Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

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.

[Turn over

1 Agar that has been stained with a blue indicator can be used to investigate diffusion.

Hydrochloric acid diffuses into blue-stained agar changing the colour of the agar from blue to yellow.

You will investigate the effect of different concentrations of hydrochloric acid on the distance the acid diffuses into the agar (diffusion distance).

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	2.0 mol dm^{-3} hydrochloric acid	irritant	30
U	unknown concentration of hydrochloric acid	irritant	10
W	distilled water	none	50
	6 test-tubes containing blue agar	none	–

If any solution 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:

- prepare different concentrations of hydrochloric acid
- measure the diffusion distance of each concentration of hydrochloric acid after 10 minutes and after 20 minutes
- use your results to estimate the concentration of hydrochloric acid in **U**.

You will need to carry out a serial dilution of the 2.0 mol dm^{-3} hydrochloric acid, **H**, to reduce the concentration by **a factor of ten** between each successive dilution.

You will need to prepare **four** concentrations of hydrochloric acid in addition to 2.0 mol dm^{-3} hydrochloric acid, **H**.

After the serial dilution is completed, you will need to have 9 cm^3 of each concentration available to use.

(a) (i) Complete Fig. 1.1 to show how you will prepare your serial dilution.

Each beaker should have:

- a labelled arrow to show the volume of hydrochloric acid transferred
- a labelled arrow to show the volume of distilled water, **W**, added
- a label under each beaker to show the concentration of the hydrochloric acid.

