國立高雄應用科技大學
九十七學年度碩士班招生考試
化學工程與材料工程系

准考證號碼□□□□□□□□□□（考生必須填寫）

物理化學

試題　共 2 頁，第 1 頁

注意：a. 本試題共 8 題，每題　分，共 100 分。
b. 作答時不必抄題。
c. 考生作答前請詳閱答案卷之考生注意事項。

Given: R = 8.314 J $K^{-1}mol^{-1}$ = 0.08314 L bar $K^{-1}mol^{-1}$ = 0.08206 L atm $K^{-1}mol^{-1}$, 1 atm = 1.013 bar, 1 bar = 10^5 Pa.

1. An ideal solution is made from 5 mol of benzene and 3.25 mol of toluene. Calculate ΔG_{mixing} and ΔS_{mixing} at 298 K and 1 bar pressure. Is mixing a spontaneous process? (10%)

2. Calculate E^o (standard electrode potential) for the process
$Cu^+ + e^- \rightarrow Cu$
making use of the following E^o values:
(1) $Cu^{2+} + e^- \rightarrow Cu^+$　　$E_1^o = 0.153$ V
(2) $Cu^{2+} + 2e^- \rightarrow Cu$　　$E_2^o = 0.337$ V (10%)

3. Nitrogen trioxide dissociates according to the reaction
$N_2O_{3(g)} = NO_{2(g)} + NO_{(g)}$
When one mole of $N_2O_{3(g)}$ is held at 25 °C and 1 bar total pressure until equilibrium is reached, the extent of reaction is 0.30. What is $\Delta_r G^o$ (standard reaction Gibbs energy) for this reaction at 25 °C. (10%)

4. An ideal gas is allowed to expand reversibly and isothermally (25°C) from a pressure of 1 bar to a pressure of 0.1 bar. (a) What is the change in molar Gibbs energy? (b) What would be the change in molar Gibbs energy if the process occurred irreversibly? (10%)

5. Show that the Clausius-Clapeyron equation for vaporization and sublimation can be expressed by

$$\ln\frac{P_2}{P_1}=\frac{\Delta_{vap}H(T_2-T_1)}{RT_1T_2}.$$

Where $\Delta_{vap}H$ is the heat of vaporization, P_2 and P_1 are the vapor pressures at temperatures T_2 and T_1, respectively. (15%)

6. Find the equations for the work of a reversible, isothermal compression of 1 mol of gas in a piston/cylinder assembly from V_1 to V_2 if the molar volume and pressure of the gas is given by (a) $V = RT/P$, (b) $V = (RT/P) + b$, and (c) $P = RT/(V-B) - a/V^2$, where a, b, and R are positive constants. (15%)

7. Set up the rate expressions for the following mechanism:

$$A \underset{k_2}{\overset{k_1}{\rightleftharpoons}} B \qquad B + C \xrightarrow{k_3} D$$

If the concentration of ***B*** is small compared with the concentrations of ***A***, ***C***, and ***D***, the steady-state approximation may used to derive the rate law. Show that this reaction may follow the first-order equation at high pressures and the second-order equation at low pressures. (15%)

8. One mol of an ideal gas is compressed adiabatically in a piston/cylinder device from 2 bar and 25 °C to 7 bar. The process is irreversible and requires 35% more work than a reversible, adiabatic compression from the same initial state to the same final pressure. What is the entropy change of the gas? C_p= 29.1 J $mol^{-1}K^{-1}$, C_v= 20.8 J $mol^{-1}K^{-1}$. (15%)