Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/61**

Paper 6 Alternative to Practical **May/June 2024**

1 hour

You must answer on the question paper.

No additional materials are needed.

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 [ ].

This document has **20** pages. Any blank pages are indicated.

DC (PB/FC) 330954/3

[Turn over

1 **(a)** A student investigates the effect of copper sulfate on the enzyme amylase.

Amylase speeds up the breakdown of starch into the sugar maltose. The word equation is shown.

$$\text{starch} \xrightarrow{\text{amylase}} \text{maltose}$$

The progress of this reaction can be followed by using iodine solution to test for the presence of starch.

Procedure

The student:

Step 1 adds 2 drops of iodine solution to 12 labelled wells on a spotting tile, as shown in Fig. 1.1

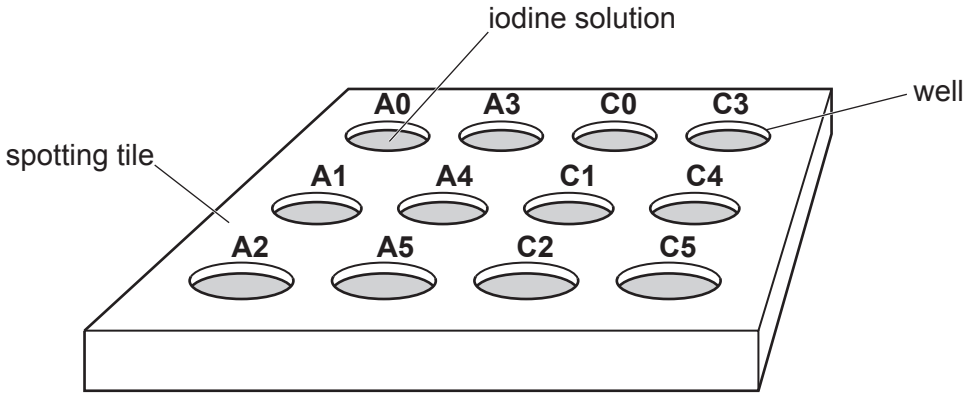


Fig. 1.1

Step 2 puts three test-tubes, one containing starch solution, one containing amylase solution and one containing copper sulfate solution, into a water-bath for 3 minutes

Fig. 1.2 shows the reading on a thermometer in the water-bath.

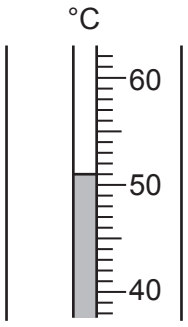


Fig. 1.2

(i) Record the temperature of the water-bath to the nearest 0.5 °C.

temperature = ... °C [1]

Step 3 puts 2 cm^3 of starch solution into each of two test-tubes labelled **A** and **C**

(ii) Suggest a piece of apparatus suitable for measuring 2 cm^3 of starch solution.

..... [1]

Step 4 adds 2 cm^3 of amylase solution to each test-tube **A** and **C**

Step 5 adds 1 cm^3 of copper sulfate solution to test-tube **C** only

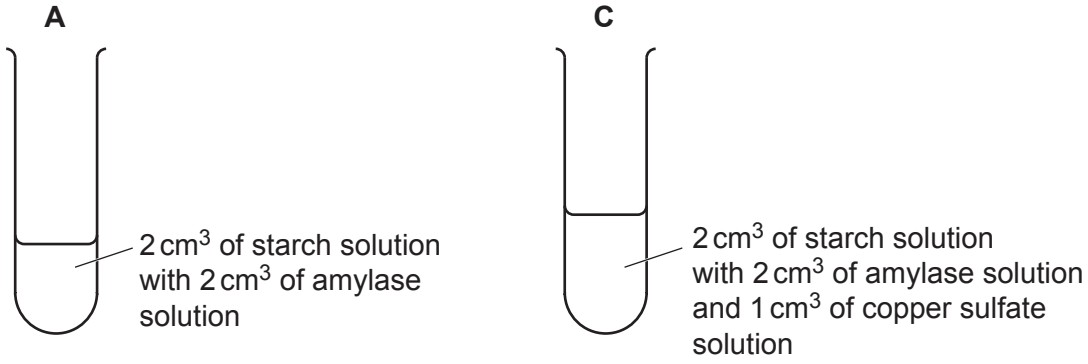


Fig. 1.3

Step 6 puts a drop of solution from test-tube **A** into well **A0** of the spotting tile (0 min)

