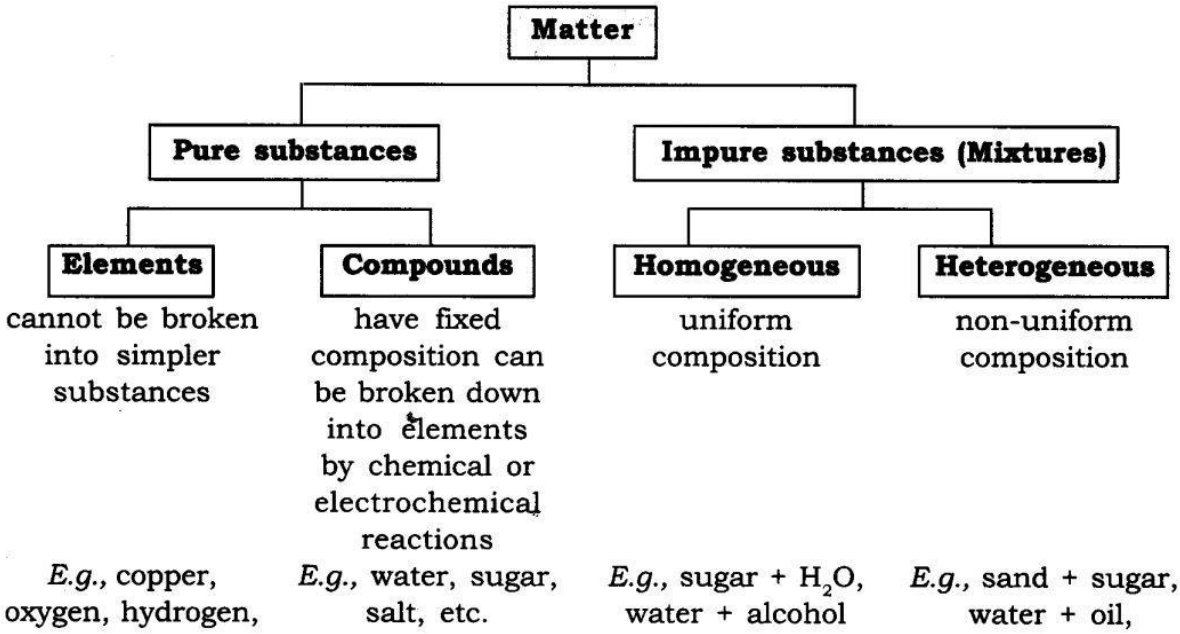
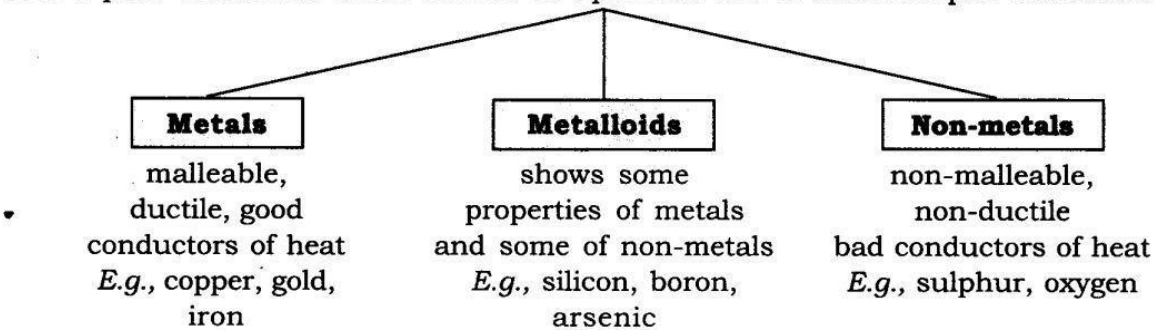
Chapter 2 Is Matter Around Us Pure



PURE SUBSTANCE	MIXTURE
· Pure substance consists of a single type of substance .	· Mixture consists of two or more pure substances.
· Pure substance cannot be separated into other substances by physical methods.	· Mixture can be separated into its components by physical methods.
· Pure substance has its own definite properties.	· Mixture shows the properties of its components.

Elements

It is a pure substance which cannot be split into two or more simpler substances.



