Halogenoalkanes

- **Halogenoalkane:** an alkane with at least one halogen atom.

- **Naming halogenoalkanes:**
- Fluorine: Fluoro-
- Chlorine: Chloro-
- Bromine: Bromo-
- Iodine: Iodo-

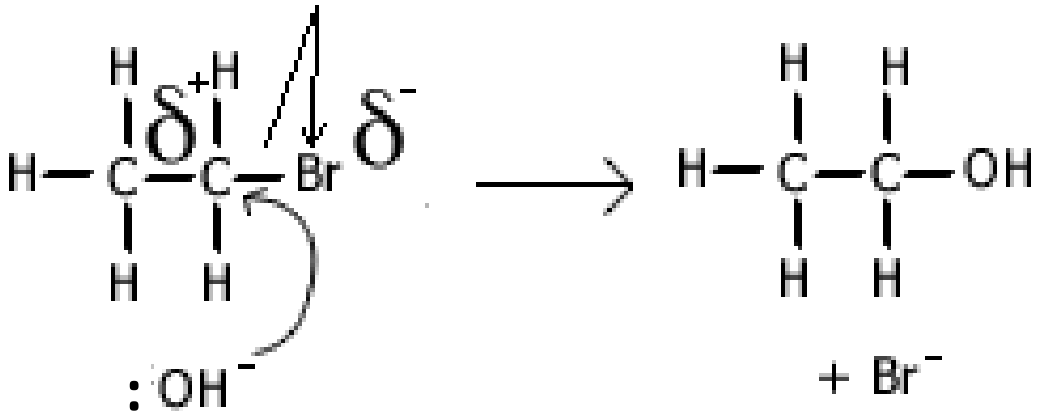
- **Chlorofluorocarbons (CFC's) →**
- Contain only chlorine, fluorine and carbon – no hydrogens.
- They are stable, volatile, non-flammable and non-toxic.
- Used to be used a lot e.g. in fridges, aerosol cans and air-conditioning.
- Scientists then realised CFC's destroyed the ozone layer.
- **Examples:**
- Trichlorofluoromethane.
- Chlorotrifluoromethane.

Nucleophilic Substitution

- **Halogens are much more electronegative than carbon – the bond is polar.**
- The δ+ carbon doesn't have enough electrons – can be attacked by a nucleophile.

- Nucleophiles:
- $:CN^-$ (cyanide ion)
- $:NH_3$ (ammonia)
- $:OH^-$ (hydroxide ion)
- Water is a nucleophile, but it reacts slowly.

- **Nucleophilic Substitution Reactions:**



Biodegradable Polymers

- Scientists can now make biodegradable polymers – can decompose quickly under certain conditions – organisms can digest them.
- Biodegradable polymers can be made from starch or the hydrocarbon isoprene.
- **Uses:** plastic sheeting to protect plants from frost.

- **Advantages of using renewable materials:**
- Won't run out.
- Carbon neutral.
- Save energy compared to oil-based plastics.

- **Disadvantages of biodegradable plastics:**
- Still need the right conditions to decompose – on a compost heap.
- Still need to collect and separate them.
- More expensive.

- **Other things scientists can do:**
- Photodegradable plastics.
- Develop better techniques for cracking so recycling is more efficient.
- Use processes with higher atom economy.
- Find new ways of making plant-based polymers.
- Develop more efficient ways of sorting and recycling polymers.

Reactions of Alcohols

- **Synthesising ethanol:**

- Steam hydration of ethene is used to produce ethanol.
- **Conditions:** 300˚c and 60 atm.
- An acid catalyst is used – usually solid phosphoric(V) acid.
- The reaction is reversible, and the yield is low – about 5%. The unreacted ethene gas can be recycled.
- **$H_2C=CH_2$ (g) + H_2O (g) → CH_3CH_2OH (g)**

- Industrial production of ethanol by fermentation.
- **Conditions:** no oxygen (anaerobic respiration) and yeast – which produces enzymes to convert sugar.
- At 15% ethanol, the yeast dies.
- Ethanol must be purified after.
- **$C_6H_{12}O_6$ (aq) → $2CH_3CH_2OH$ (g) + $2CO_2$ (g)**

Bond Enthalpies

- **Bond breaking is endothermic (ΔH+)**
- **Bond forming is exothermic (ΔH-)**

- **Bond dissociation enthalpy:** the amount of energy you need per mole to break bond attraction in gaseous compounds.

- Stronger bonds take more energy to break and release more energy when formed.
- Enthalpy change of a reaction is the overall effect of these two changes.
- If you need more energy to break the bonds than is released when the bonds are formed, then ΔH is positive.

- Enthalpy change of a reaction = total energy absorbed – total energy released.

