CLASS-VI

1

MATTER

We see many things around us such as a table, chair, book, glass, hills, mountains, river, birds, animals, sun, moon and stars etc. All the objects seen around us are either born naturally or made by humans. For example, the hill is made up of rocks; the book is made of paper. Similarly, whether it is sand, glass, table-chair, sun-moon etc., all are made up of some material. Let us now try to know what this substance is. If we take the sand in our hands, then we feel that there is some kind weight in the sand. The weight is felt even when lifting a stone or a bucket full of water. You also know that sand and water also surrounds the place. Similarly, if we place a book on the table then it surrounds the place and it also has some weight. In this lesson you will read about the different states of matter and their components etc. Matter consists of the same type of particles. Apart from this, you will also be able to get information about various elements, compounds and mixtures etc.

OBJECTIVES

After reading this lesson you will be able to;

- To know why substances are different;
- To know the composition of various substances;
- To know whether all substances are made from the same element;
- To know whether all substances are known by the same name ; And
- To understand how the ingredients in the mixture can be separated from each other.

1.1 SUBSTANCES

When you feel thirsty, you drink water or other beverages like Shinkaji, lemonade or cold drinks etc. When you feel hot, you switch on a cooler or fan and experience the wind. All such things that you can see or cannot see, but can experience them, they are called substances. You must have noticed that all these things have some weight and they also cover the area of some places. Hence, a substance can be defined as: "Any object that carries a load and the space it occupies is called a substance."

Composition of Matter

Let's now try to know about the composition of matter whether all substances are the same or different substances are different. The substances we see all around us are different from each other.

If we break a small piece of iron until it is broken into such a small part that it cannot be broken any further, then even this small piece of iron has all the properties of iron present in it. Therefore, we can say that any substance consists of the same type of particles.

Atoms

You have known by now that all the substances found around us are of different types. They all have different color, smell, taste, size etc. If we break a mountain, then we will get big rocks. If you break them too, you will get small pieces and if you keep breaking more, then small particles of sand will be found. You will see that the same properties are found in these small particles which are in a rock. Therefore, we can say that a mountain is formed by mixing small particles of sand. If you try to break even a small particle of this sand, then it can be broken into very small particles. In 1808, a scientist named Dalton, while studying the structure of matter, told that such fine particles of any substance, which have all the basic properties of matter, are called atoms. Thus, we can say that all matter is made up of atoms. Hence, an atom is the smallest component of a substance that has all the properties of that substance.

An atom is that small particle of a substance, in which all the properties of that substance are present. But it is to be noted here that atoms can be further divided, but the properties of the particles obtained from it can also be different from the properties of the original material.

The structure of the atom

Gradually various discoveries revealed that atoms can be further subdivided. The center of an atom has a nucleus consisting mainly of protons and neutrons. Electrons revolve around this nucleus. Atoms of different elements have different structures. This is shown in Figure 1.1 below:

