Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*2088314847*

**BIOLOGY** **9700/33**

Paper 3 Advanced Practical Skills 1 **February/March 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.


© UCLES 2021

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** Agar cubes that have been stained with universal indicator can be used to investigate diffusion.

When hydrochloric acid diffuses into the agar cubes, the agar cubes change colour. The end-point is reached when the **whole cube** has changed colour to pink.

You will investigate the effect of the concentration of hydrochloric acid on the rate of diffusion.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | materials | hazard | volume / $cm^3$ |
|---|---|---|---|
| **H** | 1.0 mol $dm^{-3}$ hydrochloric acid | irritant | 100 |
| **A** | agar block on a white tile | none | – |
| **W** | distilled water | none | 100 |

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

It is recommended that you wear suitable eye protection.

© UCLES 2021

You will use proportional dilution of 1.0 mol dm$^{-3}$ hydrochloric acid, **H**, to make the different concentrations of hydrochloric acid that you will need for this investigation. You will need to reduce the concentration of hydrochloric acid by 0.2 mol dm$^{-3}$ between each successive dilution.

You will prepare 20.0 cm$^3$ of each concentration of hydrochloric acid using **H** and **W**.

**(a) (i)** Complete Table 1.2 to show how you will prepare the concentrations of hydrochloric acid that you will use.

**Table 1.2**

| concentration of hydrochloric acid / mol dm$^{-3}$ | volume of **H** / cm$^3$ | volume of **W** / cm$^3$ |
|---|---|---|
| 1.0 | 20.0 | 0.0 |

[2]

Carry out step 1 to step 6.

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

2. On the white tile provided, cut three agar cubes from the agar block, **A**, for **each** of the concentrations of hydrochloric acid that you will use. Do **not** allow the agar block or agar cubes to come into contact with your skin because this may affect your results.

   The cubes should be approximately 5 mm × 5 mm × 5 mm, as shown in Fig. 1.1.

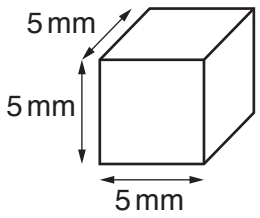



**Fig. 1.1**

In step 3 you will put three of the agar cubes into the beaker containing 1.0 mol $dm^{-3}$ hydrochloric acid.

**(ii)** State the apparatus you will use to put the agar cubes into the beaker containing 1.0 mol $dm^{-3}$ hydrochloric acid.

.....

..... [1]

3. Put three agar cubes into the beaker containing 1.0 mol $dm^{-3}$ hydrochloric acid and immediately start timing.

4. Measure the time taken for each of the three agar cubes to reach the end-point and record the time in **(a)(iii)**.

   The end-point for each cube is when the **whole** agar cube has changed colour to pink.

   If any agar cube has not reached the end-point after 3 minutes, stop timing and record as 'more than 180' for that agar cube.

5. Put three agar cubes into the beaker containing the next concentration of hydrochloric acid that you prepared in step 1 and immediately start timing.

6. Repeat step 4 and step 5 until results have been collected for all the concentrations of hydrochloric acid prepared in step 1.

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

[5]

**(iv)** State the dependent variable in this investigation.

..... [1]

**(v)** Identify **one** source of error in step 2 to step 6.

Suggest an improvement to the method that will reduce the effect of this error.

source of error .....

.....

improvement .....

.....

.....

.....

[2]

**(vi)** A student suggested the hypothesis:

> As the concentration of hydrochloric acid decreases, the time taken for acid to diffuse into the agar blocks will decrease.

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

support ☐

do not support ☐

Explain how your results provide evidence for this decision.

.....

.....

.....

[1]

**(vii)** The procedure described in step 1 to step 6 investigated the effect of changing the concentration of hydrochloric acid on the rate of diffusion, using the time taken to reach the end-point.

Describe how you could modify this procedure to investigate the effect of changing the temperature on the rate of diffusion, using the time taken to reach the end-point.

.....

.....

.....

.....

.....

.....

..... [2]

**(b)** Salt is used to preserve cheese. Cheese can be soaked in a salt solution to allow the salt to diffuse into it.

A scientist soaked cheese in a 15% salt solution at 4 °C and measured the distance that the salt had diffused into the cheese at intervals over a period of 20 hours.

The results are shown in Table 1.3.

**Table 1.3**

| time / hours | distance / cm |
|---|---|
| 0 | 0.00 |
| 4 | 0.46 |
| 8 | 0.69 |
| 13 | 0.90 |
| 16 | 0.99 |
| 20 | 1.06 |

© UCLES 2021

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

Use a sharp pencil for drawing graphs.

