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Cambridge Assessment International Education

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7036725099

COMBINED SCIENCE **0653/61**

Paper 6 Alternative to Practical **October/November 2025**

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **16** pages.

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1 A student investigates an enzyme-controlled reaction.

Catalase is an enzyme found inside potato cells. It catalyses the breakdown of hydrogen peroxide, releasing oxygen gas.

When potato is mixed with aqueous hydrogen peroxide in a boiling tube, oxygen gas produces a foam.

The height of the foam is measured as shown in Fig. 1.1.

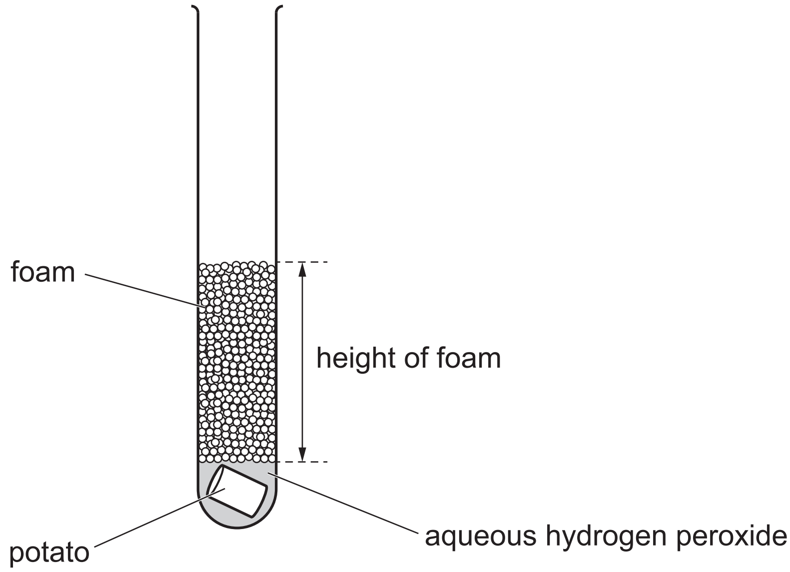

Fig. 1.1

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Procedure

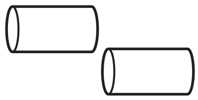
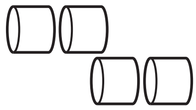
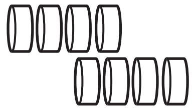
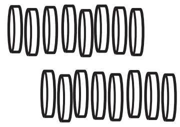
The student:

step 1 labels five boiling tubes **A**, **B**, **C**, **D** and **E**

step 2 cuts five identical cylinders of potato, each to a length of 5 cm

step 3 further cuts four of the potato cylinders into different numbers of equal-sized pieces, as shown in Table 1.1

Table 1.1

	boiling tube				
	A	**B**	**C**	**D**	**E**
how potato cylinder is cut					
number of pieces	1	2	4	8	16

step 4 puts the pieces of potato into the boiling tubes as shown in Table 1.1

step 5 adds 10 cm^3 of aqueous hydrogen peroxide to each boiling tube

step 6 leaves the boiling tubes for 5 minutes

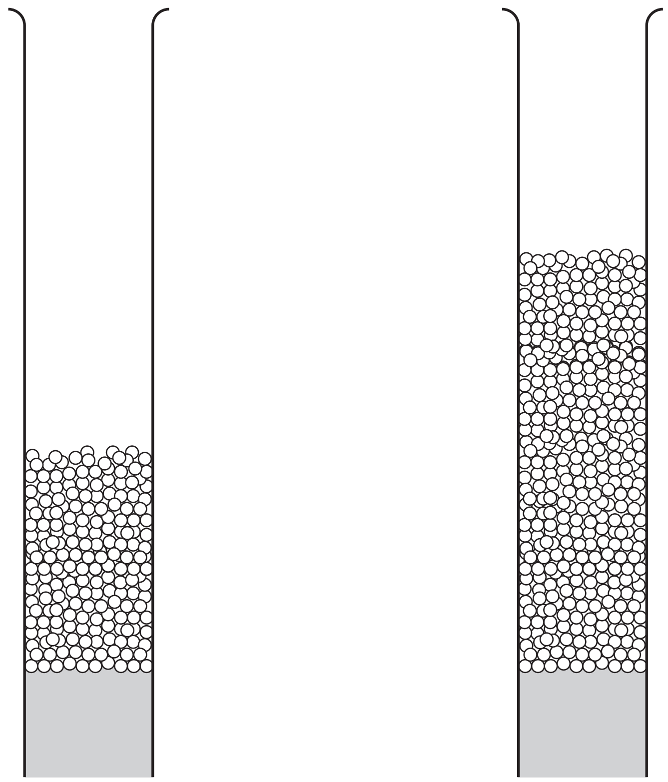
step 7 measures the height of the foam in each boiling tube.

