2021 ASSESSMENT MATERIALS

GCSE
CHEMISTRY

Chemistry Test 3: Energy changes and The rate and extent of chemical change (Foundation)

Total number of marks: 35

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0 1 This question is about copper sulfate.

Blue copper sulfate turns white when it is heated.

The word equation for the reaction is:

hydrated copper sulfate ⇌ anhydrous copper sulfate + water

blue white

0 1 . 1 What name is given to hydrated copper sulfate in this reaction?

[1 mark]

Tick **one** box.

- Catalyst ☐
- Element ☐
- Product ☐
- Reactant ☑

0 1 . 2 What does the symbol ⇌ mean?

[1 mark]

Tick **one** box.

- Endothermic ☐
- Exothermic ☐
- Reversible ☑
- Polymerisation ☐

0 1 . 3 Complete the sentence.

[1 mark]

The colour change when water is added to anhydrous copper sulfate

is white to blue .

A student heats 2.5 g of hydrated copper sulfate in a test tube.

0.9 g of water is given off.

The remaining solid is anhydrous copper sulfate.

0 1 . 4 Calculate the mass of anhydrous copper sulfate produced.

[1 mark]

$2.5 - 0.9 = 1.6$

Mass of anhydrous copper sulfate = 1.6 g

0 1 . 5 Calculate the percentage of water contained in 2.5 g of hydrated copper sulfate.

[2 marks]

$\frac{0.9}{2.5} \times 100 = 36\%$

Percentage of water = 36 %

0 3 This question is about the rate of the reaction between hydrochloric acid and calcium carbonate.

A student investigated the effect of changing the size of calcium carbonate lumps on the rate of this reaction.

This is the method used.

1. Pour hydrochloric acid into a conical flask up to the 50 cm^3 line.

2. Add 10.0 g of small calcium carbonate lumps to the conical flask.

3. Attach a gas syringe to the conical flask.

4. Measure the volume of gas produced every 20 seconds for 100 seconds.

5. Repeat steps 1 to 4 using 10.0 g of large calcium carbonate lumps.

0 3 . 1 The student used the 50 cm^3 line on the conical flask to measure the volume of hydrochloric acid.

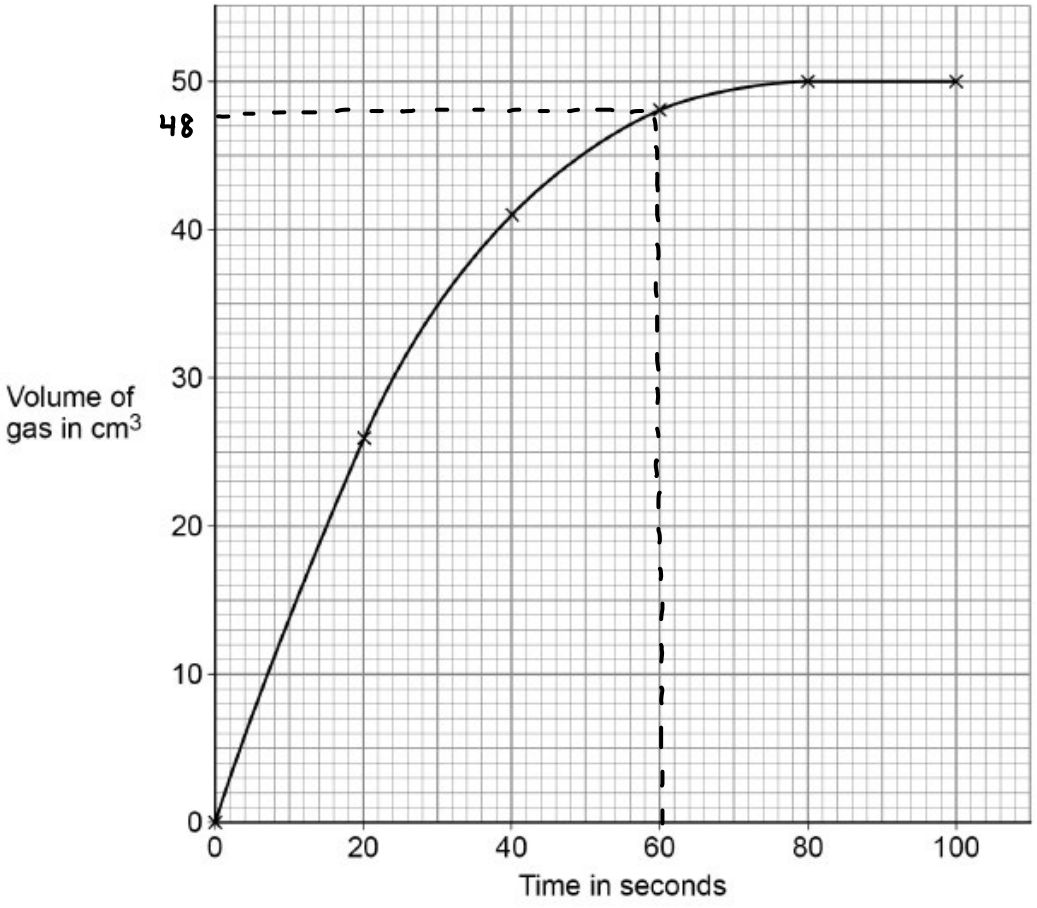
Suggest a piece of equipment the student could use to make the measurement of volume more accurate.

