Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME												
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0474443627

COMBINED SCIENCE **0653/52**

Paper 5 Practical Test **May/June 2020**

1 hour 15 minutes

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

For Examiner's Use	
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1 You are going to investigate the effect of substrate concentration on the rate of a reaction.

Catalase is an enzyme that breaks down the substrate, hydrogen peroxide, to release oxygen gas.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water} + \text{oxygen}$$

The oxygen gas causes paper disks to rise in a solution of hydrogen peroxide.

The greater the rate of reaction, the faster the disks will rise to the surface.

(a) You are provided with catalase solution and five different concentrations of hydrogen peroxide solution labelled, **5%**, **4%**, **3%**, **2%** and **1%**.

Step 1 Use the forceps to dip one of the small paper disks in the catalase solution, as shown in Fig. 1.1.

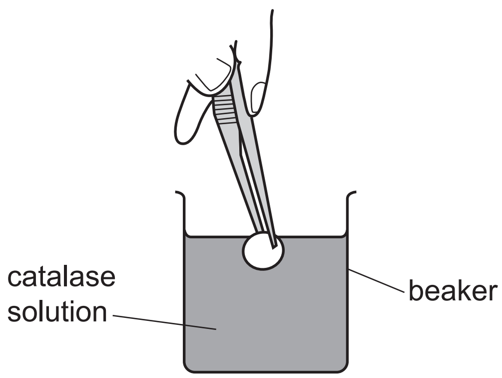

Fig. 1.1

Step 2 Place the small disk onto the paper towel.

Step 3 Repeat step 1 and step 2 with nine more disks.

Step 4 Use the forceps to pick up one of the soaked disks and drop it into the solution labelled **5%**.

Step 5 Start the stop-clock.

The disk will sink to the bottom of the beaker and then slowly rise to the surface. If the disk does not sink immediately, push it down gently with the forceps.

Step 6 Record, to the nearest second, the time it takes for the disk to rise to the surface. If it takes more than 2 minutes then record the time as **greater than 120 s**.

Step 7 Repeat step 4 to step 6 with a second disk.

Step 8 Repeat step 4 to step 7 using the solutions labelled **4%**, **3%**, **2%** and **1%**.

(i) Record your results in Table 1.1.

Table 1.1

percentage concentration of hydrogen peroxide	time for the disk to rise to the surface / s		
	1st disk	2nd disk	average
5			
4			
3			
2			
1			

[3]

(ii) Calculate the average time for each concentration and record these values in Table 1.1.

Ignore any values that are greater than 120 s. [1]

(iii) Describe the relationship between the percentage concentration of hydrogen peroxide and the average time for the disks to rise to the surface.

....

....

.... [1]

(iv) Suggest why two disks are used in each beaker.

....

.... [1]

(b) (i) On the grid, plot a graph of the average time for the disks to rise (vertical axis) and the percentage concentration of hydrogen peroxide.

[3]

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

(iii) Determine the average time for a disk to rise to the surface in a 3.7% hydrogen peroxide solution.

Show on your graph how you arrived at your answer.

average time = ... s [1]

(c) Describe **one** possible source of error in this investigation.

....

.... [1]

(d) State **one** safety hazard associated with this investigation and explain how the risk from this hazard is reduced.

safety hazard ....

explanation ....

.... [1]

[Total: 13]

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2 You are going to investigate the reaction of some metals with dilute hydrochloric acid and with aqueous copper sulfate.

The order of reactivity of some metals is shown.

potassium	most reactive
sodium	
magnesium	
aluminium	
zinc	
iron	
lead	
copper	
silver	least reactive

(a) Procedure – reaction with dilute hydrochloric acid

- Measure $10\,cm^3$ of dilute hydrochloric acid with a measuring cylinder and pour into a large test-tube.
- Measure to the nearest 0.5 °C the initial temperature of the dilute hydrochloric acid.
- Record in Table 2.1 this initial temperature of hydrochloric acid for the metal, iron.
- Add 1 spatula of iron powder to this test-tube.
- Stir the mixture and start the stop-clock.
- Measure to the nearest 0.5 °C the final temperature of the mixture after 2 minutes.
- Record in Table 2.1 this final temperature.

