AQA - Exothermic and endothermic reactions – GCSE Combined Science Chemistry

1. May/2020/Paper_8464/1F/No.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

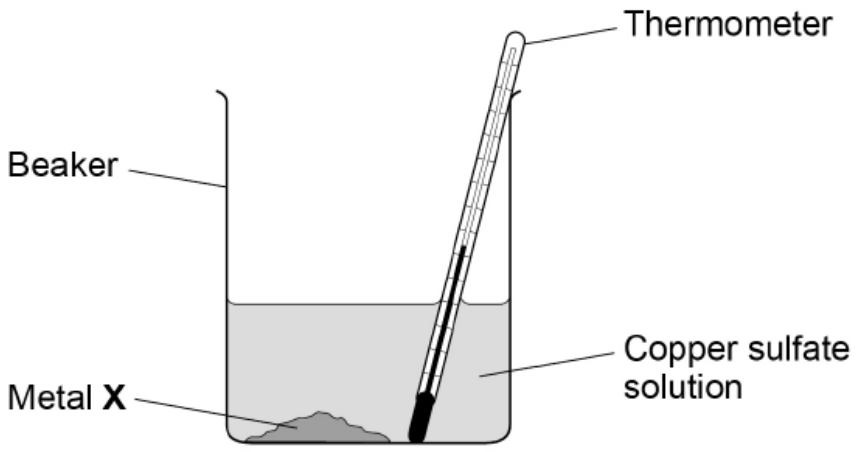
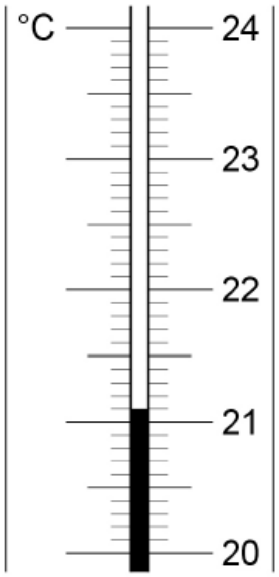


Figure 2 shows the thermometer reading of the copper sulfate solution at the start of the investigation.

Figure 2



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

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

[2 marks]

1 _____

_____

2 _____

_____

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]

_____

_____

_____

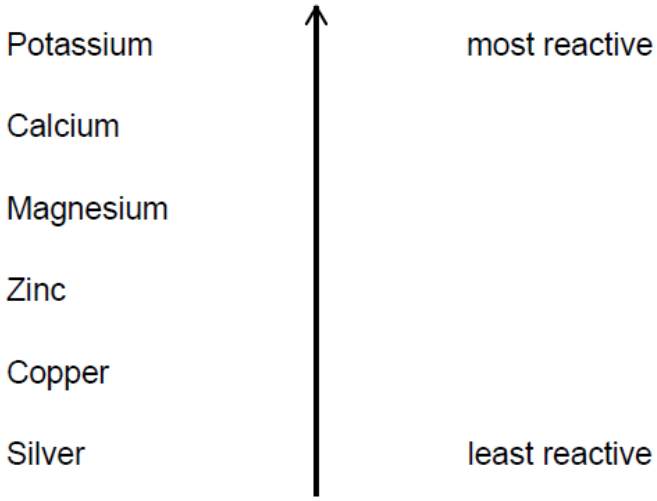
_____

Mean temperature change = _____ °C

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

Figure 3 shows a reactivity series.

Figure 3



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]

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 ☐

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

[1 mark]

_____

_____

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

2. May/2020/Paper_8464/1F/No.8

Some students investigated the thermal decomposition of metal carbonates.

The word equation for the reaction is:

metal carbonate → metal oxide + carbon dioxide

The students made the following hypothesis:

'When heated the same mass of any metal carbonate produces the same mass of carbon dioxide.'

The students heated a test tube containing copper carbonate.

Table 4 shows their results.

Table 4

Time the test tube containing copper carbonate was heated in mins	0	2	4	6
Mass of test tube and contents in g	17.7	17.1	17.0	17.0

Plan a method the students could use to test their hypothesis.

