

## 國立臺北科技大學九十五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

填准考證號碼

--	--	--	--	--	--	--	--

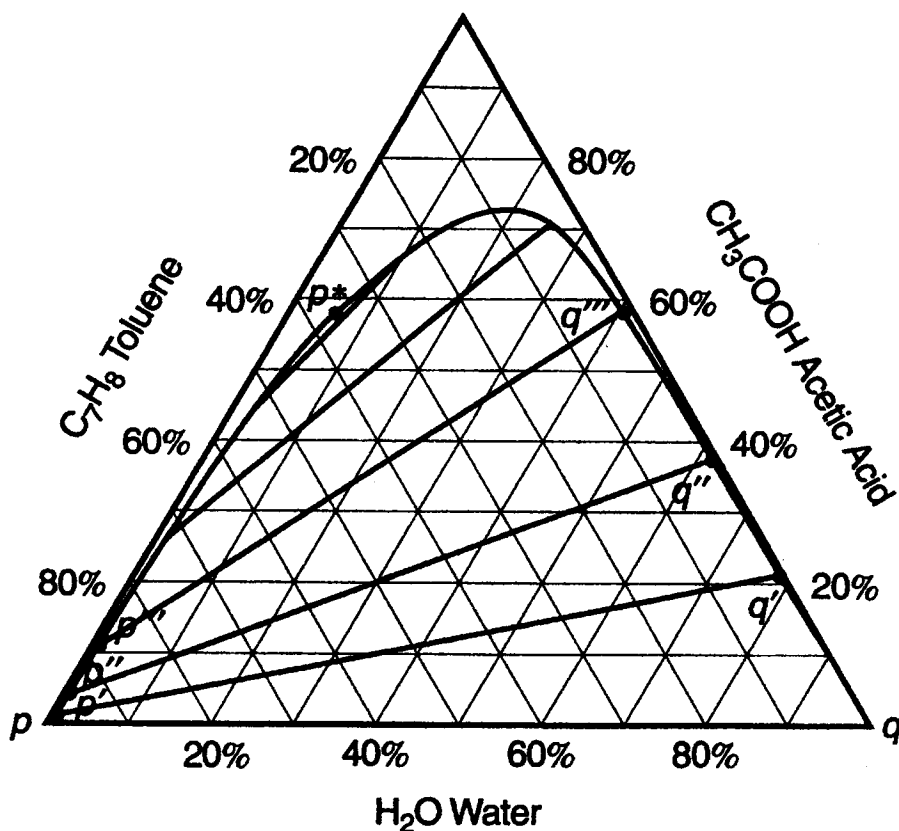
第一頁 共二頁

**注意事項：**

1. 本試題共 8 題，配分共 100 分。第 1~6 題各 12 分，第 7~8 題各 14 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. A sample of liquid methanol weighing 5.33 g was burned in a bomb calorimeter at 25°C, and 120.9 kJ of heat was evolved (after correction for standard conditions).
  - (a) Calculate enthalpy of combustion  $\Delta_c H^\circ$  for 1 mole of methanol.
  - (b) Use this value and the data  $\Delta_f H^\circ(\text{H}_2\text{O}_{(l)}) = -285.83 \text{ kJ mol}^{-1}$  and  $\Delta_f H^\circ(\text{CO}_{2(g)}) = -393.51 \text{ kJ mol}^{-1}$  to obtain a value for  $\Delta_f H^\circ(\text{CH}_3\text{OH}_{(l)})$ .
  - (c) If the enthalpy of vaporization of methanol is  $35.27 \text{ kJ mol}^{-1}$ , calculate enthalpy of formation  $\Delta_f H^\circ$  for  $\text{CH}_3\text{OH}_{(g)}$ .
  
2. Suppose that a refrigerator cools to 0°C, discharges heat at 20°C, and operates with 50% efficiency.
  - (a) How much work would be required to freeze 500 g of water (enthalpy of freeze is  $-6.02 \text{ kJ mol}^{-1}$ ).
  - (b) How much heat would be discharged during the process?
  
3. At 25.0°C the equilibrium constant for the reaction:
 
$$\text{CO}_{(g)} + \text{H}_2\text{O}_{(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_{2(g)}$$
 is  $1.00 \times 10^{-5}$ , and entropy change  $\Delta S^\circ$  is  $41.8 \text{ J K}^{-1} \text{ mol}^{-1}$ .
  - (a) Calculate Gibbs energy change  $\Delta G^\circ$  and enthalpy change  $\Delta H^\circ$  at 25.0°C.
  - (b) Suppose that 2 moles of CO and 2 moles of H<sub>2</sub>O are introduced into a 11-dm<sup>3</sup> vessel at 25.0°C. What are the amounts of CO, H<sub>2</sub>O, CO<sub>2</sub>, and H<sub>2</sub> at equilibrium?

4. The isobaric solubility diagram with unit of mole fraction for the system acetic acid-toluene-water is shown below. What phase(s) and their composition(s) will be present if 0.2 mole of toluene is added to a system consisting of 0.2 mole of water and 0.6 mole of acetic acid? Give the relative amounts of each phase.



5. A solution of cadmium iodide,  $CdI_2$ , having a molality of  $1.509 \times 10^{-2}$  mole  $kg^{-1}$ , was electrolyzed in a Hittorf cell. The mass of cadmium deposited at the cathode was 0.06924 g. Solution weighing 152.64 g was withdrawn from the anode compartment and was found to contain 0.7436 g of cadmium iodide. Calculate the transport numbers of  $Cd^{2+}$  and  $I^-$ .  
(Molecular weight:  $Cd = 112.4$ ,  $I = 126.9$ ).

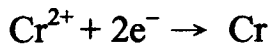
注意：背面尚有試題

6. Two solutions of equal volume are separated by a membrane which is permeable to  $K^+$  and  $Cl^-$  ions but not to  $P^-$  ions. The initial concentrations are as shown below.

<u>Left-hand compartment</u>	<u>Membrane</u>	<u>Right-hand compartment</u>
$[K^+] = 0.06 \text{ M}$ $[Cl^-] = 0.06 \text{ M}$	<div style="border-left: 1px solid black; border-right: 1px solid black; height: 100px; margin: 0 auto;"></div>	$[K^+] = 0.18 \text{ M}$ $[P^-] = 0.18 \text{ M}$

Calculate the concentrations on each side of the membrane after equilibrium has become established.

7. Calculate the standard electrode potential for the reaction at 298 K:



where  $Cr^{3+} + 3e^- \rightarrow Cr$ ,  $E^\circ = -0.74 \text{ V}$ ,

and  $Cr^{3+} + e^- \rightarrow Cr^{2+}$ ,  $E^\circ = -0.41 \text{ V}$ .

8. At  $25.0^\circ\text{C}$  the equilibrium for the reaction:



has a relaxation time of about  $40 \mu\text{s}$  and  $K_w = [H^+][OH^-] = 10^{-14}$ . Find the values of the forward and reverse rate constants.