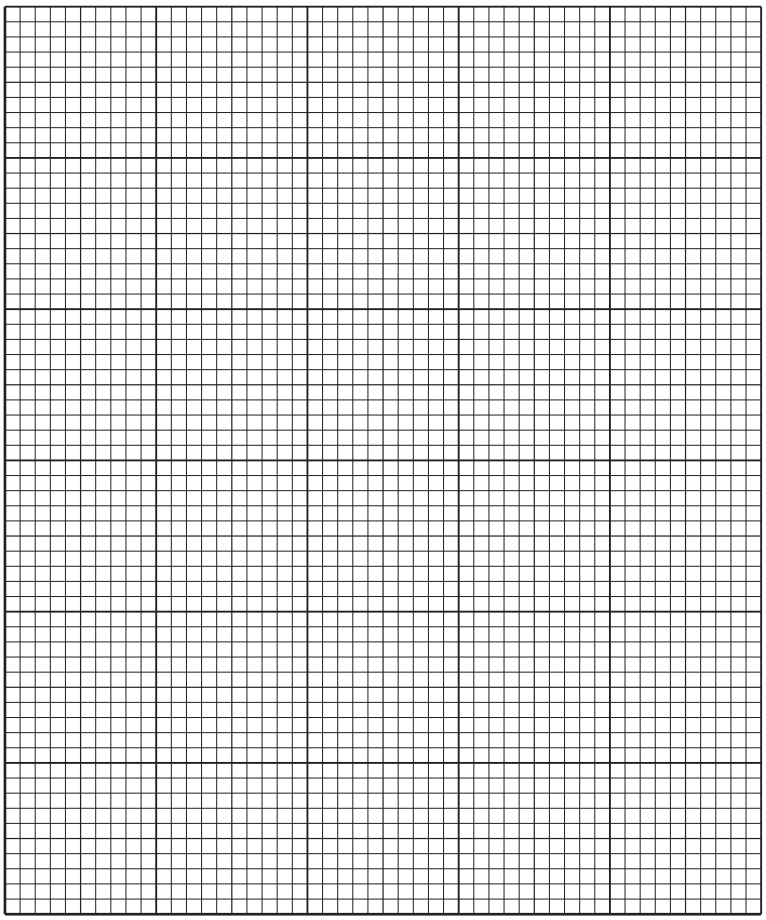


**Fig. 1.2**

[4]

**(ii)** Use your graph in Fig. 1.2 to calculate the mean rate of diffusion of salt during the first three hours.

Show your working on the graph and in the space below.

mean rate of diffusion = ..... cm hour$^{-1}$

[2]

The scientist repeated the investigation at 15 °C and found the rate of diffusion at 15 °C to be greater than the rate of diffusion at 4 °C.

**(iii)** Explain the difference between the rate of diffusion at 4 °C and the rate of diffusion at 15 °C.

.....

.....

.....

..... [1]

[Total: 21]

**Question 2 starts on page 10**

**2** **P1** is a slide of a stained transverse section through a plant stem.

**(a)** Set up the microscope so that you can observe different tissues in the area of the stem on **P1** shown by the shaded region in Fig. 2.1.

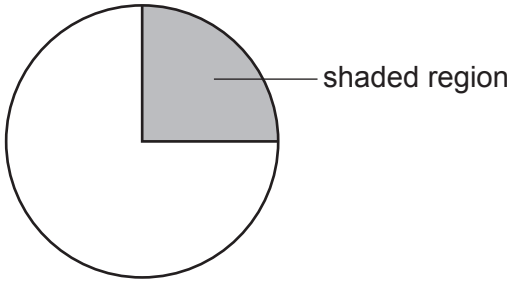



**Fig. 2.1**

Use a sharp pencil for drawings.

**(i)** Draw a large plan diagram of the area of the stem on **P1** 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 the epidermis.

[5]

**(ii)** Observe the cells in the central tissue of the stem on **P1**.

Select **four** adjacent, touching cells of the central tissue.

Each cell that you select must touch at least two of the other 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.

[5]

**(b)** Fig. 2.2 is a photomicrograph of a stained transverse section through a stem of a different type of plant. This plant is adapted to live submerged in water.