Step 7 puts a drop of solution from test-tube **C** into well **C0** of the spotting tile (0 min)

Step 8 starts a stop-watch and repeats **step 6** and **step 7** for test-tubes **A** and **C** at one minute, using well **A1** and **C1**

Step 9 repeats **step 6** and **step 7** for test-tubes **A** and **C** at one minute intervals for a further 4 minutes, using wells **A2–A5** and **C2–C5**.

Fig. 1.4 shows the spotting tile at the end of the investigation.

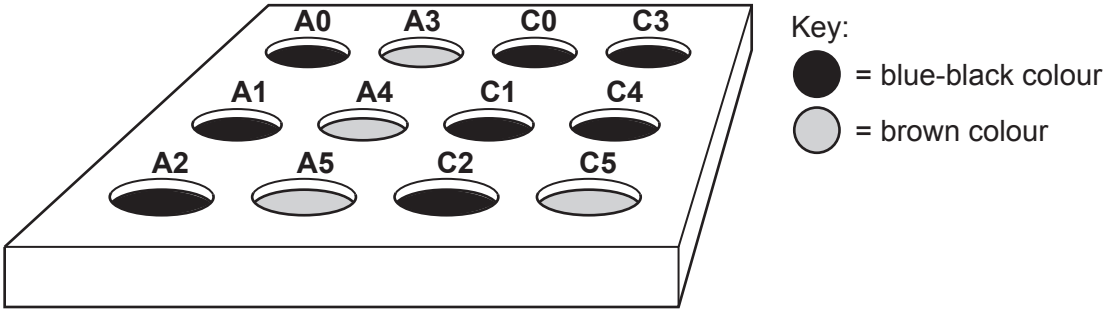


Fig. 1.4

(iii) Use Fig. 1.4 and the key to record in Table 1.1, the colour of the solution in each well for test-tubes **A** and **C**.

Table 1.1

time / minutes	colour in the well after adding solution from test-tube **A**		colour in the well after adding solution from test-tube **C**	
	well	colour	well	colour
0	**A0**		**C0**	
1	**A1**		**C1**	
2	**A2**		**C2**	
3	**A3**		**C3**	
4	**A4**		**C4**	
5	**A5**		**C5**	

[2]

(iv) Explain the results for test-tube **A**.

.....

.....

.....

..... [2]

(v) Describe the effect of copper sulfate on the reaction.

.....

..... [1]

(vi) Calculate the difference in volume of the solution in test-tube **A** and the solution in test-tube **C** at the end of **step 5**.

Use the information from **steps 3**, **4** and **5**.

volume of solution in test-tube **A** = ... cm^3

volume of solution in test-tube **C** = ... cm^3

difference in volume = ... cm^3
[1]

(vii) The difference in volume of solution you calculated in **(a)(vi)** identifies a limitation in this investigation.

Suggest a change to the procedure that removes this limitation.

.....

..... [1]

