國立台灣科技大學九十六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

共 6 大題，總分 100 分；請於答案卷內依序作答。

1. Express ΔG^M, γ, G^{XS} for binary ideal and regular solution, where M means "mixing", XS means "excess property". (10%)

2. Use $\overline{M}_1 = M + x_2 \frac{dM}{dx_1}$, $\overline{M}_2 = M - x_1 \frac{dM}{dx}$, express the $\overline{M_1}$ & $\overline{M_2}$, where $M=(A+BX_2)X_1X_2$, X_1 and X_1 are molar fraction for component 1 and 2 ,and A&B are constants. (6%)

3. Copper and Gold form the complete ranges of solid solution at temperatures between 410 and 889℃, and at 600℃, the excess molar Gibbs free energy of formation of the solid solutions is given by
$G^{xs} = -28280 X_{Cu} X_{Au}$ J
Calculate the partial pressures of Au and Cu exerted by the solid solution of $X_{Cu} = 0.5$ at 600℃. (14%)
where the saturated vapor pressure of solid Cu and Au are

$$\ln P^0_{Cu}(atm) = -\frac{40920}{T} - 0.86 \ln T + 21.67$$

$$\ln P^0_{Au}(atm) = -\frac{45650}{T} - 0.306 \ln T + 10.81$$

4 The standard Gibbs free energy change for the reaction $4Cu_{(s)} + O_{2(g)} = 2Cu_2O_{(s)}$ is $\Delta G° = -333000 + 141.3T$ (J) in the temperature range 298-1200 K. Derive the equation for the variation of $\log p_{O_2}$ with $1/T$. Plot this variation and mark the region where $Cu_2O_{(s)}$ is stable. (Gas constant R=8.3144 J/mole·K) (15%)

5. Consider an ideal gas initially at temperature T_1 and pressure p_1 and contained in a volume V_1. As the gas expands isothermally it absorbs heat from surroundings and produce work on a piston. Derive an expression for the change in entropy that accompanies the expansion. (15%)

6. Derive the entropy of mixing for the case that small-molecule solutes are dissolved in small-molecule solvents. (40 %)