TOPPER LEARNING
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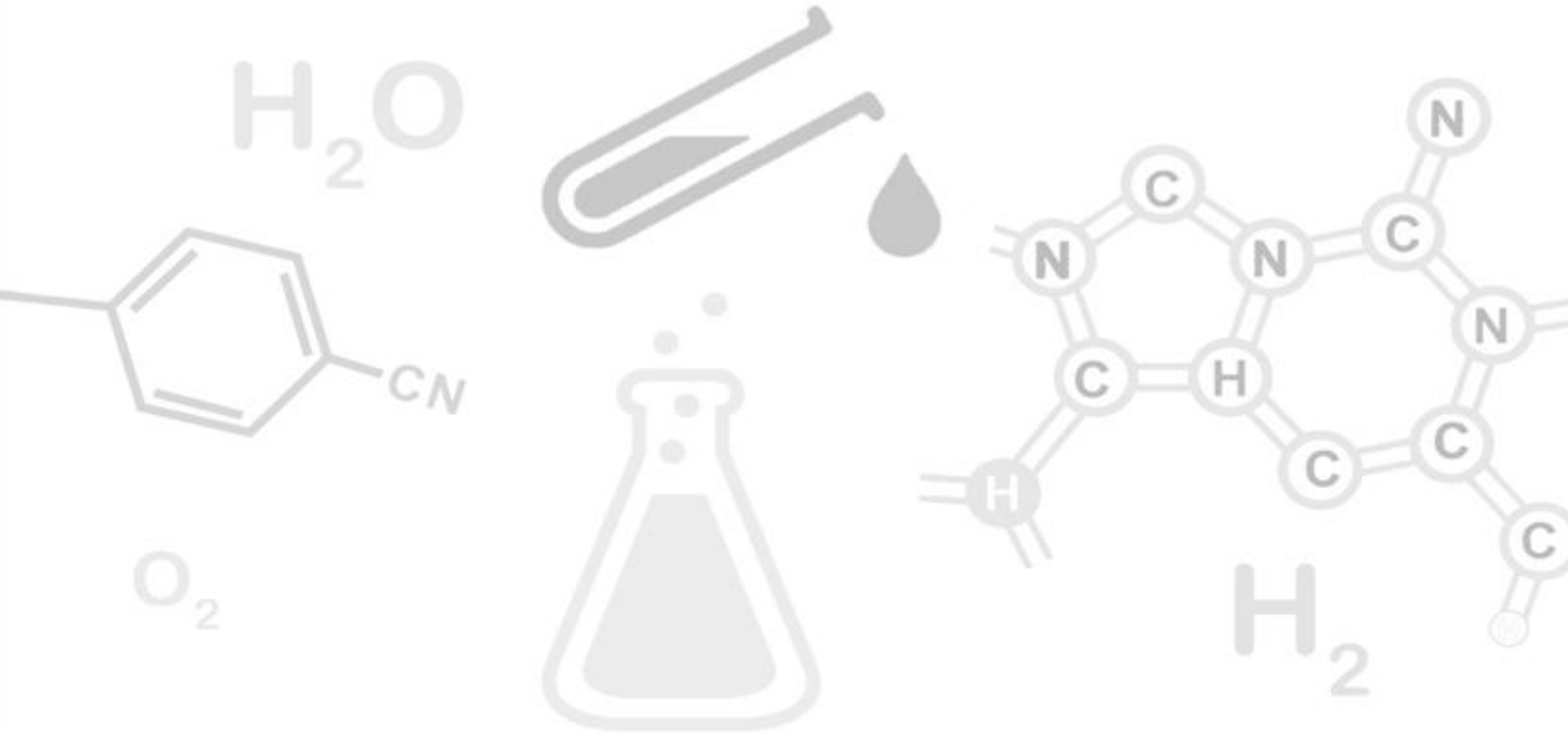
Chapter Notes

