Chapter 3

Elements, Compounds and Mixtures

Chapter Objectives

In this chapter, you will learn about:

- Elements
- The properties of elements
- The elements and their symbols
- The compounds and their characteristics
- The molecular formula of elements and compounds
- The method of writing molecular formulae of compounds
- Separation of mixtures

We read about pure substances in our previous classes. What are pure substances? How can we classify them?

INTRODUCTION

We know that all materials in the universe are made of matter. For example, sugar, salt, water are all made up of matter. Matter occupies space and has mass.

PURE AND IMPURE SUBSTANCES

We have learned in our previous classes that matter is classified into pure and impure substances. *A pure substance is made up of the same kind of matter, that is, it has same kind of particles throughout their structure.* Examples of pure substances include oxygen, hydrogen, copper and silver. The composition of a pure substance is fixed. On the other hand, *an impure substance may be a mixture of elements, a mixture of compounds; or a mixture of both compounds and elements.* The composition of a mixture may vary.

Mixture is made up of two or more kinds of substances in any proportion. Mixtures are classified into two groups—homogeneous and heterogeneous. Pure substances are classified into elements and compounds.

Elements

An element is a pure substance which is made up of only one kind of particles. They cannot be broken into two or more simpler substances by physical or chemical means. Antoine Lavoisier was the first to use modern names for elements.

Characteristics of elements

- An element is made up of only one kind of particles called atoms. For example, iron and copper are made up of only iron and copper atoms, respectively.
- Atoms of an element cannot be broken down by any physical or chemical means.
- Boiling point and melting point of an element are fixed. For example, the melting point of copper is 1083 °C.

Classification of Elements

Based on the physical and chemical properties, elements are classified into metals, non-metals, metalloids and inert or noble gases.

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There are currently a total of 118 known elements. Out of these, around 90 elements exist naturally on the Earth.

REPRESENTATION OF ELEMENTS

At present, more than hundred elements are known. Scientists use notations to name the elements. The elements are, thus, represented by their respective symbols for their simple representation. *Symbols are abbreviations of the name of the element with one or two letters of its name.*

Earlier, scientists and alchemists used picture symbols to represent elements.

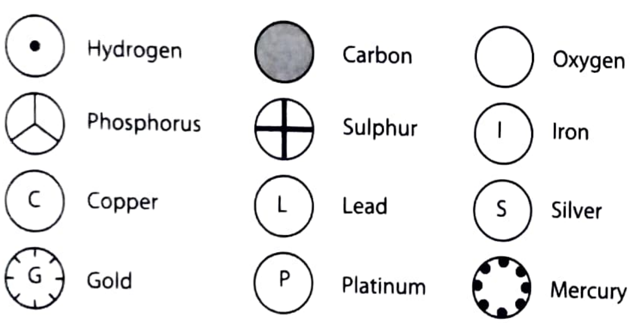

Fig. 3.1 Symbols for some elements as proposed by Dalton

In 1807, John Dalton was the first scientist to use symbols to represent elements in a short way. Dalton's symbols for an **atom** represented the element as well as one atom of that element. However, this system was not very useful as it was difficult to remember the symbols.

The Swedish chemist, J. J. Berzelius introduced the modern system of denoting the elements by their symbols. He used one or two letters from the name of the elements to denote as symbols.

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John Dalton (1766-1844) was an English chemist, physicist and meteorologist, best known for his ground-breaking work in the development of modern atomic theory. In 1807, he suggested that all matter is composed of its own kind of atoms. He also suggested that atoms of the same element are identical in shape, size, mass and other properties.

In the beginning, the names of elements were derived from the name of the place where they were found for the first time. For example, the name copper was taken from *Cyprus*. Some names were taken from specific colours. For example, gold was taken from the English word, meaning yellow.

Many of the symbols of the elements are the first one or two letters of the element's name in English, (Table 3.1). The first letter of a symbol is always written as a capital letter (uppercase) and the second as a small letter (lowercase).

Symbols of some elements have been taken from the names of elements in Latin or other languages like German or Greek. For example, symbol of iron is Fe which is derived from its Latin name *Ferrum*, the symbol of sodium is Na derived from its Latin name *Natrium*, symbol of potassium is K derived from its Latin name *Kalium*. Therefore, each element has a name and a unique chemical symbol. Table 3.2 shows symbols of some elements that are derived from their Latin names.

