Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*4915950272*

**BIOLOGY** **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 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 **16** pages. Any 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** Catalase is an enzyme produced by bacteria. Catalase breaks down hydrogen peroxide to produce oxygen gas, as shown in Fig. 1.1.




**Fig. 1.1**

The activity of catalase can be used to determine the level of bacterial contamination in a food sample.

You will investigate catalase activity in two food samples, **F1** and **F2**.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **E** | 10.0% catalase solution | harmful irritant | 30 |
| **F1** | food sample 1 | none | 20 |
| **F2** | food sample 2 | none | 20 |
| **H** | hydrogen peroxide solution | harmful irritant | 50 |
| **D** | detergent solution | irritant | 20 |
| **W** | distilled water | none | 200 |

If any solution 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**

**(a)** You will need to carry out a **serial** dilution of the 10.0% catalase solution, **E**, to reduce the concentration of catalase by **half** between each successive dilution.

You will need to prepare **four** concentrations of catalase solution in addition to the 10.0% catalase solution, **E**.

After the serial dilution is completed, you will need to have 10 $cm^3$ of each concentration available to use.

**(i)** Complete Fig. 1.2 to show how you will prepare your serial dilution.

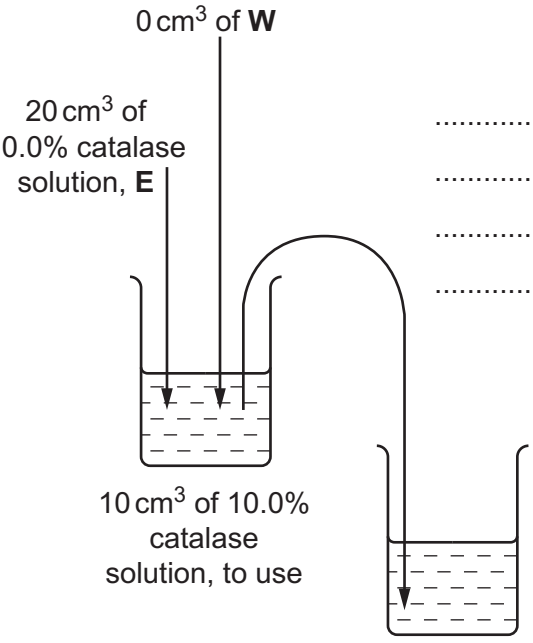
Fig. 1.2 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker add labelled arrows to show:

- the volume of catalase solution transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of catalase solution.

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0 cm3 of W
20 cm3 of 10.0% catalase solution, E
10 cm3 of 10.0% catalase solution, to use

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.....

**Fig. 1.2**

[3]

Carry out step 1 to step 15.

1. Prepare the concentrations of catalase solution, as decided in **(a)(i)**, in the beakers provided.

2. Label **five** of the test-tubes with the concentrations you prepared in step 1.

3. Put 1 $cm^3$ of each concentration of catalase solution into the appropriately labelled test-tube.

4. Label another test-tube **0.0%** and put 1 $cm^3$ of distilled water, **W**, into this test-tube.

5. Put **one** drop of detergent solution, **D**, into each labelled test-tube. Mix gently.

When detergent is used, any oxygen produced by the breakdown of hydrogen peroxide is trapped as foam. The height of the foam can be used as a measure of the volume of oxygen produced.

6. Put 5 $cm^3$ of **H** into each labelled test-tube. This should be done by touching the nozzle of the syringe against the inside of the test-tube, as shown in Fig. 1.3. Gently push the plunger of the syringe so that **H** runs down the inside of the test-tube.

