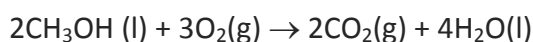


Answer on Question #81926, Chemistry/ General Chemistry

The standard enthalpies of formation, at 25.00 degrees celsius, of methanol (CH₄O (l)), water (H₂O (l)), and carbon dioxide (CO₂ (g)) are respectively -238.7 kJ / mol, - 285.8 kJ / mol, and - 393.5 kJ / mol. Calculate the change in the surrounding entropy (in J / K) when burning 15.4 g of methanol under a constant pressure of 1,000 atm at 25.00 degrees celsius (combustion is the reaction of a substance with oxygen molecular to produce water and carbon dioxide).

Solution



Calculate the standard enthalpy of this reaction

$$\Delta H_f^0 (\text{CH}_4\text{O}(\text{l})) = -238.7 \text{ kJ/mol}$$

$$\Delta H_f^0 (\text{CO}_2(\text{g})) = -393.5 \text{ kJ/mole.}$$

$$\Delta H_f^0 (\text{H}_2\text{O}(\text{l})) = -285.8 \text{ kJ/mol}$$

$$\Delta H_f^0 (\text{O}_2(\text{g})) = 0 \text{ kJ/mol}$$

$$\Delta H_{rxn}^0 = \sum H_f^0(\text{products}) - \sum H_f^0(\text{reactants})$$

$$\begin{aligned} \Delta H_{rxn}^0 &= [2 \text{ mol} \times H_f^0(\text{CO}_2(\text{g})) + 4 \text{ mol} \times H_f^0(\text{H}_2\text{O}(\text{l}))] \\ &\quad - [2 \text{ mol} \times H_f^0(\text{CH}_4\text{O}(\text{l})) + 3 \text{ mol} \times H_f^0(\text{O}_2(\text{g}))] \\ &= \left[2 \text{ mol} \times \left(-393.5 \frac{\text{kJ}}{\text{mol}} \right) + 4 \text{ mol} \times \left(-285.8 \frac{\text{kJ}}{\text{mol}} \right) \right] \\ &\quad - \left[2 \text{ mol} \times \left(-238.7 \frac{\text{kJ}}{\text{mol}} \right) + 1 \text{ mol} \times \left(0 \frac{\text{kJ}}{\text{mol}} \right) \right] = -1452.8 \text{ kJ} \end{aligned}$$

Calculate the standard enthalpy of this reaction when 15.4 g of methanol is burned:

$$n = m/M$$

$$M(\text{CH}_4\text{O}) = 32 \text{ g/mol}$$

$$n(\text{CH}_4\text{O}) = \frac{15.4 \text{ g}}{32 \frac{\text{g}}{\text{mol}}} = 0.48 \text{ mol}$$

Solve the proportion:

$$\text{When 2 mol of methanol is burned } \Delta H_{rxn}^0 = -1452.8 \text{ kJ}$$

$$\text{When 0.48 mol of methanol is burned } \Delta H_{rxn}^0 = x \text{ kJ}$$

$$\frac{2}{0.48} = \frac{-1452.8}{x}$$

$$x = -348.7 \text{ kJ}$$

$$\Delta S_{\text{surroundings}} = -\frac{\Delta H}{T}$$

$$\Delta S_{\text{surroundings}} = -\frac{-348700 \text{ J}}{(273 + 25)\text{K}} = 1170 \frac{\text{J}}{\text{K}}$$

Answer: 1170 J/K

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