

<물리화학 Homework #5>

1. Derive the equations:

$$\frac{H^R}{RT} = -T \int_0^P \left(\frac{\partial Z}{\partial T} \right)_p \frac{dP}{P}, \quad \frac{S^R}{R} = -T \int_0^P \left(\frac{\partial Z}{\partial T} \right)_p \frac{dP}{P} - \int_0^P (Z - 1) \frac{dP}{P} \quad (\text{constant } T)$$

2. The enthalpy of vaporization of a certain liquid is found to be 14.4 kJ mol^{-1} at 180 K , its normal boiling point. The molar volumes of the liquid and the vapour at the boiling point are $115 \text{ cm}^3 \text{ mol}^{-1}$ and $14.5 \text{ dm}^3 \text{ mol}^{-1}$ respectively. (a) Estimate dp/dT from the Clapeyron equation and (b) the percentage error in its value if the Clausius-Clapeyron equation is used instead.
3. The enthalpy of fusion of mercury is $2.292 \text{ kJ mol}^{-1}$, its normal freezing point is 234.3 K with a change in molar volume of $0.517 \text{ cm}^3 \text{ mol}^{-1}$ on melting. At what temperature will the bottom of a column of mercury (density 13.6 g cm^{-3}) of height 10.0 m be expected to freeze?
4. The following table gives the mole fraction of methylbenzene (A) in liquid and gaseous mixtures with butanone at equilibrium at 303.15 K and the total pressure p . Take the vapour to be perfect and calculate the partial pressures of the two components. Plot them against their respective mole fractions in the liquid mixture and find the Henry's law constants for the two components.

x_A	0	0.0898	0.2476	0.3577	0.5194	0.6036
y_A	0	0.0410	0.1154	0.1762	0.2772	0.3393
p/kPa	36.066	34.121	30.900	28.626	25.239	23.402
x_A	0.7188	0.8019	0.9105	1		
y_A	0.4450	0.5435	0.7284	1		
p/kPa	20.6984	18.592	15.496	12.295		

5. Calculate the Gibbs energy, entropy, and enthalpy of mixing when $1.00 \text{ mol C}_6\text{H}_{14}$ (hexane) is mixed with $1.00 \text{ mol C}_7\text{H}_{16}$ (heptane) at 298 K ; treat the solution as ideal.
(필요한 식들은 다 유도하세요.)