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Mixtures Classification

Homogeneous Mixtures

A homogeneous mixture has a uniform composition throughout. The solute dissolves completely in the solvent, making the mixture look the same everywhere. Examples include sugar dissolved in water, vinegar, and soda. Such mixtures are also called solutions.

Heterogeneous Mixtures

A heterogeneous mixture has visibly different parts. The components are not evenly mixed and can be seen separately. Examples include sand in water and oil in water. Particles in these mixtures may settle over time.

Suspensions

Suspensions are heterogeneous mixtures where solid particles are suspended in a liquid but do not dissolve. The particles are large enough to be seen and settle down on standing. Examples include muddy water and tea leaves in water.

Colloids

Colloids have particles larger than solutions but smaller than suspensions. The particles do not settle and are dispersed uniformly. Examples include milk, blood, and ice cream. Colloids show the Tyndall effect, scattering light passing through them.

Emulsions

Emulsions are colloids where both dispersed phase and dispersion medium are liquids. They can be oil-in-water or water-in-oil. Milk is an oil-in-water emulsion, while butter is water-in-oil. Emulsifying agents stabilize these mixtures.

Concentration of Solutions

Definition and Importance

Concentration is the amount of solute dissolved in a given amount of solvent or solution. It is crucial in preparing medicines, pesticides, and food products to ensure correct proportions for safety and effectiveness.

Mass by Mass Percentage (% m/m)

This expresses how many grams of solute are present in 100 grams of solution. It is calculated as:

Mass by mass percentage = (Mass of solute / Mass of solution) × 100

Mass by Volume Percentage (% m/v)

This expresses how many grams of solute are present in 100 millilitres of solution. It is used when volume measurement is easier, such as in medicines.

Mass by volume percentage = (Mass of solute / Volume of solution) × 100

Volume by Volume Percentage (% v/v)

This expresses how many millilitres of solute are present in 100 millilitres of solution. It is used for mixtures of miscible liquids like perfumes and vinegar.

Volume by volume percentage = (Volume of solute / Volume of solution) × 100

Solubility and Crystallization

Solubility

Solubility is the maximum amount of solute that can dissolve in a fixed amount of solvent at a given temperature. It varies with temperature; generally, solubility of solids increases with temperature, while that of gases decreases.

Crystallization

Crystallization is the process of forming pure solid crystals from a saturated solution by cooling. It is used to purify substances and separate solids dissolved in a solvent. The crystals have a regular geometric pattern.

Distillation

Process

Distillation separates components of a mixture based on differences in boiling points. The mixture is heated; the component with the lower boiling point vaporizes first, the vapor is cooled and condensed back to liquid, and collected separately.

Applications

Used to separate miscible liquids with boiling points differing by at least 25 °C, such as acetone and water, or to obtain pure liquids from solutions.

Paper Chromatography

Principle and Method

Paper chromatography separates components of a mixture based on their different rates of movement on paper with a solvent. The solvent carries the substances up the paper, separating them by their affinity to the solvent and paper.

Applications

Used to separate pigments in inks, dyes, and plant extracts.

Separation of Immiscible Liquids

Using Separating Funnel

Immiscible liquids like oil and water form separate layers due to different densities. A separating funnel allows careful separation of these layers by draining the denser liquid first.

Sublimation

Process

Sublimation is the transition of a solid directly into vapor without becoming liquid, and deposition is the reverse. It is used to separate substances like camphor from sand.

Centrifugation

Principle and Use

Centrifugation uses rapid spinning to separate components of a mixture based on density. Heavier particles move outward and settle, while lighter components remain on top. It is widely used in laboratories to separate blood components.

Coagulation

Process

Coagulation involves adding a coagulant like alum to cause fine suspended particles in a liquid to clump together and settle, aiding in purification of water and other mixtures.

Tyndall Effect

Light Scattering

The Tyndall effect is the scattering of light by particles in a colloid or suspension, making the path of light visible. It does not occur in true solutions.

Solved Examples

Example 1: Calculate the mass by mass percentage of a solution formed by dissolving 10 g of salt in 90 g of water.

Solution:

Mass of solute = 10 g

Mass of solvent = 90 g

Total mass of solution = 10 g + 90 g = 100 g

Mass by mass percentage = (10 / 100) × 100 = 10%

Example 2: Calculate the mass by volume percentage of a solution made by dissolving 5 g of glucose in 100 mL of water.

Solution:

Mass of solute = 5 g

Volume of solution = 100 mL

Mass by volume percentage = (5 / 100) × 100 = 5%

Example 3: Calculate the volume by volume percentage of a pesticide solution made by mixing 1 mL of pesticide with water to make 100 mL of solution.

Solution:

Volume of solute = 1 mL

Volume of solution = 100 mL

Volume by volume percentage = (1 / 100) × 100 = 1%

Practice Set

Conceptual Questions

- What is the difference between a suspension and a colloid?
- Why do immiscible liquids form separate layers when mixed?

Application-based Question

- A solution contains 15 g of salt dissolved in 135 g of water. Calculate the mass by mass percentage of salt in the solution.

Numerical Question

- Calculate the volume by volume percentage of alcohol in a solution made by mixing 30 mL of alcohol with 270 mL of water.

Answer Key

Conceptual Questions

- A suspension has larger particles that settle on standing, while a colloid has smaller particles that remain dispersed and do not settle.
- Immiscible liquids have different densities and do not mix, causing them to form separate layers with the denser liquid at the bottom.

Application-based Question

Mass of solute = 15 g

Mass of solvent = 135 g

Total mass of solution = 15 + 135 = 150 g

Mass by mass percentage = (15 / 150) × 100 = 10%

Numerical Question

Volume of solute = 30 mL

Volume of solution = 30 + 270 = 300 mL

Volume by volume percentage = (30 / 300) × 100 = 10%

Quick Reference Table

Common Mistakes and Misconceptions

Glossary

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