Chapter: Exploring Mixtures and Their Separation

TOPIC 1: Matter – Meaning, Nature and Properties

1.1 What is Matter?

Everything around us is made of **matter**.

Definition

Matter is anything that has mass and occupies space.

This means two conditions must be satisfied:

1. It must have **mass (weight)**
2. It must **occupy space (volume)**

If something satisfies both conditions → it is matter.

Examples of Matter

Example	Why it is Matter
Air	occupies space and has mass
Water	has volume and weight
Stone	occupies space
Milk	has mass
Soil	occupies space

Examples of Things That Are NOT Matter

Not Matter	Reason
Light	no mass
Heat	energy form
Sound	energy

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Not Matter	Reason
Thoughts	no physical existence

1.2 Nature of Matter

Matter is made of **tiny particles**.

These particles are called:

- **Atoms**
- **Molecules**

These particles are **too small to see with naked eyes**.

Evidence that Matter is Made of Particles

Scientists proved that matter is made of particles using several observations.

Experiment 1: Dissolving Sugar in Water

Procedure

1. Take a glass of water.
2. Add one spoon of sugar.
3. Stir continuously.

Observation

- Sugar disappears.
- Water level remains almost same.

Explanation

Sugar particles **break into very tiny particles**and spread between water particles.

Conclusion

Matter contains **very small particles**.

Experiment 2: Potassium Permanganate Experiment

This experiment proves that particles of matter are **extremely tiny**.

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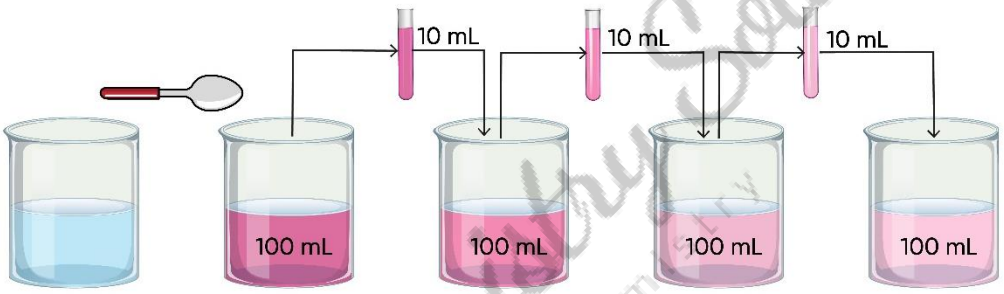
Procedure

1. Take a beaker with water.
2. Add **one crystal of potassium permanganate**.
3. Stir the solution.
4. Take 10 ml of this solution and add to another beaker of water.
5. Repeat several times.

Observation

Water remains **pink even after many dilutions**.

Conclusion



Potassium Permanganate has millions of tiny particles
which keep on dividing on each dilution.
This shows matter is made up of tiny particles

One crystal contains **millions of tiny particles**.

1.3 Characteristics of Particles of Matter

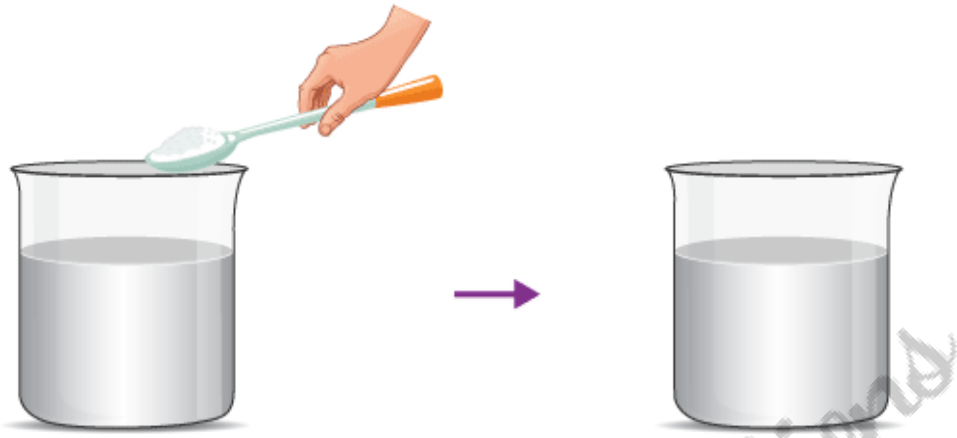
Particles of matter show **three important properties**.

Property 1: Particles of Matter Have Space Between Them

Particles are **not tightly packed**.
There is **space between particles**.

Example

When **sugar dissolves in water**, sugar particles occupy the spaces between water particles.



Property 2: Particles of Matter Are in Constant Motion

Particles are **continuously moving**.

The speed of motion depends on **temperature**.

Higher temperature → faster movement.

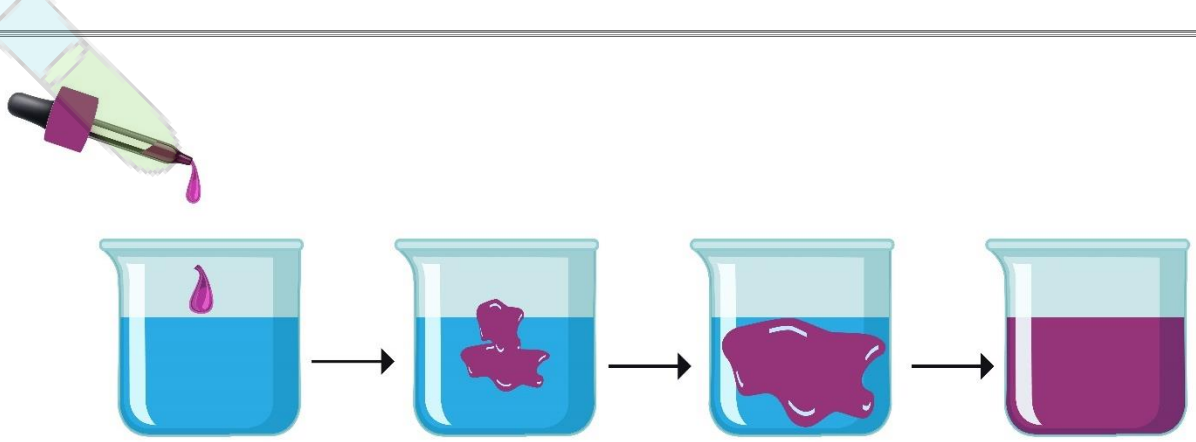
Example: Diffusion

When **perfume is sprayed**, its smell spreads throughout the room.

This happens because perfume particles **move and mix with air particles**.

Example

Drop of ink in water spreads slowly.



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Property 3: Particles of Matter Attract Each Other

Particles attract each other with **force of attraction**.

This force holds particles together.

Strength of Attraction in Different Substances

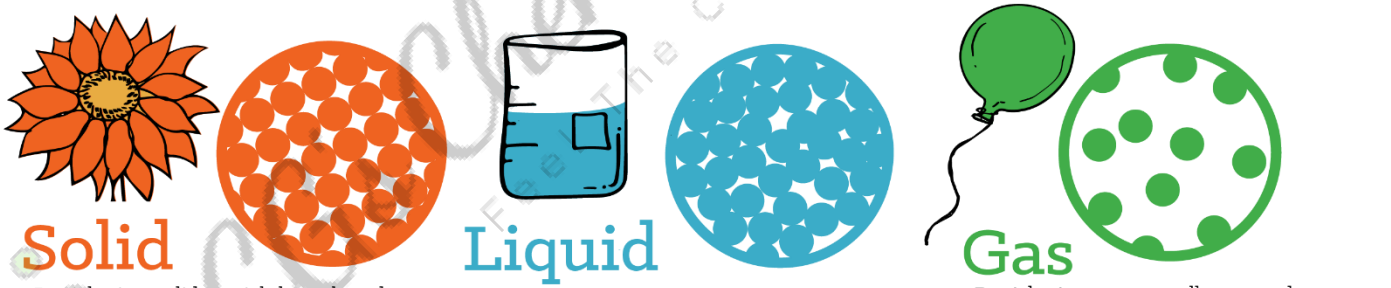
State	Force of Attraction
Solid	Very strong
Liquid	Moderate
Gas	Very weak

Example

Breaking a **chalk piece**requires force because particles attract each other.

1.4 States of Matter

Matter exists in **three main states**.



1.5 Solid State

Definition

A **solid**is a state of matter where particles are **closely packed**.

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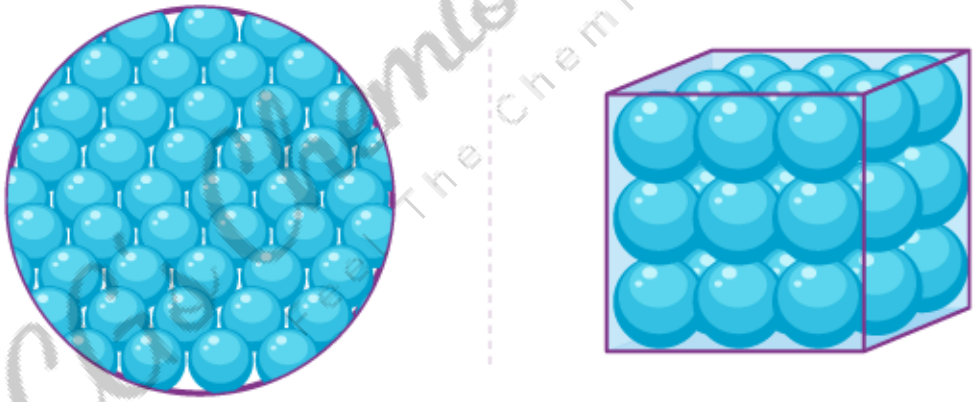
Properties of Solids

1. **Definite shape**
2. **Definite volume**
3. **Strong intermolecular forces**
4. **Particles vibrate at fixed positions**
5. **Cannot flow**

Examples

- Wood
- Ice
- Stone
- Iron
- Brick



1.6 Liquid State

Definition

A **liquid**is a state of matter with **definite volume but no fixed shape**.

It takes the **shape of the container**.

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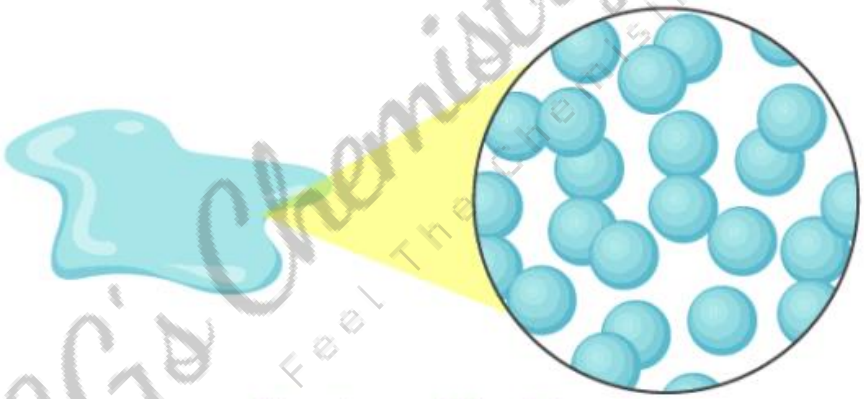
Properties

1. No definite shape
2. Definite volume
3. Particles move freely
4. Moderate force of attraction
5. Can flow

Examples

- Water
- Milk
- Oil
- Juice



Structure of Liquids

1.7 Gaseous State

Definition

A **gas**is a state of matter with **no definite shape and no definite volume**.

