Chapter 17:

Separation Techniques

Short Questions (Exercise)

1 (i) Why is it important to separate materials from a mixture?

- Separating materials allows us to obtain pure components for specific uses and remove unwanted impurities.
  Example: Separating sand from water ensures clean water for drinking.

---

1 (ii) What is distillation?

- Distillation is a technique used to separate liquids based on their boiling points by heating the mixture and condensing the vapor.
  Example: Distillation is used to obtain pure water from seawater.

---

1 (iii) What is filtration?

- Filtration is a process that separates insoluble solids from liquids or gases using a porous barrier.
  Example: Coffee filters separate coffee grounds from liquid coffee.

---

1 (iv) What is evaporation?

- Evaporation is the process of turning a liquid into vapor by heating, leaving behind the dissolved solids.
  Example: Salt can be obtained from saltwater by evaporating the water.

---

2. What technique would you use to separate sand from water? There are two possibilities. Mention their names.

- **Techniques**:

1. **Filtration**: To remove sand from water using a filter.
2. **Sedimentation and Decantation**: Allowing sand to settle at the bottom and pouring off the water.
   Example: Filtration is commonly used to clean muddy water.

---

3. What technique would you use to separate alcohol from water?

- **Fractional Distillation**: Alcohol has a lower boiling point than water, so it evaporates first and is collected after condensation.
  Example: This method is used in the distillation of ethanol.

---

4. What are mixtures?

- Mixtures are combinations of two or more substances where each retains its individual properties.
  Example: Air is a mixture of gases like nitrogen, oxygen, and carbon dioxide.

---

5. How is the separation of mixtures of two or more liquids done? Name the separation technique.

- **Fractional Distillation** is used to separate liquids with close boiling points.
  Example: Separating crude oil into petrol, diesel, and kerosene.

---

6. How to separate a mixture of two solids?

- **Method**: Use properties like solubility or magnetic properties.
  - **Example**: To separate iron filings and sulfur, use magnetic separation.

---

7. What method will you use to separate a sand and sugar mixture?

- **Method**:
  1. Add water to dissolve the sugar.
  2. Filter the mixture to separate sand.
  3. Evaporate the water to retrieve the sugar.
     Example: This method is commonly used in labs to separate heterogeneous mixtures.

Extera Short Questions (Topic Wise)

17.1: Methods of Separation

1. What are the main methods of separation?

The main methods of separation include filtration, evaporation, distillation, chromatography, and centrifugation. These techniques separate mixtures based on their physical or chemical properties.
Example: Filtration separates sand from water.

2. How does evaporation help in separating mixtures?

Evaporation removes the solvent by heating, leaving the solute behind. It is used for separating a solute dissolved in a liquid.
Example: Evaporating saltwater leaves salt crystals behind.

3. What is centrifugation, and when is it used?

Centrifugation separates components of a mixture based on density using rapid spinning. Heavier particles settle at the bottom.
Example: It separates cream from milk.

4. Why is magnetic separation used?

Magnetic separation removes magnetic materials from a mixture using a magnet.
Example: Iron filings are separated from sand using a magnet.

17.2: Chromatography

1. What is chromatography?

Chromatography is a technique used to separate and analyze components of a mixture based on their different affinities to a stationary and a mobile phase.
Example: Paper chromatography separates pigments in ink.

2. What are the common types of chromatography?

The common types include paper chromatography, thin-layer chromatography (TLC), and gas chromatography.
Example: Gas chromatography separates and identifies volatile substances.

3. Why is chromatography useful in chemical analysis?

Chromatography identifies and purifies compounds in complex mixtures. It is widely used in forensics and pharmaceuticals.
Example: It is used to detect drugs in a sample.

4. How does paper chromatography work?

In paper chromatography, the solvent moves up the paper, carrying the mixture components at different rates based on their solubility and interaction with the paper.
Example: Separating the colors in black ink into different pigments.

17.3: Distillation

1. What is distillation?

Distillation separates liquids based on their boiling points by heating a mixture to vaporize one component and condensing it separately.
Example: Distillation separates ethanol from water.

2. What is fractional distillation, and how is it different from simple distillation?

Fractional distillation separates mixtures of liquids with closer boiling points using a fractionating column, while simple distillation separates liquids with significant differences in boiling points.
Example: Fractional distillation is used to refine crude oil into petrol and diesel.

3. Why is distillation important in industries?

Distillation is used to purify liquids and separate valuable components from mixtures.
Example: It purifies water by removing impurities.

4. How is steam distillation used in extracting essential oils?

Steam distillation uses steam to vaporize heat-sensitive compounds like essential oils, which are then condensed and collected.
Example: Essential oils are extracted from lavender using steam distillation.

