

國立高雄應用科技大學
101 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 6 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: $R = 8.314 \text{ J K}^{-1}\text{mol}^{-1} = 8.314 \times 10^{-2} \text{ L bar K}^{-1}\text{mol}^{-1} = 8.206 \times 10^{-2} \text{ L atm K}^{-1}\text{mol}^{-1}$; $1 \text{ atm} = 1.013 \text{ bar}$, $1 \text{ bar} = 10^5 \text{ Pa}$; $1 \text{ F} = 96485 \text{ C mol}^{-1}$.

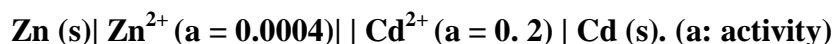
1. An ideal gas expands from 10 to 2 bar at 298 K. Calculate q (heat) per mole, w (work) per mole and each of the thermodynamic quantities, ΔS (change in molar entropy), ΔA (change in molar Helmholtz energy) and ΔG (change in molar Gibbs energy) (a) for a reversible expansion and (b) for an expansion against a constant external pressure of 2 bar. (Work done in the system is considered to be positive). (20%)
2. What is the activity, a , of liquid water at 1 and 10 bar at 25°C , assuming that the molar volume is constant. *Hint*: Use the equation of $\mu = \mu^0 + RT \ln a$, where μ and μ^0 are chemical potential and chemical potential at $a = 1$. (10%)
3. What is the freezing point of water under a pressure of 100 bar? (The heat of fusion of ice is 333.5 J g^{-1} , the density of water is 0.9998 g cm^{-3} , and the density of ice is 0.9168 g cm^{-3} , all at 0°C and 1 bar) (10%)
4. The reaction



試題 共 2 頁，第 2 頁

Comes to equilibrium at 1 bar total pressure and 227°C when the partial pressure of the nitrosyl chloride, NOCl, is 0.64 bar. Only NOCl was present initially. (a) What is the equilibrium constant? (b) Calculate ΔG° for this reaction. (c) At what total pressure will the partial pressure of NO be 0.2 bar? (d) What is the value of the equilibrium constant and ΔG° when the reaction is reversed? (20%)

5. For the cell (20%)

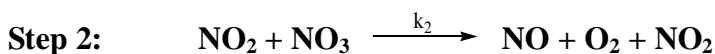
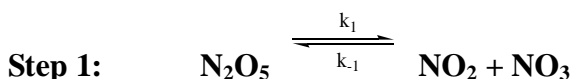


(a) What is the cell reaction? (b) What is the standard electromotive force (E°) of the cell at 25°C? (c) What is the electromotive force of the cell at 25°C? (d) What is the equilibrium constant for the cell reaction? (e) Calculate ΔG° for the cell reaction from the standard electromotive force.

The standard electrode potentials at 25°C are given as:



6. The gas-phase decomposition of N_2O_5 with overall reaction $2\text{N}_2\text{O}_5 = 4\text{NO}_2 + \text{O}_2$ occur by the following multistep mechanism:



(a) Show that $r = k [\text{N}_2\text{O}_5]$, where $k = k_1 k_2 / (k_{-1} + 2k_2)$. *Hint:* Use the steady-state approximation for both intermediates. (15%) (b) If $k = 2.05 \times 10^{13} \exp(-103135.6 \text{ J mol}^{-1}/RT) (\text{s}^{-1})$. Calculate k and $t_{1/2}$ (half-life) at 0°C. (5%)