Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4056698121

BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2022**

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 **16** pages. Any blank pages are indicated.

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[Turn over

1 Plant cells contain an enzyme which catalyses the breakdown of hydrogen peroxide, releasing oxygen, as shown in Fig. 1.1.

$$\text{hydrogen peroxide} \xrightarrow{\text{enzyme}} \text{water + oxygen}$$

Fig. 1.1

You will investigate the effect of pH on the activity of this enzyme.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	hydrogen peroxide solution	harmful irritant	130
E	enzyme solution	harmful irritant	20
B5	pH5 buffer	none	20
B6	pH6 buffer	none	20
B7	pH7 buffer	none	20
B8	pH8 buffer	none	20
B9.5	pH9.5 buffer	none	20

If any solution comes into contact with your skin, wash off immediately with cold water.

It is recommended that you wear suitable eye protection.

When discs of filter paper that have been soaked in **E** are put into hydrogen peroxide solution, **H**, the discs rise to the surface as **H** is broken down. The higher the activity of **E**, the faster the discs rise.

(a) (i) Explain why the discs rise.

.....

.....

..... [1]

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A student investigated the effect of pH on the activity of enzyme **E**.

The student suggested the hypothesis:

As the pH of the buffer containing **E** increases, the activity of **E** decreases.

Carry out step 1 to step 16 to test the student's hypothesis.

step 1 Label 5 beakers with **E5**, **E6**, **E7**, **E8** and **E9.5**.

step 2 Put 10 cm^3 of **B5** buffer solution into the beaker labelled **E5**.

step 3 Repeat step 2 by putting the appropriate buffer solution into the beakers labelled **E6**, **E7**, **E8** and **E9.5**.

step 4 Stir **E** and put 2 cm^3 of **E** into each of the labelled beakers used in step 2 and step 3. Swirl each beaker to mix the contents.

step 5 Leave the beakers for 2 minutes.

step 6 Label a small beaker **H** and put 60 cm^3 of solution **H** into this beaker.

step 7 After 2 minutes (step 5) stir **E9.5**.

step 8 Pick up one disc of filter paper using forceps.

step 9 Continue to hold the disc in the forceps **and**:

- dip the disc in **E9.5** for 5 seconds
- put the disc at the bottom of the liquid in the beaker labelled **H**.

step 10 Immediately release the disc from the forceps and start timing.

step 11 Stop timing when the disc reaches the surface of the liquid.
You may find it helps to observe the disc with a piece of black card behind the beaker.

step 12 Record in **(a)(ii)** the time taken for the disc to reach the surface of **H**. If the time taken for the disc to rise to the surface is longer than 180 seconds, record as 'more than 180'.

step 13 Remove the disc from the beaker using the forceps and put it on a paper towel.

step 14 Dip the forceps in the water in the container labelled **For washing**. Dry the forceps with a paper towel.

step 15 Repeat step 7 to step 14 **two more** times, using **E9.5**.

step 16 Repeat step 7 to step 15 using **E8**, **E7**, **E6** and **E5**.

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[Turn over

(ii) Record your results in an appropriate table, including raw results **and** processed (mean) results.

[5]

(iii) The student suggested the hypothesis:

As the pH of the buffer containing **E** *increases, the activity of* **E** *decreases.*

Tick (✓) **one** box to show whether or not your **processed** results support this hypothesis.

support ☐

do **not** support ☐

Explain how the trend in your **processed** results provides evidence for this decision.

.....

.....

..... [1]

(iv) State the independent variable in this investigation.

..... [1]

(v) Describe an appropriate control for this investigation.

.....

.....

..... [1]

(vi) One possible source of error in this investigation is reusing the same hydrogen peroxide solution for all the discs.

Suggest a reason why reusing the same hydrogen peroxide solution is a possible source of error.

.....

.....

.....

State how you could reduce this source of error.

.....

.....

.....
[2]

(vii) Describe how you could modify your procedure to determine the optimum pH for this enzyme.

.....

..... [1]

(b) Temperature is another factor that affects the activity of an enzyme.

You will show the effect of preheating the enzyme at two different temperatures, before measuring the activity of this enzyme. You will select two temperatures and standardise the pH by choosing an appropriate buffer.

(i) Measure the room temperature.

room temperature ..... [1]

(ii) Select two temperatures between room temperature and 50 °C.

State the temperatures you have selected. .....

