

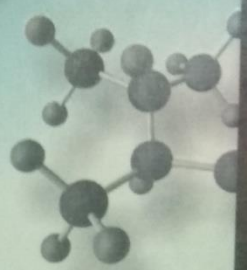


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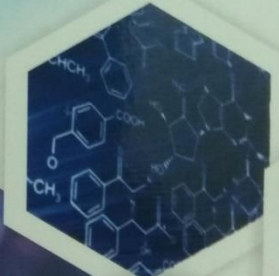


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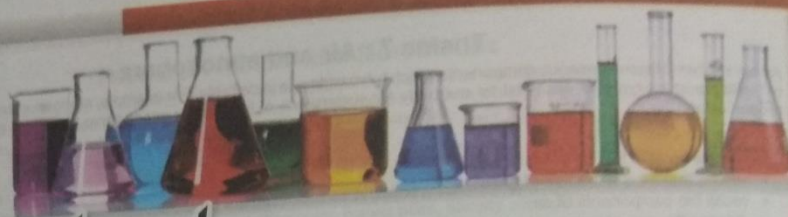


Baljinder Kaur



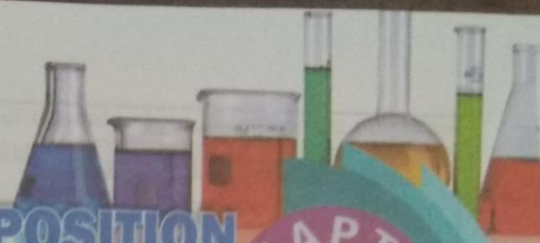
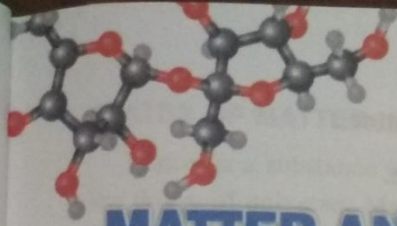
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MATTER AND ITS COMPOSITION

CHAPTER 1

INTRODUCTION

Our universe is made-up of matter and energy. We are surrounded by matter. We are ourselves matter. The air we breathe in, the water we drink, the clothes we wear, the food we eat and the land over which we walk etc. are all matter. In fact all the substances around us constitute matter.

WHAT IS MATTER ?

Anything that occupies space, has weight and can be perceived by our senses is called **matter**. Matter can range from something as small as needle to something as big as an aeroplane. So everything we see is called matter. Infact we can't see air but air has mass and occupies space, hence it is also called matter.

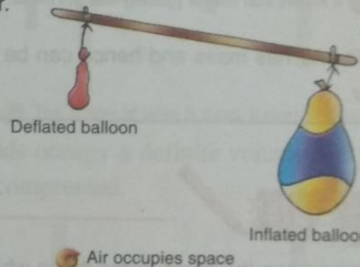


1 Activity

To show that air occupies space.

Method : Take a balloon and blow air into it. The air fills and the size of balloon increases.

Result : Air occupies space and hence air is matter.

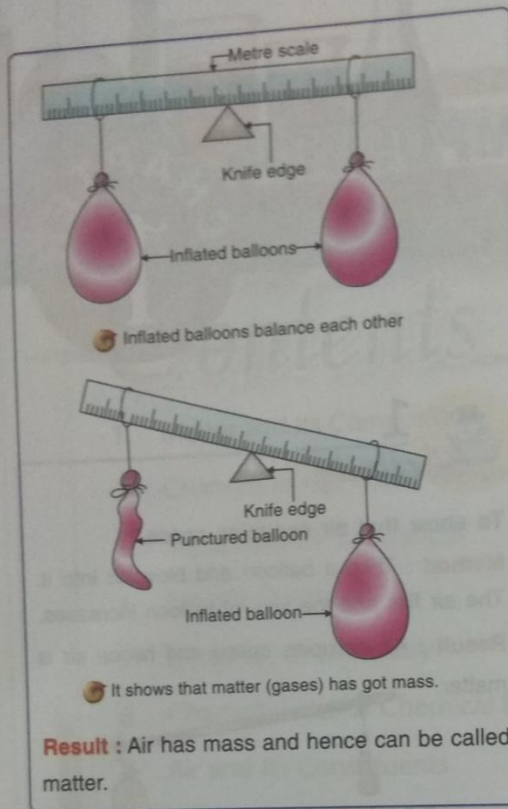


Air occupies space

2 Activity

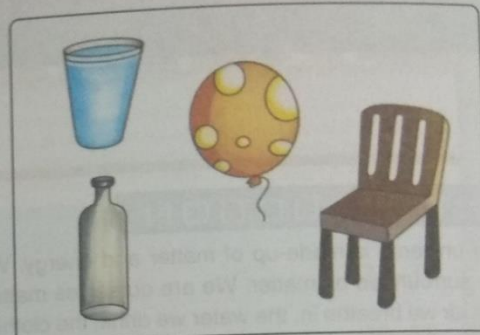
To show that air has mass.

Method : Take two similar balloons and inflate them with air equally. Suspend two balloons equally apart on the two corners of the metre scale and place it on the knife edge. The scale remains in a balanced state. Now, puncture the balloon on the left and you will see that metre scale lifts towards your right.



Properties of matter :

- It occupies space.
- It has mass.
- It can be perceived by the senses.



Note

Sound, magnetism, love, hate, shadow etc. are not regarded as matter because neither they have mass nor they occupy any space.

Skill-Fill

Choose among the given terms those which can be considered as matter and those which cannot be considered as matter.

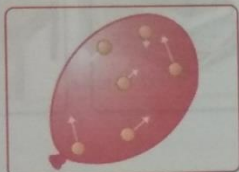
Terms	Matter	Other than matter
<div style="display: flex; flex-wrap: wrap; gap: 5px;"> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Hate</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Fear</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Ice</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Table</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Icecream</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Milk</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Love</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Wood</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Glass</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Chair</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Talcum</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Shadow</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Ball</div> <div style="border: 1px solid gray; border-radius: 10px; padding: 5px; margin: 2px;">Reflection</div> </div>		

STATES OF MATTER

Matter is a substance which constitutes all the things of universe. Matter can either be a solid, liquid or a gas. These forms are called the three physical states of matter. The liquid and gaseous states are fluid states. A fluid can be poured from one vessel to another. All these states are interconvertible with the change of condition. Each state can be recognised by its special characteristics. The physical states of matter can be interchanged by heating or cooling.

WHAT IS MATTER MADE-UP OF ?

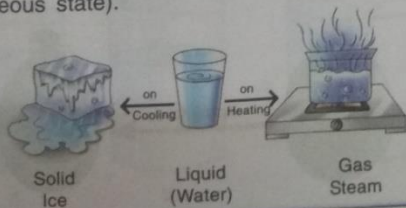
All matter is made-up of a large number of extremely small particles called **molecules**. These particles are always in the state of random motion in all possible directions.



3 Activity

To understand the three states of matter.

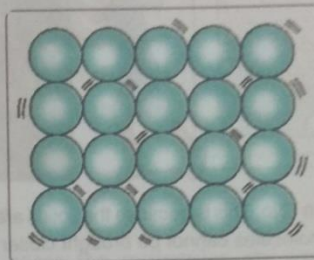
Method : Take a glass of water. It is in liquid state. Pour this water in an ice tray and keep it in freezer for some time, it turns to ice now pour water in a pan and heat it, it turns to vapours (gaseous state).



Let us study about the important properties of solids, liquids and gases.

Solids :

- In solids, the molecules are closely packed and there are no intermolecular spaces between them.

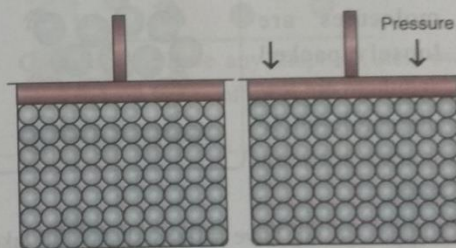


- Solids have fixed shape and do not flow.



The shape of table is fixed. It doesn't change.

- Solids occupy a definite volume and cannot be compressed.



on applying pressure
no compression takes place

- In solids the molecules are strongly attracted towards each other and hence they are dense.
- The intermolecular spaces are least in solids due to which the force of attraction is maximum.

Skill Fill

Q. Are you able to change its shape or compress it to smaller size ?



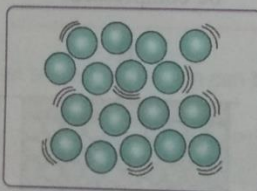
Conclusion : No, This is because the solids are not compressible. There is no space in between the molecules, thus, the molecules cannot be brought closer to each other.

Examples :



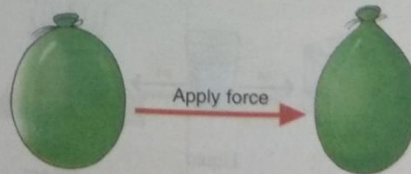
Liquid :

- In liquids the molecules are loosely packed and there are few intermolecular spaces between them.
- Liquids do not have a fixed shape and take the shape of the container. Also liquids can flow easily.



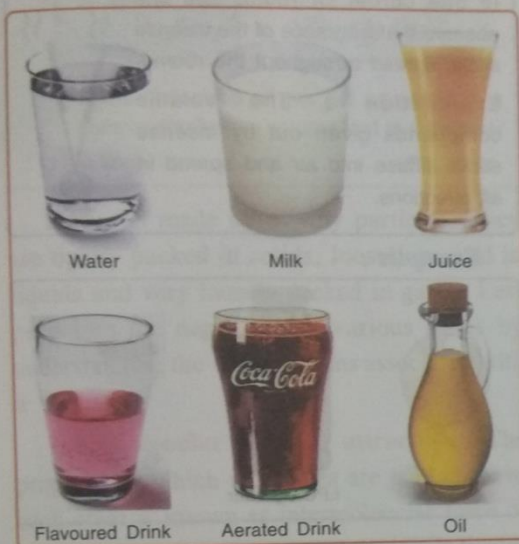
- Liquids have a definite volume and can be compressed slightly.

