國　立　宜　蘭　大　學

112 學年度碩士班考試入學招生

※物理化學
(含熱力學與動力學)試題

（化學工程與材料工程學系碩士班）

准考證號碼：

《作答注意事項》

1. 請先檢查准考證號碼、座位號碼及答案卷號碼是否相符。
2. 考試時間：100 分鐘。
3. 本試卷共有 8 題，共計 100 分。
4. 請將答案寫在答案卷上。
5. 考試中禁止使用手機或其他通信設備。
6. 考試後，請將試題卷及答案卷一併繳交。
7. 本考科可使用電子計算機（廠牌、功能不拘）。

1. Explain the following items: (10%)
(a) Dalton's Law of Partial Pressure (b) Law of Corresponding States (c) Efficiency of a Reversible Carnot Engine (d) Arrhenius Equation (e) Phase Rule

2. One mole of helium is compressed isothermally and reversibly at 100 ℃ from a pressure of 2 to 10 bar. Calculate the (a) q, (b) w, (c) ΔG, (d) ΔH, (e) ΔU and (f) ΔS of this process, assuming helium is an ideal gas. (15%)

3. (a) Derive the Gibbs-Helmholtz equation. (5%)
(b) The value of ΔG_f^o for Fe(g) is 370.7 kJ mol^{-1} at 298.15 K, and ΔH_f^o for Fe(g) is 416.3 kJ mol^{-1} at the same temperature. Assuming that ΔH_f^o is constant in the interval 250 – 400 K, calculate ΔG_f^o for Fe(g) at 400 K. (5%)

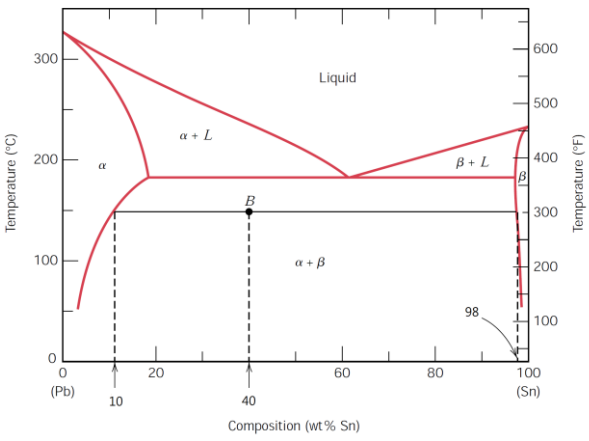
4. Calculate the $\Delta_{mix}G$ and $\Delta_{mix}S$ for the formation of a quantity of air containing 1 mol of gas by mixing nitrogen and oxygen at 298.15 K. Air may be taken to be 80% nitrogen and 20% oxygen by volume. (10%)

5. (a) Derive the Clausius-Clapeyron equation $\ln\frac{P_2}{P_1} = \frac{\Delta_{vap}H}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$. (5%)

(b) Derive the van't Hoff equation $\frac{d\ln K_P^o}{d(\frac{1}{T})} = -\frac{\Delta H^o}{R}$. (5%)

6. Mercuric oxide dissociates according to the reaction 2HgO(s) ↔ 2Hg(g) + O_2(g). At 420 ℃ the dissociation pressure is 5.16 × 10^4 Pa, and at 450 ℃ it is 10.8 × 10^4 Pa. Calculate (a) the equilibrium constants, and (b) the enthalpy of dissociation per mole of HgO. (10%)

7. (a) For a 40 wt.% Sn-60 wt.% Pb alloy at 150 ℃ (point B in the figure), what phase(s) is (are) present? What is (are) the composition(s) of the phase(s)? (10%)
(b) Calculate the mass fraction of each phase present. (10%)



8. (a) Derive the half-life of a first-order reaction is $t_{1/2} = \frac{\ln 2}{k}$. (5%)

(b) If a first-order reaction has an activation energy of 104,600 J mol^{-1} and a pre-exponentioal factor A of 5 × 10^{13} s^{-1}, at what temperature will the reaction have a half-life of (a) 1 min and (b) 30 days? (10%)