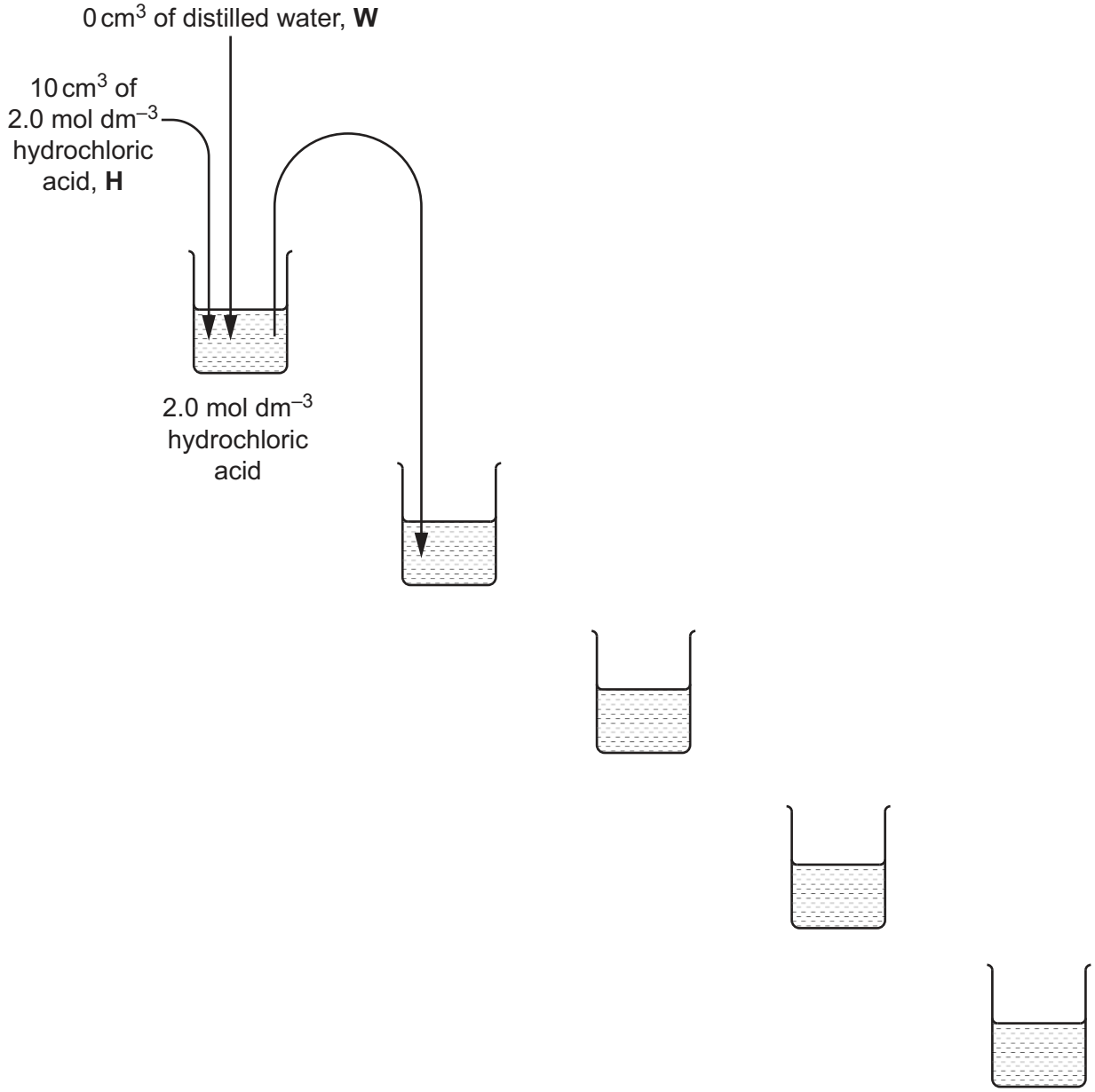

Fig. 1.1

[3]

Carry out step 1 to step 10.

step 1 Prepare the concentrations of hydrochloric acid as shown in Fig. 1.1.

step 2 Label **one** test-tube containing blue agar with the label **U**.

step 3 Label the other test-tubes containing blue agar with the concentrations of hydrochloric acid prepared in step 1.

step 4 Put 1 cm^3 of 2.0 mol dm^{-3} hydrochloric acid, **H**, into the appropriately labelled test-tube.

step 5 Put 1 cm^3 of each of the other concentrations of hydrochloric acid, as prepared in step 1, into the appropriately labelled test-tube.

step 6 Put 1 cm^3 of the unknown concentration of hydrochloric acid, **U**, into the test-tube labelled **U**.

In step 7 and step 9 you will need to wait for 10 minutes. While you are waiting, use your time to continue with other parts of Question 1.

step 7 Start timing and wait for 10 minutes.

step 8 After the 10 minutes, measure the depth of yellow agar (diffusion distance), shown in Fig. 1.2, for each concentration of hydrochloric acid and for **U**.
Record your results in **(a)(ii)**.

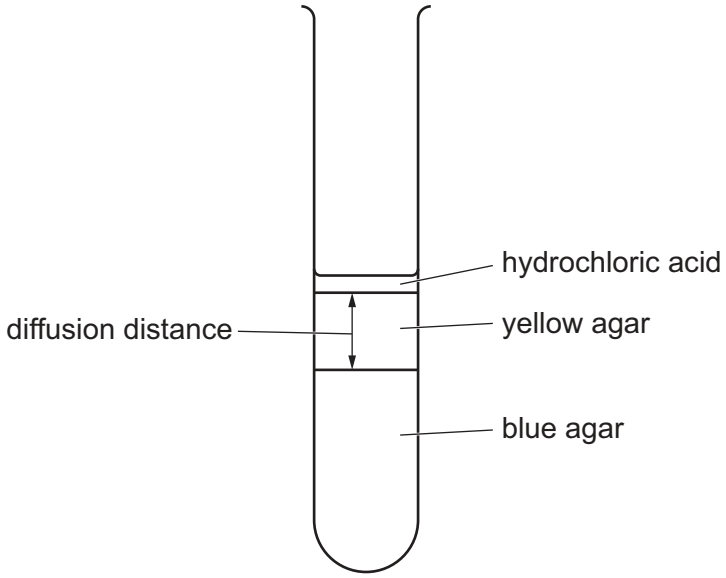

Fig. 1.2

step 9 Continue timing and wait for a further 10 minutes (20 minutes in total).

step 10 After the 10 minutes, measure the depth of yellow agar (diffusion distance) for each concentration of hydrochloric acid and **U**. Record your results in **(a)(ii)**.

