國立嘉義大學九十三學年度
應用化學系碩士班招生考試（甲組）試題

科目：綜合化學 II

注意：本試題可使用計算機

一、物理化學 (50%)

1. (1) What state function must remain constant in the Joule experiment?
   (2) What state function must remain constant in the Joule-Thomson experiment? (5 %)

2. One Kg of iron (specific heat C_p = 0.47 J K^{-1} g^{-1}) at 100 ^oC is place in 1 Kg of water (C_p = 4.19 J K^{-1} g^{-1}) at 0 ^oC. Calculate the final temperature and the entropy change. (10 %)

3. Find the wavelength of the light emitted when a $1\times10^{-27}\,g$ particle in a 0.3 nm one-dimensional box goes from the $n=2$ to the $n=1$ level. ($h=6.626\times10^{-34}\,JS^{-1}$) (10 %)

4. Find the selection rule for a particle of charge Q in a one-dimensional box of length *a*. (10 %)

5. The probability that a molecule of mass *m* in a gas at temperature T has speed v given by the Maxwell-Boltzman's distribution

$$f(v)=4\pi\left(\frac{m}{2\pi kT}\right)^{3/2}v^2e^{-mv^2/2kT}$$

where *k* is Boltzman's constant.
(1) Find the most probable speed.
(2) Find the average speed.
(3) Find the root mean square speed.
(4) Find the collision rate of a particular O_2 molecule at $25^{\circ}C$ and 1atm. The bond distance in O_2 is 0.12 nm.
(5) Find the mean free path of O_2 molecule at $25^{\circ}C$ and 1atm.

($I_n=\int_0^\infty e^{-ar^2}r^n dr$, $I_n=\frac{(n-1)}{2a}I_{n-2}$, $I_0=\frac{1}{2}\sqrt{\frac{\pi}{a}}$, $I_1=\frac{1}{2a}$) (15 %)

二、分析化學 (50%)

Part A. 單選：(20 %)

1. The degree of agreement among several measurements of the same quantity is called
   (A) accuracy (B) error (C) precision (D) certainty

2. The carbohydrate content of a glycoprotein is determined, the mean value and standard deviation obtained by five measurements are 12.3 and ± 0.4 g/100g, respectively. The t values at 95% confidence level for degree of freedom 3, 4, 5 are 3.182, 2.776, 2.571. The 95% confidence interval for the carbohydrate content is
   (A) 12.3 ±0.4 g/100g (B) 12.3 ±0.5 g/100g (C) 12.3 ±0.6 g/100g (D) none of the above.

3. The charge balance equation for a solution of Na_3PO_4 in water (considering all possible equilibrium reactions) is
   (A) $[Na^+] = 3\,[PO_4^{3-}]$
   (B) $[Na^+] = [PO_4^{3-}] + [HPO_4^{2-}] + [H_2PO_4^-]$
   (C) $3[Na^+] + [H_3O^+] = [PO_4^{3-}] + 2[HPO_4^{2-}] + 3[H_2PO_4^-] + [OH^-]$
   (D) $[Na^+] + [H_3O^+] = 3[PO_4^{3-}] + 2\,[HPO_4^{2-}] + [H_2PO_4^-] + [OH^-]$

4. Which of the following statements about EDTA titration is *correct*?
   (A) Conditional formation constant of metal-EDTA complex is increased with increasing pH.
   (B) The stoichiometry for the reaction of Fe^{3+} and EDTA is 1:3.
   (C) When analyte, metal ion A, is analyzed by the displacement titration by adding complex derived from EDTA and metal ion B, B-EDTA. The formation constant of A-EDTA must be smaller than that of B-EDTA.
   (D) When analyte, metal ion A, is analyzed by adding excess EDTA, then back titrated with metal ion B, the formation constant of A-EDTA must be smaller than that of B-EDTA.

5. $E^o_{(Cu^{2+}-Cu)}$ = 0.339V. The half-cell potential for Cu electrode immersed in a solution of 1.00×10^{-4} M Cu^{2+} is
   (A) 0.457V (B) 0.398V (C) 0.280V (D) 0.221V

6. Which of the following electromagnetic radiations corresponds to ΔE of molecular vibration?
   (A) ultraviolet radiation (B) infrared radiation (C) microwaves (D) radio waves

7. Which of the following transitions might emit fluorescent radiation? (S:singlet, T:triplet)
   (A) $S_2\rightarrow T_1$ (B) $S_0\rightarrow T_1$ (C) $T_1\rightarrow S_0$ (D) $S_1\rightarrow S_0$

背面尚有試題

8. In atomic absorption spectrometry, a reagent which is used to react with analyte to prevent it from transforming into nonanalyzable form is called
(A) protecting agent (B) releasing agent
(C) ion suppressor (D) background correction agent

9. Which of the following statements about chromatography is *incorrect*?
(A) In reverse-phase LC, mobile phase is more polar than stationary phase.
(B) In normal-phase LC, raising the polarity of mobile phase will increase the retention time of polar solute.
(C) In GC, increasing temperature will reduce the retention time of solute.
(D) In open-tubular GC, A in van-Deemter equation ($H = A + \frac{B}{u} + C\,u$) is zero.

10. For graphite furnace AAS (GFAAS) and ICP-AES, which statement is *correct*?
(A) Detection limit: GFAAS < ICP-AES (B) Sample volume: GFAAS > ICP-AES
(C) Linear working range: GFAAS > ICP-AES (D)Sample throughput: GFAAS < ICP-AES

Part B. 計算及問答: (30 %)

1. Calculate the pH of solution when 25.00 ml 0.1000M NaOH is added to 50.00 ml 0.0500M benzoic acid (C_6H_5COOH, pKa = 4.202)? (8%)

2. A 0.1576g of primary standard $Na_2C_2O_4$ (fw =134.00) in 1M H_2SO_4 required 20.93ml of a $KMnO_4$ solution to reach end point. Calculate the molarity of the $KMnO_4$ solution. (5%)

3. The concentration of the barbital (MW= 184.19) in a blood sample was determined by extracting 3.00 ml of the blood with 15 ml of chloroform. The chloroform, which now contains the barbital, is then extracted with 10.0mL of $NaOH_{(aq)}$ (pH 13). The aqueous extract is placed in a 1.00-cm cell, and an absorbance of 0.265 is measured. When 3.00 ml of a standard solution with a concentration of 3.00 mg/100 ml is analyzed through the same procedure, the absorbance is 0.404.

(1) Calculate the molar absorptivety of barbital solution at pH 13. (4%)

(2) Calculate the molar concentration of barbital in the blood sample. (4%)

4. The following data were obtained by liquid chromatography on an analytical column (Vm=1.42ml, Vs=0.170ml).

Compound	t_r, min	w, min
Unretained	2.8	–
A	8.2	0.71
B	10.1	0.84

(1) Calculate the capacity factor and the partition coefficient (K=Cs/Cm) for compound A. (6%)

(2) Calculate the resolution. (3%)