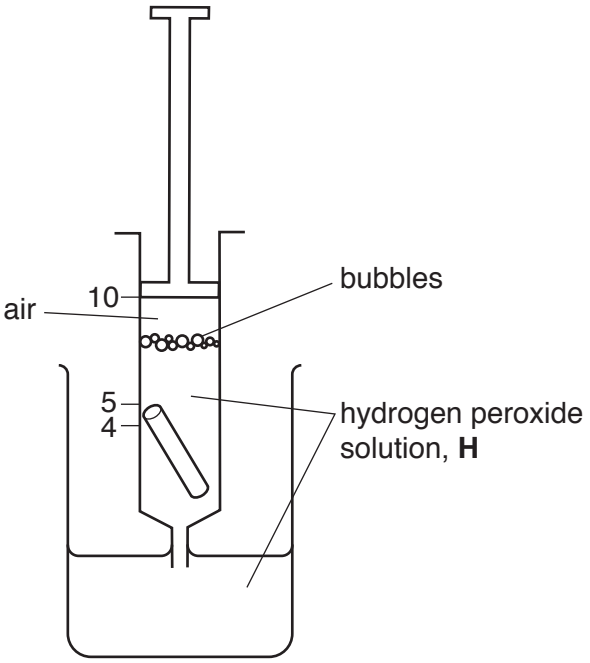


Fig. 1.6

10. Hold the syringe above the beaker containing **H** and push the plunger to adjust the level of **H** to the 5 cm^3 mark in the syringe, as shown in Fig. 1.7.

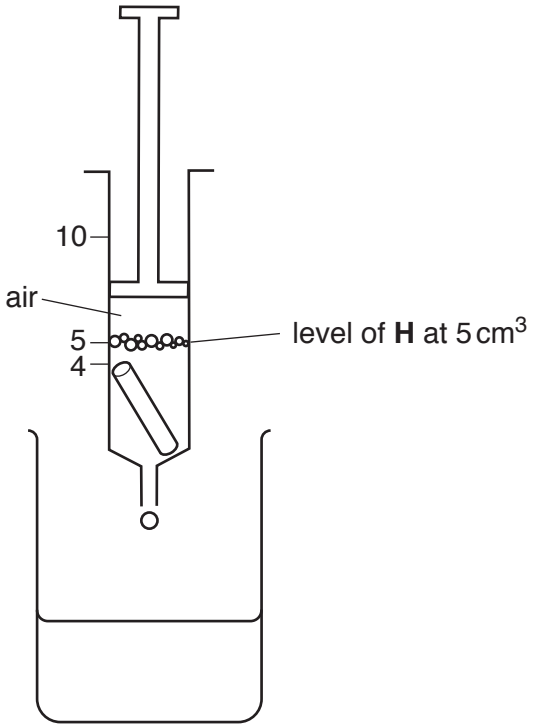


Fig. 1.7

11. Turn the syringe upside down so that the nozzle is up and there is air in the top of the syringe barrel. Carefully wipe the nozzle with a paper towel to remove excess **H**.

12. Tap the syringe barrel to make sure all the potato pieces are in **H**.

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13. Attach the delivery tube to the nozzle to make an airtight fit.

14. Put the syringe into a beaker as shown in Fig. 1.4 (page 5).

15. Put the end of the delivery tube back into the test-tube as described in **(a)(v)**.

16. Start timing when the first bubble is observed in the water in the test-tube.

17. Count the bubbles at intervals of 30 seconds up to 120 seconds. Record the results in **(a)(vi)**.

18. Using a paper towel to avoid **H** coming into contact with your skin, remove the delivery tube from the syringe, keeping the syringe nozzle up.

19. Then push the plunger to empty as much as possible of **H** into the container labelled '**For waste**'.

20. Slowly pull out the plunger and put the potato tissue and remaining **H** into the container labelled '**For waste**'.

21. Repeat step 6 to step 20 with both of the pieces from the cylinder cut into two pieces.

22. Repeat step 6 to step 20 with each of the other two cylinders which have been cut into different numbers of pieces.

(vi) Record your results for the total surface area as shown in Table 1.3 **and** the number of bubbles at each 30 seconds in an appropriate table.

[5]

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(vii) Using the results in **(a)(vi)**, calculate for the **largest** surface area:

- the mean number of bubbles in 30 seconds
- the rate of activity, number min^{-1}.

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

mean number of bubbles = ...

rate of activity = ...[3]

(viii) A significant source of error in this procedure is the different size of the bubbles which are released. An improvement to reduce this error would be to measure the volume of oxygen released.

Complete Table 1.4 to suggest:

- how to measure the volume of oxygen released
- **one** other significant source of error in this procedure
- how to make an improvement to reduce this other error.

Table 1.4

significant source of error	**how to make an improvement**
different sizes of bubbles released	
another significant source of error	

[3]

(ix) Think about how you could modify this procedure to investigate the effect of **concentration of substrate**, starting with 6% hydrogen peroxide, on the activity of the enzyme (catalase) in the potato tissue.

Describe how you could change the independent variable, **concentration of substrate**.

.....

.....

..... [1]

[Total: 19]

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Question 2 starts on page 12

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

(a) **(i)** Select a field of view so that you can observe the different tissues in the whole leaf.