A balloon containing water on applying force becomes a little smaller. Hence, showing that liquids can be compressed slightly.

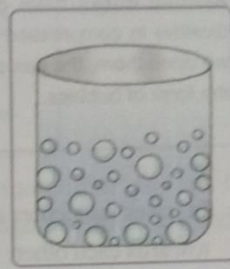


- The attractive forces between the molecules of a liquid state are lesser than in the solids.
- On heating a liquid, its molecules move apart, hence the liquids expand on heating.

Examples :

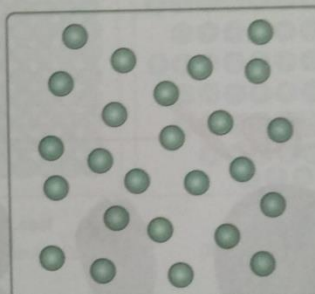


Explanation : When we mix the two liquids *i.e.*, water and milk together, the molecules of water occupy the space between milk. Hence, the intermixing of the two different types of molecules lead to the formation of a mixture. In other words we can also say that molecules of milk have diffused into water.



Gases :

- In gases the molecules are very loosely packed and there are large intermolecular spaces between them.

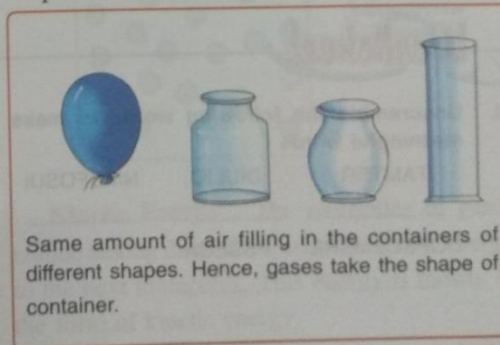
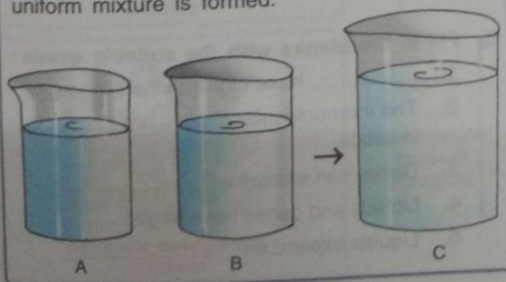


- Gases do not have any shape of their own and take the shape of the container they are put in.

4 Activity

To show that liquids can diffuse easily.

Method : Take a beaker A and pour 50 mL of milk in it. Now take another beaker B and pour 50 mL of water in it. Now pour the contents of both A and B in C. You will observe that on mixing a uniform mixture is formed.



Same amount of air filling in the containers of different shapes. Hence, gases take the shape of container.

- Gases don't have a definite volume and can be compressed easily.

Aerated drinks have gas (carbon dioxide) in compressed form. When we open them, the gas comes out in the form of bubbles.



- In gases molecules are very weakly attracted towards each other. Hence, they are very less dense.
- Gases also show the property of diffusion.
- The molecules in a gas have high kinetic energies.

5 Activity

To show that gases can diffuse easily.

Method : Take few incense sticks and burn them in one corner of room. You will observe that fragrance of the incense sticks spread throughout the room.

Explanation : The volatile compounds given out by incense sticks diffuse into air and spread in all directions.



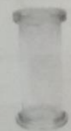
Examples :



Balloon



LPG Cylinder



Gas jar

Skill Fill



Take a balloon. Inflate it. Now reshape it in the form of 8. You will observe that half of the air, moves up and half of it moves down. This happens because of least forces of attraction and spaces present between the molecules.

Worksheet

I. Unscramble the following words to make meaningful words :

TAMTER

DIULIQ

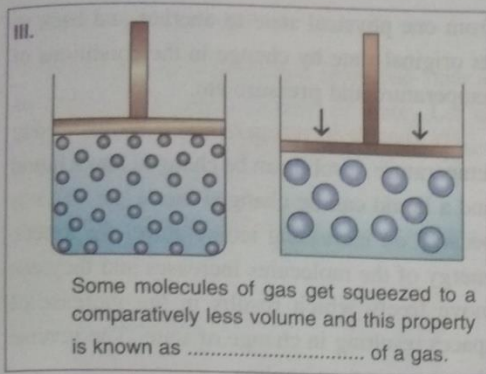
NIFDFOSUI

DOPSCEMSRE

PSSECA

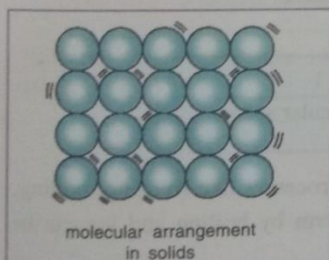
II. Fill in the blanks with the suitable words :

1. have highest kinetic energy.
2. The intermolecular spaces are in solids.
3. Gases can easily be
4. Liquids and gases have large
5. Liquids expand on

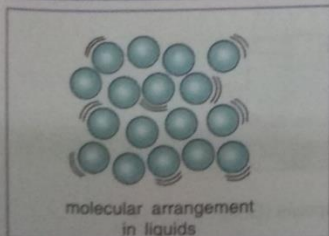


Matter is made up of tiny particles. They are tightly packed in solids, loosely packed in liquids and very loosely packed in gases. Let's peep into the depth of the various states by understanding the various terms associated with it.

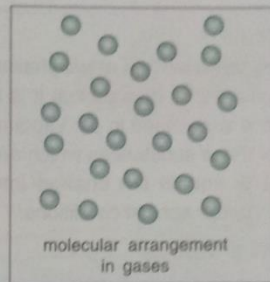
Intermolecular force of attraction : The property by which molecules are held close to each other is known as intermolecular force of attraction. It is maximum in solids, less in liquids and least in gases.



Solids
(Highest intermolecular forces of attraction)



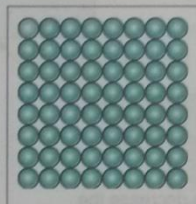
Liquids
(Less intermolecular forces of attraction)



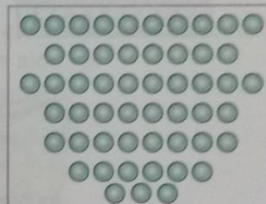
Gases
(Least intermolecular forces of attraction)

Due to high intermolecular forces of attraction, solids have high densities, are rigid and hard.

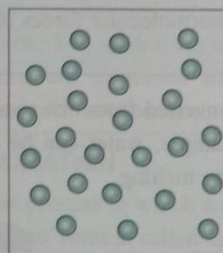
Intermolecular Spaces : The distance between the molecules in any substance is known as **intermolecular space**. These spaces are least in solids and maximum in gases.



Least
(Intermolecular Spaces)



Less
(Intermolecular Spaces)



Maximum
(Intermolecular Spaces)

Kinetic Energy : The molecules of gases collide among themselves and transfer the energy to the next molecules. This energy is mostly in the form of kinetic energy.

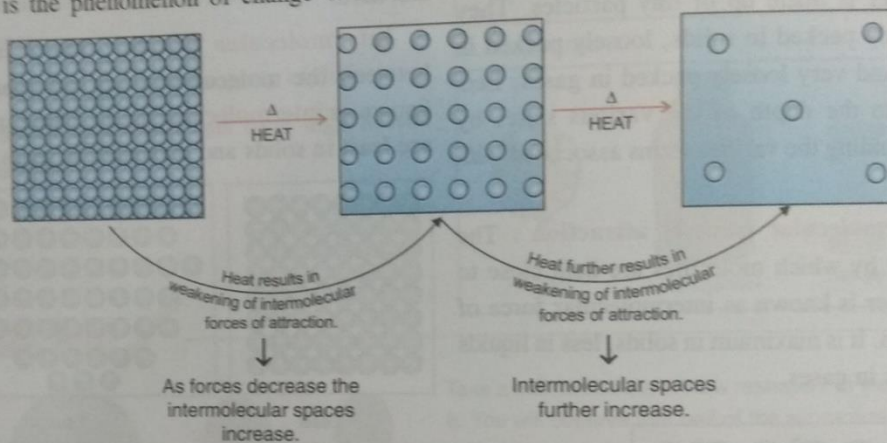
Q. What is a vapour ?

Ans. Vapour is generally a mixture of two phases - liquid and gas. It can be said that it is a gas or moisture suspended in air. Vapours are formed of those substances which are either solids or liquids but change into gaseous form under special conditions.

Example : Water vapours

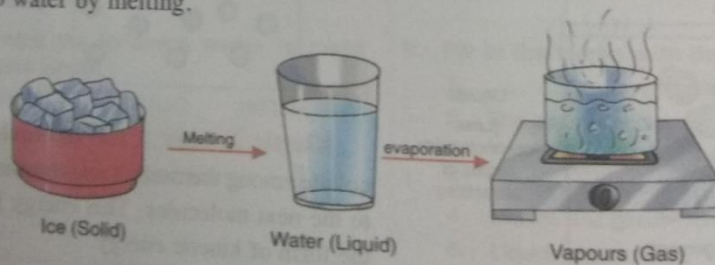
CHANGE IN STATE (INTERCONVERSION OF STATES OF MATTER)

It is the phenomenon of change of matter



$$\text{Intermolecular forces of attraction} \propto \frac{1}{\text{Intermolecular spaces}}$$

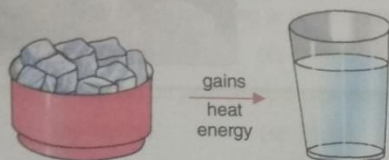
Matter can be converted from one state to another by simple processes like freezing, boiling, melting etc. For example, water can be converted to gaseous form by boiling and ice can be converted to water by melting.



