

Exercise walk-through

3.1

Energetics

Pearson Edexcel · International GCSE · Chemistry

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The method

Method — $Q = mc\Delta T$, then per mole

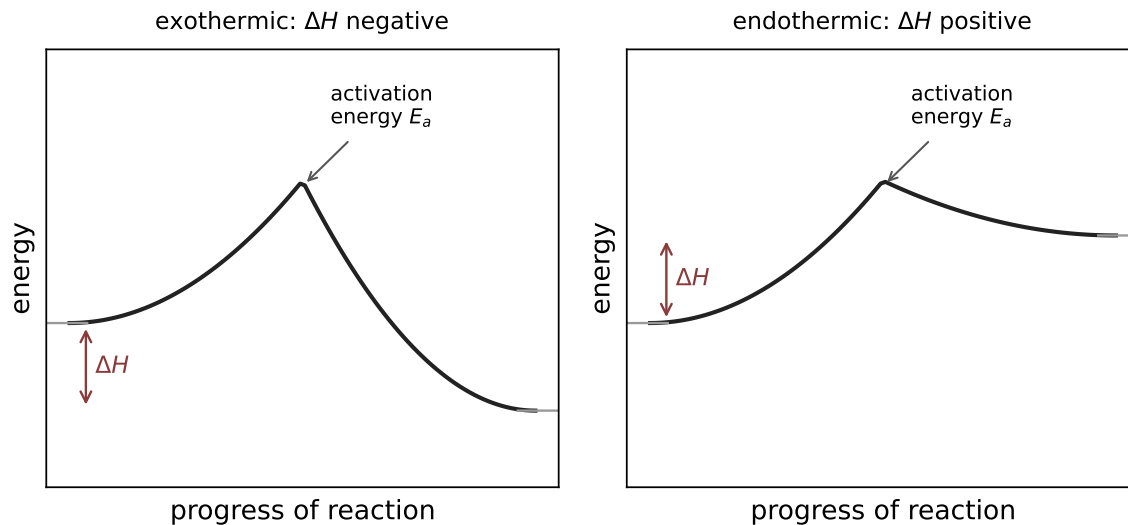
Worked check. 25.0 g of solution warms 14.6 °C in a displacement reaction:

$Q = 25.0 \times 4.2 \times 14.6 = 1533 \text{ J}$. If 0.0050 mol reacted:

$\Delta H = -1533/0.0050 = -307\,000 \text{ J mol}^{-1} \approx -307 \text{ kJ mol}^{-1}$ – negative, because the mixture warmed.

Method — $Q = mc\Delta T$, then per mole

Worked check.



Energy profiles for exothermic and endothermic reactions with activation energy marked.

Exercises 2.1·2.3

2.1 Classify as exothermic or endothermic: burning methane; decomposing limestone; acid + alkali. [3]

2.2 200 g of water warms 12 °C. Calculate Q in kJ. [2]

2.3 0.020 mol of fuel releases 8.4 kJ. Calculate ΔH in kJ/mol with its sign. [2]

Exercises 2.1·2.3

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2.1 Exothermic; endothermic; exothermic.

2.2 200 g of water warms 12 °C. Calculate Q in kJ. [2]

2.2 $Q = 200 \times 4.2 \times 12 = 10\,080 \text{ J} = 10.1 \text{ kJ}$.

2.3 0.020 mol of fuel releases 8.4 kJ. Calculate ΔH in kJ/mol with its sign. [2]

2.3 $\Delta H = -8.4/0.020 = -420 \text{ kJ mol}^{-1}$.

Exercises 2.4·3.1

2.4 (C) On an energy profile, what do the height of the hump and the gap between the levels represent? [2]

2.5 (C) Which process is exothermic: breaking bonds or making bonds? [1]

3.1 In a spirit-burner experiment 0.012 mol of ethanol heated 100 g of water from 21.0 °C to 49.0 °C. Calculate Q and the molar enthalpy of combustion, and give one reason the true value is more negative. [4]

Exercises 2.4·3.1

2.4 (C) On an energy profile, what do the height of the hump and the gap between the levels represent? [2]

2.4 (C) The hump's height above reactants is the activation energy E_a ; the gap between reactant and product levels is ΔH .

2.5 (C) Which process is exothermic: breaking bonds or making bonds? [1]

2.5 (C) Making bonds.

3.1 In a spirit-burner experiment 0.012 mol of ethanol heated 100 g of water from 21.0 °C to 49.0 °C. Calculate Q and the molar enthalpy of combustion, and give one reason the true value is more negative. [4]

3.1 $\Delta T = 28.0\text{ °C}$; $Q = 100 \times 4.2 \times 28.0 = 11\,760\text{ J}$; $\Delta H = -11.76/0.012 = -980\text{ kJ mol}^{-1}$. True value more negative because heat escaped to the air and the beaker (insulate with a lid and draught shield).

Exercises 3.2·3.3

3.2 (C) Use bond energies to calculate ΔH for $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ (H–H 436, Cl–Cl 242, H–Cl 431 kJ/mol), stating the reaction type. [4]

3.3 A student's temperature-rise results are lower than the data book's every time. Give two improvements to the apparatus. [2]

Exercises 3.2·3.3

3.2 (C) Use bond energies to calculate ΔH for $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ (H–H 436, Cl–Cl 242, H–Cl 431 kJ/mol), stating the reaction type. [4]

3.2 (C) Broken: $436 + 242 = 678$; formed: $2 \times 431 = 862$; $\Delta H = 678 - 862 = -184$ kJ/mol – exothermic.

3.3 A student's temperature-rise results are lower than the data book's every time. Give two improvements to the apparatus. [2]

3.3 Any two: insulate the cup/use a lid; use a draught shield around the burner; measure the flame closer under the container; better thermometer resolution.