

Answer on Question #71689 - Chemistry - General Chemistry

Question:

Diethyl ether ($\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$) was one of the first chemicals used as an anesthetic. At 34.6°C , diethyl ether has a vapor pressure of 760. torr, and at 15.7°C , it has a vapor pressure of 369 torr.

What is the ΔH of vaporization for diethyl ether?

ΔH of vaporization = kJ/mol

Solution:

To find the heat of evaporation of a substance, one can use the Claus-Clapeyron equation:

$$\ln \frac{P_1}{P_2} = \frac{\Delta H_{\text{vap}}}{R} \cdot \left(\frac{1}{T_2} - \frac{1}{T_1} \right);$$

$$\Delta H_{\text{vap}} = \frac{\ln \frac{P_1}{P_2} \cdot R}{\left(\frac{1}{T_2} - \frac{1}{T_1} \right)}$$

$$P_1 = 760 \text{ torr} = 101325 \text{ Pa};$$

$$P_2 = 369 \text{ torr} = 49196 \text{ Pa};$$

$$T_1 = 34.6^\circ\text{C} = 307.75 \text{ K};$$

$$T_2 = 15.7^\circ\text{C} = 288.85 \text{ K}.$$

$$\Delta H_{\text{vap}} = \frac{\ln\left(\frac{101325}{49196}\right) \cdot 8.314}{\left(\frac{1}{288.85} - \frac{1}{307.75}\right)} = \frac{6.007038}{0.000213} = 28253.29 \frac{\text{J}}{\text{mol}} = 28.253 \frac{\text{kJ}}{\text{mol}}.$$

Answer:

$$\Delta H_{\text{vap}} = 28.253 \text{ kJ/mol}.$$

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