2.3 Electrolysis

Electrolysis is the process of breaking down an ionic compound using electrical energy.

Electrolyte: liquid* which is broken down by an electrical charge.

Electrode: graphite rods which carry a current in and out of the electrolyte.

Cathode: negative electrode.

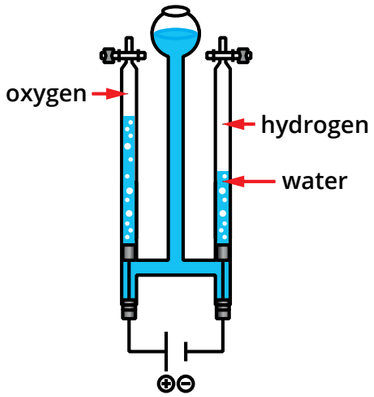
Anode: positive electrode.

* so that the ions are free to move.

Positive **A**node **N**egative **I**s **C**athode	**OIL** **O**xidation **I**s **L**oss (of electrons) **RIG** **R**eduction **I**s **G**ain

Electrolysis of water (CHEMISTRY ONLY)

Hydrogen gas is collected on the cathode while oxygen gas is collected on the anode.



On the cathode: $2H^+ + 2é \rightarrow H_2$

On the anode: $2OH^- \rightarrow O_2 + 2H^+ + 4é$

The volume of the hydrogen formed is twice the volume of the oxygen formed, as there are two hydrogen atoms for every oxygen atom in a molecule of water (H_2O).

Electrolysis of aqueous solutions (CHEMISTRY ONLY)

In aqueous solution there are H^+ a OH^- ions as well as the ions from the dissolved salt. Metals lower in the reactivity series than hydrogen are formed on the cathode. In the case of copper(II) chloride solution, the products are copper metal and chlorine gas.

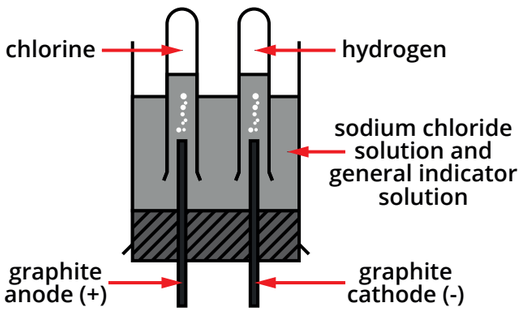
On the cathode: $Cu^{2+} + 2é \rightarrow Cu$

On the anode: $2Cl^- \rightarrow Cl_2 + 2é$

But when the dissolved salt includes ions from metals that are higher than hydrogen in the reactivity series, hydrogen gas is formed rather than the metal.

On the cathode: $2H^+ + 2é \rightarrow H_2$

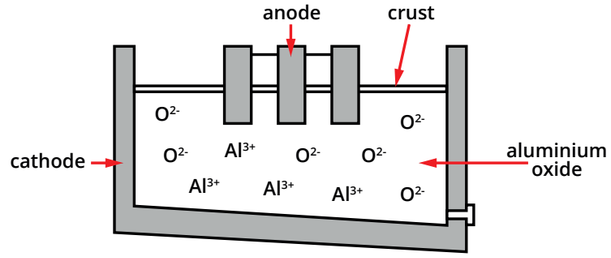
On the anode: $2Cl^- \rightarrow Cl_2 + 2é$



Aluminium Electrolysis:

The electrolysis process can be used to extract aluminium from aluminium oxide.

aluminium oxide → aluminium + oxygen



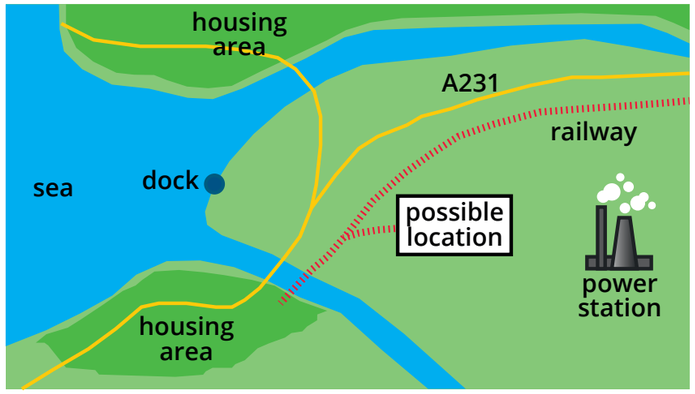
Alumina (aluminium oxide) dissolves in molten cryolite at a temperature much lower than its melting point, therefore saving energy.

On the cathode: $Al^{3+} + 3é \rightarrow Al$

On the anode: $2O^{2-} - 4é \rightarrow O_2$

The oxygen formed reacts with the carbon anodes, forming carbon dioxide gas and requiring anodes to be replaced frequently.

Aluminium Plants:



Factors which impact location:

- location near the coast in order to import raw materials
- a site away from built up areas
- a town or city within commuting distance to accommodate the workforce
- good transport links for transporting the product to buyers
- a direct electricity supply in the case of aluminium.

The properties of metals:

Iron (steel)

Strong and hard.

Aluminium

Strong, low density, good conductor of heat and electricity, resistant to corrosion.

Copper

Very good conductor of heat and electricity, malleable and ductile, attractive colour and lustre.

Titanium

Hard, strong, low density, resistant to corrosion, high melting point.