

## Chapter 3. Elements, Compounds and Mixtures

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### Solution 1:

- 1. Elements:** An element is a pure substance which can neither be broken down into simpler substances nor formed from two or more simpler substances by any known physical or chemical process. It is made of only one kind of atoms. It can be divided into four main categories
  1. Metals-Iron, magnesium
  2. Non-metals-Hydrogen, oxygen
  3. Metalloids-Arsenic, antimony
  4. Noble gas-Helium, neon
- 2. Compound:** A compound is a pure substance that is composed of two or more elements chemically combined in definite proportion by mass. The physical and chemical properties of a compound are different from those of its constituent elements. Hydrogen gas is combustible and oxygen is supporter of combustion, their compound water which is liquid is neither combustible nor a supporter of combustion.
- 3. Mixture:** Mixture is a physical combination of two or more substances, whether elements or compounds, which are mixed in any proportion by mass and retain their original properties even after mixing.

Homogeneous mixture: They have same composition and the same properties throughout their entire mass. Example- Salt solution, alloys etc.

Heterogeneous mixture: They have different composition and different properties in different parts of their mass. Example-Mixture of sand and salt, mixture of iron fillings and sulphur etc.

### Solution 2:

1. Oxygen
2. Carbon, hydrogen, Oxygen
3. Mercury, Bromine
4.
  1. Helium
  2. Oxygen
5. Gallium, caesium
6. Two noble gases are-
7. Helium
8. Argon

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### Solution 3:

Air is a mixture because-

1. The composition of air is not fixed i.e. the components may be present in any proportion by mass.
2. Components of air i.e. nitrogen, oxygen etc. do not react with each other.

#### Solution 4:

Elements – Lead, Mercury, Sodium  
Mixtures – Air, petrol, ink, gunpowder  
Compounds – Common salt, alcohol, sand

#### Solution 5:

**Pure substance** – A pure substance is one which is made up of only one kind of particles. These particles may be atoms or molecules.

Example-Sulphur, water.

**Impure substance** – They are mixtures of two or more chemically different substances mixed in indefinite proportions. The constituent substances retain their properties in the mixture.

Example-Mixture of salt and sand, gunpowder

#### Solution 6:

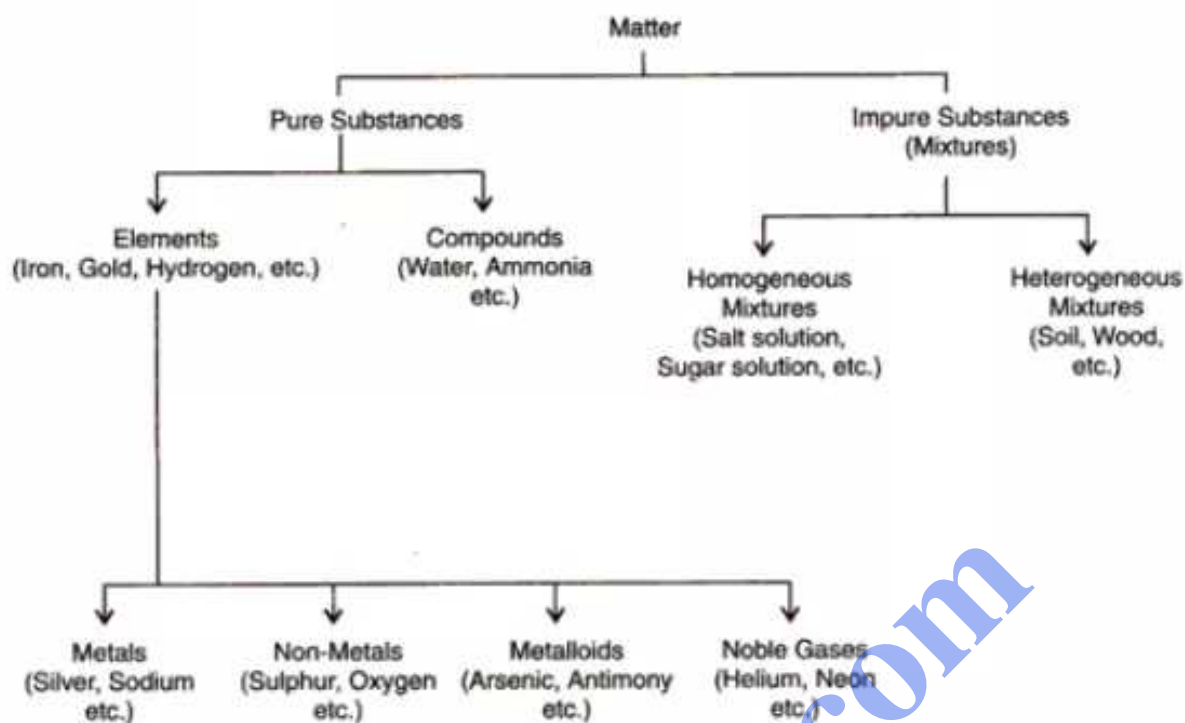
Mercury is the metal which is liquid at room temperature and bromine is the non-metal which is liquid at room temperature.