Table 1.2 shows some of the student's data.

Table 1.2

boiling tube	number of pieces of potato	height of foam / mm
A	1	17
B	2	
C	4	44
D	8	
E	16	64

(a) Fig. 1.2 shows the height of the foam after 5 minutes in boiling tubes **B** and **D**.



B **D**

Fig. 1.2

Record in Table 1.2 the height of the foam in each boiling tube in mm to the nearest mm. [2]

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(b) **(i)** Use the data in Table 1.2 to plot on the grid the height of the foam (vertical axis) against the number of pieces of potato.

[3]

(ii) Draw the best-fit curve. [1]

(iii) Cutting the potato cylinder into pieces increases the surface area.

Describe the relationship between the surface area and the height of foam produced.

....

.... [1]

(iv) Use your graph to estimate the height of foam for 12 pieces of potato.

Show your working on your graph.

height of foam = ... mm [1]

(c) All of the potato cylinders in **step 2** are cut to have the same length of 5 cm.

Explain why this helps to make the test fair.

....

.... [1]

(d) Measuring the volume of oxygen produced is a more accurate method than measuring the height of the foam.

(i) Describe **one** difficulty in measuring the height of the foam in **(a)**.

....

.... [1]

(ii) Suggest **one other** reason why measuring the volume of oxygen produced is a more accurate method than measuring the height of the foam.

....

.... [1]

(iii) Complete Fig. 1.3 to show assembled apparatus suitable for collecting and measuring the volume of oxygen produced.

Label the apparatus.

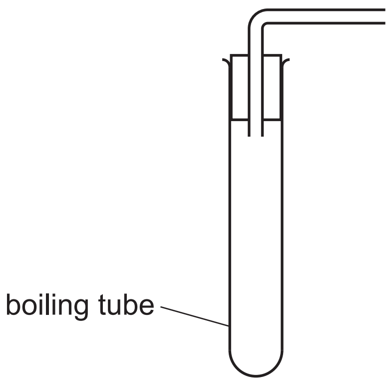

Fig. 1.3

[2]

[Total: 13]

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2 A student investigates the chemical reaction between aqueous barium nitrate and aqueous **H**.

Procedure

The student:

