

AQA GCSE Chemistry: Topic 4

"Grade 7" Examiner Cheat Sheet — Chemical Changes

Section 1: The Reactivity Series Logic

Definition: The reactivity of a metal is its tendency to **form positive ions**.

Metal	Reaction with Water	Reaction with Acid
Potassium, Sodium, Lithium	Vigorous (fizz, melt, flame)	DANGEROUSLY fast
Calcium, Magnesium	Slow reaction	Rapid (fizzing)
Zinc, Iron, Copper	No reaction	Zinc/Iron (Slow); Copper (None)

Displacement Rule: A **more reactive** metal will displace a **less reactive** metal from its compound.

Example: $Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$.

Section 2: Metal Extraction Algorithm

Decision Matrix: How to get a metal from its ore?

- Native Metals (Gold/Silver):** Found as pure metals. Just "mine" them.
- Below Carbon (Zinc to Copper):** Heat with Carbon. **Reduction** occurs as Carbon removes oxygen.
- Above Carbon (Potassium to Aluminum):** Must use **Electrolysis**. This requires massive amounts of energy (expensive).

HT Tip: Reduction is the **loss of oxygen**. Oxidation is the **gain of oxygen**.

Section 3: Redox (Higher Tier Only)

The Mnemonic: OIL RIG (Oxidation Is Loss, Reduction Is Gain of electrons).

Ionic Equation Example: $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$

- $Fe \rightarrow Fe^{2+} + 2e^-$ (**Oxidation** - Iron lost electrons).
- $Cu^{2+} + 2e^- \rightarrow Cu$ (**Reduction** - Copper gained electrons).

Section 4: The Rosetta Stone of Acid Reactions

Examiner Note: You must learn these 4 general equations off by heart.

Reactants	Products
1. Metal + Acid	→ Salt + Hydrogen
2. Metal Oxide (Base) + Acid	→ Salt + Water
3. Metal Hydroxide (Alkali) + Acid	→ Salt + Water
4. Metal Carbonate + Acid	→ Salt + Water + Carbon Dioxide

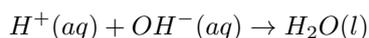
The Naming Rule:

- **Hydrochloric Acid** → makes **Chlorides**.
- **Sulfuric Acid** → makes **Sulfates**.
- **Nitric Acid** → makes **Nitrates**.

Section 5: The pH Scale & Neutralisation

Acids: Produce **Hydrogen ions** (H^+) in aqueous solution. **Alkalis:** Produce **Hydroxide ions** (OH^-) in aqueous solution.

The Neutralisation Equation:



Strong vs. Weak Acids (HT Only):

- **Strong Acids: Completely ionised** in water (e.g., HCl , H_2SO_4).
- **Weak Acids: Partially ionised** in water (e.g., Ethanoic, Citric).
- **pH Factor:** As pH decreases by 1 unit, the H^+ concentration increases by a **factor of 10**.

Section 6: Concentration vs. Strength (HT Trap)

TRAP CHECK: Do not confuse these terms.

- **Strength:** How well it ionises (Strong vs. Weak).
- **Concentration:** How much acid is dissolved in 1 dm^3 of water (Dilute vs. Concentrated).

Section 7: Required Practical 1 — Making a Soluble Salt

Method: Making Copper Sulfate from Copper Oxide and Sulfuric Acid.

1. **Add excess base:** Add Copper Oxide to the acid until no more dissolves (this ensures all acid is used up).
2. **Filter:** Filter the mixture to remove the **unreacted (excess) base**.
3. **Evaporate:** Heat the solution in an evaporating basin over a water bath until the **crystallisation point** is reached.
4. **Crystallise:** Leave to cool and dry the resulting crystals with filter paper.

Mark Scheme Gold: "Add excess base", "filter to remove unreacted solid", "heat to crystallisation point".

Section 8: Titration Algorithm (Triple Science Only)

Goal: To find the exact volume of acid needed to neutralise an alkali.

The Procedure:

1. Use a **pipette** to measure a fixed volume of alkali into a conical flask.
2. Add a few drops of **indicator** (e.g., Phenolphthalein - Pink to Colorless).
3. Add acid from a **burette** drop by drop near the end point.
4. Swirl the flask constantly.
5. Stop at the first permanent color change.
6. **Reliability:** Repeat until you get **concordant results** (within 0.1cm^3).

Section 9: Titration Calculation Algorithm (HT)

Three Steps to the Answer:

1. **Find Moles of Known:** $n = C \times V$ (Volume must be in dm^3 !).
2. **Use Ratio:** Use the big numbers in the equation to find moles of the unknown.
3. **Find Concentration:** $C = n \div V$.

Section 10: Electrolysis Fundamentals

Definition: Breaking down a substance using electricity.

- **Electrolyte:** A liquid or solution that can conduct electricity (contains **free ions**).
- **Anode (+):** Attracts negative ions (Anions). Oxidation happens here.
- **Cathode (-):** Attracts positive ions (Cations). Reduction happens here.

Mnemonic: PANIC (Positive Anode, Negative Is Cathode).

Section 11: Aqueous Electrolysis Rules (HT Only)

In water, you have H^+ and OH^- ions as well as the salt ions.

At the Cathode (-1):

- **Hydrogen** is produced *unless* the metal is **less reactive than Hydrogen** (Copper, Silver, Gold).

At the Anode (+1):

- **Oxygen** is produced *unless* the solution contains **Halide ions** (Chloride, Bromide, Iodide). If halides are present, the Halogen is produced.

Section 12: Aluminum Extraction — THE 6-MARKER

Aluminum is too reactive to be reduced by carbon, so we use electrolysis.

1. **Cryolite:** Aluminum Oxide is mixed with **Cryolite** to **lower the melting point** (saves energy/money).
2. **The Cathode (-):** $Al^{3+} + 3e^- \rightarrow Al$ (Aluminum ions are reduced to liquid metal).
3. **The Anode (+):** $2O^{2-} \rightarrow O_2 + 4e^-$ (Oxygen gas is produced).
4. **The Problem:** The oxygen reacts with the **carbon anodes** to make CO_2 .
5. **Maintenance:** The anodes burn away and must be **replaced regularly**.