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.

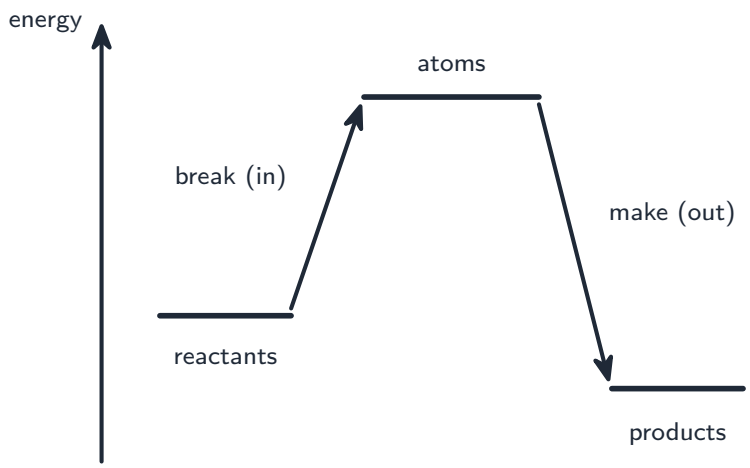
New ideas

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. $H_2 + Cl_2 \rightarrow 2HCl$. Bond energies: H–H = 436, Cl–Cl = 242, 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 $H_2 + Br_2 \rightarrow 2HBr$. Bond energies: H–H = 436, Br–Br = 193, 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 $H_2 + F_2 \rightarrow 2HF$. Bond energies: H–H = 436, F–F = 158, H–F = 568. Is it exothermic? [3]