Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2672261201

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

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

You will investigate the effect of pH on the activity of catalase in an extract from yeast cells.

You will need to immobilise the yeast cells in sodium alginate beads.

When a bead containing yeast cells is dropped into hydrogen peroxide solution the bead will sink. As oxygen is released the bead will rise. The more oxygen released, the faster the bead will rise.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
Y	yeast cell suspension	none	15
H	3.0% hydrogen peroxide solution	harmful irritant	30
S	sodium alginate solution	none	30
C	calcium chloride solution	none	30
B3	buffer pH 3	none	10
B4	buffer pH 4	none	10
B6	buffer pH 6	none	10
B7	buffer pH 7	none	10
B8	buffer pH 8	none	10

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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Carry out step 1 to step 19.

step 1 Put 10 cm^3 of **C** into a large test-tube.

step 2 Put 5 cm^3 of **S** into a small beaker.

step 3 Stir **Y** and put 3 cm^3 of **Y** into the beaker used in step 2. Mix well.

step 4 Use a 5 cm^3 syringe to collect 2 cm^3 of the mixture of **S** and **Y** (prepared in step 3).

step 5 Position the 5 cm^3 syringe over the **large** test-tube containing **C** as shown in Fig. 1.1.

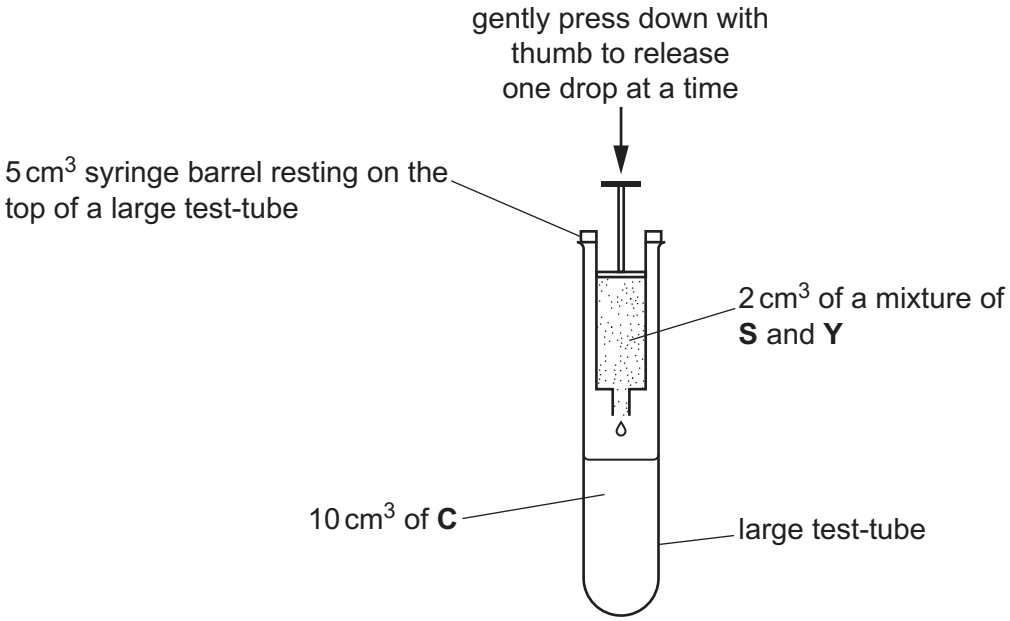


Fig. 1.1

step 6 Gently press down on the plunger of the 5 cm^3 syringe with your thumb to release **one** drop into solution **C**. The drop should form a bead.

step 7 Repeat step 6 until you have used all 2 cm^3 of the mixture.
Leave the beads in the solution **C** for 1 minute.

step 8 Tip the contents of the large test-tube from step 7 into a Petri dish.

step 9 Put **two** beads into each of the beakers containing pH buffers **B3**, **B4**, **B6**, **B7** and **B8**.

step 10 Label a **small** test-tube **B3**.

step 11 Put 3 cm^3 of the pH buffer **B3** into the test-tube labelled **B3**.

step 12 Put 3 cm^3 of hydrogen peroxide solution, **H**, into this test-tube and shake to mix. Leave this test-tube in a test-tube rack.

step 13 Pick up a bead from the pH buffer **B3** using blunt forceps.

step 14 Drop the bead into the test-tube from step 12. Start timing when the bead reaches the bottom of the test-tube.

