

國立清華大學命題紙

98 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 2403 共 4 頁第 1 頁 *請在【答案卷卡】內作答

1. (10%) A scientist determined the atomic mass of lithium and collected the following data.

Experiment	Molar Mass, g/mol
1	6.9391
2	6.9407
3	6.9409
4	6.9399
5	6.9407
6	6.9391
7	6.9406

(a) Find the medium atomic mass.

(b) Assuming that the currently accepted value for the atomic mass of lithium is the true value (6.941 g/mol), calculate the absolute error and the percentage relative error of the mean value determined shown above.

2. (10%)

(a) Please define buffer capacity.

(b) Which has the greater buffer capacity: (a) mixture containing 0.100 mol of NH_3 and 0.200 mol of NH_4Cl or (b) a mixture containing 0.0500 mol of NH_3 and 0.100 mol of NH_4Cl .

$$(K_a \text{ of } \text{NH}_3 = 5.7 \times 10^{-10})$$

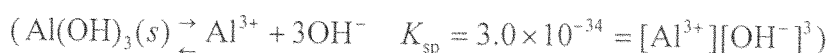
(c) How would you prepare 1.00 L of a buffer with a pH of 9.60 from 0.300 M Na_2CO_3 and 0.200 M HCl .

$$([\text{H}_3\text{O}^+][\text{CO}_3^{2-}]/[\text{HCO}_3^-] = 4.69 \times 10^{-11})$$

3. (10%) What hydroxide concentration is required to

(a) Initiate precipitate of Al^{3+} from a 2.50×10^{-2} M solution of $\text{Al}_2(\text{SO}_4)_3$?

(b) Lower the Al^{3+} concentration in the foregoing solution to 2.00×10^{-7} M?

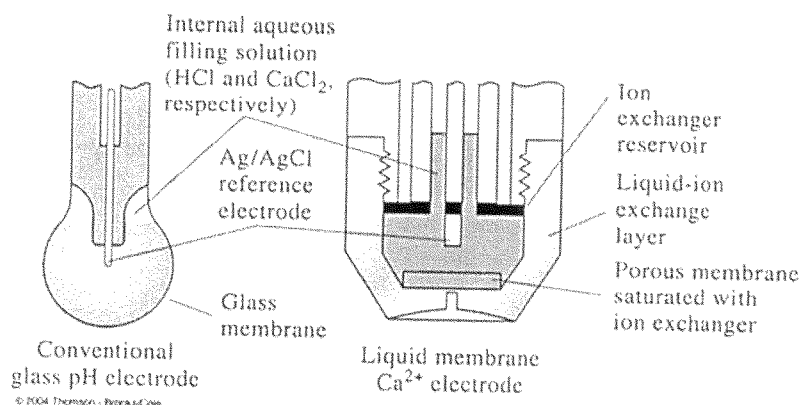


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科目 分析化學 科目代碼 2403 共 4 頁第 2 頁 *請在【答案卷卡】內作答

4. (10%) A 5.00-g sample of a pesticide was decomposed with metallic sodium in alcohol, and the liberated chloride ion was precipitated as AgCl. Express the results of this in terms of percent DDT ($C_{14}H_9Cl_5$) based on the recovery of 0.1606 g of AgCl.
(AgCl: 143.37 g/mol; $C_{14}H_9Cl_5$: 354.72 g/mol)
5. (10%) Calculate the potential of a copper electrode immersed in
- 0.440 M $Cu(NO_3)_2$. ($E_{Cu^{2+}} = 0.337V$)
 - 0.0750 M in NaCl and saturated with CuCl. ($E_{Cu^+} = 0.521V$; $K_{CuCl} = 1.9 \times 10^{-7} = [Cu^+][Cl^-]$)
 - 0.0400 M in NaOH and saturated with $Cu(OH)_2$. ($K_{Cu(OH)_2} = 4.8 \times 10^{-20} = [Cu^{2+}][OH^-]^2$)
6. (10%) Following figure shows the diagrams of a liquid membrane calcium ion and a glass pH electrode.
- Please state the working principle of glass pH electrode.
 - Please state the difference in sensing calcium and hydrogen ions by the electrodes shown below.
 - Please state the reason why both of the concentrations of hydrogen ion and calcium ion in the filling solution must be kept at a fixed level.