Electron-1 Electron-6 Electron-7 Electron-8

Proton-1 Proton-6 Proton-7 Proton-8

Neuton-6 Neuton-7 Neuton-8

(a) Hydrogen (b) Carbon Atoms (c) Nitrogen atoms (d) Oxygen atoms

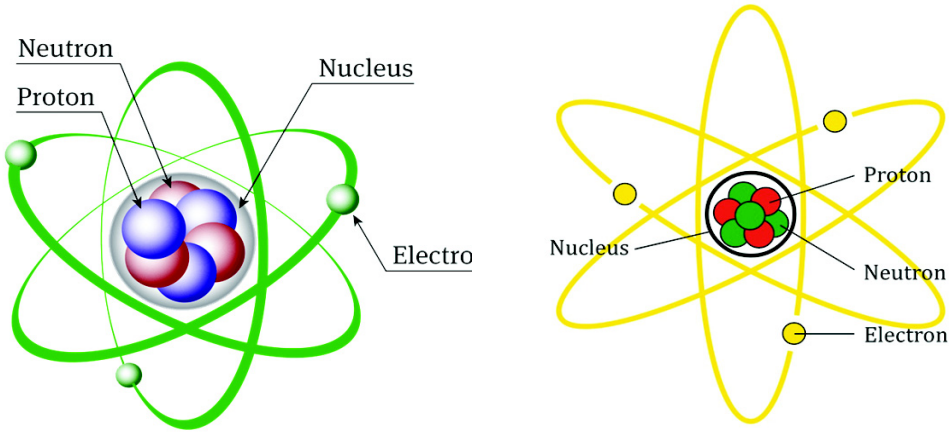

Fig. 1.1 Structure of different atoms

Molecules

The way vowels and consonants are in the Hindi alphabet, with the help of which we can make many words. We make sentences by adding these words. All sentences together form a text and a book consisting of several lessons makes a book.

In the same way, atoms of the same substance combine to form molecules. This molecule is the smallest part of any substance that can live independently. For example, a molecule of water is formed by joining two atoms of hydrogen and one atom of oxygen. Therefore, the smallest particle of a substance which has all the properties of that substance and which can remain in an independent state is called a molecule of that substance. Atoms combine to form molecules. A molecule of hydrogen is made up of two atoms of hydrogen. This is why so many substances are found all around us, which form many types of substances.

1. What microscopic particles does a substance consist of?
2. How many atoms does a molecule of hydrogen consist of?
3. Write the definition of molecule?

1.2 STATES OF FLUID

Most liquids can be divided into three groups - solids, liquids and gases, depending on their states. Let us now study them one by one.

1. Solid: If you move a piece of wood or a book from one place to another and press it with some force, you will see that neither its shape nor volume changes. So such substances whose size and volume are fixed are called solid such as ice, brick, chair, book.

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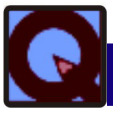

INTEXT QUESTIONS 1.1

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1.2 STATES OF FLUID

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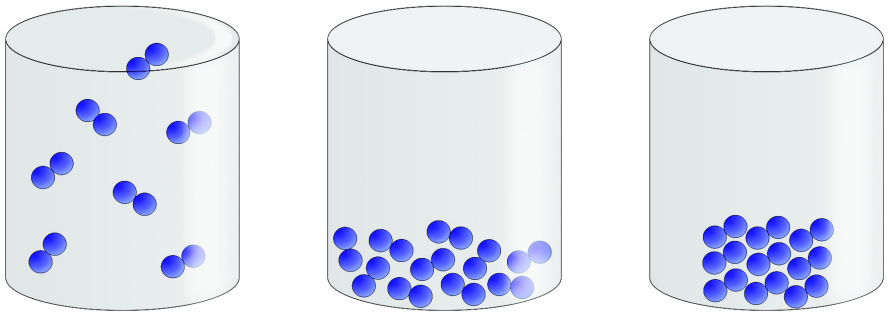
1. Solid: If you move a piece of wood or a book from one place to another and press it with some force, you will see that neither its shape nor volume changes. So such substances whose size and volume are fixed are called solid such as ice, brick, chair, book.

3. Gas: Molecules in gases are far away from each other as compared to both solid and liquid and the attraction force between them is almost equal to zero. So molecules can move more freely. Therefore, both their shape and size are fixed (Figure 1.2 (c)).



(a): solid (b): liquid (c): gas

Fig. 4.2 Status of Molecules in Solid, Fluid and Gas

Some common properties of solids, liquids and gases

Let us make a comparative study of the properties of solids, liquids and gases with the help of the following table:

Table 4.1 - Comparative study of properties of solid, liquid and gas

	Properties	Solid	Liquid	Gas
1.	Size	Definite	Not sure	Not sure
2.	Volume	Definite	Definite	Not sure
3.	Force of attraction between molecules	More	Less than solid	Almost zero
4.	Space between molecules	Close to each other	Are little far away	Are very much far away

The change in the state of substances

Fig. 1.3: Demonstration of the state of matter changes with the example of water

Substances can also be changed from one state to another. We can take water as an example to prove this. Water, which we use for drinking, bathing, washing clothes, cooking, etc., is a liquid state of matter. If we freeze it at a very low temperature then it becomes ice which is in solid state.

