

KEY POINTS



MATTER

(Solid, Liquid, or Gas)

The starting point for all physical substances, categorized by their state and chemical makeup.

Exploring Mixtures & Their Separation

PURE SUBSTANCES

Fixed nature, consistent chemical composition.

IMPURE SUBSTANCES (MIXTURES)

No fixed composition, physically combined.



ELEMENTS: The Simplest Form

Cannot be broken down into simpler substances; examples include hydrogen, oxygen, iron, copper, and mercury.

Three Types of Elements



METALS

NON-METALS



METALLOIDS



COMPOUNDS: Chemically Combined

Fixed composition, can only be broken down into elements via chemical or electrochemical reactions (e.g., water, methane, sugar, salt).



HOMOGENEOUS MIXTURES

Mixtures with a uniform composition throughout, such as salt in water, sugar in water, or water and alcohol.

TRUE SOLUTIONS



Dissolved particles that are invisible to the naked eye.



HETEROGENEOUS MIXTURES

Mixtures with a non-uniform composition, where individual components remain distinct (e.g., sugar and sand, water in oil).

SUSPENSIONS AND COLLOIDS



Suspensions
(like sand in water)



Colloids
(like milk)

Solution

A solution is a homogeneous mixture of two or more substances.

Components:

- Solute: Substance dissolved (e.g., salt)
- Solvent: Substance that dissolves solute (e.g., water)

Properties:

- Transparent
- Stable (no settling)
- Cannot be filtered
- Particle size $< 1 \text{ nm}$

On the basis of concentration solution are of three types

- ◆ Saturated solution ◆ Unsaturated solution ◆ Super saturated solution

Methods to express concentration of solution

The concentration of a solution is the amount of solute present in a given quantity of the solution or solvent.

◆ Mass by mass percentage(w/w)

$$= \frac{\text{Mass of solute (in g)}}{\text{Mass of solution (in g)}} \times 100$$

Mass of solution = Mass of solute + Mass of solvent

◆ Mass by volume percentage(w/v)

$$\text{Mass by volume percentage} = \frac{\text{Mass of solute (g)}}{\text{Volume of solution (ml)}} \times 100$$

◆ Volume by volume percentage or simply volume percentage(v/v).

$$\text{Volume by volume percentage} = \frac{\text{Volume of solute (ml)}}{\text{Volume of solution (ml)}} \times 100$$

Solubility

The maximum amount of solute in grams which can be dissolved in 100 g of the solvent at a given temperature to form a saturated solution is called solubility of the solute in that solvent at that particular temperature.

Suspension

A suspension is a heterogeneous mixture with larger particles.

Properties:

- Particles are visible
- Settle down on standing
- Can be separated by filtration
- Scatter light

Colloids

A colloid is a mixture with intermediate particle size.

Properties:

- Show Tyndall effect (scatter light)
- Do not settle down
- Cannot be filtered by ordinary filters

Examples:

Milk, fog, smoke

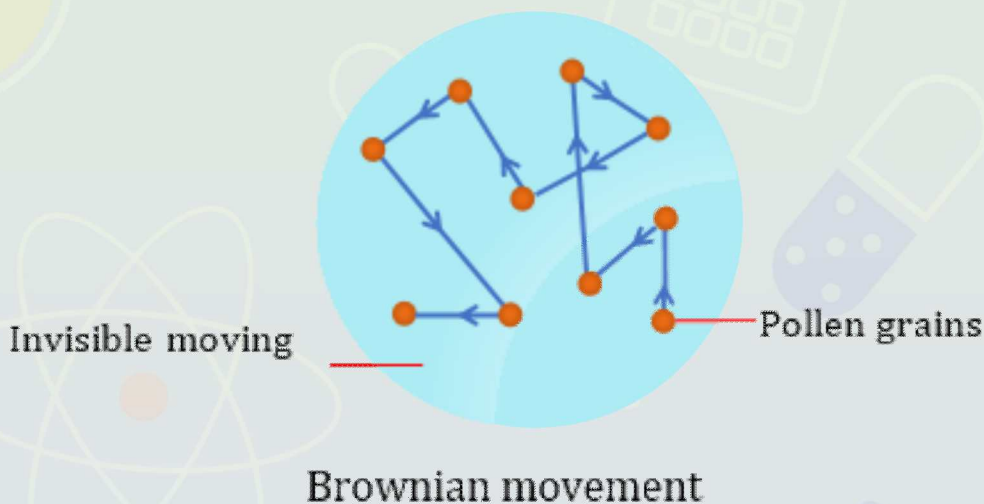


Types of colloids

Dispersed Phase	Dispersion medium	Type of colloid	Examples
Solid	Solid	Solid sol	Coloured glass, gemstones, pearls, milky glass
Solid	Liquid	Sol	Paints, starch, proteins, milk of magnesia, mud, blood
Solid	Gas	Solid Aerosol	Smoke, dust in air, smog, automobile exhaust
Liquid	Solid	Gel	Jellies, cheese, butter, boot polish
Liquid	Liquid	Emulsion	Milk, hair cream, emulsified oils, medicines, cold cream
Liquid	Gas	Liquid Aerosol	Mist, Fog, clouds, insecticide sprays
Gas	Solid	Solid foam	Foam, pumice stone, ice-cream, rubber, sponge
Gas	Liquid	Foam, Froth	Whipped cream, froth, shaving cream

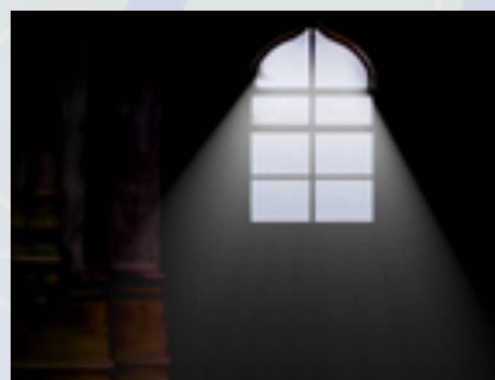
► PROPERTIES OF COLLOIDS

Particle in a colloidal solution follow zig zag path (Brownian movement). Brownian movement may be defined as continuous zig-zag movement of colloidal particles in a colloid. This Brownian movement arises due to hitting of the colloidal particles by the particles of the dispersion medium from different directions with different forces.



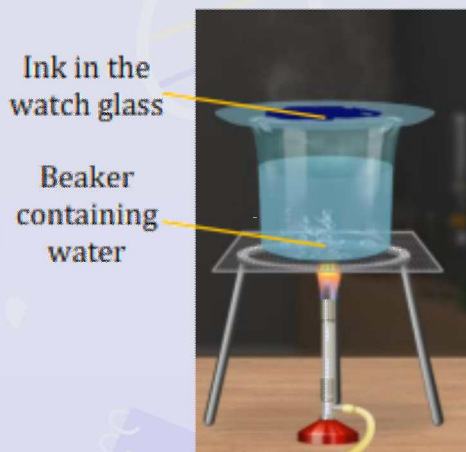
► TYNDALL EFFECT

This scattering of a beam of light by colloidal particles is called the Tyndall effect. The reason for this observation is that the particles of a colloidal solution are big enough to scatter light and hence path of light becomes visible i.e. the Tyndall effect is observed.



SEPARATION TECHNIQUES

► **EVAPORATION** This method is applied when the solvent is volatile liquid and the solute is non-volatile solid.





