

5.1 Exothermic and endothermic reactions

Name: _____ Class: _____ Date: _____

Total: 8 marks

KEY WORDS bond energy 键能 • enthalpy change 焓变 • reactants 反应物 • reaction pathway diagram 反应进程图
• products 生成物

Objective

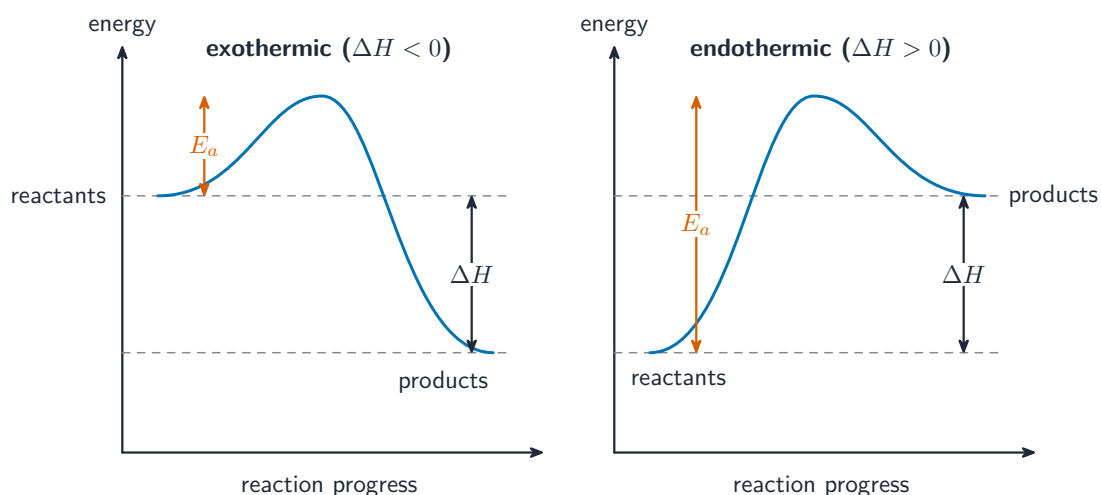
Build the skills to answer exam questions on **exothermic and endothermic reactions** 放热与吸热反应 — temperature changes, **enthalpy change** 焓变 ΔH , **reaction pathway diagrams** 反应进程图, and **bond energy** 键能 calculations.

You must be able to:

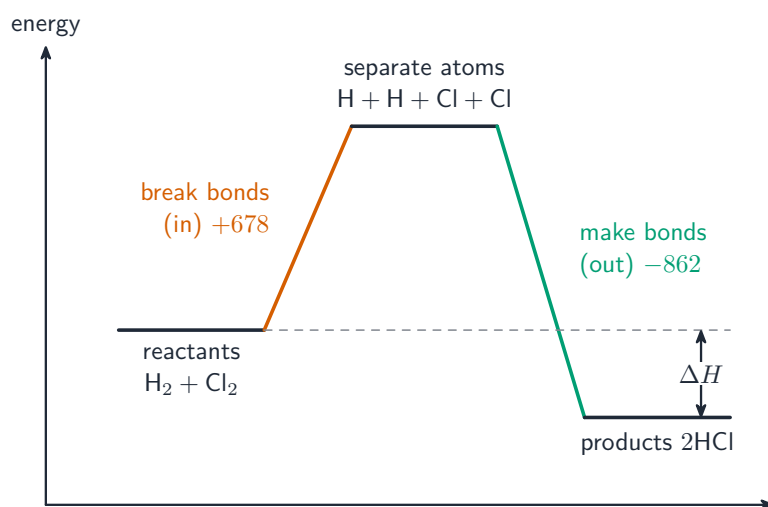
- classify reactions as exothermic ($\Delta H < 0$) or endothermic ($\Delta H > 0$)
- interpret a reaction pathway diagram (activation energy, ΔH)
- calculate ΔH from bond energies

1 Worked examples

■ Bond energy calculation



Exothermic: products lower ($\Delta H < 0$). Endothermic: products higher ($\Delta H > 0$)



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

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

$\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$: broken $436 + 242 = 678$; made $2 \times 431 = 862$; $\Delta H = 678 - 862 = -184 \text{ kJ/mol}$.

2 Practice

2.1 State the sign of ΔH for an exothermic reaction.

[1]

2.2 State whether bond breaking takes in or gives out energy.

[1]

3 Exam-style questions

3.1 During an endothermic reaction, the temperature of the surroundings: [1]

- **A** rises
 - **B** falls
 - **C** stays the same
 - **D** rises then falls
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3.2 Consider $\text{H}_2 + \text{F}_2 \rightarrow 2\text{HF}$. Bond energies (kJ/mol): $\text{H-H} = 436$, $\text{F-F} = 158$, $\text{H-F} = 568$.

(a) Calculate ΔH . [3]

(b) State whether the reaction is exothermic or endothermic. [1]

3.3 On a reaction pathway diagram, state what the height of the 'hill' above the reactants represents. [1]

Solutions

2.1 negative.

2.2 it takes in energy (endothermic).

3.1 B. An endothermic reaction takes in energy, so the surroundings cool down.

3.2 (a) bonds broken = $436 + 158 = 594$; bonds made = $2 \times 568 = 1136$; $\Delta H = 594 - 1136 = -542$ kJ/mol.

(b) exothermic (ΔH is negative).

3.3 the activation energy (the minimum energy needed for the particles to react).