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COMBINED SCIENCE

0653/62

Paper 6 Alternative to Practical

May/June 2020

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.

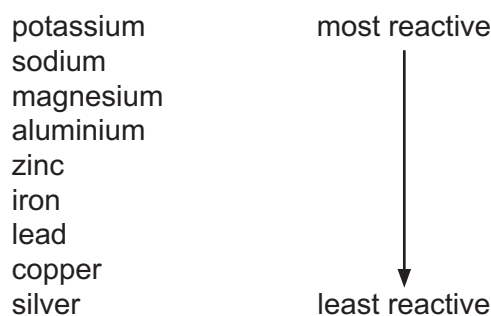
INFORMATION

- 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 **16** pages. Blank pages are indicated.

- 1 A student investigates the reaction of some metals with dilute hydrochloric acid and with aqueous copper(II) sulfate.

The order of reactivity of some metals is shown.



(a) Procedure – reaction with dilute hydrochloric acid

The student:

- measures 10 cm³ of dilute hydrochloric acid in a measuring cylinder and pours it into a large test-tube
- measures the temperature of the dilute hydrochloric acid and records it in Table 1.1
- adds 1 spatula of iron powder to the test-tube and stirs
- measures the final temperature of the mixture after 2 minutes and records it in Table 1.1.

She repeats the procedure using magnesium powder, zinc powder, lead powder and copper powder.

Table 1.1

metal	initial temperature /°C	final temperature /°C	change in temperature /°C
iron	19.5	38.0	
magnesium	21.0	78.0	57.0
zinc	21.5	56.5	
copper	21.0	21.0	0.0
lead			

- (i) The temperature readings for lead powder are shown in Fig. 1.1.

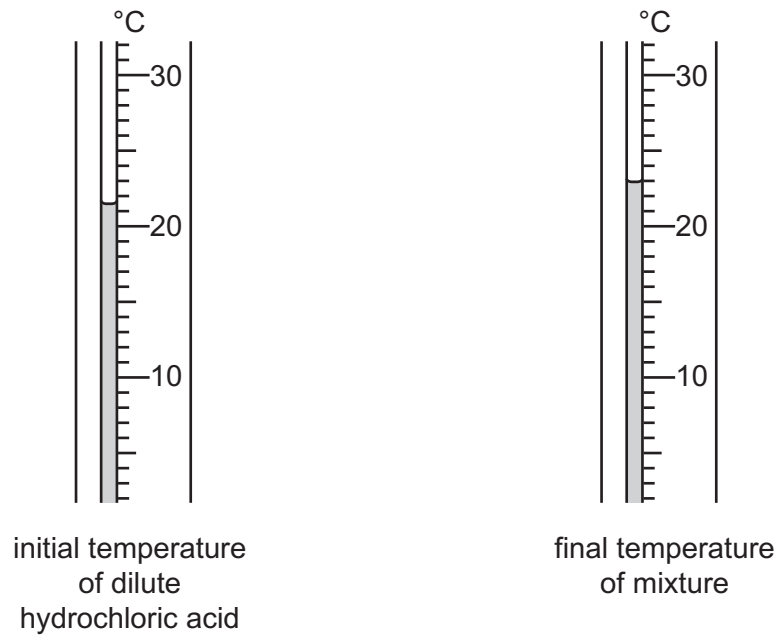


Fig. 1.1

Record in Table 1.1 these temperatures to the nearest 0.5 °C. [2]

- (ii) Calculate the change in temperature for iron, zinc and lead.
Record these changes in temperature in Table 1.1. [1]
- (iii) State which metal produces the **largest** change in temperature.
Suggest why this metal produces the largest change in temperature.

metal

suggestion

[1]

- (iv) Explain why the temperature does **not** change when copper is added to dilute hydrochloric acid.

..... [1]

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

.....

..... [1]

(vi) Hydrogen gas is given off when magnesium reacts with dilute hydrochloric acid.

State a test for hydrogen gas and give the result of a positive test.

test

positive result

[1]

(b) Procedure – reaction with aqueous copper sulfate

The student:

- pours 10 cm³ of aqueous copper(II) sulfate into a test-tube
- measures the initial temperature of the aqueous copper(II) sulfate and records it in Table 1.2
- adds one spatula of magnesium powder to the test-tube and stirs the mixture
- measures the final temperature of the mixture after 2 minutes and records this in Table 1.2.

The student repeats the procedure using iron powder instead of magnesium powder.

