# Elements, Compounds And Mixtures

**Points to Remember:**

1. Every substance is made up of very tiny particles, called molecules. Molecules are formed from even smaller particles called atoms.
2. **Element—**
   **(a)** Element is the simplest pure substance. It cannot be divided further into simpler substances by any chemical method, e.g. oxygen, hydrogen, sulphur, etc.
   **(b)** At present 116 elements are known, of which 92 are natural elements.
3. Based on their properties, elements are classified into : metals, non-metals, metalloids, noble gases.
4. Metals are ductile, malleable, good conductors of heat and electricity, high melting and boiling points. Metals are sonorous, e.g., Iron, Gold, Silver, etc.
5. Non-metals are solids and brittle in nature, bad conductor of heat and electricity (exception Graphite) low melting and boiling points, e.g. sulphur, carbon, hydrogen, etc,
6. **Metalloids—** These elements show properties of both metals and non-metals. They are hard solids, e.g. Boron, Silicon, Arsenic.
7. **Inert or noble gases—** These elements do not react chemically with other elements or compounds are called noble (Inert) gases, e.g., helium, neon, argon, etc.
8. **Symbols of Elements—** Each element is denoted by a symbol usually to first letter.
   **Examples:** Oxygen by O Hydrogen by H.
9. **Atom—** "An Atom is the smallest particle of an element that can take part in a chemical reaction but may or may not have independent existence."The atom of an element exhibits all the properties of that element.
10. **Molecule—** A molecule is the smallest particle of a pure substance of element or compound which has independent existence. It exhibits all the properties of pure substance.
11. **Atomicity—** The number of atoms of an element that join together to form a molecule of that element is known as the atomicity.
12. **Molecular Formula—** Molecular formula of an element is the symbolic representation of its molecule. It indicates the number of atoms present in it. e.g. Magnesium oxide- **MgO.**

**Exercise**

**Question 1.**
Differentiate between the terms elements, compounds and mixtures with suitable examples.

**Answer:**
**Element —** is a pure substance
e.g. Potassium

1. It is the basic unit of matter and cannot be broken down into two or more simpler substances by any means.
2. It is mainly classified into metals and non-metals.

**Compound —** Is a pure substance
e.g. Potassium chloride

1. It is formed by combination of two or more elements.
2. The elements are combined together in a fixed ratio.

**Mixture —** is an impure substance
e.g. Potassium chloride solution

1. It is formed by combination of two or more pure substances.
2. The pure substances are mixed together in any ratio.

**Question 2.**
State which element exists in the highest percentage in – (a) earth's crust (b) atmosphere (c) human body.

**Answer:**
**(a)** Oxygen (O) — 46.1%
**(b)** Nitrogen (N) — 78%
**(c)** Oxygen (O) — 65%

**Question 3.**
Elements are mainly classified into metals and non-metals. State six properties of metals which differ from non-metals.

**Answer:**

| Properties | Metals | Non-Metals |
|---|---|---|
| 1. State | Metals are generally solids at room temperature. | Non-metals are gases, liquids, soft solids at room temperature. |
| 2. Lustrous | Metals have lustre *i.e.* shine. | Non-metals do not have lustre *i.e.* do not shine. |
| 3. Malleability | Metals are malleable *i.e.* can be beaten into sheets. | Non-metals are non-malleable *i.e.* cannot be beaten into sheets. |
| 4. Ductility | Metals are ductile *i.e.* can be drawn into wires. | Non-metals are non-ductile *i.e.* cannot be drawn into wires. |
| 5. Conductivity | Metals are good conductors of heat and electricity. | Non-metals are poor conductors of heat and electricity. |
| 6. Melting and Boiling point | Metals have high melting and boiling points. | Non-metals have low melting and boiling points. |
| 7. Density | Metals have high density. | Non-metals have low density. |

**Question 4.**
Give the symbols of the following elements – and state in each case whether they are metals, non-metals, metalloids or noble gases.

