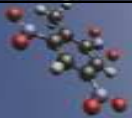


Thermochemistry - Introduction

Enthalpy (H)
Exothermic Reactions
Endothermic Reactions
Reaction Profile Diagrams
Using ΔH

Author: J R Reid



Enthalpy

- During a chemical reactions bonds are broken and/or made. When this occurs we can gain or lose chemical potential energy. If we lose chemical potential energy then it must go somewhere because energy is never created or destroyed, it just changes form. In the case of chemical potential energy it transforms into heat energy.
- The chemical potential energy of a chemical can also be called Enthalpy.
- The enthalpy of a chemical is measured in kilojoules per mole (kJmol^{-1}).
- Atoms have the highest enthalpy. When bonds form the atom loses enthalpy (chemical potential energy).



Exothermic Reactions

- 'Exo' means out and 'thermic' means heat. So Exothermic means 'heat (coming) out'.
- In other words exothermic reactions are reactions where heat is made. For example a fire is an exothermic reaction.
- Exothermic reactions show that the reactants have lost chemical potential energy (enthalpy). This can also be expressed by saying they have a negative change in enthalpy ($-\Delta H$).
- Bond making reactions are exothermic - why?

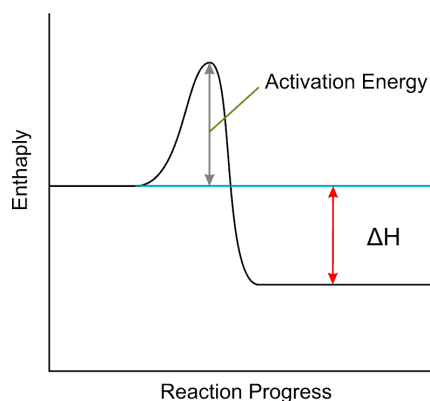


Endothermic Reactions

- 'Endo' means in, so endothermic means 'heat (going) in'.
- In other words endothermic reactions have a loss of heat. The reaction causes the chemicals to get colder.
- An endothermic reaction causes an increase in enthalpy because the heat energy has been transformed into chemical potential energy. This can also be stated by saying that there has been a positive change in enthalpy ($+\Delta H$).
- Bond breaking reactions are endothermic.

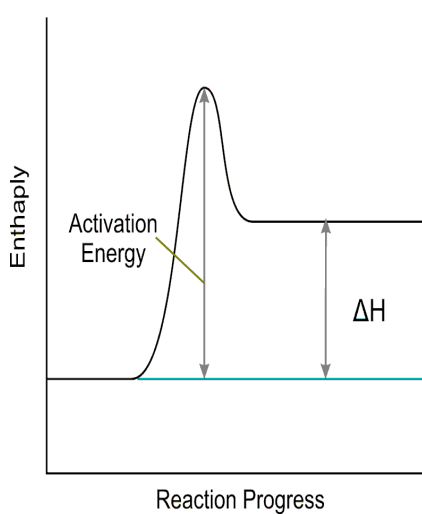
Reaction Profile Diagrams

- Reaction profile diagrams show the change in enthalpy over the progress of a reaction.
- The diagram on the right shows an exothermic reaction. We can see that at the end of the reaction the chemicals have less enthalpy than when they started.
- Note that there is a small energy lump to get over before the reaction can start. This is called an activation energy e.g. a match needs a bit of heat to get it started – this is the activation energy



Reaction Profile Diagrams II

- This diagram shows an endothermic reaction.
- Note that the products of the reaction have gained chemical potential energy (enthalpy).
- This reaction involves a high activation energy – a lot of energy is required to get the reaction started



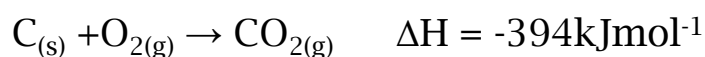


Using the ΔH Values

- Because ΔH tells us how much chemical potential energy has been lost and gained in a reaction, we can use it to calculate the heat lost or gained by a reaction.
- ΔH has the unit kJmol^{-1} . This means that if a reaction has a ΔH of 150kJmol^{-1} , then that reaction will gain 150kJ of enthalpy for every mole used. If I only used $\frac{1}{2}$ a mole I would only gain 75kJ of enthalpy. And because this enthalpy gain means a heat loss, I could also say that I lost 75kJ of heat when I used $\frac{1}{2}$ a mole of the substance.

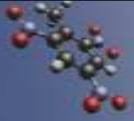


Using the ΔH Values - Example



- If I burnt 3g of carbon in oxygen, how much heat would be produced?

$$\begin{aligned}
 3\text{g} &= 0.25\text{moles (use } n = \frac{m}{M_r}) \\
 -394 \times 0.25 &= -98.5\text{kJ (enthalpy loss = heat gain)} \\
 &= 98.5\text{kJ (heat energy)}
 \end{aligned}$$



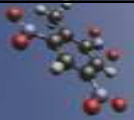
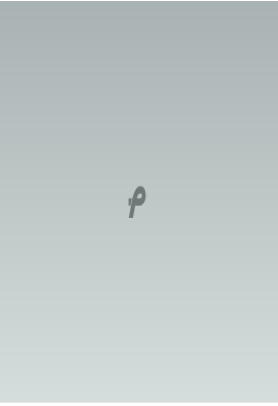
Exam Practice - 2005

Have a go at Questions:

- One
- Three

Can't see the exam paper below?

Go to the [NCEA](#) website and search for 90310




Exam Practice - 2006

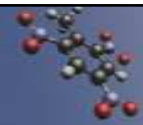
Have a go at Questions:

- Two
-

Can't see the exam paper below?

Go to the [NCEA](#) website and search for 90310





Exam Practice - 2007

Have a go at Questions:

- Four
- Six b) and c)

Can't see the exam paper below?

Go to the [NCEA](#) website and search for 90310

