Elements, Compounds and Mixtures

Points to Remember:

- Every substance is made up of very tiny particles, called molecules. Molecules are formed from even smaller particles called atoms.
- **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.
- Based on their properties, elements are classified into: metals, non-metals, metalloids, noble gases.
- Metals are ductile, malleable, good conductors of heat and electricity, high melting and boiling points. Metals are sonorous, e.g., Iron, Gold, Silver, etc.
- 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.
- **Metalloids—** These elements show properties of both metals and non-metals. They are hard solids, e.g. Boron, Silicon, Arsenic.
- **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.
- **Symbols of Elements—** Each element is denoted by a symbol usually to first letter.
  Examples: Oxygen by O, Hydrogen by H.
- **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.
- **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.
- **Atomicity—** The number of atoms of an element that join together to form a molecule of that element is known as the atomicity.
- **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 3(A)

Question 1.
Define: (a) Elements (b) Compounds
Answer:
(a) Elements: Element is a substance which cannot be broken further into simpler substances and has a definite set of properties. Elements are made up of only one kind of atoms.
(b) Compounds: Compounds are pure substances composed of two or more elements in definite proportion by mass and has properties, entirely different from those of its constituents elements.
Compound, are made up of different types of atoms combined chemically.

Question 2.
Give two examples for each of the following:
(a) Metals (b) Non-metals
(c) Metalloids (d) Inert gases
Answer:
(a) Metals: Iron, silver, gold.
(b) Non-metals: Carbon, sulphur, oxygen.
(c) Metalloids: Antimony, silicon, boron.
(d) Inert gases: Helium, argon, neon.

Question 3.
Differentiate between:
(a) Pure and impure substances
(b) Homogenous and heterogenous substances
Answer:
(a) Pure substances —

1. Pure substances have definite composition and definite physical and chemical properties.
2. They are all homogeneous i.e. their composition is uniform throughout the bulk.
3. Examples: Elements and compounds.

Impure substances —

1. Impure substances are made up of two or more pure substances mixed together in any proportion.
2. They may be homogeneous or hetergeneous i.e. their composition is not uniform throughout the bulk.
3. They are all mixtures.
   Examples: air, sea water, petroleum, a solution of sugar in water are all impure substances.

(b) Homogeneous mixture — is a mixture where the components that make up the mixture are uniformly distributed throughout the mixture.
Example — air, sugar water, rain water.
Heterogeneous mixture — is a mixture, where the components of the mixture are not uniform or have localized regios with different properties.
Example—Cereal in milk, vegetable soup.

Question 4.
Write the chemical name of the following and also give their molecular formulae:
(a) Baking soda (b) Vinegar
(c) Marble (d) Sand
Answer:
(a) Sodium bicarbonate (Baking soda) — $NaHCO_3$
(b) Acetic acid (Vinegar) — CH_3COOH
(c) Calcium carbonate (Marble) — $CaCO_3$
(d) Silicon dioxide (Sand) — SiO_2

Question 5.
Name:
(a) a soft metal
(b) a metal which is brittle
(c) a non-metal which is lustrous
(d) a liquid metal
(e) a metal which is a poor conductor of electricity.
(f) a non-metal which is a good conductor of electricity.
(g) a liquid non-metal
(h) the hardest naturally occurring substance
(i) an inert gas
Answer:
(a) Gold
(b) Zinc
(c) Iodine
(d) Mercury
(e) Tungsten
(f) Graphite
(g) Bromine
(h) Diamond
(i) Neon, helium

Question 6.
How is sodium chloride different from its constituent elements ?
Answer:
The properties of sodium chloride are completely different from those of sodium and chlorine. Sodium is a soft, highly reactive metal. Chlorine is a poisonous non-metallic

gas while sodium chloride is a very useful non poisonous compound which is added to our food to get minerals and also to add taste to it.

Question 7.
Why is iron sulphide a compound ?
Answer:
Iron sulphide is a compound which can be broken into the elements iron and sulphur they both have different properties. The properties of compound are entirely different from there of its constituents elements.