Properties of Metals:

- These are lustrous (shine).
- They conduct heat and electricity.
- All metals are malleable and ductile.
- They are sonorous.
- All metals are hard except sodium and potassium.
- All metals are solids at room temperature except mercury which is a liquid.

Properties of Non-metals:

- These are dull in appearance.
- They are poor conductors of heat and electricity except diamond which is a good conductor of heat and graphite which is a good conductor of electricity.
- They are neither malleable nor ductile.
- They are generally soft except diamond which is the hardest natural substance known.
- They may be solids, liquids or gases at room temperature.

Metalloids: The elements that have properties intermediate between those of metals and non-metals, are called metalloids.

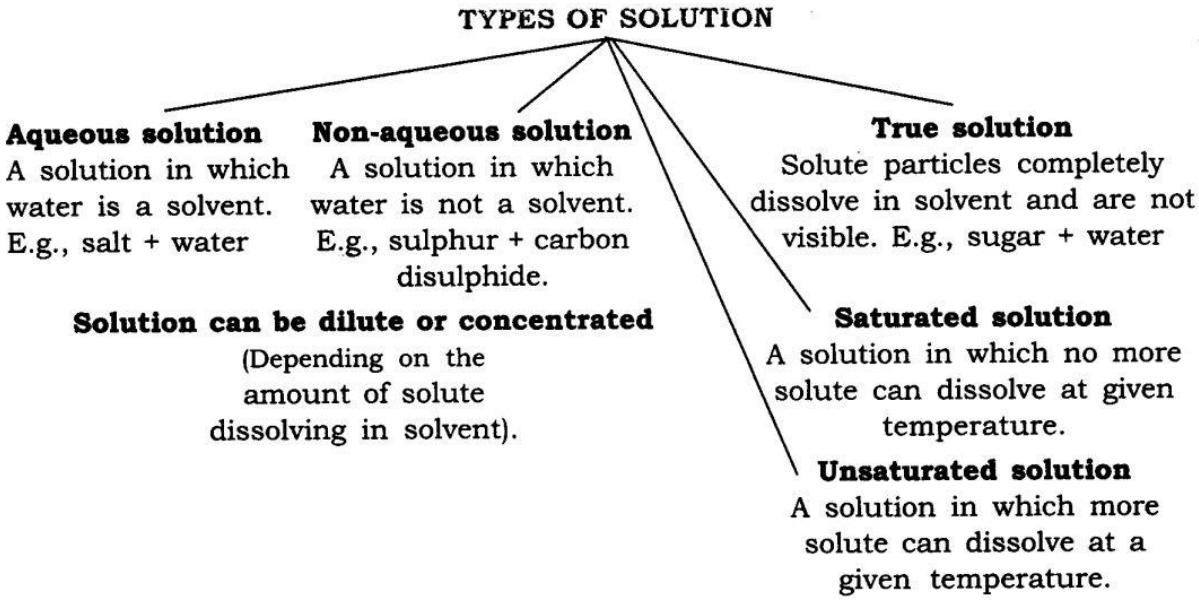
Compounds: The compound is a pure substance made up of two or more elements combined chemically in a definite ratio.

Characteristics:

- The properties of compounds differ from those of its constituents.
- Compounds have fixed melting point and boiling point.
- Compound is a homogeneous substance.
- Constituent elements can be separated by chemical process.

Solution(It is a homogeneous mixture of two or more substances.)

Solute	***Solvent***
A substance which is dissolved in a solvent. *E.g.*, salt, sugar. Solute can be solid, liquid or gas.	Liquid part of solution in which a substance is dissolved. *E.g.*, water. Solvent can be liquid, solid or gas.



Properties of solutions:

1) It is a **homogeneous mixture**.
2) Particle **size** in a solution is *less than 1 nm* in diameter.
3) Particles of a *solution cannot be seen* even with a microscope.
4) A true solution **does not scatter** the light.
5) Solution is ***stable***.
6) The solute particles cannot be separated from the mixture by **the process of filtration**.

Suspension:

The heterogeneous mixture in which solids are dispersed in a liquid are called suspensions. For example, chalk-water mixture, muddy water, flour in water, etc.

A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.