Draw a large plan diagram to show the observable tissues in the **whole** leaf.

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

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

[5]

(ii) Observe the epidermis with trichomes (hairs) in **K1**.

Select **three** adjacent, touching epidermal cells where only one cell has a trichome attached.

Make a large drawing of these epidermal cells and the trichome.

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

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

[5]

(iii) The presence of trichomes supports the conclusion that the plant grows in a dry environment.

Observe the leaf on **K1**.

Suggest **one** other observable feature in the specimen on **K1** which supports this conclusion.

Explain how this feature would prevent water loss.

feature .....

explanation .....

..... [2]

(b) Fig. 2.1 shows a photomicrograph of part of a leaf surface showing the stomata.

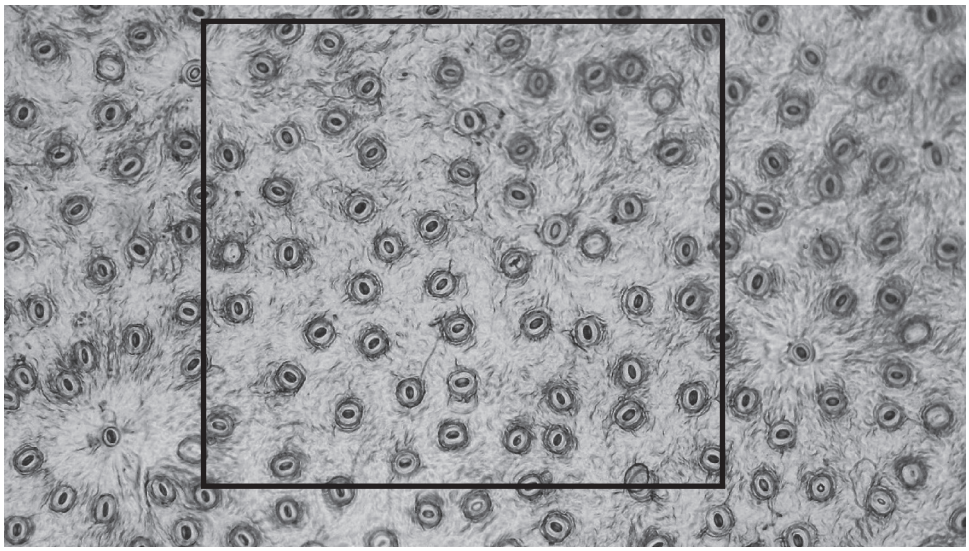


Fig. 2.1

Estimate the number of stomata inside the square shown on Fig. 2.1.
Show **on Fig. 2.1** those stomata that you counted.

If half or more of a stoma is within the square, count it as a whole stoma.
Do **not** count any stoma that is less than half within the square.

estimated number of stomata ..... [3]

(c) A scientist investigated the percentage of stomata that were open between the times of 00:00 and 12:00.

Table 2.1 shows the results for this investigation.

Table 2.1

time of day	percentage of open stomata
00:00	17
02:30	9
05:00	78
09:00	79
12:00	89

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(i) Plot a graph of the data shown in Table 2.1 on the grid in Fig. 2.2.

Use a sharp pencil for drawing graphs.

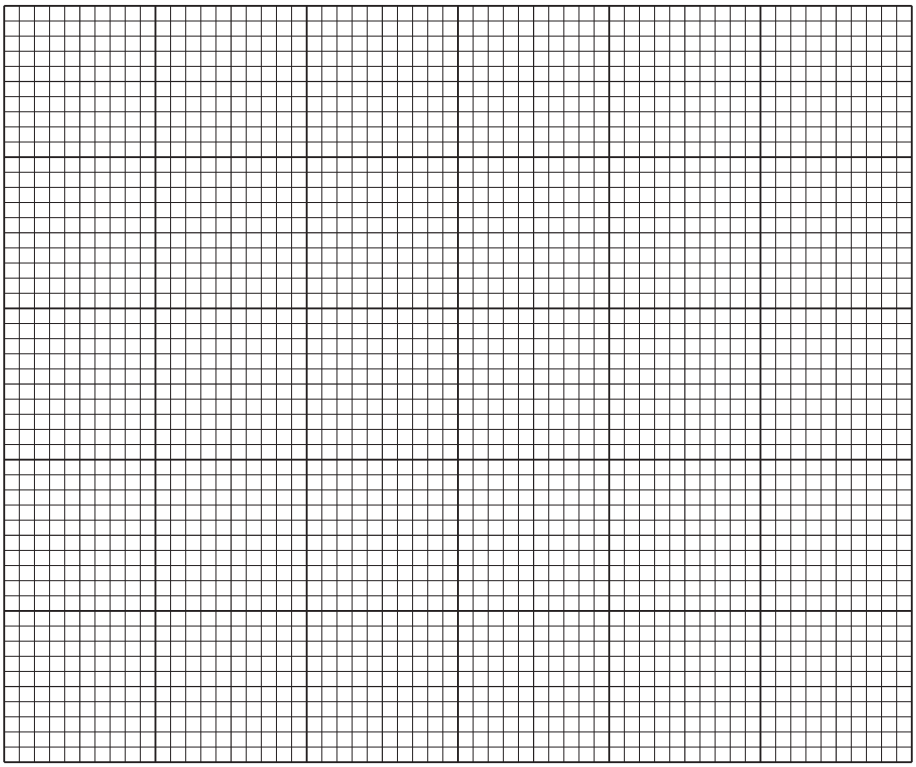


Fig. 2.2

[4]

(ii) Suggest the effect that the change in percentage of open stomata between 02:30 and 05:00 would have on the rate of transpiration.

