Year 11 Chemistry

1. Ionic Bonding

Occurs between a **metal** and a **non-metal** to form a **giant ionic lattice**

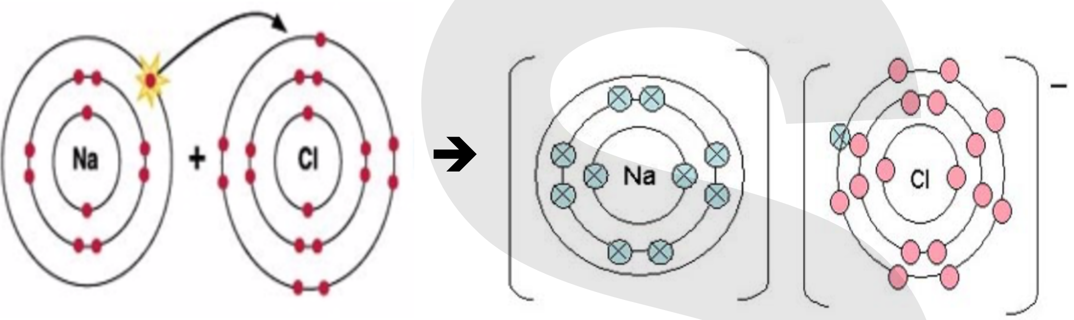
Metal will **lose** electrons to form a **positive** ion

Non-metal will **gain** electrons to form a **negative** ion

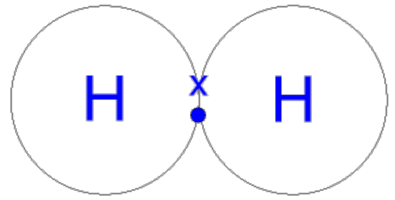
Ionic bond – strong electrostatic force of attraction between ions of opposite charges

Ionic lattices have high melting points because the attraction between ions is string and require a lot of energy to break

Ionic lattices conduct electricity when molten or in solution because **ions** are free to move and carry an electric charge.



2. Covalent Bonding



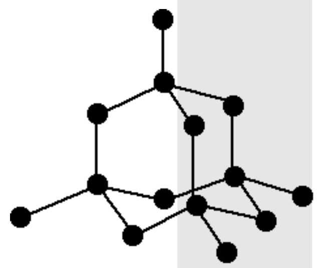
Occurs between **non-metal** atoms

Covalent bond – a shared pair of electrons

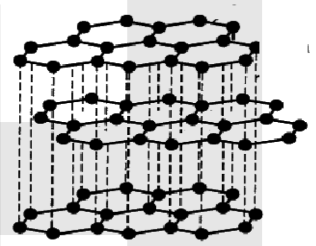
Rule – however many electrons an atoms needs is how many it shares

Forms simple covalent molecules. There are **weak intermolecular forces** between molecules which means they are liquid or gas at room temperature.

Diamond
- Each C atom covalently bonded to 4 others
- Tetrahedral shape
- Very strong
- No free electrons



Graphite
- Each C atom covalently bonded to 3 others
- Hexagonal layers
- Weak forces between layers
- Fourth electron from each C is free to move and carry an electric charge
- Layers slide over each other



Diamond and graphite are **giant covalent structures**

3. Metallic bonding

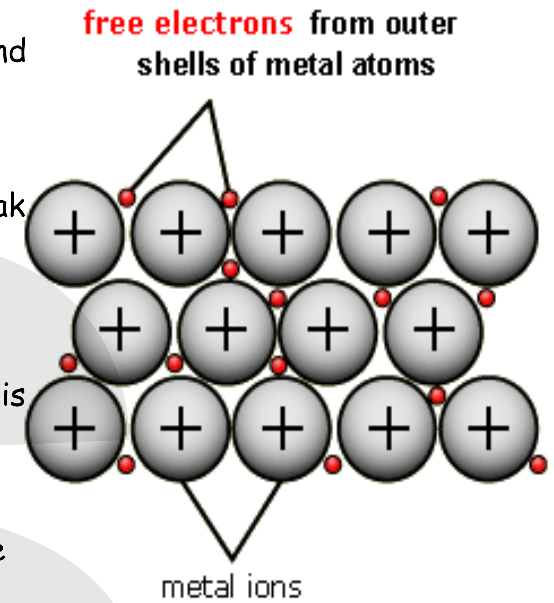
Properties of metals: Strong, high melting points, electrical conductivity, good conductors of heat, malleable, ductile
Metallic bonding- layers of atoms, sea of electrons.

