

國立台灣科技大學九十七學年度碩士班招生試題

系所組別：材料科技研究所碩士班
 科目：熱力學

熱力學；共 7 大題，總分 100 分；請於答案卷內依序作答。

- An ideal solution is made of 79 mol% of A, 20 mol% of B and 1 mol% of C at 298 K and 1 atm. Calculate the relative integral molar free energy of the solution, G^M . (10%)
- The equilibrium constant for ammonia synthesis reaction is 775 at 25°C based on 1 atm ideal gas standard state. The enthalpy change associated with the reaction, or the heat of reaction, $\Delta H_r^\circ = -45.9$ kJ. Assuming that ΔH_r° is independent of temperature, (1) derive : $\left(\frac{\partial(\ln K)}{\partial T}\right)_p = \frac{\Delta H_r^\circ}{RT^2}$; (2) estimate the equilibrium constant for the reaction at 45°C. (15%)
- The specific heat of solid copper above 300 K is given by

$$C_p = 22.64 + 6.28 \times 10^{-3} T \quad \text{J mol}^{-1}\text{K}^{-1}$$
 How much does the entropy of copper change on heating from 300 to 1000 K? (10%)
- The free-energy increase by introducing vacancies into a crystal may be written as follows:

$$G_v = n_v w - T S_v$$
 The entropy arising in the presence of vacancies is an entropy of mixing. Show that the ratio of vacancies to atoms in a crystal can be expressed as

$$n_v/n_0 = \exp[-w/kT]$$
 where G_v = the free energy due to vacancies
 S_v = the entropy due to vacancies
 w = work to form one vacancy,
 k = Boltzmann constant
 T = the absolute temperature
 n_v = number of vacancies
 n_0 = number of atoms. (15%)
- If homogeneous nucleation of ice occurs at -43°C, calculate the critical radius given values of -3.1×10^8 J/m³ and 25×10^{-3} J/m², respectively, for the latent heat of fusion and the surface free energy. (25%)



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6. Express ΔG^M , ΔH , ΔS , γ and G^{XS} for binary ideal and regular solution in detail, where M means "mixing", XS means "excess property". (5%) (for binary system)
7. Use the phase diagram in Fig. 1 to plot the each phase relationship of the Gibbs free energy of mixing curve vs. compositions, and activity vs. composition at various temperatures (20%)

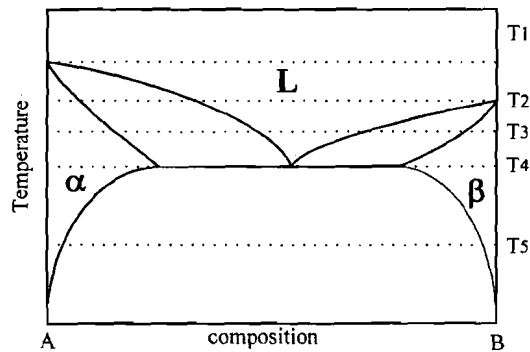


Fig.1 Simple eutectic system

