

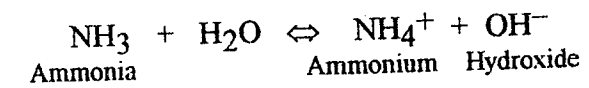
八十七學年度 原子科學 系(所) 乙 組碩士班研究生入學考試  
 科目 分析化學 科號 4202 共 3 頁第 1 頁 \*請在試卷【答案卷】內作答

1. Briefly explain the difference between the following terms:

- a) equivalent point/ end point
- b) sensitivity/ detection limit
- c) kinetic polarization/ concentration polarization
- d) sample standard deviation (s)/ population standard deviation ( $\sigma$ )
- e) confidence limit/ significant test
- f) constant current coulometry/ constant potential coulometry
- g) alkaline error/ acid error (in pH measurement with a glass electrode)
- h) linear scan polarography/ pulse polarography (16%)

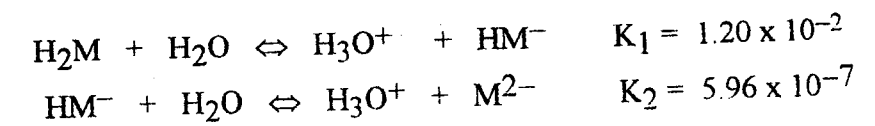
2. Answer the following questions:

- a) The concentration of a organic compound  $C_{29}H_{60}$  (Mw 408.8 g/mol) in rainwater is 34 ppb. What is the molarity of this compound? (4%)
- b) A solution of ammonia in water is called "ammonium hydroxide" because of the equilibrium



The density of concentrated ammonium hydroxide, which contains 28.0 wt%  $NH_3$  is 0.899 g/mL. What volume of this reagent should be diluted to make 500 mL of 0.250 M  $NH_3$ ? (MW of  $NH_3$  17.03g/mol). (4%)

3. Derive a curve for the titration of 25.00 mL of 0.1000M maleic acid,  $C_2H_2(COOH)_2$ , with 0.1000 M NaOH. The two dissociation equilibria can be written as



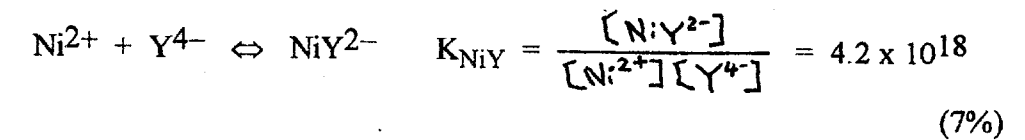
where  $H_2M$  symbolizes the free acid. Find the pH at

- a) initial point
- b) first buffer region (after addition of 5.00 mL of NaOH)
- c) first equivalent point
- d) second buffer region (after addition of 25.50 mL of NaOH) (10%)

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4. Calculate the concentration of  $\text{Ni}^{2+}$  in a solution prepared by mixing 50.0 mL of 0.0300 M  $\text{Ni}^{2+}$  with 50.0 mL of 0.0500 M EDTA. The mixture is buffered to a pH of 3.00. ( $\alpha_4$  for  $\text{H}_4\text{Y}$  at pH 3.00 is  $2.5 \times 10^{-11}$ )

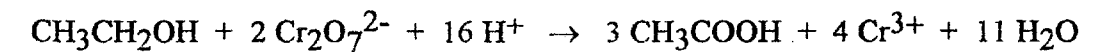


5. Calculate the voltage of the cell below, assuming no complexation of the silver ion by oxalate to form soluble species. Assume also no hydrolysis of  $\text{C}_2\text{O}_4^{2-}$ .

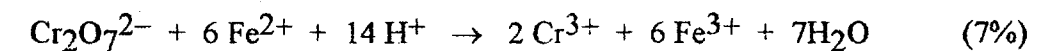
SCE ||  $\text{Na}_2\text{C}_2\text{O}_4$  ( $1.00 \times 10^{-3}\text{M}$ ),  $\text{Ag}_2\text{C}_2\text{O}_4$  (saturated) | Ag



6. A 5.00-mL portion of table wine was diluted to 100.0 mL in a volumetric flask. The ethanol in a 20.00-mL aliquot was distilled into 100.00 mL of 0.05151 M  $\text{K}_2\text{Cr}_2\text{O}_7$ . Heating completed oxidation of the alcohol to acetic acid:



following which the excess dichromate was titrated with 14.42 mL of 0.02497 M  $\text{Fe}(\text{II})$ . Calculate the weight-volume percentage of ethanol (fw = 46.07) in the wine.



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7. Describe the basic differences between the following terms and list any particular advantages and disadvantages:
- (a) Hydrogen-and deuterium-discharge lamp as sources for ultraviolet radiation.(3%)
  - (b) Single-beam and double-beam photometers.(3%)
  - (c) Atomic emission and atomic fluorescence spectroscopy.(3%)
8. The retention times for substance A and B were 14.80 and 16.20 min, respectively, in a 40.0 cm column, whereas the widths of respective peaks were 1.30 and 1.40 min. Calculate following question:
- (a) The average theoretical plate number of the column.(4%)
  - (b) The resolution ( $R_1$ ) of the column.(4%)
  - (c) The height equivalent to a theoretical plate.(4%)
  - (d) The length that the column should have in order to achieve a resolution ( $R_2$ ) of 1.40.(4%)
9. Predict the eluted order of the following solutes in the chromatographic separation.
- (a) n-hexane,n-hexanol, benzene by normal-phase.(3%)
  - (b) n-hexane,n-hexanol, benzene by reversed-phase separation.(3%)
  - (c)  $\text{Ag}^+$ ,  $\text{Na}^+$ ,  $\text{Rb}^+$ ,  $\text{Ba}^{2+}$  and  $\text{Ca}^{2+}$  by ion-exchange chromatography. The value of  $K_{eq}$  decrease in the order.  $\text{Ag}^+ > \text{Rb}^+ > \text{Na}^+$  and  $\text{Ba}^{2+} > \text{Ca}^{2+}$ .(4%)
10. A 5.00 g organic sample was decomposed by wet-ashing and subsequently diluted to 500 ml in a volumetric flask. Zinc was determined by treating 25.00 ml aliquots of this diluted solution as follows:

Zn(II) 2.50 ppm	Reagent volume (ml)		Absorbance
	Ligand	H <sub>2</sub> O	
0.00	20.00	5.00	0.400
5.00	20.00	0.00	0.520

Assume that the Zn(II)/ligand chelate obeys Beer's law and calculate the percentage of Zn in the original sample.(10%)