..... [1]

step 17 Prepare a water-bath at the lowest temperature you stated in **(b)(ii)**.

(iii) You will need to standardise the pH by choosing an appropriate mixture of buffer and enzyme, **E5**, **E6**, **E7**, **E8** or **E9.5**.

State the mixture of buffer and enzyme you will use. ..... [1]

step 18 Label one test-tube **T1** and label another test-tube **T2**.

step 19 Stir the mixture of buffer and **E** you chose in **(b)(iii)** and put approximately 5 cm^3 into each of the test-tubes **T1** and **T2**.

step 20 Put test-tube **T1** into the water-bath and leave it for 5 minutes.

step 21 Empty the small beaker labelled **H** into the container labelled **For waste**.

step 22 Put 60 cm^3 of **H** into the small beaker labelled **H**.

step 23 After 5 minutes (step 20) pour the mixture from test-tube **T1** into a clean beaker.

step 24 Pick up one disc of filter paper using forceps.

step 25 Continue to hold the disc in the forceps **and**:

- dip the disc in the mixture in the beaker for 5 seconds
- put the disc at the bottom of the liquid in the beaker labelled **H**.

step 26 Immediately release the disc from the forceps and start timing.

step 27 Stop timing when the disc reaches the surface of the liquid.
You may find it helps to observe the disc with a piece of black card behind the beaker.

step 28 Record in **(b)(iv)** the time taken for the disc to reach the surface of **H**. If the time taken for the disc to rise back to the surface is longer than 180 seconds, record as 'more than 180'.

step 29 Remove the disc using the forceps and put it on a paper towel.

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step 30 Dip the forceps in the water in the beaker labelled **For washing**. Dry the forceps with a paper towel.

step 31 Heat the water-bath to the other temperature you stated in **(b)(ii)**.

step 32 Put test-tube **T2** into the water-bath and leave it for 5 minutes.

step 33 After 5 minutes (step 32) pour the mixture from test-tube **T2** into a clean beaker.

step 34 Repeat step 24 to step 28.

(iv) Record your results for **T1** and **T2**.

T1 .....

T2 .....

[1]

(v) Explain the effect of increased temperature on the activity of enzyme **E**.

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.....

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.....

.....

..... [3]

[Total: 19]

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

(a) **(i)** Draw a large plan diagram of the whole section on **L1**. Use a sharp pencil.

Use **one** ruled label line and label to identify a trichome.

[5]

(ii) Observe the upper epidermis and the layer of cells beneath it on the section of the leaf on **L1**.

Select a group of four adjacent cells, **two** cells from the upper epidermis and **two** cells from the layer below the upper epidermis.

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 a chloroplast in **one** cell.

[5]

(b) Fig. 2.1 shows an image of some epidermal cells from the surface of a different leaf, viewed under a microscope.

