Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4531333156

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2021**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
Total	

This document has **20** pages. Blank pages are indicated.

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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 the whole of Question 1 and Question 2.

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

When hydrogen peroxide solution and a sample of potato tissue are put into a syringe, some of the solution comes out of the syringe nozzle as the oxygen is released.

You are going to investigate the effect of surface area of potato tissue on the activity of catalase.

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	irritant	40

Table 1.2

labelled	material	details	quantity
P	potato cylinders	same diameter	4

If any of **H** comes into contact with your skin, wash off immediately with cold water.

It is recommended that you wear suitable eye protection.

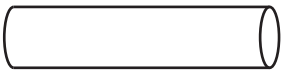
Wear gloves to protect your hands when using **H**.

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1. Cut the potato cylinders in the beaker labelled **P** to a length of 20 mm. Put the 20 mm cylinders back into the beaker labelled **P**.

   To investigate the effect of surface area, you will cut the cylinders into a different number of pieces as shown in Table 1.3.

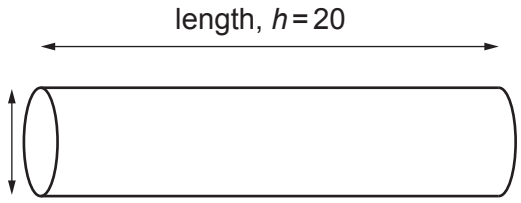
Table 1.3

length of original cylinder / mm	**number (n) of pieces to put into the syringe**	**length (h) of each small piece / mm**
20	1 	20
20	2 	10
20	4 	5
20	10 	2

You now need to calculate the total surface area of the potato tissue that will be put into the syringe. An example of how to do this is shown in Fig. 1.1 on page 4.

EXAMPLE:

One cylinder has length of 20 mm



surface area of one cylinder $= 2\pi r^2 + 2\pi rh$

$= (2 \times 3.14 \times 2^2) + (2 \times 3.14 \times 2 \times 20)$

$= 276.32\,\text{mm}^2$

where:
$\pi = 3.14$
r = radius of cylinder
h = height or length of cylinder

Fig. 1.1

The total surface area depends on the number of pieces, n.

Total surface area = surface area of one cylinder × number of pieces
$= (2\pi r^2 + 2\pi rh)n$

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

$r =$ ..... [1]

(ii) All of the cylinders have the same diameter (standardised).

State **one** other variable that should be standardised in this investigation.

.....

..... [1]

(iii) Complete Table 1.4 to calculate the total surface area of potato tissue to put in the syringe.

Show your working in the space provided in Table 1.4.

Table 1.4

n	***h*** **/ mm**	***r*** **/ mm**	**surface area of one piece / mm^2**	**show your working in this column**	**total surface area / mm^2**
1	20				
2	10				
4	5				
10	2				

[2]

Carry out step 2 to step 22.

