Answer on the question #47842, Chemistry, Physical Chemistry

Question:

At 298 K the standard enthalpy of combustion of solid L-valine (C5H11NO2 (s)) to give CO2 (g), H2O (liq) and N2 (g) is ΔcombH° = –2911 kJ/mol. Calculate ΔrxH° and ΔrxU° at 298 K for the following reaction.

C5H11NO2 (s) + HCHO (g) + 4 H2 (g) → 3 C2H5OH (liq) + NH3 (g)

Solution:

According to the Hibbs law:

$$\Delta H_r = \sum_i^N \Delta H_{comb.i}$$

For the reaction

$$C_5H_{11}NO_2\ (s) + HCHO\ (g) + 4\ H_2\ (g) \rightarrow 3\ C_2H_5OH\ (liq) + NH_3\ (g)$$

$$\Delta H_r = \Delta H_{valine} + \Delta H_{HCHO} + 4\Delta H_{H2} - 3\Delta H_{C2H5OH} - \Delta H_{NH3}$$

$$\Delta H_r = -2911 - 570.78 - 285.83 * 4 + 1368.34 * 3 + 382.85 = -137 \frac{kJ}{mol}$$

The combustion enthalpy data on combustion enthalpies was provided by NIST chemistry webbook.

According to the thermodynamics laws:

$$\Delta H_r = \Delta U_r + p\Delta V$$

$$\Delta V = (1 - 4 - 1)V_m = -4 * 22.4 * 10^{-3}\ m^3/mol$$

$$\Delta U_r == \Delta H_r - p\Delta V = -137 + 101.325 * 4 * 22.4 * 10^{-3} = -128 \frac{kJ}{mol}$$

Answer: $\Delta H_r = -137\ kJ/mol.\ \Delta U_r = -128\ kJ/mol.$