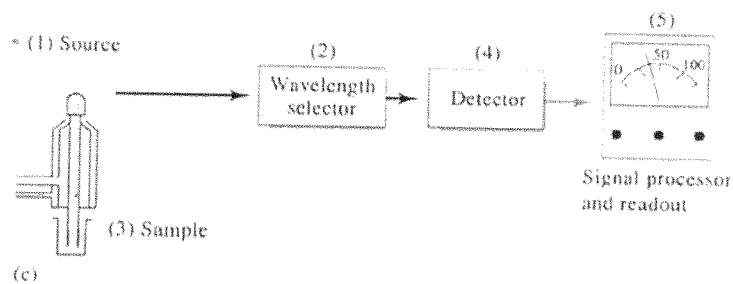
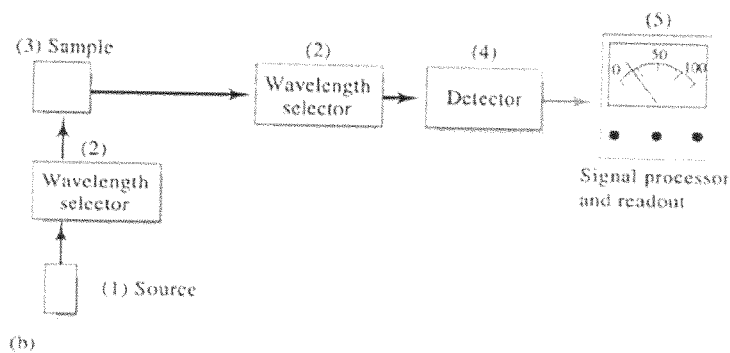
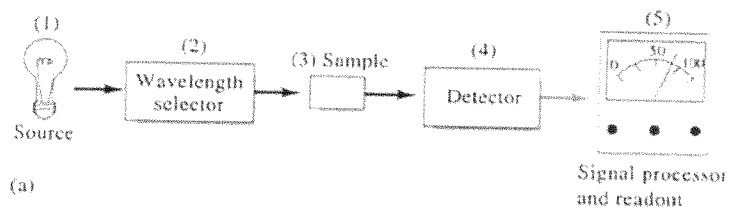
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7. (10%) Following shows the configurations of three different spectrometers.

- Please illustrate what kind of measurements can be achieved by a, b, and c instruments, respectively.
- Please illustrate the reasons why b instrument contains two wavelength selectors and why the incident light and the emitted light of b instrument are arranged in right angle.
- Photomultiplier tubes are the most widely-used detector for spectrometers. Please illustrate the reason why it is unsuited for the detection of infrared radiation?



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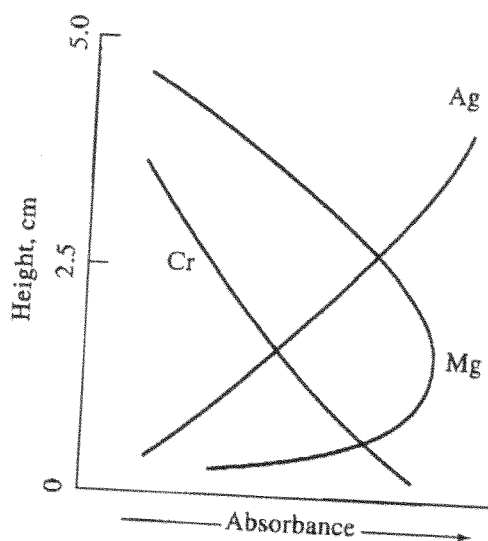
- Why do some absorbing compounds fluoresce while others do not?
- Why molecular fluorescence often occurs at a longer wavelength than the exciting radiation?
- Why is spectroflurometry potentially more sensitive than spectrophotometry?

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9. (10%) (a) Why is the ICP (inductively coupled plasma) rarely used for atomic absorption measurements?
(b) Why are the lines from a hollow-cathode lamp generally narrower than the lines emitted by atoms in a flame?
(c) Following figure shows the changes in the absorbances of Ag, Cr, and Mg measured at different observation height when flame atomic absorption spectrometer is used. Please give the reason why the changes in the absorbances of Ag, Cr, and Mg are different.



10. (10%) Briefly defined and describe the effect of following parameters on the chromatographic separation efficiency.

- (a) Capacity factor
- (b) Selective factor
- (c) Plate height
- (d) Plate number
- (e) Isocratic elution and gradient elution

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