Exercise 3(B)

Question 1.
Classify the following substances into compounds and mixtures:
Answer:
Carbon dioxide, air, water, milk, common, salt, blood, fruit juice, iron sulphide.
Carbon dioxide — (Compound)
air — (Mixture)
water — (Compound)
milk — (Mixture)
common salt — (Compound)
blood — (Mixture)
fruit juice — (Mixture)
iron sulphide — (Compound)

Question 2.
Give one example for each of the following types of mixtures
(a) solid-solid homogenous mixture
(b) solid-liquid heterogenous mixture
(c) misicible liquids
(d) liquid-gas homogenous mixture
Answer:
(a) Solid-solid homogenous mixture — Alloys of metals e.g. brass, bronze stainless steel etc.
(b) Solid-liquid heterogenous mixture — Sand and water, mud and water, sugar and oil.
(c) Misicible liquids — water and ethanol.
(d) Liquid-gas homogenous mixture — Air

Question 3.
Suggest a suitable technique to separate the constituents of the following mixtures. Also give the reason for selecting the particular method.
(a) Salt from sea water
(b) Ammonium chloride from sand
(c) Chalk powder from water
(d) Iron from sulphur
(e) Water and alcohol

(f) Sodium chloride and potassium nitrate
(g) Calcium carbonate and sodium chloride
Answer:

(a) The technique used to separate the salt from seawater is **Evaporation.**
Reason – Because this method is used to separate the components of the homogeneous solid-liquid mixture. In this method, sea water is collected in a shallow bed and allowed to evaporate in the sun. When all the water is evaporated, salt is left behind. By this method, we only get solid and liquid is evaporated in its vapour form.

(b) Technique used to separate Ammonium chloride from sand is sublimation.
Because this method is used for solid mixtures in which one of the components can sublime on heating. In this method, Ammonium chloride changes into vapours on heating and salt is left behind.

(c) Technique used to separate chalk powder from water is filtration.
Reason – Because this process is used to separate the components of a heterogeneous solid-liquid mixture in which solids are lights and insoluble in liquids. Substances used as filters are sand filter paper at C. These filters allows the liquid to pass through them, but not solids.

(d) Technique to separate iron from sulpher is magnetic separation.
Because, this method is used when one of the component of mixture is Iron. Iron gets attracted towards the magnet and hence get separated.

(e) Technique used to separate water and Alcohol is Fractional Distillation.
Because in this method, the vapours of water is left behind in the original vessel as the alcohol boils at lower temperature than water. Thus these two liquids can be separated.

(f) Technique used is Fractional-crystallisation.
Because: This method is used when solubility of solid components of mixture and different in the same solvent. Here, sodium chloride and potassium nitrate. Both are soluble in water but solubility of potassium nitrate is more.

(g) Technique used is Solvent Extraction Method: Because, by this method, salts get dissolve in water while calcium carbonate being insoluble in water settles down in the container. And hence get separated about.

Question 4.
(a) Define mixture.
(b) Why is it necessary to separate the constituents of a mixture.
(c) State four differences between compounds and mixtures.
Answer:

(a) “Mixtures can be defined as. a kind of matter which is formed by mixing two or more pure substances (elements and compounds) in any proportion, such that they do not undergo any chemical change and retain their individual properties. Therefore they are impure substances.

(b) Because: The mixtures contain unwanted substances which may be harmful and may degrade the properties of mixtures. So we, need to separated them and extract useful substances.

This is necessary because

(i) It removes unwanted and harmful substances
(ii) to obtain pure and useful substances them.
Example: Sea water is rich in common salt which is an important ingredient of our food to add taste and nutrients. But sea water, cannot be directly used to get the salt.
Hence, it is necessary to separate both.

(c) Compound

1. A compound is formed from its constituent elements as a result of chemical reaction.
2. A compound is always homogeneous in nature.
3. In a compound the elements are present in a fixed ratio by weight.
4. The components of a compound can’t be separated by physical methods but can be separated by chemical methods only.
5. The properties of a compound are different from those of its elements.
6. The formation of a compound from its elements is accompanied by energy changes.

Mixture

1. A mixture is obtained form its (elements, compounds) components as a result of physical change.
2. The mixtures can be homogeneous or heterogeneous.
3. In a mixture the components can be present in any ratio.
4. The components of a mixture can be separated by physical methods only.
5. The properties of a mixture lie between those of-its components.
6. The formation of a mixture from its constituents is not accompanied by energy changes.

Question 5.
(a) What is chromatography ? For which type of mixture is it used ?
(b) What are the advantages of chromatography.
Answer:
(a) This is one of the latest techniques to separate the coloured components of a mixture when all the components are very similar in their properties. Example: Components of ink are separated by this method. Ink is a mixture of different dyes,

which are separated by chromatography because some of the dyes are less soluble and some are more soluble in a solvent.