(ii) Record your results in an appropriate table.

[6]

(iii) Explain how the concentration of hydrochloric acid affects the diffusion distance.

.....

.....

..... [1]

(iv) Suggest **one** source of error in the procedure described in step 8 and step 10 of this investigation.

.....

.....

..... [1]

(v) Use your results at 20 minutes to estimate the concentration of hydrochloric acid in **U**.

concentration of hydrochloric acid in **U** = ...mol dm^{-3} [1]

(vi) Suggest **two** improvements to the procedure that would give you a more accurate value for your estimated concentration of hydrochloric acid in **U**.

1 .....

.....

.....

2 .....

.....

.....

[2]

(vii) For the 2.0 mol dm^{-3} hydrochloric acid, calculate the rate of diffusion over 20 minutes.

Show your working and use appropriate units.

rate of diffusion = ...

[2]

(viii) One hypothesis for this investigation is:

the rate of diffusion decreases over time.

Show, with a tick (✓) in the appropriate box, whether your results support or do **not** support this hypothesis.

results support hypothesis ☐

results do **not** support hypothesis ☐

Give **one** reason for your answer.

reason .....

.....

..... [1]

Question 1 continues on page 8.

(b) A student investigated the effect of temperature on cell membranes by measuring the diffusion of pigment from beetroot cells.

The student immersed discs of beetroot in water at different temperatures for 10 minutes.

A colorimeter was used to determine how much pigment had diffused into the water by measuring the percentage transmission of light through each sample of water.

The results are shown in Table 1.2.

Table 1.2

temperature / °C	percentage transmission of light
10	86
30	84
45	70
60	23
75	14

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

Use a sharp pencil.

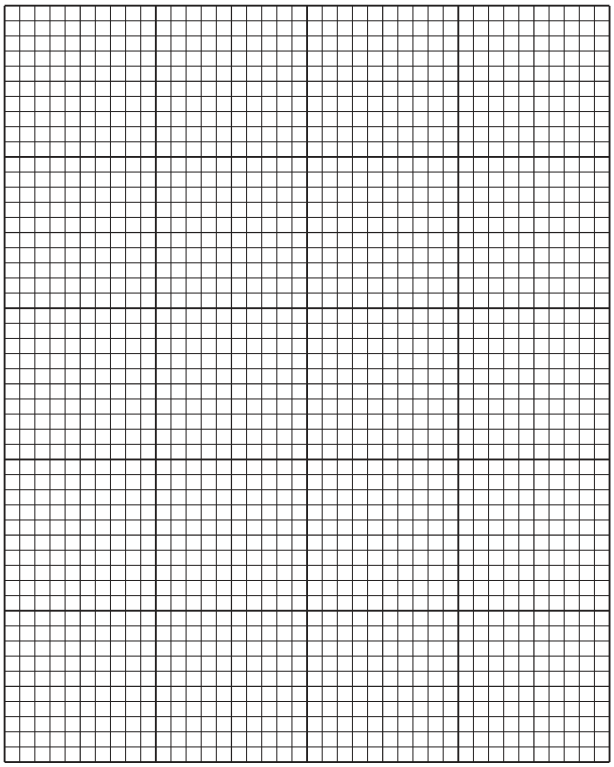

Fig. 1.3

[4]

(ii) Temperature affects the permeability of the cell membrane.

State **one** reason for the change in permeability between 45 °C and 60 °C.

.....

.....

..... [1]

[Total: 22]

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

(a) **(i)** Draw a large plan diagram of the region of the leaf section on **J1** indicated by the shaded area in Fig. 2.1. Use a sharp pencil.

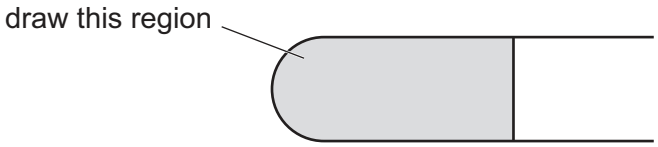

Fig. 2.1

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

[5]

(ii) The upper epidermis of the leaf on **J1** has a thicker cuticle than the lower epidermis.

