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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6049588870

CO-ORDINATED SCIENCES **0654/51**

Paper 5 Practical Test **October/November 2024**

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 60.
- 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.

For Examiner's Use	
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Total	

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

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1 You are going to investigate an enzyme-controlled reaction.

Catalase is an enzyme found inside living cells such as yeast cells. It catalyses the breakdown of hydrogen peroxide, releasing oxygen gas.

When a suspension of yeast cells is mixed with hydrogen peroxide solution the oxygen released produces a foam.

You are provided with a suspension of yeast cells and different concentrations of hydrogen peroxide solution.

(a) (i) Read through the procedure in **(a)(ii)** and draw a table to record your results. [2]

(ii) Procedure

- Stir the suspension of yeast cells with a clean glass rod.
- Use a clean syringe to put 2 cm^3 of yeast cell suspension into a clean boiling tube.
- Use a clean syringe to add 2 cm^3 of 6% hydrogen peroxide solution to the boiling tube with the yeast suspension.
- Start the stop-watch.
- At 2 minutes, measure the height *h* in your boiling tube, as shown in Fig. 1.1.
- Record in your results table in **(a)(i)** this value in millimetres to the nearest millimetre.

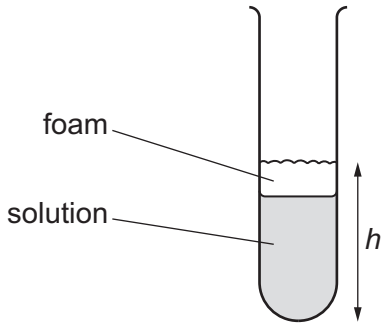

Fig. 1.1

Repeat the procedure with 4% hydrogen peroxide solution, 2% hydrogen peroxide solution and 0% hydrogen peroxide solution. [4]

(iii) State the relationship between the concentration of the hydrogen peroxide solution and the height *h* of the foam and solution.

.....

..... [1]

(iv) Explain why repeating the experiment would allow you to have more confidence in your results.

.....

..... [1]

(v) Suggest why it is important to stir and mix the yeast suspension at the start of the procedure in **(a)(ii)**.

.....

..... [1]

(vi) Suggest why it is important to use a clean syringe to add the hydrogen peroxide solution each time.

.....

..... [1]

(vii) Describe **one** difficulty in measuring the height *h*.

.....

..... [1]

(viii) Suggest a piece of apparatus that can be used to measure the amount of gas produced in a reaction more accurately.

.....

..... [1]

(b) The amount of hydrogen peroxide in a solution of hydrogen peroxide is described as a percentage.

A student has a solution of 10% hydrogen peroxide.

Calculate the volumes of water and 10% hydrogen peroxide solution needed to make 10 cm^3 of 6% hydrogen peroxide solution.

volume of 10% hydrogen peroxide solution = ... cm^3

volume of water = ... cm^3 [1]

[Total: 13]

2 The pH of saliva in the mouth is approximately 7.

Eating and drinking lowers the pH of saliva in the mouth. This can cause tooth decay.

Mouthwash is sometimes used to raise the pH of saliva in the mouth.

Plan an investigation to determine the relationship between the volume of mouthwash used and the pH of saliva.

You are provided with:

- mouthwash
- a solution of saliva at pH 3.

You may use any laboratory apparatus.

You are not required to do this investigation.

In your plan include:

- the apparatus needed
- a brief description of the method
- the measurements you will make
- the variables you will control
- how you process your results to draw a conclusion.

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..... [7]

3 You are going to investigate the reactivity of metals by heating some metal carbonates.

Some metal carbonates break down and release carbon dioxide when they are heated.

The carbonate of a more reactive metal takes a longer time to break down than the carbonate of a less reactive metal.

(a) (i) Procedure

- Half fill a test-tube with limewater and put it in the test-tube rack.
- Put three spatula loads of copper carbonate into a clean hard-glass test-tube.
- Record in Table 3.1 the colour of the copper carbonate before heating.
- Attach the delivery tube and stopper to the hard-glass test-tube as shown in Fig. 3.1.
- Place the delivery tube into the limewater as shown in Fig. 3.1.
- Hold the test-tube of copper carbonate with test-tube holders near the stoppered end of the test-tube.

