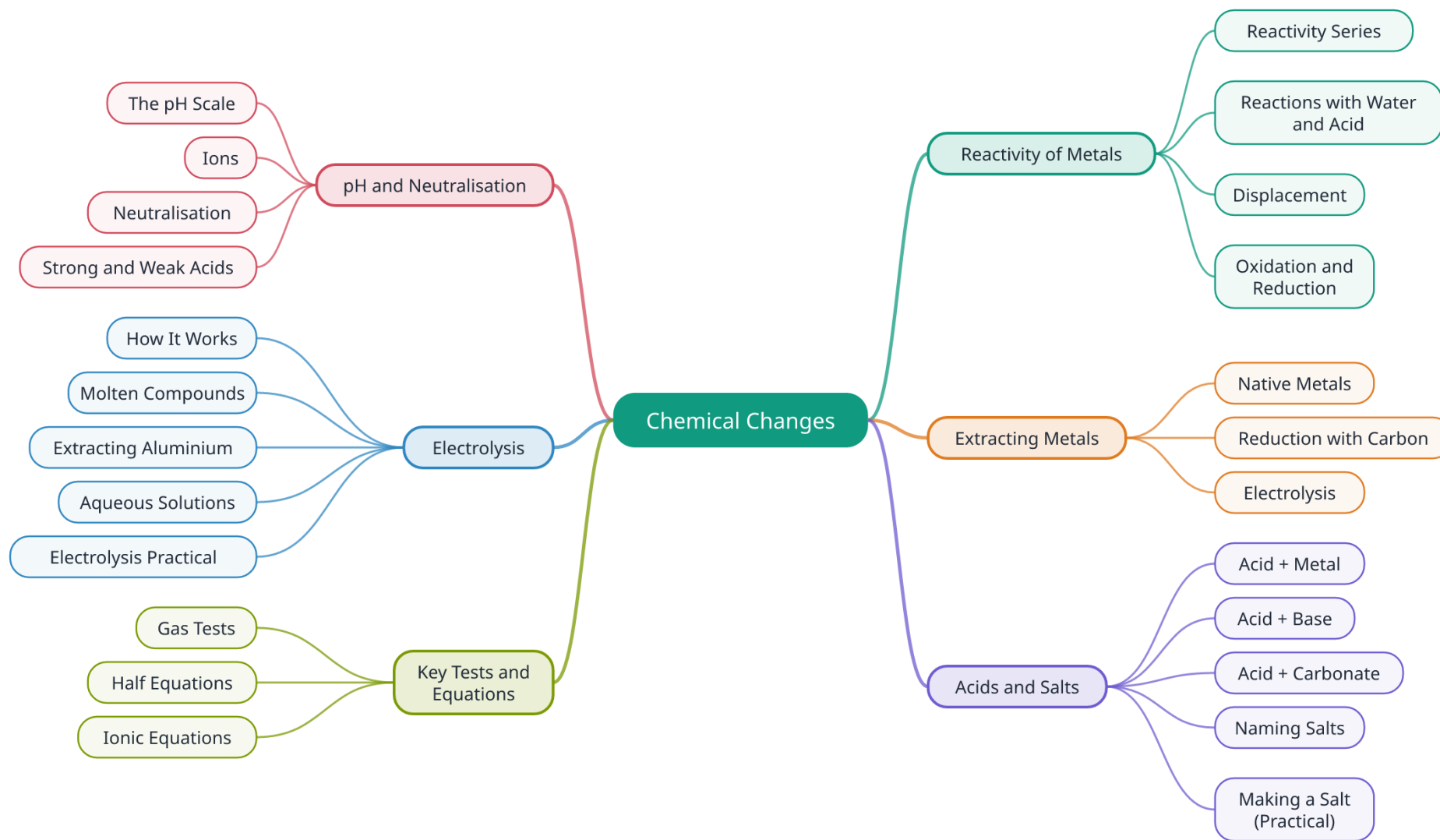


Chemical Changes Mind Map (GCSE)

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Chemical Changes mind map explained

Reactivity of Metals

Metals react with other substances by losing electrons to form positive ions. The more easily they do, the more reactive they are.

Reactivity Series

From most to least reactive: potassium, sodium, lithium, calcium, magnesium, (carbon), zinc, iron, (hydrogen), copper. Carbon and hydrogen are included for comparison.

Reactions with Water and Acid

The more reactive the metal, the more vigorously it reacts with water and acids. Metals above hydrogen react with acids to release hydrogen gas.

Displacement

A more reactive metal displaces a less reactive metal from its compound. For example, iron displaces copper from copper sulfate solution.

