96 學年度 生醫工程與環境科學 系（所） 乙（環境分子科學） 組碩士班入學考試

科目 分析化學 科目代碼 2603 共 3 頁第 1 頁 *請在答案卷內作答

1. (30%) Please define following terms and explain the difference

(a) Population mean and sample mean

(b) Randon error and systematic error

(c) Amphiprotic solute and zwitterion

(d) Mass-action law and common-ion effect

(e) Thermodynamic and concentration equilibrium constant.

(f) Colloidal and crystalline precipitation.

(g) Concentration polarization and kinetic polarization.

(h) Beer's law and Nernst equation.

(i) Single-beam and double-beam instruments for absorbance measurement

(j) Spectral interference and chemical interference for atomic absorption spectroscopy.

2. (10%) Please give appropriate answer to following two question

(a) Which of the GC detectors in following table are suitable for HPLC? Why are some of these unsuitable for HPLC?

Gas Chromatographic Detectors

Type	Applicable Samples	Typical Detection Limit
Flame ionization	Hydrocarbons	0.2 pg/s
Thermal conductivity	Universal detector	500 pg/mL
Electron capture	Halogenated compounds	5 fg/s
Mass spectrometer	Tunable for any species	0.25–100 pg
Thermionic	Nitrogen and phosphorous compounds	0.1 pg/s (P) 1 pg/s (N)
Electrolytic conductivity (Hall)	Compounds containing halogens, sulfur, or nitrogen	0.5 pg Cl/s 2 pg S/s 4 pg N/s
Photoionization	Compounds ionized by UV radiation	2 pg C/s
Fourier transform IR	Organic compounds	0.2 to 40 ng

(b) Name two general methods of improving the resolution of two substances on a chromatographic column.

3. (5%) (1) Why is source modulation employed in atomic absorption spectroscopy?

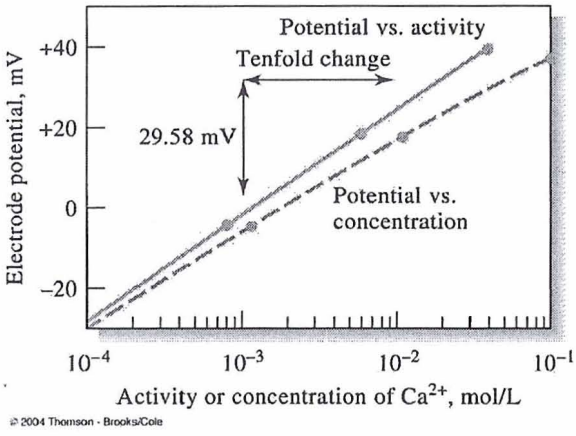
(2) Why is the inductively coupled plasma rarely used for atomic absorption measurements?

96 學年度 原子科學 系（所） 乙 組碩士班入學考試

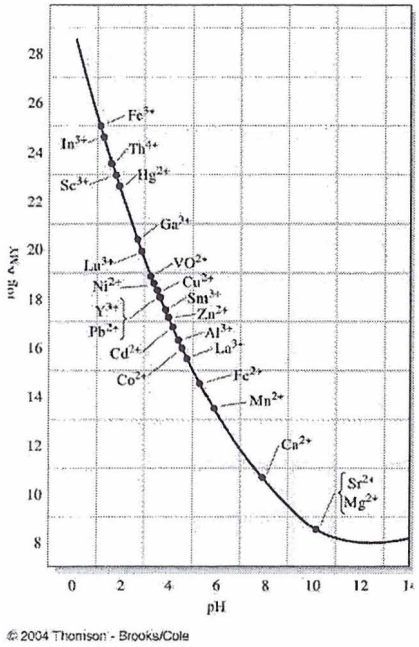
科目 分析化學 科目代碼 2603 共 3 頁第 2 頁 *請在答案卷內作答

4. (10%) Absorption of UV/VIS radiation by molecules generally occurs in one or more electronic absorption bands. Compared to atomic absorption spectrometry, the absorption behavior of atoms or ions are also caused by the promotion of electrons between the excited electronic state and ground electronic state. However, based on the experimental results, the absorption spectra of atomic and molecular species are quiet different, which one is line spectrum and another one is band spectrum. Please explain the difference between atomic and molecular spectra.

5. (5%) Based on following figure, please explain the reason why the response of a Ca^{2+} membrane electrode to the concentration is not linear.



6. (10%) Please refer to following figure and answer the question. A 50.00-mL aliquot of a solution containing Fe(II) and Fe(III) required 13.73 mL of 0.01200 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 (mg L^{-1}) of each solutes. (Atomic weight of Fe=55.85 g/mol)



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

7. (10%) The solubility-product constant for $Ni_2P_2O_7$ is 1.7×10^{-13}. Calculate E^o for the process

$$Ni_2P_2O_7\,(s) + 4e^- \Leftrightarrow 2Ni(s) + P_2O_7^{4-}$$

$$(2Ni^{2+} + 4e^- \underset{\leftarrow}{\rightarrow} 2Ni(s) \qquad E^\circ = -0.250\,)$$

8. (5%) Consider curves for the difference of 0.10 M NaOH and 0.010 M HN_3 with 0.10 M HCl. (k_a of $NH^{4+}=5.7\times10^{-10}$)

(a) Please generate the titration curves of above two titrations.

(b) Briefly account for the differences between curves for the two curves.

9. (10%) The mercury in a 0.8142 g sample was precipitated with an excess of araperiodic acid. H_5IO_6:

$5Hg^{2+} + 2\,H_5IO_6 \rightarrow Hg_2(IO_6)_2 + 10H^+$

The precipitate was filtered, washed free of precipitating agent, dried, and weighed and 0.4114 g was recovered. Calculate the percentage of Hg_2Cl_2 in the sample.

(1 mole $Hg_2(IO_6)_2$=1448.75 g; 1 mole Hg_2Cl_2=472.09 g)

10. (5%) Titration of the I_2 produced from 0.1045 g of primary standard KIO_3 required 30.32 mL of sodium thiosulfate.

$IO^{3-} + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S4O_6^{2-}$

Calculate the concentration of the $Na_2S_2O_3$.

$$(\mathcal{M}_{KIO_3} = 214.00\frac{g}{mole})$$

---- The end ----