

國立宜蘭大學

106 學年度研究所碩士班考試入學

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.本考科可使用非程式型（不具備儲存程式功能）之電子計算機。

1. Explain the following items: (20%)
(a) Tie line (b) Phase rule (c) Colligative property (d) Arrhenius equation.
2. Benzene has a normal boiling point at 760 Torr of 353.25 K and $\Delta H_{\text{vap}} = 30.76 \text{ KJ mol}^{-1}$. If benzene is to be boiled at 30.00°C in a vacuum distillation, to what value of P must the pressure be lowered, assuming the Clausius-Clapeyron equation to apply? (10%)
3. A solution contains 1.50 g of solute in 30.0 g of benzene and its freezing point is 4.74°C. The freezing point of pure benzene is 5.48°C. Calculate the molar mass of the solute. ($K_f(\text{benzene}) = 4.90 \text{ K Kg mole}^{-1}$) (10%)
4. Determine the mass percentage of carbon tetrachloride CCl_4 ($P_1^* = 114.5 \text{ Torr}$) in the vapor phase at equilibrium in a 1:1 mole ideal solution with trichloromethane CHCl_3 ($P_2^* = 199.1 \text{ Torr}$) at 25°C. ($C_1 = 35.5$) (10%)
5. A second-order reaction in solution has a rate constant of $5.7 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 25°C and of $1.64 \times 10^{-4} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 40°C. Calculate the activation energy and the preexponential factor, assuming the Arrhenius equation to apply. (10%)
6. A substance decomposes at 600 K with a rate constant of $3.72 \times 10^{-5} \text{ s}^{-1}$.
 - a. Calculate the half-life of the reaction. (10%)
 - b. What fraction will remain undecomposed if the substance is heated for 3 h at 600 K? (10%)
7. At 100°C 1 mol of liquid water is allowed to expand isothermally into an evacuated vessel of such a volume that the final pressure is 0.5 atm. The amount of heat absorbed in the process was found to be 30 KJ mol^{-1} . What are W, ΔU , ΔH , ΔS , and ΔG ? (20%)