Table 1.2

metal	initial temperature of aqueous copper(II) sulfate /°C	final temperature of mixture /°C	change in temperature /°C
magnesium	21.0		28.5
iron		34.0	13.0

(i) Complete Table 1.2 by calculating the missing temperature readings. [2]

(ii) Predict the change in temperature you would expect if zinc is added to aqueous copper(II) sulfate.
Explain your answer.

temperature change °C

explanation

.....

[1]

- (iii) Fig. 1.2 shows the observations the student makes during the reaction of magnesium powder and aqueous copper(II) sulfate.

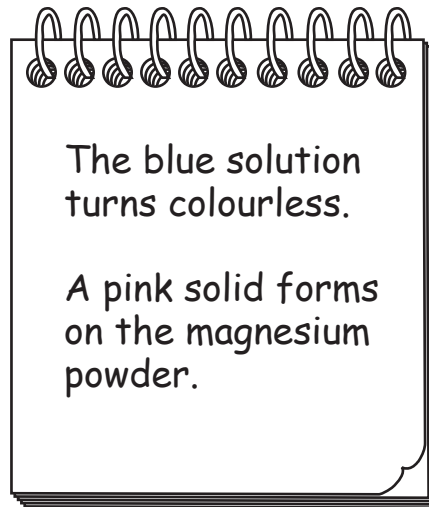


Fig. 1.2

Suggest the name of the pink solid and the salt present in the colourless solution.

name of pink solid

name of salt

[2]

- (iv) Explain the changes observed in (b)(iii).

.....

..... [1]

[Total: 13]

- 2 A student investigates 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. The oxygen gas causes paper disks to rise in a solution of hydrogen peroxide.



- (a) The student is provided with catalase solution and five different percentage concentrations of hydrogen peroxide solution, **5%**, **4%**, **3%**, **2%** and **1%**.

Step 1 He dips five small paper disks into the catalase solution.

Step 2 He drops one of the soaked disks into a beaker containing 60 cm³ **5%** hydrogen peroxide solution.

Step 3 He starts a stop-clock.

Step 4 The disk sinks to the bottom of the beaker and then slowly rises to the surface as shown in Fig. 2.1.

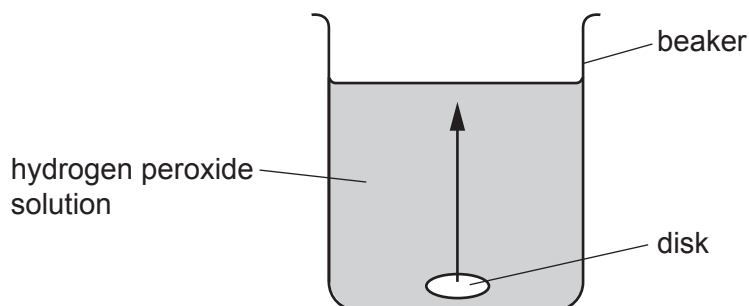


Fig. 2.1

Step 5 When the disk reaches the surface the student stops the stop-clock.

Step 6 He records the time in Table 2.1.

Step 7 He repeats step 2 to step 6 using **4%**, **3%**, **2%** and **1%** hydrogen peroxide.

The results for this first experiment are shown in Table 2.1.

Step 8 He then repeats the experiment.

Table 2.1

percentage concentration of hydrogen peroxide	time for the disk to rise to the surface/s		
	first experiment	repeat experiment	average
5	9	7	8
4	29	25	27
3	56		
2	101		
1	153	152	153

- (i) Name one piece of apparatus that would be suitable for measuring 60 cm³ of hydrogen peroxide solution.

..... [1]

- (ii) Fig. 2.2 shows the readings on the stop-clocks for **3%** and **2%** hydrogen peroxide solutions for the repeat experiment.

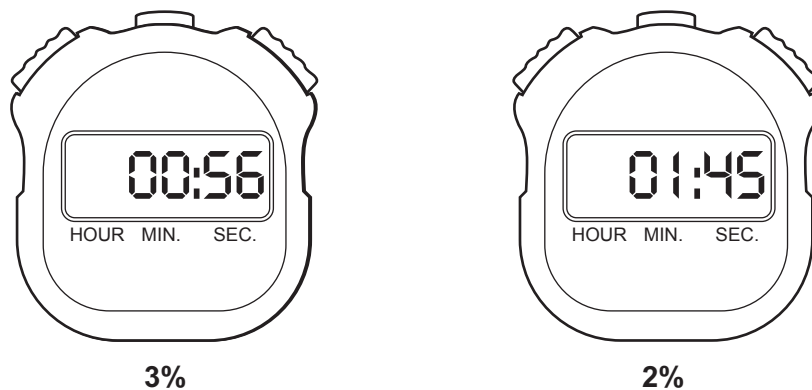


Fig. 2.2

Record in Table 2.1 the times shown in Fig. 2.2. [2]

- (iii) Calculate the average time for the **3%** and **2%** hydrogen peroxide concentrations. Record these values in Table 2.1. [1]
- (iv) Describe the relationship between the percentage concentration of hydrogen peroxide and the average time for the disks to rise to the surface.