| | | |
|---|---|---|
| **(a) potassium** | **(b) carbon** | **(c) oxygen** |
| **(d) mercury** | **(e) fluorine** | **(f) neon** |
| **(g) sulphur** | **(h) zinc** | **(i) boron** |
| **(j) copper** | **(k) calcium** | **(l) xenon** |
| **(m) arsenic** | **(n) mercury** | **(o) chlorine** |
| **(p) silicon** | **(q) neon** | **(r) lead** |
| **(s) antimony** | **(t) sodium** | **(u) iodine** |
| **(v) platinum** | **(w) radon** | **(x) phsophorus** |
| **(y) bromine** | **(z) aluminium** | |

**Answer:**

| Name | Symbols | Metal/Non-metals/ Metalloids/Noble gases |
|---|---|---|
| (a) Potassium | K | Metal |
| (b) Carbon | C | Non-metal |
| (c) Oxygen | O | Non-metal |
| (d) Mercury | Hg | Metal |
| (e) Fluorine | F | Non-metal |
| (f) Neon | Ne | Noble gas |
| (g) Sulphur | S | Non-metal |
| (h) Zinc | Zn | Metal |
| (i) Boron | B | Metalloid |
| (j) Copper | Cu | Metal |
| (k) Calcium | Ca | Metal |
| (l) Xenon | Xe | Noble gas |
| (m) Arsenic | As | Metalloid |
| (n) Mercury | Hg | Metal |
| (o) Chlorine | Cl | Non-metal |
| (p) Silicon | Si | Metalloid |
| (q) Neon | Ne | Noble gas |
| (r) Lead | Pb | Metal |

| | | | |
|---|---|---|---|
| (s) | Antimony | Sb | Metalliod |
| (t) | Sodium | Na | Metal |
| (u) | Iodine | I | Non-metal |
| (v) | Platinum | Pt | Metal |
| (w) | Radon | Rn | Noble gas |
| (x) | Phosphorus | P | Non-metal |
| (y) | Bromine | Br | Non-metal |
| (z) | Aluminium | Al | Metal |

**Question 5.**
State what is meant by the term 'activity series of metals'. State the most reactive and the least reactive metal from the following – Zn, Ag, Na, Fe, Cu, Pb.

**Answer:**
**Activity series of metals:**
The positive of metals in the decreasing order of their reactivity is called 'activity series of metals.'
It is a series of metals arranged according to their reactivity in which the most reactive metal i.e. potassium is at the top of the series and the least reactive metal i.e. gold is at the bottom.

The most reactive metal is Na.
The less reactive metals are Zn, Fe, Pb.
The least reactive metals are Ag, Cu.

**Question 6.**
Give three reasons why – carbon dioxide is considered a compound, while carbon – an element.

**Answer:**
Carbon dioxide ($C0_2$) has a formula and properties of $C0_2$ to extinguish fire etc. are quite different from the properties it constituents carbon and oxygen. Oxygen (O) and carbon (C) are elements as these are made up of one kind of atoms. Also carbon is combustible and oxygen is supporter of combustion

**Question 7.**
State what information is provided by the formula of calcium hydroxide – $Ca(OH)_2$

**Answer:**

| Compound | Formula | Information provided by formula |
|---|---|---|
| Calcium Hydroxide | $Ca(OH)_2$ | 1 atom of calcium, 2 atoms of oxygen and hydrogen. |

**Question 8.**
Four atoms of hydrogen combine with one atom of carbon to give methane [CH4]. State the valency of carbon.

**Answer:**
Methane is formed by the combination of four hydrogen atoms and one carbon atom where valency of hydrogen is 1 and valency of carbon is 4.