And if this water is boiled then steam (vapor) is formed which is gaseous state. On cooling the steam, water is formed again. Thus, we see that ice, water and steam are different states of the same substance (water). It can be understood in this way through Fig. 1.3.

INTEXT QUESTIONS 1.2

1. Fill in the blank -

   (i) There are three states of matter …… and …….

   (ii) Matter surrounds..... and contains .....

(iii) The volume of the solid is fixed.

(iv) The fluid is …… fixed and shaped …….

2. (a) What is a substance?

(b) What is a matter called?

3. Mark the correct ( ) or false ( ) in the following sentences:

(i) Matter consists of the same type of particles. ( )

(ii) There are three states of matter. ( )

(iii) The volume and size of solids can be changed. ( )

(iv) The space between the molecules of the fluid is more than the molecules of gas. ( )

(v) Both the volume and size of the gas are not fixed. ( )

4. Name the state in which the matter is found.

1.3 ELEMENTS AND COMPOUND

Elements

We often find that there are many substances that consist of the same type of atoms, such as oxygen, hydrogen, gold, copper, silver, iron, nitrogen, chlorine, sulfur, magnesium, aluminum etc. Such substances which consist of the same type of atoms are called elements.

So far 109 elements have been detected out of which 92 elements are found naturally.

Chemical signs of elements

So far, 109 elements have yet been discovered, including some metals (iron, gold, copper, etc.) and some non-metals, such as solids (iodine, sulfur, carbon), as gas (chlorine, Oxygen, nitrogen) and liquid (bromine). Since the names of so many elements are difficult to remember, that is why each element is written by a special symbol. This sign is represented by the first one or two letters of the Greek or Latin name of that element. Signs of some elements of Hindi, English and Latin names and their atomic weight are shown in the table below -

Table 1.2: Some elements of Hindi, English and Latin names and signs and atomic weight

Element's Hindi (English) name	Element's Latin name	Chemical signals of elements	Nuclear Weight
Carbon	Carbonium	C	12
Hydrogen	Hydrogenium	H	1
Oxygen	Oxygenium	O	16
Aluminium	Aluminum	Al	27
Silver	Argentium	Ag	108
Nitrogen	Nitrum	N	14
Tin	Stannum	Sn	119
Zinc	Zincum	Zn	65
Iron	Ferrum	Fe	56

Sodium	Natrum	Na	23
Chlorine	Chlorum	Cl	35.5
Copper	Cuprium	Cu	63.3

Compounds

Compounds are formed by the chemical combination of two or more atoms. The constituent atoms of a compound cannot be separated by physical methods. A compound is a new substance. Its properties differ from the properties of the elements or substances present. Most chemical substances are compounds. Examples of compounds are salt, molasses, blue stone, alum, saline, sugar and sulfuric agglomeration.

Chemical formulas

Just as the atoms of elements are written by signs, the molecules of compounds are written by chemical formula. From the chemical formula of a substance, we get to know the following things about that substance:

1. The substance is made up of how many chemical elements,
2. How many atoms of each element are there in a molecule? and
3. What is the molecular weight of its molecule?

For example, we know that a molecule of water consists of two atoms of hydrogen and one atom of oxygen, so if we were to write its chemical formula, it would be H_2O. Similarly, one molecule of glucose is composed of 6 atoms of carbon, 12 atoms of hydrogen and 6 atoms of oxygen. Therefore, the chemical formula of glucose is $C_6H_{12}O_6$ which is also known as its molecule.

To find the molecular weight of glucose, we need to know the atomic weight of carbon, hydrogen and oxygen, which is as follows - Atomic weight of carbon-12, Atomic weight of hydrogen-1, Atomic weight of oxygen-16. Therefore, we can find the follows:

Since glucose has a molecule - C6H12O6, its molecular weight will be:

Atomic mass= Atomic weight of 6x C + Atomic weight of 12 x H + Atomic weight of 6xO

= 6 x 12 + 12 x 1 + 6 x 16

= 72 + 12 + 96

= 180

Similarly, we can find the molecular weight of other compounds as well.