..... [1]

(v) Suggest why a repeat experiment is done.

.....
..... [1]

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

safety hazard

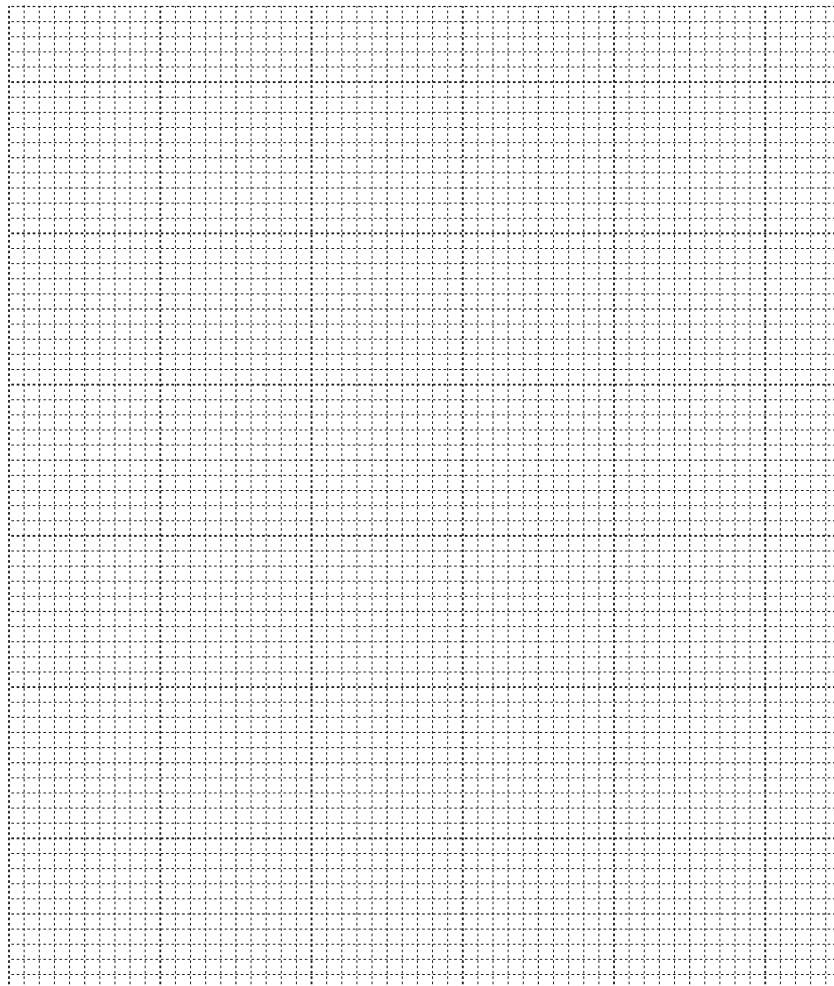
explanation

..... [1]

(vii) Suggest **one** variable that the student should keep constant during this investigation.

.....
..... [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]

[Total: 13]

3 A student investigates the resistance of a piece of wire.

(a) Fig. 3.1 shows the circuit that he sets up to find the potential difference (p.d.) across the 100.0 cm length of wire and the current through the wire.