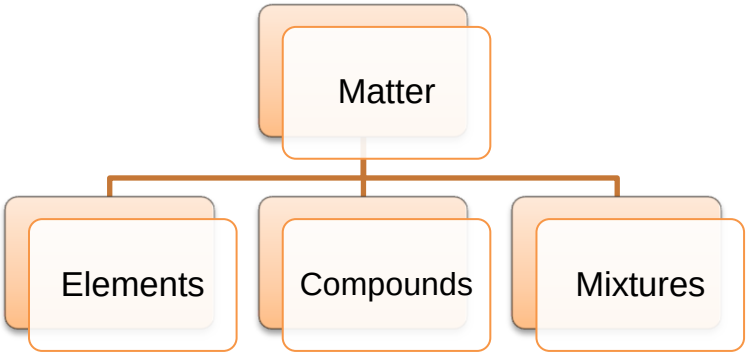
CHEMISTRY



Elements, Compounds and Mixtures

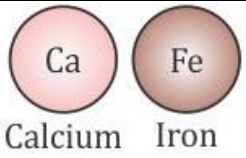
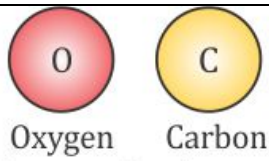
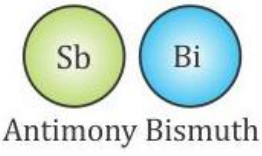
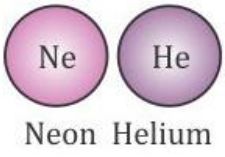
Classification of Matter

Matter may be broadly classified into Elements, Compounds and Mixtures.



Element

- An element is a pure substance composed of only one kind of atom. Examples: C, H, O, Na, Ca, N etc.
- An element cannot be broken down into two or more simple substances by any physical or chemical means.

			
Metallic elements	**Non-metallic elements**	**Metalloids**	**Noble gases**

Occurrence of Elements

Elements occur naturally in the Earth's crust and in the atmosphere. They can also be made by artificial means.

Elements occur or are made up of

- Single atoms
- Examples: All the inert gases; Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr).
- Two atoms (diatomic molecules)

Examples: All gases, except inert gases, are diatomic; Hydrogen (H_2), Oxygen (O_2), Nitrogen (N_2) etc.

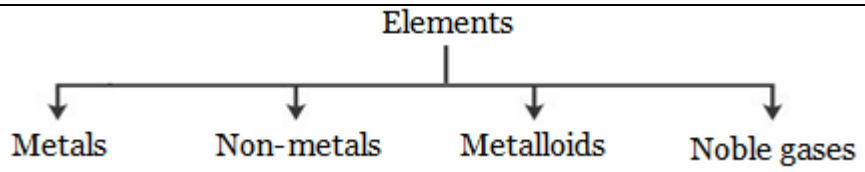
- Three atoms (triatomic molecules)
  Example: Ozone O_3
- More than three atoms (polyatomic molecules)
  Examples: P_4, S_8

Characteristics of an Element

- An element is made up of only one kind of atom.
- An element is a pure and homogeneous substance.
- An element has fixed melting and boiling points.
- An atom is the smallest particle of an element which takes part in a chemical reaction.
- An element may chemically react with another element or compound.
- An element can occur in the solid, liquid or gaseous state.

The molecules are made up of one or more atoms of the same or different elements.

Classification of Elements

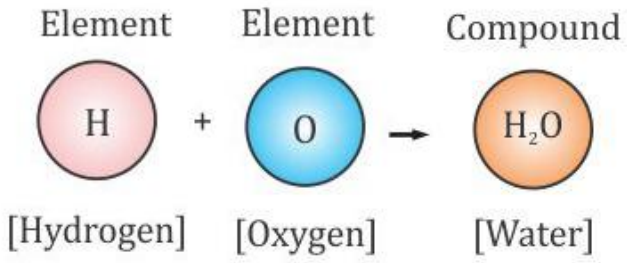
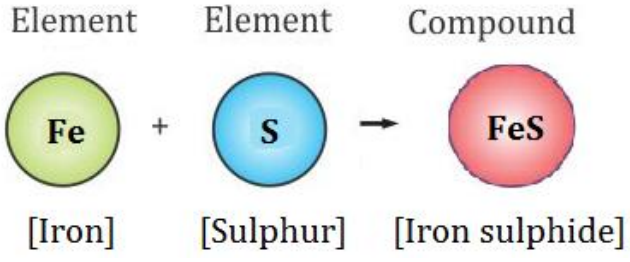


