AP CHEMISTRY • EXERCISE SHEET

6.8 Enthalpy of Formation

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

Objective

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

You must be able to:

- use standard enthalpies of formation ΔH_f°
- apply $\Delta H_{\text{rxn}} = \Sigma\Delta H_f(\text{products}) - \Sigma\Delta H_f(\text{reactants})$
- know that ΔH_f° of an element is zero

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.

Standard enthalpy of formation

ΔH_f° is the enthalpy change to make **1 mole** of a compound from its elements in their standard states. For an **element** in its standard state, $\Delta H_f^\circ = 0$.

The formula

$$\Delta H_{\text{rxn}}^\circ = \sum \Delta H_f^\circ(\text{products}) - \sum \Delta H_f^\circ(\text{reactants}),$$

weighting each by its coefficient.

A worked calculation

For $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, with ΔH_f: $CH_4 = -75$, $CO_2 = -394$, $H_2O = -286$, $O_2 = 0$:

$$\Delta H = [(-394) + 2(-286)] - [(-75) + 0] = -966 + 75 = -891 \text{ kJ}.$$

Don't forget coefficients

Multiply each ΔH_f by the species' coefficient before summing —a common lost mark.

2 Practice

Now apply the methods above.

2.1 What is ΔH_f° of an element in its standard state? [1]

2.2 Write the formula for ΔH_{rxn} from formation enthalpies. [1]

2.3 For products summing to -500 and reactants to -200 kJ, find ΔH_{rxn}. [2]

3 Exam-style questions

3.1 The standard enthalpy of formation of $O_2(g)$ is [1]

- **A** -286 kJ/mol
- **B** 0
- **C** $+286$ kJ/mol
- **D** unknown

3.2 For $2H_2 + O_2 \rightarrow 2H_2O$, $\Delta H_f(H_2O) = -286$ kJ/mol.

(a) State ΔH_f of H_2 and O_2. [1]

(b) Find ΔH_{rxn}. [3]

3.3 For $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$, with ΔH_f: $C_2H_4 = +52$, $CO_2 = -394$, $H_2O = -286$, find ΔH_{rxn}. [4]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **6.8 Enthalpy of Formation** lesson on the **Learn** page;
- read the **Enthalpy of Formation** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 Zero.

2.2 $\Delta H_{\text{rxn}} = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$.

2.3 $-500 - (-200) = -300$ kJ.

3.1 B —an element in its standard state has $\Delta H_f^\circ = 0$.

3.2 (a) Both 0 (elements). (b) $\Delta H = 2(-286) - [2(0) + 0] = -572$ kJ.

3.3 products $= 2(-394) + 2(-286) = -1360$; reactants $= 52 + 3(0) = 52$; $\Delta H = -1360 - 52 = -1412$ kJ.