Explain your answer.

.....

.....

.....

.....

.....

..... [2]

[Total: 21]

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BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

2 hours

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If you have enough time, think about how you can improve the confidence in 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 Manufacturers of fruit juice need to know the concentration of ascorbic acid (vitamin C) in fruit. The fruit is picked when the juice contains the highest concentration of ascorbic acid.

The concentration of ascorbic acid can be estimated in a fruit extract by carrying out a test using starch solution and iodine solution.

Iodine solution will be added one drop at a time using a syringe.

To practise releasing drops from a syringe:

1. Fill a syringe with 1 cm^3 distilled water.
2. Hold the syringe over an empty test-tube as shown in Fig. 1.1 and push the plunger slowly to release one drop.
3. Repeat this until you can release one drop at a time.

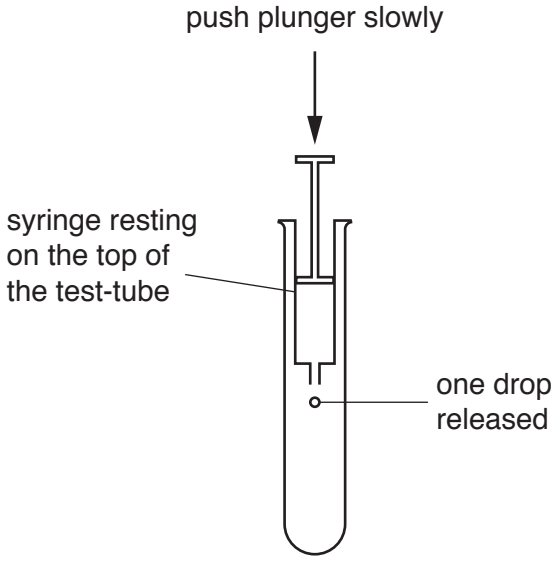


Fig. 1.1

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume/cm^3
A	0.10% ascorbic acid	none	100
W	distilled water	none	100
iodine	iodine solution	none	20
S	starch solution	none	20

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

You will now carry out a test on **A** and **W** to practise the method **and** to find the volume of iodine solution that needs to be added for the end-point to be reached.

The end-point is when the blue colour remains after 10 seconds.

4. Put 1 cm^3 of **S** into a test-tube.

5. Put 5 cm^3 of **A** into the same test-tube.

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

7. Fill a 1.0 cm^3 syringe with exactly 1.0 cm^3 of **iodine**.

8. Wipe off any **iodine** from the outside of the syringe with a paper towel.

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

10. Mix gently and observe any colour change.

11. Repeat step 9 and step 10 until a blue colour appears. You may need to refill the syringe with **iodine** as in step 7.

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

13. If the blue colour disappears then repeat step 9 to step 12 until the mixture stays blue for at least 10 seconds.

14. Record in **(a)(i)** the **volume** of iodine solution added.

15. Repeat step 4 to step 14 using **W** instead of **A** (in step 5).

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(a) (i) Record the **volume** of iodine solution added to sample **A** and sample **W**.

volume added to **A** ..... cm^3

volume added to **W** ..... cm^3

[1]

You will need to:

- prepare known concentrations of ascorbic acid using simple (proportional) dilution
- carry out a test to find the **volume** of iodine solution added to the test samples.

Make simple (proportional) dilutions of the ascorbic acid, **A** (0.10%), by reducing the concentration by **0.02%** between each successive dilution.

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

(ii) Table 1.2 shows how to make up two of the concentrations you will use, 0.10% and 0.00%.

Decide which other concentrations of ascorbic acid to prepare using simple (proportional) dilutions of **A**.

Complete Table 1.2 to show how you will prepare the other concentrations.

Table 1.2

percentage concentration of ascorbic acid	volume of **A** /cm^3	volume of **W** /cm^3
0.10	20.00	0.00
0.00	0.00	20.00

[2]

16. Prepare the concentrations of ascorbic acid as shown in Table 1.2.

17. Repeat step 4 to step 13 using one of the concentrations in Table 1.2 instead of **A** (in step 5).

18. Record your result in **(a)(iii)**.

19. Repeat step 17 and step 18 for each of the other concentrations as shown in Table 1.2.

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(iii) Record your results in an appropriate table for the known concentrations of ascorbic acid.

[4]

You will need to estimate the concentration of ascorbic acid in **X** and **Y**.

You are provided with the materials shown in Table 1.3.

Table 1.3

labelled	contents	hazard	volume/cm^3
X	fruit extract with unknown concentration of ascorbic acid	none	20
Y	fruit extract with unknown concentration of ascorbic acid	none	20

20. Repeat step 4 to step 13 using **X** instead of **A** (in step 5).

21. Record your result in **(a)(iv)**.

22. Repeat step 20 and step 21 using **Y**.

(iv) Record the volume of iodine solution added to **X** and **Y**.

volume added to **X** .....

volume added to **Y** .....