Metals	Non-metals	Metalloids	Noble gases
• Have metallic lustre. • Are good conductors of heat and electricity. • Are malleable and ductile. • Are solids. • Contain one kind of atom. • (mono-atomic) **Examples:** Iron, Copper, Sodium, Calcium etc. **Exceptions:** 1. Zinc is non-malleable and non-ductile. 2. Mercury is a liquid metal at room temperature. 3. Tungsten is a poor conductor of electricity. 4. Sodium and Potassium are not hard. They are so soft that they can be cut easily with a knife.	• Do not have lustre. • Are bad conductors of heat and electricity. • Are neither malleable nor ductile. • Are solids, liquids and gases. • Contain two kinds of atoms. • (mono-atomic or di-atomic) **Examples:** Solid: Carbon, Silicon, Phosphorus etc. Liquid: Bromine Gas: Hydrogen, Chlorine etc. **Exceptions:** 1. Carbon fibre is ductile but not malleable. 2. Graphite is a good conductor of electricity. 3. Iodine and graphite are lustrous.	• Properties are mid-way between metals and non-metals. • Contain one kind of atom. • (mono-atomic) **Examples:** Boron, Germanium, Silicon, Arsenic, Antimony, Bismuth etc.	• Are gaseous in nature. • Are chemically inert. • Occur in free state in traces in the atmosphere. • Contain one kind of atom. • (mono-atomic) **Examples:** Helium, Argon, Neon, Krypton, Xenon, Radon

Compound

- A compound is a pure substance composed of two or more elements combined chemically in a fixed proportion by mass.
- The properties of compounds are different from the properties of their constituent elements. Examples: H_2O, CO_2 etc.

Which is the smallest part of a compound whose properties are same as those of the compound?
The smallest part of a compound is a molecule. All the molecules of a compound are alike and have properties similar to those of the compound.

Compound	Molecular formula	Composition of molecule	Diagrammatic representation
Water	H_2O	Two atoms of Hydrogen and one atom of Oxygen	
Iron sulphide	FeS	One atom of Iron and one atom of Sulphur	

Characteristics of Compounds

- Components in a compound are present in a definite proportion.
- They have a homogeneous composition.
- Particles in a compound are of one kind.
- A compound is made up of one or more atoms of the same or different elements.
- In a compound the elements are present in a fixed ratio by mass.
- A compound can be divided into simpler substances by a chemical process.
- The physical and chemical properties of a compound are completely different from those of its constituents.

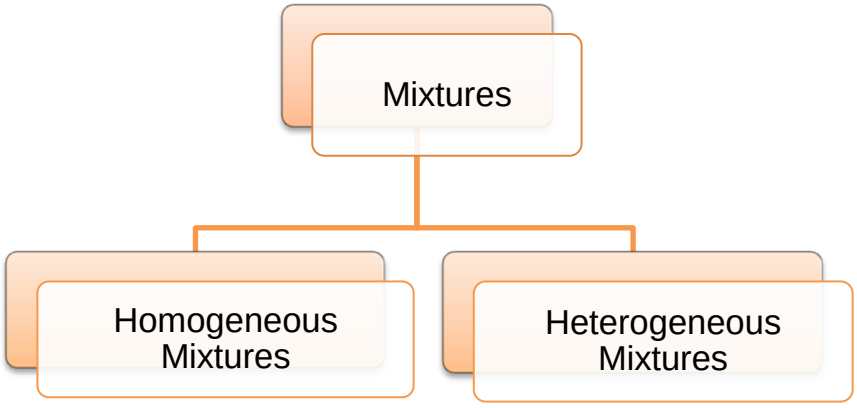
A comparative study between Elements and Compounds

