Materials, metals and corrosion

AQA GCSE Chemistry (8462) · Foundation and Higher

Answer on your own paper. Show your working where needed.

1. Conditions for rusting

After a week, nail A in dry air and nail C in oxygen-free water have not rusted. Nail B in air and water has rusted. Explain what comparing B with A and B with C tells you.

2. Protecting a scratched coating

A steel panel has a thin zinc coating. Explain how the coating protects it when intact and why the zinc can still protect the iron after a small scratch.

3. Comparing copper and brass

Brass is harder to deform than pure copper. Brass contains copper and zinc atoms of different sizes. Explain the difference in hardness at the level of atoms.

4. Choose a material for a part

A part must have density below 2.0 g/cm^3 and bend less than 3 mm in a standard load test.

Polymer: 1.2 g/cm^3, 6 mm. Steel: 7.8 g/cm^3, 1 mm. Fibre composite: 1.6 g/cm^3, 2 mm. Choose a material and use the data to justify it.

5. Choose an extraction method

A metal producer has ores containing aluminium oxide and iron oxide. For each oxide, choose between carbon reduction and electrolysis. Use the relative positions of aluminium, iron and carbon in the reactivity series to justify your choices.

6. Cost and environmental effect

On the same basis, making 1 tonne of a metal from ore uses 14 GJ and makes 1.8 tonnes CO_2 equivalent. Making it from scrap uses 5 GJ and makes 0.7 tonnes. Compare the two routes and give a cost the figures miss.

7. Higher · recovering copper

A plant-based process produces ash containing copper compounds. A bacterial process produces a solution containing copper ions. A learner says both products are samples of copper metal. Explain the error, give a method for obtaining metal from the solution and state a reason for using low-grade ore.

8. Compare two nanoparticles

A manufacturer can make a coating from 2 nm or 6 nm cubes of the same material. Calculate the surface-area-to-volume ratio for each. Which offers more exposed surface for the same total volume of the material, if the particles stay separated?

9. Extra challenge · Explain two coating results

An intact paint coating and an intact zinc coating both protect the same steel. After identical scratches reach the steel, the painted sample rusts but the zinc-coated sample shows mostly zinc corrosion.

Explain both results at the scratch. Predict how the result would change if a thin copper coating replaced the zinc, using the relative reactivities of zinc, iron and copper.

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