Notation: A technical system of symbols used to represent special things

Table 3.1 Symbols and names of some elements

Element	Symbol	Element	Symbol	Element	Symbol
Hydrogen	H	Sodium	Na	Chromium	Cr
Helium	He	Magnesium	Mg	Manganese	Mn
Lithium	Li	Aluminium	Al	Iron	Fe
Beryllium	Be	Silicon	Si	Cobalt	Co
Boron	B	Phosphorus	P	Nickel	Ni
Carbon	C	Sulphur	S	Copper	Cu
Nitrogen	N	Chlorine	Cl	Zinc	Zn
Oxygen	O	Argon	Ar	Silver	Ag
Fluorine	F	Potassium	K	Gold	Au
Neon	Ne	Calcium	Ca	Mercury	Hg

Table 3.2 Symbols of some common metals derived from their Latin names

Element	Latin Name	Symbol
Sodium	*Natrium*	Na
Potassium	*Kalium*	K
Antimony	*Stibium*	Sb
Gold	*Aurum*	Au
Silver	*Argentum*	Ag
Iron	*Ferrum*	Fe
Lead	*Plumbum*	Pb
Mercury	*Hydrargyrum*	Hg
Tungsten	*Wolfram*	W
Copper	*Cuprum*	Cu
Tin	*Stannum*	Sn

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The most abundant element in the universe is hydrogen.

Names and symbols of some non-metals, metalloids and inert gases are discussed in tables 3.3, 3.4 and 3.5, respectively.

Table 3.3 Names and symbols of some non-metals

Name	Symbol
Hydrogen	H
Nitrogen	N
Carbon	C
Oxygen	O
Iodine	I
Sulphur	S

Table 3.4 Names and symbols of some metalloids

Name	Symbol
Silicon	Si
Arsenic	Ar
Germanium	Ge

Table 3.5 Names and symbols of some inert gases

Name	Symbol	Name	Symbol
Helium	He	Neon	Ne
Argon	Ar	Krypton	Kr
Xenon	Xe	Radon	Ra

IONS

An atom or a small group of atoms that has an electrical charge due to loss or gain of electrons is called an ion. An ion that consists of only one atom with a charge is called a **monoatomic** ion or simply an ion. For example, Na^+, K^+ are monoatomic ions because they are formed from only one atom of Na and K, respectively, with +ve charge. Similarly, calcium ion (Ca^{2+}), aluminium ion (Al^{3+}), oxide ion (O^{2-}), nitride (N^{3-}) are called monoatomic ions because they are formed from only one atom of calcium (Ca), aluminium (Al), oxygen (O) and nitrogen (N), respectively.

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The names of many polyatomic ions usually ends with '*ide*' or '*ate*'.

*An ion carrying a net positive charge is called **cation**, whereas the one carrying net negative charge is called **anion**.* Most metals tend to form cations and most non-metals tend to form anions.

Table 3.6 The names of some simple cations and anions are listed below.

Cation	Name	Anion	Name
H^+	Hydrogen	Cl^-	Chloride
Li^+	Lithium	S^{2-}	Sulphide
Na^+	Sodium	O^{2-}	Oxide
K^+	Potassium	H^-	Hydride
Ca^{2+}	Calcium	F^-	Fluoride
Cs^+	Cesium	Br^-	Bromide
Be^{2+}	Beryllium	I^-	Iodide
Mg^{2+}	Magnesium	IO_3^-	Iodate
Ba^{2+}	Barium	NO_3^-	Nitrate
Cu^+/Cu^{2+}	Copper	N^{3-}	Nitride
Fe^{2+}/Fe^{3+}	Iron	NO_2^-	Nitrite

The names of cations and anions of different elements are different. For example, the cation of an element is written by adding the word 'ion'. For example, cation of sodium will be sodium ion. Anions of elements mostly end with suffixes such as 'ate', 'ite', or 'ide'. For example, anions of sulphur are suphate, sulphite and sulphide.

Quick Check 1

Write the ions and their respective symbolic representation for the following:

1. Hydrogen	6. Nitrate
2. Calcium	7. Nitrite
3. Beryllium	8. Copper
4. Iodate	9. Iron
5. Iodide	10. Magnesium

COMPOUNDS

A compound is a substance that is formed when two or more elements are chemically bonded together. For example, CO_2 is a compound consisting of carbon and oxygen bonded chemically. The constituents of a compound are combined in a fixed ratio.

A compound is made up of two or more elements. The chemical properties of a compound are different from those of its constituent elements. A compound can be broken down into its constituent elements by chemical methods.

Representation of Compounds

*The **molecular** formula of a compound is the symbolic representation of its composition.* It gives us the information about the number of atoms of various elements present in one molecule of a compound. If we know the **symbols** and **valency** of various elements, then molecular formulae of different compounds can be written very easily.

There are certain rules to be followed while writing the molecular formula of a compound.

1. Write the symbols of the elements or ions that form the compound.
2. Write the valency of the element or charge of each ion below its symbol.
3. Lastly, interchange the valencies or charges of the combining atoms or ions and write them as subscripts.
4. If the valencies and charges are divisible by common factor, then divide and simplify the formula.
5. In case of charges, do not include +ve and –ve signs, exchange the numbers and then write them as subscripts.

By applying the above rules, the method of writing molecular formula of different compounds can be derived. Some of them are discussed here.

1. Na Cl, +1 −1, NaCl
2. Mg O, +2 −2, MgO
3. Pb NO_3, +2 −1, $Pb(NO_3)_2$

Chemical formula of polyatomic ions such as calcium hydroxide can be written by following the same rules, except that the formula of polyatomic ions is written within brackets before writing the subscript.