(i) Repeat the procedure in **(a)** using separate samples of magnesium powder, zinc powder and copper powder instead of the iron powder.

Table 2.1

metal	initial temperature of hydrochloric acid / °C	final temperature of the mixture / °C	temperature change / °C
iron			
magnesium			
zinc			
copper			

[3]

(ii) Calculate the temperature change for each metal.

Record this temperature change in Table 2.1.

[1]

(iii) State which metal produces the **largest** temperature change.
Suggest why this metal produces the largest temperature change.

metal ....

suggestion ....
[1]

(iv) Explain the temperature change produced with copper.

.... [1]

(v) Suggest **one** change to the **apparatus** which would improve the accuracy of the results.

....

.... [1]

(vi) The gas given off in this experiment is hydrogen.
State the test for hydrogen gas and give the result of a positive test.

test ....

positive result ....
[1]

(b) Procedure – reaction with aqueous copper sulfate

- Measure 10 cm^3 of aqueous copper sulfate with a measuring cylinder and put into a large test-tube.
- Measure to the nearest 0.5 °C the initial temperature of the aqueous copper sulfate.
- Record in Table 2.2 this initial temperature of aqueous copper sulfate for the metal, magnesium.
- Add 1 spatula of magnesium powder to this test-tube.
- Stir the mixture and start the stop-clock.
- Measure to the nearest 0.5 °C the final temperature of the mixture after 2 minutes.
- Record in Table 2.2 this final temperature.

(i) Repeat the procedure in **(b)** using iron powder instead of the magnesium powder.

Table 2.2

metal	initial temperature of aqueous copper sulfate / °C	final temperature of the mixture / °C	temperature change / °C
magnesium			
iron			

[2]

(ii) Allow the mixture to settle. Look carefully at the test-tube containing iron.
Describe the contents of the test-tube.

....

.... [1]

(iii) Explain the change observed in **(ii)**.

....

.... [1]

(iv) Calculate the temperature change for magnesium and iron.

Record your results in Table 2.2.

Predict the change in temperature you would expect if zinc is added to aqueous copper sulfate.

temperature change for zinc = ... °C
[1]

[Total: 13]

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3 You are going to investigate the resistance of a piece of wire.

(a) The circuit shown in Fig. 3.1 has been set up for you.

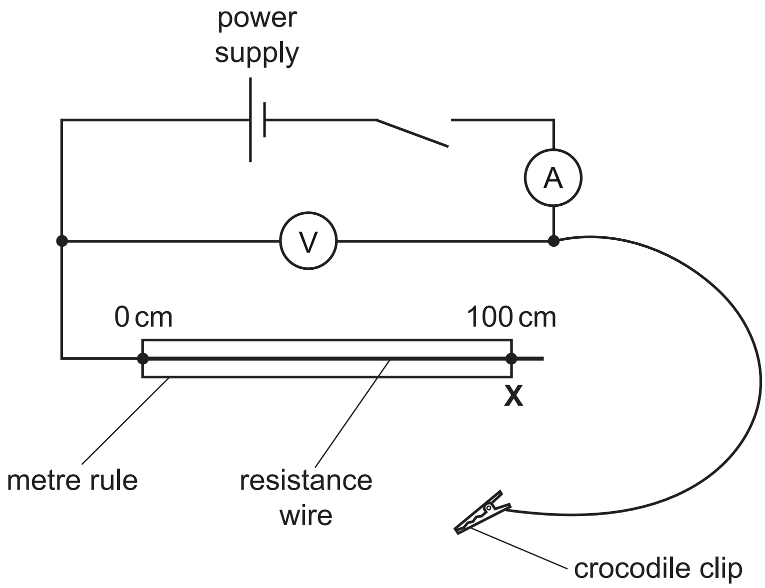

Fig. 3.1

(i)
- Connect the crocodile clip at **X** so that the length of resistance wire in the circuit is 100.0 cm.
- Close the switch.
- Measure and record the potential difference (p.d.) across the wire and the current through the wire.
- Open the switch.

