C7: Energy Changes in Reactions

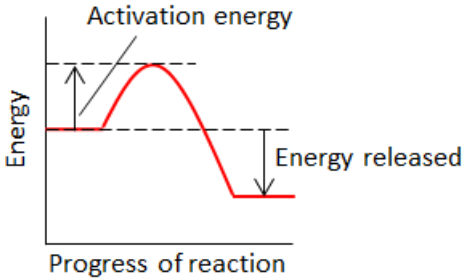
Exothermic Reactions

Heat energy is transferred to the surroundings.

Eg. Combustion, neutralisation and oxidation reactions.

Hand warmers and self heating cans use exothermic reactions.

Products are lower in energy, so energy is released to the surroundings (making the surroundings hotter).



Energy Profiles

Show the relative energies of the reactants and products.

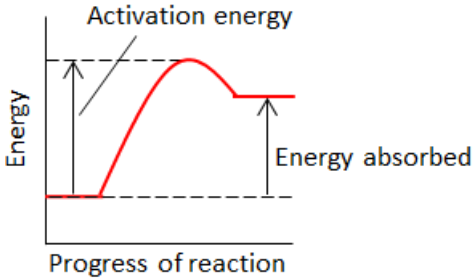
The initial rise is the activation energy – the minimum amount of energy the particles need to collide with each

Endothermic Reactions

Heat energy is absorbed by the reaction, making the surroundings cooler.

Eg. Thermal decomposition: $CaCO_3 \rightarrow CO_2 + CaO$

Sports injury packs use endothermic reactions to put on injuries.



Products are higher in energy, so energy is absorbed by the reaction (making the surroundings are cooler).

Bond Energy Calculations

Each chemical bond has an amount of energy needed to break and form it.

H-H is 436kJ/mol, Cl-Cl is 242kJ/mol, H-Cl is 431kJ/mol.

To calculate the energy change for this reaction: $H_2 + Cl_2 \rightarrow 2HCl$

1. Calculate the energy required to break the bonds:
   (1 x H-H) + (1 x Cl-Cl) = 436 + 242 = 678kJ/mol

2. Calculate the energy released to form the new bonds:
   (2 x H-Cl) = 2 x 431 = 862J/mol

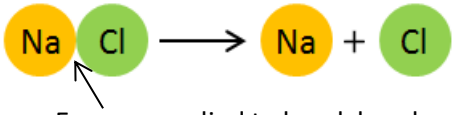
3. Calculate the difference (overall energy change):
   Energy change = energy to break bonds – energy to form bonds
   = 678 – 862 = **-184kJ/mol**

This shows that **more energy is released** than taken in, so the reaction is exothermic.

A +ve energy change would indicate an endothermic reaction.

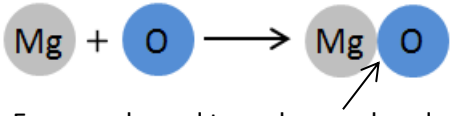
Bond Energies

Bond breaking = endothermic



Energy supplied to break bond

Bond making = exothermic



Energy released to make new bond

Measuring Energy Transfers

REQUIRED PRACTICAL
SEE PRACTICAL SHEET FOR DETAIL

The energy change of a reaction can be measured by taking the temperature of the reactants, mixing them together then taking the temperature at the end.

It is important to reduce energy loss to the surroundings by:

- Use a polystyrene cup for insulation
- Put the cup into a beaker of cotton wool for extra insulation

The variables that can affect energy transfer in a reaction can be measured in this way, eg. changing the mass or concentration of the reagents.