[1]

(v) Complete Fig. 1.2 to show the position on the line of each of the percentage concentrations of ascorbic acid shown in Table 1.2.

Using your results in **(a)(iv)**, put the labels **X** and **Y** on Fig. 1.2 to show an estimate of the concentrations of ascorbic acid in **X** and **Y**.

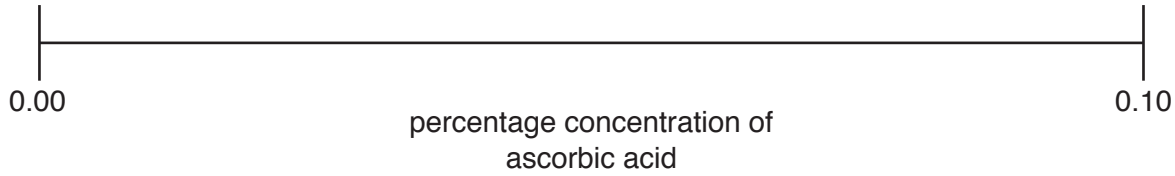


Fig. 1.2

[1]

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

.....

.....

..... [1]

(vii) Suggest how you would make **three** improvements to this investigation in order to obtain a more accurate estimate of the concentration of ascorbic acid in **X** and **Y**.

.....

.....

.....

.....

.....

.....

..... [3]

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(b) A student carried out further investigations on ascorbic acid to test its effect on the reaction of amylase on starch. Maltose is a product of the hydrolysis of starch.

Different concentrations of ascorbic acid were added to standard mixtures of amylase and starch. The student measured the mass of maltose produced.

The results are shown in Table 1.4.

Table 1.4

percentage concentration of ascorbic acid	mass of maltose produced/mg
0.000	97
0.002	52
0.004	42
0.006	33
0.008	25
0.010	19

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

Use a sharp pencil for drawing graphs.

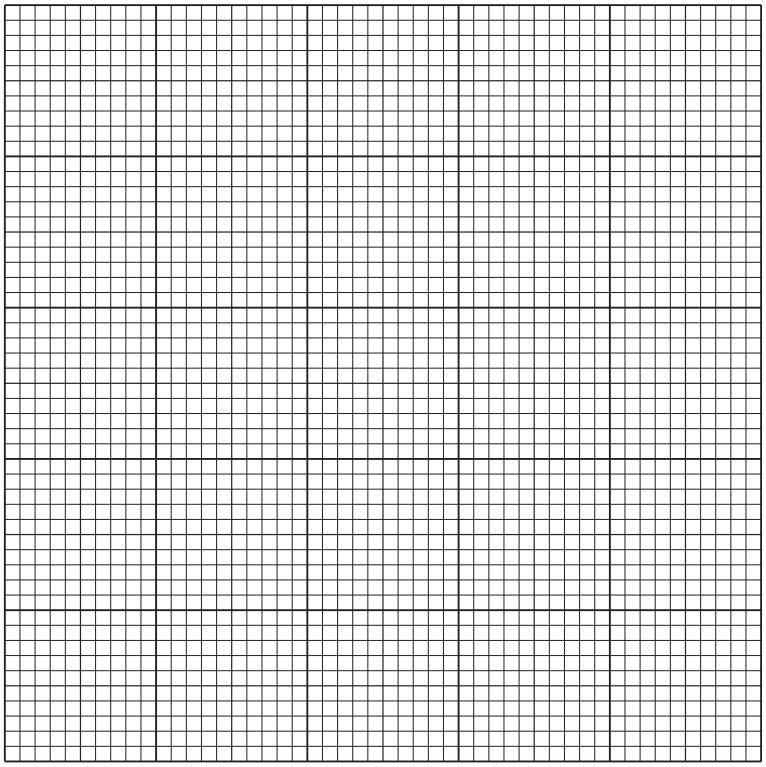


Fig. 1.3

[4]

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(ii) Use your graph to find the mass of maltose produced when 0.005% of ascorbic acid was used.
Show **on the graph** how you determined your answer.

mass of maltose = ... [2]

(iii) Suggest **one** explanation for the results between 0.000% and 0.010%.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 22]

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

(a) **(i)** Draw a large plan diagram of the transverse section through the root.

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

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

[4]

(ii) Observe the cells in the epidermis and the cells directly beneath the epidermis.

Select a group of **four** touching cells. These four cells must include:

- **two** epidermal cells that are touching each other
- **two** cells directly beneath the epidermis that are touching each other **and** are also touching at least one of the epidermal cells.

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

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

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

[5]

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

You are not expected to be familiar with this specimen.

