Answer on Question #78413 – Chemistry – General Chemistry

Task:

What is the ΔH° of the equation: $4NH_3$ (g) + $5O_2$ (g) → 4NO (g) + $6H_2O$ (g)?

Given: ΔH_f^o (NH_3) = –45.9 kJ/mol, ΔH_f^o (NO) = 90.3 kJ/mol, ΔH_f^o (H_2O) = –242 kJ/mol.

A. ΔH° = 90.7 kJ;
B. ΔH° = –90.7 kJ;
C. ΔH° = 907 kJ;
D. ΔH° = –907 kJ;
E. None of the Above.

Solution:

Hess' Law:

"The enthalpy of a given chemical reaction is constant, regardless of the reaction happening in one step or many steps."

Let's use Hess' Law that can be presented like this:

$$\Delta H_r^o = \sum \Delta H_f^o (products) - \sum \Delta H_f^o (reactants)$$

Products: H_2O, NO. ΔH_f^o (H_2O) = –242 kJ/mol; ΔH_f^o (NO) = 90.3 kJ/mol.

Reactants: NH_3, O_2. ΔH_f^o (NH_3) = –45.9 kJ/mol, ΔH_f^o (O_2) = 0 kJ/mol.

Then,

$$\Delta H_r^o = 6 * \Delta H_f^o (H_2O) + 4 * \Delta H_f^o (NO) - 4 * \Delta H_f^o (NH_3) - 5 * \Delta H_f^o (O_2);$$
$$\Delta H_r^o = 6 * (-242\, kJ / mol) + 4 * 90.3\, kJ / mol - 4 * (-45.9\, kJ / mol) - 5 * 0\, kJ / mol;$$
$$\Delta H_r^o = -1452\, kJ / mol + 361.2\, kJ / mol - (-183.6\, kJ / mol) = -907.2\, kJ / mol;$$
$$\Delta H_r^o = -907.2\, kJ / mol.$$

Answer: D. ΔH° = –907 kJ. The ΔH° of the equation is -907.2 kJ/mol.