

# 國立臺北科技大學 102 學年度碩士班招生考試

系所組別：3520 化學工程研究所乙組

## 第一節 物理化學 試題

第一頁，共一頁

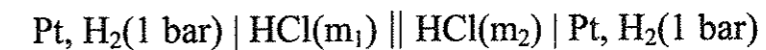
### 注意事項：

1. 本試題共 6 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Two moles of supercooled water at  $-15^{\circ}\text{C}$  and 1 atm atmosphere turns into ice. Calculate the entropy change in the system and in the surroundings and the net entropy change. Take the heat capacities ( $C_{p,m}$ ) of water and ice to be constant at 75.3 and 37.7 J K $^{-1}$  mol $^{-1}$ , respectively, and the latent heat of fusion of ice as 6.02 kJ mol $^{-1}$ . (20%)
2. (a) The ionic product  $[\text{H}^+][\text{OH}^-]$ , which is the equilibrium constant for the dissociation of water,  
$$\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$$
is  $1.00 \times 10^{-14}$  mol $^2$  dm $^{-6}$  at  $25.0^{\circ}\text{C}$  and  $1.45 \times 10^{-14}$  mol $^2$  dm $^{-6}$  at  $30.0^{\circ}\text{C}$ . Deduce  $\Delta H^{\circ}$  and  $\Delta S^{\circ}$  for the process. (14%)  
(b) Calculate the value of the ionic product at  $35.0^{\circ}\text{C}$ . (6%)
3. Two liters of water at  $20^{\circ}\text{C}$  is broken into a spray in which the droplets have an average radius of  $10^{-5}$  cm. If the surface tension of water at  $20^{\circ}\text{C}$  is  $7.27 \times 10^{-2}$  N m $^{-1}$ . Calculate the Gibbs energy change when the droplets are formed. (15%)

4. Estimate the diffusion coefficient of sodium acetate in water at  $25^{\circ}\text{C}$  from the following mobility values:  $\text{Na}^+$ :  $5.19 \times 10^{-4}$  cm $^2$  V $^{-1}$  s $^{-1}$ ,  $\text{CH}_3\text{COO}^-$ :  $4.24 \times 10^{-4}$  cm $^2$  V $^{-1}$  s $^{-1}$ . (10%)

5. (a) Consider the cell:



In which the solutions are separated by a partition that is permeable to both  $\text{H}^+$  and  $\text{Cl}^-$ . The ratio of the speeds with which these ions pass through the membrane is the ratio of their transport numbers  $t_+$  and  $t_-$ . Derive an expression for the emf of this cell. (14%)

- (b) If when  $m_1 = 0.01$  m and  $m_2 = 0.20$  m the emf is 0.0250 V, what are the transport numbers of the  $\text{H}^+$  and  $\text{Cl}^-$  ions? (6%)

6. The half-life of the thermal denaturation of hemoglobin, a first-order process, has been found to be 3460 s at  $60^{\circ}\text{C}$  and 530 s at  $65^{\circ}\text{C}$ . Calculate the enthalpy of activation and entropy of activation at  $65^{\circ}\text{C}$ , assuming the Arrhenius equation to apply. (15%)