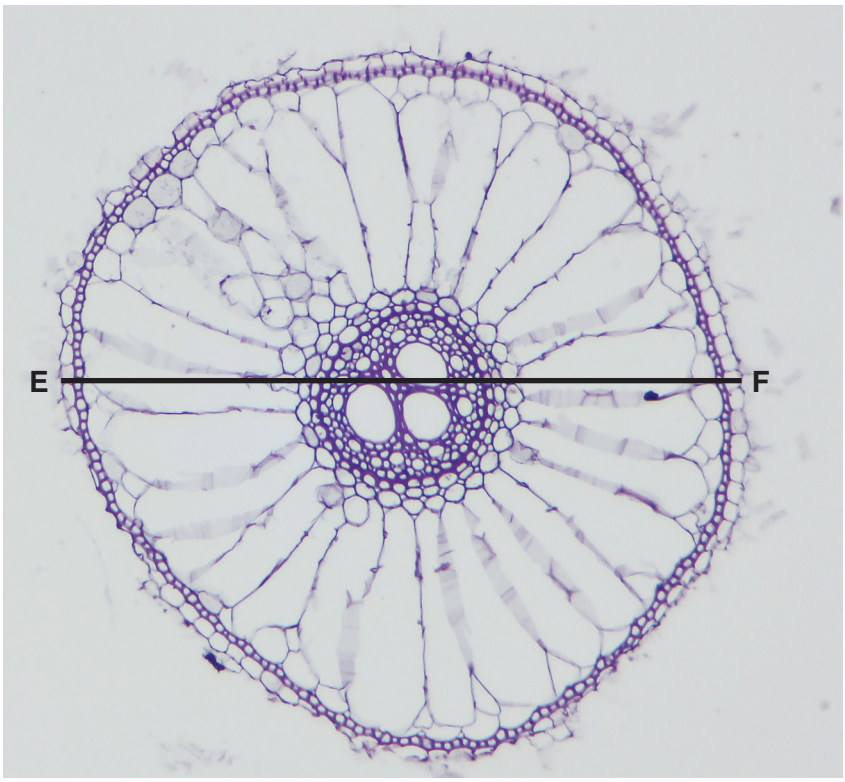


Fig. 2.1

Use the line **E–F** to determine the simplest whole number ratio of the total diameter of the root to the diameter of the central vascular tissue.

Show your working.

ratio ..... [5]

(c) Prepare an appropriate table so that it is suitable for you to record observable differences between the root on **M1** and the root in Fig. 2.1.

Record your observations in the table you have prepared.

[4]

[Total: 18]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5132729552

BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **October/November 2018**

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 confidence in 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, **E**, hydrolyses (breaks down) the protein in milk.

A mixture of milk and **E** changes from cloudy to clear as a result of the hydrolysis of protein.

The end-point is reached when the mixture is clear.

You will need to:

- investigate the activity of enzyme **E** on milk, at a range of temperatures from 70 °C to 30 °C
- record the time taken to reach the end-point for each temperature.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume /cm^3
E	0.5% enzyme solution	irritant	20
M	milk	none	50

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

You will test the activity of the enzyme **E**, at 70 °C and at 30 °C.

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

..... [1]

Read step 1 to step 10 before proceeding.

1. Set up a water-bath and heat to 70 °C.

2. Put 1 cm^3 of **E** into each of five test-tubes.

3. Put **one** of the test-tubes into the water-bath and leave for 2 minutes.

While you are waiting continue with other parts of Question 1.

4. After 2 minutes, stir **M** and put 3 cm^3 of **M** into the test-tube in the water-bath. Mix gently using a glass rod.

5. Immediately start timing.

6. Record in **(a)(ii)** the time taken for the mixture to become clear (the end-point). You may find it easier to judge the end-point if the black card is held behind the mixture.

   If the end-point is not reached by 180 seconds, record 'more than 180'.

7. Adjust the temperature of the water-bath so that it is at the highest temperature stated in **(a)(i)**.

8. Repeat step 3 to step 6.

9. Adjust the temperature of the water-bath and repeat step 3 to step 6 with the other temperatures stated in **(a)(i)**.

10. Adjust the temperature of the water-bath to 30 °C and repeat step 3 to step 6.

(ii) Record your results in an appropriate table.

[5]

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(iii) A student carried out the same procedure at 80 °C and recorded the time taken to reach the end-point as 75 seconds.

Calculate the **rate** of enzyme activity at 80 °C.

Show your working.

rate of enzyme activity = ... s^{-1} [2]

(iv) The student identified two significant sources of error in the investigation as shown in Table 1.2.

Complete Table 1.2 to suggest how to make an improvement to reduce each of the sources of error the student identified.

Table 1.2

significant source of error	how to make an improvement
difficult to judge when the end-point is reached	
difficult to maintain the temperature of the water-bath	

[2]

(v) Suggest how the student could set up an appropriate control for this investigation.

.....

..... [1]

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(b) A scientist carried out an experiment to investigate the effect of pH on the activity of a different enzyme that hydrolyses the protein in milk.

Buffer solutions were used to change the pH and the investigation was carried out at the optimum temperature for this enzyme. All other variables were kept constant.

The results are shown in Table 1.3.

Table 1.3

pH	activity of enzyme /arbitrary units
1.5	78
2.0	95
3.0	91
4.5	36
6.0	13

(i) State the independent variable in this investigation.

..... [1]

(ii) Plot a graph of the data shown in Table 1.3 on the grid in Fig. 1.1.

Use a sharp pencil for drawing graphs.

