淡江大學 97 學年度碩士班招生考試試題

系別：化學學系　　　　　　　科目：物　理　化　學

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1. Consider a closed system that only P – V work is done on. Please show that

    (a) $\triangle H = q_p$　　　　q_p : the heat absorbed in a constant-pressure process (5%)

    (b) $C_P = \left(\dfrac{\partial H}{\partial T}\right)_P$　C_P : the heat capacity in a constant-pressure process (5%)

    (c)　　$C_P - C_V = \left[\left(\dfrac{\partial U}{\partial V}\right)_T + P\right]\left(\dfrac{\partial V}{\partial T}\right)_P$　　　　　(10%)

    C_V : the heat capacity in a constant-volume process

2. Find ΔS and ΔG for the conversion of 10 g of supercooled water at -10°C and 1 atm to ice at -10°C and 1 atm. Average C_P values for ice and supercooled water in the range 0 to -10°C are 0.50 and 1.01 cal/(g °C), respectively. For ice, heat of melting = 79.7 cal/g at 0°C. (20%)

3. Please explain the following terms: (15%)
    (a) ctritical micelle concentration　(b) ideal solution　(c) diffusion　(d) effusion
    (e) Hess's Law

4. Consider two competing irreversible first-order reactions:

    $$A \xrightarrow{k_1} C \qquad \text{and} \qquad A \xrightarrow{k_2} D$$
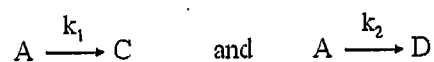
    k_1 and k_2 are the rate constants.

    (a) Find all the concentrations of A, C, and D as functions of time, respectively.
    Assume $[A] = [A]_0$, $[C] = 0$, and $[D] = 0$ at $t = 0$. (15%)
    (b) $[C] / [D] = ?$　(5%)

5. For a particle in one-dimensional-box stationary state, show that $\langle p_x \rangle = 0$. (10%)

6. Please explain the following terms: (15%)
    (a) Hamiltonian operator　(b) zero-point energy　(c) Pauli exclusion principle
    (d) degenerate　(e) stimulated emission