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0 5 A student investigated the temperature change when magnesium was added to copper sulfate solution.

This is the method used.

1. Pour 30 cm^3 of copper sulfate solution into a polystyrene cup.
2. Measure the temperature of copper sulfate solution every minute for 3 minutes.
3. Add magnesium on the fourth minute.
4. Measure the temperature of the mixture at 5 minutes and then every minute up to 14 minutes.

0 5 . 1 What is the dependent variable in this investigation?

[1 mark]

Question 5 continues on the next page

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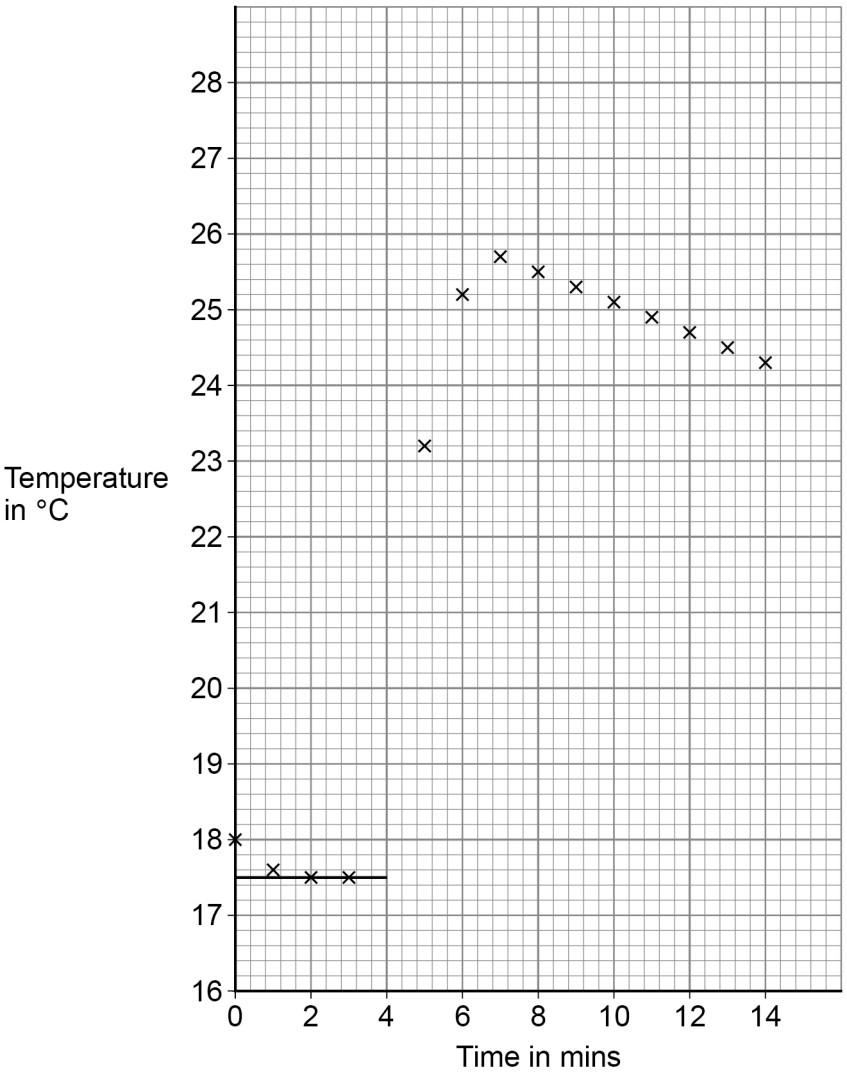
The student used the results to plot a graph.

Figure 4 shows the graph.

Figure 4



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0 5 . 2 Suggest why the copper sulfate solution was left for four minutes before adding the magnesium.

[1 mark]

0 5 . 3 Complete **Figure 4** by:

- drawing a line of best fit through all the points after 7 minutes
- extending the line back to 4 minutes.

[2 marks]

0 5 . 4 The temperature change for the reaction is the temperature difference between the two graph lines at 4 minutes.

Determine the temperature change for the reaction.

Use **Figure 4**.

[2 marks]

Temperature change = _____ °C

0 5 . 5 Explain why the temperature of the mixture decreases after 7 minutes.

[2 marks]

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0 5 . 6 The student repeated the experiment with an unknown metal **Q** instead of magnesium.

All the other variables were kept the same.

The student recorded a smaller temperature change.

Suggest the identity of metal **Q**.

Give **one** reason for your answer.

[2 marks]

Metal **Q** _____

Reason _____

_____

0 5 . 7 A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm^3 of water.

Calculate the mass of copper sulfate in 30.0 cm^3 of this solution.