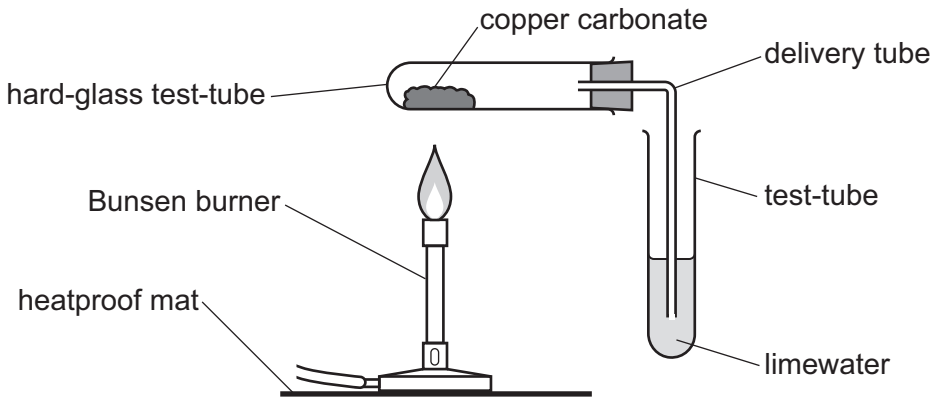

Fig. 3.1

- Carefully heat the copper carbonate and start the stop-clock.
- When the limewater starts to go milky take the delivery tube out of the limewater. **You must take the delivery tube out of the limewater while you are still heating.**
- Stop the stop-clock and stop heating.
- The hard-glass test-tube is very hot – do **not** touch it.
- Put the hard-glass test-tube on the heatproof mat with the test-tube holders still attached.
- Record in Table 3.1 the time in seconds, to the nearest second.
- Put the hard-glass test-tube in the test-tube rack to allow it to fully cool.
- Record the colour of the hot solid after heating in Table 3.1.
- Carefully remove the delivery tube from the hard-glass test-tube.
- Rinse the test-tube containing the limewater for reuse with the next metal carbonate.

Repeat the procedure with iron(II) carbonate, magnesium carbonate and zinc carbonate instead of the copper carbonate.

If the limewater doesn't go milky after 300 seconds record the time as '> 300'.

Table 3.1

metal carbonate	colour of metal carbonate before heating	time for the limewater to go milky / s	colour of hot solid after heating	rate of reaction per 100 s
copper carbonate				
iron(II) carbonate				
magnesium carbonate				
zinc carbonate				

[7]

(ii) The colour of the solid remaining after zinc carbonate is heated changes as it cools down.

State the colour of the cold solid.

..... [1]

(b) Calculate the rate of reaction for each metal carbonate.

Use the equation shown.

$$\text{rate of reaction} = \frac{100}{\text{time}}$$

Record in Table 3.1 your values to **three** significant figures.

[2]

(c) Using the results in Table 3.1 place the metals copper, iron, magnesium and zinc in order of reactivity, starting with the most reactive.

most reactive .....

.....

.....

least reactive ..... [1]

(d) In the procedure it is important to take the delivery tube out of the limewater before stopping heating.

Explain why this is important for safety reasons.

.....

..... [1]

(e) Suggest **one** improvement to the procedure that would give more confidence in the order of reactivity of the metals given in **(c)**. Do **not** include repeating the experiment.

.....

..... [1]

[Total: 13]

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4 You are going to investigate the reactivity of metals by measuring voltages in electrochemical cells.

When two different metals are dipped into an aqueous salt solution, they produce a voltage.

The larger the difference in reactivity between the two metals, the greater the voltage produced.

(a) Procedure

- Half fill a small beaker with aqueous salt solution.
- Assemble the apparatus as shown in Fig. 4.1, keeping the copper strip towards the edge of the beaker.

