Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **9700/34**

Paper 3 Advanced Practical Skills 2 **October/November 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 [ ].

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For Examiner's Use	
1	
2	
Total	

This document has **16** pages. Any blank pages are indicated.

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1 The progress of some enzyme-catalysed reactions can be followed by measuring the time taken for the substrate to be hydrolysed.

The enzyme amylase catalyses the hydrolysis of starch to maltose.

You will investigate the effect of different concentrations of amylase on the hydrolysis of starch.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3	risk
E	2.0% amylase solution	irritant	50	.....
S	1.0% starch solution	none	50	.....
W	distilled water	none	100	
iodine	iodine solution	irritant	25	.....
U	unknown concentration of amylase solution	irritant	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.

(a) **(i)** Think about the hazards of using the materials in Table 1.1 and decide whether the risk of using **E**, **S** and **iodine** is **low**, **medium** or **high**.

Complete Table 1.1, using the words **low**, **medium** or **high**, to state the risk of using **E**, **S** and **iodine**. You may use each word once, more than once or not at all. [1]

You will need to:

- prepare different concentrations of amylase solution
- record the time taken for the amylase to hydrolyse starch
- use your results to estimate the concentration of an unknown solution of amylase, **U**.

You will need to use proportional dilution to make different concentrations of amylase solution, **E**.

You will need to prepare 10 cm^3 of each concentration, using **E** and **W**.

Table 1.2 shows how to prepare two of the concentrations you will use.

Decide which other concentrations of amylase solution you will use.

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(ii) Complete Table 1.2 to show how you will prepare the other concentrations.

Table 1.2

percentage concentration of amylase solution	volume of E / cm^3	volume of W / cm^3
2.0	10.0	0.0
0.4	2.0	8.0

[2]

During the investigation you will be sampling at intervals and using iodine solution to test for the presence of starch. The end-point is reached when the iodine solution is a dark yellow-brown. There may also be some specks of blue-black present in the iodine solution. These specks can be ignored.

Carry out step 1 to step 14.

step 1 Prepare the concentrations of amylase solution as shown in Table 1.2, in the beakers provided. Mix well.

step 2 Label test-tubes with the concentrations of amylase solution prepared in step 1.

step 3 Label the white tile with the numbers shown in Fig. 1.1.

The numbers indicate the sampling times in seconds.

step 4 Put **one** drop of **iodine** on the white tile at each sampling time, as shown in Fig. 1.1.

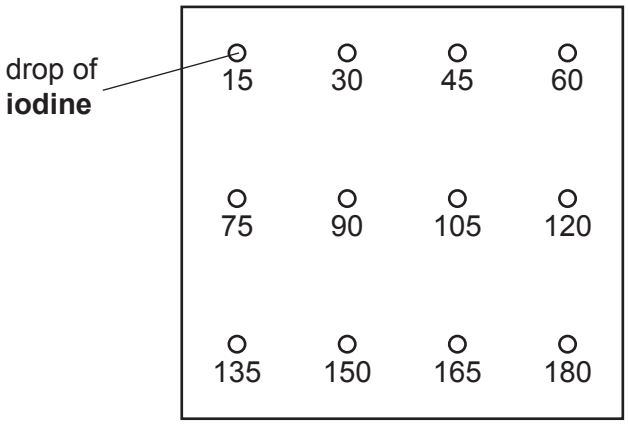

Fig. 1.1

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step 5 Put 3 cm^3 of **S** into each of the test-tubes labelled in step 2.

step 6 Put 1 cm^3 of the 2.0% amylase solution, **E**, into the test-tube labelled 2.0%. Use a glass rod to mix.

step 7 Start timing.

step 8 After 15 seconds, use the glass rod to transfer a drop of the mixture from the test-tube onto the drop of **iodine** that is labelled **15**, on the white tile.

step 9 Clean the glass rod with a paper towel.

step 10 Repeat step 8 to step 9 at 15-second intervals until the end-point is reached.

step 11 Record in **(a)(iii)** the time when the end-point is first observed.

If the end-point is not reached at 180 seconds, record as 'more than 180'.

step 12 Clean the white tile with a damp paper towel and then dry the white tile. Make sure all the numbers are still visible.

step 13 Put **one** drop of **iodine** on the white tile at each sampling time, as shown in Fig. 1.1.

step 14 Repeat step 6 to step 13 using the other concentrations of amylase solution you prepared in step 1.

(iii) Record your results in an appropriate table.

[5]

(iv) State the independent variable in this investigation.

..... [1]

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Carry out step 15 to step 23.

step 15 Put **one** drop of **iodine** on the white tile at each sampling time, as shown in Fig. 1.1.

step 16 Label a test-tube with the letter **U**.

step 17 Put 3 cm^3 of **S** into this test-tube.

step 18 Put 1 cm^3 of solution **U** into the same test-tube. Use a glass rod to mix.

step 19 Start timing.

step 20 After 15 seconds, use the glass rod to transfer a drop of the mixture from the test-tube onto the drop of **iodine** that is labelled **15**, on the white tile.

step 21 Clean the glass rod with a paper towel.

step 22 Repeat step 20 to step 21 at 15-second intervals until the end-point is reached.

step 23 Record, in **(a)(v)**, the time when the end-point is first observed.

