

Chapter	15 Basic Separation Techniques	Class	1 st Year	Subject	Chemistry
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Give Short Answers of the Following Questions

1. What is chromatography?

Ans. The technique separation in which components of a mixture of substances, (coloured pigments and coloured metallic ions) are separated on the basis of their relative affinities for stationary and mobile phases is called chromatography.

2. What do you understand by the term, “chromatogram”?

Ans. The finished dried paper with the coloured band of various components of a mixture obtained in a chromatographic experiment is called chromatogram.

3. What is the locating agent?

Ans. A suitable chemical reagent which is sprayed on the chromatogram to locate the position of various colorless substances is called locating reagent, e.g., H_2S rubenic acid etc.

4. Define analytical chemistry.

Ans. “The branch of chemistry which deals with the chemical characterization (qualitative and quantitative analysis) of a compound is called analytical chemistry.”

5. How chemical characterization of a compound is done?

OR Write down major steps involved in complete quantitative analysis.

Ans. Four Major Steps:

Following major steps are necessary for complete quantitative analysis of a compound

- (i) Obtaining a sample for analysis (ii) Separation of the desired constituents
(iii) Measurement and calculation of results (iv) Drawing conclusion from the analysis

6. Why fluted filter paper is used for greater rate of filtration than ordinary cone filter paper?

Ans. Fluted Filter Paper:

The rate of filtration through conical funnel can be considerably increased by using fluted filter paper. For preparation of such a paper ordinary filter paper is folded in such a way that a fan like arrangement with alternate elevations and depressions at various folds is obtained. In this way, we increase the surface area of filter paper. As a result, the rate of filtration by fluted filter paper increases as compared to ordinary filter paper.

7. Discuss folding of filter paper briefly.

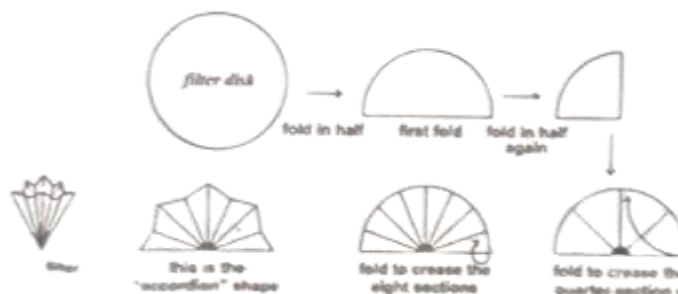
Ans. Folding of Filter Paper:

The folding of filter paper is important and following points should be kept in mind:

- The paper should be folded twice. The first fold should be along the diameter of the paper. The second fold should be such that the edges do not quite match.
- The paper should be opened on the slightly larger section. This provides a cone with three-fold thickness halfway around and one thickness the other halfway around and an apex angle very slightly greater than 60° .

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- The paper may then be inserted into 60° funnel, moistened with water and firmly pressed down.



8. How saturated solution for crystallization can be prepared?

Ans. Preparation of the Saturated Solution:

After selecting a suitable solvent, the substance is then dissolved in a minimum amount of solvent and is heated directly or on a water bath with constant stirring.

Add more solvent to the boiling solution if necessary until all the solute has dissolved.

9. Define filtration and crystallization.

Ans. Filtration: "The process in which insoluble particles (suspended particles or precipitates) are separated from liquids is called filtration."

Crystallization: "Crystallization is the removal of a solid from solution by increasing its concentration above the saturation point in such a manner that the excess solid separates out in the form of crystals."

10. What is a safe and reliable method for drying the crystals? Briefly explain.

Ans. Vacuum Desiccator:

A safe and reliable method of drying crystals is through a vacuum desiccator. In this process, crystals are spread over a watch glass and kept in vacuum desiccators for several hours.

Drying agents used in a desiccator are CaCl_2 , silica gel or phosphorous pentoxide (P_2O_5).

11. Why is there a need to crystallize a crude product?

Ans. The preparation of chemical compounds usually affords a crude product. The crude product may contain soluble and insoluble impurities. Insoluble impurities are removed by filtration while soluble impurities are removed by crystallization process. Crystallization also gives a definite geometrical shape to the crystals of the crude product. So in order to get pure product in the form of crystals there is a need to crystallize the crude product.

12. What is the function of fluted filter paper?

Ans. The function of fluted filter paper is to increase the filtration efficiency by providing a larger surface area and faster flow rate compared to flat filter paper.

Functions (Features):

1. Faster Filtration

- The fluted (folded) design creates channels for the liquid to flow through, reducing clogging and speeding up the process.

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2. Increased Surface Area

- More folds = more contact points for solids to collect, preventing premature blockage.

3. Better Airflow

- Gaps between folds allow air to escape, preventing pressure buildup that can slow filtration.