Measuring Enthalpy Changes

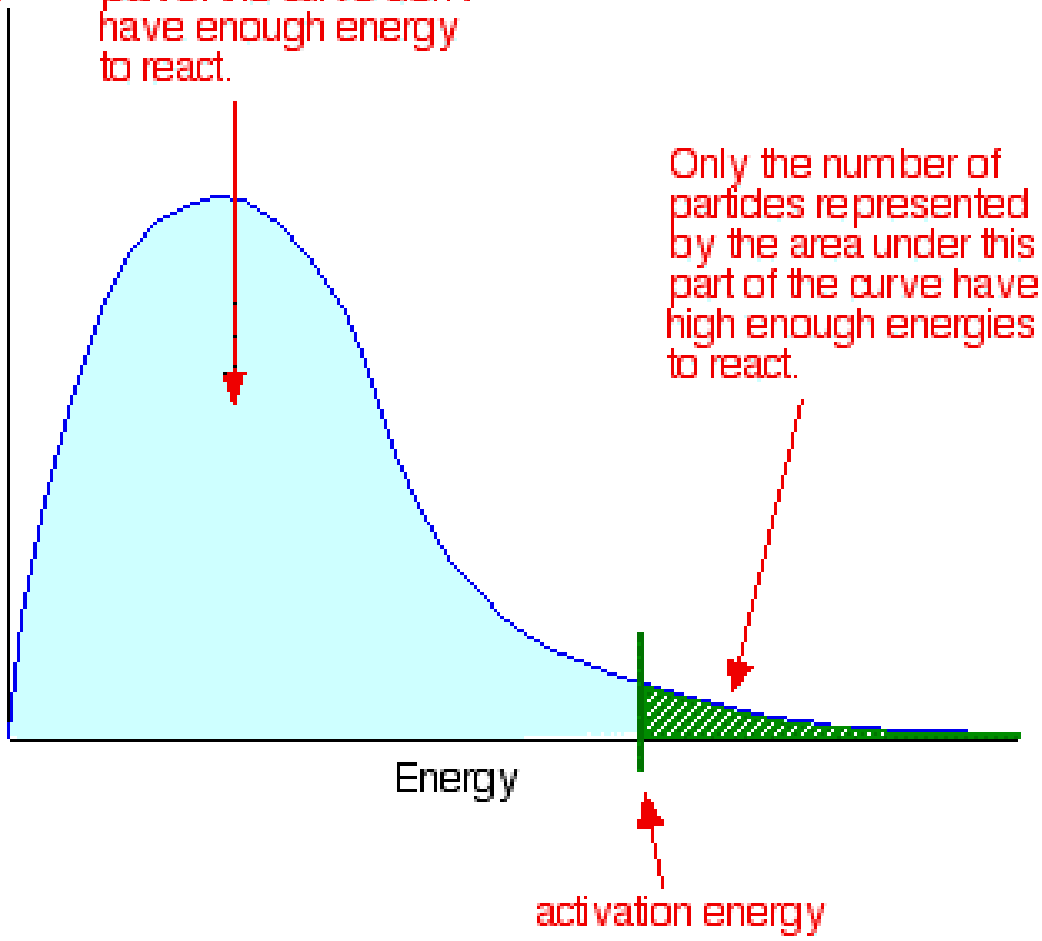
- **You must know →**
- The number of moles of the stuff that's reacting.
- The change in temperature.

- When measuring temperature with a solution, use an insulated contained like a polystyrene beaker so that you don't lose/gain much heat.
- For combustion reactions, a copper calorimeter containing a known mass of water is used – record the temperature change of water.

- **Equation:** $q = m\ c\ \Delta T$
- Q = heat lost/gained – the same as enthalpy change if pressure is constant (J).
- M = mass (g) of the solution/water in calorimeter.
- C = specific heat capacity of solution/water (4.18 j/g/k)
- ΔT = change in temperature of solution/water.

Maxwell-Boltzmann Distribution

- **Maxwell-Boltzmann distribution:**
- A graph plotted that shows different kinetic energies with molecules in a gas.



Reversible Reactions

- **Dynamic equilibrium:** the forward and backward reaction are going at the same rate so the concentrations of the reactants and products don't change – can only happen in a closed system.

- Altering the position of equilibrium – end up with different amounts of reactants and products at equilibrium.
- If it moves to the left, the backwards reaction is favoured so you'll get more reactants and vice versa.

- **Le Chatelier's principle →**
- If there's a change in concentration, pressure or temperature, the equilibrium will move to help counteract the change.
- Catalysts have no effect – only increase the rate of the reaction.

Le Chatelier's Principle

- **Changing concentration →**
- If you increase the concentration of a reactant, the equilibrium tries to get rid of the extra reactant – this makes more product – the equilibrium moves to the right.
- Decreasing concentrations has the opposite effect.

- **Changing pressure →**
- Only affects equilibrium involving gases.
- Increasing pressure moves the equilibrium to the side with fewer gas molecules in order to reduce the pressure.
- Decreasing pressure has the opposite effect.

- **Changing temperature →**
- Increasing temperature means adding heat energy.
- The equilibrium moves in the endothermic direction to absorb the extra energy.
- Decreasing temperature removes heat energy.
- The equilibrium moves in the exothermic direction to replace the heat energy.

Global Warming

- **Greenhouse effect →**
- Electromagnetic radiation from the sun is absorbed by earth.
- Earth re-emits it as infrared radiation.
- Gases in the troposphere absorb some and re-emit in all directions – including earth.
- **Main greenhouse gases →**
- Water vapour, carbon dioxide and methane.
- The C=O, O-H and C-H bonds absorb IR – they vibrate more – extra energy is passed on in collisions – raises the overall temperature.
- **The contribution of a gas depends on →**
- How much IR one molecule absorbs.
- Concentration in parts per million (ppm) of gas in the atmosphere.
- Residence time – how long the gas stays in the atmosphere.

- **Global warming:** human activities have caused a rise in greenhouse gas concentrations – more heat is being trapped and the earth is getting warmer.