**Question 9.**
**Write the symbols of the following elements and radicals along with their valencies.**

(a) Sodium
(b) magnesium
(c) chlorine Ichioridel
(d) nitrate
(e) suiphite
(f) alurniniuni
(i) zinc
(j) sulphur [sulphide ]
(h) broniine [broiiiide]
(k) sulphate
(l) hydroxide
(m) calcium
(n) caibon.te
(o) potassium
(p) phosphate
(q) iodine[iodide]
Valency list: (i) 1+ (ii) 2, (iii) 3, (iv) 1, (y) 2-(vi) 3

**Answer:**

| Name | Symbols | Radicals |
|---|---|---|
| (a) Sodium | Na | $Na^{1+}$ |
| (b) magnesium | Mg | $Mg^{2+}$ |
| (c) chlorine [chloride] | Cl | $Cl^{1-}$ |
| (d) nitrate | $NO_3$ | $NO_3^{1-}$ |
| (e) sulphite | $SO_3$ | $SO_3^{2-}$ |
| (f) aluminium | Al | $Al^{3+}$ |
| (g) oxygen [oxide] | O | $O^{2-}$ |
| (h) bromine [bromide] | Br | $Br^{1-}$ |
| (i) zinc | Zn | $Zn^{2+}$ |
| (j) sulphur [sulphide] | S | $S^{2-}$ |
| (k) sulphate | $SO_4$ | $SO_4^{2-}$ |
| (l) hydroxide | OH | $OH^{1-}$ |
| (m) calcium | Ca | $Ca^{2+}$ |
| (n) carbonate | $CO_3$ | $CO_3^{2-}$ |
| (o) potassium | K | $K^{1+}$ |
| (p) phosphate | $PO_4$ | $PO_4^{3-}$ |
| (q) iodine [iodide] | I | $I^{1-}$ |

**Question 10.**
**Write the chemical formula**
(a) magnesium oxide
(b) Sodium bromide
(c) calcium sulphide
(d) magnesium sulphate
(e) aluminium chloride
(f) zinc oxide
(g) calcium carbonate.

**Answer:**

**(a)** MgO
**(b)** NaBr
**(c)** CaS
**(d)** Mg SO4

**(e)** AIC3
**(f)** Zno
**(g)** CaCO3

**Question 11.**
**Give the formulas of the following acids:**
(a) hydrochloric
(b) nitric
(c) sulphuric
(d) carbonic — acid.

**Answer:**

**(a)** Hydrochloric — HCI
**(b)** Nitric —HNO3
**(c)** Sulphuric —H2SO4
**(d)** Carbonic acid —H2CO3

**Question 12.**
**Give the formulas of the following gases:**
(a) hydrogen chloride
(b) ammonia
(c) carbon monoxide
(d) nitric oxide
(e) nitrous oxide
(f) nitrogen dioxide
(g) nitrogen
(h) sulphur dioxide

**Answer:**

**(a)** hydrogen chloride — HCI
**(b)** ammonia — $NH_3$
**(c)** carbon monoxide— CO
**(d)** nitric oxide— NO
**(e)** nitrous oxide — $N_{2O}$
**(f)** nitrogen dioxide — $NO_2$
**(g)** nitrogen – $N_2$
**(h)** sulphur dioxide— $SO_2$

**Question 13.**
Explain the term mixture. Differentiate between a homogenous and a heterogeneous mixture with one example of each in the (a) solid-solid (b) solid-liquid If (c) liquid-liquid state of the mixture.

**Answer:**
**Mixtures:**
"Are made up of two or more elements or i compounds or both mechanically

mixed together in any proportion."

**Examples:**

1. Iron and sand mixture.
2. Sand, iron and common salt mixture.
3. Ice-cream is mixture of milk, sugar absence, dry-fruits etc.
   Differences between homogenous and heterogeneous mixtures.

**Homogenous mixture**

1. Constituents – uniformly mixed.
2. Properties and composition same throughout the mixture.
   **Example:** Alloys, (salt + water), air etc.

**Heterogeneous mixture**

1. Constituents – not uniformly mixed.
2. Properties and composition not same but varies throughout the mixture.
   **Examples:** (oil + water), (iron + sulphur).
   Solid – solid homogenous mixture is brass (Cu + Zn)
3. Solid – solid heterogenous mixture is (iron + sulphur)

