P.G. DIPLOMA IN ANALYTICAL CHEMISTRY

Term-End Examination

June, 2010

00290

MCH-002 : SEPARATION METHODS

Time : 3 hours *Maximum Marks : 75*

Note : *Attempt **any five** questions. All questions carry **equal** marks.*

1. (a) List any five properties on the basis of which a mixture of more than two components can be separated. Explain the use of any one property. **5**

(b) Name the various chromatographic methods based on different stationary and mobile phases. **5**

(c) What do you understand by 'Extraction by Solvation' ? Explain, giving equations, extraction of Fe (III) in ether with increasing concentration of HCl. **5**

2. (a) Explain how metal ions can be extracted by chelation ? Discuss the mechanism and write structures of two chelating groups used for metal ion extraction. **3+2**

(b) Distribution ratio of a metal ion in chelate extraction method using CCl_4 - water system is 84. Assuming volumes of two phases to be equal, calculate % extraction of the metal ion in CCl_4. **5**

(c) What is meant by resolution ? Draw chromatograms illustrating the separation of two components with a resolution of 0.75, 1.0 and 1.5. Give mathematical expression for resolution using half widths. **5**

3. (a) Explain the concept of theoretical plates. If retention time of a solute is 12.7 min and its half peak width is 0.63 min then calculate the number of theoretical plates. **3+2**

(b) What is planar chromatography ? Discuss its two forms briefly and compare them with regard to experimental set up and applications. **5**

(c) What is Thin Layer Chromatography (TLC) ? Discuss the nature of support, stationary phase and mobile phase and their characteristics. **5**

4. (a) What are the essential characteristics of support material used in liquid-liquid chromatography (LLC) ? Discuss the requirements of a suitable mobile phase. 5

(b) Draw a labelled typical gas chromatogram. How can you increase the column efficiency using different solvents ? Explain with suitable illustration and give an expression for its calculation. 5

(c) What are the various stationary phase supports and liquid phases used in gas chromatography ? Discuss their requirements. Illustrate the variation of retention time with % liquid loading. 5

5. (a) Draw the structure of silica gel depicting various types of OH groups interacting with the solute/solvent molecules. How are these converted into siloxanes by reacting with organohalosilanes ? 5

(b) What do you understand by reverse phase (RP) HPLC ? In what respect it differs from normal phase HPLC ? Explain the application of RP HPLC with a suitable example. 5

(c) How does interfacing a mass spectrometer with a GC increases its detection limit ? Compare its performance with other detectors. 5

6. (a) Explain the basic principle of ion chromatography and ion exchange chromatography. In what respect these differ from each other ? Give an example of application of each. 5

(b) What are natural and synthetic ion exchangers ? Describe various types of synthetic ion exchangers and their preparation methods. 5

(c) Describe various properties of ion exchange resins. Explain the difference between distribution ratio (D) and distribution coefficient (K_D). 5

7. (a) How are metal ions separated by using cation and anion exchangers ? Explain your answer by giving suitable examples. 5

(b) Describe any five properties of gels used for gel permeation chromatography. Draw a plot between log (mol. wt) and retention volume. 5

(c) What are the unique features of gel permeation chromatography ? Describe the variables defining the utility of gels. 5

8. (a) Explain membrane separation process using schematic representation and mathematical expressions. **3**

(b) Explain basic principle and operation of electrophoresis. **3**

(c) Write notes giving suitable examples : **3x3=9**

(i) Reverse Osmosis.

(ii) Ion selective membrane electrode.

(iii) Slab electrophoresis.