Metals are made up of a regular arrangement of positive metal ions surrounded by a sea of delocalised electrons.

Metals are able to conduct electricity because the electrons are delocalised and able to carry an electric charge

Metals are difficult to break because there is a strong **electrostatic attraction** between positive ions and negative electrons. This means a lot of heat **energy** is needed to break this attraction.

When a force is applied the ion slide over each other. This makes metals malleable.



4. Nanoscience and Smart Materials

Nanoscience is the study or particles between 1-100nm. One nanometre is a billionth of a metre!

*Nano-sized silver; antibacterial, antiviral and antifungal. Used in plasters, socks and in hospitals.
*Nano-sized titanium dioxide; reflect UV light. Used in sunscreens. They are also used in self-cleaning windows as they can breakdown dirt and spread out water.

Key issue: long term effects are unknown!

Smart materials: materials that change **reversibly** with a change in properties

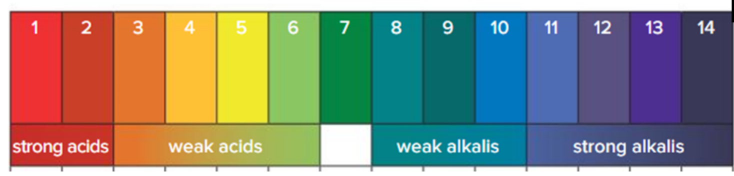
Smart Material	Property	Uses
Thermochromic	Change colour in response to heat	Mood rings, mugs, baby spoons, battery power indicators
Photochromic	Change colour in response to light	Sunglasses lenses
Shape memory alloy	Pseudoelasticity and shape retention	Glasses frames
Shape memory polymer	Shape retention when heated	Retainers
Hydrogel	Absorb large quantities of water	Nappies, magic snow

5. Acids

Acid – a substance that produces H^+ ions in water
Base – a substance that neutralises an acid, but doesn't dissolve in water
Alkali – a base dissolved in water

Acids & alkalis are classified using the pH scale.

Acids – pH less than 7
Neutral solution – pH 7
Alkalis – pH above 7



Strength – how many acid particles ionise in solution
Concentration – number of particles in a given volume (mol dm^{-3})
Acids – pH lower than 7
Neutral solution – pH 7
Alkalis – pH higher than 7

Reactions of acids

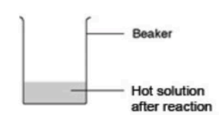
acid + metal → salt + hydrogen
Acid + metal oxide (base) → salt + water
Acid + metal hydroxide (alkali) → salt + water
Acid + metal carbonate → salt + water + carbon dioxide

Salts have 2 names – first name is the name of the metal, second name is from the acid

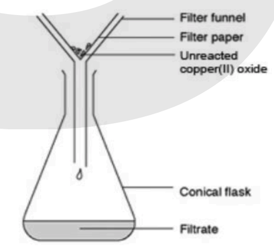
Hydrochloric acid – chloride
Sulfuric acid – sulfate
Nitric acid – nitrate
Ethanoic acid - ethanoate