**Question 14.**
**State four differences between – elements, compounds and mixtures with suitable examples.**

**Answer:**

1. **Term —**
   **Elements –** Pure substance made up of one kind of atoms only. e.g. Iron [Fe], Sulphur [S]
   **Compounds –** Pure substance made up of two or more elements, e.g. Iron sulphide [FeS]
   **Mixture –** Impure substance made up of two or more elements or compounds, e.g. Iron sulphur mixture.
2. **Existence—**
   **Elements –** Elements i.e. atoms of one kind are present on their own.
   e.g. Iron and sulphur exist on their own as elements iron and sulphur.
   **Compounds –** Components in a compound present in a definite proportion.
   e.g. Iron and sulphur are chemically combined in a fixed ratio in iron sulphide.
   **Mixture –** Components in a mixture present in any proportion.
   e.g. Iron and sulphur are mixed in any ratio in the mixture of iron and sulphur.
3. **Properties —**
   **Elements –** Elements have a definite set of properties. Elements classified into metal and non-metals each with its own properties.

**Compounds –** Compounds have a definite set of properties.
Elements of a compound do not retain their original properties.
**Mixture –** Mixture not have a definite set of properties. Components of a mixture do retain their original properties.

4. **Separation —**
**Elements –** Elements occur on their own or as compounds and can be separated by chemical and physical methods.
**Compounds –** Elements in a compound are chemically combined and can be separated by chemical methods only.
**Mixture –** Components in a mixture are chemically mixed and can be separated by physical methods only.
5. **Examples —**
**Elements –** Metals – Iron, copper, silver, gold.
**Non-metals –** Sulphur, chlorine.
**Compounds –** Iron sulphide, copper oxide, water.
Sodium chloride, copper, sulphate.
**Mixture –** Iron + sulphur, copper + silver, air, brass. Sodium chloride + water, copper sulphate + water.

**Question 15.**
**State the correct technique for separation of the following mixtures.**
(a) a sublimable solid and a non-sublimable solid.
(b) a liquid component from soluble impurities in the liquid component.
(c) a lighter liquid from a heavier liquid.
(d) a low boiling point liquid from a high boiling point liquid.
(e) solid constituents in a liquid constituent by adsorption.

**Answer:**
**(a) By sublimation**
Common salt + ammonium chloride on heating ammonium chloride sublimes common salt does not sublime and remains in the evaporating dish.

……
**(b) By evaporation:** Liquid is made to evaporate leaving behind the solid.
**(c) By separating funnel:** The heavier lower layer passes into the beaker on opening the stop-cock. Close the stop-cock as lighter layer reaches the tip. Lighter layer will remain in the funnel.
**(d) By fractional distillation:** Miscible low boiling point liquid will evaporate and is collected in the receiver, leaving behind the miscible high boiling point liquid in the flask.
**(e)** The method used is chromatography

**Question 16.**
**Give –**
(a) The principle involved in separation of the mixture
(b) The technique of separation for each of the following mixtures.
(1) Naphthalene and sodium chloride
(2) Common salt from a solution of common salt in water
(3) Pure water from impure water

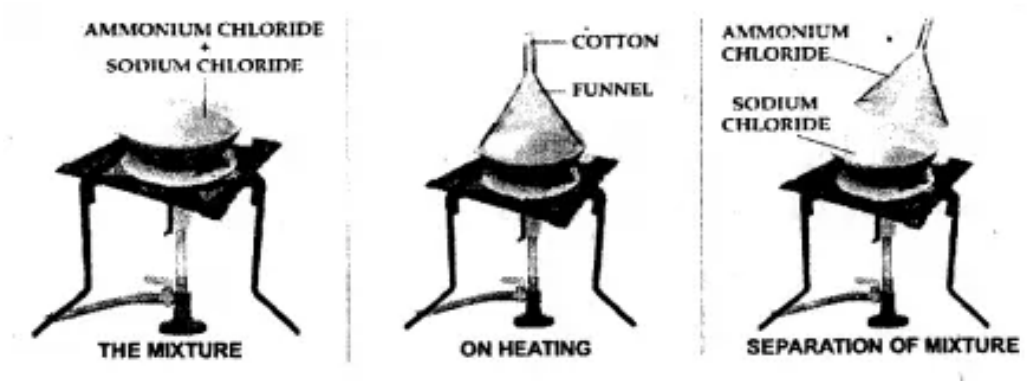
(4) Kerosene and water
(5) Methyl alcohol and water
(6)Dyes of an ink

**Answer:**
**(1) By Sublimation**

**Principle —** Based on the differenc in sublimable and non- sublimable nature of solids.

**Sublimation:** It is the process of conversion of a solid directly into vapour and back to solid without passing through the liquid state.
Sublimable solids thus turn directly into vapour on heating and back to pure solid on cooling the vapours. The non- sublimable solid in the mixture thus remains behind.