#### Solution 7:

<i>Mixture</i>	<i>Compound</i>
1. Mixtures can be homogeneous or heterogeneous. They are mostly heterogeneous except in solutions which are homogeneous.	1. A compound is always homogeneous.
2. The constituents of a mixture may be present in varying proportions.	2. The constituents of a compound are present in a definite proportion by mass.
3. Properties are an average of those of its constituents.	3. Properties of a compound are different from those of its constituents.
4. The various constituents can be separated by simple physical means.	4. The various constituents cannot be separated by simple physical means.
5. No energy change takes place in the formation of a mixture.	5. Generally, energy in the form of heat, light or electricity is either evolved or absorbed in the formation of a compound.
6. A mixture has no definite melting point or boiling point.	6. A compound generally has a definite fixed melting point or boiling point.
7. The constituents of a mixture are not chemically bound to each other.	7. The constituents of a compound are chemically bound to each other.

**Solution 8:**

The schematic representation of different types of matter is given below:

**Solution 9:**

Two reasons for believing that copper is a metal and sulphur is a non-metal are:-

1. Copper is malleable and ductile while sulphur is neither malleable nor ductile.
2. Copper is a good conductor of heat while sulphur is not good conductor of heat.

**Solution 10:**

Metalloids – The elements which possess properties intermediate between those of the metals and non-metals are called as metalloids. They react with both acids and alkali's to form salts.

Ex – Arsenic, antimony

**Solution 11:**

Graphite is a non-metal which is a good conductor of electricity.

**Solution 12:**

Properties	Metals	Non-metals
(a)Malleability	They are malleable i.e. they can be beaten into fine sheets.	They are not malleable
(b)Ductility	They are ductile i.e. they can be drawn into wires.	They are not ductile, they are usually brittle in nature.
(c)Conductivity	Good conductor of heat and electricity.	Bad conductor of heat and electricity.

**Solution 13:**

Mixture is the general name of the materials which contain atleast two pure substances and show the properties of their constituents.

**Solution 14:**

1. Sodium
2. Bromine
3. Arsenic
4. Radon
5. Mercury
6. Oxalic acid
7. Carbon dioxide

**Solution 15:**

S.N.	Element	Compound
1.	An element cannot be broken into simpler substances by any physical or chemical process.	Compound is composed of two or more elements chemically combined in definite proportion by mass.
2.	Elements have their own fixed physical and chemical properties.	Physical and chemical properties of a compound are different from those of its constituent elements.
3.	An atom is the smallest particle of an element taking part in a chemical reaction.	A compound cannot be separated into its constituents by simple mechanical means.

**Solution 16:**

1. simpler substances
2. atomic
3. same
4. mixture of salt and water
5. two

**Solution 17:**

Names of two other mixtures which contain elements only are-

1. Bronze
2. Duralumin

**Solution 18:**

1. A Molecule – The smallest particle of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms.
2. Atomicity – Atomicity of an element is defined as the number of atoms present in one molecule of that element.

