5 Enthalpy changes – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
exothermic	放热			
endothermic	吸热			
enthalpy change	焓变			
activation energy	活化能			
bond energy	键能			

Recall

At IGCSE you learned that reactions can be **exothermic** 放热 (give out heat) or **endothermic** 吸热 (take in heat). Now we measure that energy and give it a symbol.

- The energy change at constant pressure is the **enthalpy change** 焓变, ΔH.
- We can read it off an energy diagram, or work it out from bonds.

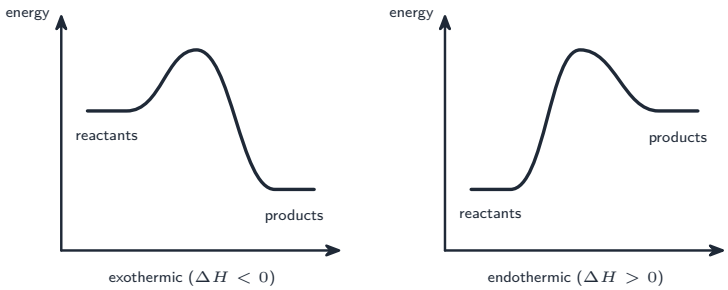
Nothing here is harder than IGCSE — it just adds the symbol ΔH and the bond method.

New ideas

Read these first, then do the Practice.

1 Exothermic and endothermic

- **exothermic** 放热 — gives out heat; products **lower** than reactants; ΔH is **negative**.
- **endothermic** 吸热 — takes in heat; products **higher** than reactants; ΔH is **positive**.



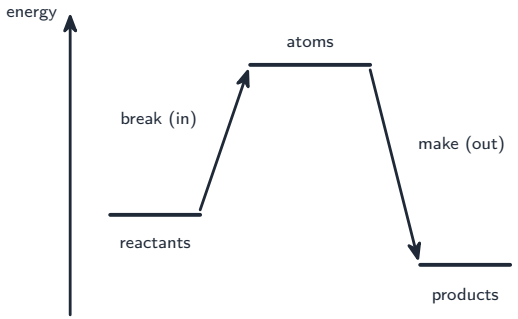
The height of the "hill" is the **activation energy** 活化能 — the least energy needed to start the reaction.

2 Energy from breaking and making bonds

- **breaking** a bond **takes in** energy.
- **making** a bond **gives out** energy.

$$\Delta H = \sum(\text{bonds broken}) - \sum(\text{bonds made})$$

The **bond energy** 键能 is the energy to break one mole of a bond (always positive).



Worked example. $H_2 + Cl_2 \rightarrow 2HCl$. Bond energies: H–H = 436, Cl–Cl = 242, H–Cl = 431.

$$\Delta H = (436 + 242) - (2 \times 431) = 678 - 862 = -184 \text{ kJ mol}^{-1}.$$

Watch out: use $\Delta H = \sum(\text{bonds broken}) - \sum(\text{bonds made})$ in that order. A *negative* answer means exothermic — more energy is released making bonds than is taken in

breaking them.

Practice

Try these in order.

5.1 State the sign of ΔH for (a) an exothermic, (b) an endothermic reaction. [2]

5.2 In an exothermic reaction, are the products higher or lower in energy than the reactants? [1]

5.3 What is meant by the *activation energy*? [1]

5.4 State whether (a) breaking a bond, (b) making a bond takes in or gives out energy. [2]

5.5 Use bond energies to find ΔH for $H_2 + Br_2 \rightarrow 2HBr$. Bond energies: H–H = 436, Br–Br = 193, H–Br = 366. [3]

5.6 Challenge. A reaction is found to have a negative ΔH. Explain what this tells you about the energy released in making bonds compared with the energy taken in breaking bonds. [2]