2. Remove the plunger from a 10 cm^3 syringe.

3. Put one 20 mm potato cylinder into the barrel of the syringe.

4. Put the plunger back into the syringe and push it to the 4 cm^3 mark, as shown in Fig. 1.2.

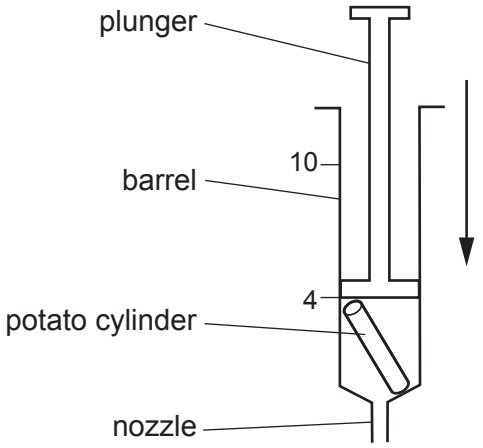


Fig. 1.2

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

6. Pull the plunger out to the 10 cm^3 mark so that **H** enters the syringe, as shown in Fig. 1.3.

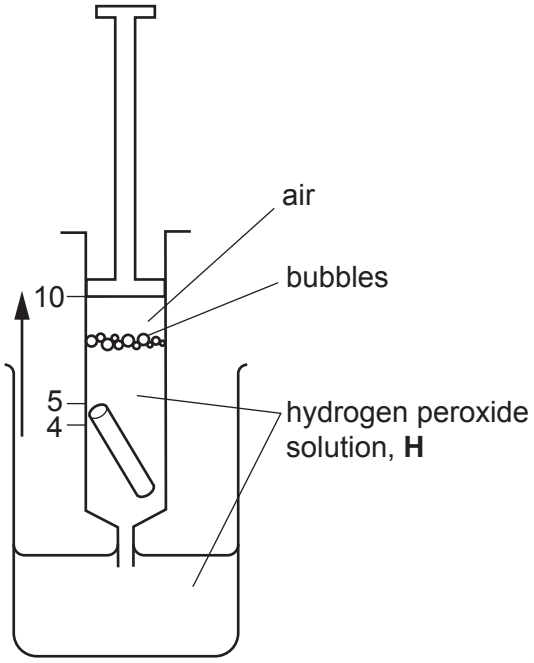


Fig. 1.3

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7. Hold the syringe above the beaker labelled **For waste**. Push the plunger so that the level of **H** is at the 5 cm^3 mark, as shown in Fig. 1.4.

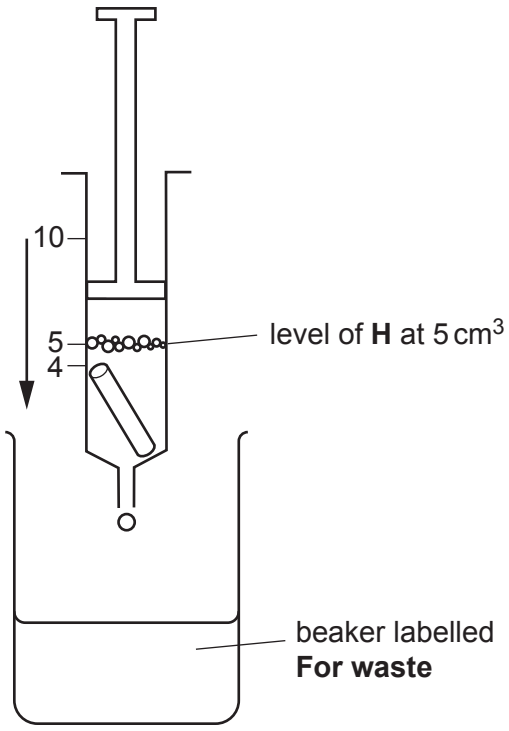


Fig. 1.4

8. Wipe the nozzle with a paper towel to remove excess **H**.

9. Hold the syringe above the beaker labelled **For waste**. Start timing.

   Count the number of drops released in 1 minute. Record the results in **(a)(iv)**.

10. Put the syringe into the beaker labelled **B**.

11. Cut a cylinder from step 1 into two pieces. Each piece should be 10 mm in length, as shown in Table 1.3 and Table 1.4.

12. Remove the plunger from an empty 10 cm^3 syringe.

13. Put the two 10 mm pieces from step 11 into the barrel of the syringe.

14. Repeat step 4 to step 10.

15. Cut a cylinder from step 1 into four pieces. Each piece should be 5 mm in length, as shown in Table 1.3 and Table 1.4.

16. Remove the plunger from an empty 10 cm^3 syringe.

17. Put the four 5 mm pieces from step 15 into the barrel of the syringe.

18. Repeat step 4 to step 10.

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19. Cut a cylinder from step 1 into 10 pieces. Each piece should be 2 mm in length, as shown in Table 1.3 and Table 1.4.

20. Remove the plunger from an empty 10 cm^3 syringe.

21. Put the ten 2 mm pieces from step 19 into the barrel of the syringe.

22. Repeat step 4 to step 10.

(iv) Record your results in an appropriate table.

[5]

(v) State the independent variable.

..... [1]

(vi) Suggest an appropriate control for this investigation.

..... [1]

(vii) Identify **two** sources of error in step 3 to step 22. For each source of error suggest an improvement to the method which will reduce the effect of the error.

error 1 .....

.....

improvement 1 .....

.....

.....

error 2 .....

.....

improvement 2 .....

.....

.....

[4]

(viii) The procedure described by step 1 to step 22 investigated the effect of surface area on catalase activity, by measuring the number of drops released in 1 minute.

Describe how you would modify the procedure to investigate the effect of changing temperature on the activity of catalase in the potato tissue.

.....

.....

..... [1]

(b) A student investigated the effect of hydrogen peroxide concentration on the activity of catalase. The student measured the distance the solution moved along a clear plastic tube attached to a syringe, as shown in Fig. 1.5.