Properties of a Suspension:

1) It is a heterogeneous mixture.
2) The particles of a suspension can be seen by naked eyes.
3) The particles of a suspension scatter a beam of light passing through it and make its path visible.
4) A suspension is unstable.
5) Constituents of a suspension can be separated by the process of filtration.

Colloid or Colloidal solution:

Solutions in which the size of particles lies in between those of true solutions and suspensions are called colloidal solutions or simply colloids. For example, Milk, smoke and starch solution, etc.

Properties of Colloids:

1) A colloid is a heterogeneous mixture.
2) The size of particles of a colloid is too small to be individually seen by naked eyes.
3) The particles of a colloidal solution are big enough to scatter a beam of light passing through it.
4) A colloid is quite stable.
5) Colloidal particles cannot be separated by the process of filtration.

Tyndall Effect: The scattering of light by the colloidal particles is known as Tyndall effect.

It can be observed when:

- A fine beam of light enters a room through a small hole.
- Sunlight passes through the canopy of a dense forest.

- Concentration of solution $= \frac{\text{Amount of solute}}{\text{Amount of solution}}$ or $\frac{\text{Amount of solute}}{\text{Amount of solvent}} \times 100$
- Mass by mass percentage of a solution

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

- Mass by volume percentage of a solution

$$= \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

Suspension	***Colloidal Solution***
• Size of solute particles are visible with naked eyes • Shows tyndall effect • Translucent • Solute particles settle down	Size of solute particles are not visible with naked eyes. Shows tyndall effect Translucent Colloidal particles do not settle down

Different Types of Colloids

Dispersed Phase	Dispersing Medium	Type	Example
Liquid	Gas	Aerosol	Fog, clouds, mist
Solid	Gas	Aerosol	Smoke, automobile exhaust
Gas	Liquid	Foam	Shaving cream
Liquid	Liquid	Emulsion	Milk, face cream
Solid	Liquid	Solution	Milk of magnesia, mud
Gas	Solid	Foam	Sponge, pumice
Liquid	Solid	Gel	Jelly, cheese, butter
Solid	Solid	Solid sol	Coloured gemstone, milky glass

Alloys(A material that has metallic properties and is composed of two or more chemical elements of which at least one is a metal .)

- These cannot be separated into their components by physical methods.
- However, these are considered as mixture because these show the properties of its constituents and can have variable composition.

Notes:-

The benefit of alloys is that you can combine metals that have varying characteristics to create an end product that is stronger, more flexible, or otherwise desirable to manufacturers.

- ❖ Aluminium alloys are extensively used in the production of automotive engine parts.
- ❖ Copper alloys have excellent electrical and thermal performance, good corrosion resistance, high ductility and relatively low cost.

Try the following question:

Q1. Is air around us a compound or a mixture?
Q2. Water is a compound. Justify.
Q3. Differentiate between homogeneous and heterogeneous mixtures.

Q4. Give reasons for the following**:**

A. Copper is used for making electric wires.
B. Graphite is used for making electrodes in a dry cell.

Q5. List any four characteristics by which compounds can be differentiated from mixtures.

Q6. What would it mean by saying a 15% of alcohol solution?

Q7. Calculate the concentration of a solution containing 2.5g of salt dissolved in 50g of water.

Q8. Name the different types of solutions along with an example for each.

Q9. Define (a) Solute (b) Solvent.

Mixtures

It is made up of two or more elements or compounds mixed in any ratio/proportion.

Properties:

- It may be homogeneous or heterogeneous.
- The properties of constituent substances are retained.
- No new compound is formed.
- Elements can be separated by simple physical processes.
- It does not have a fixed melting and boiling point.

Types of Mixtures

i) on the basis of their physical states:

	SOLID	**LIQUID**	**GAS**
SOLID	· Salt and sugar	· Salt and water	· Dust in air
LIQUID	· Mercury and copper	· Alcohol and water	· Clouds
GAS	· Hydrogen and palladium	· Oxygen and water	· Air

ii) on the basis of miscibility:

Homogeneous Mixture	Heterogeneous Mixture
· It consists of single phase. · Uniform composition. · Example: Sugar dissolved in water	· It consists of two or more phase. · Does not have uniform composition. · Example: Air, sand and common salt.