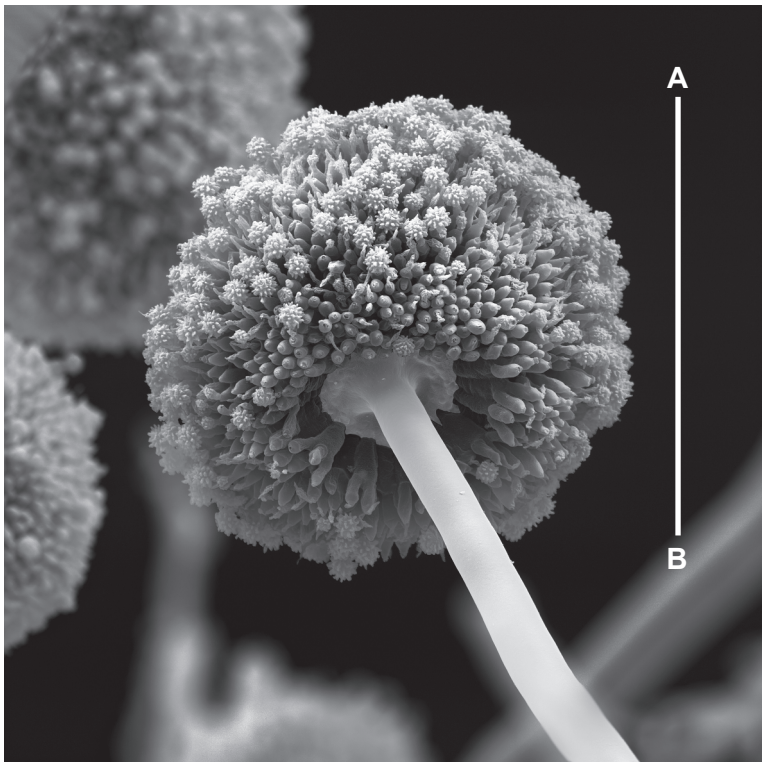
(viii) Explain why the test-tubes were left for 3 minutes in a water-bath in **step 2**.

.....

..... [1]

(b) Amylase is extracted from the fungus *Aspergillus*.

Fig. 1.5 shows a photograph of the fruiting body of the fungus taken using a microscope.



magnification = ×920

Fig. 1.5

Line **AB** represents the diameter of the fruiting body.

(i) Measure the length of line **AB** on Fig. 1.5.

length of line **AB** = ... mm [1]

(ii) Calculate the actual diameter of the fruiting body.

Use the equation shown.

$$\text{actual diameter} = \frac{\text{length of line } \mathbf{AB}}{\text{magnification}}$$

Give your answer to **one** significant figure.

actual diameter = ... mm [2]

[Total: 13]

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2 A student investigates the reaction of sodium hydrogencarbonate with dilute sulfuric acid.

This reaction produces carbon dioxide gas.

Procedure

The student:

Step 1 pours 50.0 cm^3 of dilute sulfuric acid into a beaker

Step 2 adds one spatula of sodium hydrogencarbonate to the acid

Step 3 immediately starts a stop-watch

Step 4 stirs the mixture until it stops fizzing

Step 5 stops the stop-watch

Step 6 records in Table 2.1 this reaction time.

The student repeats the procedure four more times with the number of spatulas of sodium hydrogencarbonate shown in Table 2.1.

Table 2.1

number of spatulas of sodium hydrogencarbonate	reaction time / s
1	
2	37
3	55
4	75
5	

(a) Fig. 2.1 shows the stop-watch readings for 1 spatula and 5 spatulas of sodium hydrogencarbonate.

1 spatula 5 spatulas

Fig. 2.1

Record in Table 2.1 these reaction times to the nearest second. [2]

(b) (i) On the grid, plot reaction time (vertical axis) against the number of spatulas of sodium hydrogencarbonate.

The *x*-axis must include 6 spatulas of sodium hydrogencarbonate. You should also extend your *y*-axis.

[3]

(ii) Draw the line of best fit. [1]

(iii) Describe the relationship between the number of spatulas of sodium hydrogencarbonate and the reaction time.

.....

..... [1]

(iv) Use your graph to predict the reaction time for 6 spatulas of sodium hydrogencarbonate.

Show your working on the graph.

reaction time = ... s [2]

(c) **(i)** Suggest why it is difficult to measure the reaction time accurately.

.....

..... [1]

(ii) The student repeats the measurement for each number of spatulas of sodium hydrogencarbonate.

Suggest how repeating the measurements allows the student to evaluate the quality of the data.

.....

..... [1]

(iii) Suggest a change to **step 2** to improve the procedure.

.....

..... [1]

(d) The gas given off is carbon dioxide.

Describe the test for carbon dioxide. Include the observation for a positive result.

test .....

observation .....
[1]

[Total: 13]

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3 A student determines the density of a wooden block.

(a) The student determines the volume of the wooden block.

Fig. 3.1 shows the wooden block drawn to actual size.