Oxidation and Reduction

Metals reacting with oxygen form metal oxides: this is oxidation. Removing oxygen is reduction. Higher tier: oxidation is loss of electrons, reduction is gain (OIL RIG).

Extracting Metals

How a metal is extracted depends on where it sits in the reactivity series.

Native Metals

Unreactive metals such as gold are found in the Earth as the metal itself.

Reduction with Carbon

Metals less reactive than carbon are extracted by heating their oxides with carbon. For example, iron oxide + carbon $\rightarrow$ iron + carbon dioxide.

Electrolysis

Metals more reactive than carbon, such as aluminium, are extracted by electrolysis, which uses large amounts of energy and is expensive.

Acids and Salts

Acids react with metals and bases to make salts.

Acid + Metal

acid + metal $\rightarrow$ salt + hydrogen. Test for hydrogen: a lighted splint gives a squeaky pop.

Acid + Base

acid + metal oxide or metal hydroxide $\rightarrow$ salt + water. Bases neutralise acids; soluble bases are called alkalis.

Acid + Carbonate

acid + metal carbonate $\rightarrow$ salt + water + carbon dioxide. Test for carbon dioxide: it turns limewater milky.

Naming Salts

- Hydrochloric acid makes chlorides
- Sulfuric acid makes sulfates
- Nitric acid makes nitrates

Making a Salt (Practical)

Required practical (AQA) and core practical (Edexcel). Warm dilute sulfuric acid, add copper oxide until no more dissolves (it is in excess), filter out the excess, then gently evaporate and leave the solution to crystallise into copper sulfate crystals.

pH and Neutralisation

The pH scale measures how acidic or alkaline a solution is.

The pH Scale

From 0 to 14. Below 7 is acidic, 7 is neutral and above 7 is alkaline. Measure it with universal indicator or a pH probe.

Ions

Acids produce hydrogen ions (H^+) in water; alkalis produce hydroxide ions (OH^-).

Neutralisation

Hydrogen ions and hydroxide ions react to form water: $H^+ + OH^- \rightarrow H_2O$.

Strong and Weak Acids

Higher tier. Strong acids, such as hydrochloric, nitric and sulfuric, are completely ionised in water. Weak acids, such as ethanoic, citric and carbonic, are only partially ionised. Strong is not the same as concentrated.

Electrolysis

Using electricity to break down an ionic compound that is melted or dissolved, so its ions can move.

How It Works

Positive ions move to the negative electrode (cathode); negative ions move to the positive electrode (anode). The ions are discharged there as elements.

Molten Compounds

The metal forms at the cathode and the non-metal at the anode. Molten lead bromide gives lead and bromine.

Extracting Aluminium

Aluminium oxide is dissolved in cryolite to lower its melting point and save energy. Aluminium forms at the cathode; oxygen at the anode reacts with the carbon anodes, so they must be replaced.

Aqueous Solutions

- At the cathode: hydrogen forms if the metal is more reactive than hydrogen; otherwise the metal forms
- At the anode: oxygen forms, unless the solution contains halide ions, when the halogen forms

Brine gives hydrogen, chlorine and sodium hydroxide solution.

Electrolysis Practical

Required practical (AQA) and core practical (Edexcel): electrolyse aqueous solutions with inert electrodes and identify the products, for example copper sulfate solution, where copper forms at the cathode.

Key Tests and Equations

Quick checks that come up across the topic.

Gas Tests

- Hydrogen: squeaky pop with a lighted splint
- Oxygen: relights a glowing splint
- Carbon dioxide: turns limewater milky
- Chlorine: bleaches damp litmus paper

Half Equations

Higher tier. Show what happens at each electrode, for example $Cu^{2+} + 2e^- \rightarrow Cu$ at the cathode.

Ionic Equations

Higher tier. Show only the ions that react, for example in displacement and neutralisation.

How to revise with this mind map

1. Learn the reactivity series with a mnemonic, including where carbon and hydrogen sit. It explains displacement, extraction and which metals react with acids.
2. Write the general acid equations from memory: with a metal, a base and a carbonate. Then practise naming the salt each acid makes.
3. Know both practicals step by step: making copper sulfate crystals, and electrolysis of aqueous solutions. Be ready to explain why the base is added in excess and why the excess is filtered off.
4. For electrolysis, practise predicting the products at each electrode, for molten compounds and for solutions. This is where most marks are lost.
5. Make it yours. Build your own chemical changes map in Mindmapai from your class notes, and ask the AI about any branch you are unsure of. The answer is saved into that branch's notes for next time.