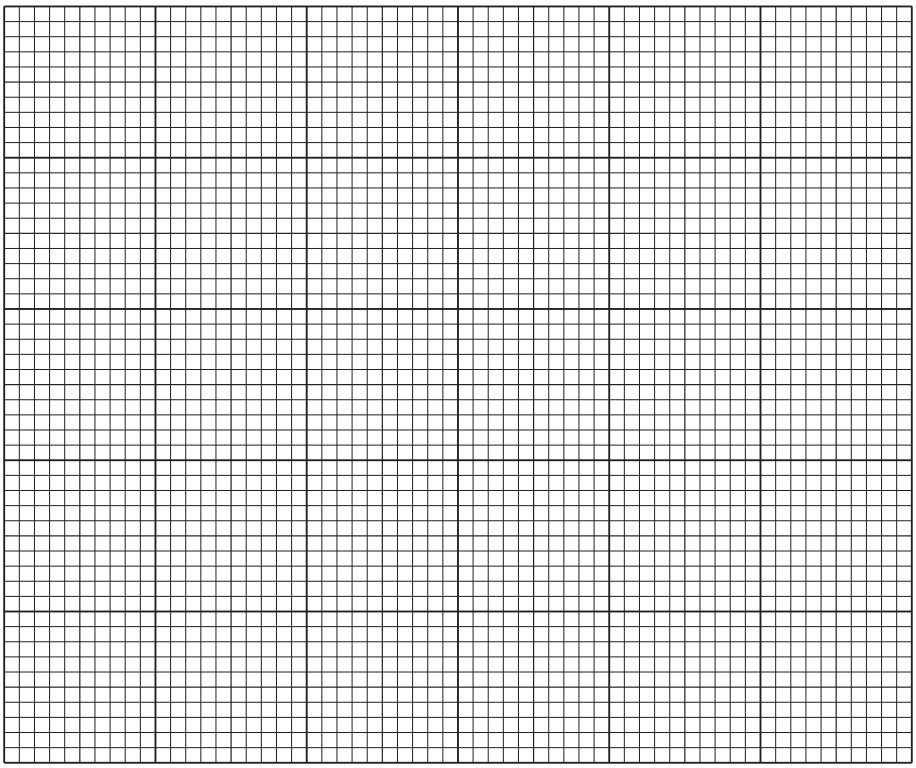


Fig. 1.1

[4]

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(iii) With reference to Fig. 1.1 describe the effect of pH on the activity of the enzyme.

.....

.....

.....

.....

..... [2]

(iv) Explain why the activity of the enzyme at pH6 is different from the activity at pH3.

.....

.....

.....

.....

..... [2]

(v) The scientist decided that the optimum pH for this enzyme had not been identified accurately.
Suggest how the experiment could be modified to find a more accurate value for the optimum pH.

.....

.....

.....

.....

..... [2]

[Total: 22]

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[Turn over

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

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

(a) **(i)** Select a field of view so that you can observe the epidermis and the vascular bundles.

Draw a large plan diagram from the selected field of view which has:

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

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

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

[5]

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(ii) Observe the cells of the epidermis on **L1**.

Select **one** group of **four** adjacent, touching epidermal 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.

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

[5]

(iii) The presence of air spaces supports the conclusion that the plant grows in water.

Suggest why the plant on **L1** contains many air spaces.

.....

.....

..... [1]

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.

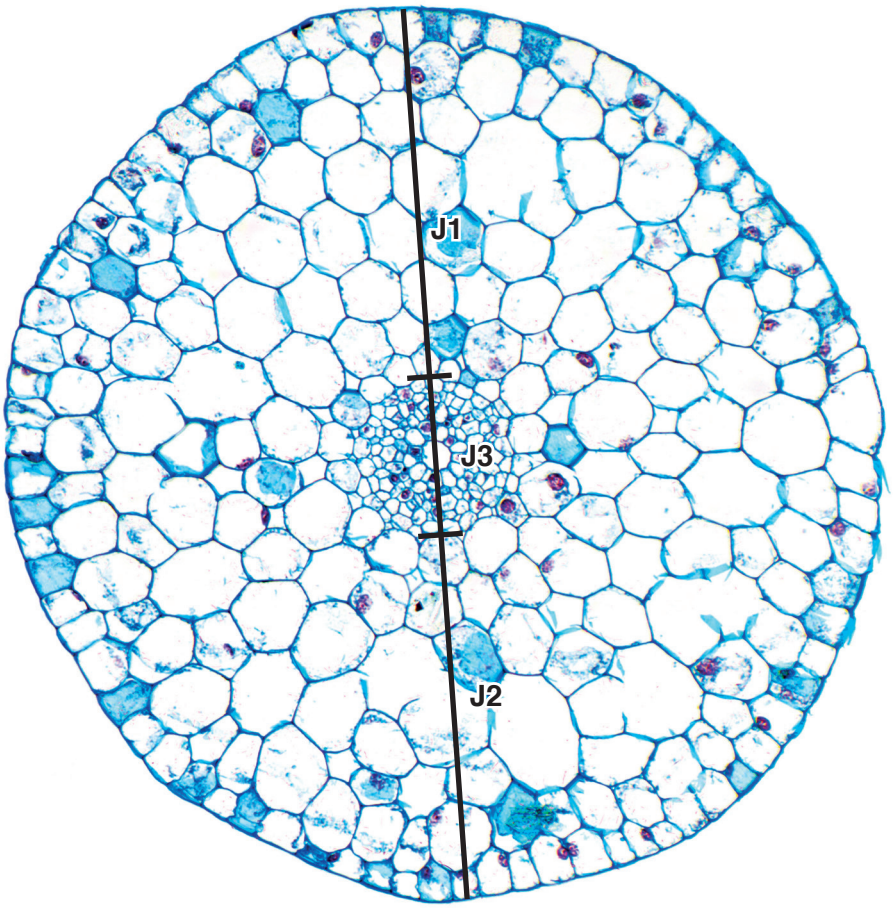


Fig. 2.1

(b) Determine the simplest whole number ratio of the total length of **J1** and **J2** (the cortex) to the length of **J3** (vascular tissue).