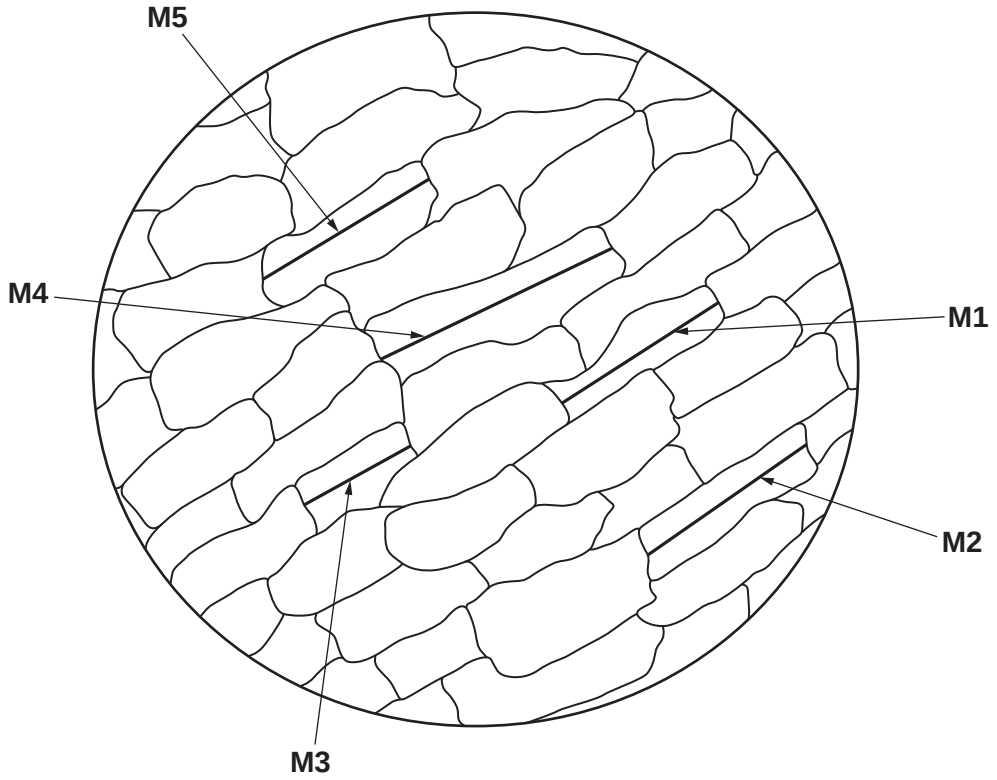

Fig. 2.1

(i) Measure the lengths of the epidermal cells using the lines **M1**, **M2**, **M3**, **M4** and **M5** in Fig. 2.1 and calculate the mean length of the lines.

Show your working.

M1 = **M2** = **M3** = **M4** = **M5** =

mean length of lines = ... [2]

(ii) Using the scale bar and the mean length of lines from **(b)(i)**, calculate the mean actual length of the epidermal cells.

Show your working.

mean actual length = ... μm [2]

Turn over for Question 2(c)

(c) Plants of the same species were grown for 6 months. Each plant was grown in a different percentage of shade.

After 6 months, the mean specific leaf area was recorded, as shown in Table 2.1.

Table 2.1

percentage shade	mean specific leaf area / $cm^2 g^{-1}$
5	118
40	140
50	151
60	153
90	206

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

Use a sharp pencil.

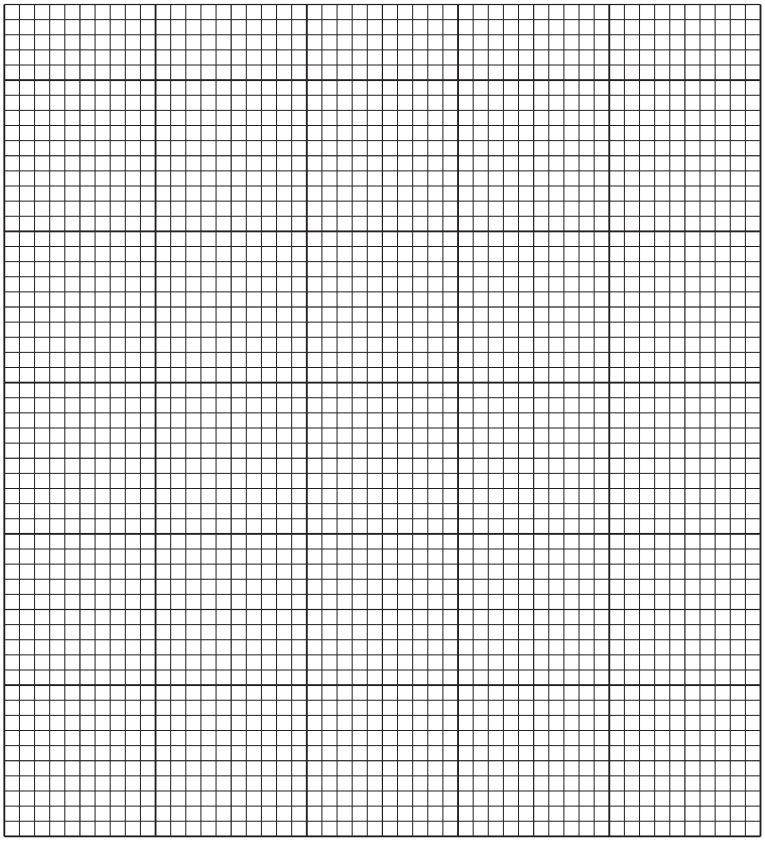

Fig. 2.2 [4]

(ii) Using the data in Table 2.1 and your graph in Fig. 2.2, describe the trend in mean specific leaf area.

.....

.....

.....

.....

..... [2]

(iii) Use the graph in Fig. 2.2 to find the mean specific leaf area in 30% shade.

mean specific leaf area ..... $cm^2\ g^{-1}$
[1]

[Total: 21]

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