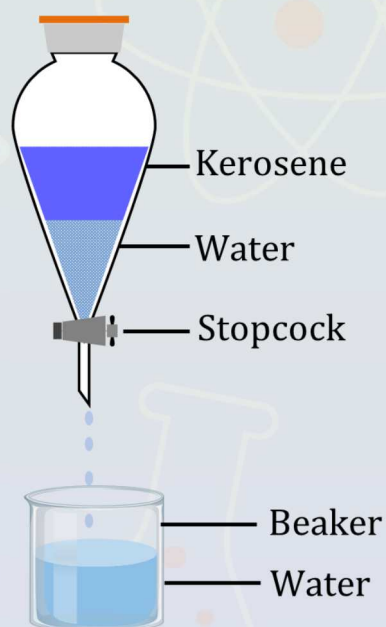
Centrifuge machine

► CENTRIFUGATION

The method of separating finely suspended particles in a liquid, by whirling the liquid at a very high speed is called centrifugation.

► SEPARATING FUNNEL

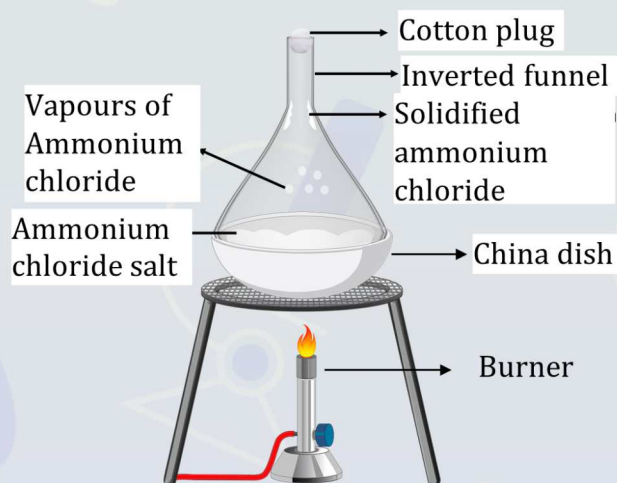
The separation of two immiscible liquids is based on the difference in their densities. The apparatus used for separation is separating funnel.



Separating funnel

► SUBLIMATION

This method is used in the separation of such solid-solid mixtures where one of the components sublimes on heating.



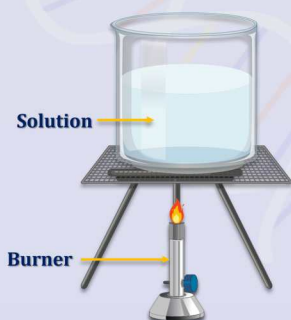
Separation of a mixture by sublimation. Here a mixture of common salt and ammonium chloride is separated by sublimation

► CRYSTALLISATION

The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallisation.