CHANGE OF STATE

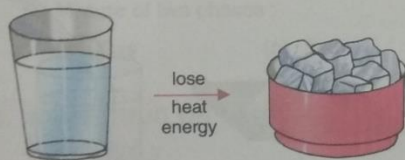
When matter is converted from one state to the other, it is called change of state. Let us understand the various processes that take place during change of state.

Conversion of solid into a liquid is called melting.



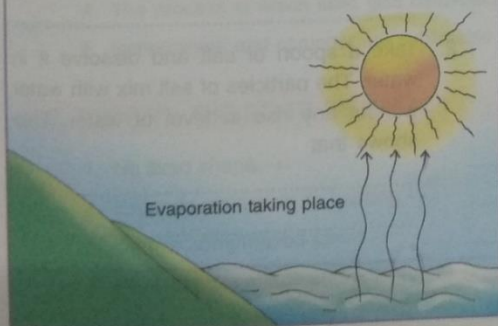
The solid substance (ice) gains heat.

Conversion of a liquid into a solid is called freezing.



The liquid substance (water) lose heat.

Conversion of liquid into vapour is called evaporation.



Conversion of vapours into liquid is called condensation.

Water vapours condense on the cooler zones of atmosphere to form clouds.

6 Activity

To observe the condensation of water vapours present in air.



Method : A glass full of ice cubes when kept in air for sometime gets droplets of water on its surface. The water vapour present in the atmosphere condense when they come in contact with cold surface.

SUBLIMATION

The process in which a solid gets converted to gaseous form is called sublimation.

Example :



Naphthalene balls

Skill-Fill

Take naphthalene balls and wrap them in a piece of cloth. Now keep it in, one side of your room.

Q. What will you observe after few days ?

Ans.

Q. Do you know why does it happen ?

Ans.



Worksheet

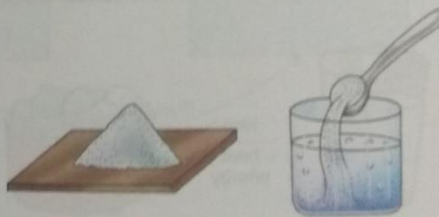
I. Complete the following sentences stating the reasons :

1. Solids have high densities because of
2. Gases have high kinetic energy because
3. Naphthalene balls change into vapours because
4. Intermolecular forces decrease on heating because

II. Fill in the blanks with suitable words :

1. The process of conversion of solid to gaseous state is known as
2. The forces of attraction keep the molecules together.
3. The process of conversion of solid to liquid is known as
4. Highest intermolecular spaces are present in

III. Give your conclusions for the following :



1. Take a spoon of salt and place it on a wooden block, the salt remains on the block only. This shows that
2. Take a spoon of salt and dissolve it in water. The particles of salt mix with water without any rise in level of water. This shows that

Objective Questions

A. TICK (✓) THE CORRECT CHOICE AMONGST THE FOLLOWING :

- Which of the following is not a matter ?
(a) Shadow (b) Chair (c) Toast (d) Juice
- What can be poured from one vessel to another ?
(a) Solids (b) Fluids (c) Air (d) Water
- Maximum intermolecular spaces are present between :
(a) Solids (b) Liquids (c) Gases (d) All of the above
- Physical states of matter can be interchanged by :
(a) Heating (b) Cooling (c) Heating or cooling (d) None of the above
- Mixture of two phases :
(a) Gas (b) Solid (c) Liquid (d) Vapour

B. WRITE TRUE OR FALSE FOR EACH STATEMENT, REWRITE THE FALSE STATEMENTS CORRECTLY :

- Solids have high densities, are rigid and hard.
- Gaseous state have least kinetic energy.
- Love, hate, shadow cannot be classified as matter.
- The process in which solid gets converted to liquid state is known as sublimation.
- Naphthalene and camphor are sublimable compounds

C. IDENTIFY THE STATE OF MATTER :

- No fixed shape → _____
- Expands maximum on heating → _____
- Can be compressed easily → _____
- Have definite shape and volume → _____
- Have maximum density → _____

D. MATCH THE ENTRIES OF COLUMN A WITH APPROPRIATE ENTRIES OF COLUMN B :

Column A	Column B
1. Liquid and gaseous state are	(a) random motion
2. Molecules are in	(b) fluid states
3. Liquids can be	(c) evaporation
4. Solids have	(d) compressed slightly
5. Conversion of liquid into vapours	(e) highest intermolecular forces of attraction

E. ANSWER THE FOLLOWING QUESTIONS :

- Name two quantities which are not regarded as matter.
- How many states of matter does water exhibit ?
- Name the state which cannot be compressed.
- Name the gas present in aerated drinks.
- Which energy is present in the molecules of gas ?
- What is matter ?
- What is matter made-up of ?
- Give three properties of matter.
- What do you understand by intermolecular space ?
- What do you understand by collision ?
- How does change in temperature results in change of state ?
- With the help of a diagram explain the compression taking place in gases.

F. SELECT THE ODD ONE OUT GIVING REASON :

- Melting, freezing, evaporation, sublimation
- Naphthalene, camphor, iodine, common salt
- Water, juice, oil, ice-cream

G. PLEASE HELP SANJAM TO FIND THE TERMS USED IN LESSON :



E	V	A	P	O	R	A	T	I	O	N
A	F	R	E	E	Z	I	N	G	R	K
M	S	P	A	X	A	P	Q	A	S	I
A	T	A	P	P	Z	P	P	S	B	N
T	B	S	P	A	C	E	S	E	A	E
T	G	I	H	N	H	X	B	O	N	T
E	F	P	R	D	N	T	S	U	E	I
R	D	I	F	F	U	S	E	S	T	C

Answers : Evaporation, freezing, gaseous, matter, kinetic, expand, diffuse, spaces.



Mind Ticking

To show compressibility in different states of matter.

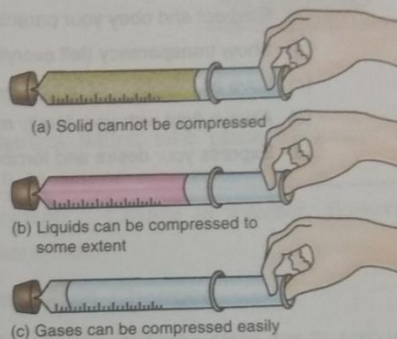
Method : Take three disposable syringes, without needle. Seal their nozzles with tape and fix them into the cork as shown in the figure. Remove their pistons and fill sand in the first syringe and coloured water in the second syringe. Remove cork and tape of third syringe. Pull its piston back to ensure the presence of air inside the syringe. Seal the nozzle again. Note down the initial reading of piston in all the three syringes. Now, try to compress all the three syringes.

Observation : You will find that :

- The piston remains unmoved in the first syringe containing coloured sand (solid).
- The piston moves a little in case of second syringe containing coloured water (liquid).
- The piston moves completely forward in case of a third syringe containing air (gas).

Result : This activity shows that :

- Solids are _____ .
- Liquids can be compressed to _____ .
- Gases can be compressed _____ .



(a) Solid cannot be compressed

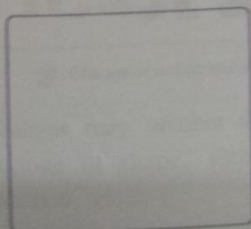
(b) Liquids can be compressed to some extent

(c) Gases can be compressed easily

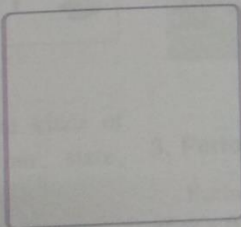


Home Assignment

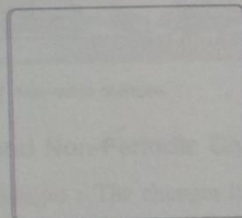
Children should prepare charts on the three states of matter showing the molecular/atomic composition.



Solid



Liquid



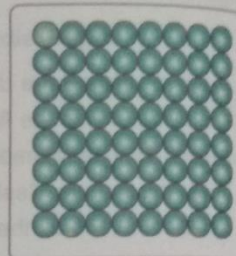
Gas

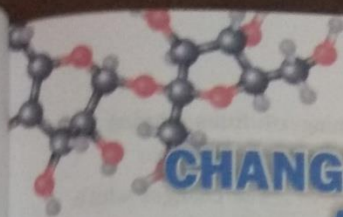
Skill Pill (Learning for Life)

Solids are hard and dense because of the intermolecular forces of attraction that exists between the molecules. Thus, where forces are strong, bonds are strong that state is the most stable one. Love your family, increase the bond strength so that your family is the strongest of all.

Q. What all can you do to increase the force of attraction between the family. Tick what all can be done.

- (a) Respect and obey your parents →
- (b) Show transparency (tell everything to your parents) →
- (c) Love all members of family →
- (d) Always fight with your family members →
- (e) Express your desire and forcibly get it done →





CHANGES IN THE WORLD AROUND US

CHAPTER 2

INTRODUCTION

Substances undergo a wide variety of changes. Many changes take place in nature for example, the change of weather, the change of a plant into a tree, the formation of cloud, the change of a child into an adult, etc. Some of these changes are beneficial to us while some are not.

"Change can be defined as alteration in physical and chemical properties of matter which give a new shape and properties to it."



Change of a child into an adult.

Changes may involve different kinds of alterations in shape, size, colour, state, composition, etc.

CLASSIFICATION OF CHANGES

Various changes have been classified into the following types as :

1. Natural Changes

Changes which take place by nature are known as *natural changes*.

Example : Change in weather, flowering of plants, etc.

2. Man-Made Changes

The changes that take place due to activities of man are called *man-made changes*.

Example : Burning of fuels, making of chapattis, formation of curd, etc.



Man-made changes.

3. Periodic and Non-Periodic Changes

Periodic changes : The changes that occur after a fixed interval of time are called *periodic changes*.

Example : Phenomenon of day and night.