step 1 assembles the apparatus and chemicals shown in Fig. 2.1

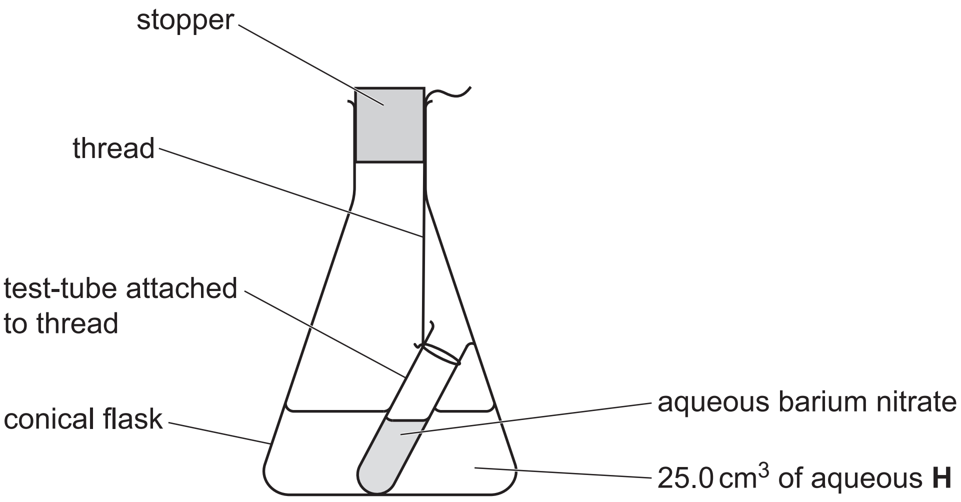


Fig. 2.1

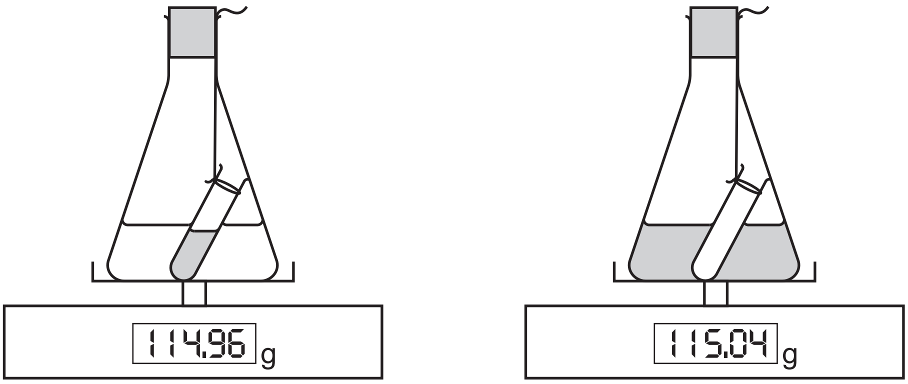
step 2 records the mass of the flask and its contents

step 3 turns the flask upside down to mix the chemicals, making certain no chemicals leak from the stopper

step 4 records the mass of the flask and its contents after mixing

step 5 records in Table 2.1 any other observations.

(a) Fig. 2.2 shows the balance readings for **step 2** and **step 4**.



mass at step 2 **mass at step 4**

Fig. 2.2

Record in Table 2.1 these masses to the nearest 0.1 g.

Table 2.1

mass of flask and its contents at **step 2** / g	
mass of flask and its contents after mixing at **step 4** / g	
observations at **step 5**	white precipitate

[2]

(b) Name a piece of apparatus suitable for measuring 25.0 cm^3 of aqueous **H**.

.... [1]

(c) A teacher states:

"In a chemical reaction, no mass is gained or lost."

Explain whether your results in Table 2.1 support this statement.

....

.... [1]

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(d) Identify **one** ion present in aqueous **H**.

Explain your answer.

ion ....

explanation ....

.... [1]

(e) Suggest why this procedure is **not** used to investigate the reaction between aqueous sodium carbonate and dilute hydrochloric acid.

Explain your answer.

....

....

.... [2]

[Total: 7]

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3 Solid citric acid is added to aqueous sodium hydrogencarbonate. There is a reaction and the temperature of the aqueous sodium hydrogencarbonate decreases.

Plan an investigation to determine the relationship between the mass of citric acid added to the aqueous sodium hydrogencarbonate and the decrease in temperature.

You are provided with:

- solid citric acid
- aqueous sodium hydrogencarbonate.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- the apparatus you will use
- a brief description of the method
- what you will measure
- which variables you will control
- how you will process your results to form a conclusion.

You may include a results table (you are **not** required to enter any data into the table).

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[7]

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4 A student uses **two** methods to determine the resistance *R* of resistor **W**.

(a) Method 1 Procedure

The student:

- assembles the circuit shown in Fig. 4.1

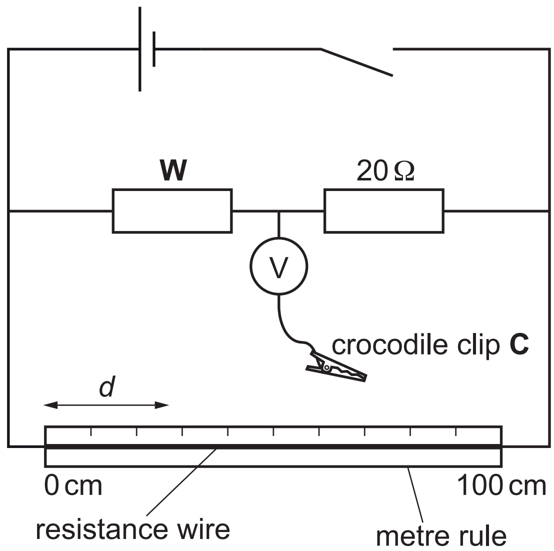

Fig. 4.1

- connects crocodile clip **C** to the resistance wire at d = 10 cm, where d is the horizontal distance of the crocodile clip along the metre rule from the 0 cm mark
- closes the switch
- moves crocodile clip **C** along the wire to $d = d_0$, where d_0 is the distance at which the reading on the voltmeter becomes zero
- opens the switch.

Fig. 4.2 shows crocodile clip **C** at d_0, as viewed from above.