6a. Making crystals of a soluble salt

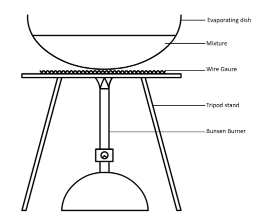
1. React



2. Filter excess solid



3. Evaporate water

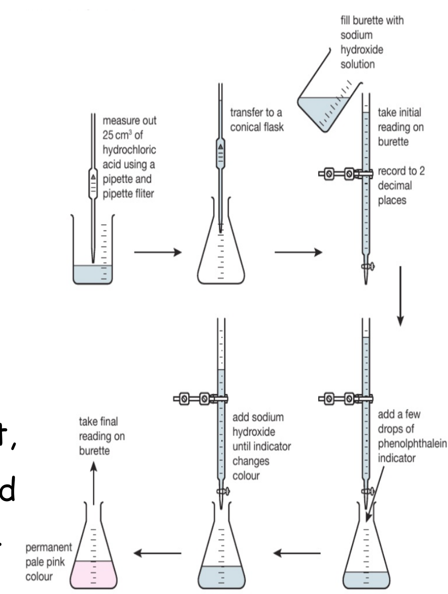


6b. Titrations

*Allow us to determine the concentration of a solution

*Allows us to produce pure crystals of a soluble salt

To produce pure crystals of a salt, find the exact volumes of acid and alkali needed and then repeat but **without** the indicator.



Year 11 Chemistry

7. Reactivity of metals

Metals are ordered in the reactivity from most reactive to least reactive.

A more reactive metal will displace a less reactive metal from a solution of its salt.

Many metals are found in the ground as **ores**. Generally, they have been reacted with oxygen to form a compound and we need to remove the oxygen from the compound to extract the metal that we want.

Haematite – Iron oxide, Fe_2O_3
Bauxite – Aluminium oxide, Al_2O_3

Most reactive
- Potassium
- Sodium
- Lithium
- Calcium
- Magnesium
- Aluminium
- Zinc
- Iron
- Copper
- Silver
- Gold

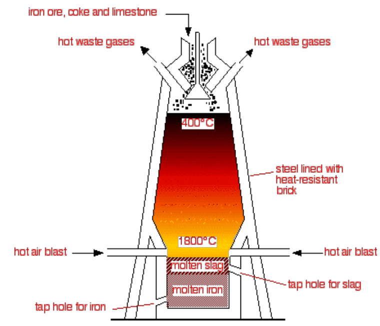
Thermite reaction
*Used to weld train tracks together
*Produces molten iron
*Competition reaction

Aluminium + Iron oxide ➔ Iron + Aluminium oxide

Oxidation – Gain of oxygen
Reduction – Loss of oxygen

8a. Blast Furnace

Used to extract iron from iron ore



Raw materials:
*Iron ore – source of iron
*Coke – reducing agent/fuel
*Limestone – removes impurities

1. Coke reacts with oxygen to corm carbon dioxide $C + O_2$ ➔ CO_2
2. Carbon dioxide reacts with more coke, forms carbon monoxide $CO_2 + C$ ➔ $2CO$
3. Carbon monoxide reduces iron oxide $Fe_2O_3 + 3CO$ ➔ $2Fe + 3CO_2$
4. Limestone reacts with silicon dioxide to from calcium silicate (slag) $CaCO_3 + SiO_2$ ➔ $CaSiO_3 + CO_2$

8b. Electrolysis

The splitting up of compounds using electricity

Aluminium oxide is dissolved in molten **cryolite** to lower its melting temperature, therefore saving money.

Don't PANIC - Positive is Anode, Negative Is Cathode.

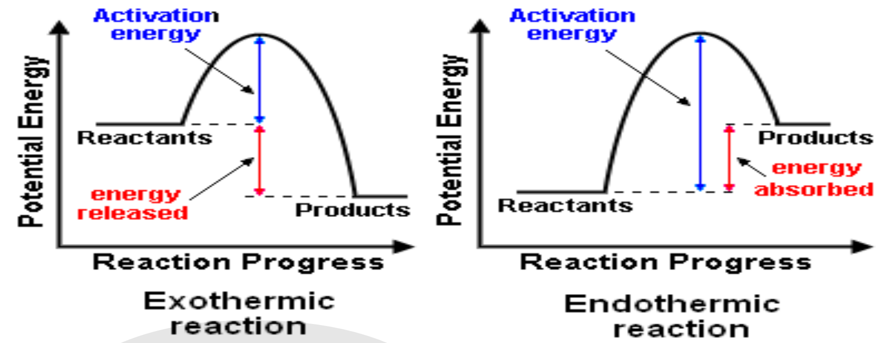
Positive ions go to the cathode
e.g. $Al^{3+} + 3e^-$ ➔ Al