You should show how the students use their results to test the hypothesis.

You do **not** need to write about safety precautions.

[6 marks]

3. May/2020/Paper_8464/1H/No.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.

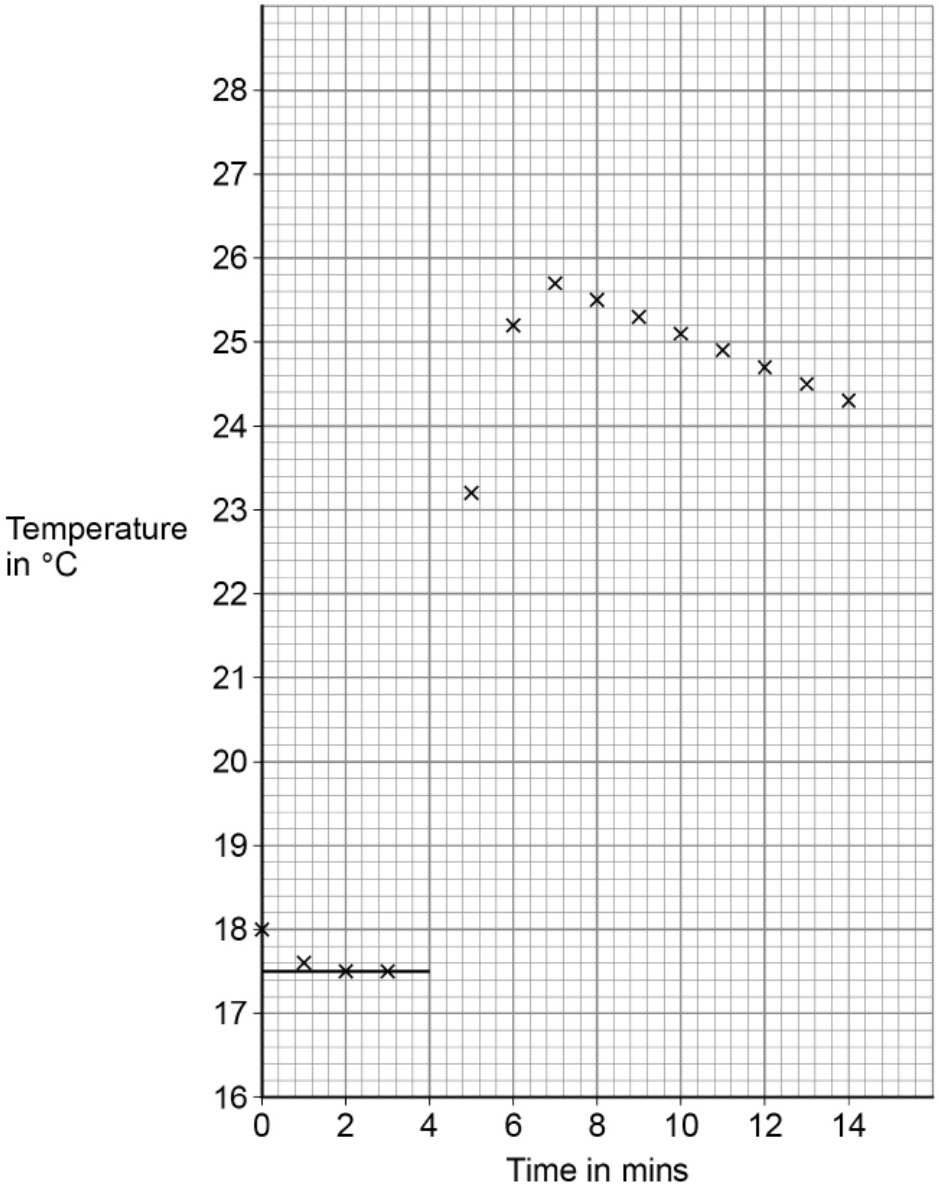
What is the dependent variable in this investigation?

[1 mark]

The student used the results to plot a graph.