**Technique of Separation —** The mixture of the sublimableand non-sublimable solids are heated in an evaporating dish covered with a funnel plugged at one end with cotton. Sublimable solid on heating sublimes and the vapours condense and collect in the pure form on the inner side of the funnel, from where the sublimable solid is scrapped off. Non-sublimable solid remains behind in the evaporating dish.




**(2) By Evaporation**

**Principle —** Based on evaporation of the liquid component in a soluble solid-liquid mixture.

**Evaporation –** It is a method used for recovery of the soluble solid from a solution by heating the mixture slowly, in a porcelain crucible on a flame.
For smoother steady heating the porcelain crucible maybe kept in a sand bath [a shallow metallic dish filled with sand].

**Technique of Separation —** The soluble solid can be separated from its liquid component by allowing the liquid component to evaporate either on its own or by heating. The liquid component is lost to the atmosphere The soluble solid

component remains behind in the evaporating dish

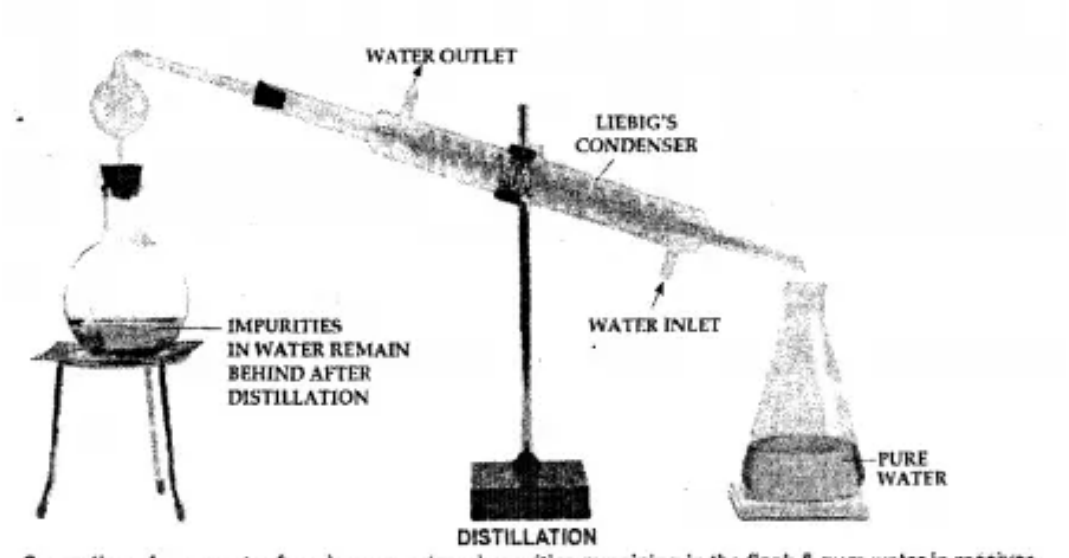

**(3) By Distillation**

**Principle —** Based on the distillation of the liquid component in a soluble solid-liquid mixture.

**Distillation —** It is the process of converting a liquid into vapour by heating in a distillation flask & subsequent condensation of the vapour back into the liquid. The method is used to separate a liquid from a soluble solid or pure liquid [water] from impure liquid [impure water].

**Technique of Separation —** The soluble solid can be separated from its liquid component or pure water from impure water by placing the mixture i.e. impure water in the distillation flask.

**On heating the distillation flask**
The solid or solid impurities in water remains behind in the distillation flask
The liquid or water vaporizes, condenses in the Liebig's condenser and is collected in the receiver.