Separation of Mixtures:

(1) Evaporation:

Evaporation is a process which is used to separate a solid substance dissolved in liquid. It is based on the fact that liquids vaporize easily whereas solids do not.

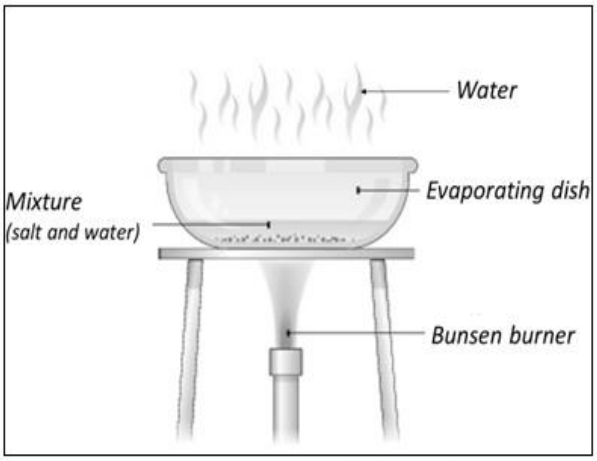


Fig. Seperation by Evaporation

Applications of Evaporation:

- Obtaining salt from sea water.

(2) Centrifugation:

It is a method of separating the suspended particles of a substance from a liquid in which the mixture is rotated at high speed in a centrifuge.

This method is useful in case the suspended particles in a liquid are too small too be retained by filter paper.

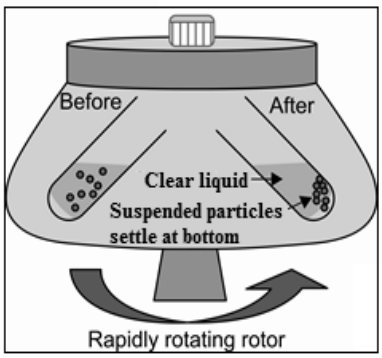


Fig. Seperation by centrigugation

Principle of Centrifugation:

When a mixture is rotated very fast, the denser particles are forced to go to the bottom of the centrifuge and the lighter particles stay at the top.

Applications of Centrifugation:

- Used in dairies to separate cream from milk.
- Used in washing machines to squeeze out water from wet clothes.

(3) Separating funnel

It is used to separate a mixture of two immiscible liquids, like oil and water.

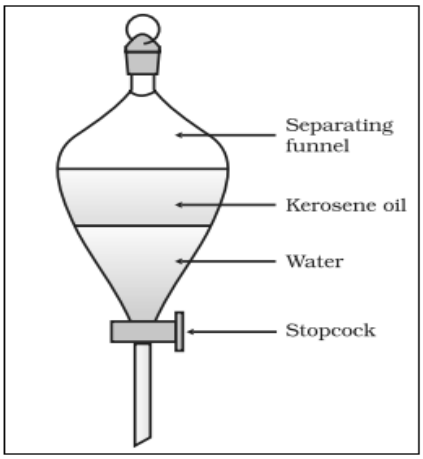


Fig. Seperation of imiscible liquids by seperating funnel

Principle of Separating funnel :

When a mixture of two immiscible liquids is kept in a separating funnel, the liquids separate out in layers depending on their densities with the heavier forming the top layer.

Applications of Separating funnel:

- To separate mixture of oil and water.
- In the extraction of iron from its ore where the lighter slag (molten waste material) is removed from the top by to leave the molten iron at the bottom of the blast furnace.

(4) Sublimation:

This method is used to separate those components from a mixture which can sublime on heating.

For example: Ammonium chloride, camphor, naphthalene etc, can be separated from their mixture by sublimation

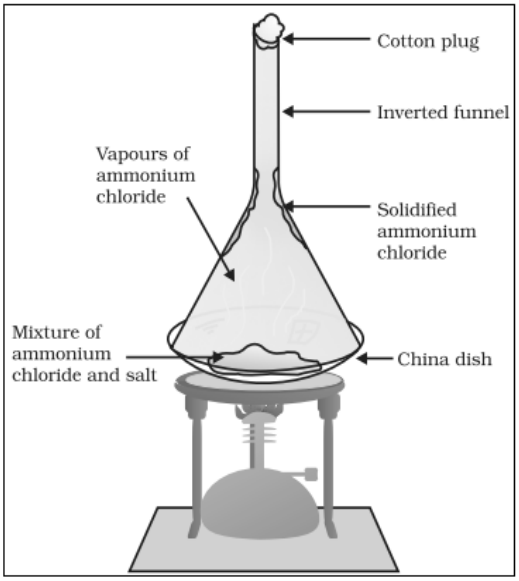


Fig. Seperation of ammonium chloride and salt by sublimation

Applications of Sublimation:

- Iron can be separated from a mixture of iron fillings and camphor (volatile).
- Common salt can be separated from a mixture of salt and ammonium chloride (volatile).

(5) Chromatography

This method is used to separate two or more dissolved solids which are present in a solution in very small quantities.

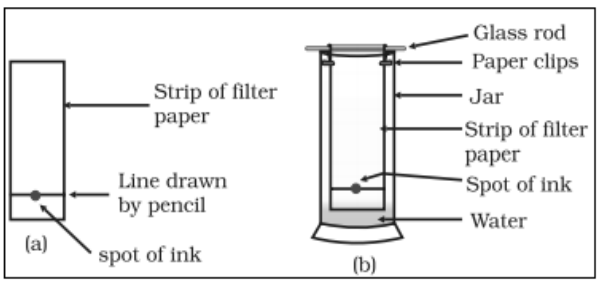


Fig. Seperation of dyes in black ink by paper chromatography

Principle of Chromatography:

This method of separation is based on the fact that though two substances are dissolved in the same solvent but their solubilities can be different. The component which is more soluble in, rises faster and gets separated from the mixture.

Applications of Chromatography:

- To separate colours in a dye by paper chromatography.
- To separate drugs from blood.

(6) Distillation:

This method is used to separate a mixture solid in a liquid. It is the process of heating the liquid to form vapour, and then cooling the vapour to get back liquid.

It is used for the separation of components of a mixture containing two miscible liquids that boil without decomposition and have sufficient difference in their boiling points.

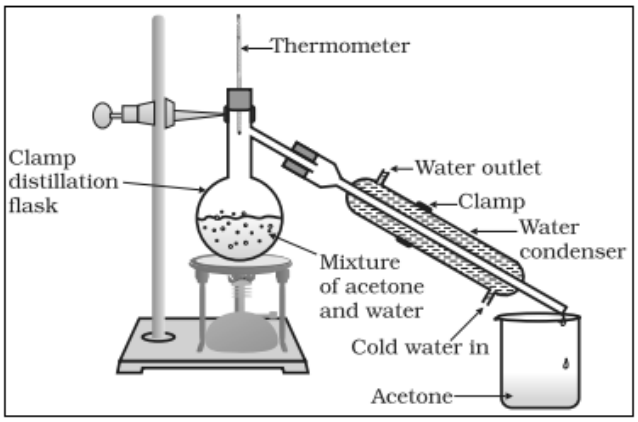


Fig. Seperation by distillation

Principle of Distillation:

The volatile liquid evaporates on heating which can be recovered by cooling its vapours by the process of condensation.

Applications of Distillation:

- It is used to remove salt from sea water to obtain drinking water.

(7) Fractional distillation

It is the process of separating two or more miscible liquids by distillation, the distillate being collected in fractions due to boiling at different temperatures.

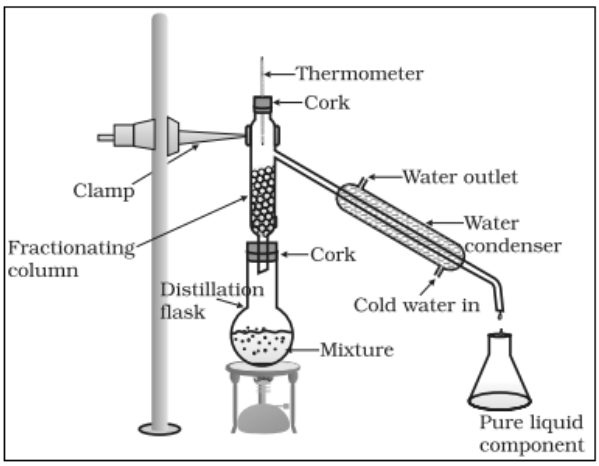


Fig. Seperation by fractional distillation

Fractionating Column:

The apparatus used in this process is similar to that for simple distillation except a fractionating column which is fitted in between the distillation flask and the condenser. A simple fractionating column is a tube packed with glass beads. The beads provide surface for the vapours to cool and condense repeatedly.