Chemical formula of polyatomic ions such as calcium hydroxide can be written as:

1. Write the names of the constituent elements of the compounds.

   Ca OH

2. Write their respective valencies below each element.

   Ca OH
   +2 − 1

3. Now interchange the valencies of the elements.

   Ca $(OH)_2$

4. Divide the valencies with a common factor, if there is any. In this case there is no common factor. Therefore, the formula is

   $Ca(OH)_2$

If the subscript of polyatomic ions is 1, then there is no need to include brackets.

Chemical formula of hydrogen sulphide	**Chemical formula of zinc sulphide**
Symbol H S	Symbol Zn S
Valency +1 −2	Valency +2 −2
Formula: $H_2S_1 = H_2S$	Formula: $Zn_2S_2 = ZnS$

Chemical formula of aluminium nitrate	**Chemical formula of ferrous sulphate**
Symbol Al NO_3	Symbol Fe SO_4
Valency +3 −1	Valency +2 −2
Formula: $Al_1(NO_3)_3 = Al(NO_3)_3$	Formula: $Fe_2(SO_4)_2 = FeSO_4$

Some more examples are:

1. Fe SO_4, +2 −2, $FeSO_4$
2. Ca CO_3, +2 −2, $CaCO_3$
3. Al PO_4, +3 −3, $AlPO_4$
4. Al OH, +3 −1, $Al(OH)_3$
5. NH_4 OH, +1 −1, NH_4OH
6. Ag I, +1 −1, AgI
7. Zn S, +2 −2, ZnS
8. Mn SO_3, +2 −2, $MnSO_3$
9. Al NO_3, +3 −1, $Al(NO_3)_3$
10. Fe SO_3, +3 −2, $Fe_2(SO)_3$
11. NH_4 HCO_3, +1 −1, NH_4HCO_3
12. H S, +1 −2, H_2S

SIGNIFICANCE OF MOLECULAR FORMULAE

1. The molecular formula of a compound represents one molecule of the compound.
2. It indicates the name of the compound.
   - The number of elements present in that compound.
   - The number of atoms of each element in that compound.

For example, sulphur dioxide is represented by the formula SO_2. The elements present in SO_2 are sulphur and oxygen. One molecule of sulphur dioxide contains one atom of sulphur and two atoms of oxygen.

Table 3.7 Some common compounds and the elements present in their formulae

Compound	Formula	Elements present	Symbols of elements	Number of atoms present in 1 molecule
Water	H_2O	Hydrogen, Oxygen	H, O	2,1
Potassium iodide	KI	Potassium, Iodine	K, I	1,1
Hydrochloric acid	HCl	Hydrogen, Chlorine	H, Cl	1,1
Sodium hydroxide	NaOH	Sodium, Oxygen, Hydrogen	Na, O, H	1, 1, 1
Magnesium oxide	MgO	Magnesium, Oxygen	Mg, O	1, 1
Nitric acid	HNO_3	Hydrogen, Nitrogen, Oxygen	H, N, O	1, 1, 3
Calcium carbonate	$CaCO_3$	Calcium, Carbon, Oxygen	Ca, C, O	1, 1, 3

MIXTURES

***Mixtures** are the substances that contain two or more substances mixed in indefinite proportions.* For example, air is a mixture of different gases, water vapours and dust particles. The constituent substances in a mixture are mixed physically and do not undergo any chemical change. Sugar dissolved in water, salt dissolved in water, lemonade, honey and milk are some examples of mixtures.

Table 3.8 Differences between mixtures and compounds

	Mixtures	Compounds
1.	Mixtures are made up of two or more elements or compounds mixed together.	Compounds are made up of two or more elements combined together chemically.
2.	The constituents of a mixture are combined in an indefinite ratio.	The constituents of a compound are combined in a definite ratio.
3.	Constituents of a mixture show their individual properties.	The properties of a compound are entirely different from its constituent elements.
4.	The components of a mixture can be separated by physical methods.	The components of a compound can be separated only by chemical methods.
5.	Salt and water, honey and milk are some examples of mixtures.	Rust, sodium chloride (salt) are some examples of compounds.

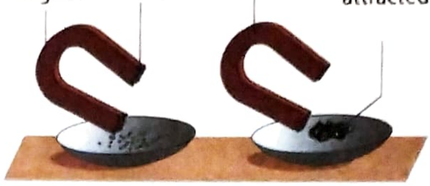
ACTION TIME 1

Aim: To show the differences between mixtures and compounds.

Materials required: iron filings, sulphur powder, test tubes, two watch glasses, Bunsen burner, magnet

Procedure: Take some iron filings and some sulphur powder on two watch glasses. Label watch glasses as A and B, and mix them gently. Transfer the mixture from watch glass B in a test tube and heat it over a Bunsen burner.