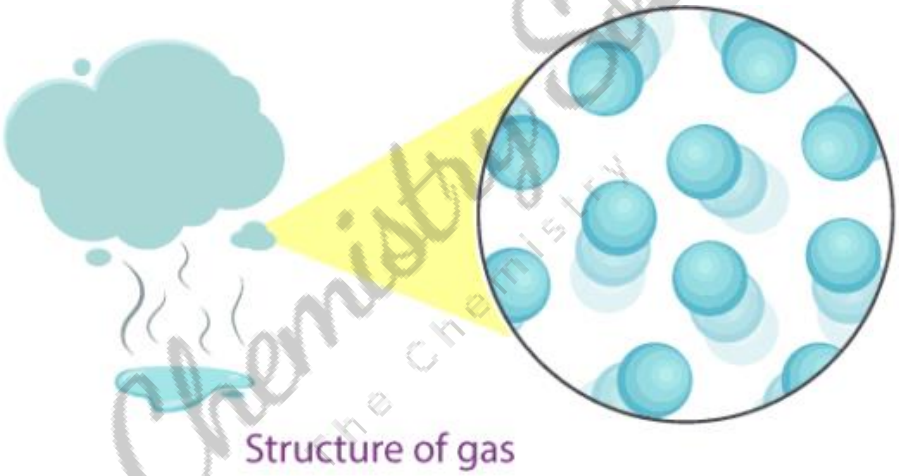
Properties

1. No fixed shape
2. No fixed volume

3. Very weak intermolecular force
4. Particles move very fast
5. Highly compressible

Examples

- Oxygen
- Nitrogen
- Carbon dioxide
- Hydrogen



Structure of gas

1.8 Comparison of States of Matter

Property	Solid	Liquid	Gas
Shape	Fixed	No fixed	No fixed
Volume	Fixed	Fixed	Not fixed
Particle distance	Very small	Medium	Very large
Motion	Vibrate	Slide	Free movement
Compressibility	Very low	Low	Very high

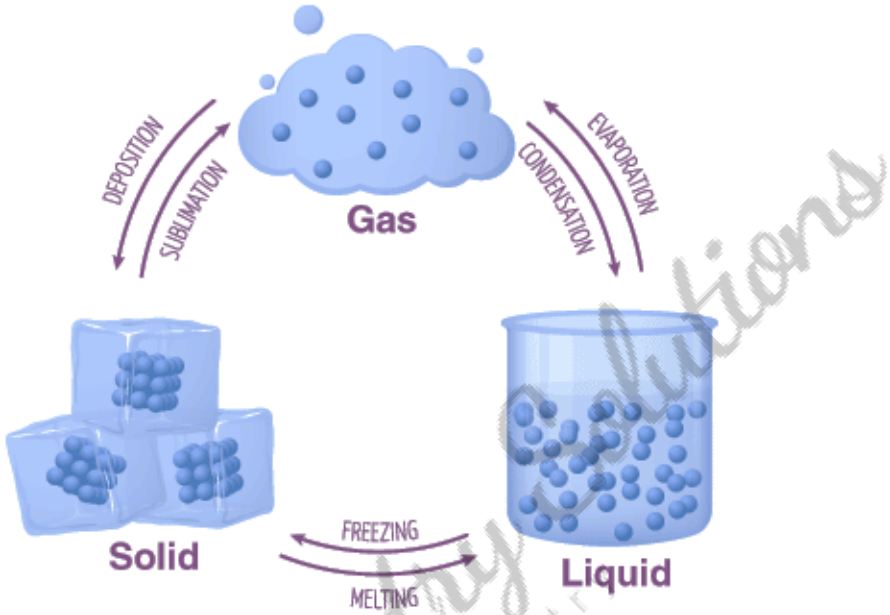
1.9 Interconversion of States of Matter

Matter can change from **one state to another**by:

1. **Changing temperature**

2. **Changing pressure**

Examples



Processes

Change	Process
Solid → Liquid	Melting
Liquid → Gas	Vaporization
Gas → Liquid	Condensation
Liquid → Solid	Freezing

1.10 Why Understanding Matter is Important

Understanding matter helps us to:

- Identify substances
- Understand mixtures
- Separate substances
- Use materials effectively

This concept leads to **next topic: Pure Substances and Mixtures**.

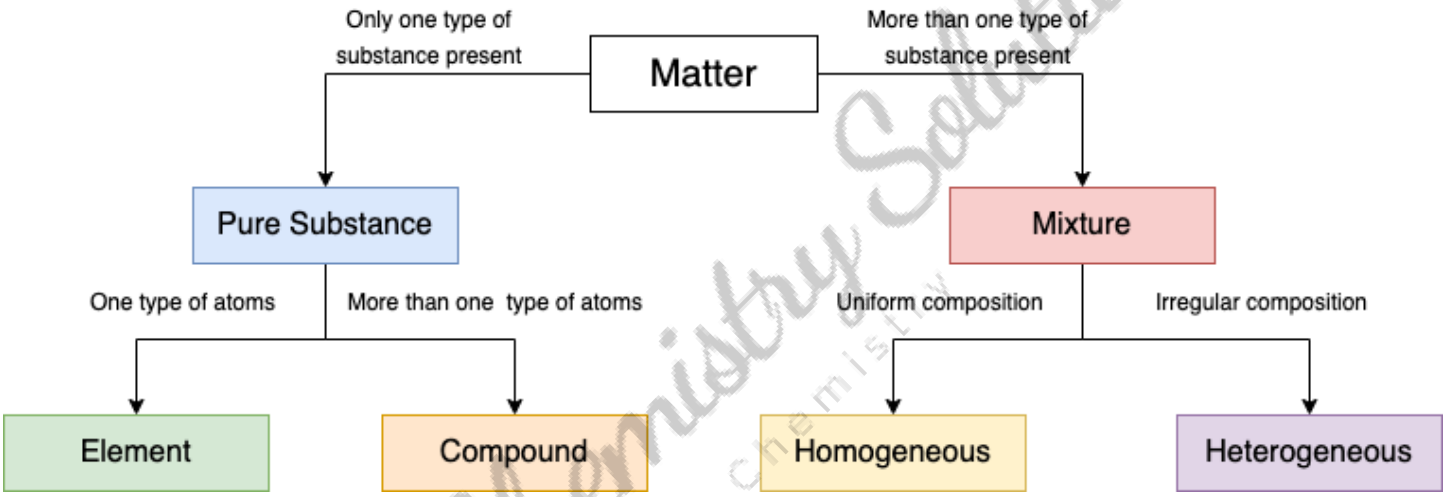
TOPIC 2: Classification of Matter — Pure Substances and Mixtures

In science, matter is classified so that we can **study substances easily, understand their properties, and separate them when needed**.

The **broad classification of matter**is based on **composition** (what matter is made of).

2.1 Classification of Matter Based on Composition

Matter can be divided into **two main categories**:



So there are **two main groups**:

1. **Pure Substances**
2. **Mixtures**

2.2 Pure Substance

Definition

A **pure substance**is a material that is made up of **only one type of particles**and has a **fixed composition and definite properties**.

The particles may be **atoms or molecules**, but they are **all identical**.

Examples of Pure Substances

Substance	Type
Oxygen	Element

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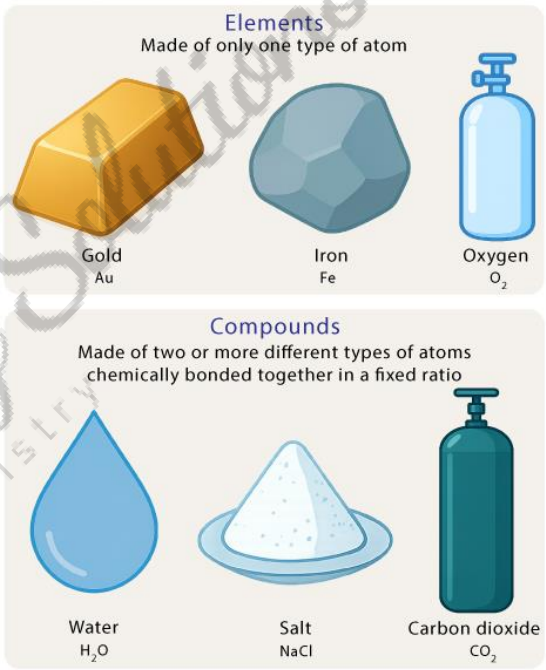
Substance	Type
Hydrogen	Element
Iron	Element
Water	Compound
Sodium chloride	Compound

Important Characteristics of Pure Substances

1 Uniform composition

Every part of the substance is exactly the same.

Example:
Every molecule of water = **H_2O**



2 Fixed properties

Pure substances have **definite physical and chemical properties**.

Example:

Property	Water
Boiling point	100°C
Freezing point	0°C

3 Cannot be separated by physical methods

Pure substances **cannot be separated by simple physical methods**like filtration or evaporation.

They can only be separated by **chemical reactions**.

4 Homogeneous nature

Pure substances are always **homogeneous** (uniform throughout).

2.3 Types of Pure Substances

Pure substances are of **two types**:

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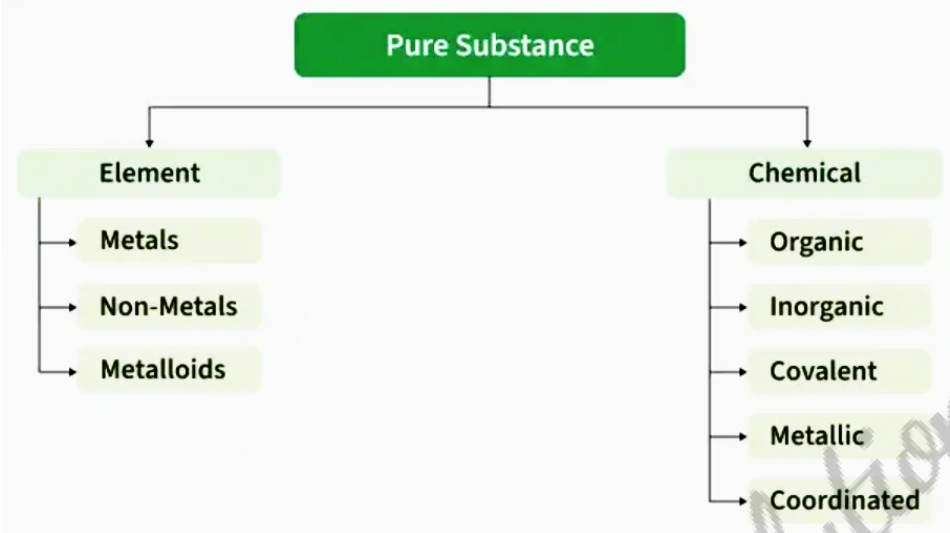


2.4 Element

Definition

An **element**is a pure substance made up of **only one kind of atom**.

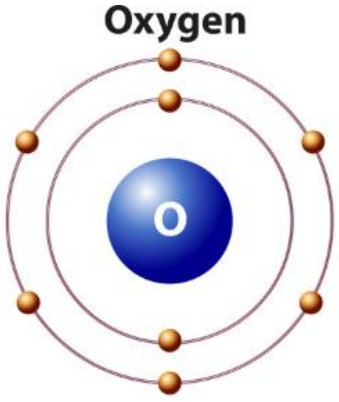
It **cannot be broken down into simpler substances by chemical methods**.

Examples of Elements

Element	Symbol
Hydrogen	H
Oxygen	O
Nitrogen	N
Iron	Fe
Gold	Au
Copper	Cu

Structure of an Element

All particles are **same atoms**.



Properties of Elements

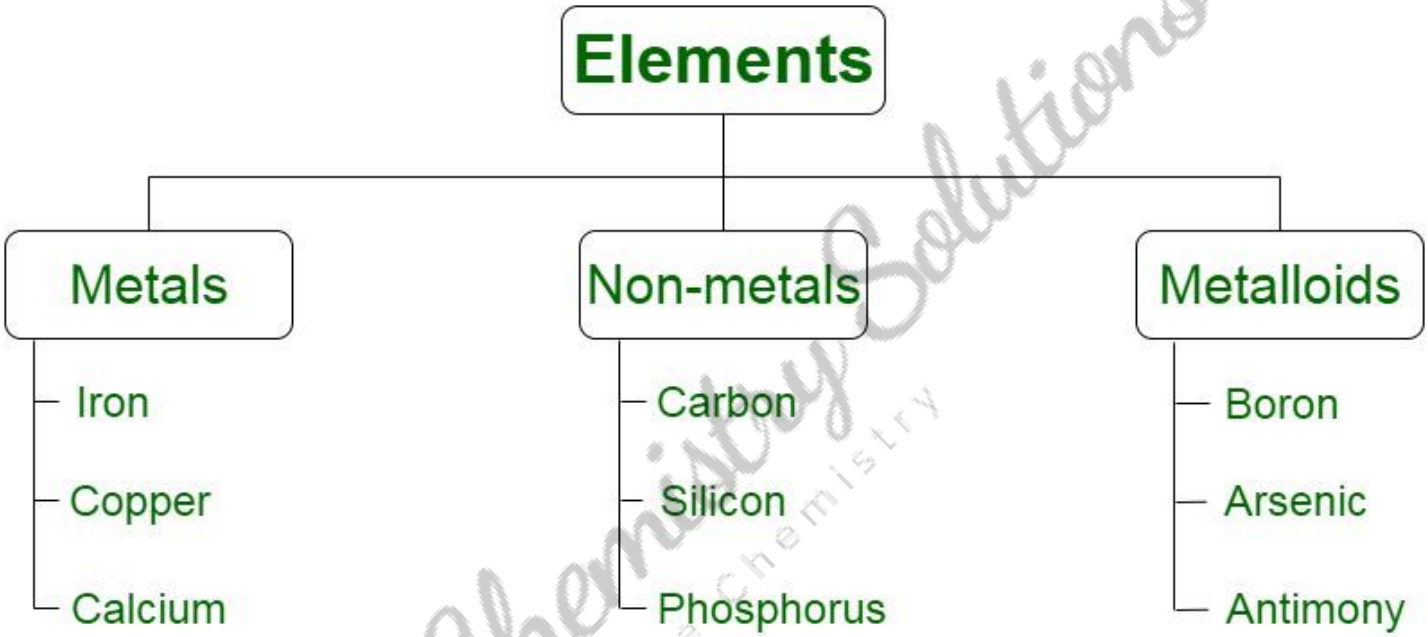
1. Made of **only one type of atom**
2. Cannot be broken into simpler substances

3 Have definite **physical properties**

4 Represented by **chemical symbols**

2.5 Types of Elements

Elements are classified into **three categories**.



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1. Metals

Metals are elements that show **metallic properties**.