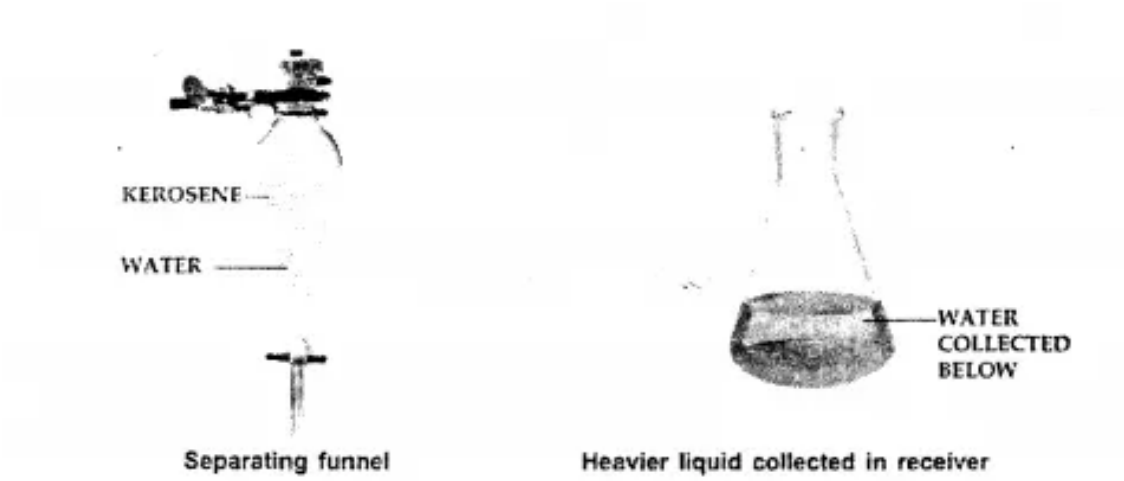
Separation of pure water from impure water – impurities remaining in the flask & pure water in receiver

**(4) By Separating funne**

**Principle —** Based on the separation of two in-miscible liquids, one heavy the other light.

**Separating funnel –** It is a pair-shaped or cylindrical bulb with a stock-cock fitted at its end. The immiscible liquids are allowed to stand in the separating funnel, till the heavier liquid settles below the lighter liquid.

**Technique of Separation —** The liquid-liquid mixture is added to the separating funnel and the funnel kept aside for sometime.
The heavier immiscible liquid settles down in the separating funnel and is then removed from below on opening the tap and collected out separately.
The lighter immiscible liquid remains above the heavier liquid, (immiscible liquids do not mix)



Separating funnel  Heavier liquid collected in receiver

**(5) By Fractional Distillation**

**Principle —** Based on the separation of mixture of two miscible liquids, with different boiling points.

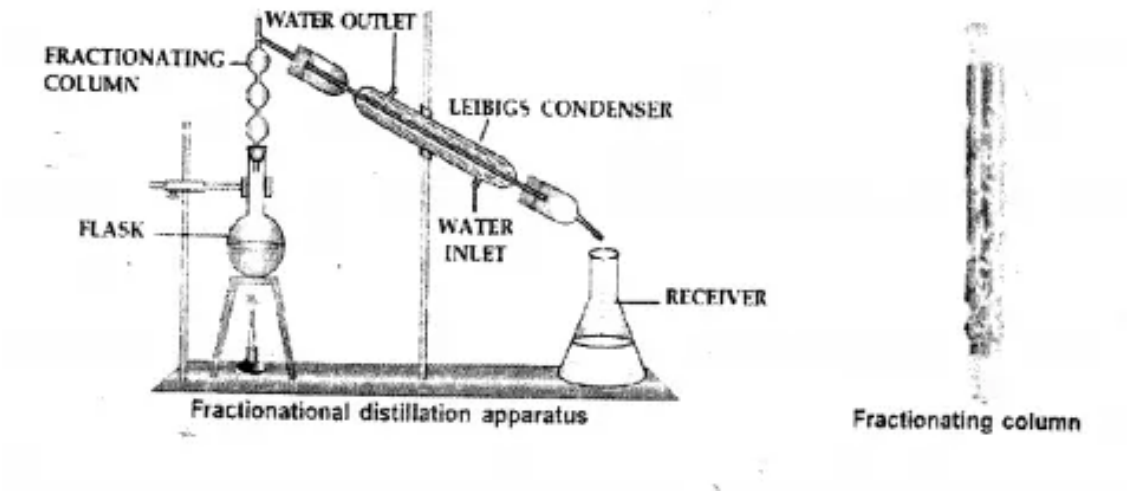
**Fractional distillation:** It is the mixture of two miscible liquids with different boiling points is heated in a distillation flask when the two liquids separate out due to their difference in boiling points.

