


注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

考試科目(代碼)：分析化學(2901)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

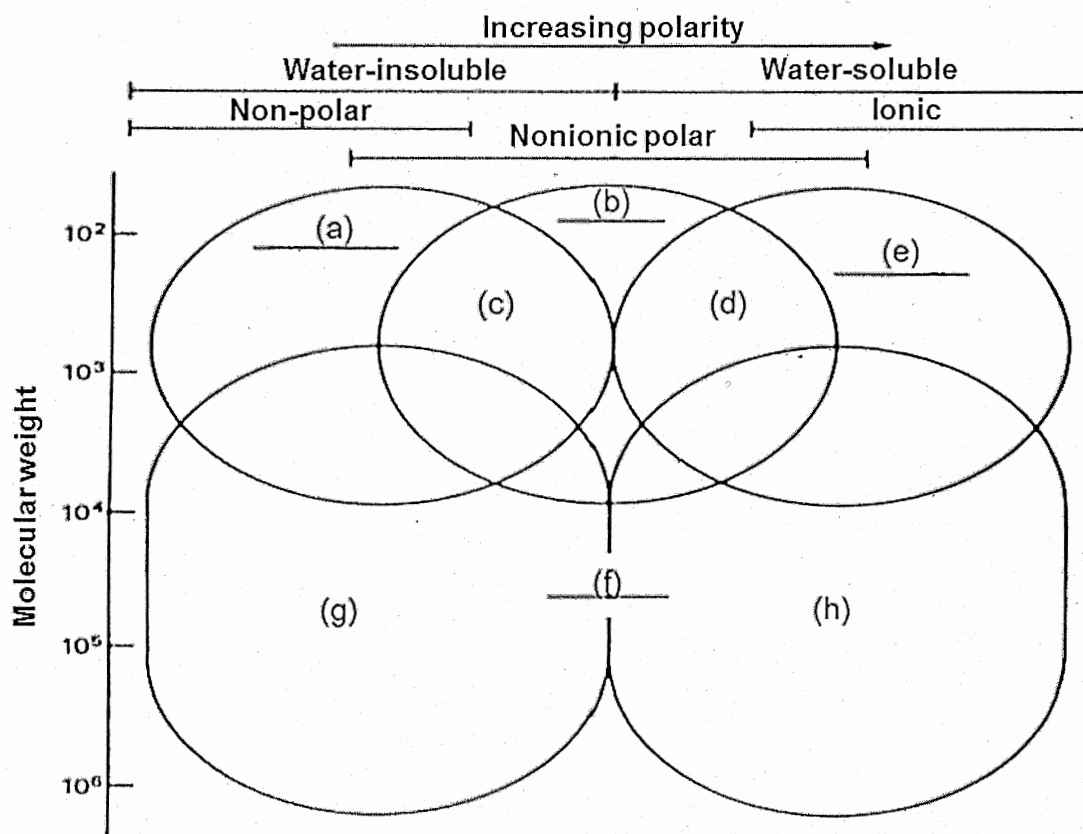
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共 3 頁，第 1 頁 *請在【答案卷】作答

1. (12%) There are five most widely used types of high-performance liquid chromatography. Please refer to the following figure and fill in the blanks.



2. (8%) Describe the physical differences between open tubular and packed columns. What are the advantages and disadvantages of each?
3. (4%) How do strong and weak acid synthetic ion-exchange resins differ in structure?
4. (6%) In flame AA with a hydrogen/oxygen flame, the absorbance for iron decreased in the presence of large concentrations of sulfate ion.
- (a) Suggest an explanation for this observation.
- (b) Suggest two possible methods of overcoming the potential interference of sulfate in a quantitative determination of iron.

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共 3 頁，第 2 頁 *請在【答案卷】作答

5. (6%) Please fill in the blanks in the following table.

Gas Chromatographic Detectors		
Type	Applicable Samples	Typical Detection Limit
(a) _____	Hydrocarbons	0.2 pg/s
(b) _____	Universal detector	500 pg/mL
(c) _____	Halogenated compounds	5 fg/s
Mass spectrometer	Tunable for any species	0.25–100 pg

6. (6%) List all the characteristics of inductively coupled plasmas that make them suitable for atomic emission and atomic mass spectrometry.
7. (6%) Describe the instrumental components and arrangement for carrying out fluorescence spectroscopic measurement.
8. (4%) Describe the characteristics of organic compounds that fluoresce.
9. (10%) Molar absorptivity data for the cobalt and nickel complexes with 2,3-quinoxalinedithiol are $\epsilon_{\text{Co}} = 36,400$ and $\epsilon_{\text{Ni}} = 5,520$ at 510 nm and $\epsilon_{\text{Co}} = 1,240$ and $\epsilon_{\text{Ni}} = 17,500$ at 656 nm. A 0.519 g sample was dissolved and diluted to 50.0 mL. A 25.0 mL aliquot was treated to eliminate interferences; after addition of 2,3-quinoxalinedithiol, the volume was adjusted to 50.0 mL. This solution had an absorbance of 0.477 at 510 nm and 0.219 at 656 nm in a 1.00 cm cell. Calculate the concentration in parts per million of cobalt and nickel in the sample. (Co = 58.93 amu and Ni = 58.69 amu)
10. (5%) What is standard addition method? What is the main advantage of this method?

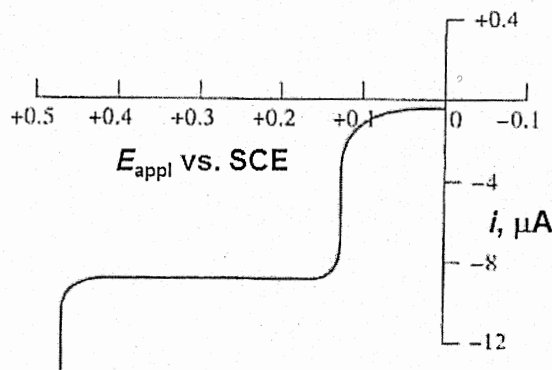
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共 3 頁，第 3 頁 *請在【答案卷】作答

11. (4%) Why is a high supporting electrolyte concentration used in most electroanalytical procedures?
12. (4%) Why is an auxiliary reagent always required in a coulometric titration?
13. (5%) Shown below is the polarogram for a solution that was 1×10^{-4} M in KBr and 0.1 M in KNO_3 . Offer an explanation of the wave that occurs at +0.12 V and the rapid change in current that starts at about +0.48 V. Would the wave at 0.12 V have any analytical applications? Explain.



14. (10%) Calculate the dissociation constant for the weak acid HP if the cell
 $\text{SCE} \parallel \text{HP} (0.010 \text{ M}), \text{NaP} (0.040 \text{ M}) \mid \text{Pt}, \text{H}_2 (1.00 \text{ atm})$
develops a potential of -0.591 V.
(The electrode potential of SCE is 0.244 V at 25°C)
15. (10%) The arsenic in a 1.010 g sample of a pesticide was converted to H_3AsO_4 by suitable treatment. The acid was then neutralized, and exactly 40.00 mL of 0.06222 M AgNO_3 was added to precipitate the arsenic quantitatively as Ag_3AsO_4 . The excess Ag^+ in the filtrate and in the washings from the precipitate was titrated with 10.76 mL of 0.1000 M KSCN ; the reaction was
- $$\text{Ag}^+ + \text{SCN}^- \rightarrow \text{AgSCN}(s)$$
- Calculate the percent As_2O_3 in the sample. (As = 74.92 amu)