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step 15 Time how long it takes for the bead to reach the surface of the liquid.
If the bead does not reach the surface after 60 seconds, stop timing and record as 'more than 60'.

step 16 Record the result from step 15 in **(a)(i)**.

step 17 Pick up the second bead from the pH buffer **B3** using blunt forceps.

step 18 Repeat step 14 to step 16.

step 19 Repeat step 10 to step 18 with the remaining pH buffers instead of **B3**.

(a) (i) Record your results in an appropriate table.

[5]

(ii) State the independent variable in this investigation.

..... [1]

(iii) State **one** significant source of error in this investigation.

.....

.....

..... [1]

You will need to estimate the pH of the solution, **U**.

You are provided with **U**, as shown in Table 1.2.

Table 1.2

labelled	contents	hazard	volume / cm^3
U	solution of unknown pH	none	10

If **U** comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

Carry out step 20 to step 27.

step 20 Put **one** bead into the beaker containing solution **U**.

step 21 Label a clean test-tube **U**.

step 22 Put 3 cm^3 of solution **U** into the test-tube labelled in step 21.

step 23 Put 3 cm^3 of hydrogen peroxide solution into this test-tube. Leave this test-tube in a test-tube rack.

step 24 Pick up the bead from the beaker containing solution **U**, using blunt forceps.

step 25 Drop the bead into the test-tube from step 23. Start timing when the bead reaches the bottom of the test-tube.

step 26 Time how long it takes for the bead to reach the surface of the liquid.
If the bead does not reach the surface after 60 seconds, stop timing and record as 'more than 60'.

step 27 Record the result from step 26 in **(a)(iv)**.

(iv) State the result for solution **U**.

result for solution **U** ..... [1]

(v) Using your results from **(a)(i)** and **(a)(iv)**, estimate the pH of solution **U**.

pH of solution **U** ..... [1]

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(vi) In the procedure described in step 1 to step 19, the effect of pH on catalase activity was investigated.

Describe how you would modify this procedure to investigate the effect of concentration of **substrate** on the time taken for the beads to rise.

.....

.....

.....

.....

..... [2]

(b) Immobilised enzymes are often used in industry. For example the enzyme lactase is used to produce lactose-free milk.

A student measured the initial rate of reaction of human lactase at different concentrations of lactose and plotted a graph, as shown in Fig. 1.2.

