Answer on the Question #63720, Chemistry / General chemistry

Chloroform has a normal boiling point of 61.7°C and has a heat of vaporization of 37.4 kJ/mol. What is its vapor pressure at 36.2°C .

Solution:

By Clausius-Clapeyron equation:

$$\frac{dp}{dt} = \frac{\Delta_{vap}H}{T(V_{vap} - V_{liq})}$$

$$V_{vap} = \frac{RT}{P_{vap}}; V_{liq} = \frac{\mu}{\rho};$$

If we put the previous 2 equations to first:

$$\frac{dp}{dt} = \frac{\Delta_{vap}H \cdot p}{RT^2}$$

or

$$\frac{dp}{p} = \frac{\Delta_{vap}H}{R}\frac{dT}{T^2}$$

After integration we will get:

$$\ln\frac{p}{p_{vap}} = \frac{\Delta_{vap}H(T_2 - T_1)}{RT_1T_2}$$

Take an exponent:

$$\frac{p}{p_{vap}} = exp\left(\frac{\Delta_{vap}H(T_2 - T_1)}{RT_1T_2}\right)$$

The vapor pressure of chloroform:

$$p_{vap} = \frac{p}{exp\left(\frac{\Delta_{vap}H(T_2 - T_1)}{RT_1T_2}\right)} = \frac{101325Pa}{\exp(\frac{37.4 \cdot 1000\frac{J}{mol}(334.7K - 309.2K)}{8.314\frac{J}{mol \cdot K} \cdot 309.2K \cdot 334.7K})} = 33.44\ kPa$$

Answer: the vapor pressure of chloroform at 36.2 °C equal to 33.44 kPa.