The chemical formulas of some commonly used compounds are given below -

Ordinary salt - NaC1, Casting Soda - NaOH

Baking Powder - NaHCO3, Laundry Soda - Na2CO3

Sugar - C12H22O11, Blue Thoth- CuSO4 .5H2O

Marble - CaCO3, Alum - K2SO2 .A1 2 (SO 4),24H2O

ammonium chloride - NH2C1

Valency

The atoms of different elements form molecules of compounds, such as one molecule of water consisting of two hydrogen atoms and one atom of oxygen. Similarly, different elements combine

to form different types of compounds. The combining ability of a chemical element is called its valency. For example -

Valency of C1 in HC1 = 1

Valency of H2O in O = 2

Valency NH3 in N = 3

Valency CH4 in C = 4

These compounds combine 1, 2, 3 and 4 atoms of hydrogen from one atom of chlorine, oxygen, nitrogen and carbon respectively to form HC1 (hydrogen acid), H2O (water), NH2 (ammonia), CH4 (methane) etc. Hence the valency of these elements will be 1, 2, 3 and 4 respectively.

Chemical equation

Two or more substances are required for any chemical reaction to occur. These substances, through which the reaction takes place, are called reactants. The substances that are formed as a result of the process are called products. To write a chemical equation, an arrow ( ) is placed between these two types of substances. We can illustrate this with the following example. If we burn magnesium in oxygen, then magnesium oxide is formed and heat is released. This will be written in words like this:

Magnesium Oxygen Magnesium Oxide Heat

This reaction consists of magnesium and oxygen reactants and the product produced (i.e. obtained at the end of the action) of the magnesium oxide product.

If we write chemical formulas of the above substances instead of words, we can write the above reaction by the following equation:

2Mg = 02 - 2 MgO + Heat

This is called a chemical equation.

INTEXT QUESTIONS 1.3

1. Which of the following is a formula of simple salt?

   (A) Nac1 (B) CaC1 2 (C) Cu (D) Ag

2. Write the formula of copper.
3. Write a chemical formula of saline and marble.

   (A) …… (B) ……

4. The water molecule is H2 O. Find its atomic mass.

   (Given: - atomic weight of hydrogen 1 - atomic weight of oxygen - 16).

1.4 MIXTURE

If you add some sugar or salt to the water, we see that in a short time they dissolve in the water and then do not appear in the water. Yes, water does become sweet or salty. We get a mixture of these two by mixing water and sugar or by mixing water and salt. Thus mixing of two or more substances in any proportion gives that mixture. Similarly, lemon-water, Shinkaji, sugar solution, garam masala, sea water etc. are all examples of mixtures. Therefore, substances that are formed on mixing any two or more elements or compounds in any uncertain proportion

are called mixtures. The air around us is also a mixture, in which many types of gases such as oxygen, nitrogen, sulfur dioxide, carbon dioxide, etc. are found.

ACTIVITY 1.1

What you need to do: Comparison between mixture and compound.

What you need: Sugar, test tube, spirit lamp, water etc.

How to do it: Heat a little sugar in a test tube (test tube). Gradually it turns brown. It becomes black on overheating. This black substance is carbon. If you look at the test tube carefully, a few drops of water are seen upwards. This means that sugar is not a substance but a compound. Sugar contains carbon, hydrogen, and oxygen.

On the other hand, since the sugar solution consists of water and sugar, it is a mixture.

What you noticed: On heating the sugar, it turns into its components and water from it gets collected in the test tube.

Conclusion: Sugar is a compound and sugar solution is a mixture.

Differences in elements, compounds and mixtures

The properties of these substances vary depending on the molecular arrangements of the elements, compounds and mixtures. The following tables show the difference between elements and compounds and mixtures and compounds.

Table 4.3: Difference between elements and compounds

Elements	Compounds
1. Consists of only one type of atom.	1. Different types of atoms are formed by mutual combination.
2. Cannot be decomposed into new substance	2. Can be decomposed into more than one new substance.