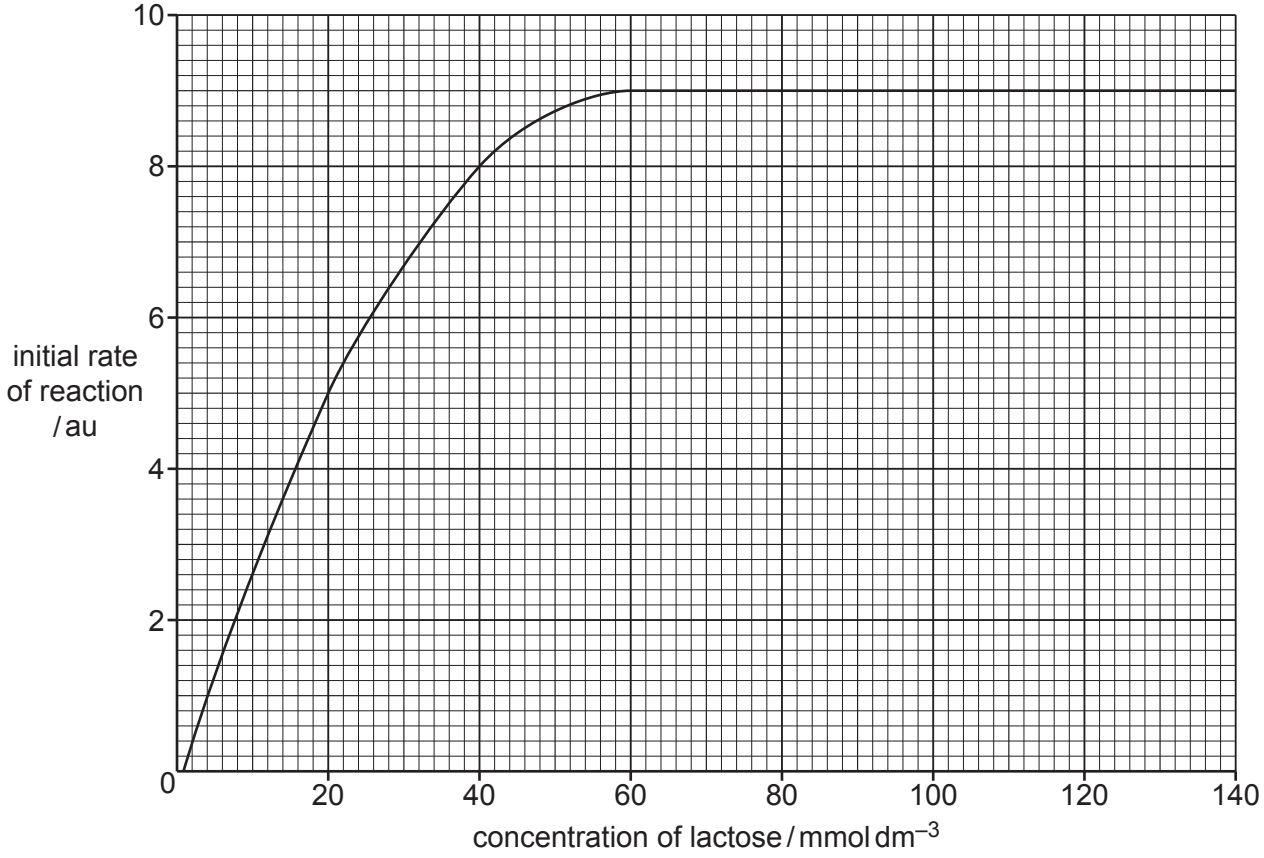


Fig. 1.2

(i) Explain the change in the initial rate of reaction between:

20 mmol dm^{-3} and 40 mmol dm^{-3} of lactose

.....

.....

.....

60 mmol dm^{-3} and 140 mmol dm^{-3} of lactose.

.....

.....

.....

.....

.....

[2]

(ii) Use the graph in Fig. 1.2 to estimate the Michaelis-Menten constant (K_m) of lactase.

Show your working **on the graph** in Fig. 1.2.

K_m = ... $mmol\,dm^{-3}$ [3]

(c) Lactose is found in the milk of many mammals.

A scientist investigated the concentration of lactose in the milk of different mammals.

Table 1.3 shows the results of this investigation.

Table 1.3

type of mammal	concentration of lactose / mmol dm^{-3}
rabbit (RA)	60.0
seal (SE)	2.5
goat (GO)	137.5
sheep (SH)	150.0
horse (HO)	222.5

Plot a bar chart of the data shown in Table 1.3 on the grid in Fig. 1.3.

Use a sharp pencil.