Non-Periodic changes : Other changes that may take place at any time are called *non-periodic changes*.

Example : Rusting of iron, breaking of glass.

4. Desirable and Undesirable Changes

Desirable changes : The changes which are useful to us are called *desirable changes*.





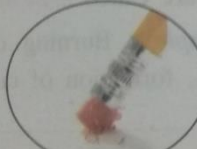

Example : Ripening of fruits, drying of clothes, etc.

Undesirable changes : The changes which are harmful to us are called *undesirable changes*.

Example : Spoiling of foodstuff, breaking of a glass, etc.

Skill Fill

Classify the following changes as desirable and undesirable changes.

Type of change	Desirable	Undesirable
 Flowering of plants		
 Spoilage of food		
 Rusting of Iron		
 Breaking of Glass		
 Erasing of Pencil		
 Drying of Clothes		

5. Fast and Slow Changes

Fast changes : The changes which occur in a short duration of time are called *fast changes*.

Example : Burning of a paper, burning of matchstick, etc.



Slow changes : The changes which take longer duration of time for their completion are called slow changes.

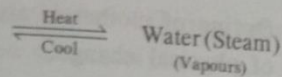
Example : Formation of curd from milk, rusting of iron, etc.

Fast and slow are relative terms. For example, the heartbeat becomes fast when one is excited, and slow when one is at rest.

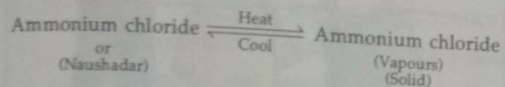
6. Reversible and Irreversible Changes

(a) Reversible changes : A change is reversible if the substances can be brought back to their original form after the occurrence of the change. A reversible change is indicated by using double arrow (\rightleftharpoons).

+ Evaporation is another example of a reversible change.



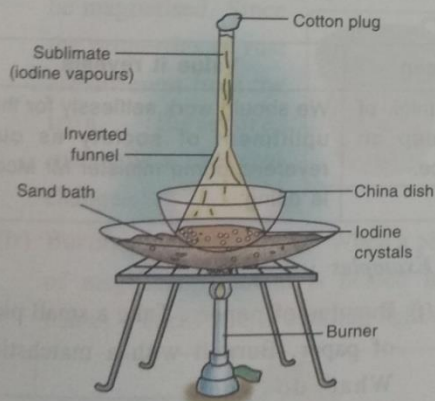
+ Sublimation is also an example of a reversible change.



1 Activity

To study the process of sublimation.

Method : Take some powdered crystals of iodine in a china dish on which an inverted funnel is placed. The stem of the funnel is plugged with a little cotton. Heat the china dish on a sand bath. The deep violet vapours of iodine will rise up and condense on the cooler walls of the funnel.



Sublimation.

(b) **Irreversible changes :** A change is irreversible if the substance cannot be brought back to its original state.

Examples of irreversible changes are :

- (i) Burning of paper
- (ii) Souring of milk
- (iii) Breaking of glass tumbler
- (iv) Germination of seed, cooking of food, growth of a plant, all are examples of the irreversible changes.

7. Physical and Chemical Changes

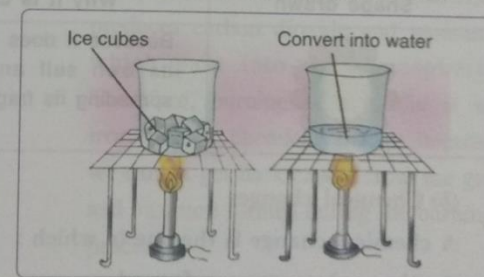
(a) Physical changes :

A physical change is the one in which :

- + The substance undergoing the change is not destroyed.
- + No new element or compound is formed.
- + Only the colour, shape or size of the substance may change.

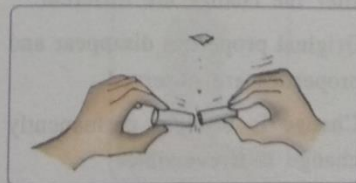
Examples :

- (i) Conversion of water into ice and conversion of water into steam are physical changes because ice and steam can be converted back into water.

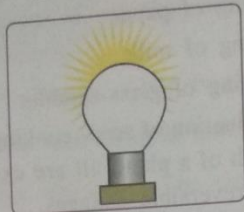


Conversion of ice into water on heating is a physical change.

- (ii) Breaking of chalk stick.



(iii) Glowing of an electric bulb.



(iv) Moulding of clay or kneading of flour is a physical change.

(v) Magnetising an iron nail is a physical change.

(vi) Powdering of sugar is also a physical change.

(vii) Drying of clothes is also an example of physical change.




Skill-Fill



CLAY MOULDING

Take coloured clay. Knead the clay properly and then using the moulds make different shapes. Conduct a competition for the students under the name. Let every student prepare something of clay and then give reason for choosing it and value revealed by it. One example has been given below.

Shape drawn	Why it is chosen	Value it reveals
	Because it does not think of its own self and keep on spreading its fragrance.	We should work selflessly for the upliftment of society as our reverend prime minister Mr Modi is doing.

(b) Chemical changes :

A chemical change is the one in which :

- + New substances are formed.
- + Properties of the substance before and after the change are different.
- + Original properties disappear and new properties are observed.
- + Change is brought permanently and change is irreversible.

Examples :

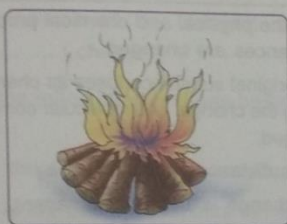
(i) **Burning of paper** : Take a small piece of paper. Burn it with a matchstick.

What do you observe ? When paper burns; carbon dioxide, water vapours and ash are produced. None



of these has the property of paper. Hence, this is chemical change.

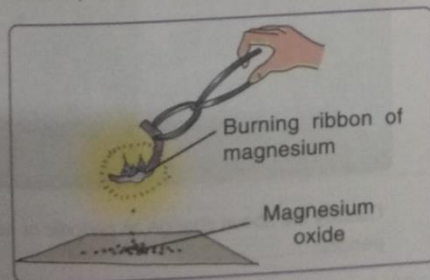
- (ii) **Burning of wood** : During burning of wood new substances like ash and smoke are produced which have properties different from that of wood. Thus, the burning of wood is irreversible chemical change because we cannot get back wood from smoke and ash.



- (iii) **Rusting of iron** : Rusting converts the grey solid iron into a reddish brown powdered solid which cannot be magnetised. Since the properties of rust are different from the iron, therefore, rusting is a chemical change.

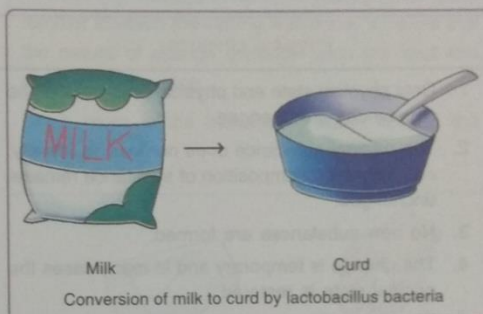


- (iv) **Burning of magnesium** : When a piece of magnesium ribbon is heated in a flame, it burns with a dazzling light and



produces a white powder of magnesium oxide.

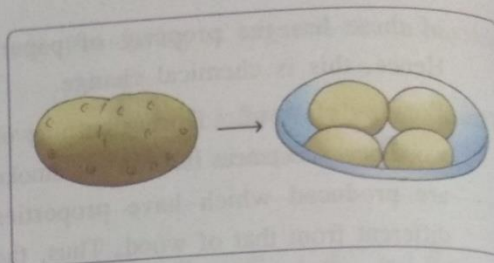
- (v) **Souring of milk** : Milk is a sweet liquid whereas curd is sour in taste and is in a semi-solid state. Souring of milk is an irreversible change because we cannot get back milk from curd.



- (vi) **Burning of a candle** : When candle burns it also melts. Melting alone is a physical change, because on cooling solid wax is formed. But burning produces carbon dioxide and moisture which pass into the atmosphere. Therefore, burning of a candle is an irreversible chemical change because we cannot get back candle from the gas and moisture formed during the burning process.



(vii) **Cooking of food** : When food is cooked many complex carbohydrates are broken down into simpler sugars. Many water soluble vitamins and fat soluble vitamins are destroyed. The texture of foodstuff change which cannot be reversed.



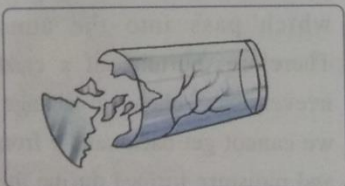
Differences between physical and chemical changes.

Physical changes	Chemical changes
<ol style="list-style-type: none"> Only physical state and physical properties of the substances are changed. The original substance does not lose its identity, <i>i.e.</i>, molecular composition of substance remains unchanged. No new substances are formed. The change is temporary and in many cases the original state is restored. <p>Example : Changing of water into ice.</p>	<ol style="list-style-type: none"> Both the physical and chemical properties of the substances are changed. The original substance loses its chemical identity during the change, <i>i.e.</i>, molecular composition gets changed. New substances are formed. The change is usually permanent, <i>i.e.</i>, original state cannot be restored. <p>Example : Burning of paper.</p>

Worksheet

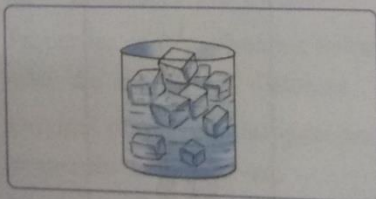
I. Complete the following sentences as per instruction :

1.



Classify the above change as desirable or undesirable

2.



Classify the above change as reversible or irreversible

3.



IRON BEING RUSTED

Classify the above change as physical or chemical

4.