**Technique of Separation –** The mixture of two miscible liquids e.g. alcohol and water having different boiling points is taken in the distillation flask and heated slowly.

The mixture boils are the respective boiling points of the components and the component with the higher boiling point remains behind in the distillation flask condensation.The component with the lower boiling point collects in the receiver, after condensation in the Leibigs condenser.

The fractionating column contains several traps to allow the vapours of the higher boiling point components to condense, there by only the lower boiling

point component enters the condenser and is collected in the receiver.




**(6) By Chromatography**

**Principle —** Chromatography is-a method by which the various components of a mixture e.g. dyes in an ink, are separated due to their difference in rate of flow over an absorbent medium i.e. stationary phase e.g. filter paper under the influence of a solvent i.e. the mobile phase.

**Chromatography —** There are two phases and they are:
**Stationary phase** in chromatography, the adsorbent medium is known as the stationary phase e.g. filter paper made of cellulose.

**Mobile phase** the solvent or the solution that moves due to capillary action is known as the mobile phase.

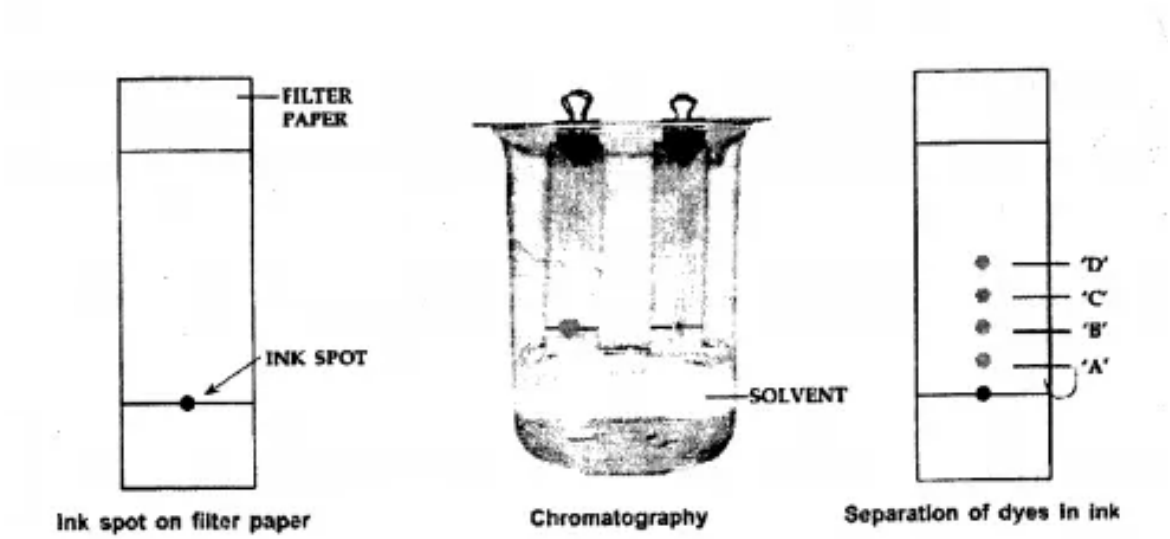
**Technique of Separation —** Separation of dyes in ink by paper chromatography Ink prepared by dissolving different dyes e.g. A, B, C, D in a suitable solvent, is taken.A line is drawn with a pencil over a long strip of a filter paper.

Place the ink spot containing the different dyes on the filter paper as shown below.
The filter paper is then hung with its lower end dipped in a suitable solvent.
The solvent maybe a mixture of ethyl alcohol and water poured into a tall jar, such that only a small lower part of the jar is filled.

