

國立宜蘭大學

113 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

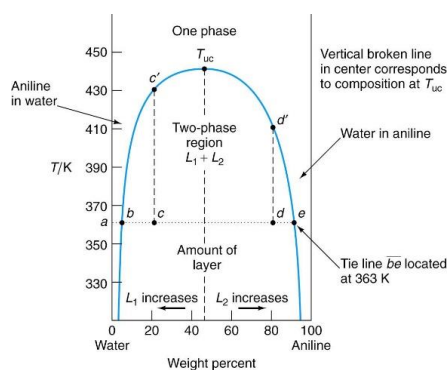
(化學工程與材料工程學系碩士班)

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 7 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）。

- Explain the following items: (20%)
 - Ideal gas
 - The first law of thermodynamics
 - The second law of thermodynamics
 - The critical point
 - Phase Rule
- One mole of an ideal gas at 300 K is reversibly and isothermally compressed from a volume of 25.0 L to a volume of 10.0 L. Calculate the (a) q , (b) w , (c) ΔU , (d) ΔG , and (e) ΔS of this process. (20%)
- A sample containing 2.25 moles of He (1 bar, 298 K) is mixed with 3.00 moles of Ne (1 bar, 298 K) and 1.75 moles of Ar (1 bar, 298 K). Calculate the ΔS_{mixing} value. (10%)
- (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%)
 - The vapor pressure of liquid SO_2 is 2,232 Pa at 201 K, and $\Delta H_{vaporization}$ is 24,940 J mol⁻¹. Calculate the temperature of SO_2 at 101,325 Pa. (10%)
- For the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \leftrightarrow 2\text{NH}_3(\text{g})$, $K = 1.60 \times 10^{-4}$ at 400 °C. Calculate the ΔG° of the reaction. (10%)
- (a) Calculate the ratio of the mass of the water-rich layer (L_1) to that of the aniline-rich layer (L_2), for a 20-wt% water-aniline mixture at 363K. The compositions along the tie line be are maintained at 363K. The composition at c is 20%; for L_1 at b , it is 8%; and for L_2 at e , it is 90%. (5%)
 - What are the compositions of L_1 and L_2 at this temperature? (5%)



- (a) Derive the half-life of a first-order reaction is $t_{1/2} = \frac{\ln 2}{k}$. (5%)
 - The half-life for the first-order decomposition of N_2O_5 is 2.05×10^4 s. What is the rate constant for the decay reaction? (5%)
 - How long will it take for a sample of N_2O_5 to decay to 60% of its initial value? (5%)