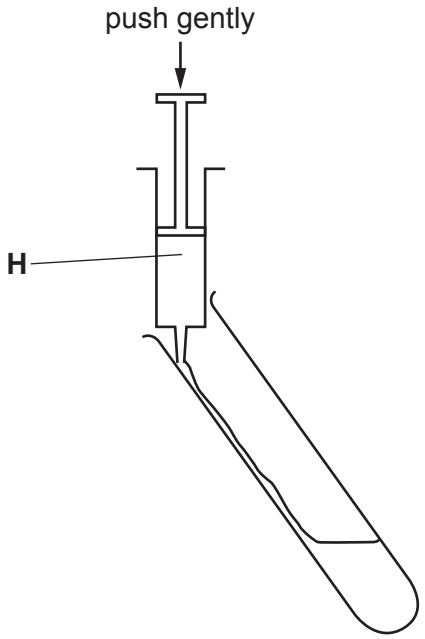



**Fig. 1.3**

7. Start timing. When the foam reaches the top of at least one of the test-tubes, **stop timing** and record this time.

   If the foam does **not** reach the top of any test-tube after 3 minutes, stop timing and record this time as '3 minutes'.

   time = .....

8. Measure the height of the foam in each test-tube. Record your results in **(a)(ii)**.

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**(ii)** Record your results in an appropriate table.

[4]

9. Label a test-tube **F1**, and label another test-tube **F2**.
10. Put 1 $cm^3$ of **F1** into the appropriately labelled test-tube.
11. Put 1 $cm^3$ of **F2** into the appropriately labelled test-tube.
12. Put **one** drop of **D** into each labelled test-tube. Mix gently.
13. Put 5 $cm^3$ of **H** into each labelled test-tube as described in step 6.
14. Start timing and leave for the time you recorded in step 7.
15. After this time (step 14), measure the height of the foam in each test-tube.

**(iii)** Record the height of the foam in each test-tube. Include appropriate units.

**F1** .....

**F2** .....

[2]

**(iv)** Use your results from **(a)(ii)** and **(a)(iii)** to estimate the concentration of catalase in food samples **F1** and **F2**.

**F1** ..... %

**F2** ..... %

[2]

**(v)** A source of error in this investigation is the difficulty of measuring the height of the foam.

Suggest an improvement to the procedure to provide a more accurate measurement of the volume of oxygen produced.

.....

.....

..... [1]

**(vi)** Suggest **one** reason for using a 0.0% concentration in this investigation.

.....

..... [1]

**(vii)** Describe how you could modify this procedure to obtain more accurate estimates of the concentrations of **F1** and **F2** in **(a)(iv)**.

.....

.....

..... [1]

**(b)** A culture of *Escherichia coli* bacteria was grown for 10 days and then placed in solutions of different glucose concentration. The rate of glucose uptake into the bacterial cells was calculated.

The results for *E. coli* are shown in Table 1.2.

**Table 1.2**

| glucose concentration / mg dm$^{-3}$ | glucose uptake rate / mg min$^{-1}$ |
|---|---|
| 0 | 0.0 |
| 25 | 1.0 |
| 40 | 2.5 |
| 60 | 4.8 |
| 75 | 5.1 |
| 100 | 5.1 |

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**(i)** Plot a graph of the data shown in Table 1.2 on the grid in Fig. 1.4.

Use a sharp pencil.