Examples

- Iron
- Copper
- Aluminium
- Gold
- Silver

Properties of Metals

Property	Explanation
Lustrous	Shiny surface
Malleable	Can be beaten into sheets

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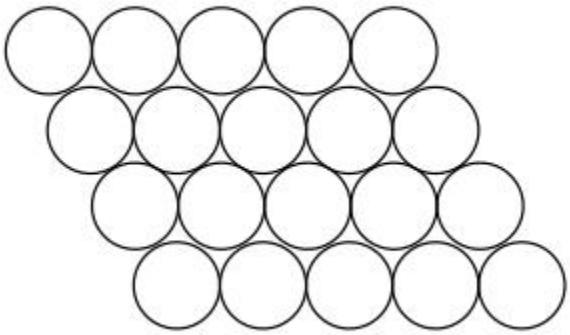
Property	Explanation
Ductile	Can be drawn into wires
Good conductor	Conduct heat and electricity



2. Non-Metals

Non-metals show **opposite properties of metals**.

Examples

- Oxygen
- Nitrogen
- Carbon
- Sulphur
- Phosphorus

Properties

Property	Explanation
Dull	No shine
Brittle	Break easily
Poor conductor	Do not conduct electricity
Not malleable	Cannot be beaten into sheets

3. Metalloids

Metalloids show **properties of both metals and non-metals**.

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Examples

- Silicon
- Germanium
- Arsenic

2.6 Compound

Definition

A **compound**is a pure substance formed when **two or more elements chemically combine in a fixed ratio**.

The elements lose their individual properties and form a **new substance**.

Examples of Compounds

Compound	Elements Present
Water (H_2O)	Hydrogen + Oxygen
Carbon dioxide (CO_2)	Carbon + Oxygen
Sodium chloride (NaCl)	Sodium + Chlorine

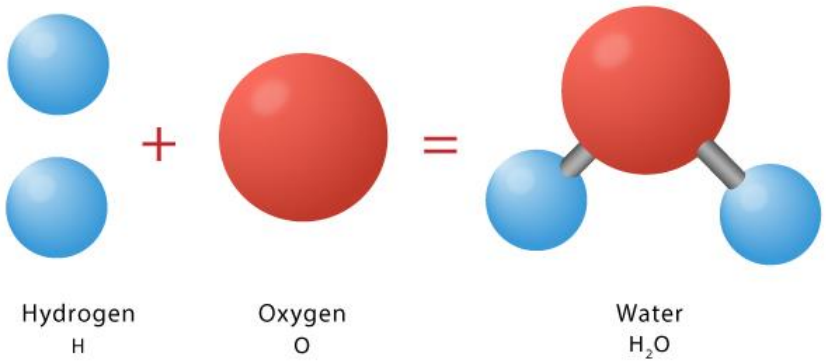
Example: Formation of Water

Hydrogen + Oxygen → Water

$H_2 + O_2 \rightarrow H_2O$

Hydrogen → combustible gas
Oxygen → supports burning
Water → liquid used for drinking

Properties **completely change**.



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2.7 Characteristics of Compounds

1 Fixed composition

Elements combine in a **fixed ratio by mass**.

Example:

Water → H_2O
Hydrogen : Oxygen = **2 : 1**

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2 New properties

Compound properties are **different from elements**.

Example:

Substance	Property
Sodium	Highly reactive metal
Chlorine	Poisonous gas
Sodium chloride	Table salt

---

3 Cannot be separated by physical methods

They can only be separated by **chemical reactions**.

Example:

Water → hydrogen + oxygen (electrolysis)

---

4 Homogeneous

Compounds are always **uniform throughout**.

2.8 Mixture

Definition

A **mixture**is formed when **two or more substances combine physically without chemical reaction**.

The substances **retain their original properties**.

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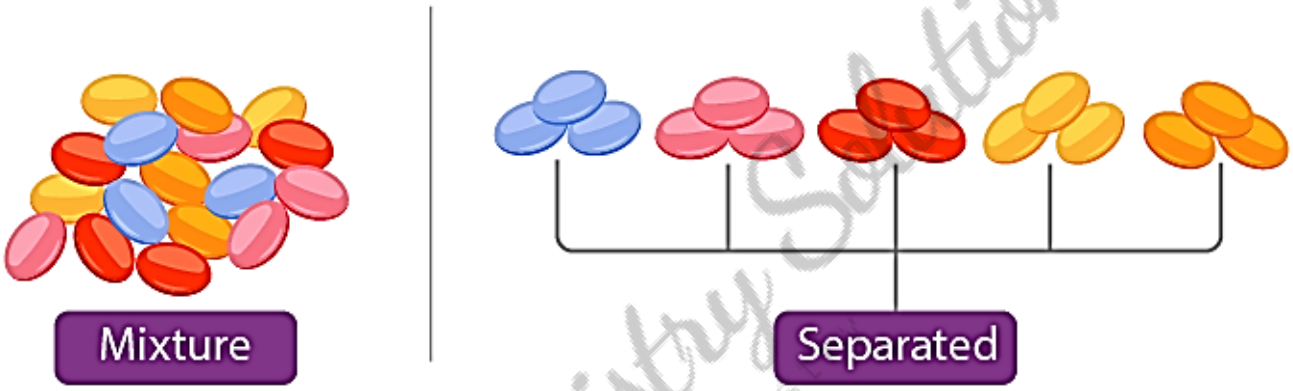
Examples

Mixture	Components
Air	Nitrogen + Oxygen + gases
Salt water	Salt + Water
Soil	Sand + clay + organic matter
Milk	Water + fats + proteins

Structure of Mixture



2.9 Characteristics of Mixtures

1 Variable composition

Components can be present in **any proportion**.

Example:

Salt water can have **more salt or less salt**.

2 Components retain their properties

Example:

Iron + sand mixture

Iron remains magnetic.

3 Separated by physical methods

Mixtures can be separated by:

- filtration

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- evaporation
- distillation
- magnetic separation

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4 **May be homogeneous or heterogeneous**

2.10 Differences Between Pure Substance and Mixture

Property	Pure Substance	Mixture
Composition	Fixed	Variable
Components	Single type	Two or more
Separation	Chemical methods	Physical methods
Properties	Definite	Depend on composition
Example	Water	Salt water

2.11 Importance of Studying Mixtures

Understanding mixtures helps in:

1 **Purification of substances**

Example:
Purifying drinking water.

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2 **Industrial processes**

Example:

- Petroleum refining
- Metal extraction

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3 **Food preparation**

Example:

- Tea
- Coffee

- Juice

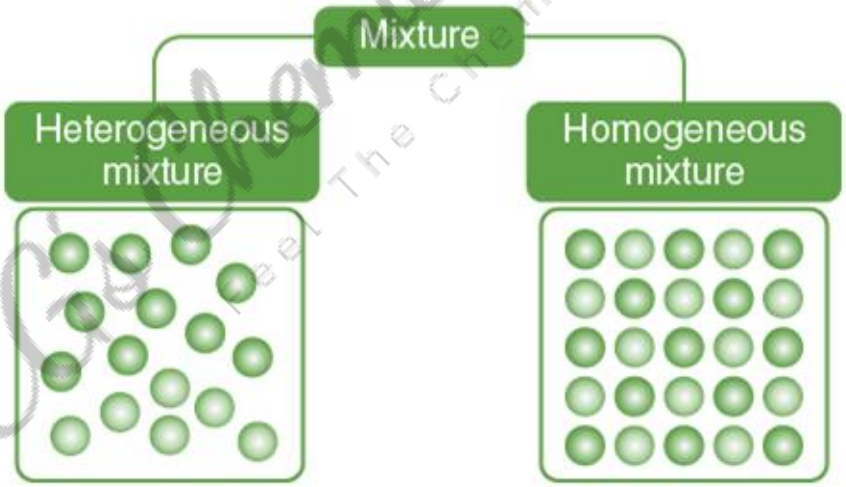
2.12 Real-Life Examples of Mixtures

Mixture	Type
Air	Homogeneous
Sea water	Homogeneous
Soil	Heterogeneous
Fruit salad	Heterogeneous

TOPIC 3: Types of Mixtures — Homogeneous and Heterogeneous Mixtures

In the previous topic, we learned that **mixtures are formed when two or more substances combine physically**.
Now we study **how mixtures are classified based on the uniformity of their composition**.

Mixtures are mainly divided into **two types**:



3.1 Homogeneous Mixture

Definition

A **homogeneous mixture**is a mixture in which **all the components are uniformly distributed throughout the mixture**.

This means:

- Every part of the mixture has **the same composition**

- The components **cannot be distinguished by naked eyes**

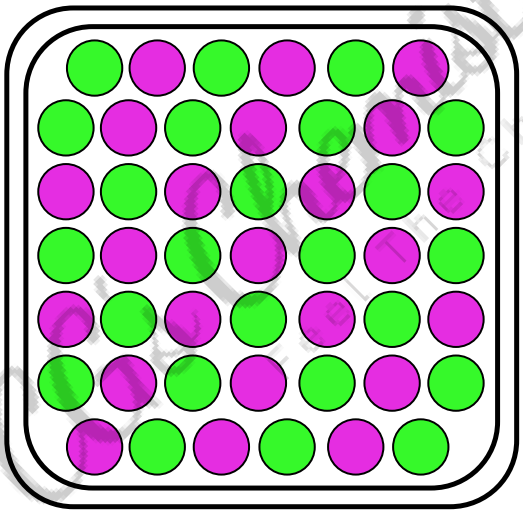
Homogeneous mixtures are also called **solutions**.

Examples of Homogeneous Mixtures

Mixture	Components
Salt water	Salt + Water
Sugar solution	Sugar + Water
Air	Nitrogen + Oxygen + other gases
Vinegar	Acetic acid + Water
Brass	Copper + Zinc

Structure of Homogeneous Mixture

Particles are **evenly distributed everywhere**.



Homogeneous Mixture

Characteristics of Homogeneous Mixtures

1. Uniform Composition

The mixture looks **same throughout**.

Example:
Salt water looks the same everywhere.

2. Single Phase

There is **only one phase visible**.

Example:

Salt dissolved in water forms **one liquid phase**.

3. Components Cannot Be Seen

The individual components **cannot be distinguished by eyes**.

Example:
In salt water, we cannot see salt particles.

4. Small Particle Size

Particles are **very tiny** (less than 1 nm).

5. Cannot Be Separated by Simple Filtration

Because particles are very small.

Examples in Daily Life

Homogeneous Mixture	Explanation
Tea	Water + sugar + tea extract
Lemon water	Lemon juice + water + sugar
Petrol	mixture of hydrocarbons
Air	mixture of gases

3.2 Heterogeneous Mixture

Definition

A **heterogeneous mixture**is a mixture in which **components are not uniformly distributed**.

Different parts of the mixture have **different compositions**.

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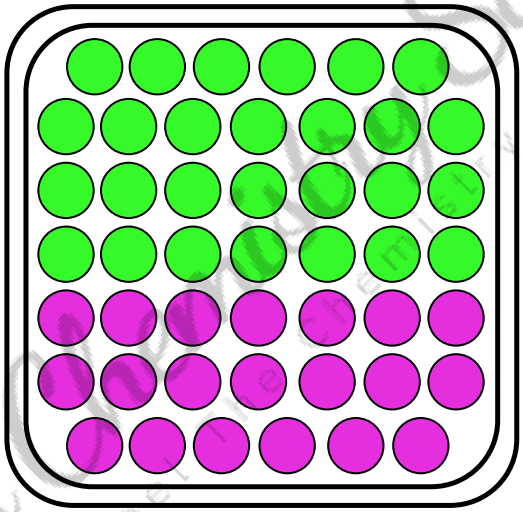
Examples of Heterogeneous Mixtures

Mixture	Components
Sand and water	Sand + Water
Oil and water	Oil + Water
Soil	Sand + clay + organic matter
Fruit salad	Different fruits
Concrete	Cement + sand + gravel

Structure of Heterogeneous Mixture

Particles are **unevenly distributed**.



Heterogeneous Mixture

Characteristics of Heterogeneous Mixtures

1. Non-uniform Composition

The mixture is **different in different regions**.

Example:
Sand settles at bottom.

---

2. More Than One Phase

Two or more phases can be seen.

Example:

Oil and water form **two layers**.

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3. Components Visible

The components can be **seen separately**.

Example:

Fruit salad shows different fruits.

---

4. Easy Physical Separation

Components can be separated by:

- filtration
- handpicking
- sieving

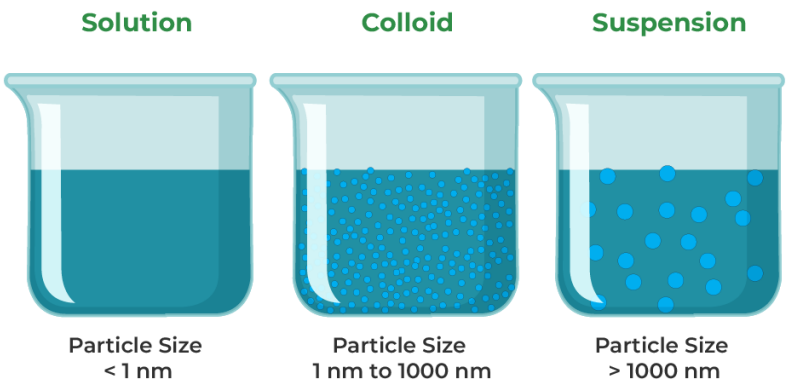
3.3 Differences Between Homogeneous and Heterogeneous Mixtures

Property	Homogeneous	Heterogeneous
Composition	Uniform	Non-uniform
Phases	Single phase	Two or more
Visibility	Components not visible	Components visible
Example	Salt water	Sand in water

3.4 Special Types of Mixtures

There are **three important types of mixtures**commonly studied:

These depend mainly on **particle size**.



