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Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME										
CENTRE NUMBER						CANDIDATE NUMBER				

3816361567

CO-ORDINATED SCIENCES **0973/51**

Paper 5 Practical Test **May/June 2025**

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	
1	
2	
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Total	

This document has **24** pages. Any blank pages are indicated.

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1 You are going to investigate diffusion in animals.

You will use different sized agar jelly cubes to represent different sized animals.

Each cube contains an indicator that turns red in acid.

The acid moves into the cubes by diffusion.

You are provided with two large cubes of agar jelly that are 10 × 10 × 10 mm.

(a) (i) **Procedure**

step **1** Cut one small cube of 5 × 5 × 5 mm from one of the large cubes.

step **2** Place the small cube of agar jelly in a clean beaker.

step **3** Pour hydrochloric acid into this beaker until the small cube is completely covered.

step **4** Start the stop-watch.

step **5** Record in Table 1.1 the time in seconds to the nearest second for the small cube to turn completely red.

Repeat step **2** to step **5** using the large cube instead of the small cube.

Table 1.1

cube side / mm	surface area of cube / mm^2	volume of cube / mm^3	ratio of surface area to unit volume	time taken to turn completely red / s
5			1.2	
10			0.6	

[4]

(ii) Use the value of the cube side given in Table 1.1 to calculate the surface area of each cube.

Use the equation shown.

surface area = length × height × 6

Record these values in Table 1.1. [1]

(iii) Use the value of the cube side given in Table 1.1 to calculate the volume of each cube.

Use the equation shown.

volume = length × height × depth

Record these values in Table 1.1. [1]

(iv) Describe a difficulty you had doing the procedure in **(a)(i)**.

....

.... [1]

(b) A student repeats the procedure in **(a)(i)** with increasing sizes of cube measured in cm.

They calculate the rate of diffusion for each cube as shown in Table 1.2.

Table 1.2

cube side / cm	ratio of surface area to unit volume	time / s	rate of diffusion per 1000 seconds
2	3.0	59	16.9
3	2.0	165	6.1
4	1.5	240	4.2
5	1.2	298	3.4
6	1.0	368	2.7

(i) On the grid, plot rate of diffusion (vertical axis) against ratio of surface area to unit volume.

[3]

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

(iii) Estimate the rate of diffusion for a cube with ratio of surface area to unit volume of 2.5.

Show your working on the graph.

rate of diffusion = ... per 1000 seconds [2]

(iv) The cubes represent different sized animals.

The acid moves into the cubes by diffusion.

Some small animals rely on diffusion from their body surface to supply all their oxygen.

Larger animals use a transport system such as blood to supply oxygen.

Use the data in Table 1.2 and your graph to suggest why large animals **cannot** use diffusion from their body surface to supply oxygen.

....

.... [1]

[Total: 14]

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

Yeast and some plants contain the enzyme catalase.

Catalase speeds up the breakdown of hydrogen peroxide, releasing oxygen gas.

The oxygen gas released forms a foam.

(a) (i) Procedure

- Stir the suspension of yeast cells with a clean stirring rod.
- Pour approximately 1 cm depth of the suspension of yeast cells into a clean test-tube.
- Use a syringe to add 1 cm^3 of aqueous hydrogen peroxide to the test-tube.
- Immediately start the stop-watch.
- Record in Table 2.1 the total height in mm of the suspension of yeast cells and any foam at 60 seconds as shown in Fig. 2.1.

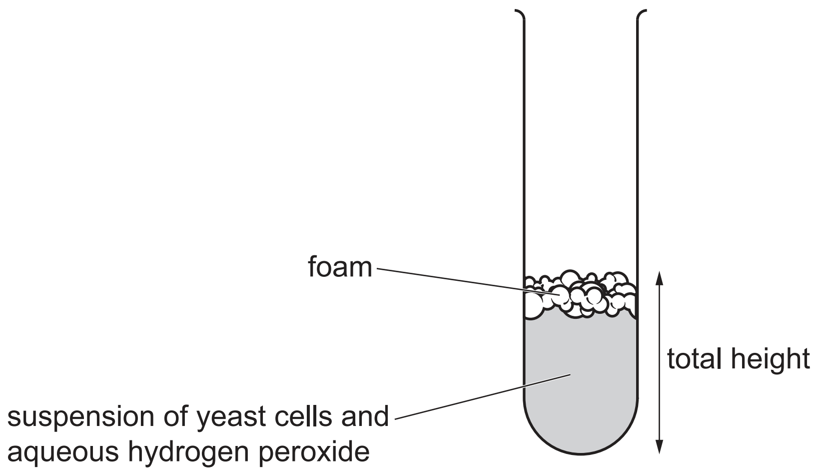

Fig. 2.1

Repeat the procedure using the liquidised apple instead of the suspension of yeast cells.