Observe what happens. Transfer the substance back from the test tube to the watch glass B carefully. Now, use a magnet and bring it closer to each watch glass (A and B) one by one. Observe.



Observations: On bringing the magnet closer to watch glass A, the iron filings are attracted towards the magnet. When mixture from watch glass B was heated, a compound called iron sulphide gets formed. On bringing the magnet closer to the compound on watch glass B, the iron sulphide on it remains as it is (the iron does not get attracted to the magnet).

Conclusion: A mixture can be separated using physical methods, whereas a compound cannot be separated using physical methods.

Types of Mixtures

Depending upon the composition of different mixtures, they can be categorised into homogeneous and heterogeneous mixtures.

Homogeneous mixture

A mixture in which the constituents are distributed uniformly and cannot be distinguished through the naked eye is called a ***homogeneous mixture****.* Mixture of salt and water, sugar and water, milk, air and blood are some examples of homogeneous mixtures.

- The mixture of salt and water, and sugar and water are examples of solutions. A **solution** is a homogeneous mixture in which constituents are mixed uniformly. The substance that is dissolved is called **solute**, and the substance in which the solute is dissolved is called **solvent**.

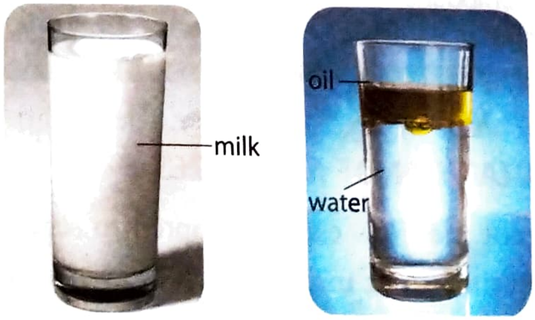
  In salt and water solution, salt is the solute and water is the solvent.

- An alloy is a homogeneous mixture of a metal with another metal or non-metal.

Heterogeneous mixture

A mixture in which the constituents are distributed non-uniformly and can be seen through naked eye is called a ***heterogeneous mixture****.* Oil in water, sand in water and iron filings in sulphur powder are some examples of heterogeneous mixtures.

- Sometimes a solute is not completely dissolved in a solvent. Such a mixture is called a **suspension**. Sand dissolved in water forms a suspension.
- Oil mixed in water and fats in milk are examples of emulsions. An **emulsion** is a heterogeneous mixture in which two immiscible liquids are mixed together.



a. Homogeneous mixture **b.** Heterogeneous mixture

Fig. 3.2 Types of mixtures

Depending upon the state of the constituents present (solute and solvent), mixtures can be categorised into different types. Some of them are discussed here.

- **Solid–solid mixtures:** In these mixtures, the solute and solvent are both solids. Alloys are examples of solid–solid mixtures. *An **alloy** is a mixture of two or more metals or non-metals in fixed ratio.* Brass is an example of an alloy made of zinc and copper.
- **Solid–liquid mixtures:** In these mixtures, the solute is a solid and the solvent is a liquid. Sugar in water is an example of such a mixture in which sugar (solid) is a solute and water (liquid) is a solvent.
- **Liquid–liquid mixtures:** In these mixtures, the solute and solvent are mixed together to form a mixture. Water (solute) in milk (solvent) is an example of liquid–liquid mixture.

Quick Check 2

State whether the following statements are True (T) or False (F).

1. Compounds can be easily separated into its constituents by physical processes. ....
2. Milk is an example of emulsion. ....
3. Salt in water is a heterogeneous mixture. ....
4. Sand in water is an example of homogeneous mixture. ....
5. Compounds are formed of the same type of particles. ....

SEPARATION OF MIXTURES

Different methods can be adopted to separate the constituents of mixtures such as evaporation, sedimentation, decantation, filtration, distillation, centrifugation and chromatography. Before we understand these methods, let us know the reasons behind the need to separate the mixtures.

We need to separate the mixtures:

- To separate the desired component from the other undesired components.
- To separate the pure form of a substance from the mixture.
- To separate the useful substance from the impurities.

Let us understand some techniques used to separate the constituents of a mixture.

Evaporation

*The process in which a liquid changes to its vapour form on heating is called **evaporation**.* Most solid–liquid mixtures are separated using this method. For example, salt can be obtained from solution of salt and water by evaporation.

Fig. 3.3 Evaporation

Distillation

*The process by which a pure substance is obtained from a mixture in a solution is called **distillation**.* This process is used to separate a liquid-liquid mixture, where pure liquid is separated from an impure liquid. In this process, the liquid mixture is heated in a distillation flask where the liquid is converted to its vapour form. These vapours are then condensed in Liebig's condenser and pure liquid is obtained.

For example, distillation of sea water can give us salt and pure water. Depending on the component required from a mixture, the best method of separation is selected. The properties of the components of the mixture need to be known to select the most effective method of separation.

