

系所組別： 化學工程學系乙組

考試科目： 物理化學

考試日期： 0225，節次： 3

※ 考生請注意：本試題可使用計算機，並限「考選部核定之國家考試電子計算器」機型

1. Answer the following questions: (18%)

(a) Compare the ΔS values for the acid dissociation of the following species and explain why: (4%)

① trimethylammonium ion, ② dimethylammonium ion, ③ methylammonium ion, ④ ammonium ion

(b) State the assumption(s) of ideal adsorption. (4%)

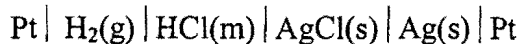
(c) The work done on the surrounding by a reversible process is higher than that by an irreversible.

Explain why and state where the lost work goes. (5%)

(d) For a closed system in which liquid and vapor are in equilibrium at a fixed temperature, does the vapor pressure increase or decrease when an inert gas is added to the gas phase? Why? (5%)

2. Prove that $\Delta_{mix} V = 0$ for an ideal solution and explain why from the viewpoint of molecular interaction. (10%)3. Describe the phenomenon of "osmosis" (4%) and derive the equation $\pi = cRT$ for a dilute ideal solution, where π is the osmotic pressure, c is the molar concentration of solute, R is gas constant, and T is the temperature (8%). (12%)

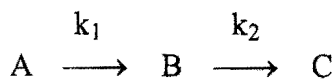
4. The effect of temperature on the standard emf of the following cell from 0 to 90°C is



$$E^\circ = 0.23659 - 4.8564 \times 10^{-4} t - 3.4205 \times 10^{-6} t^2 + 5.869 \times 10^{-9} t^3$$

where the units of E° and t are V and $^\circ C$. Calculate ΔG° , ΔH° , ΔS° , ΔC_p° , and the equilibrium constant of the cell reaction at 25°C. (15%)

5. Consider the series of first-order irreversible reactions (15%)

The initial concentration of A is $[A]_0$. Neither B nor C is present initially.

(a) Show that the concentration of B can be expressed as (9%)

$$[B] = \frac{k_1 [A]_0}{k_2 - k_1} (e^{-k_1 t} - e^{-k_2 t})$$

(b) Derive the time at which the concentration of B reach a maximum? (6%)

6. The surface tension of water at 20°C is $7.27 \times 10^{-2} \text{ Nm}^{-1}$ and its density is 0.998 g cm^{-3} . (15%)

(a) Assuming the contact angle is zero, calculate the rise of water at 20°C in a capillary tube with the radius of 0.1 mm. (5%)

(b) If a liter of water at 20°C is broken up into a spray in which the droplets have an average radius of 10^{-7} cm . Calculate (i) the Gibbs energy change when the droplets are formed and (ii) the ratio between the vapor pressure of the droplet and the vapor pressure of water at a plane surface. (10%)7. An ideal monatomic gas at 300K and 10 bar initially expands adiabatically to 1 bar against a constant pressure of 1 bar, what are w_m , ΔU_m , ΔH_m , ΔS_m and final temperature? (15%)