17.4: Filtration

1. What is filtration, and how does it work?

Filtration separates solids from liquids or gases by passing the mixture through a porous medium, which traps the solid particles.
Example: Coffee filters separate coffee grounds from the liquid.

2. What are the common uses of filtration?

Filtration is used in water purification, air purification, and in laboratories to separate precipitates.
Example: Air filters remove dust and allergens from the air.

3. What types of filters are commonly used in filtration?

Filters include paper filters, cloth filters, and membrane filters, depending on the particle size to be removed.
Example: Membrane filters are used in reverse osmosis systems.

4. How does vacuum filtration differ from normal filtration?

Vacuum filtration uses reduced pressure to speed up the separation process by pulling the liquid through the filter.
Example: It is used in chemistry labs to quickly separate crystals from a solution.

Extera Long Questions (Topic Wise)

1. Explain the Process and Applications of Chromatography

Definition of Chromatography

Chromatography is a separation technique used to isolate and analyze components of a mixture. It works by distributing the mixture between a stationary phase (e.g., paper or column) and a mobile phase (e.g., liquid or gas).

Types of Chromatography

1. **Paper Chromatography**: The stationary phase is paper, and the mobile phase is a solvent like water or ethanol.
   Example: Separating pigments in a plant extract.
2. **Thin-Layer Chromatography (TLC)**: A thin layer of silica or alumina acts as the stationary phase.
   Example: Identifying purity in pharmaceuticals.
3. **Gas Chromatography (GC)**: A gas serves as the mobile phase, and a liquid or solid serves as the stationary phase.
   Example: Detecting alcohol in blood samples.

Applications of Chromatography

- **Forensic Science**: Identifying drugs or toxins in biological samples.
- **Food Industry**: Ensuring the quality and safety of food products by detecting contaminants.
- **Pharmaceutical Industry**: Purifying and testing the purity of drugs.

Conclusion

Chromatography is an essential tool in scientific research and industry due to its ability to separate, identify, and analyze complex mixtures.

---

2. Discuss the Importance and Types of Distillation

Definition of Distillation

Distillation is a separation technique that relies on differences in boiling points to separate components of a liquid mixture. It involves heating a mixture to vaporize one component and condensing it separately.

Types of Distillation

1. **Simple Distillation**: Used when the boiling points of components differ significantly.
   Example: Separating saltwater into pure water and salt.
2. **Fractional Distillation**: Separates components with close boiling points using a fractionating column.
   Example: Refining crude oil into petrol, diesel, and kerosene.

3. **Steam Distillation**: Used for heat-sensitive compounds like essential oils.
   Example: Extracting lavender or eucalyptus oil.

Applications of Distillation

- **Water Purification**: Producing distilled water for laboratories and medical use.
- **Alcohol Production**: Separating ethanol from fermentation mixtures.
- **Petroleum Refining**: Fractional distillation converts crude oil into fuels and other useful products.

Conclusion

Distillation is an invaluable method for purifying liquids and separating mixtures in industries ranging from healthcare to energy.

---

3. Explain the Principle and Uses of Filtration

Definition of Filtration

Filtration is a mechanical separation technique that removes solid particles from liquids or gases by passing the mixture through a filter medium.

Types of Filtration

1. **Gravity Filtration**: Uses gravity to pull the liquid through the filter.
   Example: Filtering tea leaves from tea.
2. **Vacuum Filtration**: Uses reduced pressure to speed up the process.
   Example: Isolating a solid precipitate in a chemistry lab.
3. **Membrane Filtration**: Uses semi-permeable membranes to remove fine particles or microorganisms.
   Example: Reverse osmosis for purifying water.

Applications of Filtration

- **Water Treatment**: Removing impurities from drinking water.
- **Air Purification**: Filtering dust and allergens in HVAC systems.
- **Industrial Processes**: Separating solid impurities from oils or chemicals.

Conclusion

Filtration is a versatile and widely used separation technique critical in maintaining cleanliness and purity in various applications, from household use to industrial operations.

