2.2 Reactivity, rusting and metals

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

Objective

Build the skills to answer exam questions on **the reactivity series, rusting and metals** 、 : ordering metals, displacement, oxidation and reduction, rusting and its prevention, extraction and alloys.

You must be able to:

- place metals in a reactivity series from results
- write equations for displacement and identify oxidation and reduction
- explain how rusting is prevented
- plan a fair test to compare the reactivity of metals

1 Key knowledge and worked examples

Reactivity and redox

idea	rule
reactivity series	potassium, sodium, lithium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold
displacement	a more reactive metal displaces a less reactive metal from a solution of its salt
oxidation / reduction	gain / loss of oxygen; or loss / gain of electrons
rusting	iron needs **both** water and oxygen
extraction	metals above carbon by electrolysis; metals below carbon by heating with carbon

Worked example 1: displacement. Magnesium is added to copper(II) sulfate solution. Write the equation and say what is oxidised.

1. Known: magnesium is above copper.
2. Rule: the more reactive metal displaces the less reactive one.
3. Numbers: $\mathrm{Mg} + \mathrm{CuSO_4} \rightarrow \mathrm{MgSO_4} + \mathrm{Cu}$.
4. Result: **magnesium is oxidised** (it loses electrons: $\mathrm{Mg} \rightarrow \mathrm{Mg^{2+}} + 2\mathrm{e^-}$).

Worked example 2: extraction. Write the equation for iron(III) oxide being reduced by carbon monoxide in the blast furnace.

1. Known: $\mathrm{Fe_2O_3}$ and CO; products Fe and $\mathrm{CO_2}$.
2. Rule: balance iron, then oxygen.
3. Numbers: 2 Fe; 3 CO take 3 O.
4. Result: $\mathbf{Fe_2O_3} + 3\mathbf{CO} \rightarrow 2\mathbf{Fe} + 3\mathbf{CO_2}$.

Answer shapes: "OIL RIG": oxidation is loss of electrons, reduction is gain.

2 Practice

2.1 Zinc is added to copper(II) sulfate solution. State whether a reaction happens, and write the word equation if it does. [2]



2.2 Name the **two** substances iron needs in order to rust. [2]

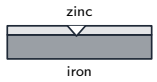


2.3 Explain why aluminium is extracted by electrolysis and not by heating its oxide with carbon. [2]

reactivity
magnesium
aluminium
carbon
zinc
iron

3 Exam-style questions

3.1 Explain how galvanising protects iron from rusting, even when the zinc coating is scratched. [3]



3.2 A student adds 1 g of powdered metal to 25 cm^3 of copper(II) sulfate solution and measures the temperature rise. The results are shown. Metal X is unknown.

(a) Use the results to place the five metals in order of reactivity, most reactive first, and explain your order. [3]

metal	temperature rise / °C
magnesium	9.0
zinc	5.0
iron	2.5
copper	0.0
X	6.5

(b) Write the balanced equation for magnesium reacting with copper(II) sulfate, and identify, in terms of electrons, which species is oxidised and which is reduced. [4]

(c) Describe how the student should make this experiment a fair test and the results reliable. [6]