Answer on Question # 73374 - Chemistry - General Chemistry

The vapor pressure of liquid aluminum is 400 mm Hg at 2.59×10^3 K. Assuming that its molar heat of vaporization is constant at 252 kJ/mol, the vapor pressure of liquid Al is mm Hg at a temperature of 2.62×10^3 K.

Solution

The Clausius-Clapeyron equation gives the variation of vapor pressure with temperature, assuming the value of the heat of vaporization to be constant over the temperature range in question. The two-point form of this equation is:

$\ln(p_1/p_2)= (-\Delta H_{vap}/R)(1/T_1-1/T_2)$,

where p_1 and p_2 are the vapor pressures of the substance at the Kelvin temperatures T1 and T2, respectively, ΔH_{vap} is the molar heat of vaporization of the substance, and R is the ideal gas constant.

Using the value of $8.314\cdot10^{-3}$ kJ/(mol·K) for R and substituting along with other givens into the above equation:

$\ln(p_1/400\text{ mm Hg})= [-252\text{ kJ/mol }/8.314\cdot10^{-3}\text{ kJ/(mol·K)}][1/(2.62\times10^3\text{ K})-1/(2.59\times10^3\text{ K})]$,

solving the equation for the unknown gives p_1 = 457 mm Hg.

Answer: 457 mm Hg.