Table 2.1

sample	total height / mm
suspension of yeast cells	
liquidised apple	

[3]

(ii) Use Table 2.1 to compare how much catalase is present in the samples of yeast cells **and** liquidised apple.

Explain your answer.

....

.... [1]

(b) **(i)** Liquidising the apple breaks open the cells.

Suggest why the cells need to be broken open.

....

.... [1]

(ii) Suggest why it is important to stir to mix the suspension of yeast cells in the procedure.

....

.... [1]

[Total: 6]

3 You are going to investigate the neutralisation of dilute hydrochloric acid by aqueous sodium hydroxide.

You will do two experiments, one with aqueous sodium hydroxide **J**, and the other with aqueous sodium hydroxide **K**.

The titration method is used.

Bromothymol blue is an indicator. It turns yellow in acid solutions, blue in alkali solutions and green in neutral solutions.

(a) Procedure

- Almost fill a burette with dilute hydrochloric acid.
- Record in Table 3.1 in column **J** this initial burette reading to one decimal place.
- Use a measuring cylinder to add 25 cm^3 of aqueous sodium hydroxide **J** to a clean conical flask.
- Add several drops of bromothymol blue indicator to the conical flask. The indicator turns blue.
- Add dilute hydrochloric acid from the burette to the conical flask until the indicator turns green. Swirl the flask to mix while you are adding the dilute hydrochloric acid.
  Fig. 3.1 shows a diagram of the apparatus.

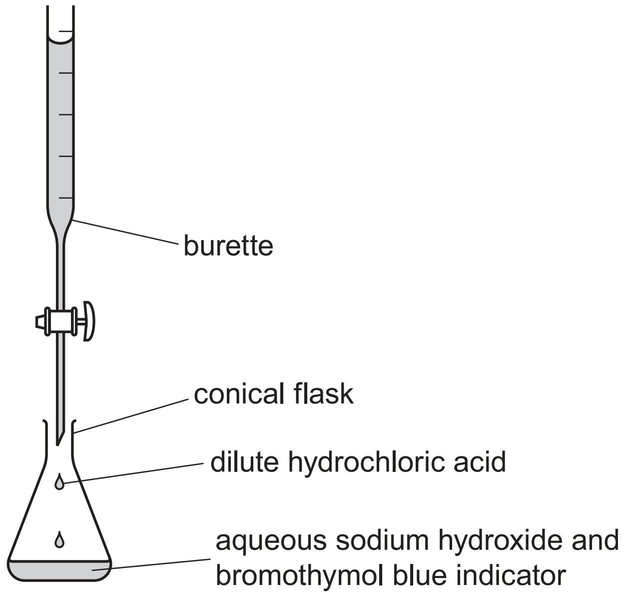

Fig. 3.1

- Record in Table 3.1 in column **J** the final burette reading to one decimal place.

Repeat the procedure using aqueous sodium hydroxide **K** instead of **J**.

Table 3.1

	J	K
initial burette reading / cm^3		
final burette reading / cm^3		
volume of dilute hydrochloric acid added / cm^3		

[6]

(b) **(i)** Suggest why the conical flask is swirled to mix the solutions as the dilute hydrochloric acid is added to the aqueous sodium hydroxide.

....

.... [1]

(ii) Suggest **one** piece of apparatus suitable for measuring the 25 cm^3 of aqueous sodium hydroxide more accurately than a measuring cylinder.

.... [1]

(iii) Calculate the volume of dilute hydrochloric acid added for aqueous **J** and aqueous **K**.

Record your values in Table 3.1. [1]

(iv) The concentrations of aqueous **J** and **K** are different.

Suggest the relationship between the concentrations of aqueous **J** and aqueous **K**.

Include a calculation in your answer.

....

....

.... [2]

(c) A student repeats the procedure but does **not** notice the indicator turning green.

