

國立高雄大學一百學年度研究所碩士班招生考試試題

科目：材料熱力學
考試時間：100 分鐘

系所：化學工程及材料工程學系
(乙組)
本科原始成績：100 分

是否使用計算機：是

1. For a reaction



Please derive the equation which describes the relationship between the equilibrium constant K_p and the standard molar Gibbs free energy difference, ΔG° . (10 %)

2. Please derive the Clapeyron equation and the Clausius-Clapeyron equation. What would happen for the water boiling temperature when the external pressure increases? (20%)
3. What is the van der Waals equation? What is the virial equation? (10%)
4. Please describe the difference between ideal solution and regular solution, respectively. (10%)
5. In a binary A-B solution, the activity coefficients of A at temperature T have been measured as: $\ln \gamma_A = \alpha X_B^2$, in which α is independent of composition. What are the activity coefficients of B as a function of compositions? Prove it. (10%)
6. Lithium bromide vapor dissociates according to $\text{LiBr}_{(g)} \rightarrow \text{Li}_{(g)} + \frac{1}{2}\text{Br}_{2(g)}$, $\Delta G^\circ = 333900 - 42.09T$ J. At what temperature does the partial pressure of Li reach the value of 10^{-6} atm when the gas is heated at a constant pressure of 1 atm. (10%)
7. What is Ellingham diagram? Explain why oxidation reactions involving solid phases (ex. $\text{A}_{(s)} + \text{O}_{2(g)} \rightarrow \text{AO}_{2(s)}$ and $\text{B}_{(s)} + \text{O}_{2(g)} \rightarrow \text{BO}_{2(s)}$) have similar line slope in an Ellingham diagram. (10%)
8. What is the Gibbs phase rule? Please prove this rule based on the equilibrium conditions of a system. (10%)
9. Calculate the solubility (in molalities) of AgBr in water at 298 K. (10%) ($E^{\circ, \text{Ag}} = 0.7991$ volts and $E^{\circ, \text{Br}} = 1.0652$ volts. $\text{AgBr}_{(s)} = \text{Ag}^+_{(m)} + \text{Br}^-_{(m)}$, $\Delta G^\circ_{298\text{K}} = 121,345$ J)

$$\begin{aligned} \ln 3 &= 1.099, & \ln 5 &= 1.609, & \ln 7 &= 1.946, & \ln 10 &= 2.303 \\ e^{-19} &= 5.6 \times 10^{-9}, & e^{-29} &= 2.5 \times 10^{-13}, & e^{-39} &= 1.2 \times 10^{-17}, & e^{-49} &= 5.3 \times 10^{-22} \end{aligned}$$