

5 Bonds and energy – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)
bond breaking	_____
bond making	_____
bond energy	_____

Recall

From Part 1 you know ΔH is the energy change. Where does that energy come from? It comes from **breaking** and **making** bonds during the reaction.

- Breaking bonds **takes in** energy.
- Making bonds **gives out** energy.

Nothing here is hard – it just adds one calculation.

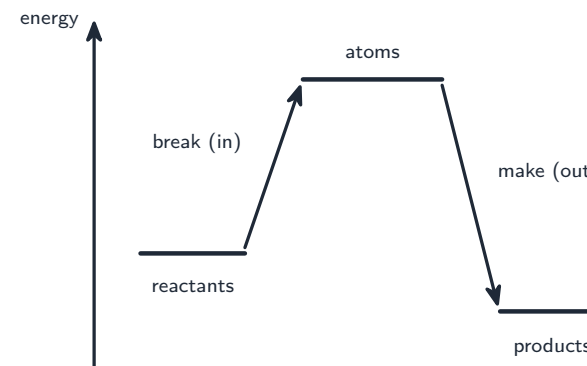
New ideas

Read these first, then do the Practice.

■ 1 Bonds and energy

A reaction breaks the bonds in the reactants and makes new bonds in the products:

- **bond breaking** takes in energy (endothermic step).
- **bond making** gives out energy (exothermic step).



■ 2 Calculating ΔH from bond energies

The **bond energy** is the energy to break one mole of a bond.

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

If more energy is given out making bonds than taken in breaking them, the reaction is **exothermic** (ΔH negative).

Worked example. $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$. Bond energies: $\text{H-H} = 436$, $\text{Cl-Cl} = 242$, $\text{H-Cl} = 431$. broken = $436 + 242 = 678$; made = $2 \times 431 = 862$; $\Delta H = 678 - 862 = -184$ kJ/mol (exothermic).

Watch out: bond **breaking** takes energy *in*; bond **making** gives energy *out*. Use $\Delta H = (\text{bonds broken}) - (\text{bonds made})$ – a **negative** answer means exothermic.

Practice

Try these in order.

5.1 Does breaking a bond take in or give out energy? [1]

5.2 Does making a bond take in or give out energy? [1]

5.3 Write the equation for ΔH in terms of bonds broken and bonds made. [1]

5.4 Use bond energies to find ΔH for $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$. Bond energies: $\text{H-H} = 436$, $\text{Br-Br} = 193$, $\text{H-Br} = 366$. [3]

5.5 Is the reaction in 5.4 exothermic or endothermic? [1]

5.6 Challenge. Use bond energies to find ΔH for $\text{H}_2 + \text{F}_2 \rightarrow 2\text{HF}$. Bond energies: $\text{H-H} = 436$, $\text{F-F} = 158$, $\text{H-F} = 568$. Is it exothermic? [3]