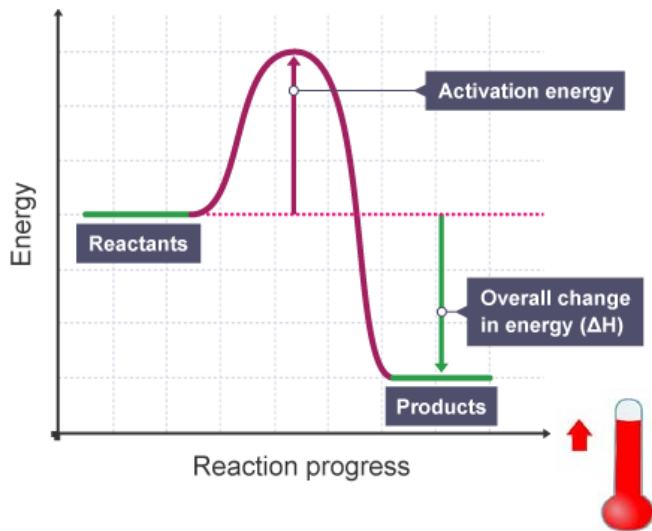


Chemistry Crib Sheet: Topic 5

In a reaction breaking bonds takes in energy.
In a reaction making new bonds releases energy.

EXOTHERMIC reactions release more energy forming new bonds than is taken in when old bonds are broken so overall give out energy.



Examples:

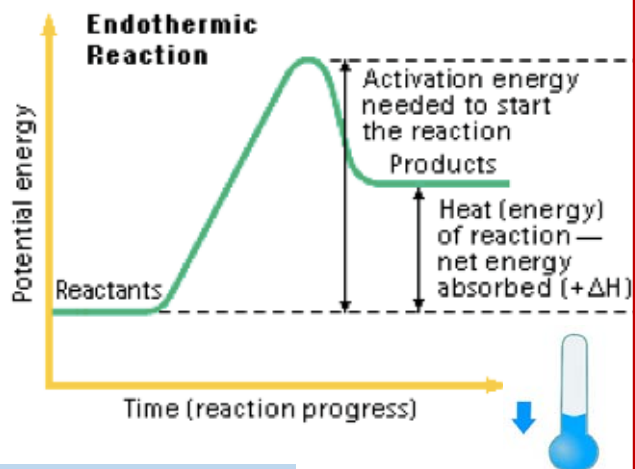
- Combustion
- Neutralisation
- Oxidation



Uses:

- Hand warmers
- Self heating cans

ENDOTHERMIC reactions release less energy forming new bonds than is taken in when old bonds are broken so overall take in energy.



Examples:

- Thermal decomposition
- Reaction between citric acid + sodium hydrogencarbonate

Uses:

- Sports injury packs



Bond energies

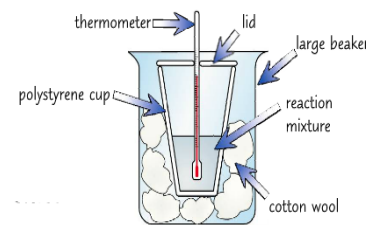
Every bond has a different energy associated with it - e.g. you need 436kJ to break the bond between 2 hydrogen atoms (H-H). You can use these to calculate the overall energy change for a reaction



Core practical: How does the concentration of hydrochloric acid affect the amount of energy released when it is neutralised?

1. Add 25cm³ of 0.25M HCl to 1 beaker and 25cm³ of NaOH to another
2. Put them in a 25°C water bath
3. Mix the liquids
4. Take the temp every 30s using a thermometer
5. Record the highest temp
6. Repeat using different acid concentrations (e.g. 0.5M, 1.0M)

Use the apparatus shown below to prevent energy loss to the surroundings



EXAMPLE:

Using the bond energies given below, calculate the energy change for the reaction between H₂ and Cl₂ forming HCl:

The bond energies you need are: H-H: +436 kJ/mol; Cl-Cl: +242 kJ/mol; H-Cl: +431 kJ/mol.

1) Find the energy required to break the original bonds:

$$(1 \times \text{H}-\text{H}) + (1 \times \text{Cl}-\text{Cl}) = 436 \text{ kJ/mol} + 242 \text{ kJ/mol} = 678 \text{ kJ/mol}$$

2) Find the energy released by forming the new bonds.

$$2 \times \text{H}-\text{Cl} = 2 \times 431 \text{ kJ/mol} = 862 \text{ kJ/mol}$$

3) Find the overall energy change for the reaction using this equation:

$$\text{Overall energy change} = \text{energy required to break bonds} - \text{energy released by forming bonds} = 678 \text{ kJ/mol} - 862 \text{ kJ/mol} = -184 \text{ kJ/mol}$$