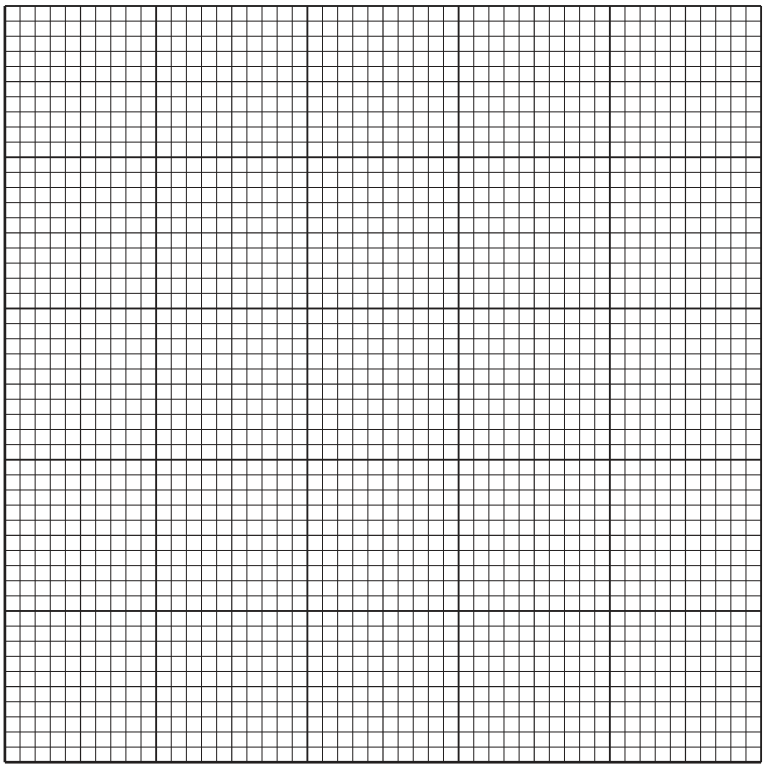


Fig. 1.3

[4]

[Total: 20]

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

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

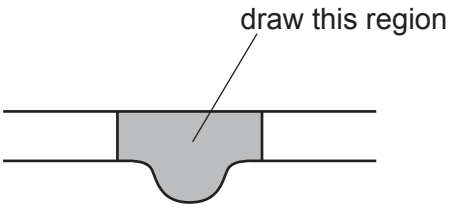


Fig. 2.1

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

[5]

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(ii) Observe the vascular tissue in the midrib on the section of the leaf on **J1**.

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

Each xylem vessel element must touch at least **two** other xylem vessel elements.

- Make a large drawing of this group of **four** xylem vessel elements.
- Use **one** ruled label line and label to identify the lumen of **one** xylem vessel element.

[5]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a different leaf.