Figure 4 shows the graph.

Figure 4



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

[1 mark]

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]

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

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

[2 marks]

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 _____

_____

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

4. Jun/2019/Paper_8464/1F/No.1.1-1.6

Which of these items uses an endothermic reaction?

[1 mark]

Tick (✓) **one** box.

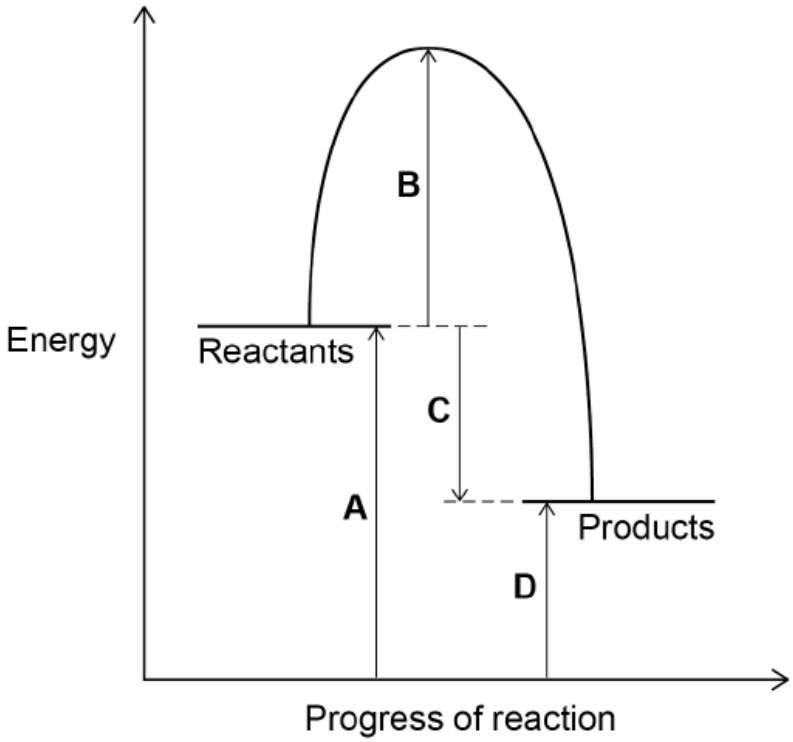
Hand warmer ☐

Sports injury pack ☐

Self-heating can ☐

Figure 1 shows the reaction profile for an exothermic reaction.

Figure 1



Which letter represents the activation energy for the reaction?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Which letter represents the overall energy change for the reaction?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Complete the sentence.

Choose the answer from the box.

[1 mark]

lower than	**the same as**	**higher than**

In an exothermic reaction the energy of the products

is _____ the energy of the reactants.

A student measured the temperature at the start and at the end of a reaction.

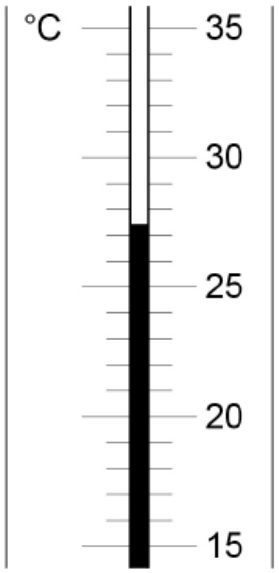
Name the apparatus used to measure the temperature.

[1 mark]

_____

Figure 2 shows the temperature at the end of the reaction.

Figure 2



Complete **Table 1**.

Use **Figure 2**.

