Exercise walk-through

Introduction to Enthalpy of Reaction ▪ 6.6

eXercise

You must be able to

- interpret ΔH_{rxn} (heat at constant pressure)
- scale ΔH with the amount reacted
- use the sign to classify a reaction

Method — Enthalpy of reaction

ΔH_{rxn} is the heat exchanged at constant pressure for the amounts in the balanced equation. A **negative** value is exothermic, **positive** is endothermic.

Method — Scaling with amount

ΔH is proportional to the moles reacted. If a reaction releases 200 kJ per mole, then 2 mol releases 400 kJ; 0.5 mol releases 100 kJ.

Method — Per the equation as written

The value belongs to the equation as written. Doubling all coefficients doubles ΔH; reversing the equation flips the sign.

Method — A worked scaling

If $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ has $\Delta H = -890$ kJ, burning 0.25 mol CH_4 releases $0.25 \times 890 = 222.5$ kJ.

Practice 2.1 ▪ 1 mark

What does a negative ΔH_{rxn} mean?

Solution 2.1

Method: Enthalpy of reaction

Worked steps

The reaction is exothermic (releases heat) **B1**.

Practice 2.2 ▪ 1 mark

A reaction releases 150 kJ/mol. How much for 3 mol?

Solution 2.2

Method: Scaling with amount

Worked steps

450 kJ **B1**.

Practice 2.3 ▪ 1 mark

How does reversing a reaction change ΔH?

Solution 2.3

Worked steps

It flips the sign **B1**.

Exam-style 3.1 ▪ 1 mark

If a reaction as written has $\Delta H = -100$ kJ, then doubling all coefficients gives

A -50 kJ

B -100 kJ

C -200 kJ

D $+100$ kJ

Solution 3.1

A -50 kJ

B -100 kJ

C -200 kJ ✓

D $+100$ kJ

Worked steps

C — ΔH scales with the coefficients, so it doubles to -200 kJ.

Exam-style 3.2 ▪ 1 mark

The reaction $N_2 + 3H_2 \rightarrow 2NH_3$ has $\Delta H = -92$ kJ.
(a) State whether it is exo- or endothermic.
(b) Find the heat released when 1.0 mol NH_3 forms.

Solution 3.2

Method: Enthalpy of reaction

Worked steps

(a) Exothermic **B1**. (b) ΔH is -92 kJ per 2 mol NH_3, so per 1 mol it is -46 kJ **M1** **A1**.

Exam-style 3.3 ▪ 3 marks

Combustion of methane releases 890 kJ/mol. Find the heat released by burning 8.0 g of methane ($M = 16$ g/mol).

Solution 3.3

Method: A worked scaling

Worked steps

$8.0\text{ g} \div 16 = 0.50\text{ mol}$ **M1**; heat $= 0.50 \times 890$ **M1** $= 445\text{ kJ}$ **A1**.