Element	Compound
1. It is a pure substance which cannot be converted into simpler substances by any physical or chemical means.	1. It is a pure substance made up two or more elements combined chemically in a fixed ratio.
2. It is made up of only one kind of atoms.	2. It is made up of two or more different kinds of atoms.
3. The molecules are made up of one or more atoms.	3. The molecules are made up of two or more atoms.
4. Elements cannot be broken down into two or more simpler substances by any physical or chemical means.	4. A compound can be divided into simpler substances only by chemical means.
5. Elements have their own set of properties. Example: Iron is grey coloured and attracted by a magnet. Sulphur is yellow coloured and soluble in carbon disulphide.	5. Properties of compounds are different from their constituent elements. Example: Iron sulphide is a black substance which is not attracted by a magnet and insoluble in carbon disulphide. While its constituent elements, Iron is grey coloured and attracted by a magnet. Sulphur is yellow coloured and soluble in carbon disulphide.

Mixtures

- A mixture is defined as matter composed of two or more substances whose particles are in contact but are not chemically combined and have not lost their individual properties.
- The properties of a mixture vary according to the proportions of the components present in it.
- Examples: Milk, Lemonade, Tea, Petroleum etc.

Types of Mixtures



Homogeneous Mixtures

A mixture which has uniform composition and properties throughout its mass is called a homogeneous mixture. Examples: Sugar solution, salt solution.

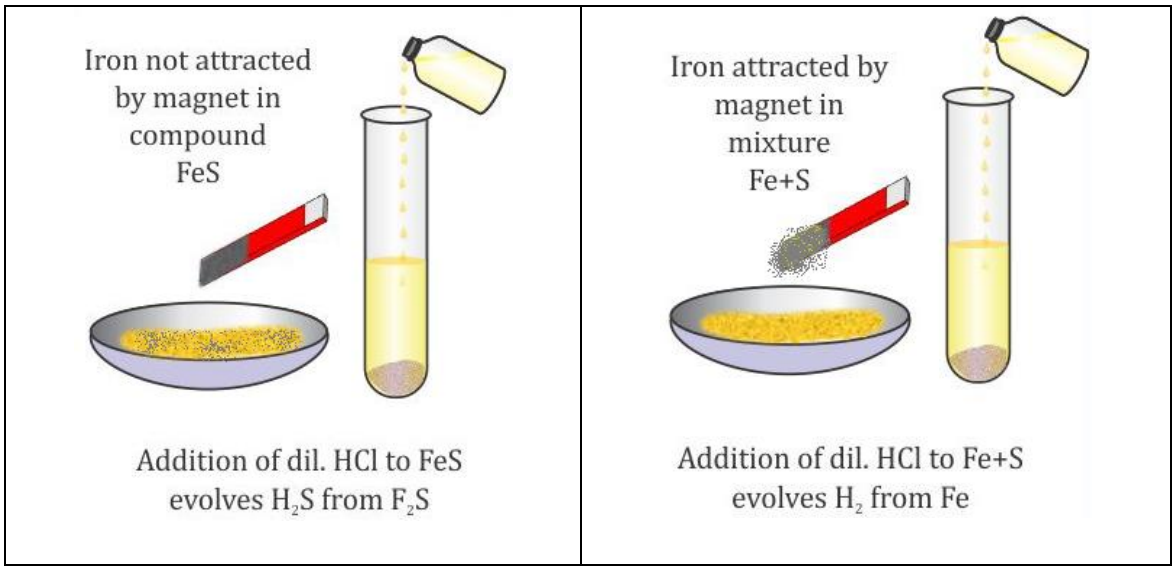
Heterogeneous Mixture

A mixture which has different composition and properties in different parts of their mass is called a heterogeneous mixture. Examples: Sand mixed with salt, sugar in oil.

