國立臺灣科技大學 107 學年度碩士班招生試題

系所組別：材料科學與工程系碩士班丙組

科　　目：熱力學

(總分為 100 分)

1 (15%) Several thermodynamic properties of the changes between water (l) and ice (s) are $H_{H_2O(l)}$, $H_{H_2O(s)}$, $\Delta H_{H_2O(s\to l)}$, $\Delta S_{H_2O(s\to l)}$, and $\Delta G_{H_2O(s\to l)}$. Indicate that these properties are greater than, equal to, or smaller than zero at 298 K, 273 K, and 253 K. Set that the melting temperature of water/ice is 273 K.

	$H_{H_2O(l)}$	$H_{H_2O(s)}$	$\Delta H_{H_2O(s\to l)}$	$\Delta S_{H_2O(s\to l)}$	$\Delta G_{H_2O(s\to l)}$
298 K					
273 K					
253 K					

2 The A-B liquid solution obeys the relation of the activity coefficient of A in the A-B liquid solution at 400 K, as:

$$\ln \gamma_A = 0.8X_B^2 - 0.5X_B^3$$

2.1 (5%) Is the solution positive deviation or negative deviation from Raoultian solution?

2.2 (10%) Derive the activity coefficient of B in the A-B liquid solution.

2.3 (5%) Calculate the activity of B in the A-B liquid solution at $X_B = 0.5$.

3 The regular solution of A-B alloy shows:

$$\Omega = 15000\ J\ mol^{-1}$$

3.1 (5%) Calculate that critical temperature of this solution.

3.2 (10%) There are two spinodal composition for the A-B solution at 500 K. Determine these two spinodal composition.

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4 Calculate (a) the work done in mercury system as the external pressure changed from 0 to 10^8 N/m (5%) and (b) the change of internal energy. (10%) For mercury at 273K, $\alpha=1.18\times10^{-4}$ K^{-1}, $\beta=3.88\times10^{-11}$ m^2/N, $C_p=27.9$ J/K · mole and V = 1.47×10^{-5} m^3/mole. Assume these data are independent to pressure change.

5 Show that $(\frac{\partial S}{\partial P})_{SV}=\frac{C_p\beta}{T\alpha}-V\alpha$, α is isobaric thermal expansivity and β is isothermal compressibility. (10%)

6 $\alpha_r=\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$ is defined as thermal expansion coefficient, V is volume, T is temperature and P is pressure. Show (a) $\frac{\partial^2 G}{\partial P\partial T}=\alpha_T V$ (10%) and (b) $\left(\frac{\partial H}{\partial P}\right)=V(1-\alpha_r\gamma)$. (10%)

7 Which statement is correct for deal gases? (5%)

(A)$\left(\frac{\partial U}{\partial V}\right)_T=0$; (B) $\left(\frac{\partial H}{\partial V}\right)_S=0$; (C) $\left(\frac{\partial U}{\partial T}\right)_V=0$; (D) $\left(\frac{\partial H}{\partial S}\right)_P=0$