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S. No. of Question Paper : 1835

Unique Paper Code : 217467

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Name of the Paper : Analytical Chemistry—4 (Separation Methods—II)

Name of the Course : B.Sc. (P) Applied Physical Sciences—Analytical Chemistry

Semester : IV

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any Five questions.

All questions carry equal marks.

1. (a) Enumerate any five characteristics that a sensing device on a gas chromatographic apparatus must possess.
- (b) Describe the working of a flame ionization detector.
- (c) How does the retention time of a specific solute change when each of the following experimental parameters is altered ?
 - (i) The carrier gas flow is increased from 70 to 90 cc/min.
 - (ii) A six-feet-long column is used instead of a ten-feet-long column.
 - (iii) The liquid coating on the solid support is increased to 15% to 8%.

P.T.O.

- (iv) The operating temperature of the column is increased from 150 to 180°C.
- (v) The rate of flow of gas is increased. 5+5+5
2. (a) Describe the principle underlying all chromatographic processes.
- (b) Define distribution ratio D in partition chromatography. What happens if the numerical value of D is very small or too large ?
- (c) Is the distribution ratio, used in partition chromatography the same as the distribution ratio, D , used in solvent extraction ? Explain.
- (d) Define a theoretical plate and give an expression that relates HETP (Plate height) to peak width and retention time.
- (e) Describe *two* solids used as support in liquid-liquid partition chromatography. 5×3
3. (a) Explain the principle that governs electrophoresis; briefly describe how you will cast a polyacrylamide gel for horizontal electrophoresis.
- (b) Why are all gel solutions normally degassed prior to use ?
- (c) What is the role of mercaptoethanol (or DTT) in SDS-PAGE ?
- (d) Define Isoelectric pH of a compound.
- (e) Describe how Isoelectric focusing is used for separation of proteins. 5+2+2+1+5

4. (a) Define an adsorption isotherm. When does an H adsorption isotherm occur ?
- (b) Enumerate the experimental factors that determine the success of a column adsorption chromatographic separation. Describe any *one* of them in detail.
- (c) What are the characteristics of a solid that must be considered when selecting an adsorbent to effect a particular chromatographic separation ? Describe any *two* of them.
- (d) How long will it take to elute one-half the amount of Coomassie Blue from an alumina column (40 cm long, 1.5 cm i.d.) on which it has a retention volume of 123 mL ? Assume that this column contains 79.5 g of alumina, has a free volume of 7.0 mL, and that the solvent moves through the column with a velocity of 4.0 cm/min. 3+3+4+5
5. (a) Define ion exchange capacity.
- (b) Define separation factor. How can you determine the numerical value of the separation factor ? If the separation factor α for ions A and B $\alpha_A^B > 1$, what does it signify ?
- (c) Explain why it is feasible to separate zinc and cadmium ions from one another using a strong anion-exchange resin.
- (d) A column containing 1.694 g of air-dried, strong cation-exchange resin in the hydrogen cycle is eluted with 250 mL of 1.0 MK Cl. Titration of the eluate required 63.72 mL of 0.0968 M NaOH to reach a phenolphthalein end point. Calculate the capacity of the air-dried cation resin. 2+5+3+5

6. (a) Describe the principle of Affinity chromatography.
- (b) Give a method for coupling the ligand to the matrix.
- (c) The ligand should have affinity for the molecule to be separated in the range of 10^{-4} to 10^{-8} M in solution. Explain.
- (d) What is affinity precipitation ? How is it carried out ?

3+5+2+5