MCQS

17.1: Methods of Separation

1. **What is the main principle of separation techniques?**
   a) Chemical reactivity
   b) Physical differences between components ✔
   c) Solubility only
   d) None of the above

2. **Which method is used to separate a soluble solid from a liquid?**
   a) Filtration
   b) Chromatography
   c) **Evaporation** ✔
   d) Decantation

3. **What is centrifugation used for?**
   a) Separating liquids with different boiling points
   b) **Separating substances based on density** ✔
   c) Separating solids from liquids
   d) Mixing components

4. **What is magnetic separation used for?**
   a) Separating liquids from gases
   b) **Separating magnetic materials from a mixture** ✔
   c) Separating organic compounds
   d) Filtering out sediments

5. **What is decantation?**
   a) Filtering liquids
   b) **Pouring off a liquid from a solid or denser liquid** ✔
   c) Using magnets to separate mixtures
   d) Boiling liquids to separate them

6. **Which separation method is used in separating cream from milk?**
   a) Filtration
   b) **Centrifugation** ✔
   c) Distillation
   d) Sedimentation

17.2: Chromatography

7. **What is the principle of chromatography?**
   a) Magnetic properties
   b) Solubility differences ✔

c) Boiling point differences
d) Electrical conductivity

8. **What is paper chromatography mainly used for?**
   a) Separating gases
   b) **Separating pigments in a mixture** ✔
   c) Filtering solid particles
   d) Separating liquids based on boiling points

9. **In chromatography, the mobile phase can be:**
   a) Solid
   b) **Liquid or gas** ✔
   c) Liquid only
   d) Solid or gas

10. **What is the stationary phase in paper chromatography?**
    a) Solvent
    b) **Paper** ✔
    c) Gas
    d) Metal

11. **What type of chromatography is used to separate volatile substances?**
    a) Paper chromatography
    b) Thin-layer chromatography
    c) **Gas chromatography** ✔
    d) Steam distillation

12. **Which is an application of chromatography?**
    a) Detecting drugs in blood ✔
    b) Measuring density
    c) Determining melting points
    d) Decanting liquids

17.3: Distillation

13. **What is distillation used for?**
    a) Separating immiscible liquids
    b) **Separating liquids based on boiling points** ✔
    c) Separating pigments
    d) Separating solids from liquids

14. **What is fractional distillation?**
    a) Separating gases
    b) **Separating liquids with close boiling points** ✔
    c) Removing solids from liquids
    d) Filtering organic mixtures

15. **Which industry heavily relies on fractional distillation?**
    a) Pharmaceuticals

b) **Petroleum refining** ✔
c) Agriculture
d) Food and beverages

16. **What is steam distillation used for?**
a) Separating salts from water
b) Purifying alcohol
c) **Extracting heat-sensitive compounds like essential oils** ✔
d) Filtering impurities

17. **What is the apparatus used in distillation called?**
a) Centrifuge
b) Chromatograph
c) **Condenser** ✔
d) Separator

18. **What is a real-life application of distillation?**
a) Extracting pigments
b) **Producing distilled water** ✔
c) Separating gases
d) Mixing solutions

17.4: Filtration

19. **What does filtration separate?**
a) Soluble solids from liquids
b) Gases from liquids
c) **Insoluble solids from liquids or gases** ✔
d) Liquids from liquids

20. **Which of the following uses filtration?**
a) Refining petroleum
b) **Water purification** ✔
c) Extracting alcohol
d) Testing pigments

21. **What type of filter is used in reverse osmosis?**
a) Cloth filter
b) **Membrane filter** ✔
c) Paper filter
d) Sand filter

22. **What is vacuum filtration?**
a) Filtering under high pressure
b) Using heat to filter liquids
c) **Using suction to speed up the filtration process** ✔
d) Filtering gases only

23. **Which part of coffee-making involves filtration?**
    a) Roasting beans
    b) Grinding beans
    c) **Separating coffee grounds from the liquid** ✔
    d) Boiling water

24. **What type of filter is used to remove allergens from air?**
    a) Cloth filter
    b) **HEPA filter** ✔
    c) Sand filter
    d) Paper filter

General Applications and Understanding

25. **What is the basis of centrifugation?**
    a) Boiling point differences
    b) **Density differences** ✔
    c) Solubility differences
    d) Magnetic properties

26. **Which separation technique is best for separating two immiscible liquids?**
    a) Distillation
    b) **Decantation** ✔
    c) Filtration
    d) Chromatography

27. **What is an example of using evaporation for separation?**
    a) Separating alcohol from water
    b) **Separating salt from saltwater** ✔
    c) Filtering coffee
    d) Distilling petroleum

28. **What is the residue in filtration?**
    a) The liquid that passes through the filter
    b) **The solid particles left on the filter** ✔
    c) The gas formed during filtration
    d) The solvent that evaporates

29. **Which method is used to separate iron filings from a mixture?**
    a) Filtration
    b) Chromatography
    c) **Magnetic separation** ✔
    d) Decantation

30. **What technique is commonly used to purify tap water?**
    a) Distillation
    b) Centrifugation
    c) **Filtration** ✔
    d) Chromatography