Types of mixture	Homogeneous	Heterogeneous
Solid in solid	Alloys (Bronze - Cu, Zn, Sn)	Gun powder (charcoal, sulphur, nitre)
Solid in liquid	Iodine in alcohol, sugar in carbon disulphide, sugar in water, salt in water	Sugar in oil, sand in water
Liquid in solid	Amalgam (Hg + Au)	Water in sponge
Liquid in liquid	Methanol in water, acetone in water	Oil in water, kerosene in water
Gas in liquid	HCl in water	Helium in water
Liquid in gas	Moisture in air	Mist, fog
Gas in gas	Pure air	Air in industries

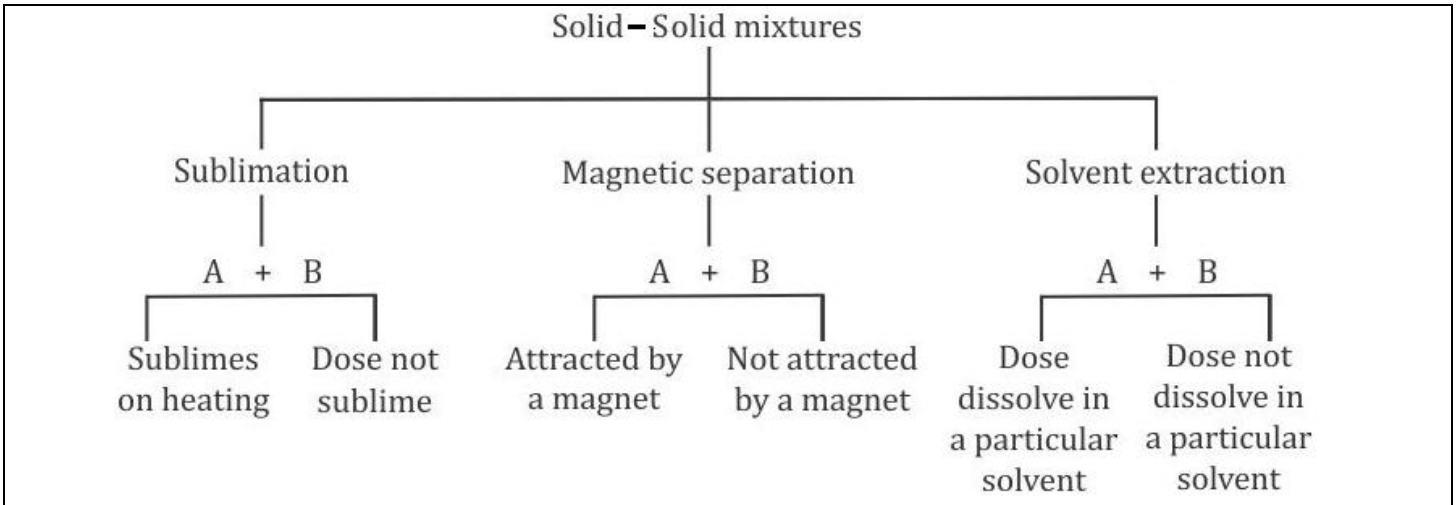
A comparative study between Compounds and Mixtures

Compound	Mixture
1. It is obtained by the chemical combination of more than one element.	1. It is obtained by the physical combination of either elements, compounds or both.
2. The composition of elements present in a compound is fixed.	2. The composition of elements present in a mixture is not fixed.
3. The properties of a compound are different from those of its elements.	3. It shows the properties of all its constituent elements.
4. Its constituents can be separated by using only chemical and electrochemical methods.	4. Its constituents can be separated using physical methods.
5. A compound is always homogeneous in nature.	5. The mixtures can be homogeneous or heterogeneous.
Example:	Example:



Methods of Separation

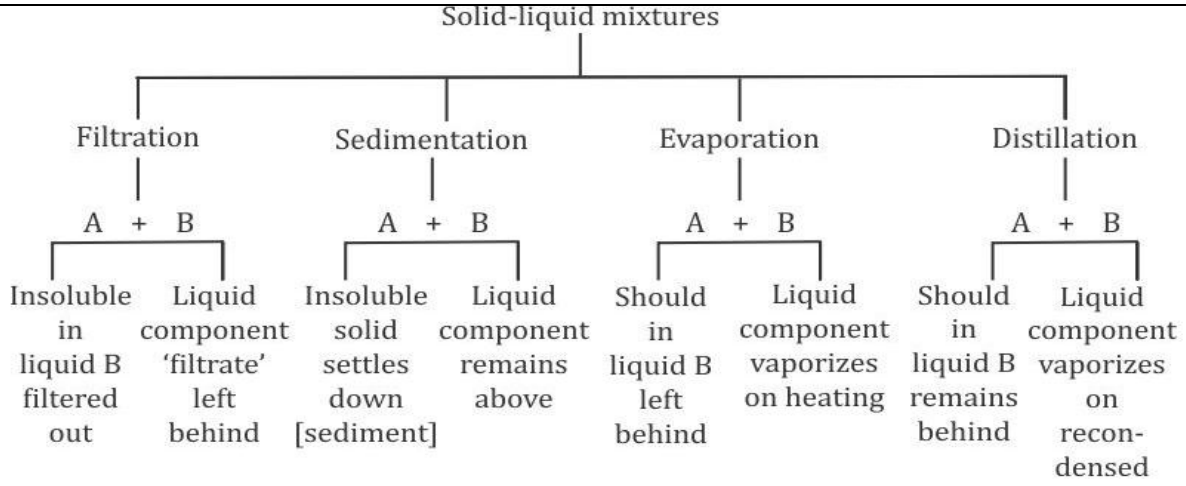
Separation of Solid-Solid Mixtures



Method of Separation	Method
Sublimation To separate the mixture of sublimable solid X + non-sublimable solid Y.	**Technique** • Take the mixture X + Y in an evaporating dish. Cover it with the funnel plugged with cotton at one end. • Heat the evaporating dish slowly. **Separation of Compounds** • Sublimable solid X gets collected on the inner side of the funnel. • Non-sublimable solid Y remains in the evaporating dish. **Example:** To separate the mixture of ammonium chloride + sodium chloride; camphor + sodium chloride

Magnetic separation To separate the mixture of magnetic solid X + non-magnetic solid Y.	**Technique** • Take the mixture X + Y in a dish and move a magnet over it. **Separation of Compounds** • Magnetic solid X is attracted to the magnet. • Non-magnetic solid Y remains in the dish below. **Example:** Mixture of iron filings and sulphur
Solvent extraction method To separate the mixture of Insoluble solid X + Soluble solid Y.	**Technique** • Take a beaker containing solvent. • Add the mixture X + Y to the beaker. • Stir the mixture well till the soluble component dissolves. • Filter the components of the beaker. **Separation of Compounds** ➢ Insoluble component X remains on the filter paper. ➢ Soluble component Y is obtained on evaporation. **Examples:** NaCl + sand; carbon + sulphur
Chromatography – For Complex Mixtures To separate the mixture of different solid constituents in a liquid constituent.	**Technique** • Place a spot of ink with the help of a capillary tube in the centre of a base line about 2–3 cm away from the lower edge of a paper. • Dry the spot and hang the paper in a glass jar with its lower end immersed in the solvent. **Separation of Compounds** • The solvent runs over the spot and carries the components to a distance along the paper indicated by coloured spots (the solid constituents of dyes A, B, C, D). **Example:** Different dyes in ink.