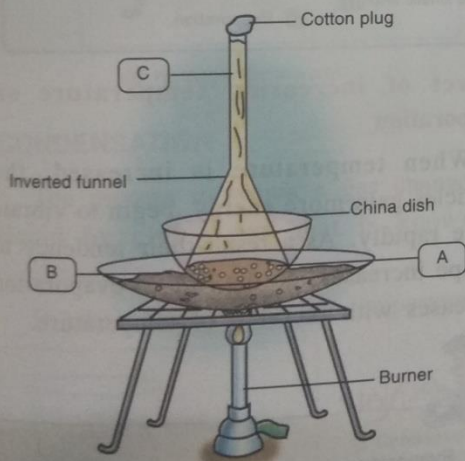
Classify the above change as periodic or non-periodic

II. Fill in the blanks :

1. Changes which take place by nature are known as
2. Changes which are harmful to us are known as changes.
3. Changes which take longer duration of time for completion are called changes.
4. Magnetising of an iron nail is a change.
5. New substances are formed during a change.

III. Answer the following questions based on the diagram :

1. Name the substances A, B and C.
2. What is the colour of vapours formed ?
3. Name the process which is shown.
4. Define the above stated process.
5. Name any other substance which also shows such phenomenon.

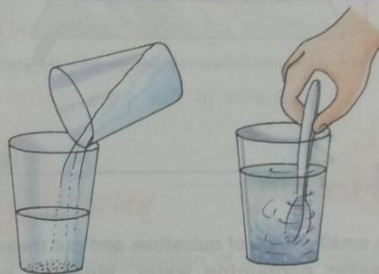


A change depends upon the nature and intensity of interaction.

Take two tumblers. Fill them about half with water. Add one teaspoonful of sugar in each tumbler. Stir the water in one tumbler with a spoon. Keep the other tumbler undisturbed. Observe carefully. In which tumbler does sugar dissolve rapidly ?

You will see that sugar dissolves rapidly in the glass tumbler in which the stirring was done. It means that the nature of change depends upon the kind and extent of interaction.

Thus, more is the interaction, faster will be the change.



CHANGES INVOLVE ENERGY

(a) Endothermic changes

Glucose + Heat (from the surface of tongue) \rightarrow Cooling effect of tongue

The change during which the heat is absorbed are called endothermic changes.

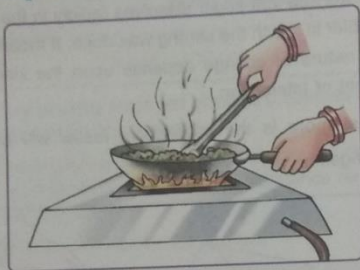
(Endo means *in* and thermic means *heat*). An endothermic change is the one in which the cooling is observed.

Example : If you put a small amount of glucose on your tongue, it dissolves and your tongue feels cool.

(b) Exothermic changes

The changes during which heat energy is evolved are known as exothermic reactions. (Exo means *out* and thermic means *heat*). An exothermic change is the one in which heat is liberated.

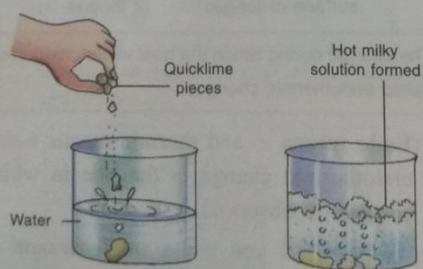
Example : Cooking of food; slaking of lime.



2 Activity

Take small pieces of quicklime and put them in a beaker containing water. What do you observe?

Result : You will notice that water becomes very hot forming a milky white solution. It is because of the fact that reaction between quicklime and water is an exothermic reaction.

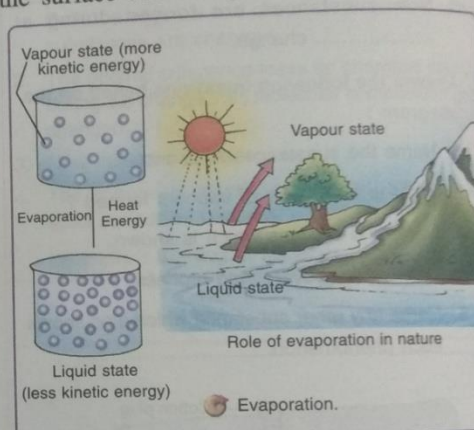


An exothermic change.

EVAPORATION

“The process in which a liquid changes into vapour is known as evaporation.”

When heat is supplied to a liquid, the molecules start vibrating with increased speed and the particles in the liquid move in all directions. This increase in amount of kinetic energy reduces the forces of attraction between the existing molecules and these molecules leave the surface and change into vapour state.



Effect of increasing temperature on evaporation

When temperature is increased, the particles gain more energy, begin to vibrate more rapidly. As a result their tendency to escape increases, so the rate of evaporation increases with increase of temperature.



1. Evaporation is a surface phenomenon. It means that evaporation takes place only from the surface of the existing liquid.
2. Evaporation takes place at all temperatures.

Skill-Fill

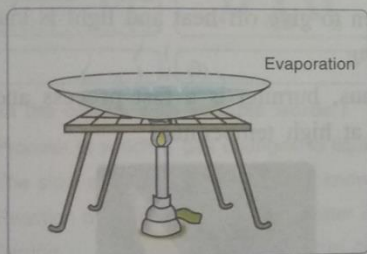
Measure 200 mL of water and pour it in an open vessel. Now, take 200 mL of water and pour it in another narrow vessel. Keep both on the flame and note the time taken for complete evaporation of water.


Observation : Vessel _____ has more surface area so the water will evaporate at a faster rate than the water in vessel _____.



BOILING

“The constant temperature at which liquid changes to vapour is known as *boiling point* and the phenomenon is referred to as *boiling*”.

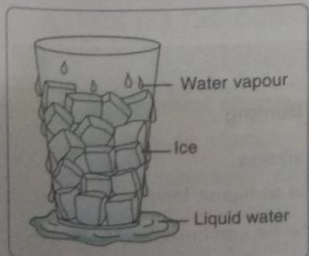



 Heating water in a pan.

CONDENSATION

The process in which a gas changes to liquid by giving out heat is known as *condensation*.

It takes place when the temperature is



 Condensation of water vapours on the cold surface.

decreased. This can be seen when a glass full of ice cubes is kept for sometime in air.

DISSOLUTION

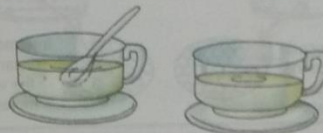
The process in which a substance mixes thoroughly in another substance is known as *dissolution*, e.g., salt in water.

3 Activity

To show the dissolution of sugar in water.

Method : Take a glass of water. Add 50 g of sugar to it and stir it. You will find that the crystals of sugar get reduced in size and finally become so small that they get mixed with water molecules.

Result : Sugar solution is obtained.

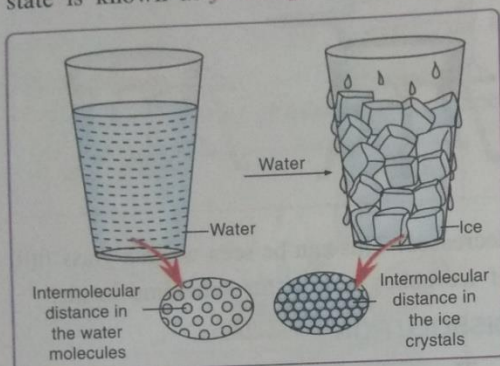


Factors affecting dissolution :

1. **Temperature :** More is the temperature, more is dissolution.
2. **Stirring :** Greater the stirring, more is the dissolution.
3. **Concentration of solvent :** More is the concentration of solvent, less is the dissolution.

FREEZING

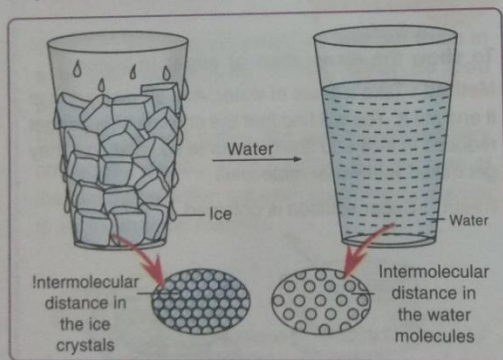
The process in which a liquid substance loses its heat and gets converted into solid state is known as *freezing*.



Freezing of water.

MELTING

The process in which a solid absorbs heat and gets converted into liquid state is known as *fusion* or *melting*.

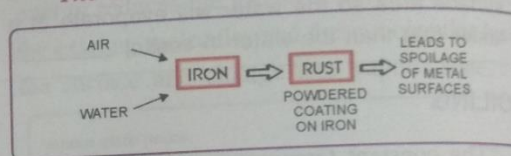


Melting of ice.

RUSTING

The process in which iron forms a layer of powdered iron oxide over it in the presence of air and water is known as *rusting*. This rust is loosely attached to the metal surface and gets removed easily. Thus, metal is lost. Hence, rusting can be defined as :

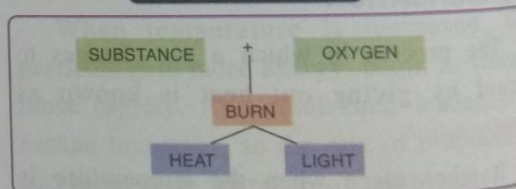
"The slow eating away of metal."



BURNING

The process in which a substance burns in oxygen to give off heat and light is known as *burning*.

Thus, burning is a fast process and takes place at high temperature.



Comparison of Rusting and Burning

Rusting

1. Rusting is a slow process.
2. Rusting takes place at room temperature.
3. Rusting takes place on metal surfaces.

Burning

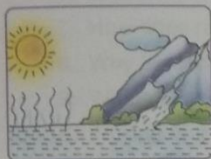
1. Burning is a fast process.
2. Burning takes place at higher temperature.
3. Burning takes place for combustible substances.