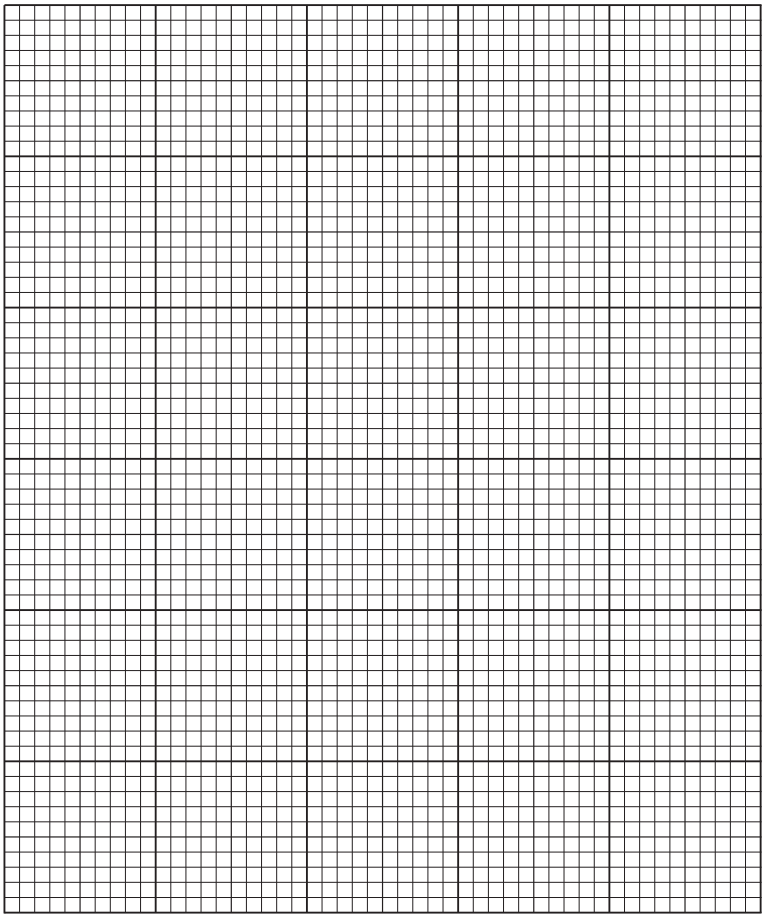


**Fig. 1.4**

[4]

**(ii)** Use your graph in Fig. 1.4 to suggest how glucose is transported into bacterial cells.

Suggest an explanation for your answer.

.....

.....

.....

..... [2]

**(iii)** The rate of glucose uptake in another culture of bacteria, *Chelatobacter heintzii*, was also calculated.

The results for *C. heintzii* are shown in Table 1.3.

**Table 1.3**

| glucose concentration / mg dm$^{-3}$ | glucose uptake rate / mg min$^{-1}$ |
|---|---|
| 0 | 0 |
| 25 | 4.6 |
| 40 | 6.2 |
| 60 | 7.0 |
| 75 | 7.0 |
| 100 | 7.0 |

Cultures of *E. coli* and *C. heintzii* bacteria were placed in the same container with 40 mg dm$^{-3}$ glucose.

Use the data in Table 1.3 and your graph in **(b)(i)** to suggest which population of bacteria would grow the fastest.

Suggest an explanation for your answer.

.....

.....

.....

..... [2]

[Total: 22]

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**2** **N1** 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 **N1**.

Observe the different tissues in the area on **N1** shown by the shaded region in Fig. 2.1.

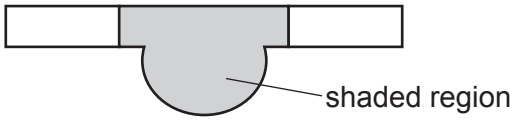



**Fig. 2.1**

Use a sharp pencil for drawing.

**(i)** Draw a large plan diagram of the area of the section on **N1** shown by the shaded region in Fig. 2.1.

Your drawing should show the correct shapes and proportions of the different tissues.

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

[5]

**(ii)** Observe **one** vascular bundle of the section on **N1**.

Select **one** large xylem vessel element and **three** adjacent smaller cells.

Each smaller cell must touch the large xylem vessel element and at least **one** of the other smaller cells.