Relative formula mass (M_r): $CuSO_4$ = 159.5

[4 marks]

_____

_____

_____

_____

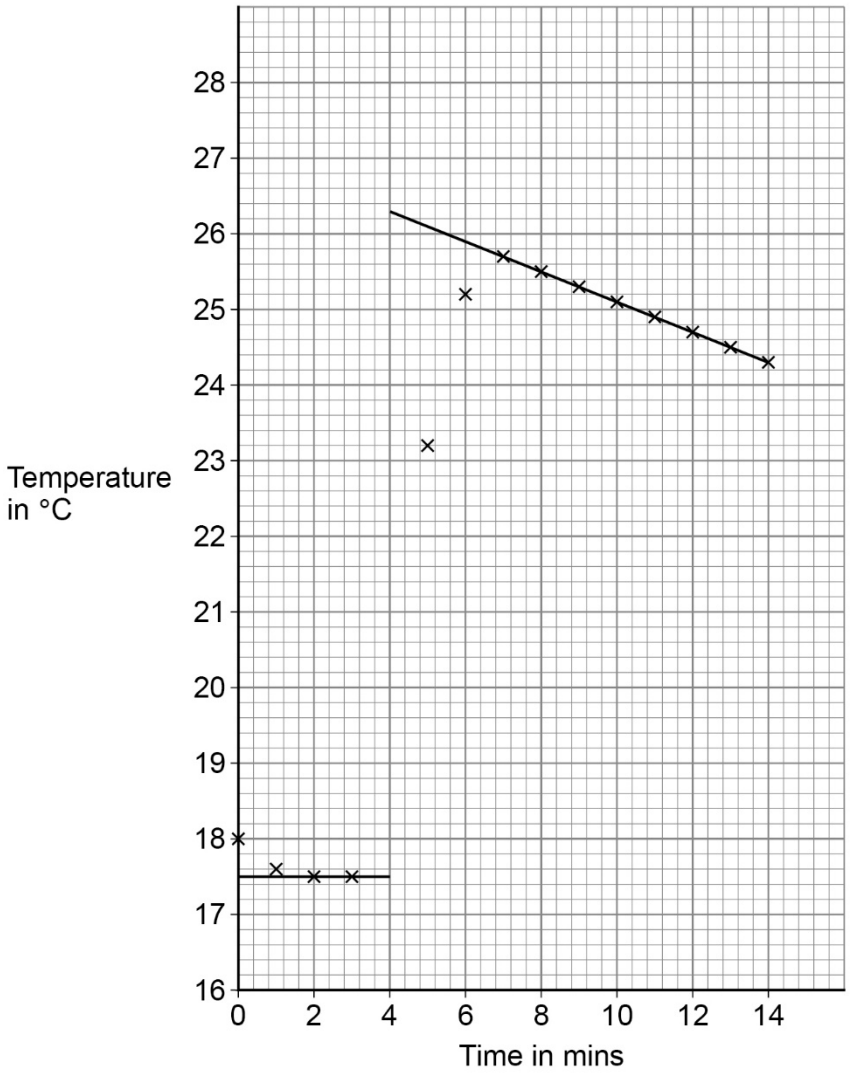
_____

_____

Mass = _____ g

14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	temperature (change)		1	AO2 5.4.1.2 5.5.1.1 RPA 10
05.2	to reach a constant temperature	allow to reach room temperature	1	AO3 5.4.1.2 5.5.1.1 RPA 10

05.3	line of best fit after 7 minutes extends line back to 4 minutes	 ignore extension of line beyond 4 minutes	1 1	AO2 5.4.1.2 5.5.1.1 RPA 10
	the diagram below scores **2** marks  			

05.4	(maximum **and** minimum values at 4 minutes) 26.3 (°C) **and** 17.5 (°C) (temperature change at 4 minutes) = 8.8 (°C)	allow ecf from **05.3**	1 1	AO3 5.4.1.2 5.5.1.1 RPA 10

05.5	the reaction finished / stopped (so) energy is lost to surroundings / atmosphere **or** (so the) solution cools (back to room temperature)	allow maximum temperature has been reached allow heat for energy	1 1	AO3 5.4.1.2 5.5.1.1 RPA 10

05.6	aluminium / zinc / iron / beryllium metal **Q** is less reactive (than magnesium) **or** metal **Q** is lower in reactivity series	allow Al / Zn / Fe / Be do **not** accept copper, silver MP2 dependent on a correct answer to MP1 allow converse	1 1	AO3 AO2 5.4.1.2 5.5.1.1 RPA 10

05.7	(unit conversion) 30.0 cm^3 = 0.030 dm^3 **or** 0.500 dm^3 = 500 cm^3		1	AO2 5.3.2.1 5.4.1.2 5.5.1.1
	(moles = $\frac{30}{500}$ × 0.1 =) 0.006 **or** (moles = $\frac{0.030}{0.50}$ × 0.1 =) 0.006	allow correct use of incorrect / no unit conversion	1	
	mass = 0.006 × 159.5	allow correct use of incorrect value for number of moles	1	
	= 0.957 (g)	allow 0.96 (g)	1	

Total			**14**