

國立臺灣科技大學 110 年度產業碩士專班招生(秋)試題

專 班 別：新穎薄膜暨電池材料

科 目：物理化學

(總分為 100 分)

不得使用計算器

物理化學

1. Please describe the items: (30 points)

- (a) First law of thermodynamics (b) State function (c) Quasi-static process
 (d) Adiabatic (e) Spontaneous process (f) Second law of thermodynamics

2. Prove that $P_i V_i^\gamma = P_f V_f^\gamma$ ($\gamma = C_{p,m} / C_{v,m}$) for the adiabatic reversible process, where P , V , $C_{p,m}$, and $C_{v,m}$ represent pressure, volume, heat capacity per mole at constant pressure, and heat capacity per mole at constant volume, respectively.

(20 points)

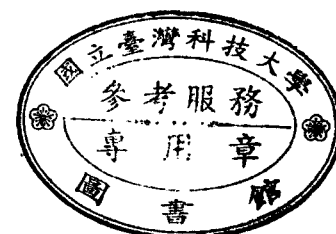
3. Please derive

(a) $\left(\frac{\partial H}{\partial S}\right)_P = T$ and $\left(\frac{\partial H}{\partial P}\right)_S = V$ (10 points)

(b) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (10 points)

where H , V , T , P , and S represent enthalpy, volume, temperature, pressure, and entropy, respectively.

4. The average bond enthalpy of the O-H bond in water is defined as one-half of the enthalpy change for the reaction $\text{H}_2\text{O}_{(g)} \rightarrow 2\text{H}_{(g)} + \text{O}_{(g)}$. The formation enthalpies, ΔH_f° , for $\text{H}_{(g)}$ and $\text{O}_{(g)}$ are 218.0 and 249.2 kJ mol^{-1} , respectively, at 298.15 K, and ΔH_f° for $\text{H}_2\text{O}_{(g)}$ is $-241.8 \text{ kJ mol}^{-1}$ at the same temperature. Use this information to determine the average bond enthalpy of the O-H bond in water at 298.15 K. (10 points)



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5. n_0 moles of chlorine gas are placed in a reaction vessel, whose temperature can be varied over a wide range, so that molecular chlorine can partially dissociate to atomic chlorine. Assume the total pressure is P .
- (a) Define the degree of dissociation as $\alpha = \delta_{eq} / n_0$, where $2\delta_{eq}$ is the number of moles of $\text{Cl}_{(g)}$ present at equilibrium, and n_0 represents the number of moles of $\text{Cl}_{2(g)}$ that would be present in the system if no dissociation occurred. Derive an expression for thermodynamic equilibrium constant (K_P) in terms of n_0 , δ_{eq} , and P . (10 points)
- (b) Derive an expression for α as a function of K_P and P . (10 points)