The student continues adding dilute hydrochloric acid to the flask.

Suggest the final colour of the mixture in the flask.

.... [1]

(d) Aqueous sodium chloride is the product in the conical flask.

The aqueous sodium chloride is coloured green with the indicator.

Suggest how the procedure in **(a)** is changed to make colourless aqueous sodium chloride.

....

.... [1]

[Total: 13]

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4 An iron key is electroplated with copper metal using the apparatus shown in Fig. 4.1.

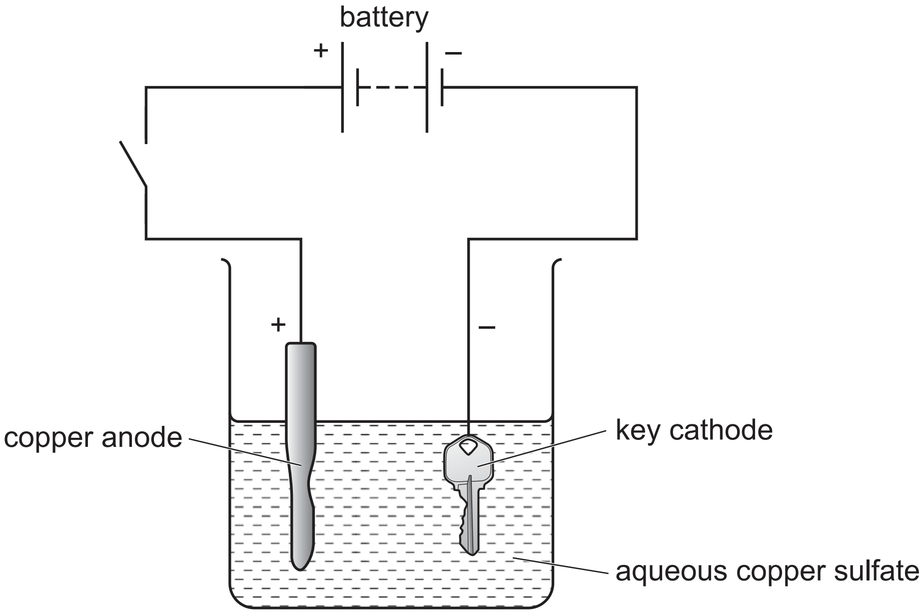

Fig. 4.1

When the switch is closed, the copper dissolves from the anode, moves through the aqueous copper sulfate and coats (plates) onto the key at the cathode.

Plan an investigation to find the relationship between the number of volts supplied by the batteries and the mass of copper coated onto the key.

You are provided with:

- several 1.5 V batteries
- the apparatus and chemicals shown in Fig. 4.1.

You may use any common laboratory apparatus in your plan.

You are **not** required to do this experiment.

In your plan, include:

- any other apparatus you will need
- a brief description of the method
- the measurements you will make and how you make them as valid as possible
- the variables you will control
- how you will process your results to reach a conclusion.

[7]

5 You are going to do an experiment to find the density of glass using solid glass marbles.

(a) Procedure

- Use a balance to record the mass *m* of 5 glass marbles.

m = ... g

- Approximately half-fill a 50 cm³ measuring cylinder with water.
- Record the volume V_1 of water in cm³ to the nearest 0.5 cm³.

V_1 = ... cm^3

- Carefully drop the 5 glass marbles into the water as shown in Fig. 5.1.

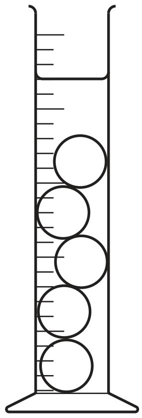

Fig. 5.1

- Record the new volume V_2 of water in cm^3 to the nearest 0.5 cm^3.

V_2 = ... cm^3 [2]

(b) **(i)** Calculate the volume V_m of the 5 glass marbles.

Use the equation shown.

$$V_m = V_2 - V_1$$

V_m = ... cm^3 [1]

(ii) Calculate the density ρ of the glass marbles.

Use the equation shown.

$$\rho = \frac{m}{V_m}$$

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

ρ = ... g/cm^3 [2]

(iii) A student does the same experiment and calculates the density of the glass marbles as $2.80\,g/cm^3$.

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

Explain if your value in **(b)(ii)** and the student's value are equal within the limits of experimental error.