The impure solid is dissolved in a solvent



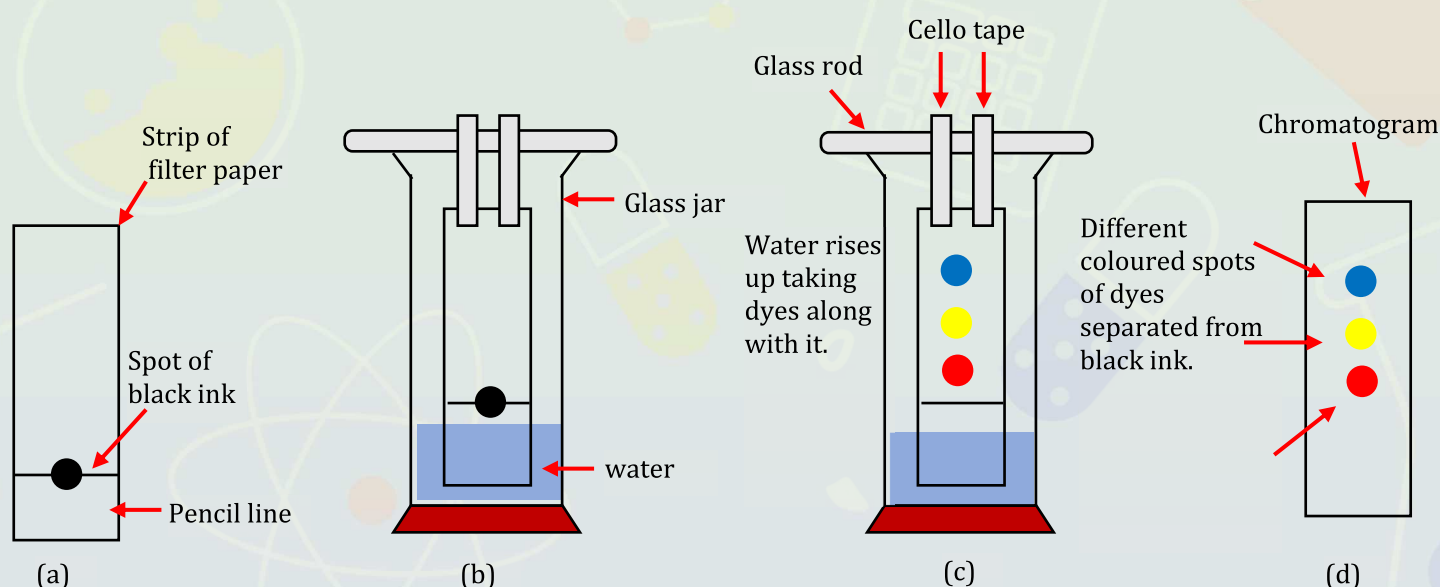
The solution is heated to evaporate most of the solvent



The hot solution is allowed to cool, the solid appears as pure crystals

▶ CHROMATOGRAPHY

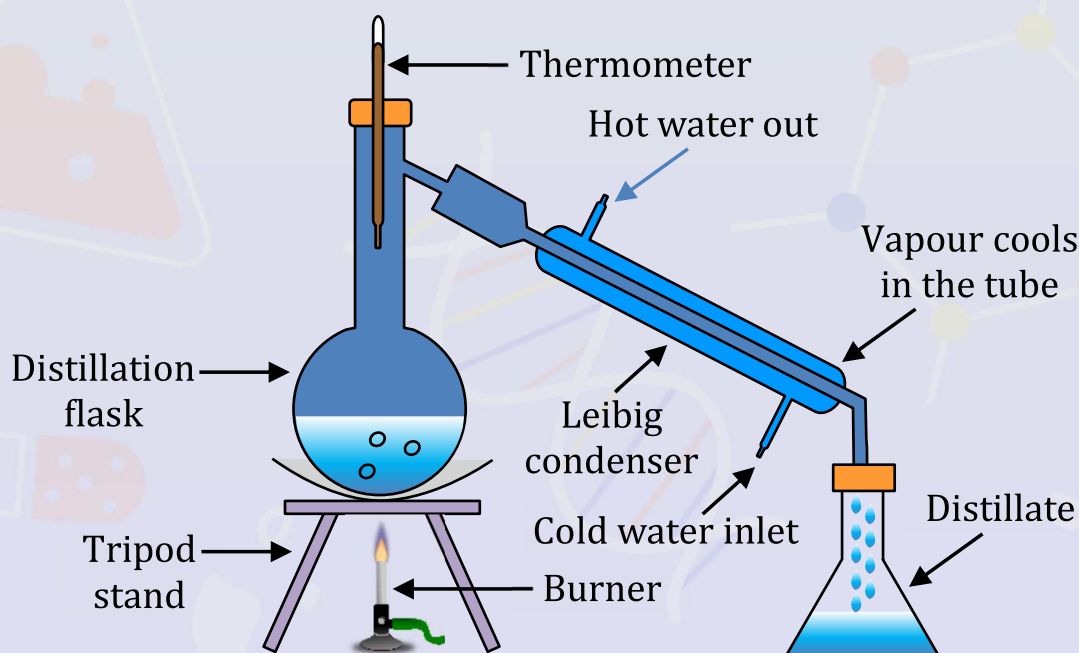
Separation of different components of a mixture based upon their different solubilities in the same solvent is known as chromatography.