- Make a large drawing of these **four** cells.
- Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

**Question 2 continues on page 14**

**(b)** Fig. 2.2 is a photomicrograph showing part of a leaf surface.

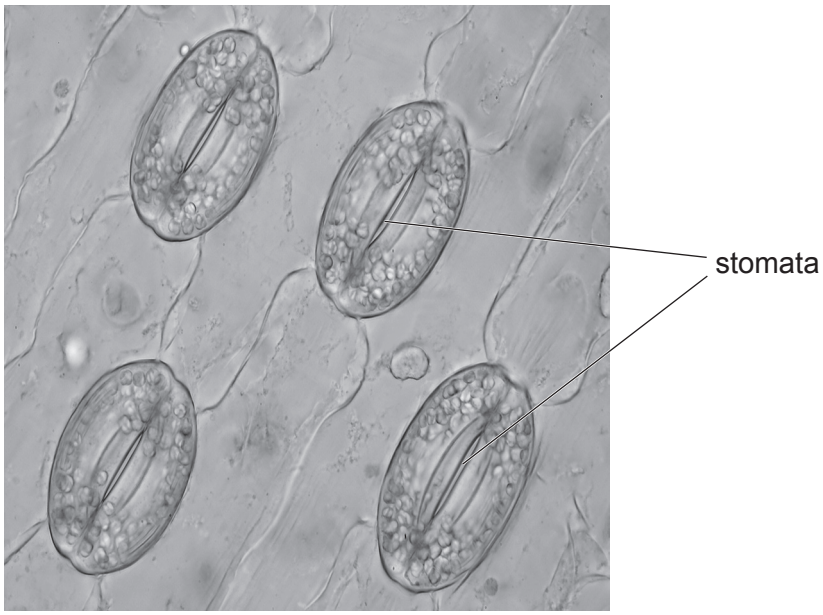



**Fig. 2.2**

The actual area of the photomicrograph in Fig. 2.2 is 0.04 $mm^2$.

The leaf from which Fig. 2.2 is taken has a total surface area of 20 $cm^2$.

1 $cm^2$ = 100 $mm^2$

**(i)** Use Fig. 2.2 to estimate the total number of stomata on the leaf.

Show your working.

number of stomata on the leaf = .....
[3]

**(ii)** One way to improve the accuracy of the estimate of the total number of stomata on a leaf is to use a photomicrograph with a larger area.

State **one other** way to improve the accuracy of the estimate of the total number of stomata on a leaf.

.....

.....

..... [1]

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**(iii)** Fig. 2.3 is a photomicrograph showing part of a leaf surface of a different type of plant.

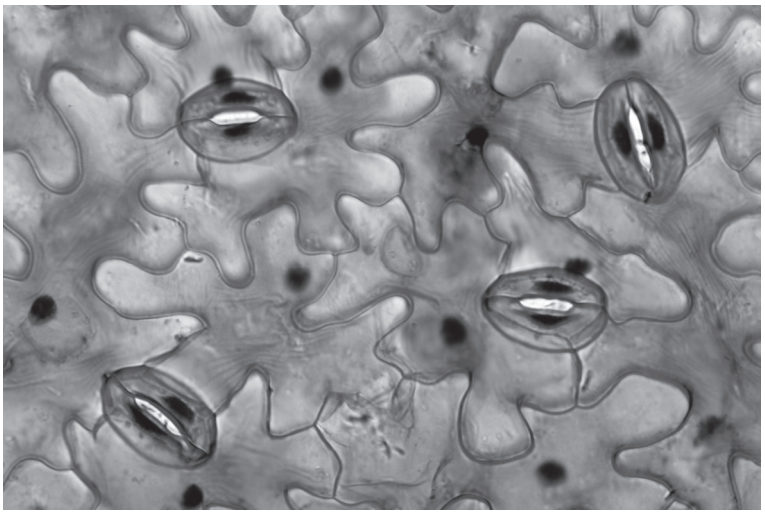


**Fig. 2.3**

Fig. 2.2 and Fig. 2.3 have the same magnification.

Identify the observable differences between the leaf surface shown in Fig. 2.2 and the leaf surface shown in Fig. 2.3.

Record the observable differences in Table 2.1.

**Table 2.1**

| feature | Fig. 2.2 | Fig. 2.3 |
|---|---|---|
| | | |

[4]

[Total: 18]

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