

CHEMISTRY 4 | Chemical changes

AQA Combined Science Trilogy • Core knowledge first • Purple panels are Higher Tier

1 Reactivity and extraction

More reactive → less reactive

K	Na	Li	Ca	Mg	Al	C
Zn	Fe	H	Cu	Ag	Au	

C and H are non-metal reference points.

More reactive metals form positive ions more readily; they displace less reactive metals.

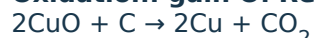


Below carbon: reduce the oxide with carbon.

Above carbon: e.g. aluminium, use electrolysis.

Gold: may occur as the metal itself.

Oxidation: gain O. Reduction: lose O.



CuO is reduced; carbon is oxidised.

2 Acids, salts and pH

Acid + suitable metal → salt + hydrogen

Acid + base / alkali → salt + water

Acid + carbonate → salt + water + CO₂

HCl → **chlorides**; H₂SO₄ → **sulfates**;

HNO₃ → **nitrates** (reactions with bases).

First salt name comes from the metal ion.

Neutral salt formula: balance ion charges.



Acid < 7

Neutral 7

Alkali > 7



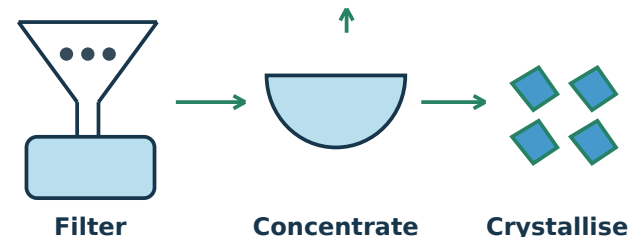
Universal indicator estimates pH; a probe gives a numerical reading. An **alkali is a soluble base**.

CO₂ test: limewater turns milky.

3 Required practical: soluble salt

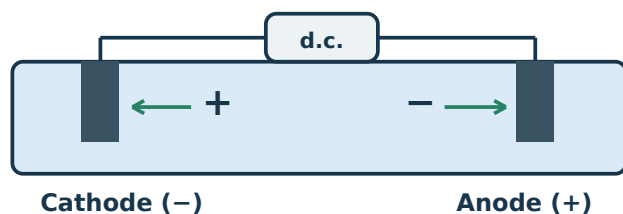


Make pure, dry copper sulfate crystals.



1. Warm dilute acid gently; stop heating.
2. Add **excess** oxide to use up all the acid.
3. Filter off excess oxide; keep the solution.
4. Gently evaporate **some** water, then cool.
5. Filter crystals; rinse with a little cold distilled water. Blot dry. Wear eye protection.

4 Electrolysis: predict the products



Molten or aqueous: mobile ions carry charge.

Solid: ions fixed, so does not conduct.

Molten binary: metal at cathode; non-metal at anode.

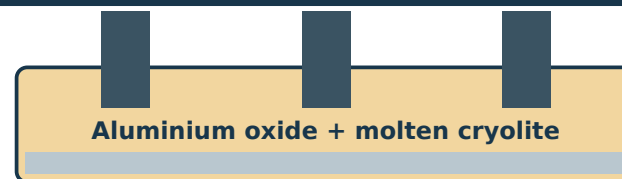
Aqueous, inert electrodes:

Cathode: metal above H → hydrogen; metal below H → the metal.

Anode: halide → halogen; otherwise oxygen.

CuSO₄(aq): Cu at (-); O₂ at (+).

5 Aluminium and practical evidence



Al collects at the negative cathode

Cryolite lowers the melting temperature, so less heating energy is needed.

Oxygen reacts with the carbon anodes → **CO₂**.

Carbon is used up: **replace the anodes**.

Practical: graphite electrodes, low-voltage d.c.; test each product. Control conditions; repeat. Eye protection; ventilation for chlorine.

H₂: lit splint → squeaky pop.

O₂: glowing splint relights.

Cl₂: bleaches damp litmus white.

6 Higher Tier: redox and acids

OIL RIG: Oxidation Is Loss of electrons; Reduction Is Gain of electrons.

Cathode = reduction; anode = oxidation.

Displacement: $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$



Balance **atoms and total charge**.

Strong acid: fully ionised in water.

Weak acid: partly ionised.

Concentration: amount of acid per volume.

Strong can be dilute; weak can be concentrated.

pH 4 → pH 3 → pH 2

Each pH step down: **H⁺ concentration ×10**.
pH 2 has **100×** the H⁺ concentration of pH 4.