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MCH-002

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

00478

June, 2015

MCH-002 : SEPARATION METHODS

Time : 3 hours *Maximum Marks : 75*

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

1. (a) Explain the various properties on the basis of which a two-component mixture may be separated. Discuss the use of any one property. 5

(b) What are the criteria for the selection of a separation method ? Explain the capabilities of hyphenated methods. 5

(c) List the various factors affecting solvent extraction. Explain any one of these briefly. 5

2. (a) Discuss the role of diluents and modifiers in solvent extraction. Give two examples for each of these. 5

(b) Explain the two options of gas chromatography i.e. Gas-Solid Chromatography (GSC) and Gas-Liquid Chromatography (GLC). Explain how two components in a mixture are separated in a column showing signal detector output at various stages. 5

(c) Explain the plate theory of chromatography and give van Deemter equation explaining all the terms. Draw the nature of plot between plate height (h) and carrier gas velocity (u). 5

3. (a) What are the requirements of column and detector in sophisticated liquid column chromatographic set-up ? 5

(b) How will you separate and identify Mn^{2+}, Cu^{2+} and Zn^{2+} in a mixture by paper chromatography ? In a separation procedure, solvent went up to 7·6 cm, whereas spots were observed at 2·3, 5·8 and 6·5 cm, respectively. Calculate their R_f values. 3+2

(c) Compare Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) with similarities and dissimilarities with regard to type and amount of analyte, column tubing, instrumental set-up and type of detectors used. 5

4. (a) A mixture of two components analyzed by chromatography showed retention times of 6·53 and 8·75 min with respective bandwidths 0·27 and 0·34 min, respectively. If the solvent peak showed at 2·41 min, then calculate : 5

(i) retention factors,

(ii) resolution, and

(iii) number of plates.

(b) What are the various types of detectors used in HPLC ? Discuss their characteristic requirements. 5

(c) What do you understand by solvent efficiency ? How is it measured ? Explain its variation with temperature. 5

5. (a) Draw the structure of Silica gel depicting the various types of hydroxyl groups. What is the order of increasing activity ? How are siloxanes prepared ? 5

(b) How are ion exchangers classified broadly and on the basis of category of material ? Give a suitable example for each type. 5

(c) What are the different types of synthetic inorganic ion exchangers ? Discuss their special properties. 5

6. (a) Explain the basic principle of size exclusion chromatography with the help of an illustration. Draw the nature of plot between log mol wt and retention volume. 5

(b) What are the different types of gels available for chromatography ? Draw the structure of Sephadex and describe its characteristics. 5

(c) Derive the expression for the fraction of the solute remaining in the aqueous phase after n extractions with an organic solvent. 5

7. (a) Explain the phenomenon of osmosis and define osmotic pressure. What do you understand by reverse osmosis ? 5

(b) Explain the basic principle and operation of electrophoresis. What are its applications ? 5

(c) What are the differences between paper chromatography and thin layer chromatography ? 5

8. Write brief explanatory notes on any ***three*** of the following : $3 \times 5 = 15$

(a) Elution analysis

(b) Slab electrophoresis

(c) Masking agents in solvent extraction

(d) Electrodialysis