**Solution 19:**

Since, the constituents of a mixtures may be present in varying proportions so it cannot be expressed by a fixed chemical formula.

**Solution 20:**

1. Air
2. Cement
3. Milk Sugar solution

**Solution 21:**

If a mixture of powdered iron and sulphur is heated in a test tube, a black shiny compound iron(II) sulphide (FeS) is formed.

**Solution 22:**

1. Tungsten, Mercury
2. Graphite, Iodine

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**Solution 23:**

Type	Homogeneous/Heterogeneous	Examples
1. Solid-solid mixture	Homogeneous	Alloys, e.g., brass (zinc + copper), Bronze (Zinc + tin + copper).
	Heterogeneous	Sand + common salt; iron + sulphur; Charcoal + sulphur + nitre (gun powder).
2. Solid-liquid mixture (solid in liquid)	Homogeneous	Salt + water; sugar + water; sulphur + carbon disulphide.
	Heterogeneous	Mud + water, sand + water.
3. Liquid-solid mixture (liquid in solid)	Homogeneous	Amalgamated zinc which is a mixture of mercury in zinc.
4. Liquid-liquid mixture	Homogeneous	Alcohol + water, diesel + petrol.
	Heterogeneous	Water + oil, petrol + water.
5. Gas-liquid mixture	Homogeneous	Carbon dioxide + water
		Ammonia + water.
6. Gas in gas	Homogeneous	Air (mixture of oxygen, nitrogen and carbon dioxide).

**Solution 24:**

1. **Chromatography** – The chromatography is a technique of separating pure substances from the mixture.

Advantages of chromatography –

1. It requires a very small amount of the substance or sample.
2. The components retain their individuality during the process.
3. Chromatography finds application in easy separation of substances with similar physical and chemical properties.

- 2. Filtration** – It is a separation technique for separating a mixture in which one component should be solid and insoluble in the other liquid component.  
Example- Barium sulphate in water.
- 3. Fractional distillation** – It is a technique used to separate two liquids which dissolve in one another. The separation relies on the differences in boiling points of the two liquids.  
No, mixture of chloroform and water cannot be separated by this method.
- 4. Centrifugation** – It is a method for separating the suspended particles of a substance from a liquid in which the mixture is rotated at a high speed in centrifuge machine.  
Application – The clay particles in water (which are very fine) can be separated by centrifugation.

#### **Solution 25:**

1. The vapour state which is obtained by heating solid without passing through liquid state is called sublimate.
2. A liquid condensed from vapour in distillation is called distillate.
3. The liquid produced after filtering a suspension of a solid in a liquid is called filtrate.
4. Supernatant liquid is the upper layer of fluid found after a mixture has been centrifuged.
5. If there is a heterogeneous mixture containing an insoluble solid in a liquid, then the solid substance that settle down is called sediment.

#### **Solution 26:**

We use **fractional distillation** to separate alcohol from a mixture of alcohol and water since the difference in boiling point between alcohol and mixture is very less.

#### **Solution 27:**

1. We obtain pure water from sea water by distillation.
2. A sample of pure iodine and sodium chloride is obtained by sublimation.

#### **Solution 28:**

The separation of the mixture depends upon-

1. Size of the constituents
2. Magnetic properties of constituents
3. Mass of the constituents
4. Solubility of the constituents
5. Miscibilities of the constituents
6. Boiling point of the constituents
7. Diffusion rate of the constituents

#### **Solution 29:**

This is a separation technique of solid-solid mixture. This method involves the use of a solvent in which only one of the solid present in the mixture dissolves. Undissolved solid is removed by filtration. Mixture of ammonium chloride and silver chloride is separated by this method.