[1 mark]

measuring cylinder

Figure 4 shows the student's results for small calcium carbonate lumps.

Figure 4



0 3 . 4 Determine the mean rate of reaction using **small** calcium carbonate lumps between 0 seconds and 60 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced}}{\text{time taken}}$$

Use **Figure 4**.

[3 marks]

$\frac{48\ cm^3}{60\ s} = 0.8\ cm^3/s$

Mean rate of reaction = 0.8 cm^3/s

0 3 . 5 Describe what happens to the volume of gas collected using **small** calcium carbonate lumps:

- between 0 and 20 seconds
- between 80 and 100 seconds.

Use **Figure 4**.

[2 marks]

Between 0 and 20 seconds increases proportianally to increase in time

Between 80 and 100 seconds no more gas is collected

0 3 . 6 The balance used to weigh 10.0 g of calcium carbonate lumps caused an error.

The balance always read 0.2 g before being used.

What type of error was caused by the balance?

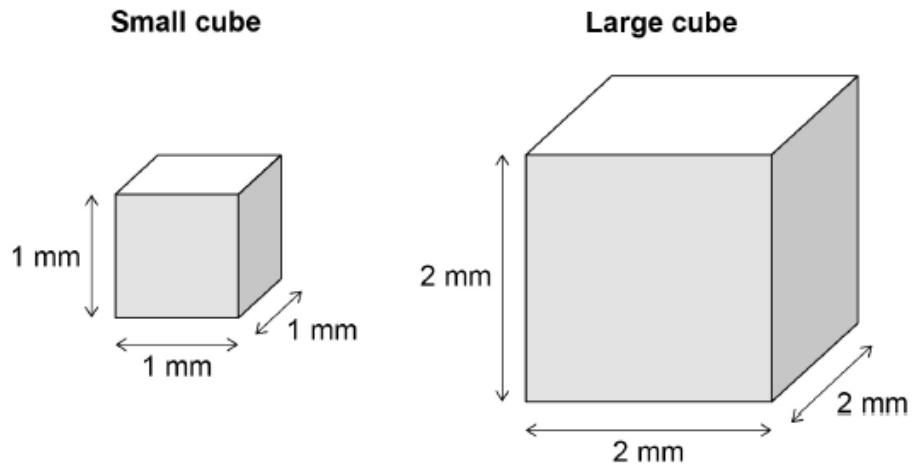
[1 mark]

Tick (✓) **one** box.

Human error	
Random error	
Systematic error	✓

Figure 5 shows the dimensions of two cubes of calcium carbonate.

Figure 5



0 3 . 7 A cube of calcium carbonate has six faces.

Calculate the total surface area of the **large** cube of calcium carbonate.

Use **Figure 5**.

[3 marks]

$2 \times 2 \times 6 = 24$ mm^2

Total surface area = 24 mm^2

0 3 . 8 The large cube of calcium carbonate was divided into eight smaller cubes.

The eight smaller cubes have a greater total surface area than the one large cube.

Compare the rate of reaction when using the eight smaller cubes with the rate of reaction when using the large cube.

Complete the sentence.

Choose the answer from the box.

[1 mark]

faster	**slower**	**the same**

The rate of reaction of the eight smaller cubes is faster.

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

Citric acid is a solid.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.

2. Measure the temperature of the sodium hydrogencarbonate solution.

3. Add 0.25 g of citric acid to the cup.

4. Stir the solution.

5. Measure the temperature of the solution.

6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

Table 4 shows some of the student's results.

Table 4

Mass of citric acid added in g	Temperature of solution in °C
0.00	22.6
0.25	22.2
0.50	21.8
0.75	21.4
1.00	21.0
1.25	20.6

0 6 . 4 How do the results in **Table 4** show that the reaction is endothermic?

temperature of solution decreases as more citric acid is added

[1 mark]

0 6 . 5 Three of the student's results are plotted on **Figure 9**.

A line of best fit for these points is drawn.