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3.5 Solution

Definition

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

Components of Solution

Every solution has two components.

Solute

The substance that **gets dissolved**.

Example:

Salt in salt water.

Solvent

The substance that **dissolves the solute**.

Example:

Water in salt solution.

Example of Solution

`Salt + Water → Salt solution`

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Examples of Solutions

Solution	Solute	Solvent
Salt water	Salt	Water
Sugar solution	Sugar	Water
Soda water	Carbon dioxide	Water
Air	Oxygen, CO_2	Nitrogen

Characteristics of Solutions

1. Homogeneous mixture
2. Very small particles
3. Transparent
4. Cannot be separated by filtration
5. Stable mixture

3.6 Suspension

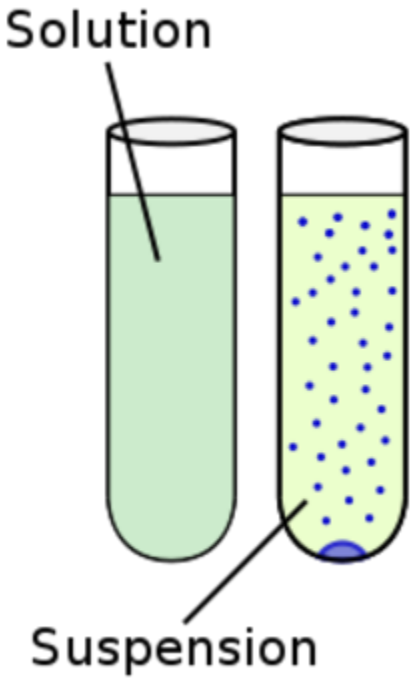
Definition

A **suspension**is a **heterogeneous mixture in which solid particles are dispersed in a liquid**.

The particles are **large and settle down after some time**.

Examples

Suspension	Components
Muddy water	Mud + Water
Chalk powder in water	Chalk + Water
Paint	Pigments + liquid



Characteristics of Suspensions

1. Heterogeneous mixture
2. Particles visible
3. Particles settle on standing
4. Can be separated by filtration

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3.7 Colloid

Definition

A **colloid**is a mixture where particles are **intermediate in size between solution and suspension**.

Examples

Colloid	Components
Milk	Fat + Water
Fog	Water droplets + air
Smoke	Solid particles + air
Butter	Fat + water

Characteristics of Colloids

1. Particles do **not settle down**
2. Cannot be filtered by normal filter paper
3. Show **Tyndall effect**

3.8 Tyndall Effect

Definition

The **scattering of light by colloidal particles**is called the **Tyndall effect**.

Example

- Sunlight passing through a dusty room
- Car headlights in fog

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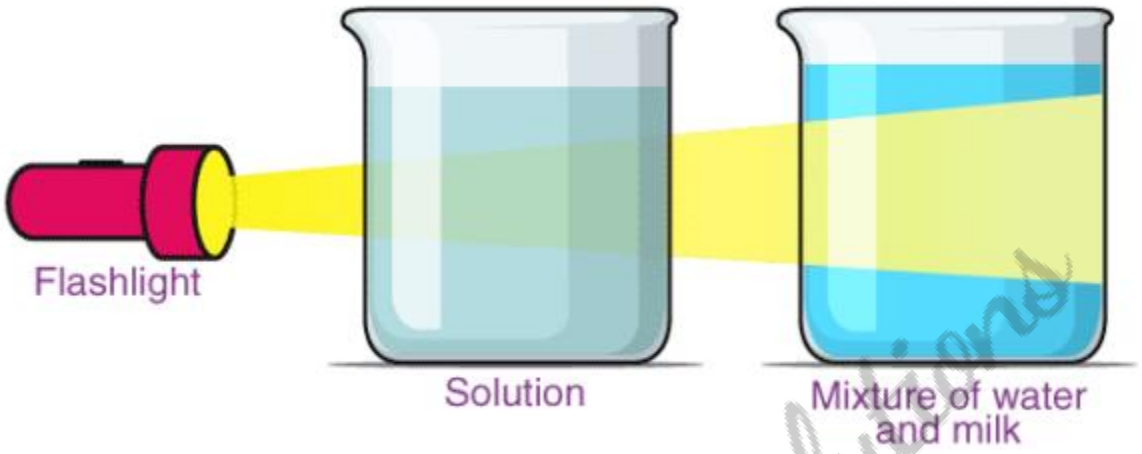
Diagram



3.9 Difference Between Solution, Suspension and Colloid

Property	Solution	Suspension	Colloid
Type	Homogeneous	Heterogeneous	Intermediate
Particle size	Very small	Large	Medium
Visibility	Not visible	Visible	Not visible
Sedimentation	No	Yes	No
Filtration	No	Yes	No

3.10 Real-Life Examples

Mixture	Type
Salt water	Solution
Milk	Colloid
Muddy water	Suspension
Fog	Colloid
Air	Solution

3.11 Importance of Studying Types of Mixtures

This knowledge helps us to:

- Identify substances
- Choose correct **separation techniques**

- Understand **industrial processes**
- Study **environmental phenomena**

TOPIC 4: Concentration of Solutions

In the previous topic, we learned that a **solution is a homogeneous mixture consisting of a solute and a solvent**.
Now we study **how much solute is present in a solution**, which is called **concentration**.

Understanding concentration helps us know **how strong or weak a solution is**.

4.1 Meaning of Concentration

Definition

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

In simple words:

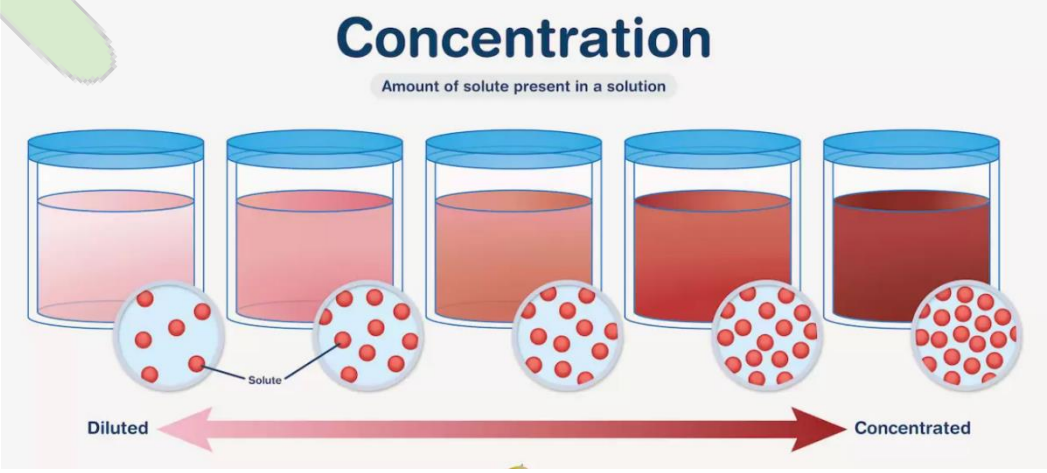
> Concentration tells us **how much solute is present in the solution**.

Example

Suppose we prepare two salt solutions:

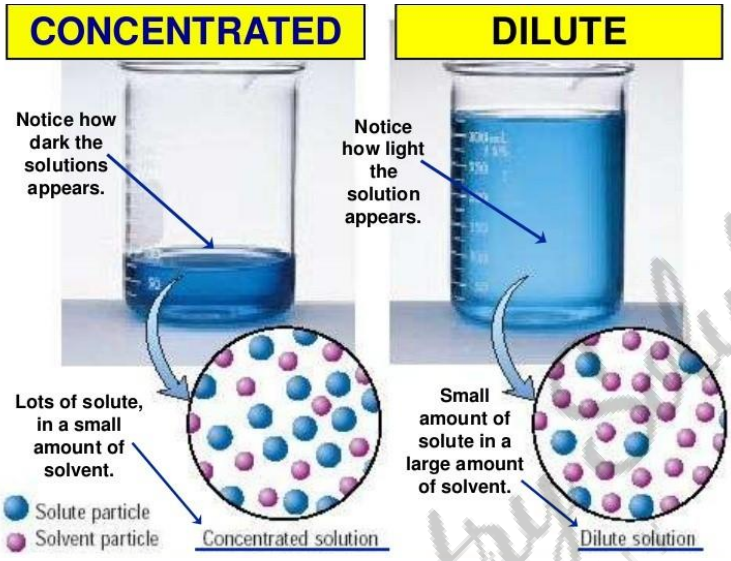
Solution	Amount of Salt	Amount of Water
Solution A	1 spoon	1 glass
Solution B	5 spoons	1 glass

Solution B has **more salt**, so it is **more concentrated**.



4.2 Types of Solutions Based on Concentration

Solutions can be classified as:



4.3 Dilute Solution

Definition

A **dilute solution**contains **a small amount of solute dissolved in a large amount of solvent**.

Example

- Light sugar solution
- Weak salt solution
- Lemon water with little sugar

Characteristics

1. Small amount of solute
2. Large amount of solvent
3. Weak taste or effect

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4.4 Concentrated Solution

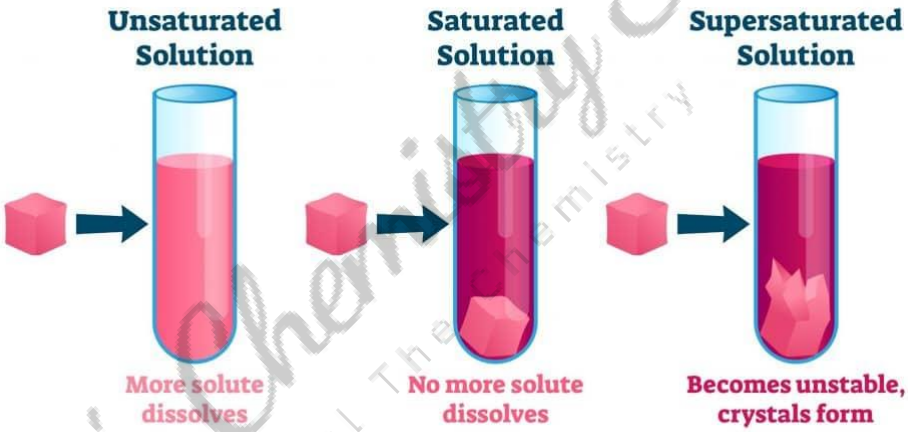
Definition

A **concentrated solution**contains **a large amount of solute dissolved in a small amount of solvent**.

Example

- Strong sugar syrup
- Highly salty water
- Concentrated fruit juice

Diagram



Characteristics

1. Large amount of solute
2. Less solvent
3. Strong taste or effect

4.5 Saturated Solution

Definition

A **saturated solution**is a solution that **cannot dissolve any more solute at a given temperature**.

When the solution becomes saturated, **extra solute remains undissolved**.

Example

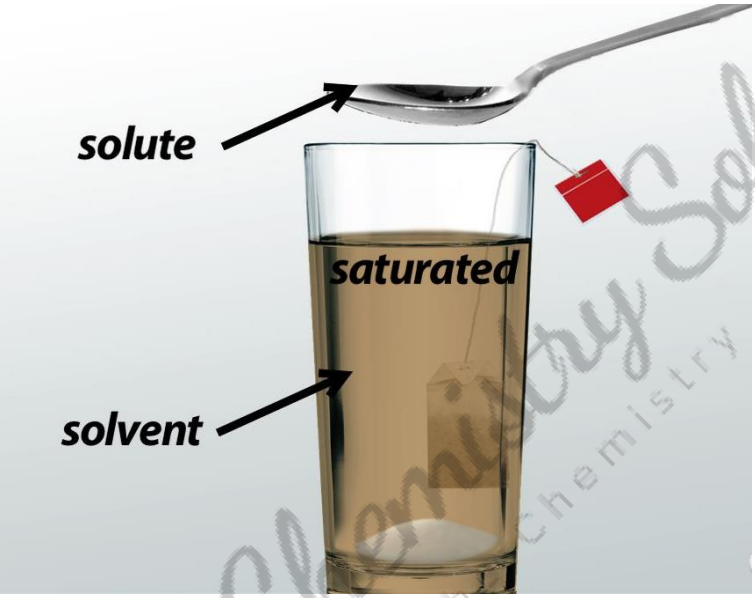
Suppose we keep adding sugar to water.

Initially sugar dissolves.

After some time, sugar **stops dissolving and settles at the bottom**.

This means the solution has become **saturated**.

Diagram



Important Point

Saturation depends on **temperature**.

Higher temperature → more solute dissolves.

