2.2 Reactivity, rusting and metals

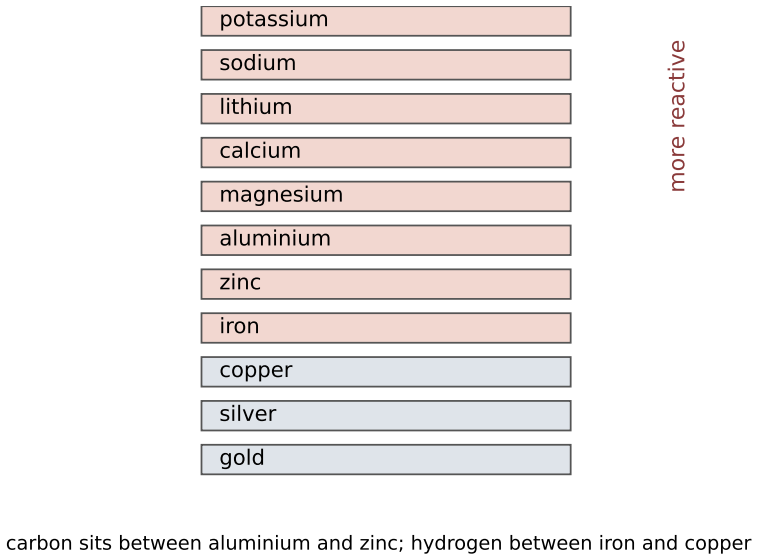
Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Cover the reactivity series, rusting and metals (2.15–2.27C): ordering metals, displacement, redox terms, rusting prevention, (C) extraction by carbon or electrolysis, alloys. Original IGCSE-level practice.

1 Key knowledge and worked examples

■ The ladder



K > Na > Li > Ca > Mg > Al > **(C)** > Zn > Fe > **(H)** > Cu > Ag > Au. Metals above hydrogen – down to iron – fizz with dilute acids giving H_2. A metal displaces a less reactive metal's ions from solution or its oxide.

■ Rusting and redox

Rusting needs **oxygen and water**. Barrier methods, galvanising (zinc coat) and sacrificial protection prevent it. **Oxidation = loss of electrons; reduction = gain.** In $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$, zinc is oxidised (the reducing agent) and Cu^{2+} is reduced (copper(II) sulfate is the oxidising agent).

■ (C) Extraction and alloys

Below carbon (iron): reduce the ore with carbon. Above (aluminium): electrolyse the molten ore. Alloys are harder than pure metals – different-sized atoms stop the layers sliding.

2 Practice

2.1 State the order of reactivity of potassium, zinc, copper and gold. [2]

2.2 Name the two substances iron needs to rust, and one barrier prevention. [3]

2.3 Zinc is added to copper(II) sulfate solution. Write the ionic equation and state which ion is reduced. [3]

2.4 (C) Why is sacrificial zinc bolted to a ship's steel hull? [2]

2.5 (C) State why stainless steel resists rusting, and one use. [2]

3 Exam-style questions

3.1 Explain, using the reactivity series, why magnesium reacts with dilute hydrochloric acid but copper does not, and name the gas formed. [3]

3.2 (C) Aluminium is above carbon in the reactivity series. Explain why this decides its extraction method, naming the process and the molten substance electrolysed. [3]

3.3 (C) Explain why a pure metal is soft and malleable but an alloy is harder, in terms of particle arrangement. [3]

Solutions

2.1 potassium > zinc > copper > gold.

2.2 Oxygen and water; any barrier: paint, oil/grease, plastic coating, galvanising.

2.3 $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$; Cu^{2+} is reduced – it gains two electrons.

2.4 (C) Zinc is more reactive than iron, so it corrodes preferentially, protecting the steel even where the coat is scratched.

2.5 (C) It contains chromium which forms an oxide layer resisting corrosion; cutlery/surgical instruments/sinks.

3.1 Magnesium lies above hydrogen in the series, so it displaces hydrogen from the acid; copper lies below hydrogen and cannot. The gas formed is hydrogen.

3.2 (C) Carbon cannot reduce aluminium's oxide because aluminium is more reactive than carbon; so the oxide must be split by electrolysis ; molten aluminium oxide/alumina (often in molten cryolite) is electrolysed.

3.3 (C) In a pure metal the identical ions sit in regular layers that slide over each other when a force is applied – soft and malleable; in an alloy the different-sized atoms distort the layers, so they cannot slide – harder.