Observe the upper epidermis and the layer of cells beneath it.

Select a group of four adjacent cells. This group must include **two** cells from the upper epidermis and **two** cells from the layer beneath the 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 the cell wall of **one** epidermal cell.

[5]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a leaf from a different plant from **J1**.

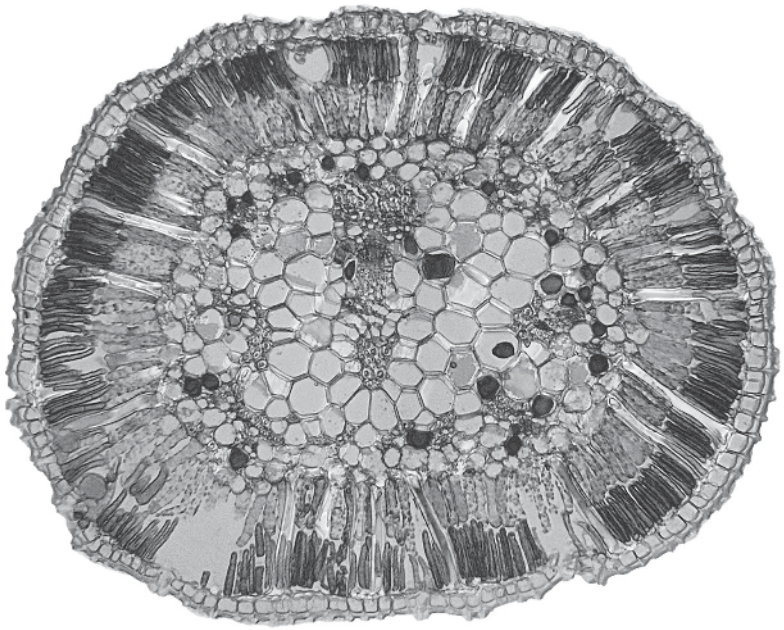

Fig. 2.2

(i) Identify **three** observable differences, other than colour, between the section on **J1** and the section in Fig. 2.2.

Record these **three** observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.2

[3]

(ii) The leaf in Fig. 2.2 grows in a dry habitat.

For **one** observable feature in Fig. 2.2, explain how this allows the plant to survive in a dry habitat.

feature .....

explanation .....

.....

[1]

(c) Fig. 2.3 is the same photomicrograph as that shown in Fig. 2.2.

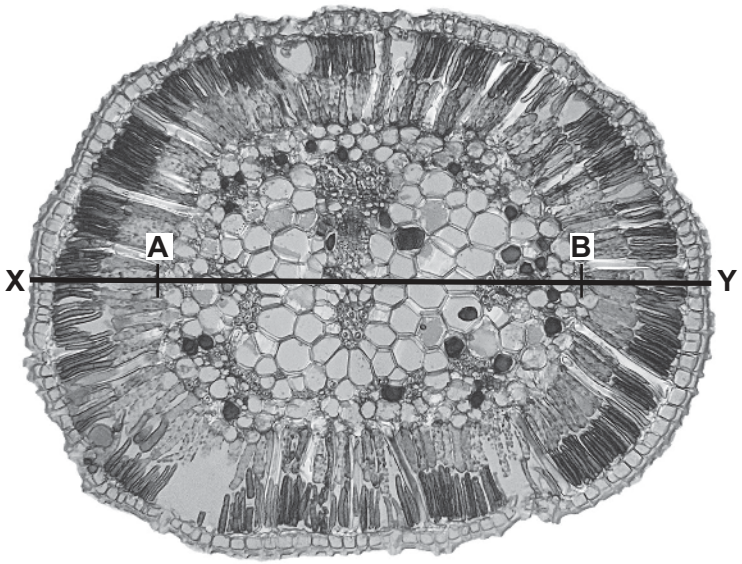

Fig. 2.3

In Fig. 2.3:

- the line **X**–**Y** represents the width of the whole leaf section
- the line **A**–**B** represents the width of the central region.

Calculate the width of the central region as a percentage of the width of the whole leaf section.

Show your working.

answer = ...% [4]

[Total: 18]

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