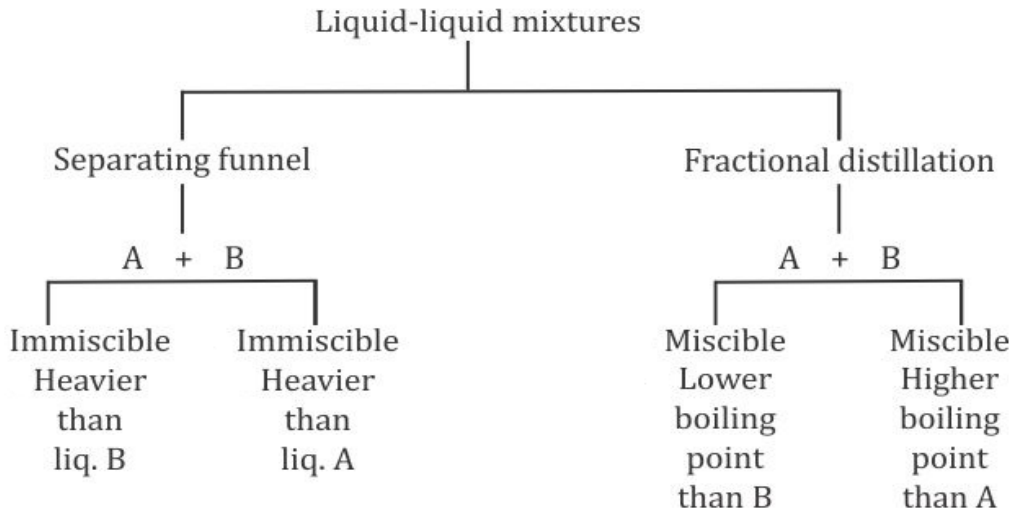
Separation of Solid-Liquid Mixtures



Method of Separation	Method of Separation
Filtration To separate the mixture of insoluble solid X from liquid component Y.	**Technique** • Place a wet folded filter paper in a funnel clamped above a beaker. • Pour the mixture X + Y carefully through it. **Separation of Compounds** • Insoluble solid X remains on the filter paper. It is then dried and recovered. • Liquid component Y remains behind in the lower beaker. **Example:** Chalk + Water
Sedimentation and Decantation Insoluble solid X from liquid component Y.	**Technique** • Take the mixture X + Y in a beaker containing water. • Keep the contents aside for a while to let it settle down. **Separation of Compounds** • Insoluble component X (sediment) settles down. • Upper liquid Y is decanted/poured out into another beaker. **Example:** Sand + Water

Evaporation To separate the mixture of soluble solid X from liquid component Y.	**Technique** • Place the mixture X + Y in an evaporating dish. Heat the dish carefully on a sand bath. • Adjust the flame to prevent the solid which is left behind in the dish from spurting out. **Separation of Compounds** • Soluble solid X in the dish is recovered on evaporation. • Liquid component Y is lost as water vapour. **Example:** Salt water solution
Distillation To separate the mixture of soluble solid X from liquid component Y.	**Technique** • Add the mixture X + Y to the flask A of the distillation apparatus. • Carefully heat the flask. • The mixture evaporates and later condenses. **Separation of Compounds** • Solid component X remains in the flask A after evaporation. • Liquid component Y gets collected in the receiver B after condensation. **Examples:** Salt water solution; distillation of impure water

Separation of Liquid-Liquid Mixtures



Method of Separation	Method
Separating funnel To separate the mixture of immiscible heavier liquid X from immiscible lighter liquid Y.	**Technique** • Take a separating funnel. • Pour the mixture X + Y from the top of a separating funnel. • Allow the mixture to stand in the funnel for sometime till both the layers separate out. • The two distinct layers are formed (heavier below and lighter above). **Separation of Compounds** • Heavier liquid X can be collected first in a beaker on opening the tap/stop cork. • Lighter liquid X remains in the separating funnel which can be collected in another beaker. **Example:** Water + Oil; Kerosene + Oil

Fractional distillation To separate the mixture of miscible liquid X having lower boiling point and miscible liquid Y with higher boiling point.	**Technique** • The mixture X + Y is kept in a distillation flask A attached with a fractionating column of glass beads. • The flask is then carefully heated. • The mixture first evaporates and later gets condensed. The glass beads present in the fractional column provide larger surface area for the vapours to cool down. • This technique is used to separate the mixtures having their temperature difference less than 30°C. **Separation of Compounds** • Liquid with the higher boiling point Y remains in the flask A after condensation. • Liquid with the lower boiling point X gets collected in the flask B after condensation. **Example:** Benzene + Toluene; Water + Carbon tetrachloride