All questions are for both separate science and combined science students

Q1.

This question is about energy changes of reactions.

Zinc reacts with copper sulfate solution.

The word equation for the reaction is:

zinc + copper sulfate → zinc sulfate + copper

(a) What type of reaction is the reaction between zinc and copper sulfate solution?

Tick (✓) **one** box.

Combustion ☐

Decomposition ☐

Displacement ☐

(1)

(b) Calculate the percentage (%) by mass of copper in copper sulfate (CuSO4).

Give your answer to 3 significant figures.

Relative atomic mass (*Ar*): Cu = 63.5

Relative formula mass (*Mr*): $CuSO_4$ = 159.5

_____

_____

_____

_____

_____

Percentage by mass (3 significant figures) = _____ %

(3)

A student investigated the energy change in the reaction between zinc and copper sulfate solution.

This is the method used.

1. Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.

2. Weigh 0.20 g of zinc powder.

3. Add the zinc powder to the copper sulfate solution.

4. Measure the highest temperature reached by the mixture.

5. Repeat steps 1 to 4 using different masses of zinc powder.

(c) Control variables are used to make an investigation a fair test.

Which is a control variable in the investigation?

Tick (✓) **one** box.

Highest temperature reached by the mixture ☐

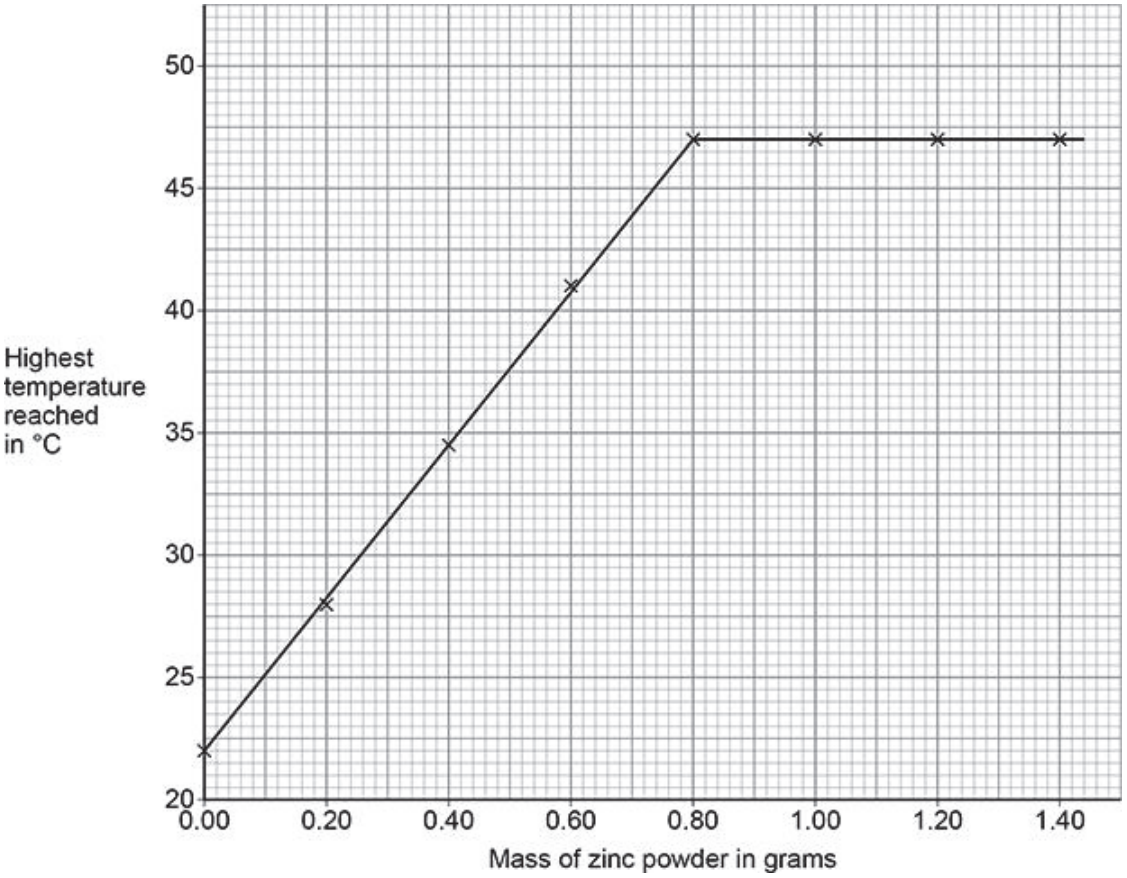
Mass of zinc powder ☐

Volume of copper sulfate solution ☐

(1)

Figure 1 shows the results.

Figure 1



(d) What is the minimum mass of zinc powder needed to react with all the copper sulfate solution?

Use **Figure 1**.

Minimum mass of zinc powder = _____ g

(1)

(e) What is the maximum temperature change in the reaction between zinc powder and 25 cm^3 of copper sulfate solution?

Use **Figure 1**.

