<물리화학 Homework #5>

1. Derive a relational expression representing the Excess property corresponding to Gibbs energy, Enthalpy, Entropy, and Volume of a regular solution.

2. Predict the ideal solubility of lead in bismuth at 280℃ given that its melting point is 327℃ and its enthalpy of fusion is 5.2 kJ/mol.

3. The volume of an aqueous solution of NaCl at 25℃ was measured at a series of molalities b, and it was found that the volume fitted the expression $v = 1003 + 16.62x + 1.77x^{3/2} + 0.12x^2$ where $v = V/cm^3$, V is the volume of a solution formed from 1.000 Kg of water, and $x = b/b^{\ominus}$. Calculate the partial molar volume of the components in a solution of molality 0.100 mol/kg.

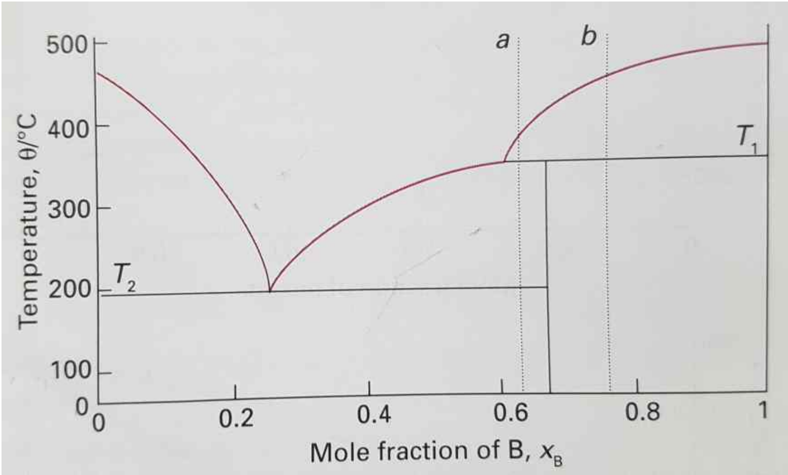
4. The vapour pressure of pure liquid A at 298 K is 68.8 kPa and that of pure liquid B is 82.1 kPa. These two compounds form ideal liquid and gaseous mixtures. Consider the equilibrium composition of a mixture in which the mole fraction of A in the vapour is 0.612. Calculate the total pressure of the vapour and the composition of the liquid mixture.

5. The excess Gibbs energy of solutions of methylcyclohexane (MCH) and tetrahydrofuran (THF) at 303.15 K was found to fit the expression

$$G^E = RTx(1-x)\{0.4857 - 0.1077(2x-1) + 0.0191(2x-1)^2\}$$

where x is the mole fraction of the methylcyclohexane. Calculate the Gibbs energy of mixing when a mixture of 1.00 mol of MCH and 3.00 mol of THF is prepared.

6. Use the phase diagram to state (a) the solubility of B in A at 390℃ and (b) the solubility of AB_2 in B at 300℃



7. Calculate the equilibrium constant for the ammonia synthesis reaction,

$$N_2(g)+3H_2(g)\leftrightarrow 2NH_2(g)$$

at 298 K and show how K is related to the partial pressures of the species at equilibrium when the overall pressure is low enough for the gases to be treated as perfect.

8. Use the Gibbs-Duhem equation to derive the Gibbs-Duhem-Margules equation

$$\left(\frac{\partial \ln f_A}{\partial \ln x_A}\right)_{p,T}=\left(\frac{\partial \ln f_B}{\partial \ln x_B}\right)_{p,T}$$

where f is fugacity. Use the relation to show that, when the fugacities are replaced by pressures, if Raoult's law applies th one component in a mixture then Henry's law must apply to the other.