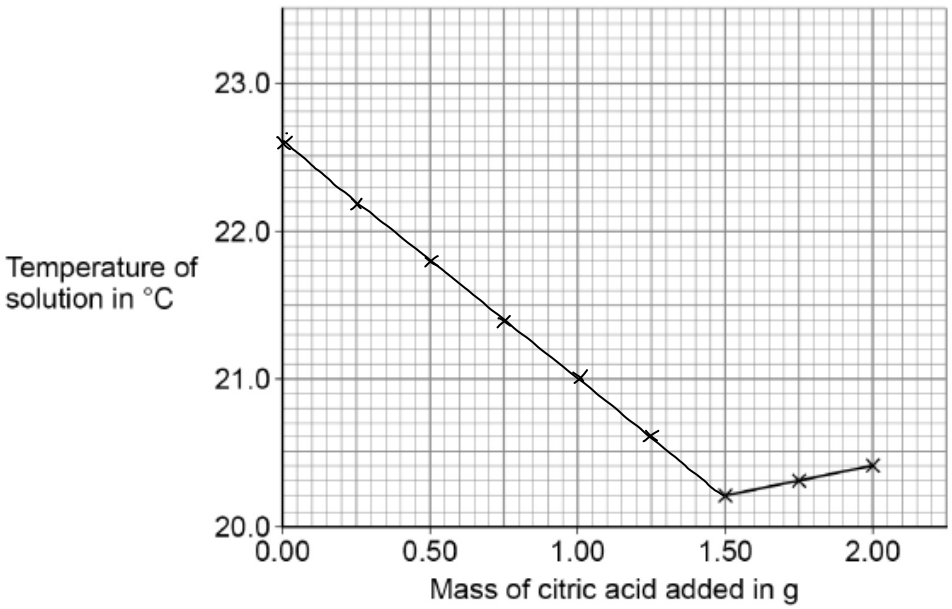
Complete **Figure 9**.

You should:

- plot the data from **Table 4** on **Figure 9**
- draw a line of best fit through the points you have plotted
- extend your line of best fit to meet the line of best fit already drawn on **Figure 9**.

[4 marks]

Figure 9



0 6 . 6 Determine the overall temperature change for the reaction.

Use **Figure 9**.

[2 marks]

22.6 - 20.2 = 2.4

Overall temperature change = 2.4 °C

0 6 . 7 What is the dependent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

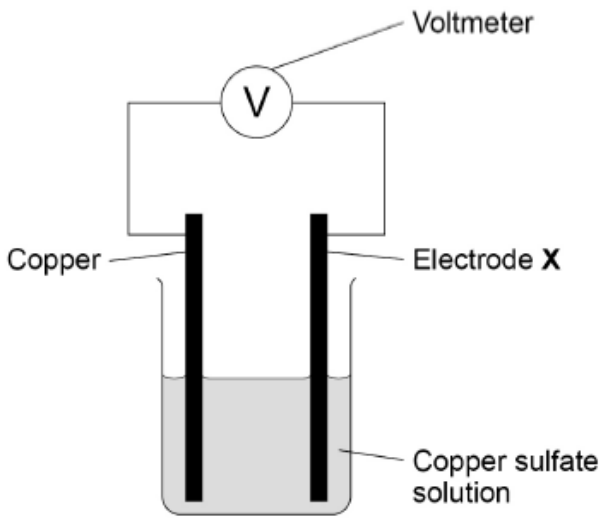
- Mass of citric acid ☐
- Temperature of solution ☑
- Volume of solution ☐

0 4 This question is about chemical cells and batteries.

A student investigated the voltage produced by different chemical cells.

Figure 7 shows the apparatus.

Figure 7



This is the method used.

1. Use cobalt metal as electrode **X**.

2. Record the cell voltage.

3. Repeat steps 1 and 2 using different metals as electrode **X**.

0 4 . 1 Suggest **two** variables the student should keep the same to make the investigation valid.

[2 marks]

1 concentration of copper sulfate solution

2 mass of electrode X

Table 1 shows the student's results.

Table 1

Electrode X	Voltage of the cell in volts
cobalt	0.62
magnesium	2.71
zinc	1.10

0 4 . 2 Write the three metals used for electrode **X** in order of reactivity.

Use **Table 1**.

[1 mark]

Most reactive magnesium

zinc

Least reactive cobalt

0 4 . 2 Batteries consist of cells.

Describe how a 6.0 V battery can be made from cells of voltage 1.5 V

[2 marks]

connect 4 1.5V cells in series

0 4 . 3 Why do non-rechargeable cells stop producing electricity?

[2 marks]

one of the reactants in the cell is used up and is not replenished

0 4 . 5 Which is the most suitable use for a non-rechargeable cell?

[1 mark]

Tick (✓) **one** box.

Electric toy	✓
Laptop computer	
Mobile phone	

0 4 . 6 Hydrogen fuel cells or rechargeable cells can be used to power electric vehicles.

Suggest **one** advantage and **one** disadvantage of using a hydrogen fuel cell compared with a rechargeable cell.

[2 marks]

Advantage of hydrogen fuel cell small size

Disadvantage of hydrogen fuel cell needs a constant supply of hydrogen, which is a flammable gas