Negative ions go to the anode
e.g. $2O^{2-}$ ➔ $O_2 + 4e^-$

9. Chemical reactions and energy

Exothermic- reactions that give out heat energy
Endothermic – reactions that take in heat energy

Bond breaking is endothermic and bond making is exothermic

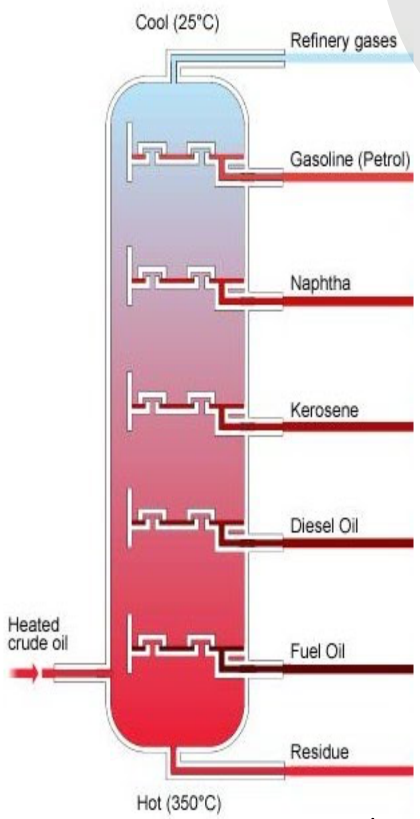


Overall energy change = Breaking – Making

A **negative** value tells us the reaction is **exothermic**

A **positive** value tells us the reaction is **endothermic**

10. Fractional Distillation



Crude oil is a complex mixture of hydrocarbons formed over millions of years from the remains of simple marine organisms.

The fractions contain mixtures of hydrocarbons (alkanes) with similar boiling points.

The compounds in the fractions have increasing chain lengths and boiling points as you go down the fractionating column.

The shorter the hydrocarbon chain, the more useful it is as a fuel.

Crude oil is heated until it vapourises, vapours rise up the column until they reach a temperature lower than their boiling point, they condense and are collected.

Catalytic cracking can be used to turn longer hydrocarbon chains into shorter, more useful hydrocarbons using heat and a nickel catalyst.

11. Combustion

Hydrocarbons and other fuels undergo combustion with oxygen to produce carbon dioxide and water.

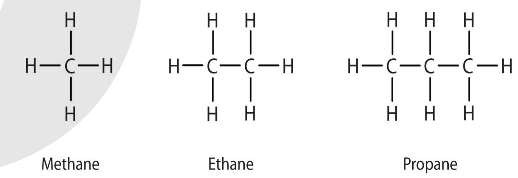
Hydrogen has advantages and disadvantages as a fuel. For example, it only produces water when it burns, however it is very flammable and can explode so is potentially more dangerous than oil based fuels. To obtain the hydrogen also requires a large amount of energy

The fire triangle indicates the components required for fire and is used in fire fighting and prevention.

Removing heat	Use water e.g. in a house fire or a bonfire
Removing oxygen	Use a fire blanket e.g. person on fire CO_2 fire extinguisher e.g. aeroplane fire
Removing fuel	Create a fire break e.g. in a forest fire Turn off the gas supply e.g. in a natural gas fire.

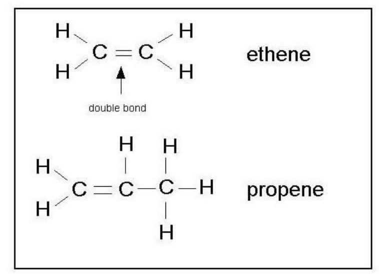
12. Organic Chemistry

Alkanes
* General formula C_nH_{2n+2}
* C-C single bonds
* Saturated



Alkenes
* General formula C_nH_{2n}
* C=C double bond
* Unsaturated

Test for an **alkene** – add **bromine water** and it will **decolourise**



Alkene **monomers** can be added together in an **addition polymerisation** reaction to form **polymers**