



ENERGETICS – INTRODUCTION

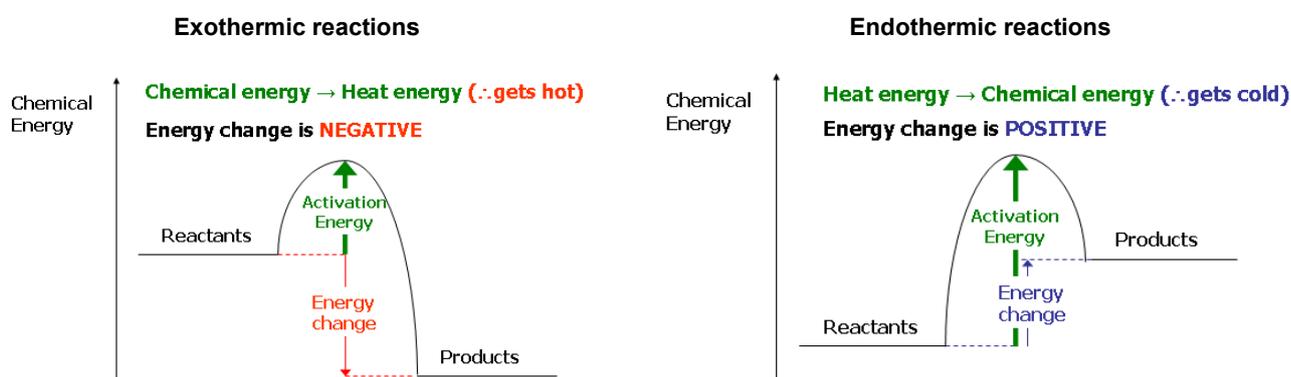
1) What is enthalpy?

What is enthalpy? *It is a measure of the heat content of a substance*

Enthalpy change (ΔH) = *Change in heat content at constant pressure*

Standard conditions (ΔH°) = *100 kPa and a stated temperature (usually 298K)*

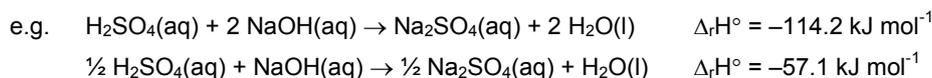
2) Reaction profiles



3) Standard enthalpy change of reaction ($\Delta_r H^\circ$) ("enthalpy of reaction")

This is the enthalpy change for a reaction with the quantities shown in the chemical equation. This means that the value should always be quoted along with the equation.

In this example, the second equation contains half the molar quantities of the first and so the $\Delta_r H^\circ$ value is half as much. The value of $-114.2 \text{ kJ mol}^{-1}$ in the first equation means that 114.2 kJ of heat energy is released when 1 mole of H_2SO_4 reacts with 2 moles of NaOH. The value of $-57.1 \text{ kJ mol}^{-1}$ in the second equation means that 57.1 kJ of heat energy is released when $\frac{1}{2}$ mole of H_2SO_4 reacts with 1 mole of NaOH.



4) Standard enthalpy change of formation ($\Delta_f H^\circ$) ("enthalpy of formation")

Enthalpy change when 1 mole of a substance is formed from its constituent elements with all reactants and products in standard states under standard conditions.

e.g. $\text{CH}_4(\text{g})$
 $\text{H}_2\text{O}(\text{l})$
 $\text{NH}_3(\text{g})$
 $\text{C}_2\text{H}_5\text{OH}(\text{l})$
 $\text{CH}_3\text{Br}(\text{l})$
 $\text{Na}_2\text{O}(\text{s})$

Note: re $\Delta_f H^\circ$ of an element in its standard state = 0 by definition

5) Standard enthalpy change of combustion ($\Delta_c H^\circ$) ("enthalpy of combustion")

Enthalpy change when 1 mole of a substance is completely burned in oxygen with all reactants and products in standard states under standard conditions.

- e.g. CH₄(g)
- H₂(g)
- C₂H₆(g)
- C₂H₅OH(l)
- Na(s)
- C₆H₁₄(l)

6) Standard enthalpy change of neutralisation ($\Delta_{\text{neut}} H^\circ$) ("enthalpy of neutralisation")

Enthalpy change when 1 mole of water is formed in a reaction between an acid and alkali under standard conditions.

- e.g. HCl(aq) + NaOH(aq)
- H₂SO₄(aq) + NaOH(aq)
- HNO₃(aq) + KOH(aq)
- HNO₃(aq) + Ba(OH)₂(aq)
- H₂SO₄(aq) + Ba(OH)₂(aq)