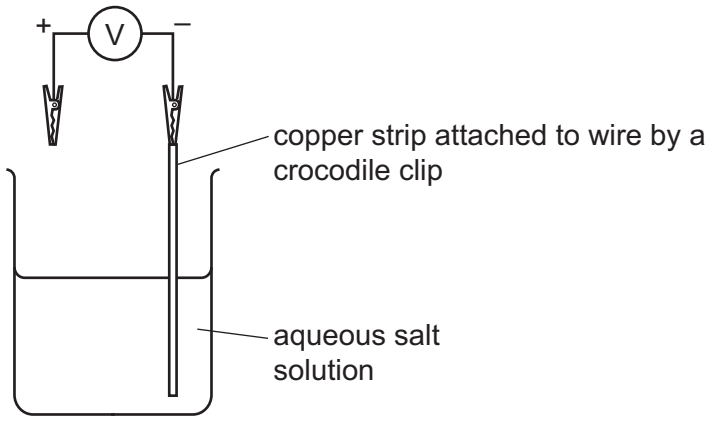


Fig. 4.1

- Attach a strip of iron to the positive terminal of the voltmeter and place it carefully at the opposite side of the beaker to the strip of copper as shown in Fig. 4.2.
  Do **not** let the metals touch.

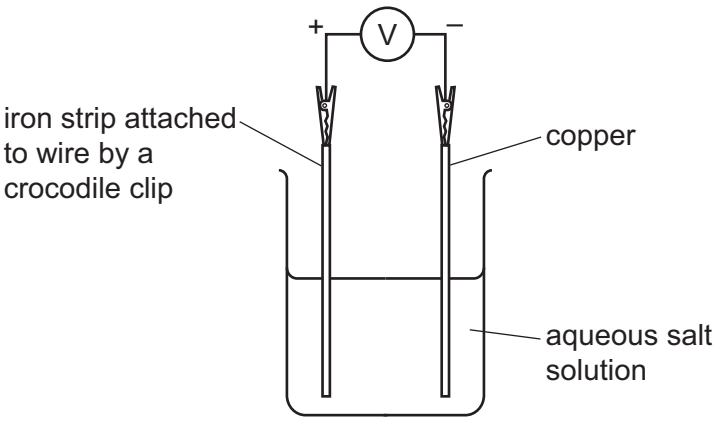


Fig. 4.2

- Record in Table 4.1 the voltage reading on the voltmeter as soon as the iron strip is placed into the aqueous salt solution.
- Remove the iron strip.

Repeat the procedure using strips of magnesium, zinc and copper instead of iron.

Table 4.1

metal attached to the positive terminal	voltage / V
iron	
magnesium	
zinc	
copper	

[5]

(b) Using the results in Table 4.1 place the metals copper, iron, magnesium and zinc in order of reactivity, starting with the most reactive.

most reactive .....

.....

.....

least reactive ..... [1]

(c) Question **3** and question **4** use two different procedures to determine the order of reactivity of the metals.

Suggest which procedure allows the order of reactivity to be determined with more accuracy.

Tick (✓) the box.

procedure from question **3** ☐

procedure from question **4** ☐

Explain your answer.

.....

..... [1]

[Total: 7]

5 You are going to investigate the changes in potential difference V across a length of resistance wire in an electrical circuit.

Fig. 5.1 shows a circuit with a resistance wire. The circuit is assembled for you.

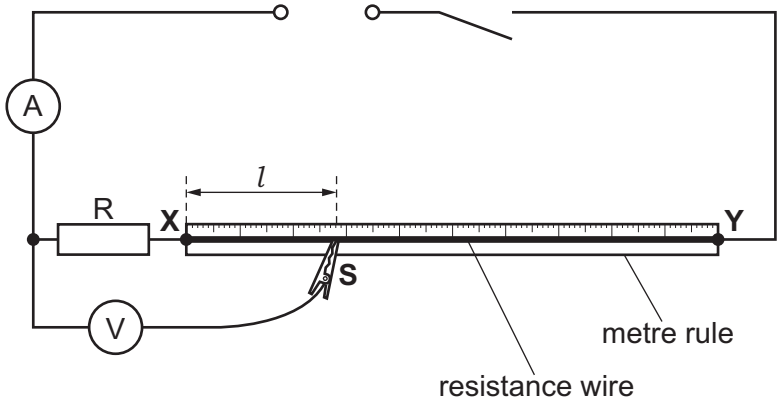


Fig. 5.1

(a) Procedure

- Close the switch.
- Record the current I in the circuit.
- Open the switch.

