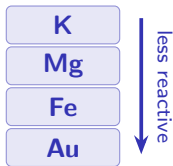


Metals

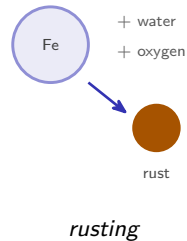
IGCSE Chemistry ■ Topic 9

IGCSE Chemistry



What we will cover

- 1 Properties & uses
- 2 Alloys
- 3 The reactivity series
- 4 Rusting & its prevention
- 5 Extraction of metals
- 6 The blast furnace



Properties and uses

metals

good conductors; **mal-
leable** 有展性 & **duc-
tile** 有延性; high melting points

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

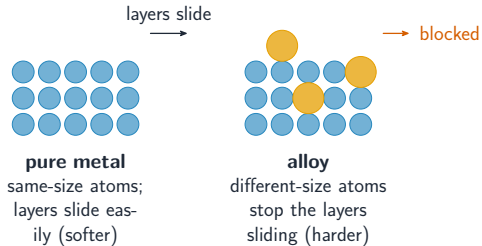
non

poor con
tle 易碎; lo



Aluminium is light and resists corrosion

Alloys



Metals have useful properties and uses

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 re- duction with carbon
	Cu	copper	
	Ag	silver	
	Au	gold	
least reactive			



*Corrosion
degrades metals over time*

Displacement and aluminium

displacement 置换反应

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

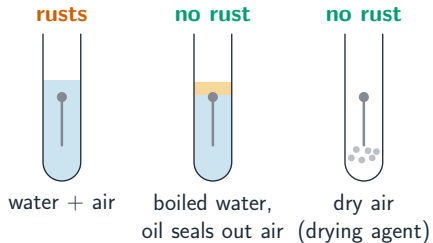
aluminium

a tough oxide
makes
reactive



*Rusting is a
costly form of corrosion*

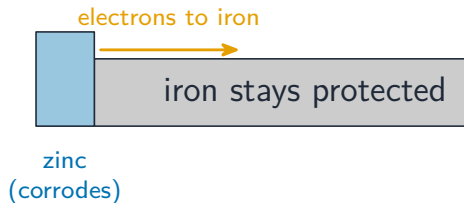
Rusting



Rusting 生锈 needs **both** water and oxygen.

The nail rusts only in the tube with both – rust is hydrated iron(III) oxide.

Preventing rust

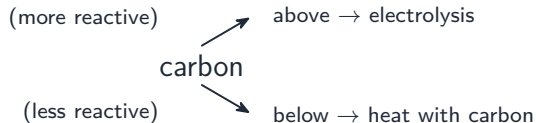


- **barrier** 隔离法 – paint, grease, plastic

- **galvanising** 镀锌 – a zinc coat

Zinc gives **sacrificial protection** 牺牲保护: being more reactive, it corrodes **instead** of the iron.

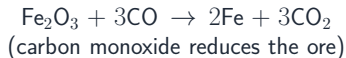
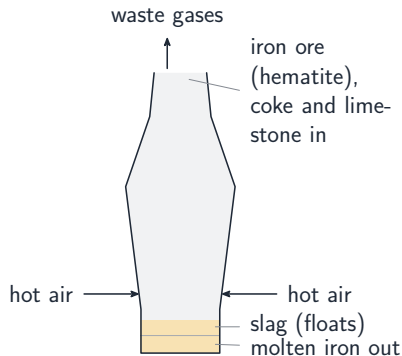
Extraction: reactivity decides



How a metal leaves its **ore** 矿石 depends on its reactivity:

- above carbon → **electrolysis** 电解 (aluminium)
- below carbon → heat with carbon (iron)

The blast furnace



Iron from **hematite** 赤铁矿:

- coke burns $\rightarrow \text{CO}_2 \rightarrow$ **carbon monoxide** 一氧化碳
- **CO reduces** 还原 the iron oxide to iron
- **limestone** 石灰石 removes sandy impurities as **slag** 炉渣

Worked example – which extraction method?

Iron is extracted with carbon but aluminium needs electrolysis. Explain.

- The method depends on the metal's place in the **reactivity series**.
- Iron is **below carbon**, so carbon can **reduce** its oxide in a blast furnace – cheap.
- Aluminium is **above carbon**, so carbon cannot take its oxygen away.
- Only **electrolysis** is powerful enough – which is why aluminium is expensive.

Above carbon $\Rightarrow$ **elec-trolysis**. Below carbon $\Rightarrow$ **reduce with carbon**. Un-reactive (gold) $\Rightarrow$ found **native**, just dig it up.

Topic 9 – key takeaways

1

Alloys

harder – mixed atom sizes block sliding

2

Reactivity

order of forming positive ions

3

Rust

needs water + oxygen; zinc protects

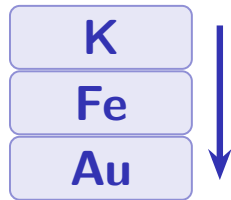
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Extraction

above carbon: electrolysis; below: carbon

Check yourself

- 1 Why is an alloy harder than a pure metal?
- 2 What two things are needed for iron to rust?
- 3 How does zinc protect iron even when scratched?
- 4 How is a metal above carbon extracted?



Answers 1. different-sized atoms block sliding layers 2. water and oxygen 3. it corrodes sacrificially instead 4. by electrolysis