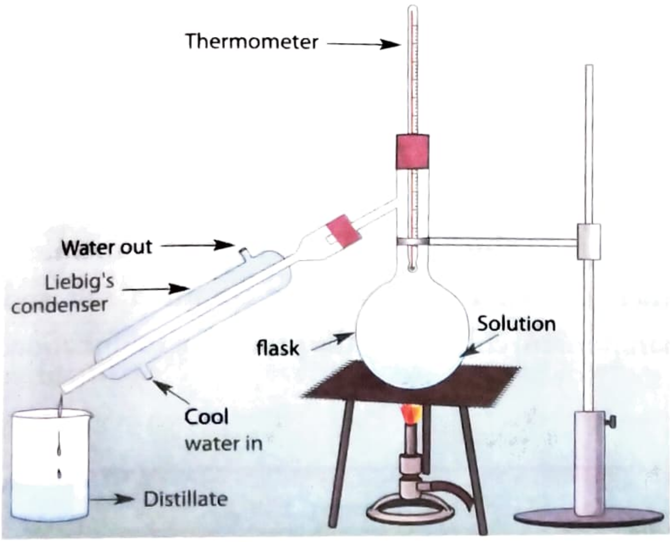


Fig. 3.4 Distillation

Fractional Distillation

Fractional distillation *is a method which is used to separate two miscible liquids. It works on the principle of difference in boiling points of different liquids.* Mixture of water and alcohol can be separated using fractional distillation. The apparatus used in fractional distillation is similar to the apparatus used in the method of distillation, except that it has a fractionating column. The temperature in the fractionating column is different at different levels. The vapours of the liquid with high boiling point condense at the bottom of the fractionating column and the vapours of the liquid with low boiling point condense at the top of the fractionating column.

Let us understand how a mixture of alcohol and water is separated using fractional distillation. In this method, the mixture of alcohol and water is placed in the round-bottom flask. A fractionating column is fixed on the mouth of a round-bottom flask and the mixture is heated. As the mixture heats up, the vapours of the liquid start rising and pass through the fractionating column. As the water has higher boiling point than alcohol, it separates at the bottom and the alcohol separates at the top.

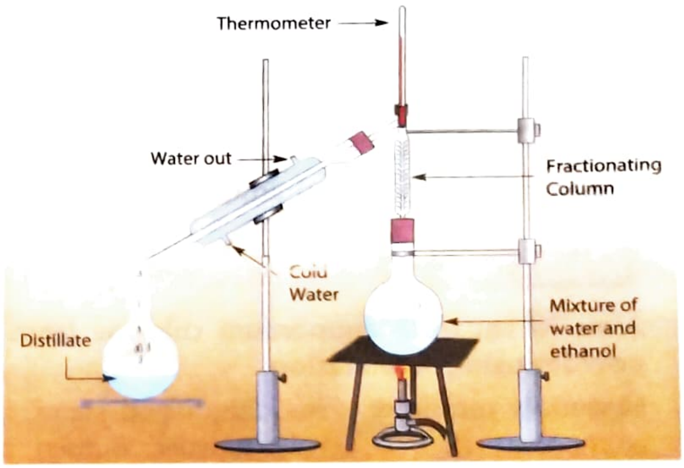


Fig. 3.5 Fractional distillation

Separating Funnel

Separating funnel is an apparatus used to separate immiscible liquids from their mixture. Mixture of oil and water can be separated using a separating funnel. This method works on the principle that the lighter liquid floats on the top and the denser liquid is left at the bottom.

ACTION TIME 2

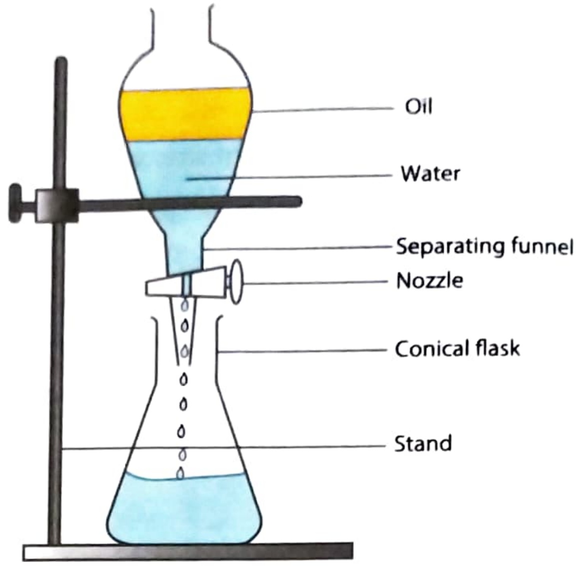
Aim: To separate a mixture of oil and water using separating funnel.

Materials required: water, oil, separating funnel, clamp stand, conical flask

Procedure: Take a mixture of oil and water in a separating funnel. Tighten up the cork and shake the mixture in the funnel. Set up the apparatus as shown here. Let it rest for some time. Now, keep the flask below the nozzle of the separating funnel and let the water flow in it.

