# 國　立　清　華　大　學　命　題　紙

95 學年度 生醫工程與環境科學 系（所） 環境分子科學 組碩士班入學考試

科目 分析化學 科目代碼 3103 共 3 頁第 1 頁 *請在答案卷內作答

1. (20%) Please define following terms and explain the difference

   (a) Sensitivity and detection limit

   (b) Differentiating solvent and leveling solvent for revealing the strength of acidity of different acids

   (c) Activity and activity coefficient

   (d) Gravimetric precipitation method and gravimetric volatilization method

   (e) Formation constant and conditional formation constant.

   (f) Electrode potential and formal potential.

   (g) Junction potential and boundary potential.

   (h) Conventional and diode-array spectrophotometers.

   (i) Resonance fluorescence and stock shift

   (j) Ionization suppressor and releasing agent for atomic absorption spectroscopy.

2. (10%) What volume of 0.200 M HCl must be added to 250.0 mL of 0.300 M sodium mandelate to produce a buffer solution with a pH of 3.37? ($K_a$ mandelic acid $=4\times10^{-4}$)

3. (5%) A 0.2121-g sample of an organic compound was burned in a stream of oxygen, and the $CO_2$ produced was collected in a solution of barium hydroxide. Calculate the percentage of carbon in the sample if 0.6006 g of $BaCO_3$ was performed. (MW of $BaCO_3$=197.34 g/mol)

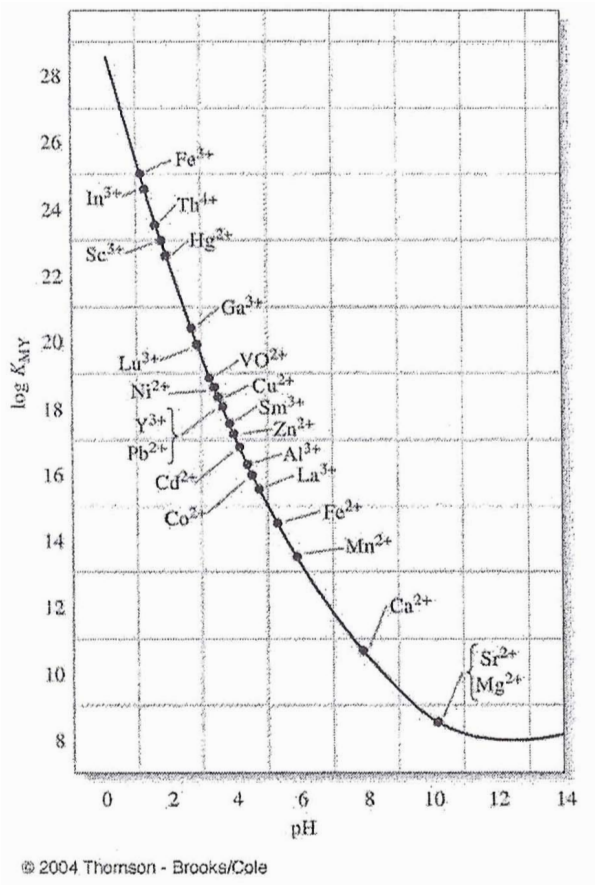
4. (5%) A solution of $HClO_4$ was standardized by dissolving 0.4125 g of primary-standard-grade HgO in a solution of KCl:

   $$HgO_{(s)} + 4Br^- + H_2O \rightarrow HgBr_4^{2-} + 2OH^-$$

   The liberated $OH^-$ consumed 46.51 mL of the acid. Calculate the molarity of the $HClO_4$.
   (MW of HgO= 216.59 g/mol)

5. (10%) Calculate the pH after addition of 0.00, 25.00, 50.00 and 60.00 mL of 0.1000 M NaOH in the titration of 50.00 mL of 0.1000 M lactic acid. ($K_a$, Lactic Acid$=1.38\times10^{-4}$)

6. (10%) A 50.00 mL aliquot of a solution containing Fe(II) and Fe(III) required 13.73 mL of .01200 M EDTA when titrated at pH 2.0 and 29.62 mL when titrated at pH 6.0. Express the concentration of the solution in terms of the parts per million of each solute. (Atomic weight of Fe=55.85 g/mol)




Minimum pH needed for satisfactory titration of various cations with EDTA.

7. (10%) The $KClO_3$ in a 0.1279-g sample of an explosive was determined by reaction with 50.00 mL of 0.08930 m $Fe^{2+}$:

$$ClO_3^- + 6Fe^{2+} + 6H^+ \rightarrow Cl^- + 3H_2O + 6Fe^{3+}$$

When the reaction was complete, the excess $Fe^{2+}$ was back-titrated with 14.93 mL of 0.083610 M $Ce^{4+}$. Calculate the percentage of $KClO_3$ in the sample. (MW of $KClO_3$ =122.549 g/mol)

8. (5%) The molar absorptivity for aqueous solutions of phenol at 211 nm is $6.17\times10^3$ L $cm^{-1}$ $mol^{-1}$. Calculate the permissible range of phenol concentrations that can be used if the transmittance is to be less than 80% and greater than 5% when the measurements are made in 1.00-cm cells.

9. (10%) (a) Describe the characteristics of organic compounds that fluosce.

(b) Explain why molecular fluorescence often occurs at a longer wavelength than the exciting radiation.

(c) Describe the components of a fluorometer.

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10. (5%) Please state the sources of nonlinearity in atomic emission and atomic absorption spectrometer.

11. (10%)The following data are for a liquid chromatographic column:

| | |
|---|---|
| Length of Packing | 24.7 cm |
| Flow rate | 0.313 mL/min |
| $V_M$ | 1.37 mL |
| $V_S$ | 0.164 mL |

A chromatogram of a mixture of species A, B, C, and D provided the following data:

| | Retention time, min | Width of peak base(W), mm |
|---|---|---|
| Noretained | 3.1 | -- |
| A | 5.4 | 0.41 |
| B | 13.3 | 1.07 |
| C | 14.1 | 1.16 |
| D | 21.6 | 1.72 |

Calculate

(a) the number of plates from each peak.

(b) the plate height for the column.

(c) the resolution for species C and D.

(d) the length of column necessary to separate species B and C with a resolution of 1.5.

(Hints: the length of column=24.7 cm ; $N= 16(t_R / W)^2$; $R_S =2[(t_R)_C - (t_R)_B] / (W_B + W_C)$ ; $\frac{(R_S)_1}{(R_S)_2} = \frac{\sqrt{N_1}}{\sqrt{N_2}}$ )

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