#### **Solution 30:**

1. By distillation and fractional distillation we separate the mixture of two liquids.
2. Yes, mixture of chloroform (B.P.= 61 °C) and carbon tetrachloride (B.P.=77 °C) be satisfactorily separated by the process of fractional distillation which is used for separating the various fractions of petroleum.  
For this purpose we will make two fractionating columns in the apparatus.

### **Solution 31:**

1. Solid-solid mixtures
  1. Magnetic separation method-Separation of iron ore from impurities
  2. Gravity separation-Mixture of saw dust and sand
  3. Solvent extraction-Mixture of sulphur and sand
2. Solid- liquid mixtures
  1. Evaporation-Water and sodium chloride
  2. Distillation-Iodine in chloroform
  3. Filtration-Barium sulphate in water
3. Liquid-liquid mixtures
  1. By separating funnel-Oil and water mixture
  2. Distillation-Acetone and water
  3. Fractional distillation-Ethyl alcohol and water

### **Solution 32:**

The chromatography is the technique of separating pure substances from the mixtures. The chromatographic techniques was first employed by a Russian scientist Michael Tswett in 1903 for the separation of coloured substance from the mixture.

Principle of chromatography: The principle of chromatography is based on the difference in the extent of interaction (absorption) of various substances with a stationary phase and a mobile phase. A substance which interacts strongly with the mobile phase goes ahead of the other substance which interacts strongly with the stationary phase.

### **Solution 33:**

Ink generally contain more than one dye. This mixture of ink is used as moving phase. Different constituents of ink move at different speed. The solvent rises up the filter paper over the spot and carries the different coloured components of ink to different heights on the filter paper. Each spot thus obtained at a particular height on the filter paper contains a particular constituent of the ink. Thus, the components of the ink are separated.

### **Solution 34:**

By the help of fractional distillation we separate the components of liquid air.

### **Solution 35:**

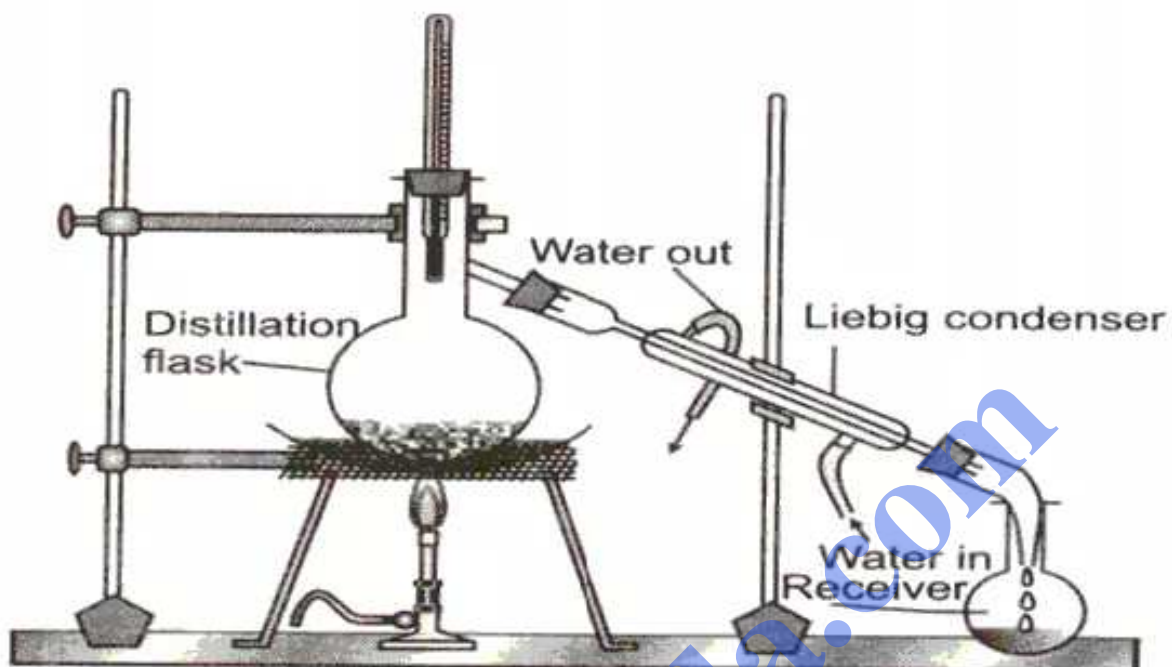
1. Increase in weight – Sulphuric acid and iron
2. Decrease in weight – Sodium carbonate crystals
3. No change in weight – Sodium chloride

### **Solution 36:**

By filtration, we will separate a mixture of chalk powder and water.