Let the water flow drop-by-drop carefully avoiding the flow of oil from the nozzle. As the water from the funnel is completely removed, close the nozzle.

After this process, the water will be collected in the flask and the oil will be left in the separating funnel.



Separating funnel

Sublimation

The process in which a solid converts directly into its vapours on heating is called ***sublimation***. Sublimation is used to separate substances from a mixture. Camphor, naphthalene and ammonium chloride undergo sublimation. We can separate mixtures, such as iodine and sand or common salt and ammonium chloride by the process of sublimation.

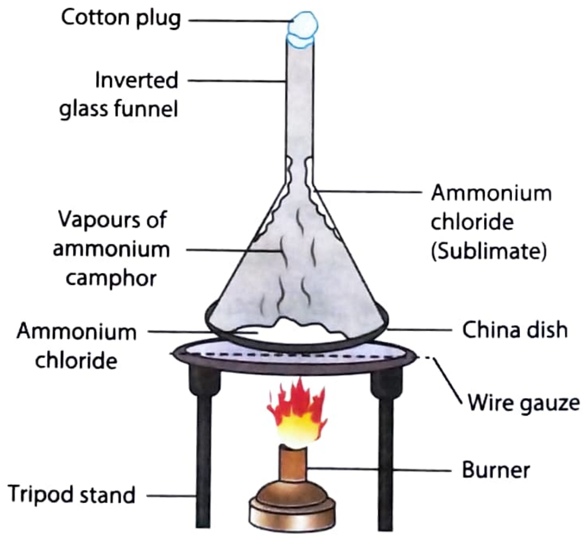
ACTION TIME 3

Aim: To separate ammonium chloride from chalk powder using sublimation.

Materials required: china dish, tripod stand, beaker, ammonium chloride, chalk powder, Bunsen burner, cotton plug, glass funnel

Procedure:

1. Mix some ammonium chloride and chalk powder in a china dish.
2. Take a glass funnel and invert it to cover the dish as shown. Use the cotton plug to close the open end of the funnel.
3. Heat the mixture in the dish covered with the funnel on a tripod stand and burner.
4. Observe the changes.



Sublimation

Observations: The vapours of ammonium chloride start coming out. They cool down as they hit the walls of the glass funnel.

Conclusion: On heating, ammonium chloride gets directly converted to vapour and then condenses to solid ammonium chloride.

CHROMATOGRAPHY

Mixture of chemicals in their liquid or gaseous form can be separated using ***chromatography*** *method.* The method is based on the principle of selective absorption of components of a mixture. This process involves a stationary phase and a mobile phase.

Paper Chromatography

Paper chromatography is done using special chromatography paper and a solvent in which substances are dissolved. The chromatography paper is the stationary phase here, while the solvent is the mobile phase. In this method, a mixture of different substances in a solution is taken in a glass jar. The chromatography paper is then dipped in the solution such that it only touches the liquid and is not completely immersed in it. The set-up is then kept aside, undisturbed. The solvents present in the mixture start moving up the chromatography paper through capillary action and start separating out on the paper. The solute with the maximum affinity to the solvent separates last, while the solute with the least affinity for the solvent separates out first on the chromatography paper. *The pattern obtained due to separation of solutes on the chromatography paper is called a* ***chromatograph.*** This pattern can be represented in the form of a graph to interpret the data.

Fig. 3.6 Paper chromatography

ACTION TIME 4

Aim: To separate a mixture using paper chromatography.

Materials required: Whatman No. 1 paper, water, marker pens of different colours, glass jar, water, pencil

Procedure:

1. Take a Whatman No.1 paper. Draw a line approximately 5 cm from the bottom of the paper.
2. Using the markers of different colours, put small spots on the pencil line at equal distances from each other.
3. Now, hang this paper on a glass jar containing little water. Make sure that the water does not touch the spots and remains below the pencil line.
4. As the water gets absorbed, it separates the multiple components of the markers.

Observations: The solutes in the form of colours start moving up the paper, from the base and a chromatograph is obtained.

Teacher Tip: Explain to the students about stationary phase and mobile phase.
Whatman paper: Papers with different pore sizes, used for chromatography

Quick Check 3

State whether the following statements are True or False.

1. Evaporation is the process used to separate a liquid from another liquid. ....
2. Distillation is the process by which a pure substance is obtained from a mixture. ....
3. In the process of filtration, the solution is allowed to pass through Whatman paper. ....
4. Fractional distillation is a method used to separate two miscible liquids. ....
5. All liquids dissolve completely in each other. ....
6. During the process of sublimation, a liquid is converted into its vapours on heating. ....