If the end-point is not reached at 180 seconds, record as 'more than 180'.

(v) State the result for **U**.

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

(vi) Using your results in **(a)(iii)** and **(a)(v)**, estimate the concentration of amylase in **U**.

..... [1]

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

..... [1]

(viii) Suggest how you could make **one** improvement to reduce the source of error stated in **(a)(vii)**.

.....

.....

.....

..... [1]

(ix) Describe how you would modify the procedure to investigate the effect of **pH** on the time taken for amylase to hydrolyse starch.

.....

.....

.....

.....

..... [2]

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(b) A student investigated the effect of different substrate concentrations on the activity of an enzyme in the presence of an inhibitor.

The concentration of the inhibitor was standardised.

The results are shown in Table 1.3.

Table 1.3

concentration of substrate / mol dm^{-3}	rate of reaction / arbitrary units
0.0	0.000
0.2	0.750
0.4	1.375
0.6	1.800
0.8	2.175
1.0	2.250

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

Use a sharp pencil.

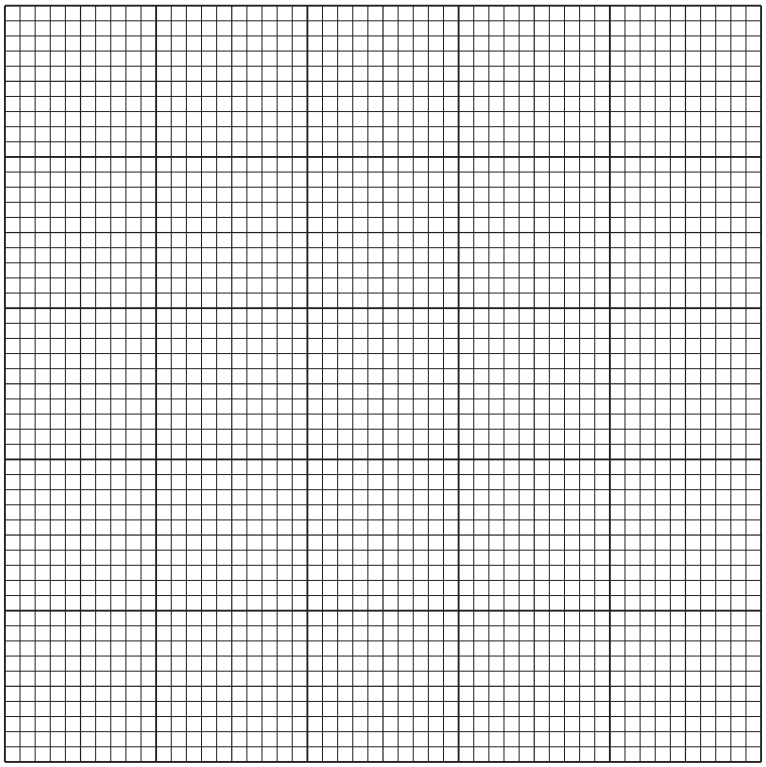

Fig. 1.2

[4]

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(ii) Use your graph in Fig. 1.2 to determine the rate of reaction when the concentration of substrate is 0.45 mol dm^{-3}.

rate of reaction = ... arbitrary units [1]

(iii) The V_{max} of this enzyme is 2.250 arbitrary units.

Using this information and the graph in Fig. 1.2, state whether the inhibitor is a competitive inhibitor or a non-competitive inhibitor.

.....

Explain your answer.

.....

.....

.....

..... [2]

[Total: 22]

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2 **M1** 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 **M1** indicated by the shaded area in Fig. 2.1.

Use a sharp pencil.

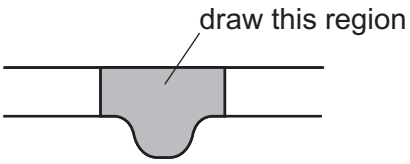

Fig. 2.1

Use **one** ruled label line and label to identify the palisade tissue.

[5]

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(ii) Observe the cells in the upper epidermis on the section of the leaf on **M1**.
Select a line of **four** adjacent epidermal cells.

Each cell must touch at least **one** of the other epidermal cells.

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

[4]

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(b) Fig. 2.2 is a photomicrograph of a stained transverse section of a different leaf from **M1**.

You are not expected to be familiar with this specimen.