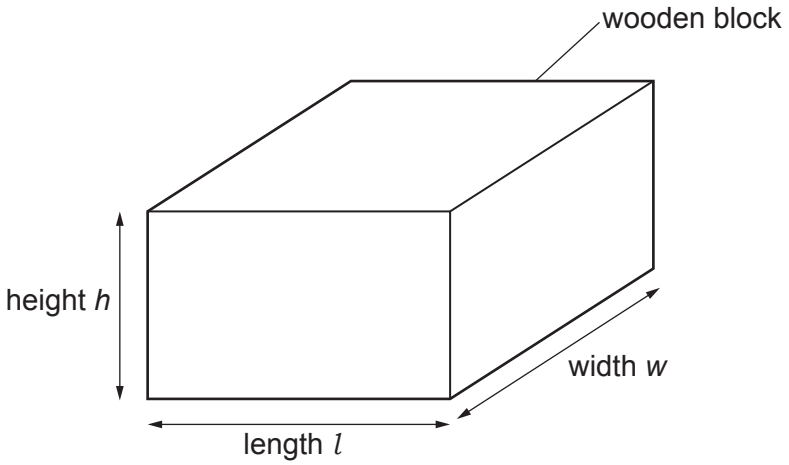

Fig. 3.1

(i) Measure the height h, width w and length l of the wooden block.

Record each measurement to the nearest 0.1 cm.

h = ... cm

w = ... cm

l = ... cm
[1]

(ii) Calculate the volume V_{block} of the wooden block.

Use the equation shown.

$$V_{block} = h \times w \times l$$

V_{block} = ... cm^3 [1]

(b) The student uses a displacement method to measure the mass of the wooden block.

The student has two identical beakers labelled **A** and **B**, each containing 100 cm^3 of water. The student also has a measuring cylinder containing water.

Procedure

The student:

- carefully places the wooden block in beaker **A**.

The water level in beaker **A** rises as the wooden block displaces water and the block floats as shown in Fig. 3.2.

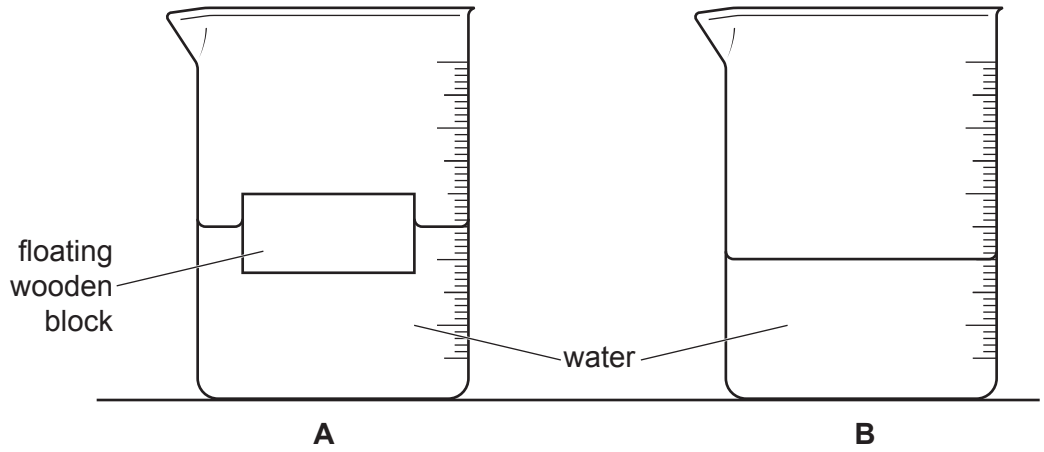

Fig. 3.2

The student:

- records the initial volume of water V_1 in the measuring cylinder
- slowly pours water from the measuring cylinder into beaker **B** until the water level is the same in both beakers
- records the final volume of water V_2 in the measuring cylinder.

(i) Fig. 3.3 shows the water level in the measuring cylinder before and after pouring the water into beaker **B**.

