

CLASS 9 SCIENCE – CHAPTER 5

EXPLORING MIXTURES AND THEIR SEPARATION

1. MIXTURES

A mixture is formed when two or more substances are combined without forming a new substance.

Types of mixtures :

A. Homogeneous mixtures

- Have uniform composition throughout.
- Components are not separately visible.
- Also called solutions.

Examples : Sugar + water, Salt + water, Vinegar, Soda.

B. Heterogeneous mixtures

- Do not have uniform composition.
 - Different components may be visible.
 - Components may settle on standing.
- Examples : Sand + water, Oil + water, Muddy water, Smoke, Fog.

Key Idea: Sugar solution is uniform and equally sweet everywhere, but sand in water is not uniform and settles with time.

2. SOLUTIONS

A solution is a homogeneous mixture.

- **Solute** – the substance that gets dissolved.
- **Solvent** – the substance that dissolves the solute.



Example: Sugar + Water → Sugar solution
Solute → Sugar
Solvent → Water

3. CONCENTRATION OF A SOLUTION

The amount of solute dissolved in a given amount of solvent or solution is called the concentration of the solution.

Why important?

Correct proportion is important in medicines, ORS, agriculture, food, cosmetics and laboratory solutions.

Remember:

Changing the amount of solute or solvent changes the concentration.

4. METHODS OF EXPRESSING CONCENTRATION

A. Mass by Mass

Percentage (% m/m or % w/w)

Mass of solute in 100 g of solution.

$$\% \text{ m/m} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

Mass of solution = Mass of solute + Mass of solvent

Example :

10 g salt in 90 g water
 $10 + 90 = 100 \text{ g}$

$$\% \text{ m/m} = \frac{10}{100} \times 100 = 10\%$$

Used on food labels, milk powder, spices, etc.

B. Mass by Volume

Percentage (% m/v or % w/v)

Mass of solute in 100 mL of solution.

$$\% \text{ m/v} = \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

Example :

5 g glucose in 100 mL solution

$$\% \text{ m/v} = \frac{5}{100} \times 100 = 5\%$$

Commonly used for medicines and laboratory solutions.

Important:

0.9% m/v saline solution contains 0.9 g NaCl in 100 mL solution.

C. Volume by Volume

Percentage (% v/v)

Volume of solute in 100 mL of solution.

$$\% \text{ v/v} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

Example :

1 mL liquid pesticide in 100 mL solution

$$\% \text{ v/v} = \frac{1}{100} \times 100 = 1\%$$

Commonly used for perfumes, cosmetics, vinegar.

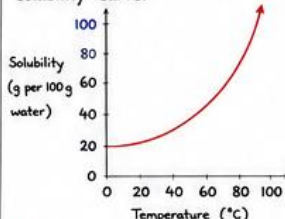
5. SOLUBILITY

- The maximum amount of solute that dissolves in a fixed quantity of solvent at a given temperature is called its **solubility**.
- The fixed quantity may be 100 mL solvent or 100 g solvent.
- For most solid solutes in liquids :
Temperature ↑ → Solubility ↑
- For gases in liquids :
Temperature ↑ → Solubility ↓

Saturated solution: A solution that cannot dissolve any more solute at a particular temperature.

6. SOLUBILITY CURVE

A graph showing the relationship between solubility and temperature is called a solubility curve.



Uses: Helps to find solubility at a given temperature and to understand how much solute separates on cooling.

7. CRYSTALLISATION

The process of forming crystals from a saturated solution is called crystallisation.

Principle: Based on the difference in solubility of a substance at different temperatures.

Uses:

1. Obtain pure solids.
2. Separate solids from mixtures.
3. Purify substances.

Example: Formation of copper sulfate crystals.

1. Prepare saturated copper sulfate solution.
2. Heat gently.
3. Filter the hot solution to remove insoluble impurities.
4. Allow the filtrate to cool slowly.
5. Blue copper sulfate crystals form.
6. Filter the crystals.
7. Wash with cold water.
8. Dry the crystals.

Why slow cooling? Slow cooling allows particles to arrange properly producing larger, shiny and well-shaped crystals.

12. IMMISCIBLE LIQUIDS & SEPARATING FUNNEL

Liquids that do not mix with each other are called immiscible liquids.

Examples: Oil + water, Mustard oil + water. They form separate layers.



Principle: Difference in density of immiscible liquids.

8. EVAPORATION

When a solvent is allowed to escape into the atmosphere as vapour, the dissolved solid may remain behind.

Example: Salt solution → evaporation → Salt (Useful when we want the solid but do not need to recover the solvent.)

