

國立宜蘭大學

102 學年度研究所碩士班考試入學

物理化學試題

(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》

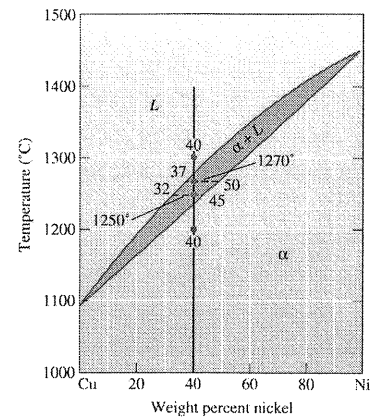
1. 請先檢查准考證號碼、座位號碼及答案卷號碼是否相符。
2. 考試時間：100 分鐘。
3. 本試卷共有 9 題，共計 100 分。
4. 請將答案寫在答案卷上。
5. 考試中禁止使用大哥大或其他通信設備。
6. 考試後，請將試題卷及答案卷一併繳交。
7. 本試卷採雙面影印，請勿漏答。
8. 本考科可使用非程式型（不具備儲存程式功能）之電子計算機。

1. Explain the following items: (a) Boyle's law (b) ideal gas (c) law of corresponding states (d) colligative properties (e) phase rule (15%)
2. Calculate the average molar mass of air at sea level and 0°C if the density of air is 1.29 kg m⁻³. (5%)
3. The heat of vaporization of water at 25°C is 44.01 kJ mol⁻¹, and the equilibrium vapor pressure at that temperature is 0.0313 atm. Calculate ΔS , ΔH and ΔG when 1 mol of liquid water at 25°C is converted into vapor at 25°C and a pressure of 10⁻⁵ atm, assuming the vapor to behave ideally. (10%)
4. Initially 1 mol of O₂ is contained in a 1-liter vessel, and 5 mol of N₂ are in a 2-liter vessel; the two vessels are connected by a tube with a stopcock. If the stopcock is opened and the gases mix, what is the entropy change? (10%)
5. The solubility of silver chloride in pure water at 25°C is 1.265×10⁻⁵ mol dm⁻³. Calculate the solubility product (K_{sp}) and ΔG° for the process $\text{AgCl}(s) \leftrightarrow \text{Ag}^+(aq) + \text{Cl}^-(aq)$. (10%)
6. Thermodynamic data for n-pentane(g) and neopentane(g) (standard state: 1bar and 25°C) are as follows

	Enthalpy of formation, ΔH_f° (kJ mol ⁻¹)	Entropy, S° (J K ⁻¹ mol ⁻¹)
n-Pentane(g)	-146.44	349.0
Neopentane(g)	-165.98	306.4

- (a) Calculate ΔG° for n-pentane→neopentane. (5%)
 - (b) Pure n-pentane(g) is in a vessel at 1bar and 25°C, and a catalyst is added to bring about the equilibrium between n-pentane and neopentane. Calculate the final partial pressure of the two isomers. (5%)
7. (a) Derive the Clausius-Clapeyron equation $\ln \frac{P_2}{P_1} = \frac{\Delta_{vap}H_m}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$. (10%)
(b) The vapor pressure of n-propanol is 1.94 kPa at 293 K and 31.86 kPa at 343 K. What is the enthalpy of vaporization? (5%)

8. Determine the amount and composition of each phase in a Cu-40% Ni alloy at 1300°C, 1270°C, 1250°C, and 1200°C. (15%)



9. (a) Derive the half-life of a first-order reaction is $t_{1/2} = \frac{\ln 2}{k}$. (5%)
- (b) The isotope $^{32}_{15}\text{P}$ emits radiation and has a half-life of 14.3 days. Calculate the decay constant in s^{-1} . (5%)