

Extraction and uses of metals

Most metals are extracted from ores found in the Earth's crust

Metal ores are found in the Earth's crust

METAL ORE - this is a sample of rock containing a high concentration of a metal from which it is economical to extract that metal.

Unreactive metals (e.g. gold) are often found as the uncombined metal.

Most metals are present as a chemical compound - often an oxide.

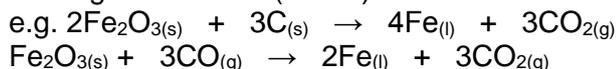
If the metal is present as a different compound it is often converted to the oxide.

The ores must be MINED (dug out of the ground), purified and the chemical compounds broken down to produce the pure metal in an EXTRACTION process.

The extraction process involves redox – the metal in the ore is **reduced** to form the uncombined metal

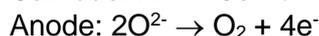
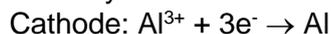
The method which has to be used to extract a metal from its ore depends on the position of the metal in the reactivity series.

Metals below C in the reactivity series may be extracted by heating with carbon (or CO)



Carbon is more reactive than iron and will displace it from its oxide
Carbon is a stronger reducing agent than iron and will reduce iron(III) oxide to iron.

Metals above C in the reactivity series can only be extracted by electrolysis (or by heating with a more reactive metal). E.g. Aluminium is extracted by electrolysis of aluminium oxide (Al₂O₃)



Aluminium is below C in the reactivity series – C cannot reduce it / displace it from its oxide

USES OF METALS

Uses of aluminium:

- overhead power cables (low density and good conductor of electricity)
- aeroplanes (low density and strong)
- saucepans (resistant to corrosion)

Aluminium resists corrosion because it has a very thin, impermeable layer of aluminium oxide on the surface. This prevents anything else reaching the surface and reacting with it

Aluminium is less dense than steel and doesn't corrode but it is more expensive to produce – electricity is very expensive for electrolysis

STEEL

Type of steel			uses
mild steel	< 0.25% C	a strong material that can be easily hammered into various shapes (malleable) and drawn into wires (ductile) but rusts	nails, car bodies, ship building, girders
high-carbon steel	0.6 – 1.2% C	harder and more resistant to wear than mild steel but more brittle (not as malleable and ductile)	cutting tools, masonry nails
stainless steel	C + Cr	very resistant to corrosion – more expensive than mild steel	cutlery, cooking utensils, kitchen sinks

COPPER

Use	Property
electrical wires	very good conductor of electricity and ductile
pots and pans	very good conductor of heat (thermal conductor), very unreactive and malleable
water pipes	unreactive – does not react with hot or cold water and malleable

ALLOYS

Most metals are used as **alloys** rather than the pure metal. An alloy is a mixture of a metal with, usually, other metals or carbon.

Alloys tend to be harder and stronger than pure metals – a different-sized atom prevents the layers of atoms from sliding over each other as easily.