_____

_____

_____

Maximum temperature change = _____ °C

(2)

(f) 25 cm^3 of copper sulfate solution contained 6.75 g of copper sulfate.

Calculate the concentration of the solution in g/dm^3.

You should:

- calculate the volume of the solution in dm^3 (1000 cm^3 = 1 dm^3)
- use the equation:

$$\text{concentration of solution in g/dm}^3 = \frac{\text{mass of copper sulfate in grams}}{\text{volume of solution in dm}^3}$$

_____

_____

Volume of solution = _____ dm^3

_____

_____

_____

Concentration of solution = _____ g/dm^3

(3)

Another student investigated the energy change of the reaction between sodium hydrogencarbonate and hydrochloric acid.

This is the method used.

1. Measure 25 cm^3 of hydrochloric acid.

2. Weigh 1.0 g of sodium hydrogencarbonate.

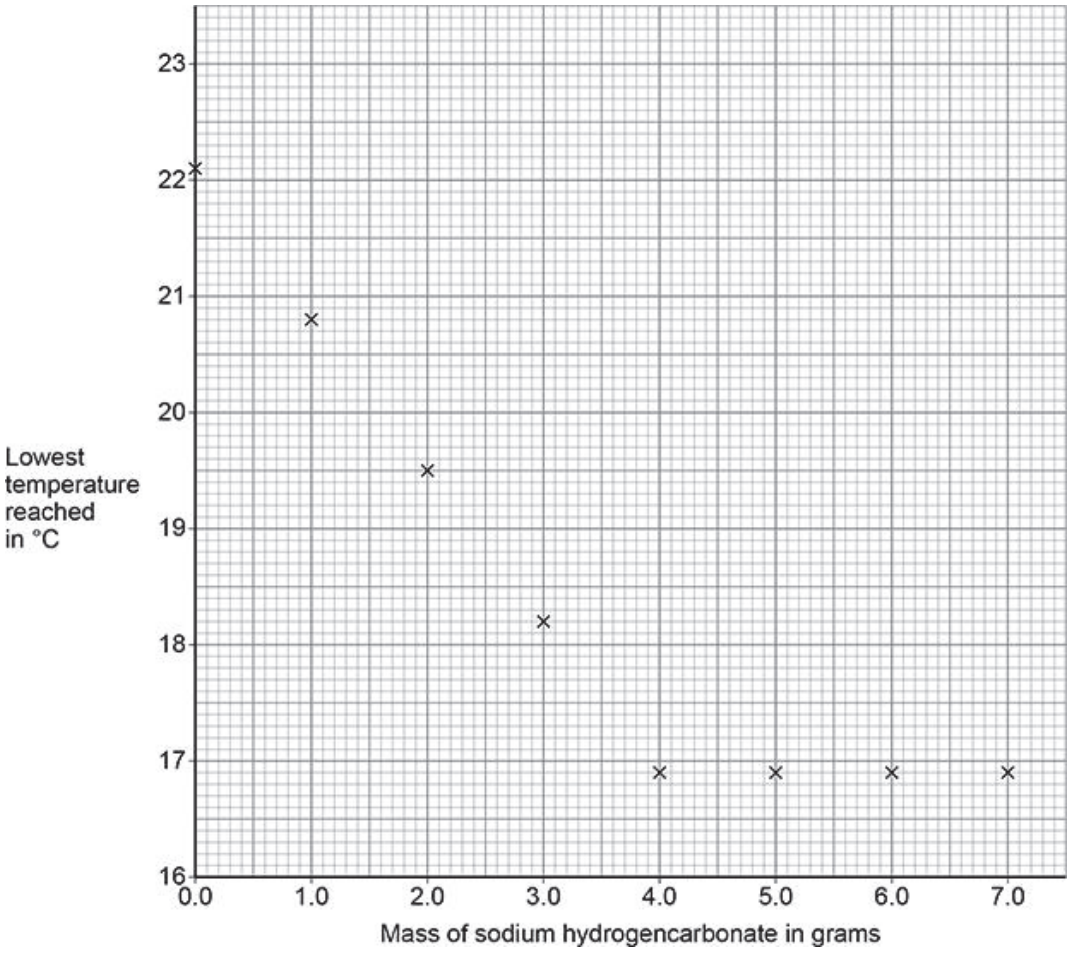
3. Add the sample of sodium hydrogencarbonate to the hydrochloric acid.

4. Measure the lowest temperature reached by the mixture.

5. Repeat steps 1 to 4 using different masses of sodium hydrogencarbonate.

Figure 2 shows the results.

Figure 2



(g) Draw **two** straight lines of best fit on **Figure 2**.

The lines should cross.

(2)

(h) Which statement describes the energy change in the reaction shown in **Figure 2**?

Tick (✓) **one** box.

Energy is **transferred to** the surroundings so the reaction is **endothermic**. ☐

Energy is **transferred to** the surroundings so the reaction is **exothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **endothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **exothermic**. ☐

(1)

(Total 14 marks)