Separation of dyes in black ink by paper chromatography

▶ DISTILLATION

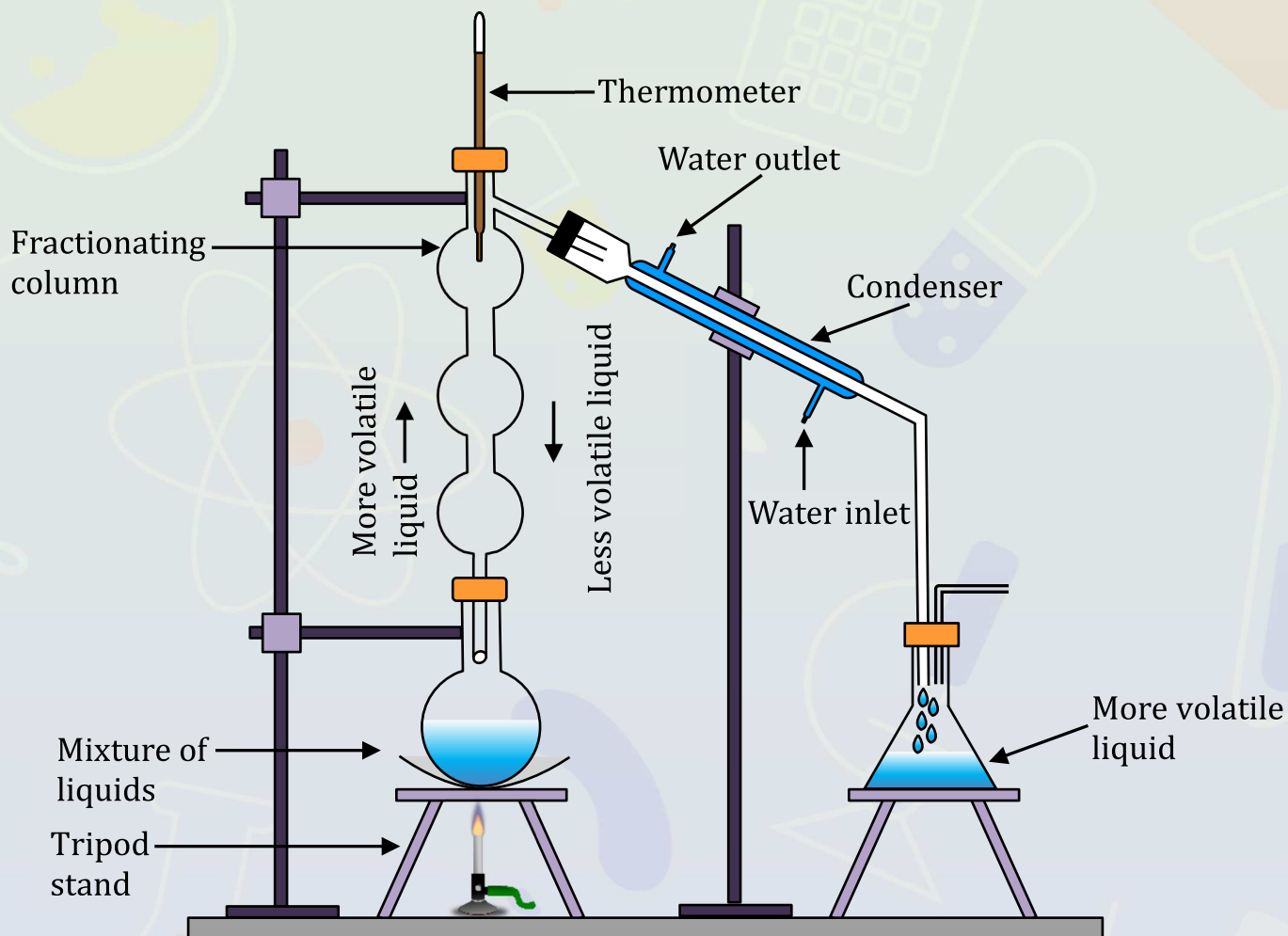
This method is applied for the separation of a mixture containing two miscible liquids having large difference in their boiling points or a mixture containing solid dissolved in liquid.