(b)

1. A very small quantity of the substance can be separated.
2. Components with very similar physical and chemical properties can be separated.
3. It identifies the different constitutes of a mixture.
4. It also helps in quantitive estimation of components of a mixture.

6. Choose the most appropriate answer from the options given below:

(a) a mixture of sand and ammonium chloride can be separated by

1. filtration
2. distillation
3. **sublimation**
4. crystallisation

(b) A pair of metalloids are

1. Na and Mg
2. **B and Si**
3. C and P
4. HeandAr

(c) Which of the following property is not shown by compounds?

1. **They are heterogeneous.**
2. They are homogeneous.
3. They have definite molecular formulae.
4. They have fixed melting and boiling points.

(d) A solvent of Iodine is

1. Water
2. Kerosene oil
3. **Alcohol**
4. Petrol

(e) Which of the gas is highly soluble in water ?

1. **Ammonia**
2. Nitrogen
3. Carbon monoxide
4. Oxygen

ADDITIONAL QUESTIONS

Check Your Progress 1

Fill in the blanks.

1. A pure substance has definite **composition** and constant **properties.**
2. Mixtures can be **heterogeneous** or **homogenous.**
3. Use of a **sieve** to separate the components of a mixture of solids is based on the difference in the size of the components.
4. **Winnowing** is used when the constituents of a mixture of solids have difference in their weights.
5. Iodine, camphor, naphthalene, ammonium chloride and dry ice are some substances that **sublimate.**

Check Your Progress 2

Question 1.
Filtraction is a method used to separate fine particles of …….. solid from a liquid.
Answer:
Filtraction is a method used to separate fine particles of **insoluble** solid from a liquid.

Question 2.
Loading is basically speeding up ……
Answer:
Loading is basically speeding up **sedimentation.**

Question 3.
Name the techniques used to separate a solid from its solution.
Answer:
Sedimentation and Decantation

Question 4.
A separating funnel can be used for separating a mixture of immiscible liquids. True or false ?
Answer:
True

Question 5.
During centrifugation, solid particles of the mixture move towards the bottom. True or false ?
Answer:
True

EXERCISES

Tick the most appropriate answer.

1. The constituents of a mixture are present in

1. a fixed ratio
2. **a variable ratio,**
3. the ratio of 2: 1
4. none of these

2. Solutions are

1. heterogeneous mixtures.
2. compounds
3. **homogeneous mixtures.**
4. elements.

3. The methods of separating components of a given mixture are based on the

1. **physical properties and state of the components.**
2. colour of the components only.
3. state of the components.
4. none of these.

4. Winnowing is the method used to separate

1. **chaff from grain.**
2. stones from rice
3. oil from water
4. salt from sand

5. During filtration the substance left behind on the filter paper is called

1. distillate
2. filtrate
3. sublimate.
4. **residue.**

6. Loading is a process in which

1. **impurities become heavy and sink to the bottom.**
2. impurities float on the top.
3. impurities vaporize.
4. none of these

7. Fractional distillation is used to separate liquids having an appreciable difference in their

1. size and shape
2. solubility
3. **boiling points.**
4. none of these

8. The different constituents of an ink are separated by

1. handpicking.
2. **paper chromatography**
3. filtration.
4. magnetic separation.

B. Fill in the blanks.

1. A **pure** substance has only one kind of matter.
2. The composition and properties of a **homogenous** mixture is uniform throughout.
3. An **alloy** is a homogeneous mixture of two or more metals.
4. Chalk powder dissolved in water is an example of a Chalk powder dissolved in water is an example of a **suspension.**
5. An **emulsion** is formed when one liquid is dispersed as tiny droplets throughout another liquid
6. Immiscible liquids are separated by using a **separating funnel.**

C. Write true or false for each statement. Rewrite the false statements correctly.

Question 1.
All pure substances have characteristic melting and boiling points.
Answer:
True

Question 2.
Milk is an emulsion.
Answer:
True

Question 3.
A heterogeneous mixture has a uniform composition throughout the mixture.
Answer:
False. A heterogeneous mixture has a non-uniform composition throught the mixture.

Question 4.
The constituents of a mixture can only be separated by chemical means.
Answer:
False. The constituents of a mixture can be separated by chemical means and physical means.

Question 5.
Handpicking can be used as a separation technique if the particle size of the constituents of the mixture is the same.
Answer:
False. Handpicking can be used as a separation technique if the particle size of the constituents of the mixture is the not the same.