Show your working and use appropriate units.

ratio ..... [4]

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(c) Observe the stem on **L1** and the stem in Fig. 2.1 and identify the differences between them.

Record the observable differences in Table 2.1.

Table 2.1

feature	**L1**	**Fig. 2.1**

[3]

[Total: 18]

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CENTRE NUMBER

CANDIDATE NUMBER

3769447782

BIOLOGY **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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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 confidence in 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 emulsion test is used to detect the presence of lipids in a sample.

To carry out the emulsion test, ethanol is added to the sample. If lipids are present they will dissolve in the ethanol. When water is then added, the lipids in the ethanol will form droplets in the water. The droplets in the water form an emulsion.

The emulsion appears as cloudiness in the layer towards the bottom of the test-tube, as shown in Fig. 1.1.

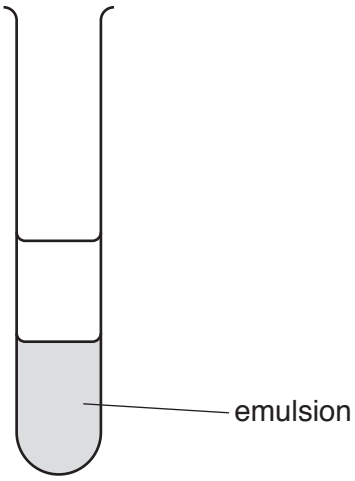


Fig. 1.1

(a) A student investigated the effect of the concentration of ethanol on the cloudiness of the emulsion during the emulsion test.

The student suggested the following hypothesis:

lowering the concentration of ethanol below 100% will have no effect on the cloudiness of the emulsion.

You will need to investigate this hypothesis by:

- diluting 100% ethanol, **A**, to provide further concentrations of ethanol
- carrying out the emulsion test using these concentrations of ethanol
- recording the cloudiness of the emulsion formed.

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You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume /cm^3
A	100% ethanol	flammable	60
L	vegetable oil (lipid)	flammable	40
W	distilled water	none	60

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

You will need to use simple (proportional) dilution of the ethanol, **A**, to make further concentrations of ethanol between 100% and 75%, by reducing each successive dilution by 5%.

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

Table 1.2 shows how to prepare the highest concentration (100%) and the lowest concentration (75%).

(i) Complete Table 1.2 to show how you will prepare further concentrations of ethanol.

Table 1.2

volume of **A** /cm^3	volume of **W** /cm^3	percentage concentration of ethanol
10.0	0.0	100
7.5	2.5	75

[2]

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[Turn over

Read step 1 to step 13 before carrying out this investigation.

1. Prepare the concentrations of ethanol as shown in Table 1.2, in the beakers provided.

2. Label **one** test-tube as a control.

3. Put 2 cm^3 of **L** into this test-tube.

4. Put 4 cm^3 of **W** into the same test-tube. Shake the test-tube gently for 20 seconds.

   The control test-tube will be needed for step 10.

5. Put 2 cm^3 of **L** into all the other test-tubes.

6. Put 2 cm^3 of 100% ethanol into **one** of the test-tubes containing **L**. Shake the test-tube gently for 20 seconds.

7. Put 2 cm^3 of **W** into the same test-tube. Shake the test-tube gently for 20 seconds.

8. Repeat step 6 to step 7 with each of the other concentrations of ethanol as prepared in step 1.

9. Leave all the test-tubes for approximately 1 minute so that the layers become visible.

10. Observe the cloudiness of the emulsion, as shown in Fig. 1.1, in each test-tube compared with the control.

    The control will **not** be cloudy.

    Use the key in Fig. 1.2 and record the results in **(a)(ii)**.

You may find it useful to observe the cloudiness of the emulsion with a piece of black card behind it.

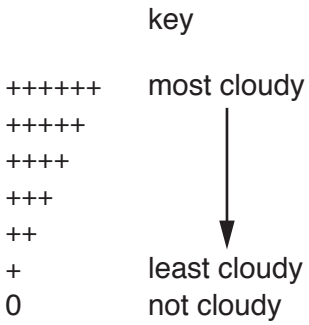


Fig. 1.2

11. Tip the contents of each test-tube, except the control, into the container labelled **For waste**.

12. Rinse these test-tubes **twice** using a syringe and the water in the container labelled **For washing**.

13. Repeat step 5 to step 10.

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(ii) Record your results in an appropriate table, including the mean result for each concentration of ethanol.

[5]

(iii) State the independent variable in the investigation you have just carried out.