I = ... A [1]

(b)

- Place the sliding contact **S** at a distance of l = 10.0 cm from end **X** of the resistance wire and then close the switch.
- Record in Table 5.1 the reading V on the voltmeter.
- Open the switch.

Table 5.1

l / cm	V / V
10.0	
20.0	
40.0	
60.0	
80.0	

[1]

(c) Repeat the procedure in **(b)** for values of l of 20.0 cm, 40.0 cm, 60.0 cm and 80.0 cm. [2]

(d) Suggest **one practical** reason why your values for the length l of resistance wire are only approximate.

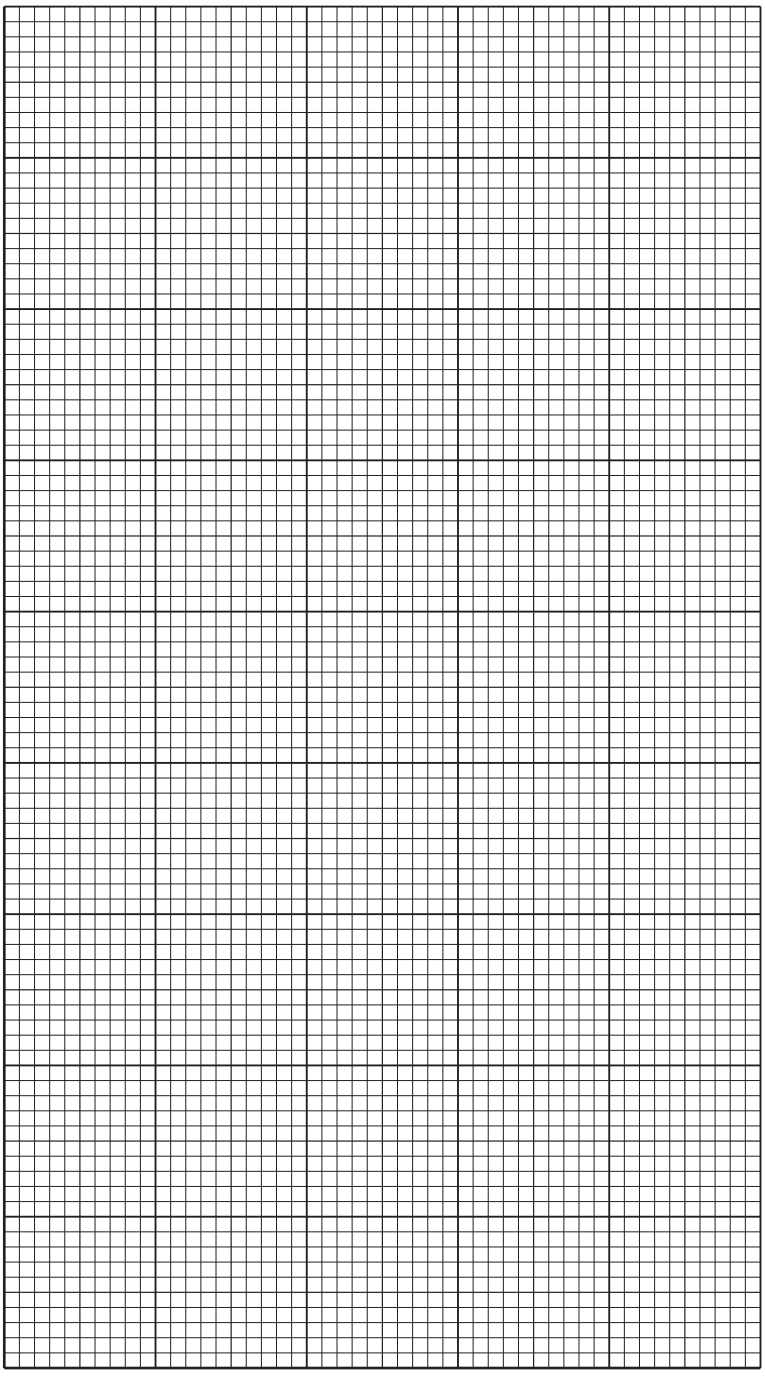
.....

