

Chemical Energetics

IGCSE Chemistry ▪ Topic 5

IGCSE Chemistry



Chemical Energetics

What we will cover

- 1 Exothermic vs endothermic
- 2 Enthalpy change ΔH
- 3 Activation energy
- 4 Reaction pathway diagrams
- 5 Bonds & energy

breaking
↓
takes in
bonds and energy

making
↑
gives out
bonds and energy

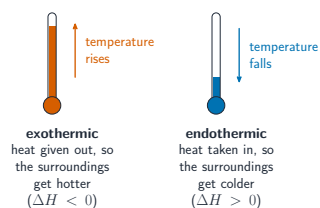
1

Direction of energy

Chemical Energetics

↳ Direction of energy

Exothermic vs endothermic

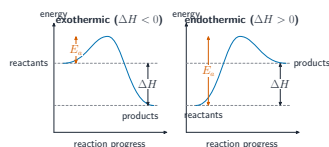


- An **exothermic reaction** 放热反应 gives out **thermal energy** 热能 to the **surroundings** 环境. So the temperature of the surroundings goes **up**.
- An **endothermic reaction** 吸热反应 takes in thermal energy from the surroundings. So the temperature of the surroundings goes **down**.

Chemical Energetics

↳ Direction of energy

Reaction pathway diagrams



- The line starts at the energy level of the **reactants** 反应物.
- It rises over a 'hill' – the height of this hill is the activation energy E_a .
- It then falls or rises to the energy level of the **products** 生成物.
- The gap between the reactant level and the product level is the enthalpy change ΔH .

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Bonds

Bonds and energy

bond breaking 断键
takes energy in – endothermic

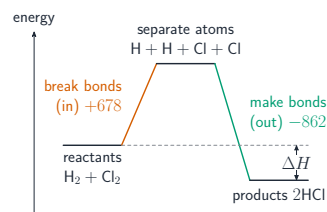
bond making 成键
gives energy out – exothermic

$\Delta H = (\text{energy to break bonds}) - (\text{energy released making bonds})$. More out than in $\Rightarrow$ exothermic.



Exothermic reactions release energy as heat

Worked example: $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$



net: $\Delta H = 678 - 862 = -184 \text{ kJ/mol}$ (exothermic)

Bond energies (kJ/mol)

broken: $\text{H-H} + \text{Cl-Cl} = 436 + 242 = 678$
made: $2 \times \text{H-Cl} = 862$
 $\Delta H = 678 - 862 = -184$
negative $\Rightarrow$ exothermic

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Recap

Topic 5 – key takeaways

1. Exo & endo

out warms ($\Delta H < 0$); in cools ($\Delta H > 0$)

2. Pathway

hill = E_a ; reactant-product gap = ΔH

3. Bonds

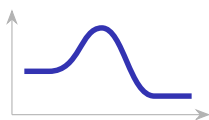
breaking takes in, making gives out

4. ΔH

break minus make energy

Check yourself

- What sign is ΔH for an exothermic reaction?
- What does the hill height represent?
- Is bond breaking endothermic or exothermic?
- If 678 kJ goes in and 862 kJ comes out, what is ΔH ?



Answers 1. negative 2. the activation energy E_a 3. endothermic 4. -184 kJ/mol (exothermic)