..... [1]

(iv) Identify **one** significant source of error when measuring the dependent variable **and** suggest **one** improvement to reduce this source of error.

source of error .....

.....

.....

improvement .....

.....

[2]

(v) The student's hypothesis stated that:

> lowering the concentration of ethanol below 100% will have no effect on the cloudiness of the emulsion.

State whether you **support** or **reject** this hypothesis.

Explain how your results provide evidence for this decision.

support or reject .....

explanation.....

.....

.....

.....
[3]

(vi) In the test-tubes the layer above the emulsion consists of undissolved lipids.

Suggest how the student could find the volume of ethanol required to dissolve **all** the lipid in **L**.

.....

.....

.....

.....

.....[2]

Question 1 continues on page 8

(b) Some foods contain two types of fat, unsaturated fat (**U**) and saturated fat (**S**). The proportions of these two types of fat vary according to the food.

A scientist carried out some tests to determine the mass of these two types of fat found in three food samples, **X**, **Y** and **Z**. The total mass of each food sample was 100 g.

The results are shown in Table 1.3.

Table 1.3

type of fat / food sample	mass of fat in 100 g of food / g	
	U	**S**
X	10.75	23.50
Y	1.50	1.25
Z	8.50	6.50

(i) Calculate the percentage of the total fat in food sample **X** that is unsaturated.

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

[3]

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(ii) Draw a bar chart of the data shown in Table 1.3 on the grid in Fig. 1.3.

The bars should be separated for each food sample.

Use a sharp pencil for drawing bar charts.

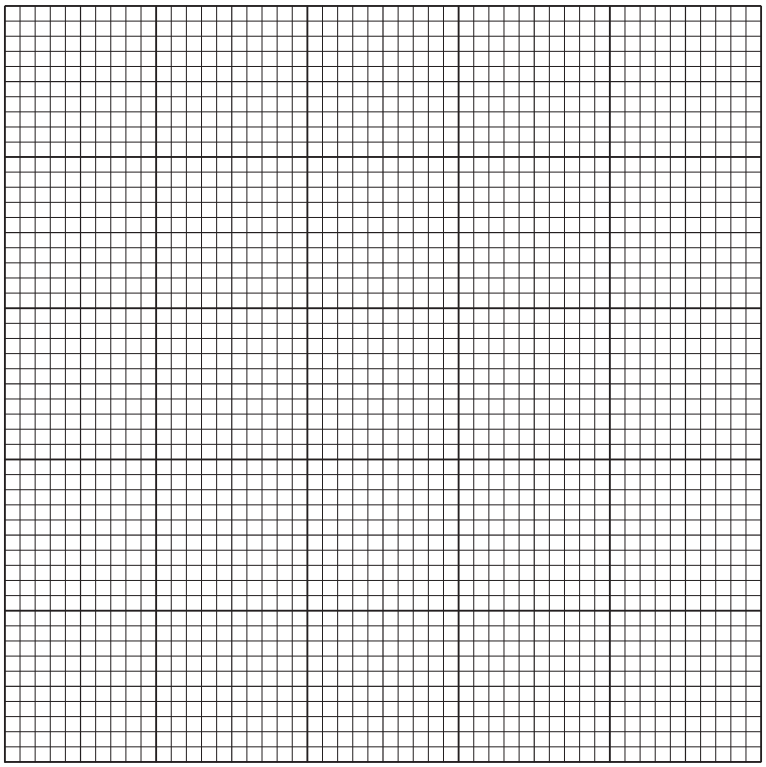


Fig. 1.3

[4]

[Total: 22]

2 **(a)** **N1** is a slide of a stained transverse section through a leaf-like structure.

You are not expected to be familiar with this specimen.

Use a sharp pencil for drawing.

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

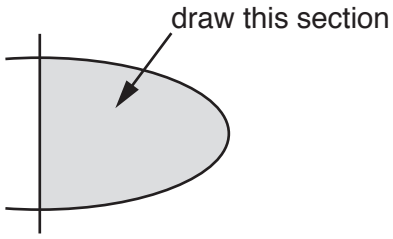


Fig. 2.1

Draw a large plan diagram from the selected field of view which has:

- part of the epidermis
- the outline of **two** vascular bundles
- any other observable tissues.

No details of the internal tissues of the vascular bundles are required.

Use **one** ruled label line and the label **C** to identify the tissue containing chloroplasts.

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

[5]

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(ii) Observe the **largest** vascular bundle on **N1**.

Select **one** group of **four** adjacent, touching xylem vessel elements.
Each xylem vessel element must touch at least one of the other xylem vessel 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.

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

[5]

(iii) On your drawing in **(a)(ii)**, use **one** ruled label line and the label **T** to identify an observable feature which enables water to be transported through the xylem vessel element.

Next to the letter **T** explain how this feature enables the xylem vessel element to carry out its function. [2]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through the trachea of a mammal.



Fig. 2.2

(i) On Fig. 2.2, use **one** ruled label line and the label **Q** to identify an observable feature which prevents the tube from collapsing. [1]

(ii) Determine the simplest whole number ratio of the length of **P3** (the air space) to the total length of **P1** and **P2**.

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

ratio .....[5]

[Total: 18]

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