13. What is the difference between a Gooch crucible and sintered glass crucible?

Ans.

Feature	Gooch Crucible	Sintered Glass Crucible
Material	Porcelain or silica, lined with asbestos/glass fiber mat.	Made entirely of fused glass with frit.
Porosity	Adjustable (depends on mat used).	Fixed porosity.
Use case	Filtering fine/gelatinous precipitates (e.g., BaSO ₄)	Filtering fine to coarse precipitates) e.g., AgCl).
Heat Resistance	High (can be ignited/dried at high temps).	Moderate (may crack with rapid temp change).
Chemical Resistance	Resists acids/bases (depends on mat).	Resist most acids (except HF) but not strong alkalis.
Cleaning	Mat must be replaced; crucible reused.	Reusable; cleaned with acids or solvents.
Typical Setup	Used with vacuum filtration.	Used with vacuum or gravity filtration.

14. What types of mixtures are filtered through a Gooch crucible?

Ans. Gooch crucibles are used to filter precipitate-solid and liquid mixtures, especially gravimetric analysis samples where the solid is dried and weighed.

15. What is function of fractionating column during fractional distillation?

Ans. The fractionating column in fractional distillation provides multiple vaporization-condensation cycle, enhancing separation of liquids with close boiling points by increasing surface area for selective condensation of higher-boiling components.

- Improves purity by allowing repeated condensation and re-vaporization.
- Enables separation of mixtures (e.g., crude oil into gasoline, kerosene, etc.).

16. What is the stationary phase in the paper chromatography?

Ans. In paper chromatography, the stationary phase is the water molecules adsorbed (bound) onto the cellulose fibers of the filter paper.

1. Composition:

- Cellulose (paper) + bound water (from humidity or solvent).
- Acts as a polar hydrophilic layer.

2. Function:

- Interacts with analytes via hydrogen bonding and dipole forces.
- Polar compounds bind more strongly, moving slower; non-polar compounds move faster.

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17. What will happen during paper chromatography if the components of the mixture have a comparable attraction for the stationary phase?

Ans. If the components of a mixture have comparable attraction for the stationary phase in paper chromatography:

1. Poor Separation:

- Components will travel at similar rates, staying close together on the paper.

2. Overlapping Spots:

- Bands/spots may merge, making it difficult to distinguish individual compounds.

3. Low Resolution:

- R_f values (retention factors) will be nearly identical.

Solution:

Use a different mobile phase or modify the stationary phase (e.g., polar/non-polar solvents) to alter affinities.

18. What is the meant by the term "developing the chromatogram" in paper chromatography?

Ans. "Developing the chromatogram" in paper chromatography refers to the process of allowing the mobile phase (solvent) to migrate up the paper, separating the mixture's components based on their differential affinities for the stationary (paper) and mobile phases.

Important Points:

- **Solvent Movement:** The mobile phase travels along the paper via capillary action.
- **Separation:** Components partition between the stationary (cellulose/water) and mobile phases, forming distinct spots/bands.
- **Completion:** The process stops when the solvent front nears the top of the paper.

19. What is the basic principle of paper chromatography?

Ans. The basic principle of paper chromatography is differential partitioning of components between two phases:

- **Stationary phase:** Water-bound cellulose fibers in the paper (polar/hydrophilic).
- **Mobile phase:** Solvent (e.g., ethanol, water) moving via capillary action.

20. Why water is not generally used as a solvent in paper chromatography?

Ans. Water is rarely used alone in paper chromatography because:

- **Slow Evaporation:** Prolongs drying time.
- **Poor Solubility:** Many organic compounds dissolve poorly in water.
- **Weak Separation:** Limited ability to differentiate components due to high polarity.

21. Differentiate between adsorption and partition chromatography.

Ans. See (Differences between Adsorption and Partition Chromatography) {Already Answered above}

22. How can you check the purity of a compound with the help of paper chromatography?

Ans. To check the purity of a compound using paper chromatography:

1. Run the Sample:

- Spot the compound on chromatography paper and develop it with a suitable solvent.

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2. Analyze the Result:

- Pure Compound: Forms a single spot on the chromatogram.
- Impure Compound: Shows multiple spots (each spot = a different component).

3. Compare R_f Values:

- A single R_f (Retention Factor) value confirms purity, multiple values indicate impurities.

23. You have prepared a solid sample of glucosazone in the laboratory. How will you proceed to check the purity of the sample?

Ans. Purity of Glucosazone:

1. Melting Point Test:

Compare observed melting point with literature value (sharp range pure).

2. TLC (Thin-Layer Chromatography):

Spot on silica plate, develop solvent → single spot confirms purity.

3. HPLC or NMR (if available)

Sharp peaks in HPLC/NMR spectra indicate purity.