Comparison of Burning and Respiration

Burning	Respiration
<ol style="list-style-type: none"> 1. Burning is a fast process. 2. Burning takes place at higher temperature. 3. Burning takes place for combustible substances. 4. Burning do not involve any enzymes. 	<ol style="list-style-type: none"> 1. Respiration is a slow process. 2. Respiration takes place at body temperature. 3. Respiration take place in living organism. 4. Enzymes are biocatalyst and these are required for respiration.

Worksheet

I. Name the process shown in picture :



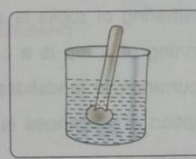
E



B



M



D

II. Fill in the blanks with suitable words :

1. Process in which a gas changes to liquid by giving out heat is known as
2. The slow eating away of metals is known as
3. Reaction between quicklime and water is an
4. Stirring the rate of dissolution.
5. takes place at all temperatures.

Objective Questions

A. TICK (✓) THE CORRECT CHOICE AMONGST THE FOLLOWING :

1. Sublimation of iodine is a :

(a) Chemical change	(b) Physical change
(c) Periodic change	(d) Irreversible change
2. When magnesium ribbon is burnt, heat and light are produced. It is an example of :

(a) Chemical change	(b) Physical and irreversible change
(c) Chemical and exothermic change	(d) Chemical and endothermic change

3. Powdering of sugar is :
- (a) Chemical and irreversible change (b) Physical change
 (c) Reversible change (d) Irreversible change
4. Making ice from water is an example of :
- (a) Man-made change (b) Chemical change
 (c) Sublimation (d) Undesirable change
5. Melting of butter is not a :
- (a) Fast change (b) Desirable change
 (c) Reversible change (d) Permanent change

B. FILL IN THE BLANKS :

1. Curdling of milk by bacteria is a change.
2. Weathering of rocks is a change.
3. Spinning of a top is a change.
4. Occurrence of landslides is a change.
5. Eruption of volcanoes is a change.
6. Moulding of clay is a change.
7. Rusting of iron nails is a change.
8. Evaporation of water is a change.
9. Burning of paper is a change.
10. Formation of day and night is a change.

C. WRITE TRUE OR FALSE FOR EACH STATEMENT. REWRITE THE FALSE STATEMENTS CORRECTLY :

1. In an exothermic reaction, heat is given out.
2. In a chemical reaction no new substance is formed.
3. Reaction of zinc pieces with hydrochloric acid is an exothermic reaction.
4. Glowing of an electric bulb is a physical change.
5. Breaking of a glass tumbler is a reversible change.
6. Burning of wood is a chemical change.

D. GIVE ONE WORD FOR THE FOLLOWING :

1. Changes which take place by nature are known as :
2. Changes that take place due to activities of man are known as :
3. Changes which take place after a fixed interval of time :
4. Changes which take place at any time are known as :
5. Changes which occur in short duration of time :
6. Changes which take longer duration of time :

7. Changes which can be reversed :
8. Changes which cannot be reversed :
9. Change of state from solid to liquid :
10. Change of state from liquid to gas :

E. ANSWER THE FOLLOWING QUESTIONS :

1. What is the formula of quick lime ?
2. Which arrow is used to indicate a reversible change ?
3. What is the colour of flame when magnesium burns in air ?
4. Give two factors on which a change depends.
5. Name the reactions in which heat is absorbed.
6. Define dissolution.
7. How does rate of evaporation change when temperature is increased ?
8. Why is rusting referred as slow eating of metals ?
9. Which changes are referred to as undesirable changes ?
10. 'Pulling of a rubber string is a reversible change'. Explain.
11. Differentiate between :
 - (a) Rusting and burning.
 - (b) Burning and respiration.
12. What is evaporation ? How does water change to its vapour state ?
13. Differentiate between physical and chemical changes.

F. SELECT THE ODD ONE OUT GIVING REASON :

1. Burning of wood, rusting of iron, souring of milk, freezing of water.
2. Freezing of water, magnetising an iron nail, breaking of chalk stick.
3. Rusting, burning, combustion, melting.

G. COMPLETE THE FOLLOWING TABLE RELATED TO THE DIFFERENCE BETWEEN RUSTING AND BURNING :

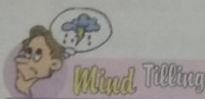
Rusting		Burning	
1. S.....(process)		F.....(process)	
2. R.....(temperature)		H.....(temperature)	
3. M.....(substance)		G.....(substance)	

Moist	Room	Fast
Slow	High	Combustible

H. HELP SANJAM TO CONCLUDE FOR THE EXPERIMENT :



When water is added to copper sulphate it turns
 B..... . When it is heated it turns
 W..... again. This proves that
 P..... change is taking place.



With respect to rusting of iron, answer the following questions :

- What is rust :
 - (a) powdered iron oxide
 - (b) powdered sodium chloride
- Why rust gets removed easily ?

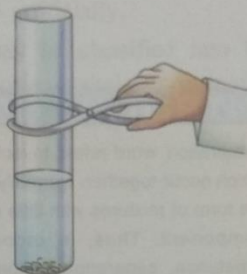
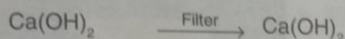
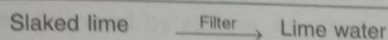
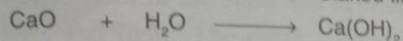
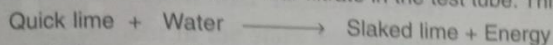
- What type of change it is ?
 - slow
 - reversible
 - physical





SLAKING OF LIME I

Take 5 g of quick lime (CaO) in a test tube and hold it with the help of tongs. Now, add 10 mL of water to it. Keep the test tube at a distance. You will hear hissing sound due to reaction of lime with water. After the reaction has stopped, touch the test tube, you will find that the test tube is hot. Now, filter the solution in another test tube. You will find clear filtrate in the test tube. This filtrate is lime water.



Based upon the above experiment answer the following :

1. Why does the reaction mixture become hot ?
.....
2. Why is hissing sound observed ?
.....



Skill Pill (Learning for Life)

We cannot live in same conditions forever. We need a change. A positive change helps us to do better whereas negative change reduces our efforts and drags us back. Knowledge and experience brings a positive change in our life.

Q. What can you do to bring a positive change in yourself ?

- (a) Count your blessings (what you got from life)
- (b) Count your missed opportunities. (Which you haven't got from life)



SEPARATION OF SUBSTANCES

CHAPTER 3

INTRODUCTION

'Separation' word refers to isolation of substances which occur together. Normally substances exist in the form of mixtures with little or more of the other component. Thus, in order to have a pure substance, separation becomes must and this separation can be done by physical or chemical methods.



Milk (Not a pure substance).

PURE SUBSTANCES

"Pure substance is the one which is made-up of only one kind of molecules. It has definite composition and properties."

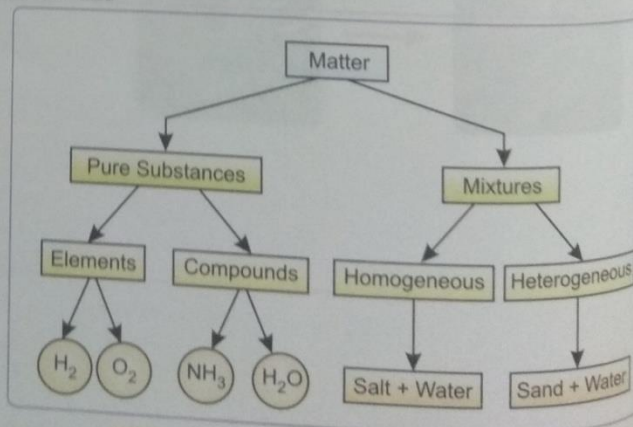
Pure substance is the one which has uniform composition and properties. It is pure and composed of single units which cannot be separated by physical means. Elements and compounds are thus, classified as pure substances.

Milk appears to be pure but actually it is a mixture of carbohydrates, fats, proteins, sugar, vitamins and minerals. Thus, it is a mixture and not a pure substance.

Any substance, if it is to be categorised as a pure substance

should exhibit the following properties :

- It should have fixed melting and boiling points.
- It should have a definite specific gravity.
- It should have uniform composition.
- It could be separated by chemical means only.

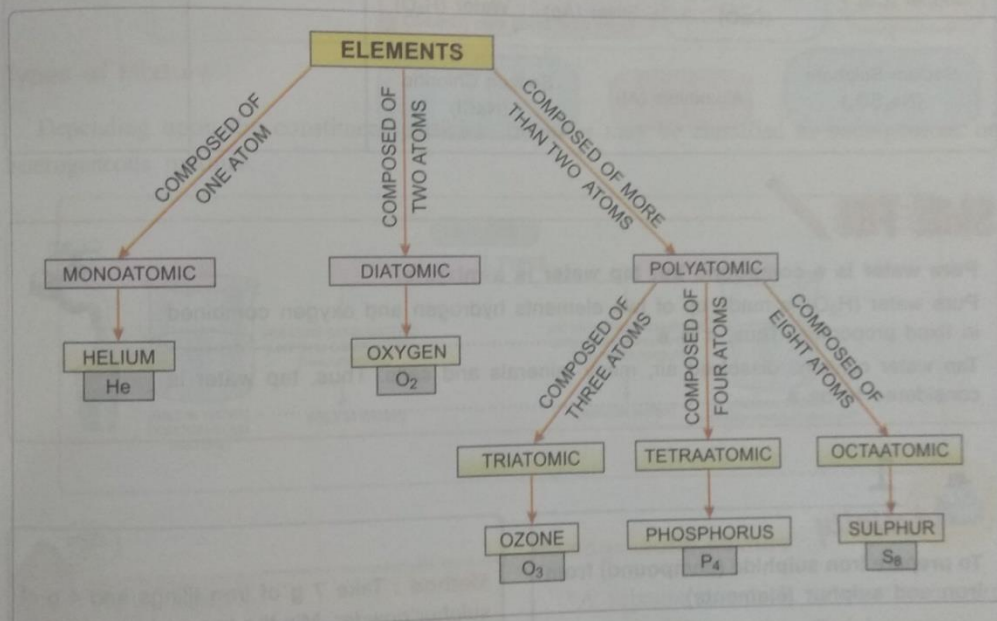


ELEMENTS

There are nearly 120 elements known to us, out of which nearly 90 elements are natural whereas other elements are created artificially. The two elements which are considered to be the building blocks of this universe are hydrogen and helium. Today also they are present in the stars and account for their heat and light. The earth's crust is rich in oxygen followed by silicon. Our body comprises mainly of carbon, hydrogen and oxygen.