Justify your answer with a calculation.

....

.... [2]

(c) Describe how you measure the volume of water accurately using the measuring cylinder.

You may draw a diagram to help.

....

.... [1]

(d) (i) Another student does the experiment and uses a balance to measure the mass of the glass marbles.

Fig. 5.2 shows the balance before any glass marbles are added.

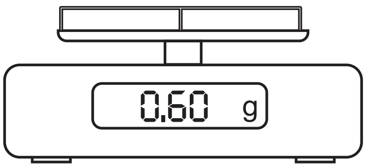

Fig. 5.2

State why this balance does **not** give the correct reading for the mass of the glass marbles.

Suggest what the student does to obtain an accurate mass of the glass marbles.

statement ....

....

suggestion ....

....

[1]

(ii) The student calculates the volume of one glass marble using its diameter.

The student measures the diameter of one glass marble using a 30 cm ruler.

The student uses two wooden blocks to make the measurement of the diameter more accurate.

Describe how the student uses the blocks.

You may draw a diagram to help.

....

.... [1]

(iii) The student repeats the procedure in **(a)** but uses different marbles.

The 5 marbles used have the same diameter and are made of the same glass as those used in the procedure in **(a)**.

These marbles have a large air bubble in the centre as shown in Fig. 5.3.

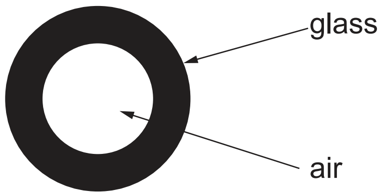

Fig. 5.3

State the effect the air bubble has on the density of the marbles.

Explain your answer.

effect on density of the marbles ....

explanation ....

....

[1]

[Total: 11]

6 You are going to do an experiment to find a value for the acceleration of free fall g using a pendulum.

(a) A pendulum is set up as shown in Fig. 6.1.

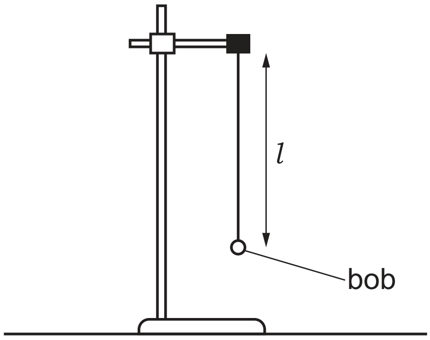

Fig. 6.1

The length l is the distance from the bottom of the clamp to the centre of the pendulum bob.

(i) Record the length l of the pendulum in cm to the nearest 0.1 cm.

l = ... cm [1]

(ii) **One** complete swing of the pendulum from **A** to **B** and back to **A** is shown in Fig. 6.2.

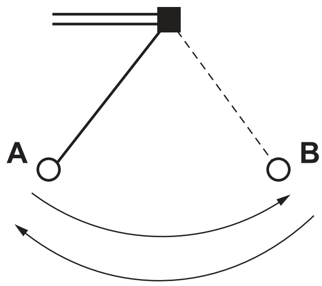

Fig. 6.2

Gently pull the pendulum bob to one side and release it.

Measure the time t for the pendulum to complete **20** swings.

Record your value in seconds to the nearest 0.1 s.

t = ... s [1]

(iii) Use your answer to calculate the time T for **one** swing.

T = ... s [1]

(iv) Calculate T^2.

T^2 = ... s^2 [1]

(v) Calculate the acceleration of free fall g.

Use your answers from **(a)(i)** and **(a)(iv)** and the equation shown.

$$g = \frac{0.395 \times l}{T^2}$$

g = ... m/s^2 [2]

(b) (i) A student is given ruler **A** and ruler **B** to measure the length of the pendulum.

Parts of the rulers are shown in Fig. 6.3.

Fig. 6.3

State which ruler the student uses.

Explain your answer.

ruler ....

explanation ....

.... [1]

(ii) The student does the experiment and uses a fan to keep the room cool.

The wind from the fan changes the time taken for one swing of the pendulum.

Suggest what the student does to minimise the effect of the wind on the pendulum.

The student does **not** adjust the fan.

....

.... [1]

(c) Explain why it is more accurate to time 20 swings of the pendulum instead of just one swing.

....

.... [1]

[Total: 9]

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.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
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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