Table 4.4: Difference between Mixture and Compound

Mixture	Compound
1. There is no fixed ratio of ingredients.	1. The ingredients have a fixed ratio.
2. Components can be separated by simple means.	2. Components cannot be separated by simple means.
3. The composition is not uniform in all parts of the mixture.	3. The atoms in all parts of the compound have the same composition.
4. They reflect the properties of all their ingredients.	4. They exhibit some new properties apart from their ingredients.

INTEXT QUESTIONS 1.4

1. Which of the following sentences are true and false?

   (i) All the substances in the mixture have the same ratio.( )

   (ii) Air is a mixture of different gases. ( )

   (iii) Lemonade is a compound. ( )

2. Give any three examples of mixing from your daily life.
3. Write any difference between the element and the compound.
4. Explain the definition of mixture.

1.5 SEPERATING THE DIFFERENT COMPONENTS OF THE MIXTURE

To make lemonade or Shinkaji, we mix water, lemon juice and sugar with each other. It is a type of mixture. Most of the substances we look around are mixtures. For example - milk, lassi, soil, air etc. Ice cream or Kulfi is also a mixture of many substances. If some substances are mixed by mistake, then they need to be separated from each other, but sometimes it is very difficult to separate them. In such situations we use a variety of special methods, such as filtering, gleaning, sublimation, evaporation, precipitation, etc., to easily separate substances. Let us know about them in brief.

Gleaning (Handpicking)

Fig. 1.5 Separating impurities by handpicking

You must have noticed that in homes, often grains and pulses are picked by hand by separating the pebbles etc. This method is

called gleaning. This method is called gleaning. This can happen because the color, shape, grain, and pulses of the substances found in the mixture differ from the particles in the mixture. (Fig. 1.4).

Winnowing

Have you noticed? - How to clean wheat, rice etc. in the house. They are winnowed and cleaned. In wheat, pebbles- stones, straw etc. are separated by winnowing through flail.

Fig. 1.5 Winnowing obtain the pure substance

Have you seen it? When the wheat crop is ready in the field and the straw has to be separated from the wheat, the farmers take the mixture of wheat and straw in the soup and throw it from the height. By doing this, the straw, which is lighter, flies away with the wind and collects it, and the wheat falls down due to the heaviness, which is later cleaned. This is how wheat and chaff are separated. (Fig. 1.5).

Sieving

At home, the mother uses a sieve to separate the bran (husk) from the flour. The sieve separates those substances which have

Fig. 1.6 Separating the pure substance by sieving the mixture

different sizes of particles. Sand and scree are also separated in a similar way. (Fig. 1.6).

By Magnet

When a substance is found in the mixture, which can be attracted towards the magnet, it can be separated by the magnet. If iron shavings are found in the sawdust, it can be separated in this way (Figure 1.7).

Fig. 1.7 separating iron shavings and sawdust by a magnet

Sublimation

You must have noticed that when we put a naphthalene ball in woolen clothes, it gradually disappears. Would you like to know why this happened? This happened because some solid matter becomes vapor without changing into liquid. Have you ever noticed camphor burning in worships, it is also an example of this. If one of the substances inside the mixture is such a solid that it becomes vapor without changing into liquid, then by this method, it is separated from the mixture. Sublimation is the conversion of liquid into vapor without changing.

To understand this action, we take a mixture of iodine and sand. Put it in a porcelain cup and keep the funnel upside down on top of that cup and close the funnel with a cotton ball. Now we place this bowl on a wire mesh and heat it. The heat turns into iodine gas and this vapor accumulates on the cold part of the funnel and the sand remains in the bowl. Thus, iodine and sand are separated

Evaporation

We use the evaporation method to obtain salt from sea water. For this, we fill the water in a pit and due to the sunlight, the water gradually evaporates and the salt remains in the pit. You can heat the solution to get salt from the salt solution in the house and can get salt by blowing water from it.

Filtration

Sand and water solutions are easily separated by the filtration method. Putting filter paper in the funnel as per the picture, the sand and water solution are gently poured into the funnel. The water is filtered and goes into the beaker and the sand remains on top.

Sedimentation and Decantation

If you make a solution of sand and water and leave it in a beaker, you will see that the sand settles down slowly. The sand gets sediment. This is called sedimentation. The water comes up. Pour out the water and separate it.

