Do not write outside the box

0 2 A student investigated the temperature change when metal **X** was added to copper sulfate solution.

This is the method used.

1. Add 25 cm^3 of copper sulfate solution to a beaker.
2. Measure the temperature of the copper sulfate solution.
3. Add 1.0 g of metal **X** and stir.
4. Measure the highest temperature reached when metal **X** is added to copper sulfate solution.
5. Repeat steps 1 to 4 with different metals.

Figure 1 shows the apparatus used.

Figure 1

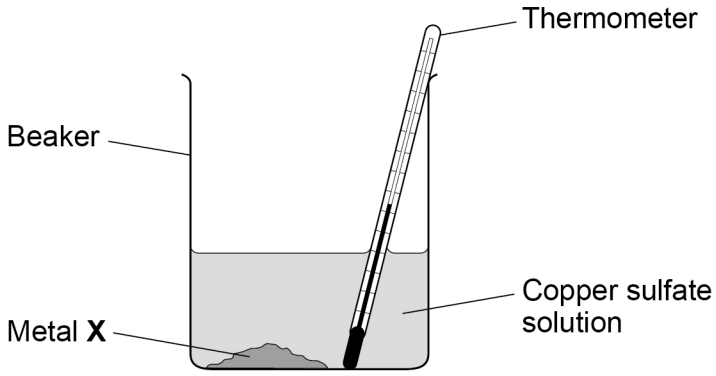
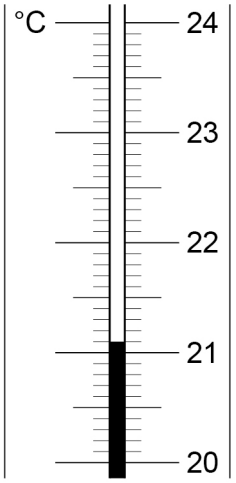


Figure 2 shows the thermometer reading of the copper sulfate solution at the start of the investigation.

Figure 2



Do not write outside the box

0 2 . 1 The highest temperature reached when metal **X** was added to copper sulfate solution was 35.5 °C

Determine the temperature change when metal **X** is added to copper sulfate solution.

Use **Figure 2**.

[2 marks]

Highest temperature = 35.5 °C

Temperature at start = _____ °C

Temperature change = _____ °C

0 2 . 2 Give **two** variables the student should keep the same in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 3 The student repeated the experiment with metal **Y**.

Table 1 shows four results for metal **Y**.

Table 1

	Test 1	**Test 2**	**Test 3**	**Test 4**
Temperature change in °C	9.2	7.3	9.5	9.2

Calculate the mean temperature change for metal **Y**.

Do **not** include the anomalous result in your calculation.

[2 marks]

_____

_____

_____

_____

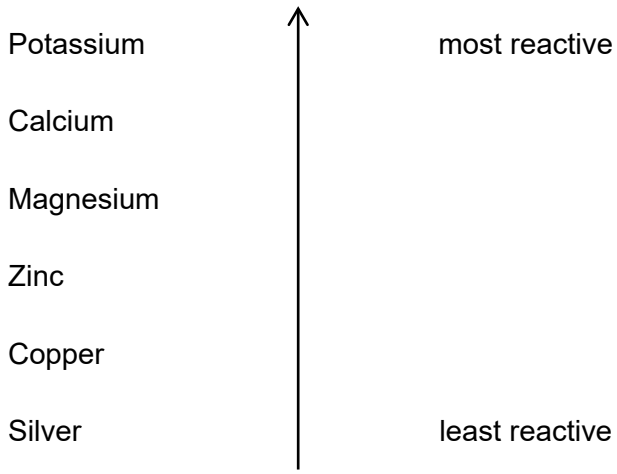
Mean temperature change = _____ °C

Turn over ►

The more reactive the metal added to copper sulfate solution, the greater the temperature change.

Figure 3 shows a reactivity series.

Figure 3



0 2 . 4 The student repeated the experiment.

The student added:

- magnesium to copper sulfate solution
- an unknown metal **A** to copper sulfate solution.

Table 2 shows the results.

Table 2

Metal	**Temperature change in °C**
Magnesium	12
Metal **A**	8

The student concludes metal **A** is zinc.

Give **one** reason why the student is correct.

Use **Figure 3** and **Table 2**.

[1 mark]

Do not write outside the box

0 2 . 5 The student did the experiment with silver and copper sulfate solution.

What happens to the temperature of the mixture?

Use **Figure 3**.

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Increases ☐

Stays the same ☐

0 2 . 6 Suggest **one** reason why the student should **not** add potassium metal to copper sulfate solution.

[1 mark]

0 2 . 7 100 cm^3 of the copper sulfate solution contains 1.8 g of copper sulfate.

Calculate the mass of copper sulfate in 25 cm^3 of this copper sulfate solution.

[2 marks]

Mass = _____ g

11

Turn over for the next question

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	21.1 (°C) 14.4 (°C)	 allow correct use of an incorrect start temperature	1 1	AO2 5.4.1.2 5.5.1.1 RPA 10
02.2	any **two** from: • surface area of metal • 25 cm^3 / volume of copper sulfate solution • concentration of copper sulfate solution • mass / 1 g of metal	 ignore amount ignore temperature ignore stirring	2	AO2 5.4.1.2 5.5.1.1 RPA 10
02.3	$\frac{9.2 + 9.5 + 9.2}{3}$ **or** $\frac{27.9}{3}$ = 9.3 (°C)	 if no other mark awarded allow **1** mark for 8.8 (°C)	1 1	AO3 AO2 5.4.1.2 5.5.1.1 RPA 10

02.4	(metal **A** / zinc) is less reactive (than magnesium) **or** (metal **A** / zinc) is lower in reactivity series **or** change in temperature is lower (with metal **A** / zinc)	allow converse	1	AO3 5.4.1.2 5.5.1.1 RPA 10
02.5	stays the same		1	AO3 5.4.1.2 5.5.1.1 RPA 10
02.6	too dangerous **or** too reactive	allow potassium would react with water	1	AO2 5.1.2.5 5.4.1.2 5.5.1.1 (RPA 10)
02.7	$\frac{25}{100} \times 1.8$ **or** $\frac{1}{4} \times 1.8$ = 0.45 (g)		1 1	AO2 5.3.2.5 RPA 10
Total			**11**	