The paper strip with the spot of ink at its, is dipped into the solvent in a way that the spot itself remains above the liquid surface.

The solvent flows over the ink spot and the various components of the mixture,

of dyes in the ink are separated as shown below.




**Objective Type Questions**
**Elements, Compounds & Mixtures**

**1. Select the correct answer from A, B, C, D and E for each statement given below:**
A: Chalk B: Oxygen C: Silicon D: Bromine E: Nitrous oxide

An element present in the earth's crust, atmosphere and human body.
**Ans.** B: Oxygen

The chemical name for dinitrogen oxide [$N_20$].
**Ans.** E: Nitrous oxide

A compound containing carbon, oxygen and calcium.
**Ans**. A: Chalk

A metalloid.
**Ans.** C: Silicon

A non-metal which exists in the liquid state.
A**ns.** D: Bromine

**2. Select the correct answer from the choice in bracket.**

The least reactive metal, [magnesium/silver/copper]

**Ans.** silver.

The positively charged particle of an atom, [electron/ proton/neturon]

**Ans.** proton

The formula of caustic soda. [KOH/Ca(OH)./NaOH]

**Ans**. NaOH

The ideal method to separate iodine and KCI. [sublimation/ evaporation/distillation]

**Ans.** sublimation

A homogenous mixture, [brass/dust in air/chalk and water]

**Ans.** brass

**3. Match the ideal method of separation of components in a mixture in List I with the – appropriate process in List II.**

| List I | List II |
|---|---|
| 1. Sand from a mixture of sand and water | A : Separating funnel |
| 2. Kerosene from a mixture of kerosene water | B : Sublimation |
| 3. Alcohol from a mixture of methyl alcohol and water | C : Filtration |
| 4. Naphthalene from a mixture of naphthalene and lead chloride | D : Distillation |
| 5. Pure water from impure water | E : Fractional distillation |

**Answer:**

| List I | List II |
|---|---|
| 1. Sand from a mixture of sand and water | C : Filtration |
| 2. Kerosene from a mixture of kerosene and water | A : Separating funnel |
| 3. Alcohol from a mixture of methyl alcohol and water | E : Fractional distillation |
| 4. Naphthalene from a mixture of naphthalene and lead chloride | B : Sublimation |
| 5. Pure water from impure water | D : Distillation |

**4. Give reasons for the following statements :**

**Question 1.**
If fractional distillation is carried out using a liquid-liquid mixture, one liquid will remain in the flask and the other will be collected in the receiver.

**Answer:**
The vapours of the higher boiling point components to condense, thereby only the lower boiling point component enters the condenser and is collected in the receiver.

**Question 2.**
Evaporation of a common salt solution or sea water, leaves behind common salt inside the evaporating dish after heating.

**Answer:**
The liquid component is lost to the atmosphere on heating the mixture in an evaporating dish.

**Question 3.**
Components in a mixture are present in varying proportions and not in a fixed proportion.

**Answer:**
A mixture is an impure substance containing more than one element or compound, mechanically mixed together in any proportion and the mixture retains the properties of its constituents i.e. elements or compounds.

**Question 4.**
Gunpowder is an example of a heterogenous mixture.

**Answer:**
Because Gun powder is produced by mixing two or more substances in any proportion by weight.

**Question 5.**
In chromatography the absorbent medium e.g. What man filter paper is known as the – stationary phase.

**Answer:**
Chromatography is a method by which the various components of a mixture e.g. dyes in an ink. What man filter paper is known as the stationary phase because it act as a substance that stays fixed inside the column.

**5. Name the following:**

The non-sublimable solid from a mixture of iodine and potassium nitrate.

**Ans.** Potassium nitrate.

The heavier liquid component from – mercury and water.

**Ans.** Mercury.

The lower boiling point component from methyl alcohol and water.

**Ans.** Methyl alcohol.

The compound containing one atom of sulphur and two atoms of oxygen.

**Ans.** Sulphur dioxide.

An acid whose formula is '$H_2C0_3$'.

**Ans.** Carbonic acid