

## Introduction to enthalpy

N Goalby  
Chemrevise.org

## Enthalpy

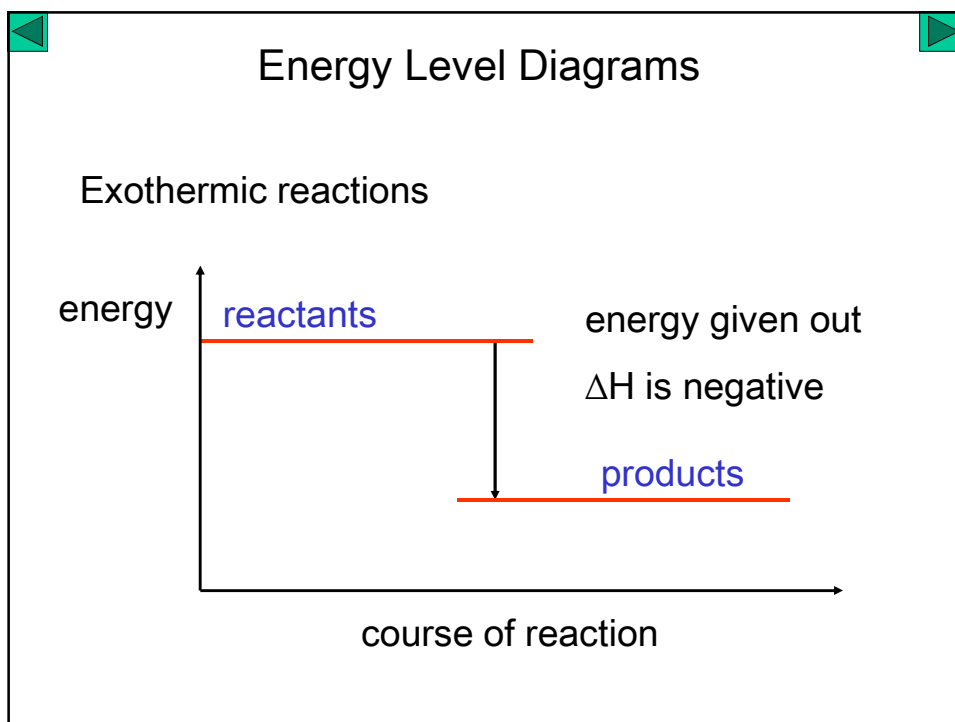
Energy is the ability of a system to do work

Enthalpy (symbol H) is the name used for chemical energy.  
In most reactions an enthalpy change occurs (symbol  $\Delta H$ )

If an enthalpy change occurs then energy is transferred between **system** and **surroundings**. The system is the chemicals and the surroundings is everything outside the chemicals.

### Definition

Enthalpy change is the amount of heat energy taken in or given out during any change in a system provided the pressure is constant

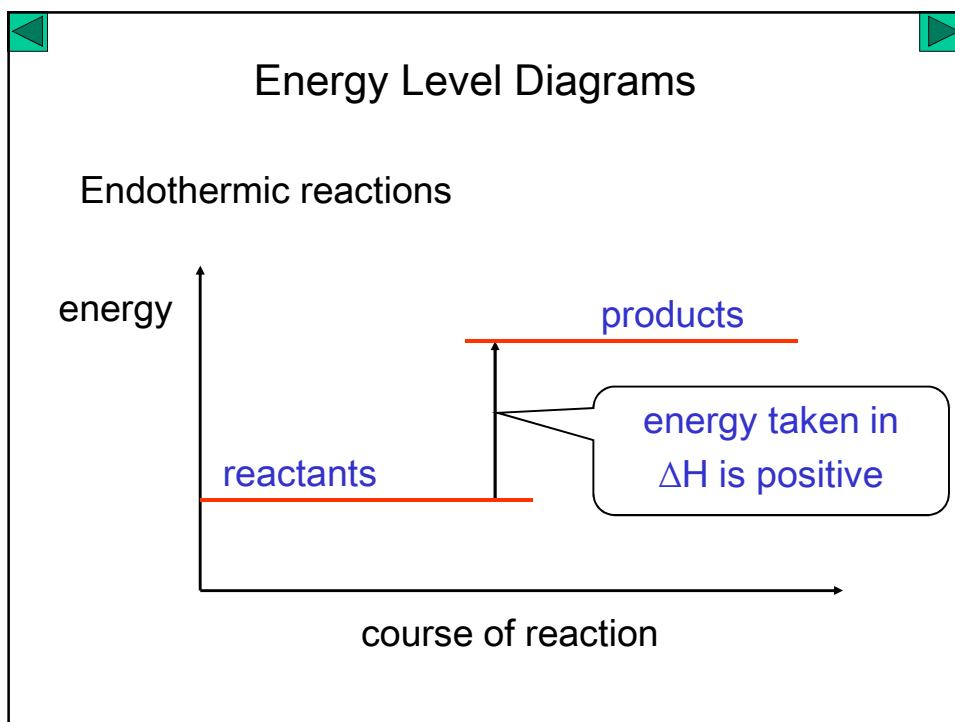


### Energy Levels

Exothermic reactions

- In an exothermic change energy is transferred from the system (chemicals) to the surroundings.
- The products have less energy than the reactants

Combustion and neutralisation are exothermic



### Energy Level Diagrams

Endothermic reactions

- Energy is taken in
- The products have more energy than the reactants

The energy is taken in from the surroundings

### Summary Table

Exothermic reactions	Endothermic reactions
Energy is given out to the surroundings	Energy is taken in from the surroundings
$\Delta H$ is negative	$\Delta H$ is positive
Products have less energy than reactants	Products have more energy than reactants

### Definitions of enthalpy change

Enthalpy changes are normally quoted at standard conditions.

Standard conditions are :

100kPa pressure

298 K (room temperature or 25°C)

Solutions at 1mol dm<sup>-3</sup>

all substances should have their normal state at 298K

When an enthalpy change is measured at standard conditions the symbol  $\ominus$  is used

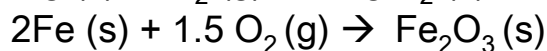
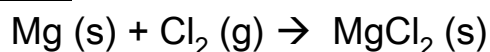
Eg  $\Delta H^\ominus$

### Standard enthalpy change of formation

The standard enthalpy change of formation of a compound is the energy transferred when 1 mole of the compound is formed from its elements under standard conditions (298K and 100kPa), all reactants and products being in their standard states

Symbol  $\Delta H_f^\ominus$

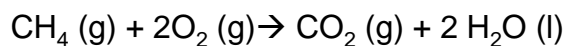
### Equations representing enthalpy change of formation



### Standard enthalpy change of Combustion

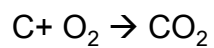
The standard enthalpy of combustion of a substance is defined as the enthalpy change that occurs when one mole of a substance is combusted completely under standard conditions. (298K and 100kPa), all reactants and products being in their standard states

Symbol  $\Delta H_c^\ominus$

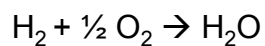


Incomplete combustion will lead to soot (carbon), carbon monoxide and water. It will be less exothermic than complete combustion.

Is this reaction a  $\Delta H_c$  or  $\Delta H_f$ ?



It is the  $\Delta H_c$  of C and the  $\Delta H_f$  of  $\text{CO}_2$



It is the  $\Delta H_c$  of  $\text{H}_2$  and the  $\Delta H_f$  of  $\text{H}_2\text{O}$

You need to be aware these are the same as there are times when they are used to confuse