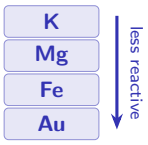
Metals

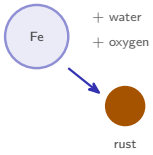
IGCSE Chemistry ▪ Topic 9

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



rusting

1 Properties

Properties and uses

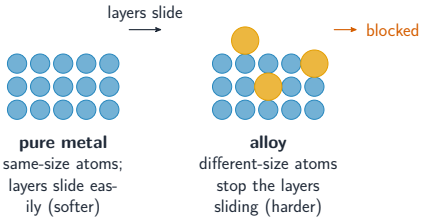
metals
good conductors; **mal-leable** 有展性 & **duc-tile** 有延性; high melting points

non-metals
poor conductors; **brit-tle** 易碎; low melting points

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

Aluminium is light and resists corrosion

Alloys



- **Brass** 黄铜 is a mixture of copper and **zinc** 锌.
- **Stainless steel** 不锈钢 is a mixture of **iron** 铁 with other elements such as **chromium** 铬, **nickel** 镍 and **carbon** 碳.

2 Reactivity

The reactivity series

most reactive

K	potassium	above carbon: extract by **electrolysis**
Na	sodium	
Ca	calcium	
Mg	magnesium	
Al	aluminium	
C	carbon (non-metal)	
Zn	zinc	below carbon: extract by **reduction with carbon**
Fe	iron	
H	hydrogen (non-metal)	
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 置换反应
a more reactive metal pushes out a less reactive one (zinc displaces copper)

alu
a tough **oxi** makes reactiv

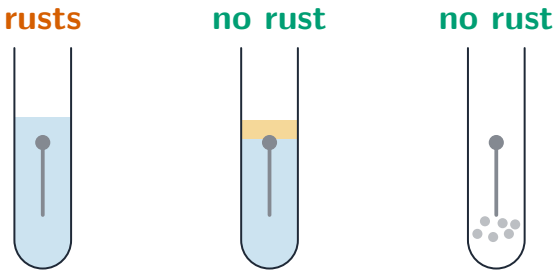
Rusting is a costly form of corrosion

3 Corrosion

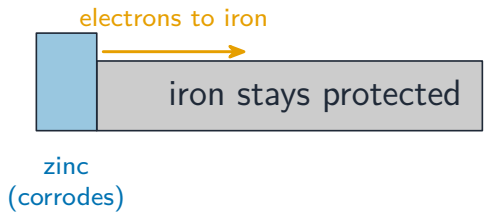
Rusting

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.

4 Extraction

Extraction: reactivity decides

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

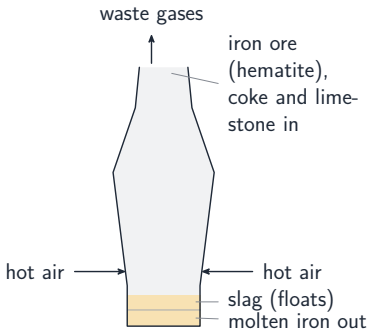
- above carbon → **electrolysis** 电解 (aluminium)
- below carbon → heat with carbon (iron)

(more reactive) → above → electrolysis

carbon

(less reactive) → below → heat with carbon

The blast furnace



$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
(carbon monoxide reduces the ore)

Iron from **hematite** 赤铁矿:

- coke burns → CO_2 → **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

5 Recap

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.

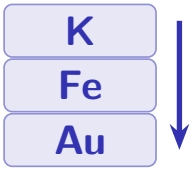
Above carbon ⇒ electrolysis. Below carbon ⇒ reduce with carbon. Unreactive (gold) ⇒ found native, just dig it up.

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
4. **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