

Exothermic and endothermic reactions – GCSE Combined Science Chemistry**1. 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 cm³ 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.

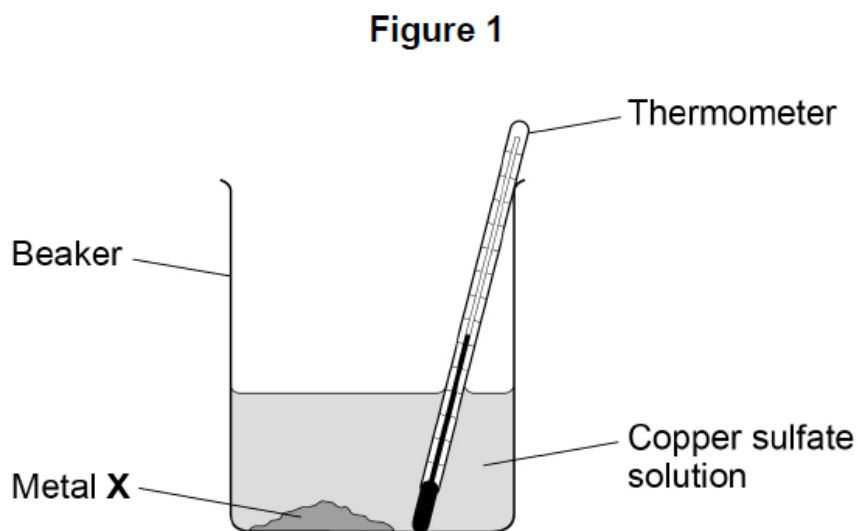
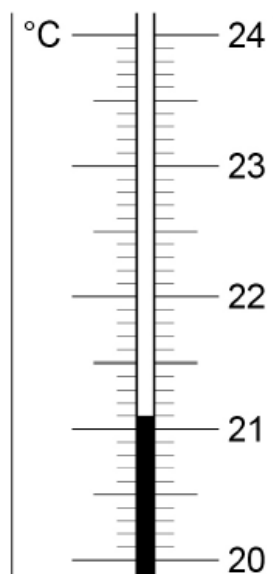


Figure 2 shows the thermometer reading of the copper sulfate solution at the start of the investigation.

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**.

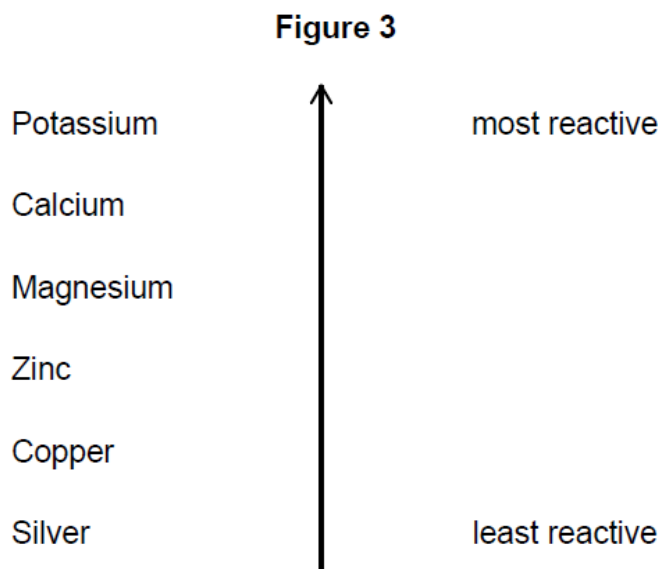
Do **not** include the anomalous result in your calculation.

[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.



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 cm³ of the copper sulfate solution contains 1.8 g of copper sulfate.

Calculate the mass of copper sulfate in 25 cm³ of this copper sulfate solution.

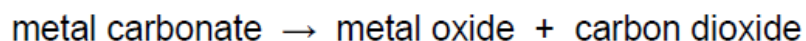
[2 marks]

Mass = _____ g

2. No.8

Some students investigated the thermal decomposition of metal carbonates.

The word equation for the reaction is:



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]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

3. No.5

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

This is the method used.