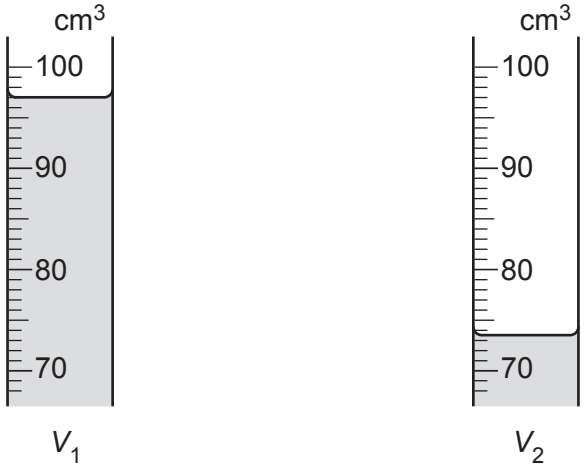

Fig. 3.3

Record V_1 and V_2 as shown in Fig. 3.3.

V_1 = ... cm^3

V_2 = ... cm^3
[2]

(ii) The mass M of the wooden block is equal to the mass of water displaced by the block when it is placed in beaker **A**.

$1.0\,cm^3$ of water has a mass of 1.0 g.

Calculate the mass M.

Use the equation shown.

$$M = (V_1 - V_2) \times 1.0$$

M = ... g [1]

(c) Calculate the density ρ of the wooden block.

Use your answers to **(a)(ii)** and **(b)(ii)** and the equation shown.

$$\rho = \frac{M}{V_{\text{block}}}$$

ρ = ... g / cm^3 [1]

(d) Another student repeats the experiment and makes an error when reading V_2. Their value of V_2 is too small.

State the effect this has on the calculated density ρ of the wooden block.

Give a reason for your answer.

effect .....

reason .....

.....

[1]

[Total: 7]

4 A thermistor is a type of variable resistor.

A thermistor is used to measure changes in the temperature of water in a beaker. The resistance of the thermistor changes as the water temperature changes.

The resistance R of the thermistor at temperature T is calculated using the equation:

$$R_T = \frac{V}{I}$$

where V is the potential difference across the thermistor
and I is the current through the thermistor.

Plan an investigation to find the relationship between the temperature of the water and the resistance of the thermistor.

You are provided with:

- a supply of hot and cold water
- extra connecting wires (or leads)
- the assembled apparatus shown in Fig. 4.1.

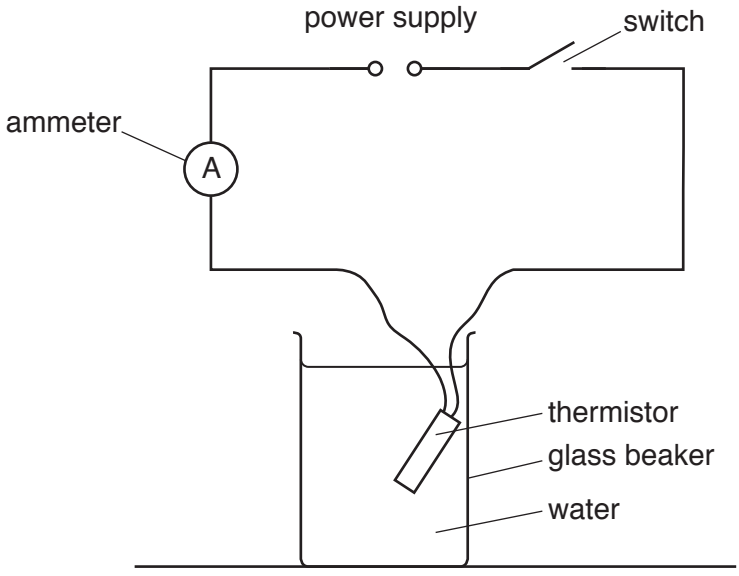

Fig. 4.1

You may use any common laboratory apparatus in your plan.

In your plan, include:

- a brief description of how you will use the assembled apparatus shown in Fig. 4.1
- any other apparatus needed
- what you will measure and how you will make sure your measurements are accurate
- a results table to record your measurements (you do **not** need to enter any readings in the table)
- how you will process your results to draw a conclusion.

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