Characteristics of element :

1. An element is made-up of only one kind of atom.
2. It cannot be broken down into simpler substances by any physical or chemical process.
3. Elements may occur naturally or may be prepared artificially.
4. Elements may be classified into four main categories-metals, non-metals, metalloids and noble gases.



COMPOUNDS

A compound is a pure substance which is made-up of two or more elements combined chemically in a fixed ratio by weight and it can be broken down into elements by chemical methods only.

Characteristics of a compound :

1. It is homogeneous in nature.
2. It has a fixed composition by weight.
3. Compound is formed from its elements by chemical reaction.

4. The properties of a compound are different from those of constituent elements.
5. A compound has a definite melting and boiling points.

Skill-Fill

Classify the following chemical substances into elements and compounds

	Elements	Compounds
Iron (Fe) Plaster of Paris (CaSO ₄) ₂ H ₂ O Sodium Hydrogen carbonate (NaHCO ₃) Copper (Cu) Calcium oxide (CaO) Silver (Ag) Water (H ₂ O) Sodium Sulphate (Na ₂ SO ₄) Aluminium (Al) Sodium Chloride (NaCl)		

Skill-Fill

Pure water is a compound but tap water is a mixture.

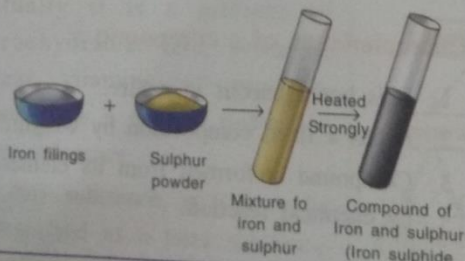
Pure water (H₂O) is made up of two elements hydrogen and oxygen combined in fixed proportion. Thus, it is a

Tap water contains dissolved air, many minerals and salts. Thus, tap water is considered to be a

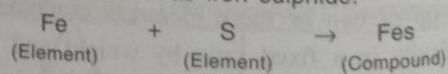


1 Activity

To prepare iron sulphide (compound) from iron and sulphur (elements).



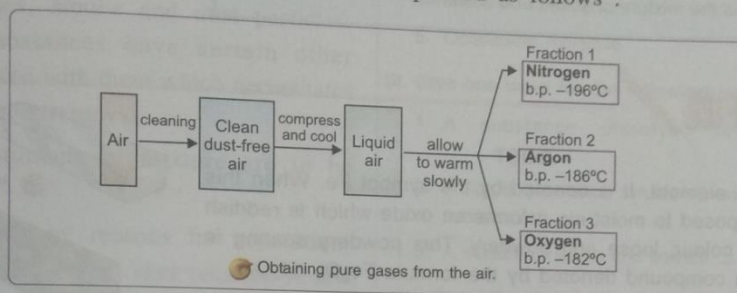
Method : Take 7 g of iron filings and 4 g of sulphur powder. Mix the two and transfer it to a test tube. Now heat it strongly for some time. You will observe a colour change i.e., a black compound of iron and sulphur will be formed known as iron sulphide.



MIXTURE

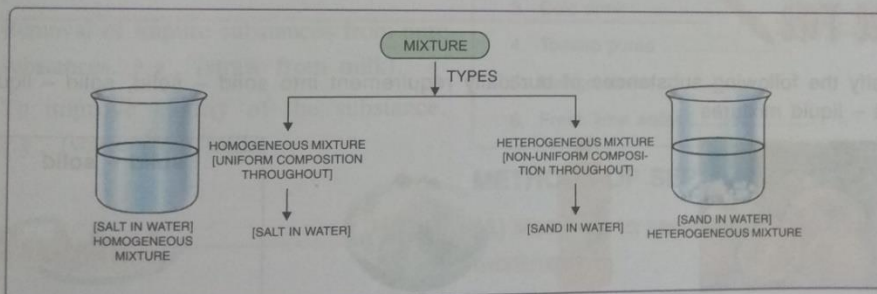
“A *mixture* is formed when two or more substances are mixed together in any proportion such that they retain their individual properties and can be separated by physical means”.

Air is a mixture and its components can be separated as follows :



Types of Mixture :

Depending upon the constituent particles, mixtures may be classified as homogeneous or heterogeneous mixture.



Do You Know ?

Any solution is a homogeneous mixture of solute and solvent.

Alloys are the homogeneous mixture of one metal with another or of a metal with a non-metal.

Homogeneous Mixture

“A mixture in which its constituents are distributed uniformly is called homogeneous mixture.”

Heterogeneous Mixture

“A mixture in which its constituents are not distributed uniformly is called heterogeneous mixture.”

Remember

- « Solute is the solid or dissolved substance in a solution.
- « Solvent is the liquid substance which dissolves other substances.
- « Solution is the mixture of solute and solvent.

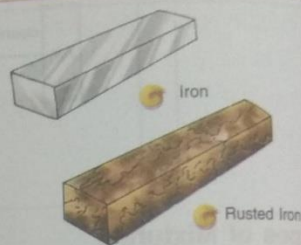
Skill Fill

RUST

Iron is an element. It is denoted by the symbol Fe. When this iron is exposed to moist air, it forms an oxide which is reddish brown in colour, loose and powdery. This powdery coating is actually a compound denoted by the formula $Fe_2O_3 \cdot xH_2O$.

The two conditions necessary for rusting are :

- (i) _____ (ii) _____



Skill Fill

Classify the following substances of our daily requirement into solid – solid, solid – liquid, liquid – liquid mixtures



Mixture of Fruits



Orange Squash



Boiled Rice

solid – solid



Dough



Mixed Vegetable

solid – liquid



Lemon Water

liquid – liquid



Talcum Powder



Idli



Hard drink

SEPARATION OF MIXTURES

Most substances around us contain impurities. For example, the rice we buy has stone, sand and husk in it. Milkman usually mix water in milk. Air we breathe contains chemical fumes, smoke and dust particles. Thus, all substances have certain other substances mixed with them which necessitates the need of their removal.

Why constituents of mixture are to be separated?

There are many reasons for separation. It depends on needs and other reasons. A few reasons are as follow :

- To remove undesirable material from desirable material. *e.g.*, (stones from pulses).
- Removal of impure substances from pure substances. *e.g.*, (straw from milk).
- To improve quality of the substance. *e.g.*, (water from milk).

Worksheet

I. Fill in the blanks with suitable words :

- Pure substance is the one which is made-up of only one kind of
- The two elements which are considered to be the building blocks of this universe are and
- cannot be broken down into simpler substances.
- A has a definite melting and boiling point.
- Air is a mixture of gases.

II. Give one example of :

- Monoatomic element.
- Diatomic molecule.
- Triatomic molecule.
- Tetraatomic molecule.
- Octaatomic molecule.

III. Give one word for the following :

- A substance dissolved in solvent
- A liquid substance which dissolves other substances
- A mixture of solute and solvent

IV. Classify the following solutions into homogeneous or heterogeneous :

- Milk
- Muddy water
- Cold drink
- Tomato puree
- Mango shake
- Fresh lime water

METHODS OF SEPARATING MIXTURES

(A) Methods to separate a solid from solid mixtures :

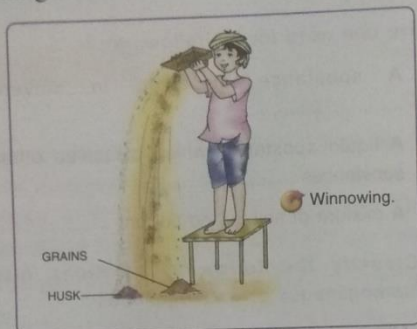
With advanced science and technology, we are able to separate different mixtures with different methods devised and formulated for specific purposes. Some of the methods are as follow :

1. **Winnowing** : It is a process used by farmers to separate grains from husk (outer coating of grains).

Principle : Winnowing is based on the fact that grains are heavier than husk.

Method : The mixture of grains and husk is made to fall from a height. Wind carries the husk with it, and two separate heaps are obtained for husk and grains.

Example : Separating chaff or husk from wheat grains.



2. Hand picking : It is a process in which undesirable components are removed from the desired components manually.

Principle : It is based on the fact that, one of the component differs in shape, size or colour.

Method : This method is used only when any one of the component is present in small quantities and differs in colour, shape or size so that it can be picked up manually.

Example : Stones in pulses.

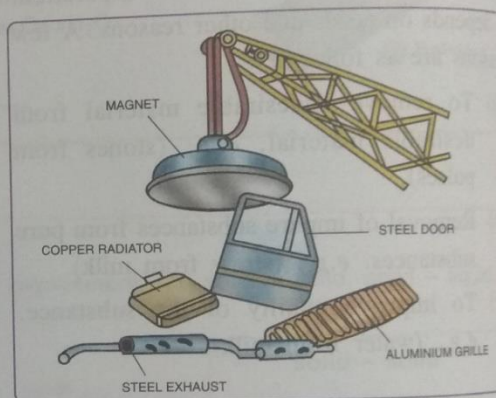


3. Magnetic separation : This method is employed to separate the magnetic substances from the mixture.

Principle : It is based on the property of a magnet to attract magnetic substances towards it.

Method : Magnet is passed over the mixture containing iron. All the iron particles get clinged to the magnet and impurities are left behind.