4.6 Unsaturated Solution

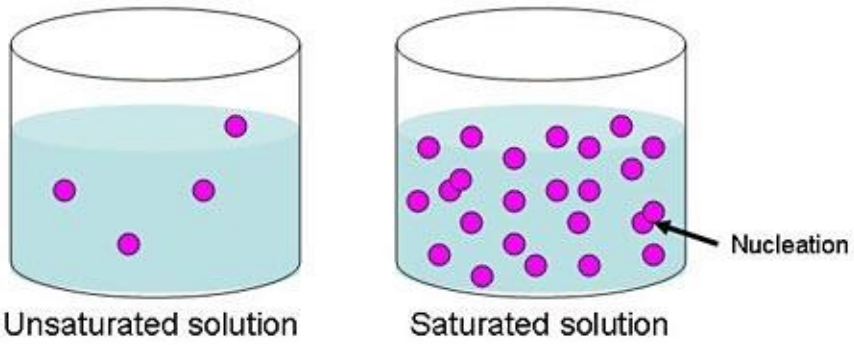
Definition

An **unsaturated solution**is a solution that **can still dissolve more solute at a given temperature**.

Example

Salt dissolving easily in water.

Diagram

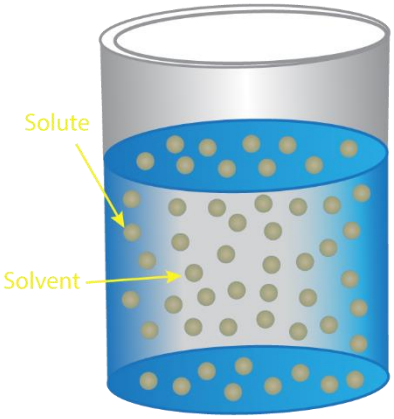


4.7 Supersaturated Solution

Definition

A **supersaturated solution**contains **more solute than the saturated solution at a given temperature**.

This type of solution is **unstable**.



Example

Hot sugar solution that contains **extra sugar dissolved**.

When cooled, **sugar crystals start forming**.

Example in Daily Life

Formation of **sugar crystals in honey or sugar syrup**.

4.8 Solubility

Definition

Solubilityis the **maximum amount of solute that can dissolve in a given amount of solvent at a specific temperature**.

Example

At room temperature:

- Only a certain amount of salt can dissolve in water.

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- After that, the solution becomes **saturated**.

4.9 Factors Affecting Solubility

There are mainly **three factors**.

---

1. Temperature

Temperature greatly affects solubility.

For most solids

Solubility **increases with temperature**.

Example:

Sugar dissolves faster in **hot water**.

Diagram

---

2. Pressure

Pressure mainly affects **gases dissolved in liquids**.

Higher pressure → more gas dissolves.

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Example

Carbon dioxide dissolved in **cold drinks**.

The bottle is sealed under **high pressure**.

When opened:

Gas escapes.

---

3. Nature of Solute and Solvent

Some substances dissolve easily, others do not.

Example:

Substance	Solubility in Water
Sugar	Soluble
Salt	Soluble
Sand	Insoluble
Oil	Insoluble

4.10 Rate of Dissolving

The **speed at which solute dissolves**depends on:

1. **Temperature**
2. **Stirring**
3. **Surface area of solute**

Example

Sugar cube vs sugar powder.

Sugar powder dissolves faster because **surface area is larger**.

4.11 Real-Life Examples of Solutions

Solution	Solute	Solvent
Tea	Sugar	Water
Salt water	Salt	Water
Soda water	CO_2	Water

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Solution	Solute	Solvent
Lemonade	Sugar + lemon juice	Water

4.12 Importance of Concentration

Concentration is important in many fields.

Medicine

Correct drug concentration is necessary.

Cooking

Taste depends on concentration of salt or sugar.

Chemistry Experiments

Exact concentration is required for **accurate reactions**.

TOPIC 5: Methods of Separation of Mixtures

In everyday life, mixtures often contain **useful substances mixed with unwanted substances (impurities)**.
To obtain **pure and useful materials**, we need to **separate the components of mixtures**.

This process is called **separation of mixtures**.

5.1 Why Do We Need to Separate Mixtures?

Separation is important for several reasons.

1. To Remove Unwanted Substances

Example:

- Removing **stones from rice**
- Removing **dust from wheat**

---

2. To Obtain Useful Components

Example:

- Extracting **butter from milk**
- Extracting **petrol from crude oil**

---

3. To Remove Harmful Impurities

Example:

- Purifying **drinking water**
- Removing **pollutants from air**

---

4. To Separate Different Useful Substances

Example:

Separating **different metals from ores**.

5.2 Basis of Separation

Different separation techniques work based on **differences in physical properties of substances**.

Some important properties used are:

Property	Example
Size	Sieving
Weight	Winnowing
Magnetism	Magnetic separation
Solubility	Filtration
Boiling point	Distillation

5.3 Common Methods of Separation

Later methods include:

- Evaporation
- Distillation
- Chromatography

5.4 Handpicking

Definition

Handpicking is the method of separating **larger unwanted particles manually by hand**.

When is Handpicking Used?

This method is used when:

- The impurity is **larger in size**
- The quantity of mixture is **small**

Examples

Mixture	Separated Component
Rice + stones	Stones removed
Wheat + husk pieces	Husk removed
Pulses + impurities	Impurities removed

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Advantages

✓ Simple method
✓ No equipment required

Limitations

❌ Cannot be used for **large quantities**
❌ Not useful when particles are **very small**

5.5 Winnowing

Definition

Winnowing is a method of separating **lighter particles from heavier particles using wind or air**.

Principle

The method works on the **difference in weight of particles**.

Lighter particles → blown away
Heavier particles → fall down

Example

Separating **husk from wheat grains**.

Farmers commonly use this method.

Process

1. The mixture is taken in a tray.
2. It is dropped from a height.
3. Wind blows away lighter husk particles.
4. Heavy grains fall down.

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Other Examples

Mixture	Separation
Wheat + husk	Husk removed
Rice + chaff	Chaff removed

5.6 Sieving

Definition

Sieving is the method of separating particles **based on difference in particle size**.

Principle

Small particles pass through **small holes of the sieve**, while larger particles remain on the sieve.

Examples

Mixture	Separation
Flour + bran	Bran removed
Sand + gravel	Gravel removed
Wheat flour	Impurities removed

Diagram

Uses

✓ Used in **construction work**
✓ Used in **flour mills**

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5.7 Magnetic Separation

Definition

Magnetic separation is the process of separating **magnetic substances from non-magnetic substances using a magnet**.

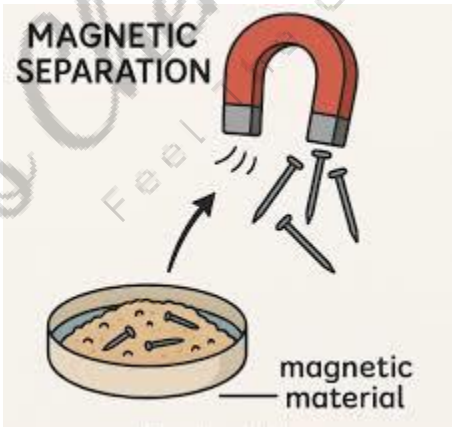
Principle

Magnetic materials are **attracted by magnets**.

Examples

Mixture	Separation
Iron filings + sand	Iron removed
Steel scrap + waste	Steel separated

Diagram



Magnetic Substances

Examples:

- Iron
- Nickel
- Cobalt
- Steel

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Non-magnetic Substances

Examples:

- Sand
- Plastic
- Wood

5.8 Sedimentation

Definition

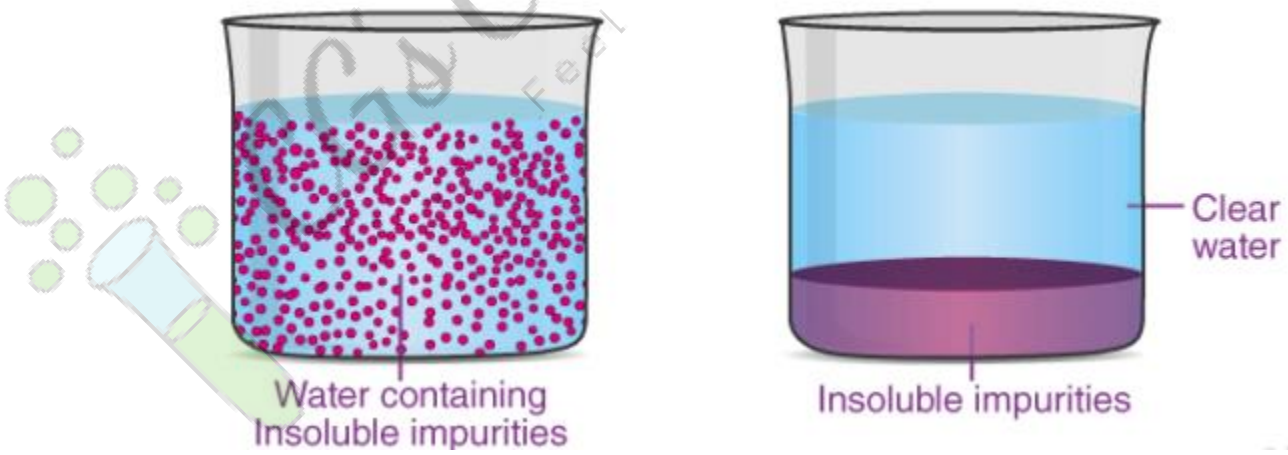
Sedimentation is the process in which **heavier insoluble particles settle at the bottom of a liquid**when left undisturbed.

Example

Muddy water.

When kept undisturbed, **mud particles settle at the bottom**.

Diagram



5.9 Decantation

Definition

Decantation is the process of **gently pouring off the clear liquid from the sediment**.

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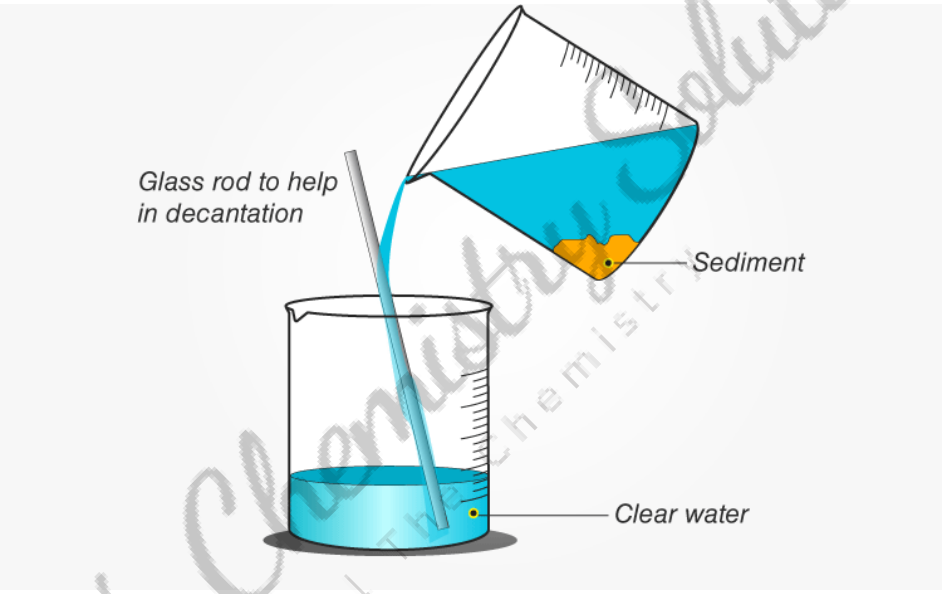
Process

1. Allow sedimentation.
2. Slowly pour the upper liquid.

Example

Separating **sand from water**.

Diagram



5.10 Filtration

Definition

Filtration is the process of separating **insoluble solid particles from a liquid using a filter**.

Examples

Mixture	Separation
Tea + tea leaves	Leaves removed
Sand + water	Sand removed
Coffee	Coffee grounds removed

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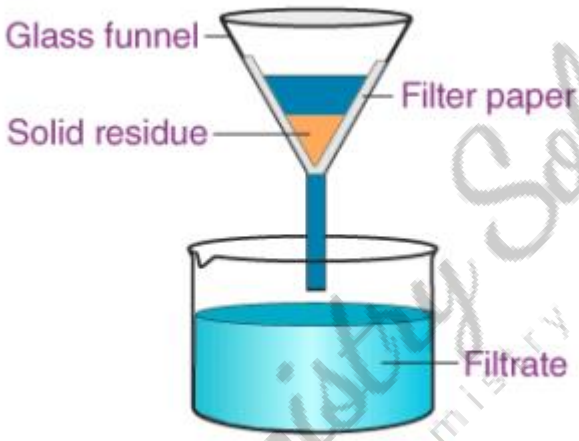
Terms in Filtration

Term	Meaning
Residue	Solid left on filter
Filtrate	Liquid collected

Diagram



Filtration process

5.11 Evaporation

Definition

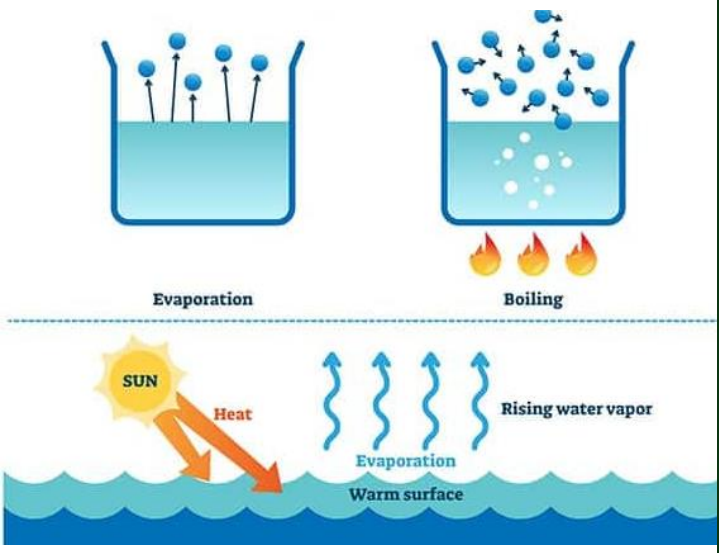
Evaporation is the process of **converting liquid into vapour to obtain the dissolved solid**.