p.d. = ... V

current = ... A
[1]

(ii) Calculate the resistance R_1 of the 100.0 cm length of wire. Use your results in **(a)(i)** and the equation shown.

$$\text{resistance} = \frac{\text{p.d.}}{\text{current}}$$

R_1 = ... Ω [1]

(b) **(i)**
- Remove the crocodile clip and connect it so that the length of resistance wire in the circuit is 50.0 cm.
- Close the switch.
- Measure and record the p.d. across the wire and the current through the wire.
- Open the switch.

p.d. = ... V

current = ... A
[1]

(ii) Calculate the resistance R_2 of the 50.0 cm length of wire. Give your answer to two significant figures.

R_2 = ... Ω [1]

(c) A student suggests that the resistance of a 100.0 cm length of the wire should be double the resistance of a 50.0 cm length of the wire.

State whether your values of R_1 and R_2 support the student's suggestion. Justify your answer with reference to your results.

....

....

.... [1]

(d) Another student suggests that the resistance of a wire is proportional to its length.

(i) Describe how the student can extend this experiment to test their suggestion.

....

.... [1]

(ii) Explain how the student can process the results to reach a conclusion.

....

.... [1]

[Total: 7]

4 Fig. 4.1 shows an empty test-tube, floating in a measuring cylinder containing pure water. If the same test-tube is put into a measuring cylinder containing a solution of salt and water it will float with a smaller length of the test-tube below the surface. This is because the salt solution has a greater density than pure water.

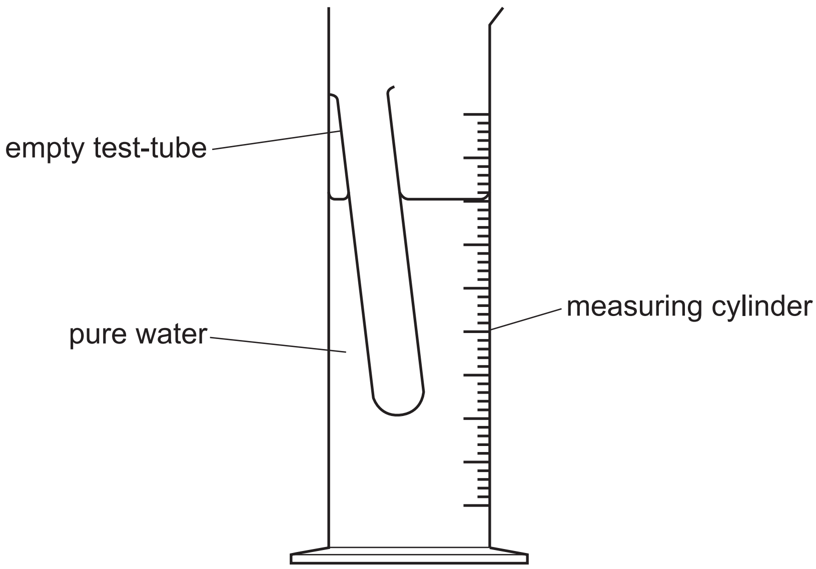

Fig. 4.1

The higher the concentration of salt in the solution the greater the density of the solution.

Five salt solutions of different, known concentrations are placed in beakers and labelled **A**, **B**, **C**, **D** and **E**. Another salt solution of unknown concentration is placed in another beaker and labelled **X**.

Plan an investigation to determine the concentration of salt solution **X** using the following apparatus:

- a measuring cylinder
- a test-tube
- a 30 cm ruler.

You may use any other common laboratory apparatus in your plan.

You are not required to do this investigation.

In your plan, include:

- a brief description of the method
- how you will ensure that your results are as accurate as possible
- how you will process your results
- how you will determine the concentration of **X**.

....

....

....

....

....

....

....

....

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....

....

....

....

.... [7]

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.
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 (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