

6.6 Introduction to Enthalpy of Reaction

Name: _____ Class: _____ Date: _____ **Total: 10 marks****KEY WORDS** enthalpy of reaction 反应焓 • heat 热量 • exothermic 放热 • endothermic 吸热

Objective

Build the skills to answer exam questions on the **enthalpy of reaction**.**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

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ 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.

■ 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.

■ Per the equation as written

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

■ A worked scaling

If $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ has $\Delta H = -890$ kJ, burning 0.25 mol CH_4 releases $0.25 \times 890 = 222.5$ kJ.

2 Practice

Now apply the methods above.

2.1 What does a negative ΔH_{rxn} mean? [1]**2.2** A reaction releases 150 kJ/mol. How much for 3 mol? [1]**2.3** How does reversing a reaction change ΔH ? [1]

3 Exam-style questions

3.1 If a reaction as written has $\Delta H = -100$ kJ, then doubling all coefficients gives [1]

- **A** -50 kJ
- **B** -100 kJ
- **C** -200 kJ
- **D** $+100$ kJ

3.2 The reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ has $\Delta H = -92$ kJ.

(a) State whether it is exo- or endothermic. [1]

(b) Find the heat released when 1.0 mol NH_3 forms. [2]**3.3** Combustion of methane releases 890 kJ/mol. Find the heat released by burning 8.0 g of methane ($M = 16$ g/mol). [3]

Solutions

2.1 The reaction is exothermic (releases heat).

2.2 450 kJ.

2.3 It flips the sign.

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

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

3.3 $8.0 \text{ g} \div 16 = 0.50 \text{ mol}$; heat $= 0.50 \times 890 = 445$ kJ.