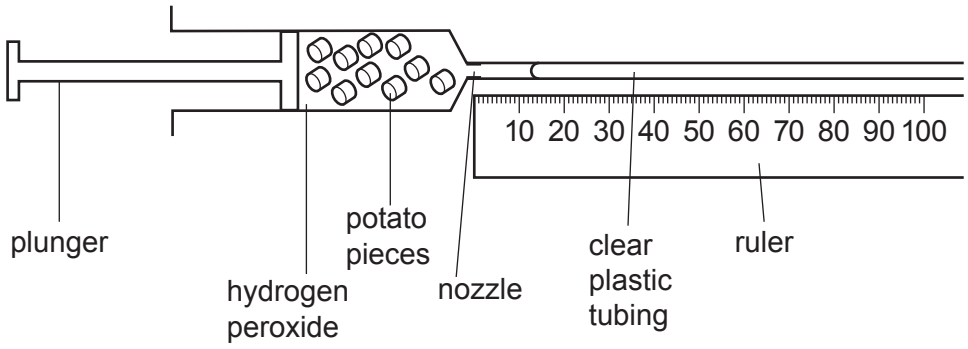


Fig. 1.5

The results are shown in Table 1.5.

Table 1.5

percentage concentration of hydrogen peroxide	distance moved in 1 minute / mm
0.2	11
0.4	18
0.8	50
1.5	69
3.0	73
6.0	73

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(i) Plot a graph of the data in Table 1.5 on the grid in Fig. 1.6.

Use a sharp pencil for drawing graphs.

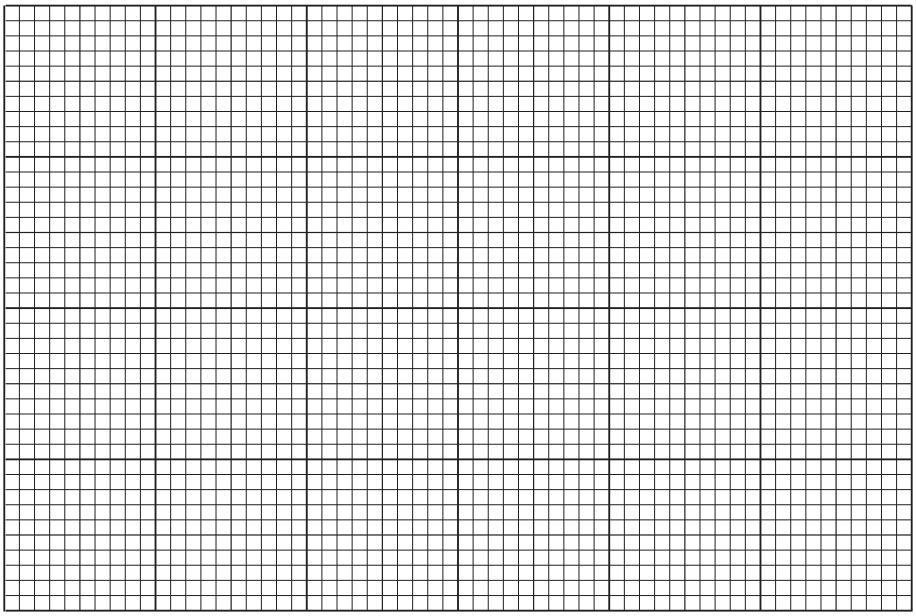


Fig. 1.6

[4]

(ii) Suggest an explanation for the results between 0.2% and 6.0% hydrogen peroxide.

.....

.....

.....

.....

.....

.....

..... [2]

[Total: 22]

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

(a) Set up the microscope so that you can observe the section on **J1**.

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the whole section of the leaf on **J1**. Your drawing should show the correct shapes and proportions of different tissues.

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

[5]

(ii) Observe the ring of cells surrounding the vascular tissue in the centre of the section on **J1**.

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

Each cell that you draw must touch at least one of the other cells.

- Make a large drawing of this line 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 leaf of a different type of plant.



Fig. 2.1

(i) Identify the observable differences between the section on **J1** and the section in Fig. 2.1.

Record the observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.1

[3]

(ii) The presence of a thick waxy cuticle in the leaf section in Fig. 2.1 supports the conclusion that the plant is adapted to live in a dry environment.

Observe the leaf section in Fig. 2.1.

