

Metals by reactivity and how we extract them

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab answers

The answers use the sample data. Your own temperatures will differ, but the order of the rises, the energy calculations and the explanations of the errors should follow the same pattern.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE C4

Question 1 Temperature rises

Magnesium $66.5 - 21.0 = 45.5\text{ }^{\circ}\text{C}$; zinc $42.5 - 21.0 = 21.5\text{ }^{\circ}\text{C}$; iron $36.0 - 21.0 = 15.0\text{ }^{\circ}\text{C}$; copper = $0.0\text{ }^{\circ}\text{C}$.

Question 2 Order of reactivity

The order of rise is $\text{Mg} > \text{Zn} > \text{Fe} > \text{Cu}$, so the order of reactivity is **magnesium, zinc, iron, copper**, which agrees with the series.

Question 3 Explain the copper result

Copper is the same metal as in the solution, so there is **nothing to displace**: no reaction occurs.

Question 4 Energy released

$Q = 25.0 \times 4.18 \times 45.5 = 4755\text{ J} = 4.76\text{ kJ}$.

Question 5 Energy per mole

Magnesium: $4.755 \div 0.0125 = 380\text{ kJ/mol}$. Zinc: $Q = 25.0 \times 4.18 \times 21.5 = 2247\text{ J} = 2.25\text{ kJ}$, so $2.247 \div 0.0125 = 180\text{ kJ/mol}$.

Question 6 Why excess metal

1.0 g of zinc is $1.0 \div 65 = 0.0154\text{ mol}$, more than the 0.0125 mol of Cu^{2+} , so **zinc is in excess** and all the copper ions are displaced.

Question 7 Errors

Heat is lost to the surroundings, so the rise is too small. **Use a lid and an insulated cup**, and stir gently so the thermometer reads the true maximum.

Question 8 Extending the lab

Aluminium is above zinc, so a large rise is expected, but its **surface oxide layer** can delay the reaction and the temperature may rise slowly.