Exercise walk-through

Exothermic and endothermic reactions ▪ 5.1

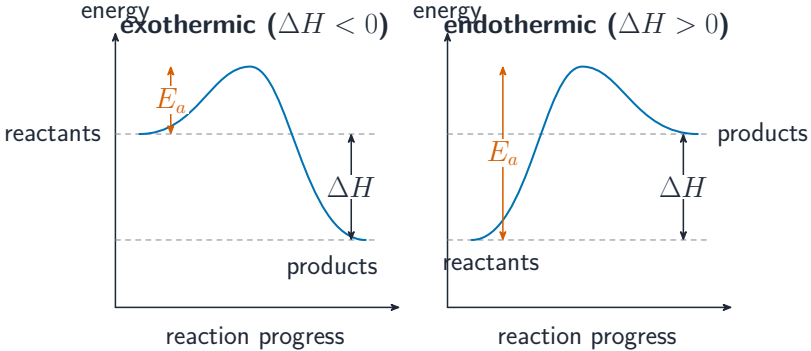
eXercise

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

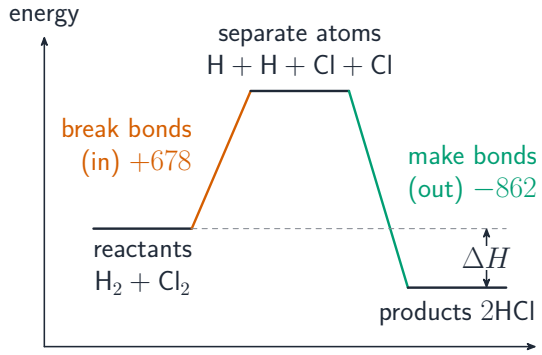
Method — Bond energy calculation

$H_2 + Cl_2 \rightarrow 2HCl$: broken $436 + 242 = 678$; made $2 \times 431 = 862$; $\Delta H = 678 - 862 = -184$ kJ/mol.



Exothermic and endothermic reaction pathway diagrams

Method — Bond energy calculation



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

Energy diagram for H + Cl → 2HCl

Practice 2.1 ▪ 1 mark

State the sign of ΔH for an exothermic reaction.

Solution 2.1

Method: Bond energy calculation

Worked steps

negative B1.

Practice 2.2 ▪ 1 mark

State whether bond breaking takes in or gives out energy.

Solution 2.2

Method: Bond energy calculation

Worked steps

it takes in energy (endothermic) B1.

Exam-style 3.1 ▪ 1 mark

During an endothermic reaction, the temperature of the surroundings:

A rises

B falls

C stays the same

D rises then falls

Solution 3.1

Method: Bond energy calculation

A rises

B falls ✓

C stays the same

D rises then falls

Worked steps

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

Exam-style 3.2 ▪ 3 marks

Consider $H_2 + F_2 \rightarrow 2HF$. Bond energies (kJ/mol): H–H $= 436$, F–F $= 158$, H–F $= 568$.

(a) Calculate ΔH.

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

Solution 3.2

Method: Bond energy calculation

Worked steps

(a) bonds broken $= 436 + 158 = 594$; bonds made $= 2 \times 568 = 1136$ M1 M1; $\Delta H = 594 - 1136 = -542$ kJ/mol A1.

(b) exothermic (ΔH is negative) B1.

Exam-style 3.3 ▪ 1 mark

On a reaction pathway diagram, state what the height of the ‘hill’ above the reactants represents.

Solution 3.3

Method: Bond energy calculation

Worked steps

the activation energy (the minimum energy needed for the particles to react) B1.