D. Match the columns.

1. to separate grain from chaff	**a. filtration**
2. to separate sawdust from water	**b. sedimentation and decantation**
3. to separate iodine from sodium chloride	**c. winnowing**
4. to separate iron fillings from sand	**d. sublimation**
5. it is used to separate sand and water	**e. magnetic separation**
	f. handpicking

Ans.

1. to separate grain from chaff	c. winnowing
2. to separate sawdust from water	a. filtration
3. to separate iodine from sodium chloride	d. sublimation
4. to separate iron fillings from sand	e. magnetic separation
5. it is used to separate sand and water	b. sedimentation and decantation

E. Differentiate between the following.

1. solution and suspension
2. Supernatant liquid and Fill rate
3. Filter Paper and Alum

Answer:

1. Solution and Suspension
Solution

1. It is an example of homogeneous mixture.
2. It is formed when a solid dissolves in liquid.
3. For example – sugar dissolved in water.

Suspension

1. It is an example of heterogeneous mixture.
2. It is formed when an insoluble solid is added to solvent.
3. For example-chalk dissolved in water.

2. Supernatant liquid and Fill rate

Supernatant liquid

1. It is obtained during sedimentation.
2. It is used to separate mixture of liquid and insoluble solid heavier than liquid.
3. No filter paper is used.

Filtrate

1. It is obtained during filtration.
2. It is used to separate fine particles of insoluble solids from liquids.
3. filter paper is used.

3. Filter Paper and Alum

Filter Paper

1. It is a special paper fitted in funnel during filtration.
2. It does not dissolve in water.
3. It does not speeds up-loading.

Alum

1. It is a solid which is used to load suspended mud particles in watei.
2. It dissolves easily in water.
3. It speeds up loading

Write short answers.

Question 1.
Is food that we eat a mixture ?
Answer:
Yes food that we eat is a mixture of carbohydrates, proteins, fats, minerals and vitamins.

Question 2.
Name two methods by which solid-solid mixtures can be separated.

Answer:
(i) Winnowing (ii) Hand Picking

Question 3.
How can you separate iron metal from non-magnetic impurities ?
Answer:
We can separate iron metal from non-magnetic impurities by the method of magnetic separation.

Question 4.
Name the technique that you use if only the solid component of a solution is required.
Answer:
Evaporation.

Question 5.
Name the substance you will add to speed up sedimentation.
Answer:
Alum

Question 6.
Name the different types of chromatographic techniques.
Answer:

1. Paper Chromatography
2. Column Chromatography
3. Thin Layer Chromatography
4. Gas Chromatography.

Answer in detail.

Question 1.
What is the difference between a pure substance and a mixture ?
Answer:
A pure substance consists of only one kind of matter, that is. all the particles are same. It has a definite composition and constant properties. It cannot be split into simpler substances by physical meAll pure substances have characteristic melting and boiling points. A pure substance is either a compound or an element.

A Mixture contains two or more substances in any proportion which can be separated by physical methods. Mixtures are generally of two types:
Homogeneous and Heterogeneous.
In a mixture, the constituents can be present in any ratio. They do not have characteristic melting and boiling points. In a mixture each constituent retain its original properties. These can be separated by physical means.

Question 2.
What are the different types of mixtures ?
Answer:
Mixtures are basically of two types:
(i) Homogeneous (ii) Heterogeneous
Homogeneous Mixtures: The composition of these mixtures is uniform throughout the mixture. Besides the properties of the mixture are the same in all the parts of the mixture, e.g. sugar dissolved in water.
Heterogeneous Mixtures: A heterogenous mixture composition is not uniform throughout the mixture. The properties of the mixture are different in different parts of mixture e.g. chalk dissolved in water.

Question 3.
Why is filtration a better technique than sedimentation and decantation ?
Answer:
Filtration is a better technique than sedimentation and decantation because it can separate very Fine insoluble particles as compared to the latter. Besides the filtrate obtained is generally pure solvent. In decantation when we pour out supernatant liquid there are chances of their getting mixed up with solute particles.

Question 4.
How is distillation method different from evaporation?
Answer:
In distillation and evaporation both the solution is allowed to boil by giving heat. Evaporation does not involves the collection of vapour thus obtained.Distillation involves the condensation of the vapour obtained to obtain pure solvent. This is done in specially designed condensation chamber.

Question 5.
What is centrifugation ? Also write the principle on which it works.
Answer:
Centrifugation: It is a technique used to speed up sedimentation of fine particles suspended in a solid liquid mixture.
Principle: The principle of centrifugation is that an object, when spun at high speed, experiences an outward force away from the centre of rotation.