Principle of Fractional Distillation:

In a mixture of two or more miscible liquids, the separation of various liquids depends on their boiling points. The liquid having lower boiling point boils first and can be obtained first from the fractionating column than the liquid having higher boiling point.

Applications of Fractional Distillation:

- It is used to separate a mixture of miscible liquids like alcohol-water mixture.
- It is used to separate crude oil 'petroleum' into useful fractions like kerosene, petrol, diesel, etc.
- It is used to separate different gases of the air by taking the liquid air.

(8) Crystallisation :

Crystallisation is a process used to separates a pure solid in the form of its crystals from a solution. The process involves cooling a hot, concentrated solution of a substance to obtain crystals.

Applications of Crystallisation:

- Purification of common salt obtained from sea water.
- To obtain crystals of alum (phitkari) from impure samples.
- To obtain pure copper sulphate from an impure sample.

Type of Mixture	*Separation method*
1. Two immiscible liquids. Example, oil + water	By using separating funnel
2. Ammonium chloride + sand	Sublimation
3. Dyes in black ink. (One solvent different constituents)	Chromatography
4. Two miscible liquids. (Acetone + water)	Distillation
5. Solid particles insoluble from (solvent) liquid. (Milk + Cream)	Centrifugation

Physical and Chemical Change

Physical Change	*Chemical Change*
• No new substance is formed.	A new substance is formed.
• Properties of constituent elements/ substance is retained.	Properties of constituent elements/substance changes.
• Change does not involve loss or gain of	Loss or gain of heat may be involved in this

Difference B/W :-

a) <u>on the basis of size of solute particles:</u>

True solution(Solution)	**Sol [Colloid]**	**Suspension**
· Homogeneous	· Heterogeneous	· Heterogeneous

· Size of solute particles is less than 1 n m or 10^{-9} m .	· Size of solute particles is between 1 nm to 1000 nm.	· Size of solute particles is more than 1000 nm.
· Particles cannot pass through filter paper.	· Particles can pass through filter paper.	· Particles cannot pass thorough filter paper.
· Stable	· Stable and settle only on centrifugation.	· Unstable and settle down on its own.
· Solution of sodium chloride in water, sugar & water.	· Milk , Fog	· muddy water, chalk & water, · smoke in the air.

b) <u>on the basis of amount of solute:</u>

Unsaturated solution	**Saturated Solution**	**Supersaturated solution**
A solution which has lesser amount of solute that it can dissolve at a given temperature	A solution which has maximum amount of solute that it can dissolve at a given	A solution which can dissolve amount of solute by increasing temperature saturated solution

is known as unsaturated solution.	temperature is known as saturated solution.	is known as supersaturated solution.

c) <u>on the basis of nature of solvent</u>

Aqueous solution	Non-Aqueous solution
The solution in which the solvent is water is known as aqueous solution.	The solution in which the solvent is other than water (ether, alcohol or acetone) known as non-aqueous solution.

Try the following question:

Q1. How will you distinguish a colloid from a solution?
Q2. What is effect of temperature on the solubility of solids in liquids?
Q3. Sea water can be classified both as a homogeneous as well as a heterogenous mixture. Comment?
Q4. Distinguish between the following as physical changes and chemical changes?

a) Burning of a magnesium wire
b) Rusting of iron
c) Condensation of steam
d) Glowing of an electric bulb

Q5. Name the method of separation that you will apply for separation of the following mixtures?
(a) Ammonium chloride from a powdered mixture of sodium chloride and Ammonium chloride.
(b) Butter from cream.
(c) Oil from water.
Q6. Which of the following will show Tyndall effect:
(a) Salt solution
(b) Milk
(c) Starch
Q7. How will you separate a mixture of iron filings, chalk powder and common salt?
Q8. Discuss the process of purification of impure copper sulphate by crystallization.
Q9. Explain how nitrogen, oxygen and argon gases are separated from air?