1. Pour 30 cm³ 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.

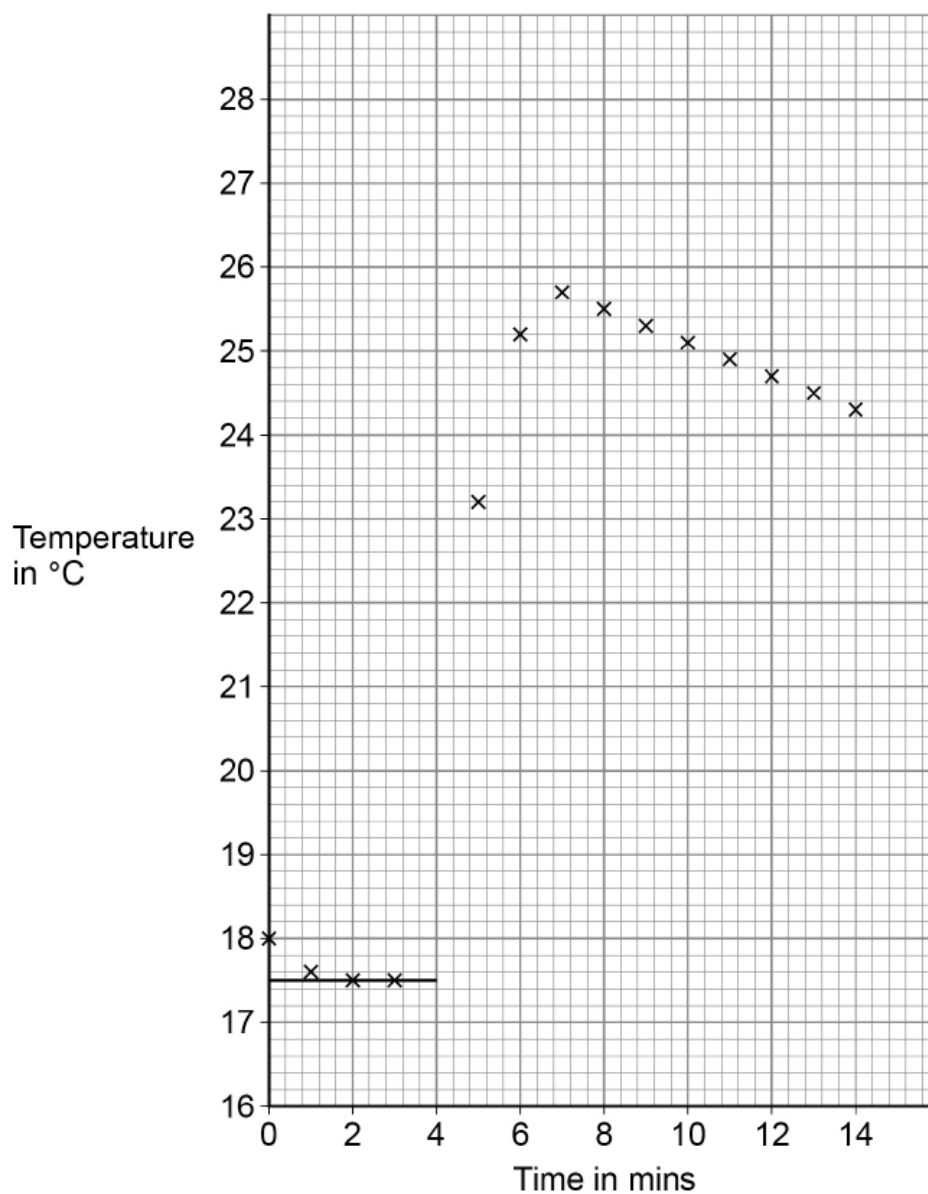
What is the dependent variable in this investigation?

[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 dm³ of water.

Calculate the mass of copper sulfate in 30.0 cm³ of this solution.

Relative formula mass (M_r): CuSO₄ = 159.5

[4 marks]

Mass = _____ g

4. No.1.1-1.6

Which of these items uses an endothermic reaction?

[1 mark]

Tick (✓) **one** box.

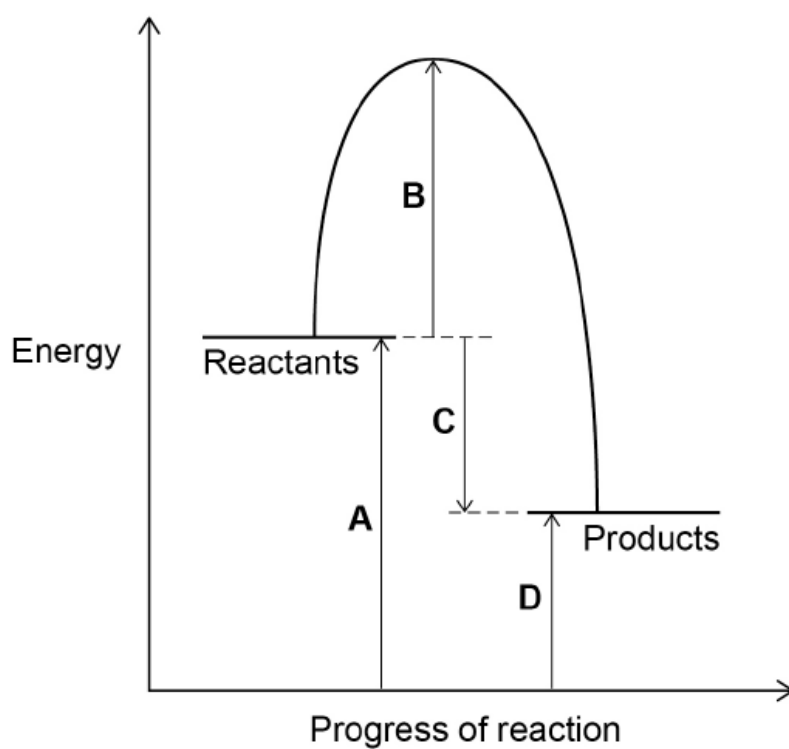
Hand warmer

☐

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.