[2 marks]

Table 1

Temperature at start in °C	14.3
Temperature at end in °C	
Change in temperature in °C	

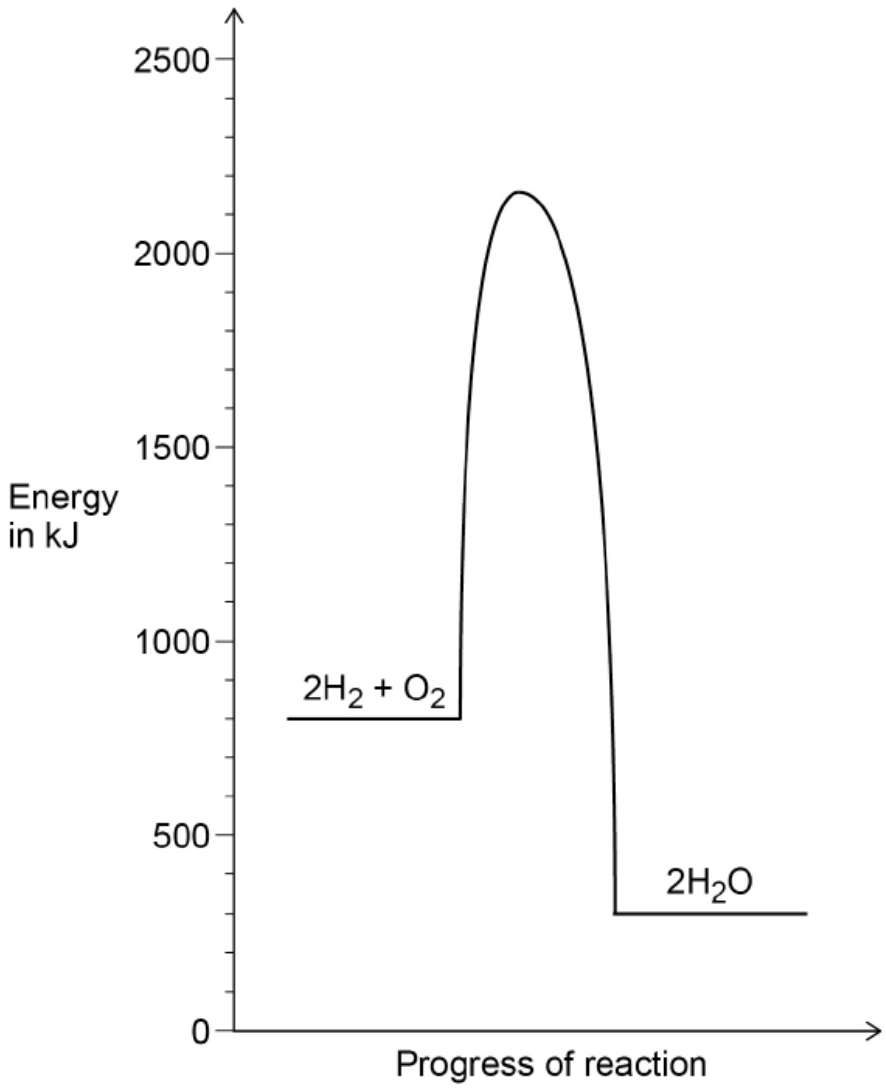
5. Jun/2019/Paper_8464/1H/No.3.1

Hydrogen reacts with oxygen.

$$2\,H_2\,(g) + O_2\,(g) \rightarrow 2\,H_2O\,(g)$$

Figure 2 shows the relative energies of the reactants and products at a certain temperature.

Figure 2



Label the activation energy on **Figure 2**.

[1 mark]

6. Jun/2019/Paper_8464/1H/No.3.2

Determine the overall energy change for the reaction between hydrogen and oxygen shown in Question **03.1**

Use **Figure 2**.

[2 marks]

Energy change = _____ kJ

7. Jun/2019/Paper_8464/1H/No.3.4

The equation shows the decomposition of hydrogen peroxide.

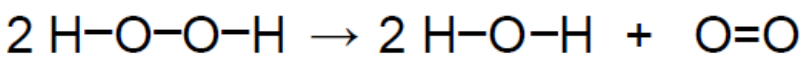


Table 1 shows the bond energies.

Table 1

Bond	**O–O**	**O=O**	**O–H**
Bond dissociation energy in kJ per mole	138	496	463

Calculate the overall energy change for the reaction.

[3 marks]

Energy change = _____ kJ