Example

Obtaining **salt from seawater**.

Process

1. Seawater kept in shallow ponds.
2. Sun heat evaporates water.
3. Salt remains behind.



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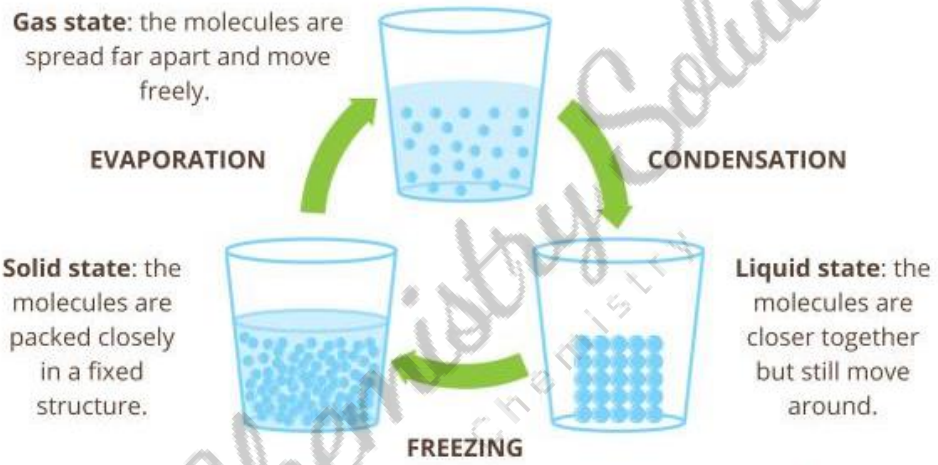
5.12 Condensation

Definition

Condensation is the process in which **vapour changes into liquid on cooling**.

Example

Water droplets forming on a **cold glass**.



5.13 Distillation

Definition

Distillation is the process of separating **liquids with different boiling points**.

Examples

Mixture	Separation
Alcohol + water	Distillation
Pure water from salt water	Distillation

Process

1. Liquid is heated.
2. Lower boiling liquid evaporates first.
3. Vapour cools in condenser.

4. Liquid collected.

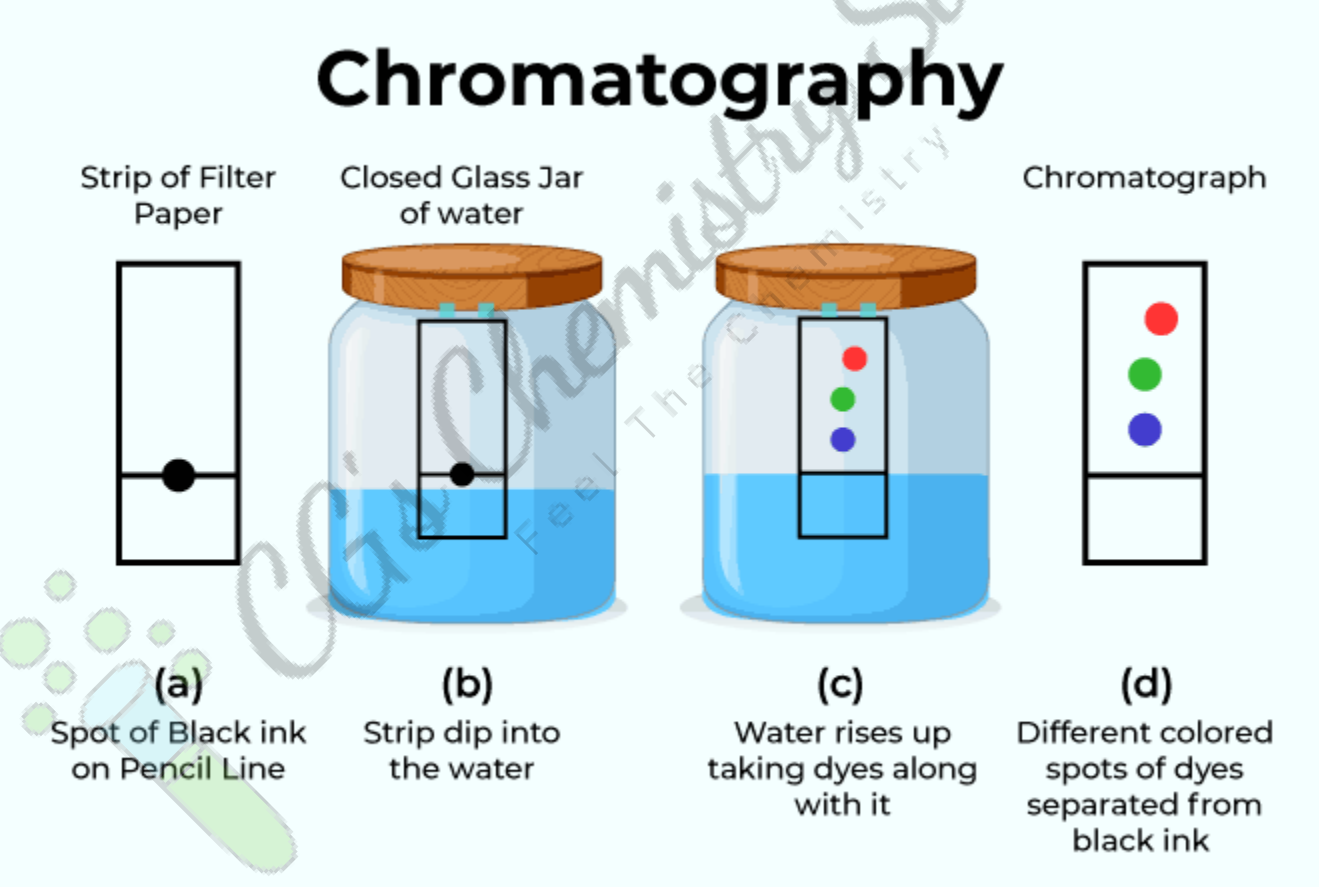
5.14 Chromatography

Definition

Chromatography is used to **separate coloured components of a mixture**.

Example

Separating **different colours in ink**.



5.15 Summary of Separation Methods

Method	Property Used	Example
Handpicking	Size	Stones from rice
Winnowing	Weight	Husk from wheat
Sieving	Particle size	Flour

Method	Property Used	Example
Magnetic	Magnetism	Iron from sand
Sedimentation	Density	Muddy water
Filtration	Insolubility	Tea leaves
Evaporation	Volatility	Salt from water
Distillation	Boiling point	Alcohol + water

5.16 Importance in Daily Life

Separation techniques are used in:

- **Agriculture**
- **Industries**
- **Food processing**
- **Water purification**
- **Medicine production**

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WORKSHEET

Chapter: Exploring Mixtures and Their Separation

SECTION A – Multiple Choice Questions (20 × 1 = 20)

1. A mixture is defined as a substance formed by:
   a) Chemical combination of two substances
   b) Physical combination of two or more substances
   c) Reaction between two elements
   d) Only liquids mixed together

2. Which of the following is a **homogeneous mixture**?
   a) Sand in water
   b) Oil and water
   c) Salt solution
   d) Soil

3. The components of a mixture are separated because they have:
   a) Same properties
   b) Different physical properties
   c) Same chemical composition
   d) Same density

4. Which method is used to separate **insoluble solid from liquid**?
   a) Filtration
   b) Distillation
   c) Chromatography
   d) Sublimation

5. Which technique is used to obtain **pure salt from salt solution**?
   a) Filtration
   b) Evaporation
   c) Magnetic separation
   d) Sieving

6. Cream can be separated from milk using:
   a) Filtration
   b) Churning / Centrifugation
   c) Evaporation
   d) Distillation

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7. Which property is used in **sublimation**?
   a) Difference in boiling point
   b) Direct conversion of solid to vapour
   c) Density difference
   d) Magnetic property

8. Which mixture can be separated using **a magnet**?
   a) Sand and sugar
   b) Iron filings and sand
   c) Salt and water
   d) Oil and water

9. Which of the following is a **heterogeneous mixture**?
   a) Sugar solution
   b) Air
   c) Soil
   d) Vinegar

10. The process used to separate liquids with different boiling points is:
    a) Distillation
    b) Sedimentation
    c) Filtration
    d) Sieving

11. Sedimentation followed by decantation is used for separating:
    a) Insoluble solid from liquid
    b) Two gases
    c) Two liquids
    d) Dissolved solids

12. A mixture of **sand and water** can be separated by:
    a) Evaporation
    b) Filtration
    c) Sublimation
    d) Magnetic separation

13. Chromatography is used for separating:
    a) Immiscible liquids
    b) Colored components
    c) Metals
    d) Gases

14. Which method is used in **water purification plants**?
    a) Filtration
    b) Evaporation
    c) Churning
    d) Sublimation

15. Which of the following mixtures can be separated by **sieving**?
    a) Rice and flour
    b) Sand and water

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c) Oil and water
d) Salt and water

16. Distillation works on the principle of difference in:
    a) Solubility
    b) Density
    c) Boiling point
    d) Colour

17. Oil and water can be separated using:
    a) Separating funnel
    b) Filtration
    c) Sublimation
    d) Sieving

18. Which method separates **camphor from salt**?
    a) Filtration
    b) Sublimation
    c) Sedimentation
    d) Chromatography

19. The process of settling down of heavier particles is called:
    a) Decantation
    b) Sedimentation
    c) Filtration
    d) Distillation

20. Which of the following is **not a mixture**?
    a) Air
    b) Brass
    c) Distilled water
    d) Soil

SECTION B – Assertion and Reason (5 × 1 = 5)

Directions:
Choose the correct option:

A. Both A and R are true and R is correct explanation
B. Both A and R are true but R is not correct explanation
C. A is true but R is false
D. A is false but R is true

21.
Assertion: Filtration is used to separate insoluble solids from liquids.
Reason: Filter paper allows liquid to pass but stops solid particles.

22.
Assertion: Oil and water can be separated using a separating funnel.
Reason: Oil and water have different densities.

23.
Assertion: Chromatography separates colored substances in ink.
Reason: Different colors travel at different speeds.

24.
Assertion: Sublimation can separate ammonium chloride from sand.
Reason: Ammonium chloride directly changes from solid to vapour.

25.
Assertion: Evaporation is used to obtain salt from sea water.
Reason: Water evaporates leaving solid salt behind.

SECTION C – Very Short Answer (10 × 2 = 20)

26. Define **mixture**.

27. Write two characteristics of mixtures.

28. What is a **homogeneous mixture**? Give one example.

29. What is a **heterogeneous mixture**? Give one example.

30. Define **sedimentation**.

31. What is **decantation**?

32. What is **filtration**?

33. What is **sublimation**?

34. What is **chromatography**?

35. Give two examples of mixtures from daily life.

SECTION D – Short Answer Questions (8 × 3 = 24)

36. Differentiate between **homogeneous and heterogeneous mixtures**.

37. Explain the **process of filtration** with an example.

38. Describe the **method of evaporation**.

39. Explain **sedimentation and decantation** with examples.
40. Describe the **principle of distillation**.
41. Explain how **magnetic separation** works.
42. Describe the **method of chromatography**.
43. Explain how **a separating funnel works**.

SECTION E – Long Answer Questions (5 × 5 = 25)

44. Explain different **types of mixtures** with examples.
45. Describe the **various methods used to separate mixtures**.
46. Explain the **process of distillation with labelled diagram**.
47. Explain **sublimation and its applications**.
48. Describe **chromatography in detail and its uses**.

SECTION F – Case Study Questions (3 × 4 = 12)

Case Study 1 – Water Purification

In water treatment plants, muddy water is allowed to stand so that solid particles settle down. After that the clear water is poured into another container and then passed through filters.

Questions:

49. What is the settling process called?
50. What is the pouring off process called?
51. What method removes remaining solid impurities?
52. Why is filtration important?

Case Study 2 – Separation of Cream

Milk contains fat which is lighter than water. In dairy industries, milk is rotated at high speed in machines to separate cream from milk.

Questions:

53. What is this method called?
54. On which property does this method depend?

55. What is the separated fat layer called?

56. Give one more example where this method is used.

Case Study 3 – Ink Separation

A student places a drop of black ink on filter paper and dips it in water. After some time different colours appear on the paper.

Questions:

57. Name the separation technique used.

58. Why do different colours appear separately?

59. What is the role of water in this process?

60. Write one application of this technique.

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SOLUTION

Chapter: Exploring Mixtures and Their Separation

SECTION A – MCQ Solutions

1. A mixture is defined as a substance formed by:

Correct Answer: (b) Physical combination of two or more substances

Explanation:
A **mixture** is formed when two or more substances are **physically combined without any chemical reaction**.

Important characteristics:

- Components retain their **original properties**.
- Composition may **vary**.
- Components can be **separated by physical methods**.