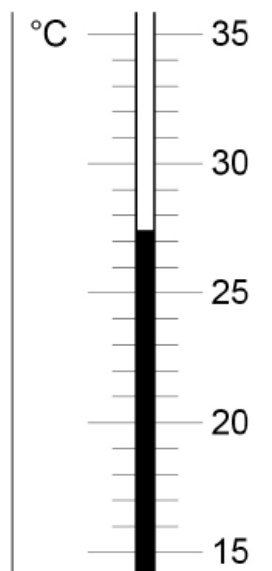
A student measured the temperature at the start and at the end of a reaction.

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. No.3.1

Hydrogen reacts with oxygen.

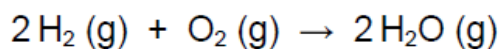
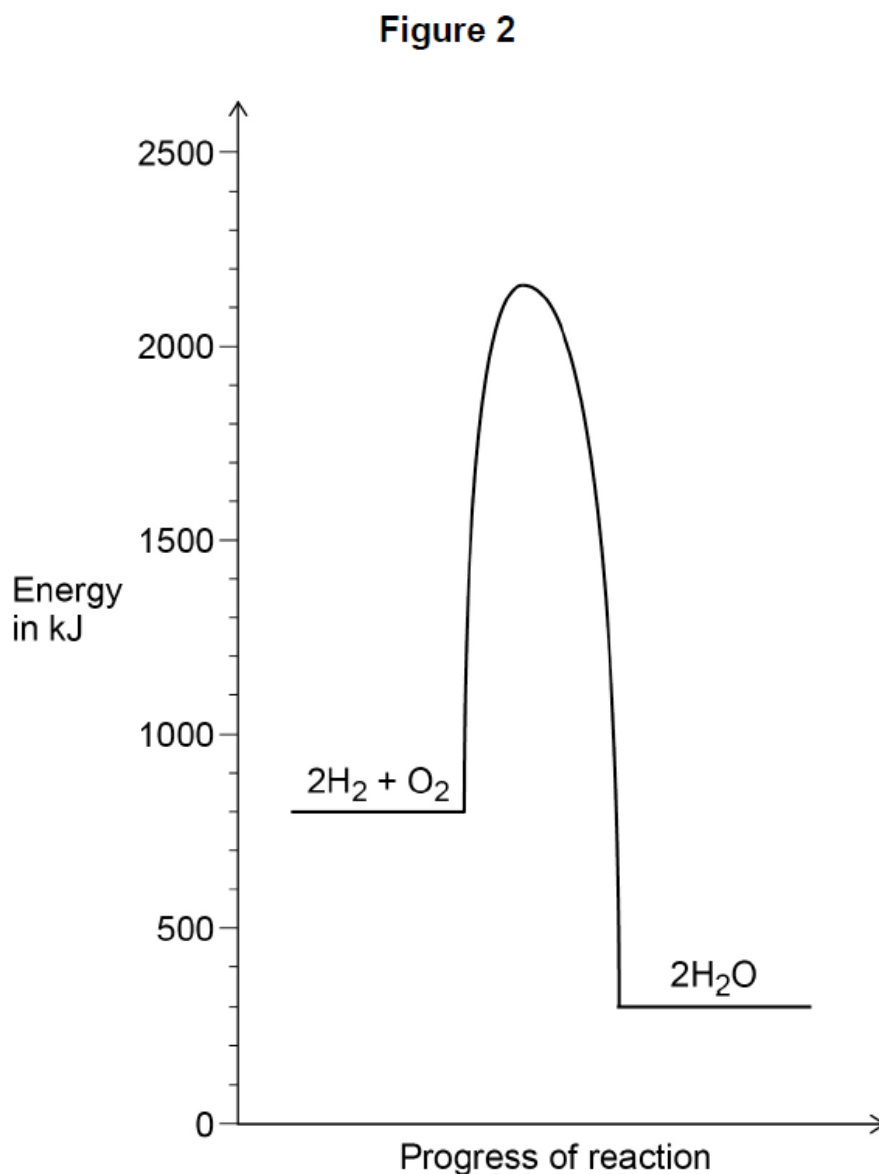


Figure 2 shows the relative energies of the reactants and products at a certain temperature.



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

[1 mark]

6. 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. No.3.4

The equation shows the decomposition of hydrogen peroxide.

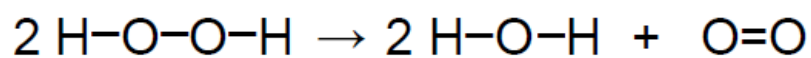


Table 1 shows the bond energies.

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