

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

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° (standard electrode potential) for the process
 $\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$
making use of the following E° values:
(1) $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+ \quad E_1^\circ = 0.153 \text{ V}$
(2) $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} \quad E_2^\circ = 0.337 \text{ V}$ (10%)
3. Nitrogen trioxide dissociates according to the reaction
 $\text{N}_2\text{O}_{3(\text{g})} = \text{NO}_{2(\text{g})} + \text{NO}_{(\text{g})}$
When one mole of $\text{N}_2\text{O}_{3(\text{g})}$ is held at 25 °C and 1 bar total pressure until equilibrium is reached, the extent of reaction is 0.30. What is $\Delta_r G^\circ$ (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%)

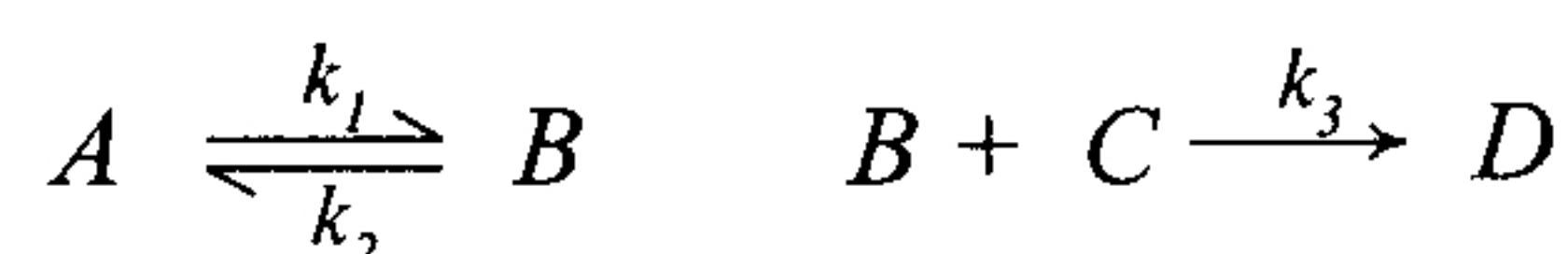
5. Show that the Clausius-Clapeyron equation for vaporization and sublimation can be expressed by

$$\ln \frac{P_2}{P_1} = \frac{\Delta_{\text{vap}} H (T_2 - T_1)}{RT_1 T_2}.$$

Where $\Delta_{\text{vap}} H$ 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:



If the concentration of **B** is small compared with the concentrations of **A**, **C**, and **D**, the steady-state approximation may be 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? $C_p = 29.1 \text{ J mol}^{-1} \text{ K}^{-1}$, $C_v = 20.8 \text{ J mol}^{-1} \text{ K}^{-1}$. (15%)