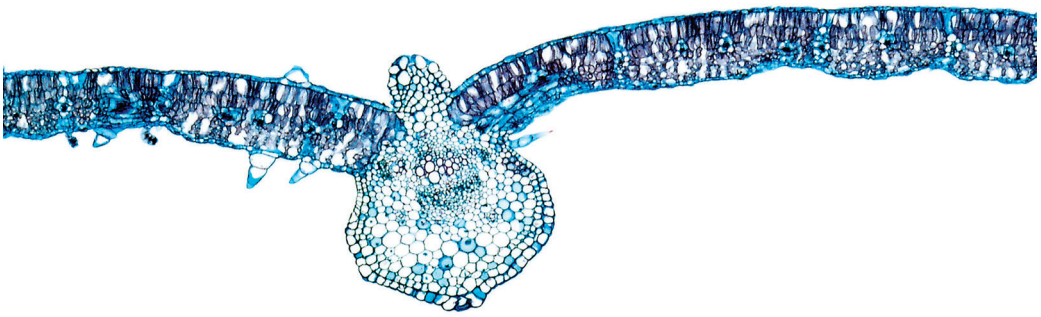

Fig. 2.2

Identify **three** observable differences, other than colour, between the leaf section in Fig. 2.2 and the leaf section on **M1**.

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

Table 2.1

feature	Fig. 2.2	M1

[4]

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(c) Fig. 2.3 shows a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

The length of one division on this stage micrometer is **1.0 mm**.

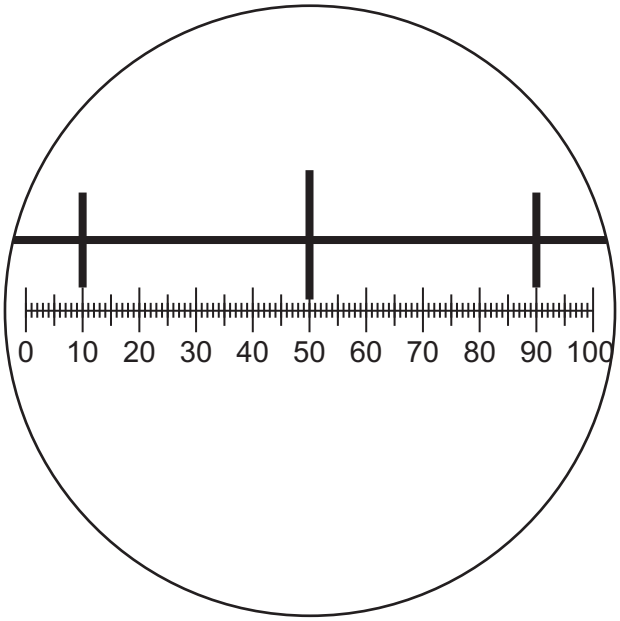

Fig. 2.3

(i) Use Fig. 2.3 to calculate the actual length of one eyepiece graticule unit.

Show your working and give your answer in micrometres (μm).

actual length = ... μm
[3]

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Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.2. This was taken using the same microscope and eyepiece graticule as in Fig. 2.3.

The eyepiece graticule scale has been placed across the midrib of the leaf section.

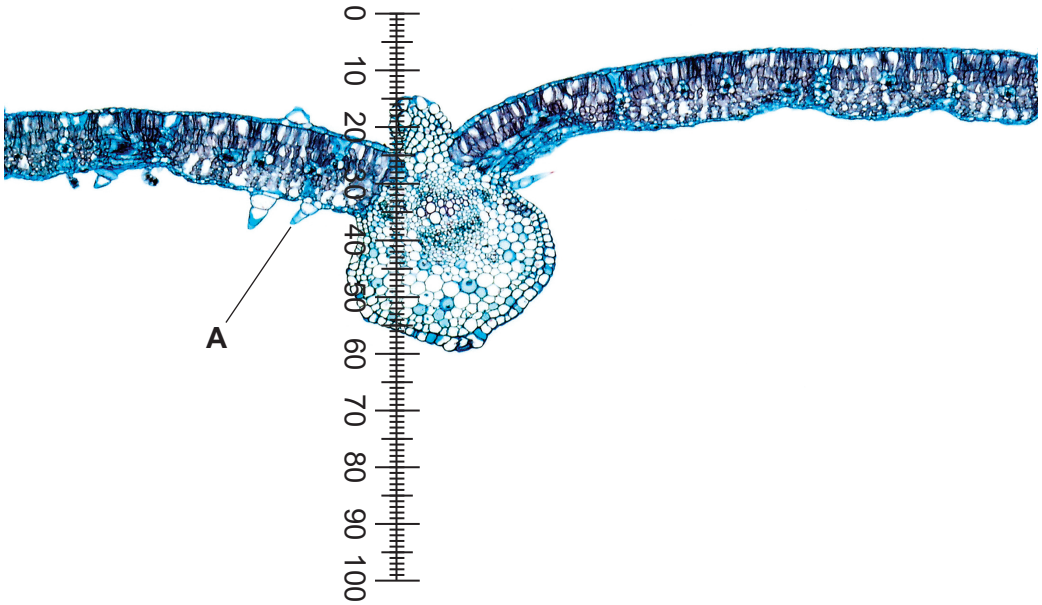

Fig. 2.4

(ii) Use the calibration of the eyepiece graticule unit from **(c)(i)** to calculate the actual thickness of the midrib of the leaf section in Fig. 2.4.

Show your working and use appropriate units.

actual thickness of the midrib of the leaf section = ... [1]

(iii) Suggest a possible function of the structure labelled **A** in Fig. 2.4.

.....

.....

..... [1]

[Total: 18]

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