

國立清華大學 106 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(環境與分子科學組)

考試科目 (代碼)：分析化學(2401)

共 2 頁，第 1 頁 \*請在【答案卷】作答

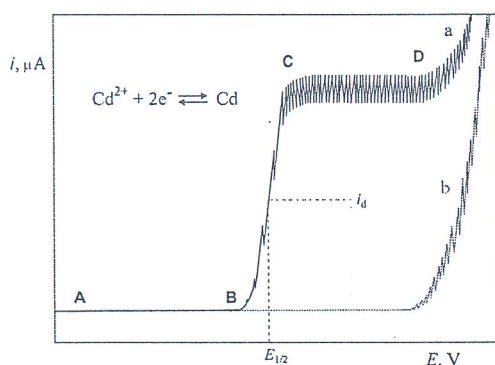
- (10%) How to prepare 1.0 L of a buffer with a pH of 7.0 from 0.2 M  $\text{H}_3\text{PO}_4$  and 0.16 M NaOH? ( $\text{H}_3\text{PO}_4$ :  $K_{a1} = 7.11 \times 10^{-3}$ ,  $K_{a2} = 6.32 \times 10^{-8}$ ,  $K_{a3} = 4.5 \times 10^{-13}$ )
- (10%) Most spectroscopic instruments are made up of five components. Draw a diagram to illustrate the configuration of these components in (a) absorption spectroscopy and (b) fluorescence spectroscopy, respectively.
- (6%) Standard addition methods are particularly useful for analyzing complex samples in which the likelihood of matrix effects is substantial. Please illustrate how the method of standard additions works?
- (10%) Calculate the formation constant  $K_f$  for  $\text{Ag}(\text{CN})_2^-$ :  

$$\text{Ag}^+ + 2 \text{CN}^- \rightleftharpoons \text{Ag}(\text{CN})_2^-$$
 if the cell  

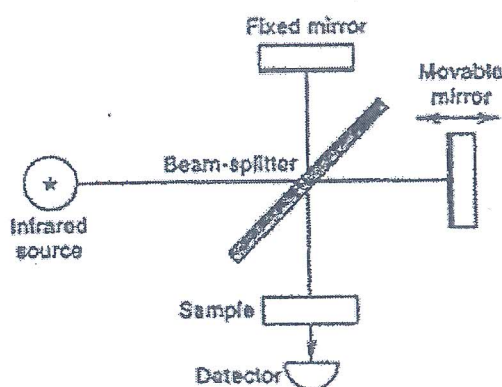
$$\text{SCE} \parallel \text{Ag}(\text{CN})_2^- (7.5 \times 10^{-3} \text{ M}), \text{CN}^- (0.025 \text{ M}) \mid \text{Ag}$$
 develops a potential of -0.625V.  
 (The electrode potential of SCE is 0.244 V at 25°C)  

$$(\text{Ag}^+ + e^- \rightleftharpoons \text{Ag}_{(s)} \quad E^\circ = +0.799 \text{ V})$$
- (4%) Please assign a suitable name to the corresponding analytical techniques.

(a)



(b)



國立清華大學 106 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 乙組(環境與分子科學組)

考試科目 (代碼)：分析化學(2401)

共 2 頁，第 2 頁 \*請在【答案卷】作答

6. Describe the principles of operation of (a) Inductively coupled plasma-mass spectrometry (6%) and (b) Flow injection analysis (4%).
7. (10%) List the variables that lead to zone broadening in chromatography. Please explain why the length of LC columns (~25 cm) are much shorter than GC capillary columns (50 m).
8. (10%) In the Volhard method, silver ions are titrated with a standard solution of thiocyanate ion:  $\text{Ag} + \text{SCN}^- \rightleftharpoons \text{AgSCN}_{(s)}$  ( $K_{\text{sp}} = 1.1 \times 10^{-12}$ )  
Iron(III) serve as the indicator.  
 $\text{Fe}^{3+} + \text{SCN}^- \rightleftharpoons \text{Fe}(\text{SCN})^{2+}$  ( $K_{\text{f}} = 1.05 \times 10^3$ )  
Experiment shows that the red color of  $\text{Fe}(\text{SCN})^{2+}$  is observed when its concentration is  $6.4 \times 10^{-6}$  M. In the titration of 50 mL of 0.05 M  $\text{Ag}^+$  with 0.1 M KSCN, what concentration of  $\text{Fe}^{3+}$  should be used to lower the titration error to zero?
9. (10%) In flame AA, the calcium signal depressed in the presence of large concentrations of sulfate ion.  
(a) Suggest an explanation for this observation.  
(b) Suggest three possible methods of overcoming the potential interference of sulfate in a quantitative determination of calcium.
10. (5%) Describe the cause of liquid-junction potential.
11. (10%) Please state the working principle of electron capture detector (ECD). Why ECD is considered as the best detector for the measurement of polychlorinated biphenyls and organo-halogen pesticides by GC?
12. (5%) A solution containing 4.48 ppm  $\text{KMnO}_4$  has a transmittance of 0.309 in a 1.0-cm cell at 520 nm. Calculate the molar absorptivity of  $\text{KMnO}_4$ . Please express your result with the proper unit as well. (K = 39.1 amu, Mn = 54.9 amu)