

Exercise walk-through

9.4

Reactivity series

IGCSE Chemistry

The reactivity series

most reactive			
	K	potassium	
	Na	sodium	
	Ca	calcium	
	Mg	magnesium	
	Al	aluminium	
	C	carbon (non-metal)	above carbon: extract by electrolysis
	Zn	zinc	
	Fe	iron	
	H	hydrogen (non-metal)	below carbon: extract by reduction with carbon
	Cu	copper	
	Ag	silver	
	Au	gold	
least reactive			

- potassium, sodium and calcium react with cold water.
- magnesium reacts with steam (but only very slowly with cold water).
- magnesium, zinc and iron react with dilute hydrochloric acid; copper, silver and gold do not.

Displacement and aluminium

displacement

a more reactive metal
pushes out a less reactive
one (zinc displaces copper)

aluminium

a tough **oxide layer**
makes it seem less
reactive than it is



Rusting is a costly form of corrosion

Extracting aluminium by electrolysis

The ore

Aluminium comes from **bauxite**, which is purified to aluminium oxide.

Why electrolysis

Aluminium is above carbon in the reactivity series, so carbon cannot displace it – a **displacement reaction** will not work.

Cryolite

The oxide melts at over 2000°C , so it is dissolved in molten **cryolite** to lower the working temperature and save energy.

At the electrodes

At the **cathode**, $\text{Al}^{3+} + 3\text{e}^{-} \rightarrow \text{Al}$: gain of **electrons**, so **reduction**. At the **anode**, oxide ions lose electrons and the carbon burns away as **carbon dioxide**.

Reduction is gain of electrons – and the cathode is where the positive ions go, which is how to remember which is which.

Displacement: what you would actually see

the reaction

$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$ – a more reactive metal displaces a less reactive one

observation

a **pink-brown solid** coats the zinc – that is the displaced copper

observation

the grey zinc **dissolves** and gets smaller

observation

the blue solution **fades**, as copper ions leave it

metal and acid

effervescence

as hydrogen escapes, and the **solid dissolves**

aluminium's puzzle

it seems less reactive than its position suggests, because a thin, strong **oxide layer** covers it and stops the reaction

Observations are **separate marks** from the equation. Say what changes colour, what dissolves, and what appears.

Exercises 2.1·2.2

2.1 State which is more reactive: zinc or copper.

[1]

2.2 Name a metal that reacts with cold water.

[1]

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2.1 State which is more reactive: zinc or copper.

[1]

2.1

- zinc is **more reactive** than copper

2.2 Name a metal that reacts with cold water.

[1]

2.2

- e.g. **potassium, sodium or calcium**

Exercise 3.1

3.1 Four metals are added to separate samples of dilute sulfuric acid. Only one produces no bubbles at all. Which row is correct? [1]

☐

A silver produces no bubbles, because it is above hydrogen in the reactivity series

B silver produces no bubbles, because it is below hydrogen in the reactivity series

C calcium produces no bubbles, because it is below hydrogen in the reactivity series

D tin produces no bubbles, because it is above hydrogen in the reactivity series

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3.1 B

- silver is **below hydrogen**, so it produces **no bubbles**
- A has the wrong reason; C and D name metals that do react

Exercise 3.2 (a)

3.2 A piece of iron is placed in copper(II) sulfate solution.

(a) State what you would observe.

[2]

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(a) State what you would observe.

[2]

(a)

- iron becomes coated with **pink/brown copper**
- the **blue solution fades**

Exercise 3.2 (b)

3.2 A piece of iron is placed in copper(II) sulfate solution.

(b) Explain why this reaction happens.

[1]

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(b) Explain why this reaction happens.

[1]

(b)

- iron is **more reactive** than copper, so it **displaces** copper

Exercise 3.3

3.3 Aluminium is high in the reactivity series but appears unreactive. Explain why. [2]

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3.3

- aluminium is covered by a thin, strong **oxide layer**
- this stops other substances reaching the metal, so it **seems unreactive**