KEY TERMS

Atom: A smallest particle that shows the properties of the element

Element: A pure substance that cannot be separated by any chemical method

Ion: An atom or molecule with a positive or negative charge due to the loss or gain of one or more electrons

Compound: A substance formed when two or more elements are chemically bonded together

Homogenous mixture: A mixture in which the constituents are distributed uniformly

Heterogeneous mixture: A mixture in which the constituents are distributed non-uniformly

QUICK NOTES

* Element is a pure substance that cannot be separated by any chemical method.
* Elements are made up of tiny, indivisible particles called atoms.
* An atom is the smallest particle that shows the properties of the element.
* A molecule is a group of two or more atoms joined together by a chemical bond.
* Atoms of different elements combine together in definite proportion to form molecules of compounds.
* The molecular formula of a compound gives the symbolic representation of its composition. For example, NaCl, H_2O, CaO, etc.
* Mixtures are the substances that contain two or more substances mixed physically in indefinite proportions.
* A solution is a homogeneous mixture in which constituents are mixed uniformly.
* The substance that is dissolved is called solute, and the substance in which the solute is dissolved is called solvent.
* Sometimes a solute is not completely dissolved in a solvent. Such a mixture is called a suspension.
* An emulsion is a heterogeneous mixture in which two immiscible liquids are mixed together.
* The process in which a liquid changes to its vapour form on heating is called evaporation.
* The process by which a pure substance is obtained from a mixture (solution) is called distillation.
* Fractional distillation is a method used to separate two miscible liquids. It works on the principle of difference in boiling points of different liquids.

RUN-THROUGH

I. Very Short Answer Questions.

A. Tick (✓) the correct option.

1. Which of the following statements is correct for a mixture?
   a. It is not a pure substance ☐ b. It is not formed by chemical reaction ☐
   c. It is a pure substance ☐ d. Both a and b ☐
2. Al is the symbol for which of the following elements?
   a. Sodium ☐ b. Aluminium ☐ c. Hydrogen ☐ d. Gold ☐
3. Which of the following is not a compound?
   a. NaCl ☐ b. H_2O ☐ c. N_2 ☐ d. $CaCO_3$ ☐
4. Which of the following is the symbol for silver?
   a. Ag ☐ b. Au ☐ c. Al ☐ d. Ar ☐
5. A compound is a/an:
   a. Impure substance due to other elements ☐
   b. Pure substance not bonded chemically ☐
   c. Pure substance with more than one element ☐
   d. None of these ☐
6. Which mixture can be separated using distillation?
   a. Oil and water ☐ b. Ethanol and water ☐
   c. Salt and water ☐ d. Ink and water ☐
7. Which of these elements are present in sodium hydroxide?
   a. H, O, Ca ☐ b. Na, H, O ☐
   c. Mg, N, O ☐ d. C, H, O ☐
8. Which of the following is an example of heterogeneous mixture?
   a. Sand and water ☐ b. Salt and water ☐
   c. Milk and water ☐ d. Air ☐
9. Mixture of ethanol and water can be separated by using which of the following methods?
   a. Distillation ☐ b. Fractional distillation ☐
   c. Chromatography ☐ d. Sublimation ☐

B. Fill in the blanks.

Chromatograph, Valency, *Cuprum*, Negatively, $ZnCl_2$, One, ZnS, Positively, Separating funnel

1. .... is the molecular formula of zinc chloride.
2. The elements are made up of only .... type of particles.
3. The Latin name of copper is ....
4. Anions are .... charged.

5. Cations are .... charged

6. .... is the combining capacity of an element.

7. The pattern obtained on chromatography paper is called ....

8. Mixture of oil and water can be separated using ....

C. Match the following:

Column A	Column B
1. Mixture	a. Separating funnel
2. Compound	b. Alloy
3. Element	c. Fractional distillation
4. Brass	d. Definite composition
5. Ethanol and water	e. Indefinite composition
6. Oil and water	f. One type of particles

D. Write chemical formulae of the following compounds.

1. Sodium carbonate
2. Aluminium nitrate
3. Calcium hydroxide
4. Hydrogen sulphide
5. Nitric acid
6. Potassium hydroxide

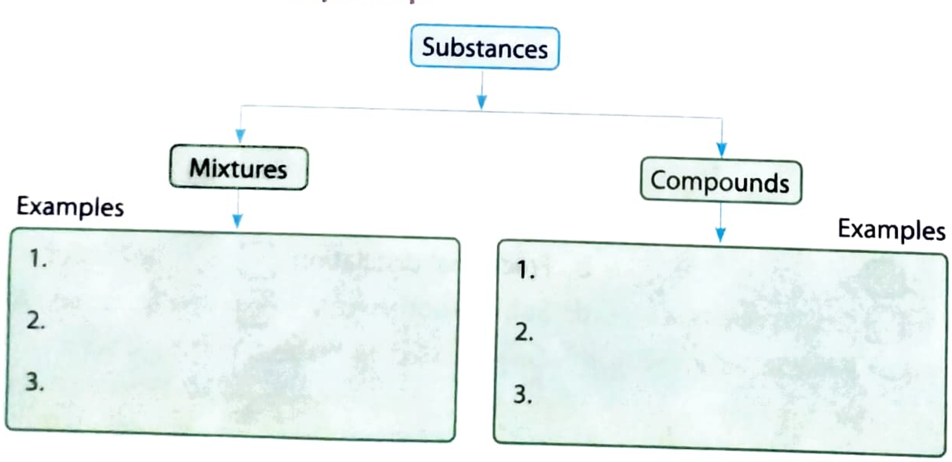
E. Write the names of the compounds represented by the given formulae.