Example:

- Salt + water
- Sand + iron filings

2. Which of the following is a homogeneous mixture?

Correct Answer: (c) Salt solution

Explanation:
A **homogeneous mixture** has **uniform composition throughout**.

Salt dissolves completely in water forming a **single phase solution**.

Example	Type
Salt solution	Homogeneous
Sugar solution	Homogeneous
Sand in water	Heterogeneous

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3. The components of a mixture are separated because they have:

Correct Answer: (b) Different physical properties

Explanation:
Separation methods rely on **differences in physical properties**, such as:

Property	Example Separation
Particle size	Sieving
Density	Separating funnel
Boiling point	Distillation
Solubility	Evaporation
Magnetism	Magnetic separation

Thus, mixtures are separated using **physical differences**.

---

4. Which method is used to separate insoluble solid from liquid?

Correct Answer: (a) Filtration

Explanation:
Filtration separates **insoluble solids from liquids** using a **filter paper or porous material**.

Example:

- Sand + water

During filtration:

- Solid = **Residue**
- Liquid passing through = **Filtrate**

---

5. Which technique is used to obtain pure salt from salt solution?

Correct Answer: (b) Evaporation

Explanation:
In **evaporation**, the liquid solvent evaporates leaving the dissolved solid behind.

Example:

Salt solution → Heat → Water evaporates → Salt remains.

This method is widely used in **salt production from seawater**.

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6. Cream can be separated from milk using:

Correct Answer: (b) Churning / Centrifugation

Explanation:
Cream separation uses the principle of **difference in density**.

In centrifugation:

- Heavier particles move outward.
- Lighter fat particles move inward and separate.

Applications:

- Dairy industries
- Blood component separation

---

7. Which property is used in sublimation?

Correct Answer: (b) Direct conversion of solid to vapour

Explanation:
Sublimation is the process where a **solid directly converts into vapour without becoming liquid**.

Examples of sublimable substances:

- Camphor
- Ammonium chloride
- Naphthalene

Example separation:

Ammonium chloride + Sand

Heating causes ammonium chloride to sublime leaving sand behind.

---

8. Which mixture can be separated using a magnet?

Correct Answer: (b) Iron filings and sand

Explanation:
Magnetic separation works when **one component is magnetic**.

Magnetic substances:

- Iron
- Nickel

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- Cobalt

Procedure:

21. Bring magnet near mixture.
22. Magnetic particles stick to magnet.
23. Non-magnetic particles remain.

---

9. Which of the following is a heterogeneous mixture?

Correct Answer: (c) Soil

Explanation:
A **heterogeneous mixture** has **non-uniform composition**.

Soil contains:

- Sand
- Clay
- Organic matter
- Small stones

These components are **visible separately**.

---

10. The process used to separate liquids with different boiling points is:

Correct Answer: (a) Distillation

Explanation:
Distillation separates liquids based on **difference in boiling points**.

Process:

24. Heat mixture.
25. Liquid with lower boiling point vaporizes first.
26. Vapour condenses to form pure liquid.

Example:

- Alcohol + Water

---

11. Sedimentation followed by decantation is used for separating:

Correct Answer: (a) Insoluble solid from liquid

Explanation:

Sedimentation:
Heavier particles settle at the bottom.

Decantation:
Clear liquid is carefully poured out.

Example:

- Muddy water separation.

---

12. A mixture of sand and water can be separated by:

Correct Answer: (b) Filtration

Explanation:
Sand is **insoluble in water**, so filtration can easily separate it.

Process:

- Pour mixture through filter paper.
- Sand remains as **residue**.
- Water passes as **filtrate**.

---

13. Chromatography is used for separating:

Correct Answer: (b) Colored components

Explanation:
Chromatography separates substances based on **difference in adsorption and solubility**.

Common applications:

- Separation of ink colours
- Drug testing
- Food colouring analysis

---

14. Which method is used in water purification plants?

Correct Answer: (a) Filtration

Explanation:
Water purification uses several steps:

27. Sedimentation

28. Filtration

29. Chlorination

Filtration removes:

- Sand
- Suspended particles
- Impurities

---

15. Which of the following mixtures can be separated by sieving?

Correct Answer: (a) Rice and flour

Explanation:
Sieving separates substances based on **particle size difference**.

Applications:

- Flour milling
- Construction sand separation
- Grain cleaning

---

16. Distillation works on the principle of difference in:

Correct Answer: (c) Boiling point

Explanation:
Liquids vaporize at different temperatures.

Example:

Liquid	Boiling Point
Alcohol	78°C
Water	100°C

Alcohol evaporates first and can be condensed separately.

---

17. Oil and water can be separated using:

Correct Answer: (a) Separating funnel

Explanation:
Oil and water are **immiscible liquids**.

Oil is **less dense**, so it forms the **upper layer**.

Separating funnel allows:

- Lower layer to be drained first
- Upper layer to remain

---

18. Which method separates camphor from salt?

Correct Answer: (b) Sublimation

Explanation:
Camphor sublimates while salt does not.

Heating causes camphor to:
Solid → Vapour → Solid (on cooling surface)

Salt remains behind.

---

19. The process of settling down of heavier particles is called:

Correct Answer: (b) Sedimentation

Explanation:
In sedimentation:

- Heavy insoluble particles settle under **gravity**.

Example:

- Mud settling in water.

---

20. Which of the following is not a mixture?

Correct Answer: (c) Distilled water

Explanation:
Distilled water is a **pure substance (compound)** consisting only of **H_2O molecules**.

Whereas:

Substance	Type
Air	Mixture
Brass	Alloy (mixture)
Soil	Mixture

SECTION B – Assertion & Reason Solutions

Directions

Choose the correct option:

A. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C. Assertion is true but Reason is false.
D. Assertion is false but Reason is true.

21.

Assertion: Filtration is used to separate insoluble solids from liquids.
Reason: Filter paper allows liquid to pass but stops solid particles.

Correct Answer: A

Explanation:
Filtration is a commonly used **physical separation method** that separates **insoluble solid particles from liquids** using a **porous barrier** such as filter paper.

Working principle:

- Filter paper has **tiny pores**.
- Liquid particles pass through the pores.
- Solid particles are **too large to pass**, so they remain behind.

Terms used in filtration:

Term	Meaning
Residue	Solid left on filter paper
Filtrate	Liquid that passes through filter paper

Example:
Sand + water mixture.

Thus, the **reason correctly explains the assertion**.

22.

Assertion: Oil and water can be separated using a separating funnel.
Reason: Oil and water have different densities.

Correct Answer: A

Explanation:
Oil and water are **immiscible liquids**, meaning they **do not mix with each other**.

Because of their **different densities**, they form **two separate layers**:

Liquid	Density	Position
Oil	Lower density	Upper layer
Water	Higher density	Lower layer

A **separating funnel** allows the denser liquid (water) to flow out first through the stopcock while the lighter liquid remains above.

Thus, the reason correctly explains the assertion.

23.

Assertion: Chromatography separates coloured substances in ink.
Reason: Different colours travel at different speeds.

Correct Answer: A

Explanation:
Chromatography separates substances based on **differences in solubility and adsorption**.

When the solvent moves through the paper:

- Different dye molecules **dissolve differently in the solvent**.
- Some molecules **move faster**, others **move slower**.

Therefore, the colours **separate into different bands** on the paper.

Example:
Black ink separates into:

- Blue
- Green
- Yellow
- Red pigments

Thus, the reason correctly explains the assertion.

24.

Assertion: Sublimation can separate ammonium chloride from sand.
Reason: Ammonium chloride directly changes from solid to vapour.

Correct Answer: A

Explanation:
Sublimation is the process in which a **solid directly converts into vapour without becoming liquid**.

Examples of sublimable substances:

- Ammonium chloride
- Camphor
- Naphthalene
- Iodine

Separation process:

30. Heat the mixture of **ammonium chloride + sand**.
31. Ammonium chloride **sublimes into vapour**.
32. Vapour cools and deposits as **solid crystals** on a cold surface.
33. Sand remains in the container.

Thus, the reason correctly explains the assertion.

25.

Assertion: Evaporation is used to obtain salt from sea water.
Reason: Water evaporates leaving solid salt behind.

Correct Answer: A

Explanation:
Evaporation is a process in which **liquid changes into vapour due to heating or exposure to air**.

Sea water contains **dissolved salt**. When it is kept in **large shallow ponds (salt pans)**:

34. Sunlight heats the water.
35. Water evaporates slowly.
36. Solid salt crystals remain.

This method is widely used in **coastal salt production**.

Example: Salt production along **Gujarat coast (India)**.

Thus, the reason correctly explains the assertion.

Key Concepts Summary (Important for Exams)

Separation Method	Principle	Example
Filtration	Particle size difference	Sand + water
Separating funnel	Density difference	Oil + water

Separation Method	Principle	Example
Chromatography	Solubility difference	Ink colours
Sublimation	Solid → Vapour transition	Ammonium chloride + sand
Evaporation	Solvent vaporization	Salt from sea water

SECTION C – Very Short Answer Solutions

26. Define mixture.

Answer:

A **mixture** is a substance formed when **two or more substances are physically combined without any chemical reaction**.

Key Characteristics

- Components **retain their original properties**.
- Composition can **vary**.
- Components can be **separated by physical methods**.

Examples

- Salt + water
- Air (mixture of gases)
- Soil

Thus, mixtures are **not chemically bonded substances** but **physical combinations of components**.

27. Write two characteristics of mixtures.

Answer:

Two important characteristics of mixtures are:

1. Components retain their properties

Each component in a mixture keeps its **original physical and chemical properties**.

Example:
In a mixture of **iron and sand**, iron still shows **magnetic property**.

2. Components can be separated by physical methods

Mixtures can be separated using **simple physical techniques** such as:

- Filtration
- Evaporation
- Distillation
- Magnetic separation

Example:
Salt can be separated from salt water by **evaporation**.

---

28. What is a homogeneous mixture? Give one example.

Answer:

A **homogeneous mixture** is a mixture in which the **composition is uniform throughout the substance**.

Characteristics

- Components are **evenly distributed**.
- Individual components **cannot be seen separately**.
- Appears as **one single phase**.

Example

- Salt solution
- Sugar solution
- Air

Example Explanation:
When salt dissolves in water, it forms a **uniform solution** where salt particles are evenly spread.

---

29. What is a heterogeneous mixture? Give one example.

Answer:

A **heterogeneous mixture** is a mixture in which the **composition is not uniform throughout**.

Characteristics

- Components remain **distinct and visible**.
- Different parts of the mixture have **different properties**.

Examples

- Sand in water
- Soil

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- Oil and water

Example Explanation:
In a mixture of **sand and water**, sand particles settle at the bottom and can be seen clearly.

---

30. Define sedimentation.

Answer:

Sedimentation is the process in which **heavier insoluble particles settle down at the bottom of a liquid due to gravity**.

Example

In muddy water:

- Mud particles are heavier.
- They slowly settle at the bottom when the mixture is left undisturbed.

Application

Sedimentation is used in:

- Water purification
- Separation of sand from water

---

31. What is decantation?

Answer:

Decantation is the process of **carefully pouring off the clear liquid from the top without disturbing the settled solid particles**.

Process

37. Sedimentation occurs first.
38. Solid settles at bottom.
39. Clear liquid is gently poured into another container.

Example

Separating **clear water from muddy water** after sedimentation.

Thus, decantation is often used **after sedimentation**.

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32. What is filtration?

Answer:

Filtration is a separation technique used to **separate insoluble solid particles from liquids using a filter**.

Principle

It works on **difference in particle size**.

Process

- Liquid passes through **filter paper**.
- Solid particles remain on the filter.

Terms

Term	Meaning
Residue	Solid left on filter paper
Filtrate	Liquid that passes through

Example

Sand + water separation.

---

33. What is sublimation?

Answer:

Sublimation is the process in which a **solid directly changes into vapour without passing through the liquid state**.

Sublimable Substances

- Camphor
- Ammonium chloride
- Naphthalene
- Iodine

Example

Mixture of **ammonium chloride and sand**.

When heated:

- Ammonium chloride → vapour → solid crystals
- Sand remains behind.

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34. What is chromatography?

Answer:

Chromatography is a technique used to **separate coloured substances in a mixture based on their different solubilities in a solvent**.

Principle

Different components move at **different speeds on a stationary surface** when a solvent flows over them.

Example

Separation of **different colours in black ink**.

Applications

- Ink analysis
- Drug testing
- Food colour detection

---

35. Give two examples of mixtures from daily life.

Answer:

Two common mixtures found in daily life are:

1. Air

Air is a mixture of several gases such as:

- Nitrogen (~78%)
- Oxygen (~21%)
- Carbon dioxide
- Water vapour

2. Soil

Soil contains a mixture of:

- Sand
- Clay
- Humus

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- Small stones

Both air and soil are **natural mixtures** found in the environment.

SECTION D – Short Answer Solutions

---

36. Differentiate between homogeneous and heterogeneous mixtures.

Answer:

A mixture is classified into **homogeneous** and **heterogeneous** based on the **uniformity of composition**.