Suggest **one** other observable feature in the section in Fig. 2.1 which supports this conclusion.

.....

Explain how this feature would prevent water loss.

.....

.....

..... [1]

(c) Fig. 2.2 is a photomicrograph of the same leaf section that is in Fig. 2.1.

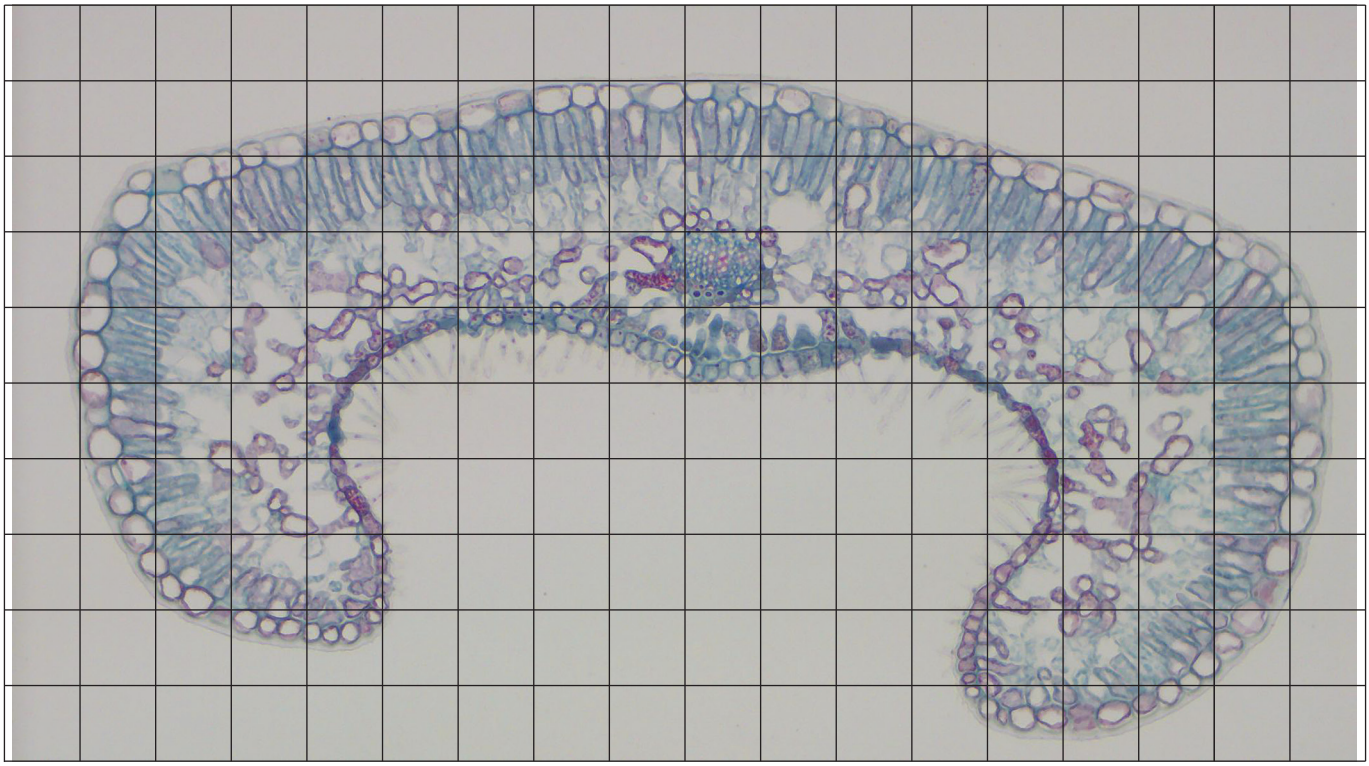


Fig. 2.2

You will need to use the grid to find the area of the palisade layer **and** the total area of the leaf section in Fig. 2.2.

Each square of the grid is 1 cm^2.

In some squares the palisade layer or the leaf section does not fill the whole square.

(i) Describe the method you will use to decide which of these squares to include.

.....

.....

..... [1]

(ii) State the area of the palisade layer and the total area of the leaf section in Fig. 2.2.

area of palisade layer = ... cm^2

total area of the leaf section = ... cm^2
[2]

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(iii) Calculate the area of the palisade layer as a percentage of the total area of the leaf section.

Show your working.

[1]

[Total: 18]

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