1. $Al(NO_3)_3$
2. $CaCO_3$
3. Cu_2S
4. PbO
5. $BaSO_4$
6. HNO_3

F. Define the following terms:

1. Anion
2. Cation
3. Sublimation
4. Compound
5. Fractional distillation
6. Chromatography

G. Complete the concept map.



II. Short Answer Questions.

A. Question and Answers.

1. What is the difference between an atom and a molecule?
2. What is an element?
3. How will you differentiate between the composition of a pure substance and a mixture?

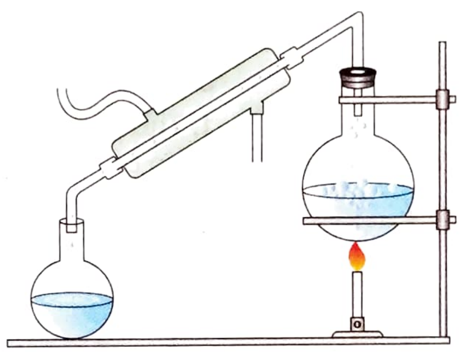
4. What is the significance of chemical formula of compounds?
5. Draw the symbols of mercury, silver and carbon as proposed by Dalton.
6. Write the Latin name of gold and silver.
7. What are the combining elements of hydrogen chloride and ammonia?
8. On what principle does chromatography work?
9. What is the principle used in distillation?

B. Differentiate between:

1. Distillation and Fractional distillation
2. Sublimation and Evaporation
3. Mixtures and Compounds
4. Ions and Elements

C. Label the figure given below.

1. What is the process called?
2. Where and why is it used?



III. Long Answer Questions.

1. With the help of an activity, prove that mixtures can be separated through physical methods, whereas compounds cannot be separated.
2. Differentiate between the molecule of an element and molecule of a compound. Give examples.
3. Observe the image. Explain the method and why is it used?

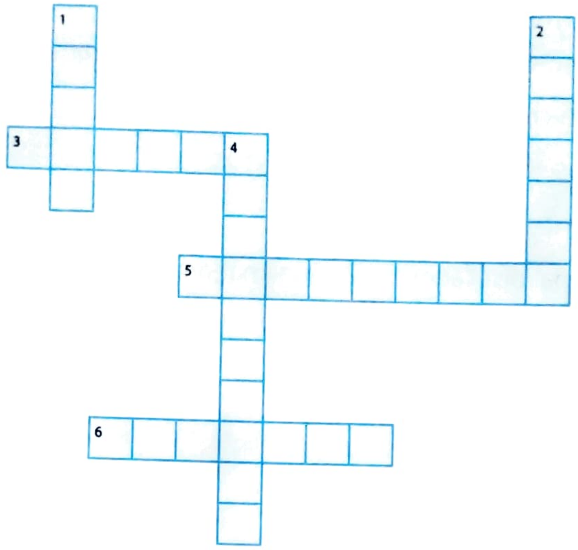
IV. Challenge

1. What is the valency of sodium in NaCl and calcium in CaO?
2. An element 'A' has the valency 1 and an element 'B' has valency 2. Write the formula of the compound formed by 'A' and 'B.'
3. The formula of the chloride of a metal 'A' is ACl. Write the formula of its oxide and sulphide.

SCIENTIFIC QUEST

Search in the Internet and try to find out different types of alloys and their composition.

1. Solve this crossword.



Across

3. This is the Latin name for iron.

5. They are made up of two or more elements combined together chemically.

6. A pure substance made up of only one kind of particles.

Down

1. This compound is in liquid state and is made up of hydrogen and oxygen.

2. We use these to represent elements.

4. An ion having only one atom with a charge.

2. What is wrong in the given valency/molecular formula. Circle it. Also, write the name of the compound.

1. Ca CO_3
   −1 +2
   $Ca(CO_3)_2$
   ....

2. Al NO_3
   +1 −3
   $Al(NO_3)_3$
   ....

3. Zn S
   +2 −2
   SZn
   ....

4. Ca OH
   +2 −1
   $Ca(OH)_2$
   ....

5. Mg O
   +2 −2
   Mg_2O
   ....

6. Ag I
   +0 −0
   AgI
   ....

PICTURE SURVEY

1. **Look at the pictures carefully and write which of them is: Heterogenous mixture, Emulsion or Homogeneous mixture.**

a. 

b. 

c. 

....

2. **Look at the picture given alongside carefully.**
   a. What process does it show?
   b. What is the paper in the glass called?
   c. What do these four separate layers of colours on the paper depict?