..... [1]

(e) (i) On the grid, plot a graph of V (vertical axis) against l.

Start both axes from the origin (0, 0). [2]

V / V



l / cm

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

(f) **(i)** Extend the best-fit line until it crosses the vertical axis.

Record the intercept c that the line makes on the vertical axis.

c = ... [1]

(ii) Calculate the numerical ratio r.

Use the equation shown and the current I you measured in **(a)**.

$$r = \frac{c}{I}$$

r = ... [1]

(g) The teacher says that the ratio r in **(f)(ii)** is expected to be 3.3.

Two values are considered to be equal within the limits of experimental accuracy if they are within 10% of each other.

Compare your ratio r from part **(f)(ii)** with the expected ratio 3.3.

State if your value of r is close enough to 3.3 so that the ratios can be considered equal, within the limits of experimental accuracy.

Justify your statement with a calculation.

statement .....

.....

justification .....

.....

.....

.....

[2]

[Total: 12]

6 You are going to use two different methods to measure the density of water.

Method 1

(a) Record the mass m_1 of the empty 100 cm^3 measuring cylinder to the nearest gram.

m_1 = ... g [1]

(b) Remove the measuring cylinder from the balance and approximately half-fill it with water.

Record the volume V_1 of the water in the measuring cylinder.

V_1 = ... cm^3

Record the mass m_2 of the measuring cylinder containing the water to the nearest gram.

Keep the measuring cylinder containing the water for use in **method 2**.

m_2 = ... g [1]

(c) Calculate the density ρ_1 of the water.

Use the equation shown.

$$\rho_1 = \frac{(m_2 - m_1)}{V_1}$$

ρ_1 = ... g / cm^3 [1]

(d) State how you ensure that your reading of the volume of water in the measuring cylinder is as accurate as possible.

.....

..... [1]

Method 2

(e) (i) Use the balance to record the mass m_3 of the test-tube to the nearest gram.

m_3 = ... g [1]

(ii) Procedure

- Use the measuring cylinder containing the water used in **method 1**.
- Slowly lower the test-tube into the measuring cylinder until it floats, approximately vertically, as shown in Fig. 6.1. The test-tube should **not** touch the bottom of the measuring cylinder.

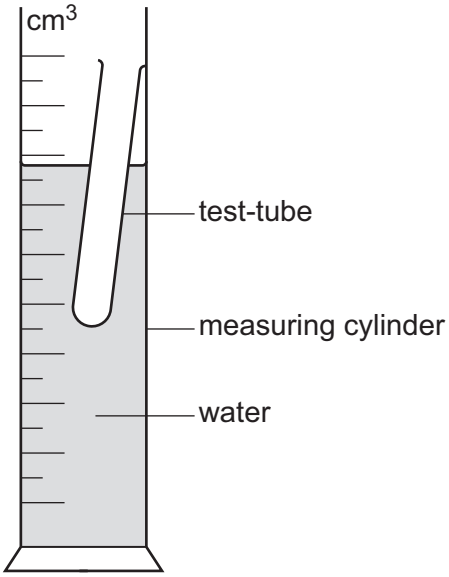


Fig. 6.1

Record the new water level V_2 in the measuring cylinder.

V_2 = ... cm^3

Calculate the volume V_3 of water displaced by the test-tube.

Use the equation shown.

$$V_3 = V_2 - V_1$$

V_3 = ... cm^3 [1]

(f) Calculate the density ρ_2 of the water using your values from **(e)(i)** and **(e)(ii)**.

Use the equation shown.

$$\rho_2 = \frac{m_3}{V_3}$$

ρ_2 = ... g/cm^3 [1]

(g) Suggest why **method 1** is done before **method 2**.

.....

.....

..... [1]

[Total: 8]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	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.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, 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	green ppt., insoluble in excess
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