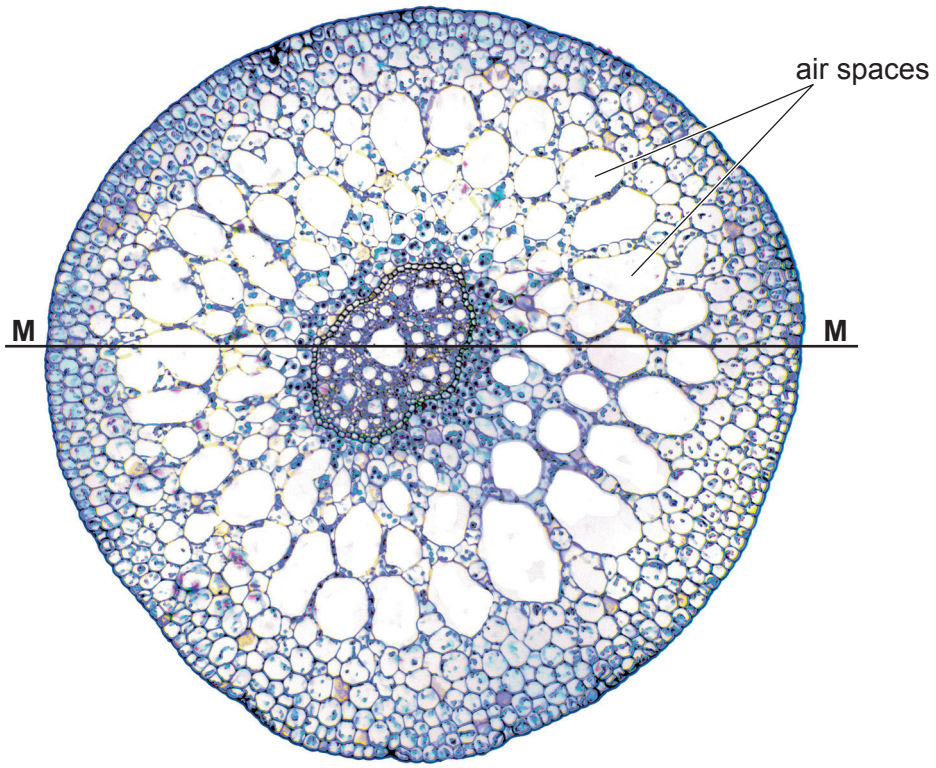



**Fig. 2.2**

**(i)** Calculate the total area, in $mm^2$, of the image of the stem shown in Fig. 2.2.

- Assume that the stem is circular in cross-section.
- Measure the diameter of the image of the stem along line **M–M**.
- Show your working.

The formula for calculating the area of a circle is:

area = $3.14 \times r^2$ ($r$ = radius)

area = ..... $mm^2$
[3]

© UCLES 2021

**(ii)** In Fig. 2.2, the tissue that contains air spaces has an area in the image of 4500 $mm^2$.

Use your answer to **(b)(i)** to calculate the percentage area of the stem shown in Fig. 2.2 that contains air spaces.

percentage area = .....
[1]

**(iii)** The presence of a large number of air spaces in the stem is one adaptation of the plant shown in Fig. 2.2 for living submerged in water.

Suggest a function of these air spaces.

.....

.....

..... [1]

**(c)** Fig. 2.3 is a photomicrograph of the same stem section that is shown in Fig. 2.2.

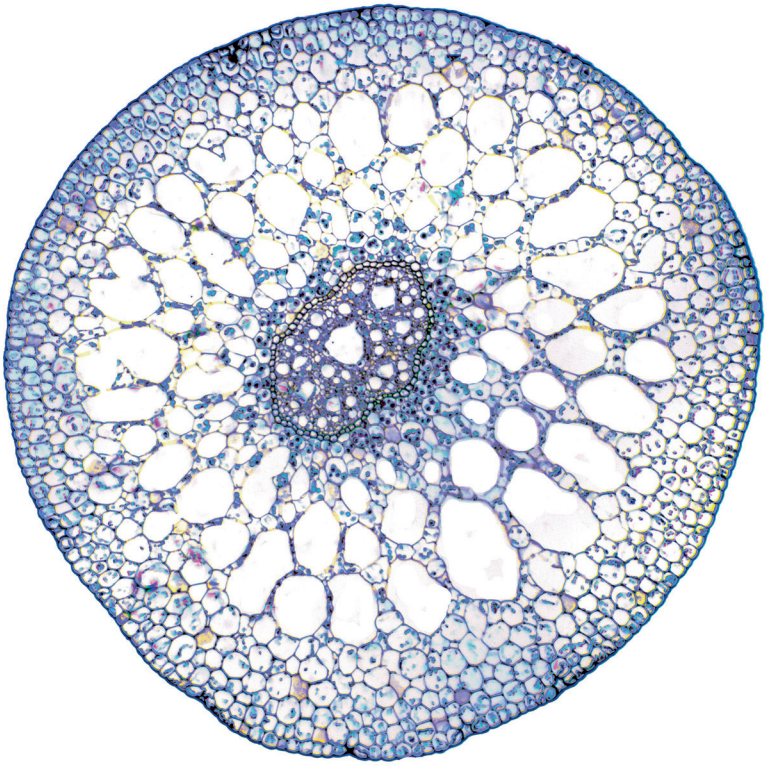


**Fig. 2.3**

One difference between the stem shown in Fig. 2.3 and the stem on slide **P1** is the presence of air spaces in the stem shown in Fig. 2.3.

Identify **other** observable differences between the stem shown in Fig. 2.3 and the stem on slide **P1**.

Record these observable differences in an appropriate table.

[4]

[Total: 19]

**BLANK PAGE**

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

© UCLES 2021