

6.7 Bond Enthalpies

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS exothermic 放热 • endothermic 吸热

Objective

Build the skills to answer exam questions on **bond enthalpies**.

You must be able to:

- use $\Delta H \approx \Sigma(\text{bonds broken}) - \Sigma(\text{bonds formed})$
- calculate a reaction enthalpy from bond energies
- explain the sign from bond breaking vs forming

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ The bond-enthalpy method

$$\Delta H \approx \sum(\text{bond enthalpies of bonds broken}) - \sum(\text{bond enthalpies of bonds formed}).$$

Breaking bonds costs energy (+); forming bonds releases energy (−).

■ A worked calculation

For $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$: bonds broken = H-H (436) + Cl-Cl (242) = 678; bonds formed = $2 \times \text{H-Cl}$ ($2 \times 431 = 862$). So $\Delta H = 678 - 862 = -184$ kJ (exothermic).

■ The sign logic

If the bonds **formed** are stronger (release more) than those **broken**, ΔH is negative (exothermic). If breaking costs more than forming releases, it is endothermic.

■ An estimate, not exact

Bond enthalpies are **averages**, so this method gives an approximate ΔH — good for gases where all species have well-defined bonds.

2 Practice

Now apply the methods above.

2.1 Write the bond-enthalpy formula for ΔH . [1]

2.2 Breaking bonds — does it absorb or release energy? [1]

2.3 If bonds formed release 900 kJ and bonds broken cost 700 kJ, find ΔH . [2]

3 Exam-style questions

3.1 A reaction is exothermic when the bonds formed are [1]

A	B
C	D

- A** weaker than the bonds broken
- B** stronger than the bonds broken
- C** equal to the bonds broken
- D** all single bonds

3.2 For $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$: $\text{H-H} = 436$, $\text{Br-Br} = 193$, $\text{H-Br} = 366$ kJ/mol.

- (a) Find the total energy to break the reactant bonds. [1]
- (b) Find the total energy released forming the product bonds. [1]
- (c) Find ΔH and classify it. [2]

3.3 Explain why bond-enthalpy calculations give only an approximate ΔH . [2]