1) Explain the general theory of chromatographic processes.

Various types of chromatographic techniques are based on the principle of continuous counter current extraction or separation. Every chromatographic technique involves a mobile phase (a liquid or a gas), which passes over the surface of a stationary phase. which may be a solid, or a liquid immobilised by some method like adsorption on the surface of a solid. The sample to be separated or extracted is introduced at or near the point where contact is first made between the two phases. The components of the sample are then carried along at various rates depending on their relative affinities for the two phases.

A classical theory of chromatography was developed by martin and synge, in order to describe liquid - liquid chromatography, in which the stationary phase is a liquid coated (adsorbed) on the surface of a finely divided solid support. This stationary phase behaves like a normal

liquid and the solid serves to hold it in place. And this liquid acting as a stationary phase is immiscible with the mobile phase. This theory can be extended to various chromatographic techniques with certain modifications.

In principle this theory is based on the on the principle of the partition ratio k, that can be expressed as

$$k = \frac{C_s}{C_m}$$

Where C_s = concentration of solute in stationary phase, and C_m = concentration of solute in mobile phase. If 'x' is the fraction of solute in the mobile phase and 'y' is the fraction of solute in the stationary phase, then.

$$x = \frac{V_m}{V_m + kV_s} \; ; y = \frac{V_s}{k' V_m + V_s} \; ; \text{and } x + y = 1$$

Where V_m and V_s are the volumes of mobile phase and stationary phase respectively, and $k' = 1/k$.

(2) S.I ②
Briefly Explain the classification of chromatography methods.

Every chromatographic technique involves two phases, the stationary phase and the mobile phase. The chromatographic methods of analysis are classified by different features, namely by the state of aggregation of the phase used, by the nature of sorbate-sorbent interaction (separation mechanism), by the technique used etc.

According to separation mechanism, chromatographic methods are classified as adsorption chromatography, partition chromatography, ion-exchange chromatography, precipitation chromatography etc.

According to the technique of carrying out the operation, chromatography has been classified as thin layer chromatography, paper chromatography etc.

According to the medium in which separation is performed, chromatography is classified as liquid chromatography, gas chromatography etc.

(1) In adsorption chromatography, the stationary phase is a solid (alumina, silica gel etc.,). The solutes are

are adsorbed in different parts of the adsorbent column. The adsorbed components are then eluted by passing suitable solvents called eluents, as liquid mobile phase through the column. When a column is used in such type of chromatography, the technique is known as column chromatography.

Thin layer chromatography (TLC) is a special type of adsorption chromatography, in which a glass plate or a plastic plate coated with a thin layer of the adsorbent is used as a stationary phase.

(2) In partition chromatography, the stationary phase may be a liquid strongly adsorbed on a solid, which acts as a support. In partition chromatography, the solute is distributed between the stationary liquid phase and the moving liquid (solvent) phase.

Phase combination in adsorption and partition chromatography are given in the following table.

S.NO	Stationary Phase	Mobile phase	Type of chromatography
1.	Solid	Liquid	Adsorption
2.	Solid	Gas	Adsorption
3.	Liquid	Liquid	Partition
4.	Liquid	Gas	Partition.

1. Paper chromatography: Paper chromatography may be defined as the technique in which the analysis of an unknown mixture is carried out mainly by the flow of solvent on specially designed filter paper holding the stationary liquid phase separation takes place by the differential migration of the components in the mixture.

2. Thin Layer chromatography: The chromatographic technique using thin layers of an adsorbent held on a glass plate or other supporting medium, separation of a mixture is affected either by adsorption or by partition.

3. Column chromatography: The technique in which the stationary phase is a solid (silica gel or alumina) taken in a glass

column and the mobile phase is a liquid is known as column chromatography.

4. High performance Liquid chromatography (HPLC): It is also known as High pressure Liquid chromatography. HPLC is a method of separation in which the stationary phase is contained in a column, one end of which is attached to a source of pressurised liquid eluent (mobile phase).

5. Gas Liquid chromatography (GLC): GLC is the technique of chromatography in which the mobile phase is a gas and the stationary phase is a non-volatile liquid held as a thin layer on a solid support.

Explain

(13) What is meant by Rf values & Explain, Mention some of the factors on which the Rf value of a compound depends.

A measure of the speed of a components in a given mixture, for the given phases and support, under the given conditions of temperature etc. is known as retardation factor, or retention ratio or Rf value. Rf value of a component from the place is defined as the ratio of the distance travelled by the component from the place of application to the distance travelled by the solvent (mobile phase) from the place of application of the mixture.

$$Rf = \frac{\text{Distance travelled by the component from the place of application (original line)}}{\text{Distance travelled by the solvent (mobile phase) from the original line.}}$$

It should be noted that Rf value is always a proper fraction and the value is less than one Rf value of a compound

depends on the following factors.

(1) Nature of the solvent- (mobile phase)

(2) Nature of the mixture in which the component is present

(3) Quality of chromatographic paper

(4) Temperature