

國立臺北科技大學

九十五學年度化學工程研究所碩士在職專班入學考試

乙組：物理化學 試題

填准考證號碼

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注意事項：

1. 本試題共【7】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

1. Explain the following terms: (25%)
 - (1) Mean free path
 - (2) Boyle temperature
 - (3) Phase rule
 - (4) Activation energy
 - (5) Fugacity
2. The density of liquid water at 100°C is 0.9584 g cm^{-3} , and that of steam at the same temperature is $0.000596\text{ g cm}^{-3}$. If the enthalpy of evaporation of water at atmospheric pressure is 40.63 kJ mol^{-1} , what is the internal energy change (ΔU)? How much work is done by the system during the evaporation process? (10%)
3. At 30°C 2 moles of an ideal gas is expanded isothermally from 3 to 30 dm^3 . Calculate internal energy change (ΔU), enthalpy change (ΔH), entropy change (ΔS), Helmholtz energy change (ΔA), and Gibbs energy change (ΔG). Do the values depend on whether the process is reversible or irreversible? (10%)

4. Methane dissolves in benzene with a Henry's law constant of 4.27×10^5 Torr. Calculate methane's molal solubility in benzene at 25°C if the pressure above benzene is 755 Torr. The vapor pressure of benzene is 94.6 Torr at 25°C . (10%)
5. Determine the mass percentage of CCl_4 ($P_1^* = 114.5$ Torr) in the vapor phase at equilibrium in a 1:2 mole ideal solution with CHCl_3 ($P_2^* = 199.1$ Torr) at 25°C . (Molecular weight: C = 12.0107, H = 1.0079, Cl = 35.4527). (15%)
6. The electrolytic conductivity of a 0.002 M solution of Na_2SO_4 is $5.21 \times 10^{-4} \Omega^{-1} \text{cm}^{-1}$. If the solution is saturated with CaSO_4 , the conductivity becomes $8.7 \times 10^{-4} \Omega^{-1} \text{cm}^{-1}$. Calculate the solubility product for CaSO_4 using the following molar conductivities at these concentrations: $\lambda(\text{Na}^+) = 50.08 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$; $\lambda(\frac{1}{2}\text{Ca}^{2+}) = 59.47 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$. (15%)
7. Suppose that a gas phase reaction
- $$2 \text{A(g)} \rightarrow 2 \text{B(g)} + \text{C(g)}$$
- follows second-order kinetics and goes to completion. If the reaction is allowed to proceed in a constant volume vessel at an initial pressure of 3 bar (only A is initially present), what will be the partial pressures of A, B, and C and the total pressure at $t = 2t_{1/2}$ and infinity? (15%)