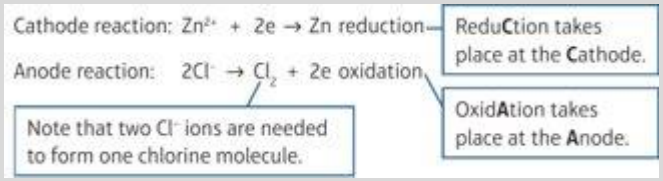
Knowledge Organiser: Chemistry, Extracting Metals and Equilibria Part A

Jesus grew in wisdom and stature" Luke 2:52

1	**Ions** are atoms that have lost or gained **electrons** and so become **charged.**
2	Ionic compounds need to be molten or dissolved for ions to be separated by electrolysis.
3	An ionic substance with freely moving ions is called an electrolyte.
4	**Positive ions** are called cations are **attracted** to the **negative** electrode called the **cathode**.
5	**Negative ions** are called anions are **attracted** to the **positive** electrode called the **anode**.
6	Half equations show what happens at the electrodes (OILRIG): Redu**C**tion at the **C**athode, oxid**A**tion at **A**node. 
7	**Oxidation I**s the **L**oss of electrons and **Reduction I**s **G**ain of electrons during a reaction (OILRIG)
8	Copper is purified by electrolysis, more expensive but lower resistance when used in wires
9	Direct current (d.c.) is needed electrolysis
10	Electrodes are washed in distilled water (remove surface impurities) and dipped in propanone (remove the water) to ensure an accurate reading on the **mass balance**.
11	Molten salts undergoing electrolysis with inert electrodes decompose into their elements. The metal ions (+ve) move to the cathode (-ve), the non-metal (-ve) moves to the anode (+ve)
12	Opposite charges attract and like charges repel.
13	Products of salt solutions are harder to predict as water also ionises to a very small extent producing hydrogen ions (H+) and hydroxide ions (OH-)
14	At the negative electrode (cathode): If there is more than one type of positive ion in solution then the LEAST reactive element will be produced at the cathode.

Ions	Cu^{2+}(aq) and Cl^-(aq) (from salt), H^+(aq) and OH^-(aq) (from water)	
cathode	Cu^{2+}(aq) and H^+(aq) ions are attracted. Copper ions are discharged more readily than hydrogen ions, so copper is formed as a brown solid.	H Cu^{2+}(aq) + 2e → Cu(s) (reduction)
anode	Cl^-(aq) and OH^-(aq) ions are attracted. Chloride ions are discharged more readily than hydroxide ions, so chlorine is formed as a pale green gas.	H $2Cl^-$(aq) → Cl_2(g) + 2e (oxidation)
Overall	The copper chloride decomposes but the water does not change. $CuCl_2$(aq) → Cu(s) + Cl_2(g)	

Knowledge Organiser: Chemistry, Extracting Metals and Equilibria Part B

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1	At the positive electrode (anode): oxygen is produced (from hydroxide ions), unless halide ions (chloride, bromide or iodide ions) are present. In that case, the negatively charged halide ions lose electrons and form the corresponding halogen (chlorine, bromine or iodine).
2	The **reactivity series** is a list of metals in order of **reactivity**, the most reactive are at the top.
3	The reactivity series is determined by how **vigorously** an elements reacts with other substances e.g. water and acid.Elements higher up the reactivity series can **displace** those below them. e.g. $Zn + CuSO_4$ $Cu + ZnSO_4$ More reactive zinc replaced copper.

Ions	$Na^+(aq)$ and $Cl^-(aq)$ (from salt), $H^+(aq)$ and $OH^-(aq)$ (from water)	
cathode	$Na^+(aq)$ and $H^+(aq)$ ions are attracted. Hydrogen ions are discharged more readily than sodium ions, so hydrogen gas is formed.	H $2H^+(aq) + 2e \rightarrow H_2(g)$ (reduction)
anode	$Cl^-(aq)$ and $OH^-(aq)$ ions are attracted. Chloride ions are discharged more readily than hydroxide ions, so chlorine is formed as a pale green gas.	H $2Cl^-(aq) \rightarrow Cl_2(g) + 2e$ (oxidation)
Overall	The sodium chloride decomposes to form hydrogen and chlorine. The sodium and hydroxide ions remain in the solution. $2NaCl(aq) + 2H_2O(l) \rightarrow H_2(g) + Cl_2(g) + 2NaOH(aq)$	

4	**Displacement reactions** are also **redox** reactions. The reaction between zinc and copper sulphate above can be written as an ionic equation: $Zn + Cu^{2+}$ $Cu + Zn^{2+}$ The copper has gained two electrons this is **red**uction, zinc has lost two electrons to become Zn^{2+} this is **ox**idation. This happens at the same time so a **redox** reaction.
5	An **ore** is a rock containing enough of a compound (or element) to be profitable when its sold. Very unreactive metals can be found their own or **native state** .e.g. **gold** and **platinum**.
6	The metals below carbon in the reactivity series e.g. iron are extracted by smelting. Metals above carbon e.g. aluminium by **electrolysis.** Both process use a lot energy and cause a lot of pollution. Biological methods of extraction **e.g. bioleaching** and **phytoextraction** are less damaging to the environment and can work on ores with less metal in them.

Metal	Reaction with water	Reaction with dilute acid	Tendency of metal atoms to form cations
potassium	react with cold water to form hydrogen and a metal hydroxide	react violently	increasing ability of metal atoms to form positive ions
sodium			
calcium		react to form hydrogen and a salt solution	
magnesium	react very slowly, if at all, with cold water but react with steam to form hydrogen and a metal oxide		
aluminium			
zinc			
iron			
copper	do not react with cold water or steam	do not react	
silver			
gold			

1	Most metals react with oxygen in the air, this is called **corrosion**. **Paint**, coating of **oil** and a **sacrificial block** of a more reactive metal can stop corrosion. An oxide layer (a **tarnish**) also stops further reaction
2	**Corrosion** of **iron** needs **water** and is called **rusting.**
3	A life cycle assessment (LCA) Is used to work out the environmental impact of a product.
4	Recycling can make natural reserves of metal ore last longer, reduced mining of ores results in less damage to habitats, noise and dust. Less energy is needed so less carbon dioxide (global warming) and sulphur dioxide (acid rain) is emitted.