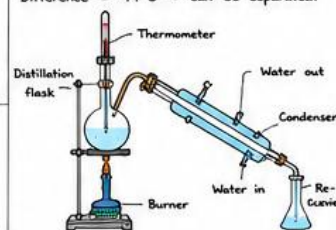
9. DISTILLATION

Method of separating a homogeneous mixture.

- Heat the mixture.
- Convert the lower-boiling component into vapour.
- Cool the vapour.
- Condense it back to liquid.

Principle: Different liquids have different boiling points.

Example: Acetone (56°C) + Water (100°C)
Difference = 44°C → can be separated.



13. GASEOUS MIXTURES

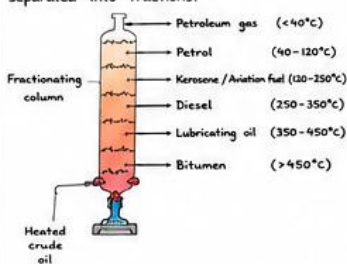
Gases mix uniformly because their particles move freely.

Examples of heterogeneous mixtures involving gases:

10. FRACTIONAL DISTILLATION

Used when liquids have small differences in boiling points (< about 25°C).

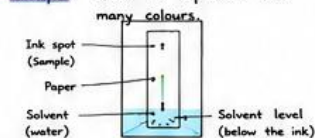
Example: Crude petroleum is separated into fractions.



11. PAPER CHROMATOGRAPHY

A technique where components of a mixture move at different rates through paper with a solvent.

Example: Black ink separates into many colours.



Principle: Different components have different interactions with paper and solvent; hence they move at different speeds.

Uses: Separate ink colours, food colours, plant pigments, etc.

14. SUBLIMATION

Direct change of a solid into vapour without passing through liquid state.

Example: Camphor
Solid → Vapour (sublimation)
Vapour → Solid (deposition)

On cooling, vapour → solid
Example: Camphor + sand → camphor sublimes and sand does not.

Other examples: Naphthalene, Dry ice.

15. ALLOYS

An alloy is a homogeneous mixture of two or more metals, or a metal and a non-metal.

Examples:

- Brass : ~80% copper + 20% zinc
- Bronze : ~80% copper + 20% tin
- Stainless steel: Iron with carbon, chromium, nickel, molybdenum, etc.

Why made? Alloys are stronger, more rigid and more corrosion-resistant.

16. SUSPENSIONS

A heterogeneous mixture in which solid particles do not dissolve but remain suspended in the medium.

- Particles are relatively large.
- Particles can be seen.
- Particles settle on standing.
- Filtration can separate many particles.

Examples: Sand + water, Sawdust + water, Tea leaves + water.

17. CENTRIFUGATION

Mixture is spun rapidly to separate components based on difference in movement under centrifugal force.

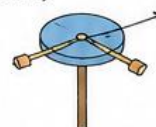
- Heavier particles move outward and settle.
- Lighter liquid remains above.

Used to separate components of blood, laboratory mixtures and industrial mixtures.

18. PAPERFUGE

A simple hand-powered device based on centrifugation.

Separates heavier and lighter components of blood without electricity.



19. COAGULATION

A colloid in which fine suspended particles clump together to form larger particles.

Example: Muddy water + Alum → larger clumps → settle → clearer water.

Alum acts as a coagulant. Larger clumps settle by gravity and are removed by decantation or filtration.

Example: Paneer formation from milk (acid acts as coagulant).

24. QUICK REVISION – SEPARATION vs COLLOID

Property	Solution	Colloid	Suspension
Nature	Homogeneous	Appears homogeneous (but colloidal)	Heterogeneous
Particle size	< 1 nm	1 – 1000 nm	> 1000 nm
Visibility	Not visible	Not visible	Visible
Settling	Does not settle	Does not settle	Settles
Filtration	Cannot be separated by ordinary filtration	Cannot be separated by ordinary filtration	Can generally be separated
Tyndall effect	No	Yes	Yes
Example	Salt solution	Milk, Blood	Sand + water

21. COLLOIDS

Mixture in which particles are intermediate in size between those in solutions and suspensions.

Examples: Milk, Blood, Tomato sauce, Ice cream.

Important property:

Colloidal particles do not settle down with time and remain dispersed.

22. TYNDALL EFFECT

Scattering of light by particles is called the Tyndall effect (named after John Tyndall).

Examples: Sunlight through dusty air, light in fog, floodlights in stadium.

Occurs in colloids and suspensions but not in true solutions.



23. EMULSIONS

A colloid in which both dispersed phase and dispersion medium are liquids.

• Oil-in-water (O/W): Oil dispersed in water. Examples: Milk, Vanishing cream.

• Water-in-oil (W/O): Water dispersed in oil. Examples: Butter, Cream, Body lotion.

Emulsifying agents help to stabilise emulsions (e.g., proteins in milk and butter).