Simple distillation

► FRACTIONAL DISTILLATION

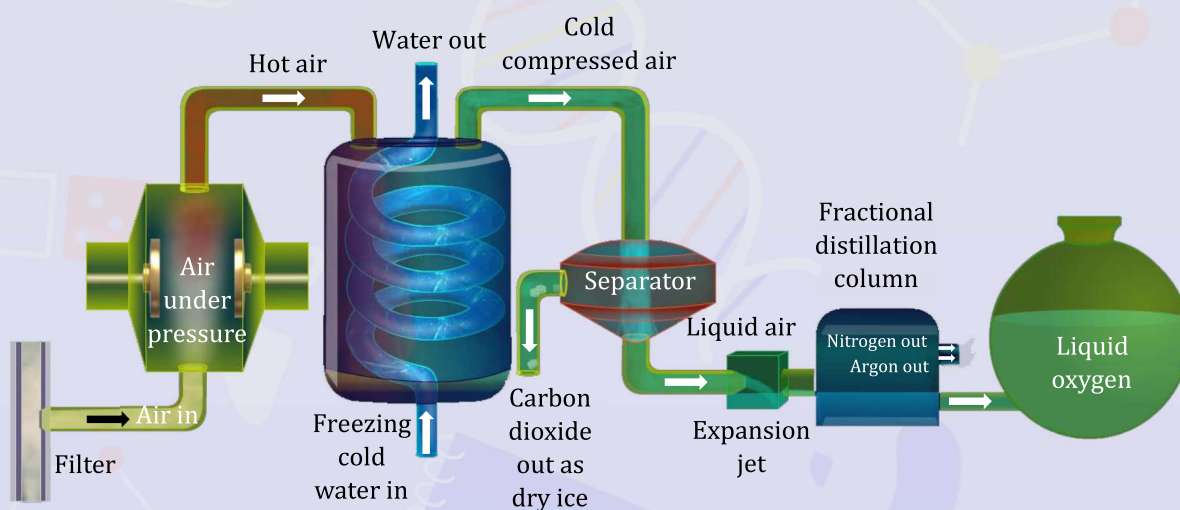
If the boiling points of the two liquids which form a solution, differ only by a small temperature difference (less than 25 K), the fractional distillation is carried out using a fractionating column.



Fractional distillation

Separation of components of air :

Air is a homogeneous mixture and can be separated into its components by fractional distillation of liquid air.



► COAGULATION

This process of bringing together very tiny, suspended particles to form bigger particles that settle down is called coagulation, also known as loading, and the substance that helps in this process is called a coagulating agent or coagulant, for example alum.



► PHYSICAL AND CHEMICAL CHANGES

There are some changes during which no new substances are formed. Changes during which new substances are formed. On the basis of whether new substances are formed or not, we can classify all the changes into two groups



Cutting of vegetables

PHYSICAL CHANGES

- Changes in which no new substances are formed, are called physical changes.
- The change that takes place only in state, colour, texture, electrical and magnetic properties. However, composition (molecular properties) remains the same.
- Specific properties of the substance do not change.
- There is no net absorption or release of energy.
- It is a temporary change and can be reversed.



Curdling of milk

CHEMICAL CHANGES

- Changes in which new substances are formed, are called chemical changes.
- The change that takes place in state, colour, texture, etc. along with the change in composition (molecular properties).
- Specific properties of a substance change completely.
- There is always net absorption or release of energy.
- It is a permanent change and cannot be reversed.