

Heat changes, energy cycles and bond enthalpies

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers enthalpy definitions, calorimetry, Hess's law and bond enthalpies. Show your working, give the sign and unit of every ΔH , and use the mark values as a guide to how much detail is needed.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB R1.1-R1.2

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

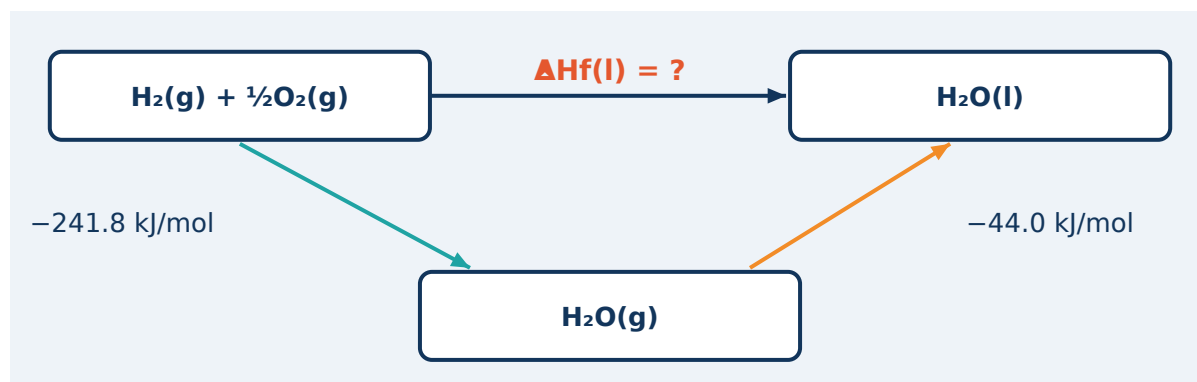
Question 1 Combustion enthalpy (2 marks)

- Define the standard enthalpy of combustion. (1 mark)
- Write the equation for the standard enthalpy of combustion of propane, $C_3H_8(g)$. (1 mark)

Question 2 Dissolving ammonium nitrate (3 marks)

4.00 g of ammonium nitrate ($M = 80.0 \text{ g/mol}$) dissolves in 100 g of water and the temperature falls by 3.1°C . Calculate ΔH of solution in kJ/mol ($c = 4.18 \text{ J/(g K)}$).

Question 3 Energy cycle (3 marks)



Energy cycle for the formation of liquid water.

- State Hess's law. (1 mark)
- Use the cycle to calculate the enthalpy of formation of liquid water. (2 marks)

Question 4 Bromine addition (3 marks)

Use the bond enthalpies C=C 612, Br-Br 193, C-C 347, C-Br 285 (all kJ/mol) to calculate ΔH for $\text{C}_2\text{H}_4 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_4\text{Br}_2$.

Question 5 Why only an estimate (2 marks)

Explain why ΔH calculated from mean bond enthalpies differs slightly from values found by calorimetry.

Question 6 Decomposition of calcium carbonate (3 marks)

ΔH_f (kJ/mol): $\text{CaCO}_3(\text{s}) -1207.0$, $\text{CaO}(\text{s}) -634.9$, $\text{CO}_2(\text{g}) -393.5$. Calculate ΔH for $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ and state whether it is exothermic.

Question 7 Per mole (2 marks)

A reaction releases 5.6 kJ of heat when 0.020 mol of reactant reacts. Calculate ΔH in kJ/mol.

Question 8 Experiment versus data book (2 marks)

A student finds ΔH_c of a fuel to be -1450 kJ/mol but the data book gives -1780 kJ/mol. Explain the difference.