## Answer on the question #56034 - Chemistry - Physical Chemistry

**Question:**

At 1000 K, from the data :
N2 (g) + 3H2 (g) ----> 2NH3 (g).....H = -86.2 kJ/mol
Cp/R ratios of N2, H2 and NH3 are 3.5, 3.5 and 4 respectively. Heat of formation of NH3 at 300 K is?

**Solution:**

N2 (g) + 3H2 (g) ----> 2NH3 (g).....H = -86.2 kJ/mol

The enthalpy of the reaction at 300 K can be calculated, using Kirchhoffs' law:

$$\Delta H^{300\,K} = \Delta H^{1000\,K} + \int_{1000}^{300} \Delta c_p dT$$

where $\Delta c_p$ is the difference between the heat capacities of the products and reactants, taking into account the stochimetry of reaction:

$$\Delta c_p = 2c_p(NH3) - 3c_p(H2) - c_p(N2) = \frac{1}{R}(2 * 4 - 3 * 3.5 - 3.5) = -\frac{6}{R}$$

Then, the enthalpy of reaction at 300 K is:

$$\Delta H^{300\,K} = -86.2\ kJ/mol + \left(-\frac{6}{R}\right) * (300 - 1000) = 419\ kJ/mol$$

By definition, the enthalpy of formation of NH3 is the enthalpy of reaction of formation of 1 mole of NH3 from simple substances. Then, the value $\Delta H^{300\,K}$ should be divided by 2:

$$\Delta H_f^{300\,K} = \frac{\Delta H^{300\,K}}{2} = \frac{419}{2} = 210\ \ kJ/mol$$

**Answer:** 210 kJ/mol