Answer on Question #49936, Chemistry, Inorganic Chemistry

Question 1:

A compound A reacts according to the following hypothetical equation and has a molecular weight of 48.36 g/mol.

3 A (s) +B (aq) —> 2 C (aq) ΔH° = ?

A sample of **A**, weighing 0.152 g reacts in a flask containing 250.00 g of water and the water temperature increases from 24.85 °C to a temperature of 26.26 °C. Calculate ΔH° for the reaction as written in the equation.

Answer: -1408 kJ

Question 2:

For which of the following reactions is $\Delta H° = \Delta H°_f$, the heat of formation?

i. C (s) + 2 F_2(g) → CF_4 (g) ΔH° = – 221.0 kJ

ii. H(g) + Br (g) → HBr (g) ΔH° = –366.2 kJ

iii. 2 C(s) + H_2(g) + 3 Cl_2(g) → 2 $CHCl_3$ (g) ΔH° = –268.2

Could you also explain exactly what Delta H means.

Solution:

Delta H (ΔH) is defined as the amount of heat evolved or absorbed in the reacting species.

Question 1:

Hearing of water:

The amount of heat spent on heating of water (**Q**) equal to the amount of heat that was allocated in the chemical reaction (**ΔH**):

$$\Delta H = Q = c_{H_2O} \times m_{H_2O} \times (T_2 - T_1)$$

c_{H_2O} is a constant 4.187×10^3 J/(kg×K). So:

$$\Delta H = 4.187 \times 10^3 \times 0.25 \times (299.41 - 298) = 1.476 \times 10^3 = 1.476\ kJ$$

$$v = \frac{\Delta H}{\Delta H^0}$$

$$\Delta H^0 = \frac{\Delta H}{v}$$

$$v = \frac{v_a}{3} = \frac{m_a}{M_r \times 3}$$

$$\Delta H^0 = \frac{\Delta H \times M_r \times 3}{m_a} = \frac{1.476 \times 48.36 \times 3}{0.152} = 1408\ {}^{kJ}/_{mol}$$

$$\Delta H^0 = \sum \Delta H_f^0\ (products) - \sum \Delta H_f^0\ (reagents)$$

ΔH_f^0 is the standard enthalpy of formation or standard heat of formation of a compound is the change of enthalpy from the formation of 1 mole of the compound from its constituent elements, with all substances in their standard states at 1 atmosphere (1 atm or 101.3 kPa).

If the heat is produced, enthalpy change (ΔH^0) would be negative ($\Delta H^0<0$)

Answer:

-1408 kJ

Question 2:

The standard enthalpy of formation or standard heat of formation of a compound is the change of enthalpy from the formation of 1 mole of the compound from its constituent elements, with all substances in their standard states at 1 atmosphere (1 atm or 101.3 kPa).

Standard states are as follows:

- For a gas: the standard state is a pressure of exactly 1 atm
- For a solute present in an ideal solution: a concentration of exactly 1 M at a pressure of 1 atm

- For a pure substance or a solvent in a condensed state (a liquid or a solid): the standard state is the pure liquid or solid under a pressure of 1 atm

For the reaction **iii,** it's not the heat of formation because it's not formed one mole of a substance, and chloroform ($CHCl_3$) under normal conditions is a liquid but not a gas.
For the reaction **ii,** it's not the heat of formation because all substances aren't in their standard states at 1 atmosphere; shoulb be H_2 and Br_2.
For the reaction **i,** it's the heat of formation, all conditions are satisfied!
Answer:
i.C (s) + 2 F2(g) → CF4 (g) ΔH° = – 221.0 kJ ***ΔH° = ΔH°f***