

Exercise walk-through

9.1

Properties of metals

IGCSE Chemistry

Properties and uses

metals

good conductors; **mal-
leable** & **duc-
tile** ; high melting points

non-metals

poor conductors; **brit-
tle** ; low melting points

Uses follow properties: **aluminium** is light (aircraft, cables); **copper** conducts & is ductile (wiring).



Aluminium is light and resists corrosion

The physical properties that decide a metal's use

electrical conductivity

metals: **good**. Non-metals: poor, **except** graphite

melting and boiling point

metals: usually **high**. Non-metals: usually low

malleability and ductility

metals can be hammered into shape and drawn into wires

copper

electrical wiring – good conductivity *and* ductility, so it can be drawn into wire

aluminium

aircraft and drinks cans – low density and corrosion-resistant

alloys

harder than the pure metal, because different-sized atoms stop the layers sliding

Give the property **and** the use it explains. “Copper conducts” is half a mark; “so it is drawn into wiring” completes it.

Why metals behave as they do

Conduction

Delocalised electrons move freely, giving high electrical and **thermal conductivity**.

Malleable

Layers of ions slide over each other without breaking the metallic bond – so metals bend rather than shatter.

With acids

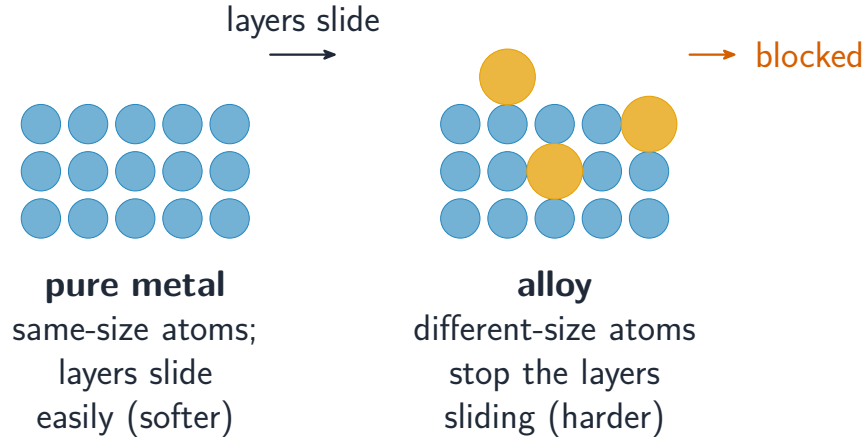
A reactive metal reacts with **acids** to give a **salt** and hydrogen – the fizz test.

A useful oxide

Calcium oxide (from limestone in the blast furnace) removes acidic impurities as slag.

Every metallic property traces back to one picture: positive ions in a sea of delocalised electrons.

Alloys



- **Brass** is a mixture of copper and **zinc**.
- **Stainless steel** is a mixture of **iron** with other elements such as **chromium**, **nickel** and **carbon**.

Exercises 2.1·2.2

2.1 State two physical properties of metals. [2]

2.2 Give the products when a metal reacts with a dilute acid. [1]

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2.1

- any **two** of: good conductor of heat/electricity / malleable / ductile / high melting point
-

2.2 Give the products when a metal reacts with a dilute acid. [1]

2.2

- metal + dilute acid $\rightarrow$ **salt + hydrogen**

Exercise 3.1

3.1 Which property is typical of a non-metal?

[1]

☐

A good electrical conductor

B malleable

C brittle

D high density

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3.1 C

- non-metals are usually **brittle**
- A, B and D are metal properties

Exercise 3.2 (a)

3.2 Magnesium reacts with dilute hydrochloric acid.

(a) Name the two products.

[2]

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[2]

(a)

- **magnesium chloride** and **hydrogen**

Exercise 3.2 (b)

3.2 Magnesium reacts with dilute hydrochloric acid.

(b) Name the gas given off and a test for it.

[2]

Exercise 3.2 (b)

3.2 Magnesium reacts with dilute hydrochloric acid.

(b) Name the gas given off and a test for it.

[2]

(b)

- the gas is **hydrogen**
- it gives a **squeaky pop** with a lighted splint

Exercise 3.3

3.3 State why metals are good electrical conductors.

[1]

Exercise 3.3

3.3 State why metals are good electrical conductors.

[1]

3.3

- metals have **delocalised electrons** that move and carry charge

Exercise 3.4 (a)

3.4 Four metals – copper, magnesium, iron and zinc – are tested with cold water, steam and dilute hydrochloric acid.

(a) State **three** physical properties that most metals have and most non-metals do not.[3]

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(a)

- any **three** of: shiny when cut / good conductors / malleable and ductile / high melting point and density / sonorous

Exercise 3.4 (b)

3.4 Four metals – copper, magnesium, iron and zinc – are tested with cold water, steam and dilute hydrochloric acid.

(b) Only magnesium reacts noticeably with cold water; copper reacts with neither steam nor acid. Place the four metals in order of reactivity, most reactive first, and explain how the tests justify your order. [4]

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(b)

- order: **magnesium, zinc, iron, copper**
- magnesium is the only one to react with **cold water**
- copper reacts with **neither steam nor acid**
- zinc reacts with acid **faster** than iron

Exercise 3.4 (c)

3.4 Four metals – copper, magnesium, iron and zinc – are tested with cold water, steam and dilute hydrochloric acid.

(c) Write the word equation and the balanced symbol equation for zinc reacting with dilute hydrochloric acid. [3]

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(c) Write the word equation and the balanced symbol equation for zinc reacting with dilute hydrochloric acid. [3]

(c)

- zinc + hydrochloric acid → zinc chloride + hydrogen
- **$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$**

Exercise 3.4 (d)

3.4 Four metals – copper, magnesium, iron and zinc – are tested with cold water, steam and dilute hydrochloric acid.

(d) A piece of magnesium is placed in copper(II) sulfate solution. Predict what you would see, and write the ionic equation. [3]

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(d)

- blue solution **fades**; **pink-brown copper** coats the magnesium
- $\text{Mg} + \text{Cu}^{2+} \rightarrow \text{Mg}^{2+} + \text{Cu}$ – magnesium is more reactive