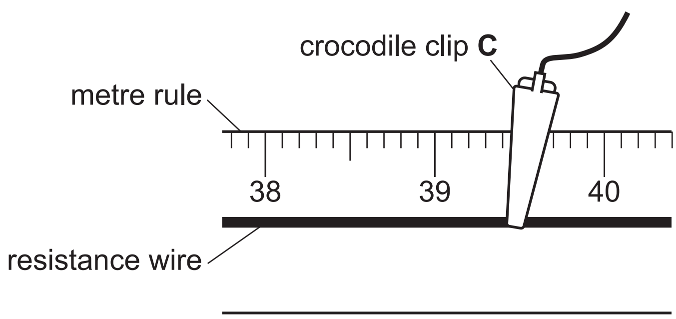

Fig. 4.2

(i) Record d_0 in cm to the nearest 0.1 cm.

d_0 = ... cm [1]

(ii) Another student suggests replacing crocodile clip **C** with the piece of apparatus shown in Fig. 4.3.

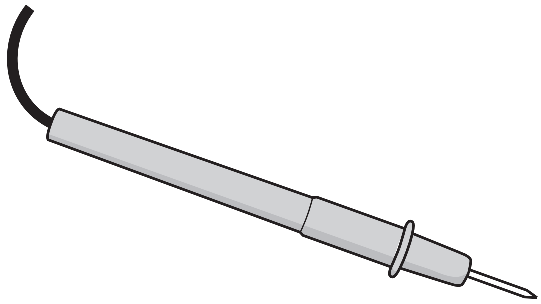

Fig. 4.3

Explain why this is an improvement to the apparatus.

....

....

....

.... [2]

(iii) Calculate the resistance R of resistor **W**.

Use your answer in **(a)(i)** and the equation shown.

$$R = 20 \times \left(\frac{d_0}{100 - d_0} \right)$$

Give your answer to **two** significant figures.

R = ... Ω [2]

(b) **Method 2 Procedure**

The student:

- assembles the circuit shown in Fig. 4.4

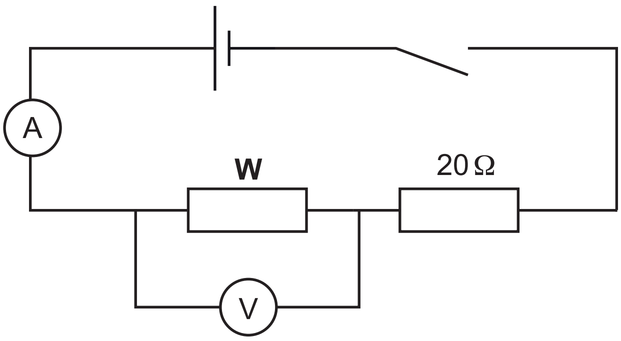

Fig. 4.4

- closes the switch
- records the reading on the ammeter, I
- records the reading on the voltmeter, V
- opens the switch.

(i) Fig. 4.5 shows the readings on the ammeter and the voltmeter.

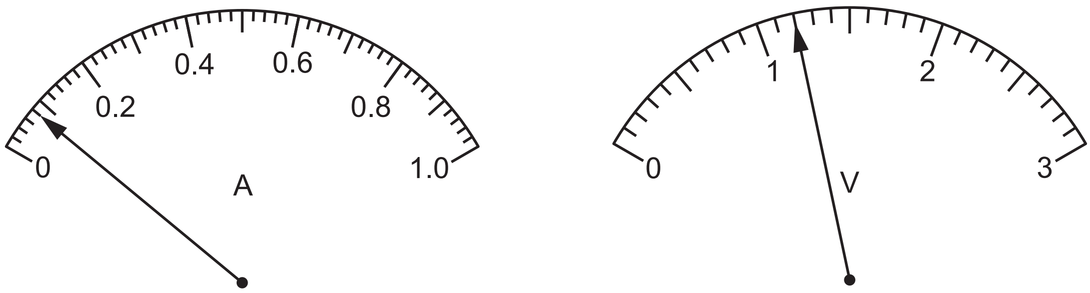

Fig. 4.5

Record the values of I and V.

I = ... A

V = ... V
[2]

(ii) The ammeter and the voltmeter shown in Fig. 4.5 are **analogue**.

Suggest **one** advantage of taking readings from a **digital** ammeter or voltmeter.

....

.... [1]

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(iii) Calculate the resistance R of resistor **W**.

Use your answers in **(b)(i)** and the equation shown.

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

R = ... Ω [1]

(c) Two values are considered equal within the limits of experimental error if the difference between them is less than 10%.

Explain whether your values of R in **(a)(iii)** and **(b)(iii)** are equal within the limits of experimental error.

Justify your answer with a calculation.

....

.... [2]

(d) In both procedures, the student opens the switch after each set of readings.

Suggest **two** reasons why this is a good precaution.

1 ....

2 ....
[2]

[Total: 13]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	‘pops’ with a lighted splint
oxygen, O_2	relights a glowing splint

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
copper(II), Cu^{2+}	blue-green

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