**Solution 37:**

Pure water is obtained by distillation from a salt water mixture. The apparatus we would use to obtain pure water from a salt water mixture is given below-

**Solution 38:**

Fractionating column avoid the collection of distillate and re-distillation of distillate several times during fractional distillation.

**Solution 39:**

Two pair of liquids which can be separated by using a separating funnel-

1. Oil and water
2. Chloroform and water

**Solution 40:**

At first, with the help of magnet, iron nails will separate. Then, by sublimation camphor will separate from common salt.



**Solution 41:**

(a)

S.No.	Decantation	Filtration
1.	This method is used to separate a heterogeneous mixture containing an insoluble solid in a liquid.	This method is used when a light, suspended insoluble solid has to be recovered from the solid in a liquid.
2.	In this process, the supernatant liquid obtained on the sedimentation of a solid is poured out carefully, leaving the solid behind. Example-Mixture of water and oil is separated by the process of decantation.	This is the process of separating a mixture containing an insoluble solid component in the liquid component by passing it through a porous medium. Example-Barium sulphate is insoluble in water, so separation of Barium sulphate from water is done by filtration

(b)

S.No.	Filtrate	Distillate
1.	The liquid collected after filtration is called as filtrate.	The liquid that has been condensed from vapour during distillation is called as distillate. It is a purified form or a fraction of an original liquid.
2.	Example-When separation of mixture of Barium sulphate and water occurs. Pure water obtained is called as filtrate.	Example-In distillation of mixture of alcohol and water, alcohol is obtained as distillate.

(c)

S.N.	Fractional distillation	Fractional crystallization
1.	This method is based upon the difference in boiling points of the components of the liquid-liquid mixture.	This method is based upon the difference in the solubilities of the two components of a solid - solid mixture in a particular solvent.
2.	Example-Crude petroleum is fractionally distilled to get various fractions such as natural gas, naphtha, paraffin, kerosene, diesel oil, lubricating oil, etc.	Example-Potassium chloride crystallises out first from a hot saturated solution of potassium chloride and sodium nitrate in water.

(d)

S.N.	Metal	Metalloid
1.	Metals are monoatomic and generally hard solids.	These are the elements which possess properties intermediate between those of the metals and non-metals.
2.	Metals possess metallic lustre. They are malleable, ductile and possess high tensile strength. Example: zinc, silver, gold etc.	Metalloids do not have lustre. They are neither malleable nor ductile. Example-Germanium, Bismuth, Arsenic, Antimony etc.

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**Solution 42:**

1. When a magnet is moved over 'X', iron fillings are pulled away and stick to the magnet. When a magnet is moved over 'Y', it remained unaffected.
2. When 'X' is treated with carbon disulphide, sulphur dissolves but not iron. While, when 'Y' is treated with carbon disulphide, iron sulphide does not dissolve but sinks to the bottom of the test tube.
3. When 'X' is treated with dilute HCl, a colourless, odourless gas hydrogen is evolved which burns with a blue flame and is extinguished with a pop sound. While, when 'Y' is treated with dilute HCl, a colourless gas with the smell of rotten eggs is evolved which is H<sub>2</sub>S.

There is difference in the behavior of 'X' and 'Y' because 'X' is a mixture while 'Y' is a compound. The component of a mixture do not react chemically, so retain their identity in the mixture while the components of compound react chemically, so do not retain their identity in the compound.

**Solution 43:**

Centrifugation is used in milk dairies to separate cream from milk dairies.