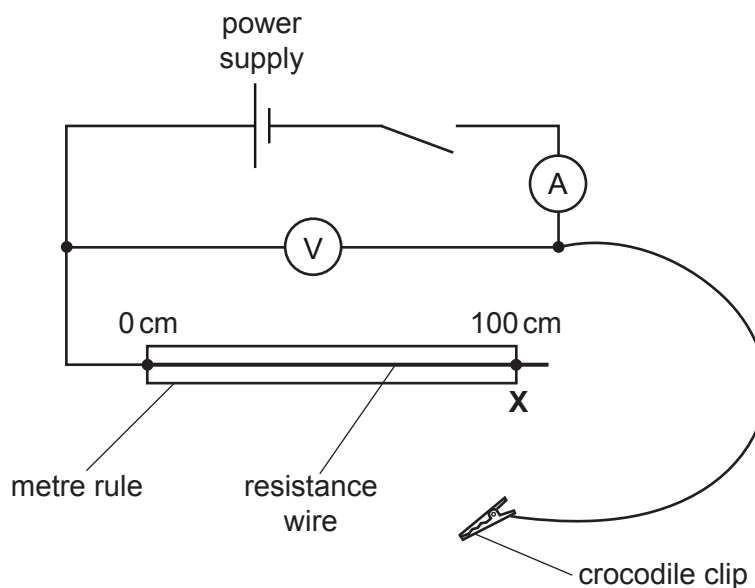


Fig. 3.1

- (i) • The student connects the crocodile clip at X so that the length of resistance wire in the circuit is 100.0 cm.
- He closes the switch.
- He measures and records the potential difference (p.d.) across the wire and the current through the wire.
- He opens the switch.

Fig. 3.2 shows the voltmeter and ammeter readings.

Read and record the p.d. and current.

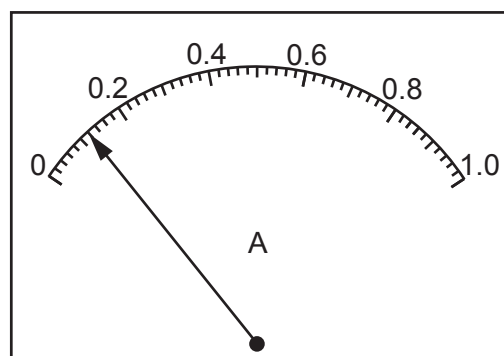
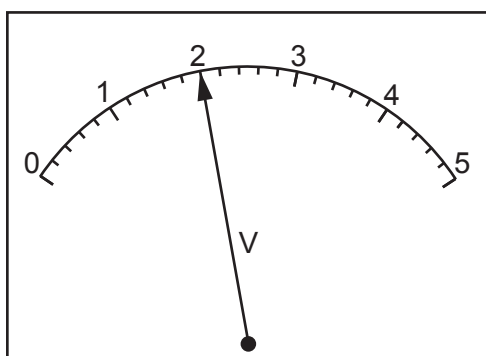


Fig. 3.2

p.d. = V
 current = A
 [2]

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

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

$$R_1 = \dots\dots\dots \Omega \quad [1]$$

- (b)
- The student removes the crocodile clip and connects it so that the length of resistance wire in the circuit is 50.0 cm.
 - He closes the switch.
 - He measures and records the p.d. across the wire and the current through the wire.
 - He opens the switch.

Table 3.1 shows his results.

Table 3.1

p.d. /V	current /A
1.8	0.21

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

$$R_2 = \dots\dots\dots \Omega \quad [1]$$

- (c) Another 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 the values of R_1 and R_2 support the student's suggestion. Justify your answer with reference to these values.

.....
 [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.

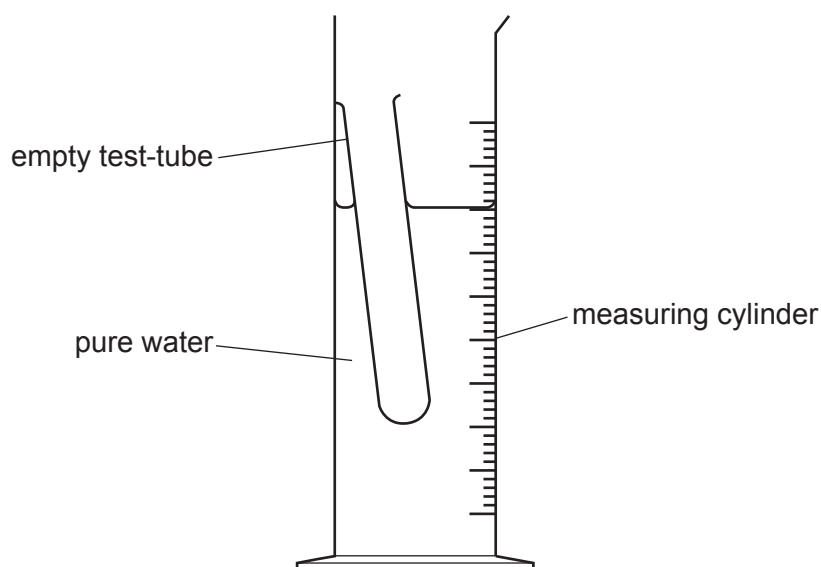


Fig. 4.1

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.

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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