When the above clean water is poured into another vessel, this process is called Decantation.

Loading

Take the dirty water and keep it for a while. See what happens? Does the dirt sit down slowly? Yes, but with a little shaking, dirt particles start appearing again in the water. Now tie the alum in a thread and hang it in the middle of dirty water and see what happens? The particles of mud along with alum particles get heavy and sit in the bottom, that is, they become depressed, which are then removed and separated. This method is called loading.

Distillation

Distilled water is required to make medicines. Distilled water is also needed for research and etc. in laboratories. Distilled water

is obtained by distillation method. In this, the water is first heated and steam is made, which is collected and cooled and we get distilled water.

ACTIVITY 1.2

What you need to do: Separate the salt and camphor mixture.

What you need: Salt, camphor, bottle, hot water.

How to do it: Fill a bottle with a mixture of salt and camphor and close its mouth. When this bottle is kept in hot water, the camphor gets heated and turns into white smoke and cools and collects in the top part of the bottle. You will see that salt and camphor can be easily separated by the process of sublimation. Salt remains in the bottom of the bottle.

Conclusion: Thus, this is how the mixture of salt and camphor is separated.

INTEXT QUESTIONS 1.5

1. Which method would you use to separate the following?
   (i) Pieces of blue and green marble stone.....
   (ii) Salt from sea water……
   (iii) Sand and scum.....
   (iv) Iron shavings from tea leaf…...
2. The conversion of a solid into vapor without changing it into liquid is called …….

   (A) Evaporation (B) Decantation (C) Sublimation (D) Filtering

WHAT HAVE YOU LEARNT

- Matter surrounds space and carries weight.
- There are three states of matter: solid, liquid and gas.
- Both volume and size of solid substances are fixed, while volume of liquid substances is fixed but the size is not fixed. Both the volume and size of gaseous substances are undetermined.
- The atom is the smallest part of matter which has all the properties of that substance. Atoms combine to form molecules.
- Atoms of two or more atoms of the same element form a molecule.
- Compounds are formed by the chemical combination of two or more substances.
- The substance that is formed by combining any two or more elements or compounds in any uncertain proportion is called a mixture.
- Pure substances from the mixture are handpicking, sieving, winnowing, evaporation, decantation, etc. by methods.
- Any chemical element is also written by its signs rather than its name.
- The Chemical equation gives information about the components (substances) of a reaction and the substances it produces.

TERMINAL QUESTIONS

1. Give three examples of solid, liquid and gas substances.
2. Explain the difference between atoms and molecules.
3. The sludge water is cleaned by the loading method. For loading which substance is used?
4. Sort elements and mixtures from the following substances -

   water, salt, mercury, iron, wood, nitrogen, hydrogen, oxygen, Sugar, chlorine, sugar syrup, saliva, garam masala, baking soda.
5. How can the mixture of saline and sand be separated?
6. What is a compound called? Give two examples.
7. What is valency? Explain by giving examples.
8. What is a chemical formula? What information can be obtained from it? Give an example.
9. Describe the distillation method with a picture.

ANSWERS TO INTEXT QUESTIONS

1.1

1. Atoms
2. Two atoms

3. The smallest particle of matter that has all the properties of matter and which can remain in an independent state

1.2

1. (a) solid, liquid, gas

   (b) location, loads

   (c) Size

   (d) Volume, Indeterminate

2. Substances (matter) occupy space and carry weight?

3. (i) True (ii) True (iii) False (iv) False (v) True

4. Three-solids, liquids, gases

1.3

1. NaC1

2. Cu

3. (i) NH_4C1

   (ii) $CaCO_3$

4. H_2O

   2 x H +O

   2 x 1 + 6 = 18

1.4

1. (i) False (ii) True (iii) False
2. Lemonade, lassi, air, hot spices, seawater etc.
3. atom- is formed from the same type of atoms.

   Compound - is formed by the combination of different types of atoms.

1.5

1. (i) Handpicking (ii) Evaporation (iii) Sieving (iv) By Magnet
2. Sublimation