

**國立嘉義大學九十四學年度  
應用化學系碩士班招生考試試題**

**科目：綜合化學 II**

**說明：由招生單位提供相同規格計算機**

**Part A. Physical chemistry(50%)**

- Derive the equation:  $\frac{\kappa_T}{\kappa_S} = \frac{C_P}{C_V}$ , where  $\kappa_T = -\frac{1}{V}(\frac{\partial V}{\partial P})_T$ ,  $\kappa_S = -\frac{1}{V}(\frac{\partial V}{\partial P})_S$ . (15 points)
- $A \xrightarrow{k_1} B$  and  $A \xrightarrow{k_2} C$  are two parallel first-order processes. (15 points)
  - Find the concentration of each species,  $[A]$ ,  $[B]$  and  $[C]$  at time  $t$ . Assume that  $[A]_0 = a$ ,  $[B]_0 = 0$  and  $[C]_0 = 0$  at time  $t = 0$ .
  - Find  $[A]$ ,  $[B]$  and  $[C]$  at  $t \rightarrow \infty$ .
- The 2s orbital of hydrogen atom is  $\psi_{2s} = \frac{1}{4\sqrt{2\pi a_0^3}}(2 - r/a_0)e^{-r/2a_0}$ . Find (10 points)
  - the node.
  - the most probable distance in the unit of  $a_0$  (Bohr radius) for 2s orbital.
- The rotational constant  $B_0$  of CO in the ground state is  $1.922 \text{ cm}^{-1}$ . (10 points)
  - Calculate the rotational partition function  $z_{\text{rot}}$  of CO at 300 K.
  - What is the most probable rotational level of CO at 300 K.

**Part B. Analytical chemistry (50%)**

**Problems 5-14: Multiple-choice with only one correct answer.**

(2 points each for questions 5-8; 3 points each for questions 9-14; otherwise as specified.)

- A method is rather free from interferences, it is said that the method is highly
  - sensitive
  - selective
  - accurate
  - precise
- Which kind of the following impurities can not be minimized by digestion process?
  - inclusion
  - occlusion
  - adsorbate
  - none of the above
- The  $\text{pK}_a$  values of EDTA ( $\text{H}_4\text{Y}$ ) are  $\text{pK}_{a1} = 2.0$ ,  $\text{pK}_{a2} = 2.68$ ,  $\text{pK}_{a3} = 6.11$ , and  $\text{pK}_{a4} = 10.17$ . Which species is the predominate form at pH 10.00?
  - $\text{H}_3\text{Y}^-$
  - $\text{H}_2\text{Y}^{2-}$
  - $\text{HY}^{3-}$
  - $\text{Y}^{4-}$
- Which of the following is not an optical spectrometric method?
  - UV-Vis absorption spectrometry
  - atomic emission spectrometry
  - fluorescence spectrometry
  - mass spectrometry

- The concentration of lead (Pb: 207.2) in an industrial waste stream is 0.35 ppm. What is the molar concentration (M)?
  - $1.7 \times 10^{-3}$
  - $3.5 \times 10^{-4}$
  - $1.7 \times 10^{-6}$
  - $3.5 \times 10^{-6}$
- Calculate the pH of a buffer consisting of 0.100 M  $\text{NH}_3$  and 0.150 M  $\text{NH}_4\text{Cl}$ . ( $K_b$  for  $\text{NH}_3$  is  $1.76 \times 10^{-5}$ )
  - 9.422
  - 4.578
  - 4.930
  - 9.070
- The amount of Fe in a 0.5846-g sample of an ore was determined by a redox titration with  $\text{K}_2\text{Cr}_2\text{O}_7$ . The sample is dissolved in HCl and the iron brought into the +2 oxidation state using a Jones reductor. Titration to the diphenylamine sulfonic acid end point required 38.42 mL of 0.01988 M  $\text{K}_2\text{Cr}_2\text{O}_7$ . Calculate the weight percentage of iron (Fe: 55.85) in the ore sample.
  - 43.78
  - 21.89
  - 14.59
  - 7.30
- The transmittance of a solution is found to be 42.0%. What is the transmittance if the solution is diluted in half?
  - 84.0%
  - 75.3%
  - 64.8%
  - 58.4%
- The following data were obtained by liquid chromatography on a 25-cm column

Compound	$t_r$ , min	w, min
Unretained	2.52	-
A	5.82	0.71
B	7.15	0.84

The resolution is

- 0.86
  - 1.72
  - 1.29
  - 10.2
- By how many volts will the potential of a  $\text{Mg}^{2+}$  ion selective electrode change if the electrode is removed from  $1.00 \times 10^{-4}$  M  $\text{MgCl}_2$  and placed in  $1.00 \times 10^{-3}$  M  $\text{MgCl}_2$ ?
    - + 0.0592 V
    - + 0.0296 V
    - 0.0296 V
    - 0.0592 V
  - For quantitative analysis of an analyte in seawater, how to examine the method's accuracy and precision? (6 points)
  - An edible plant is found to have excellent antioxidative activity. Design the procedures for identifying the major antioxidative component (or components) in the plant. (10 points)
  - Describe and compare "standard addition method" and "internal standard method". (8 points)