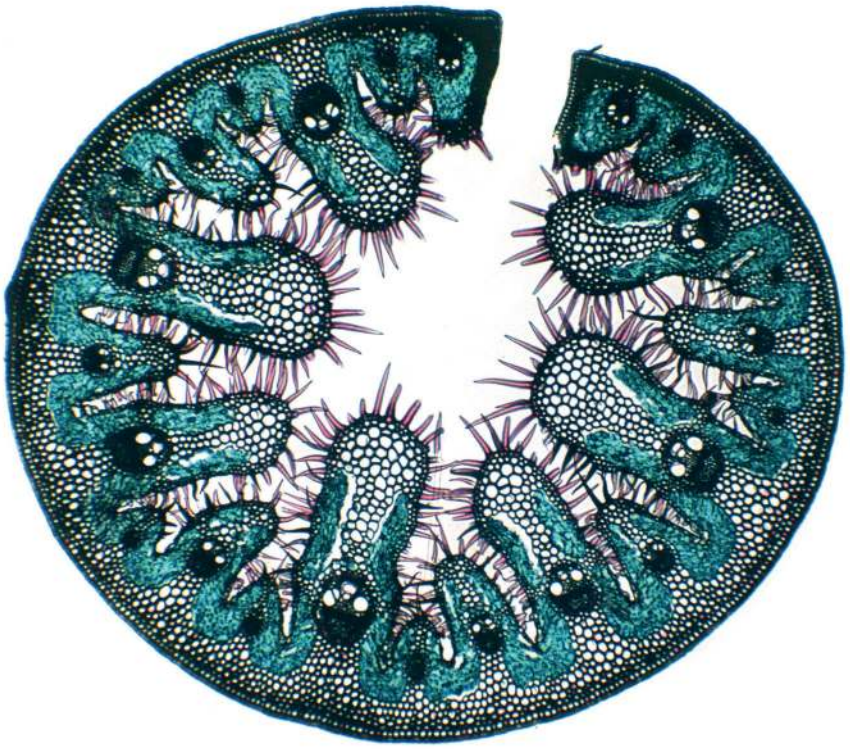


Fig. 2.2

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

Record these three observable differences in Table 2.1.

Table 2.1

feature	Fig. 2.2	J1

[4]

(ii) The leaf section shown in Fig. 2.2 is from a xerophytic plant which grows in sand dunes where there is very little water.

State **two** observable features of the leaf section shown in Fig. 2.2 which help the plant to survive in dry conditions. Explain how each feature allows the plant to survive in dry conditions.

feature 1 .....

explanation

.....

feature 2 .....

explanation

.....

[2]

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

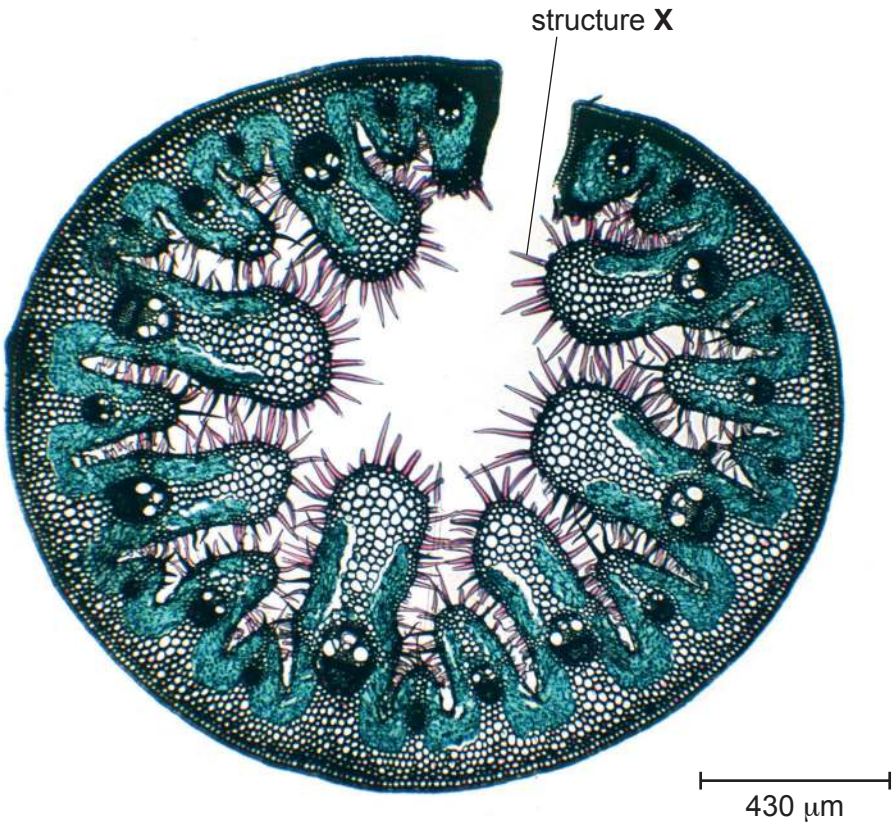


Fig. 2.3

Use the scale bar to calculate the actual length of structure **X**.

Show your working and use appropriate units.

actual length of structure **X** = ... [4]

[Total: 20]

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