Basis of Difference	Homogeneous Mixture	Heterogeneous Mixture
Composition	Uniform throughout	Non-uniform
Visibility of components	Components cannot be seen separately	Components can be seen separately
Phases	Single phase	Two or more phases
Example	Salt solution, air	Oil and water, sand in water

Explanation:
In a **homogeneous mixture**, particles are evenly distributed and appear as a single substance.
In a **heterogeneous mixture**, different substances remain visibly separate.

---

37. Explain the process of filtration with an example.

Answer:

Filtration is a method used to **separate insoluble solid particles from a liquid using a porous material such as filter paper**.

Principle

Filtration works on the **difference in particle size**.

Procedure

40. A filter paper is placed inside a funnel.
41. The mixture is poured through the funnel.
42. The liquid passes through the filter paper.
43. The solid particles remain on the filter paper.

Terms used in filtration

Term	Meaning
Residue	Solid left on filter paper
Filtrate	Liquid passing through

Example

Separating **sand from water**.

Filtration is also used in:

- Water purification
- Coffee preparation
- Laboratory experiments

---

38. Describe the method of evaporation.

Answer:

Evaporation is the process of converting a **liquid into vapour by heating**, leaving the dissolved solid behind.

Principle

Evaporation works on the **difference in volatility between solvent and solute**.

Process

44. The mixture is heated in an evaporating dish.
45. The liquid solvent evaporates.
46. The solid solute remains behind as residue.

Example

Obtaining **salt from sea water**.

Applications

- Salt production from sea water
- Recovery of dissolved solids
- Concentrating solutions

---

39. Explain sedimentation and decantation with examples.

Answer:

Sedimentation

Sedimentation is the process in which **heavier insoluble particles settle at the bottom of a liquid when left undisturbed**.

Example:
Mud settling in muddy water.

Decantation

Decantation is the process of **carefully pouring the clear liquid into another container without disturbing the settled particles**.

Steps in separation

47. Allow sedimentation to occur.
48. Solid particles settle at the bottom.
49. Carefully pour off the clear liquid.

Example

Separation of **sand from water**.

Sedimentation and decantation are commonly used in:

- Water purification
- Household separation processes

---

40. Describe the principle of distillation.

Answer:

Distillation is a process used to **separate liquids with different boiling points by heating and condensation**.

Principle

It is based on **difference in boiling points of liquids**.

Working

50. The mixture is heated.
51. The liquid with **lower boiling point vaporizes first**.
52. Vapour passes through a condenser.
53. Vapour cools and converts back into liquid.

Example

Separation of **alcohol and water**.

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Applications

- Preparation of **distilled water**
- Separation of petroleum products
- Purification of liquids in laboratories

---

41. Explain how magnetic separation works.

Answer:

Magnetic separation is a method used to separate **magnetic substances from non-magnetic substances using a magnet**.

Principle

It is based on the **magnetic property of certain materials**.

Magnetic substances include:

- Iron
- Nickel
- Cobalt

Procedure

54. A magnet is brought near the mixture.
55. Magnetic particles are attracted to the magnet.
56. Non-magnetic substances remain behind.

Example

Separation of **iron filings from sand**.

Applications

- Recycling industries
- Mining industries
- Laboratory experiments

---

42. Describe the method of chromatography.

Answer:

Chromatography is a technique used to **separate components of a mixture based on differences in their movement through a stationary medium**.

Principle

Different substances move at **different speeds depending on their solubility and adsorption**.

Procedure

57. A drop of ink is placed on filter paper.
58. The paper is dipped in a solvent.
59. The solvent moves upward through the paper.
60. Different colours separate into bands.

Example

Separation of colours present in **black ink**.

Applications

- Detection of drugs
- Food colour testing
- Forensic investigations

---

43. Explain how a separating funnel works.

Answer:

A **separating funnel** is used to separate **two immiscible liquids that have different densities**.

Principle

It works on the **difference in density between two liquids**.

Procedure

61. The mixture of liquids is poured into the separating funnel.
62. The liquids form **two distinct layers**.
63. The stopcock is opened.
64. The **denser liquid flows out first**.

Example

Separation of **oil and water**.

Liquid	Density	Layer
Oil	Lower density	Upper layer
Water	Higher density	Lower layer

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Applications

- Oil and water separation
- Petroleum refining
- Chemical laboratories

SECTION E – Long Answer Solutions

---

44. Explain different types of mixtures with examples.

Answer

A **mixture** is formed when two or more substances are physically combined without undergoing a chemical change.

Mixtures are mainly classified into **two types**:

65. **Homogeneous Mixture**
66. **Heterogeneous Mixture**

---

1. Homogeneous Mixture

A **homogeneous mixture** is a mixture in which the **composition is uniform throughout the substance**.

Characteristics

- Components are evenly distributed.
- Only **one phase** is present.
- Individual components **cannot be seen separately**.

Examples

- Salt solution
- Sugar solution
- Air
- Vinegar

Example Explanation

In **salt solution**, salt particles dissolve completely in water forming a **uniform mixture** where salt cannot be seen.

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2. Heterogeneous Mixture

A **heterogeneous mixture** is a mixture in which the **composition is not uniform**.

Characteristics

- Components remain **distinct**.
- More than **one phase** exists.
- Components are **visible separately**.

Examples

- Sand and water
- Oil and water
- Soil
- Mixture of stones and sand

Difference Between Homogeneous and Heterogeneous Mixtures

Property	Homogeneous	Heterogeneous
Composition	Uniform	Non-uniform
Phases	Single phase	Multiple phases
Visibility	Components not visible	Components visible
Example	Salt solution	Sand in water

Conclusion

Mixtures can be classified based on the **uniform distribution of components**, and understanding this classification helps in choosing the **appropriate separation method**.

---

45. Describe the various methods used to separate mixtures.

Answer

Mixtures can be separated using **different physical methods based on differences in physical properties** of their components.

Major Methods of Separation

---

1. Filtration

Filtration separates **insoluble solids from liquids** using a filter.

Example:
Sand and water separation.

Principle: Difference in particle size.

---

2. Evaporation

Evaporation separates **dissolved solids from liquids** by heating.

Example:
Obtaining salt from sea water.

Principle: Solvent evaporates leaving solid behind.

---

3. Distillation

Distillation separates **liquids with different boiling points**.

Example:
Separation of alcohol and water.

Principle: Difference in boiling points.

---

4. Magnetic Separation

Magnetic separation removes **magnetic substances from non-magnetic substances**.

Example:
Iron filings from sand.

Principle: Magnetic property.

---

5. Sublimation

Sublimation separates substances that **directly change from solid to vapour**.

Example:
Ammonium chloride and sand.

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Summary Table

Method	Property Used	Example
Filtration	Particle size	Sand + water
Evaporation	Volatility	Salt solution
Distillation	Boiling point	Alcohol + water
Magnetic separation	Magnetism	Iron + sand
Sublimation	Sublimation property	Ammonium chloride + sand

---

46. Explain the process of distillation with labelled diagram.

Answer

Distillation is a technique used to **separate liquids based on differences in their boiling points**.

Principle

The liquid with the **lower boiling point evaporates first**, and its vapour is **condensed to form pure liquid**.

Apparatus Used

- Distillation flask
- Thermometer
- Condenser
- Receiver flask
- Heat source

Process

67. The liquid mixture is heated in a **distillation flask**.
68. The component with the **lower boiling point vaporizes first**.
69. Vapours move into the **condenser**.
70. The condenser cools the vapour using cold water.
71. Vapour condenses into **liquid in the receiver flask**.

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Example

Separation of **alcohol and water**.

Liquid	Boiling Point
Alcohol	78°C
Water	100°C

Alcohol vaporizes first and is collected separately.

Applications

- Preparation of **distilled water**
- Petroleum refining
- Alcohol purification
- Laboratory experiments

---

47. Explain sublimation and its applications.

Answer

Sublimation is the process in which a **solid directly changes into vapour without passing through the liquid state**.

Sublimable Substances

Examples include:

- Camphor
- Ammonium chloride
- Iodine
- Naphthalene

Separation by Sublimation

A mixture of **ammonium chloride and sand** can be separated using sublimation.

Process

72. Heat the mixture in a container.

73. Ammonium chloride changes directly into vapour.

74. Vapours cool and deposit as solid crystals on a cold surface.

75. Sand remains behind.

Applications

76. Purification of substances like **iodine and camphor**.

77. Used in **chemical laboratories** for separating mixtures.

78. Used in **manufacturing mothballs (naphthalene)**.

---

48. Describe chromatography in detail and its uses.

Answer

Chromatography is a technique used to **separate the components of a mixture based on their different movement rates through a stationary phase**.

Principle

Different substances travel at **different speeds depending on their solubility in the solvent and attraction to the stationary surface**.

Components of Chromatography

Component	Function
Stationary phase	Filter paper or solid surface
Mobile phase	Solvent (water/alcohol)
Sample	Mixture to be separated

Process

1. A small drop of **ink** is placed on filter paper.
2. The paper is dipped in a **solvent**.
3. The solvent rises upward through the paper.
4. Different colours travel at **different speeds**.
5. Colours separate into **different bands**.

Example

Black ink separates into:

- Blue
- Yellow
- Red
- Green pigments.

Applications

Chromatography is widely used in:

1. **Forensic science**
2. **Drug detection**
3. **Food colouring analysis**
4. **Biotechnology research**
5. **Chemical laboratories**

SECTION F – Case Study Solutions

Case Study 1 – Water Purification

Passage:
In water treatment plants, muddy water is allowed to stand so that solid particles settle down. After that the clear water is poured into another container and then passed through filters.

This process is commonly used to remove **suspended impurities** from water before making it safe for further purification.

---

49. What is the settling process called?

Answer:
The settling process is called **Sedimentation**.

Explanation:
Sedimentation is the process in which **heavier insoluble particles settle at the bottom of a liquid due to gravity when the mixture is left undisturbed**.

Example:

- Mud particles settling in muddy water.

This method is widely used in **water treatment plants** to remove suspended impurities.

---

50. What is the pouring off process called?

Answer:
The pouring off process is called **Decantation**.

Explanation:
Decantation is the process of **carefully pouring the clear liquid from the top into another container without disturbing the settled particles at the bottom**.

Steps:

1. Sedimentation occurs first.
2. Impurities settle at the bottom.
3. Clear water is poured off.

This helps in separating **liquid from insoluble solids**.

---

51. What method removes remaining solid impurities?

Answer:
The method used is **Filtration**.

Explanation:
Filtration removes **very fine solid particles** that remain suspended in water even after sedimentation and decantation.

During filtration:

- Water passes through **filter media**.
- Solid impurities remain behind.

Filtration is used in:

- Water purification plants
- Household water filters
- Laboratory experiments

52. Why is filtration important?

Answer:
Filtration is important because it **removes fine suspended impurities that cannot settle by sedimentation**.

Importance:

- Makes water **clear and cleaner**.
- Helps remove **dust, sand, and microorganisms**.
- Essential step in **water purification systems**.

Thus, filtration improves the **quality and safety of water**.

Case Study 2 – Separation of Cream

Passage:
Milk contains fat particles which are lighter than water. In dairy industries, milk is rotated at very high speed in machines to separate cream from milk.

This technique is commonly used in **dairy processing industries**.

---

53. What is this method called?

Answer:
This method is called **Centrifugation**.

Explanation:
Centrifugation is a separation technique in which **a mixture is rotated at high speed so that components separate based on their density**.

In milk:

- Lighter **fat particles move upward**.
- Heavier **liquid portion remains below**.

Thus, cream separates from milk.

---

54. On which property does this method depend?

Answer:
This method depends on **difference in density of components**.

Explanation:
When the mixture rotates rapidly:

- Heavier particles move outward.
- Lighter particles move inward or upward.

Since **fat is less dense than milk**, it separates easily.

---

55. What is the separated fat layer called?

Answer:
The separated fat layer is called **Cream**.

Explanation:
Cream contains **high concentration of milk fat**.

Uses of cream:

- Butter production
- Ice cream
- Dairy products

---

56. Give one more example where this method is used.

Answer:
Another example of centrifugation is **separating blood components in medical laboratories**.

In blood:

- Plasma separates from
- Red blood cells and white blood cells.

This method helps doctors **analyze blood samples for medical diagnosis**.

Case Study 3 – Ink Separation

Passage:
A student places a drop of black ink on filter paper and dips it into water. After some time, different colours appear on the paper.

This experiment demonstrates a **scientific separation technique used in chemistry laboratories**.

---

57. Name the separation technique used.

Answer:
The technique used is **Chromatography (Paper Chromatography)**.

Explanation:
Chromatography is used to **separate coloured components of a mixture based on their different movement rates in a solvent**.

---

58. Why do different colours appear separately?

Answer:
Different colours appear separately because **each dye has different solubility in the solvent and moves at a different speed on the paper**.

Explanation:

- Some colours dissolve more in the solvent and move faster.
- Others dissolve less and move slower.

Thus, colours separate into **distinct bands**.

---

59. What is the role of water in this process?

Answer:
Water acts as the **solvent (mobile phase)**.

Explanation:
The solvent moves upward through the filter paper due to **capillary action**, carrying the dissolved dye molecules along with it.

This movement helps separate the different colours.

---

60. Write one application of this technique.

Answer:
One important application of chromatography is **forensic analysis**.

Uses include:

- Detecting drugs
- Identifying chemicals
- Analyzing food colours
- Studying biological substances

Thus, chromatography is widely used in **scientific research and laboratories**.