Example : Iron from a mixture of iron and sulphur.



Magnetic separation technique is used to separate iron scrap from plastic and other metals.



Electromagnet is the magnet which shows its magnetic properties only in the presence of an electric current.

4. Sieving : It is the process in which any mixture is passed through porous material. The smaller components of the mixture pass through the sieves and bigger components are left on the sieves.

Principle : It is based on the principle of filtration.

Method : The mixture is taken on the sieve and given mechanical force, the smaller components pass through the sieve and bigger components are left.

Examples : (i) Tea leaves from tea.
(ii) Sieving of flour.



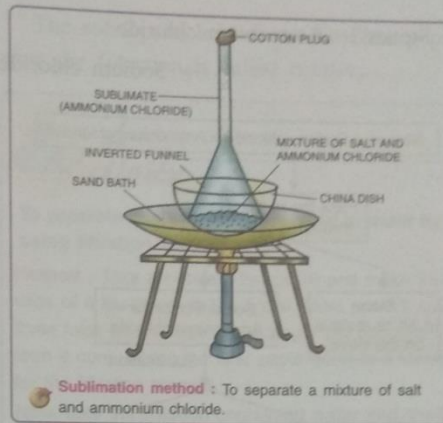
5. Sublimation : It is the process in which a solid changes directly into vapour and vapour changes directly into solid.

Principle : It employs the principle of change of state by skipping the intermediate state.

Method : The mixture is taken in a sublimating dish and heated strongly until one component gets evaporated and condense to form solid on the upper part of the sublimating flask (or inverted funnel) as shown in the diagram.

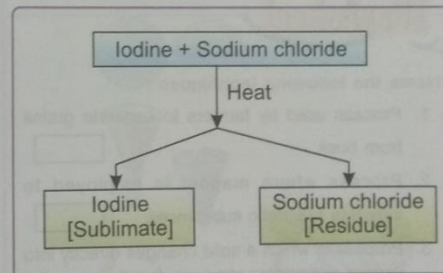
Remember

Camphor, iodine, naphthalene and ammonium chloride undergo sublimation.

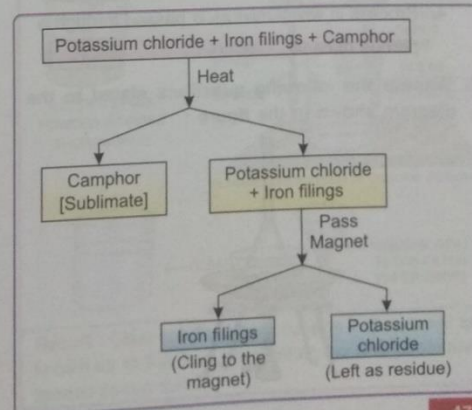


Schematic schemes to separate solid-solid mixture

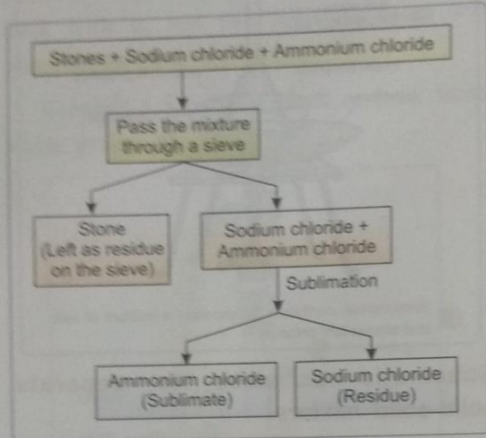
1. Iodine + Sodium chloride



2. Potassium chloride + Iron filings + Camphor



3. Stones + Ammonium chloride
+ Sodium chloride



Worksheet

I. Name the following techniques :

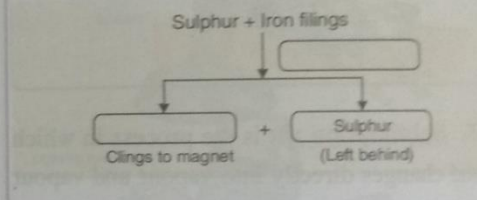
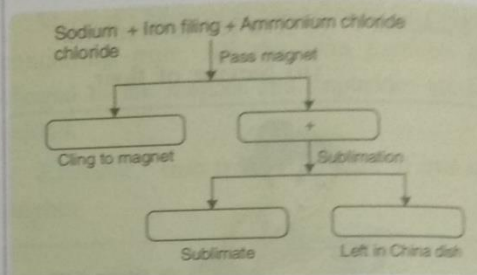
1. Process used by farmers to separate grains from husk.
2. Process where magnet is employed to separate magnetic substances.
3. Process in which a solid changes directly into vapour and vapour changes directly into solid.
4. Process in which mixture is passed through a porous material.

II. Answer the following questions stated to the diagram shown in the figure :



1. Which process is shown in the diagram ?
2. Which compounds are taken for sublimation ?
3. Name the sublimable compound.
4. Which compound will be left in China dish ?
5. Give the principle of sublimation.

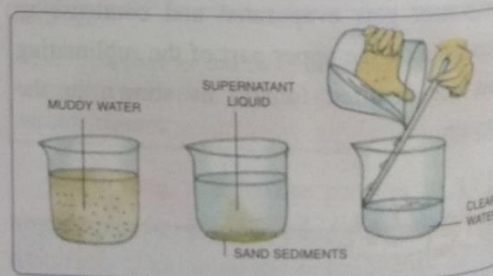
III. Complete the following schematic schemes :



(B) Methods to separate a liquid or a solid from liquid mixtures :

1. Sedimentation

It is the process of settling down of heavy solids at the bottom.



Separation of sand from water by sedimentation.

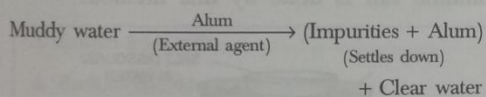
This method is used to separate mixtures in which one component is heavier and on prolonged standing, the heavier component settles down.

Take a glass, fill it with muddy water and allow it to stand for sometime. You will observe that mud settles down at the base and clear water can be seen above it. This process is known as *sedimentation*.

Pour carefully the clear water (supernatant liquid) into another beaker without disturbing the sediments. This process is called *decantation*. Thus, 'removal of the clear layer of the liquid without disturbing the settled solids is called *decantation*.'

2. Loading or Coagulation

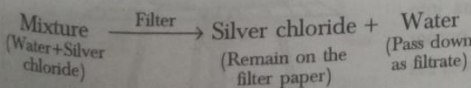
The process in which an external agent is added to bring the process of sedimentation is known as loading.



This process is carried out when the volume of water to be purified is large. Loading is done by dissolving alum in water. Alum is dissolved in muddy water. The dissolved particles of alum load the fine clay particles, makes them heavier and settles them down.

3. Filtration

The process in which an insoluble component is removed from the liquid mixture is known as *filtration*.



The clear liquid obtained from the suspension of an insoluble solid and liquid by the process of filtration is known as *filtrate*.

The solid particles left on the filter paper after the filtration is called *residue*.

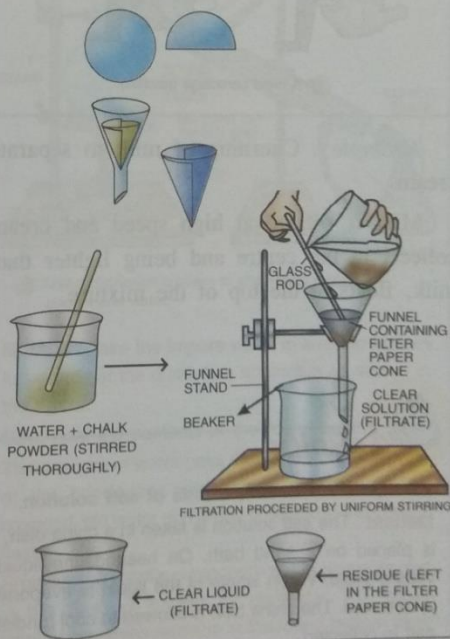
2 Activity

To separate chalk powder dissolved in water by using filtration technique.

Method : Take a circular filter paper and make four folds of it as shown in the figure. Now, open it out, three folds on one side and a single fold opposite to form a cone. Place the filter paper cone in a funnel for the filtration process.

Now, take the solution containing water and chalk powder and proceed as shown in the figure.

- Fix the cone on the filter paper by slightly wetting it.
- Now, pour the solution by continuous stirring.
- Don't overflow the funnel with solution.



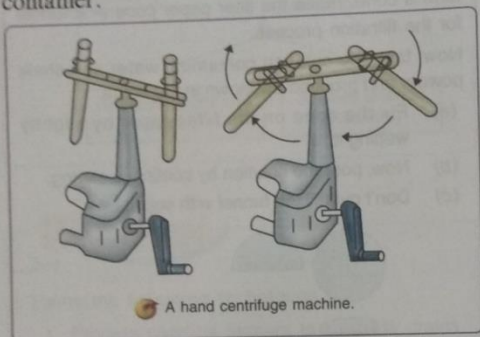
Result : Clear solution which collects in the beaker is known as *filtrate*. Impurities left on the filter paper are termed as *residue*.

4. Flootation

It is the process by which we can remove insoluble lighter solids from the liquid-solid mixture. e.g., saw dust and water can be separated by this method.

5. Centrifugation

Centrifugation is a method for separating the fine suspended particles of a substance in a liquid by rotating the liquid in a closed container.



Example : Churning of milk to separate cream.

Milk is rotated at high speed and cream collects in the centre and being lighter than milk, floats at the top of the mixture.

3 Activity

To separate the components of salt solution.

Method : The salt solution is taken in a china dish, and china dish is placed on a sand bath. On heating, the liquid changes into vapour state. When whole of the liquid is evaporated, the burner is removed. The china dish is allowed to cool (undisturbed) and the salt is collected.

Result : Salt is obtained from the salt solution by evaporation method.



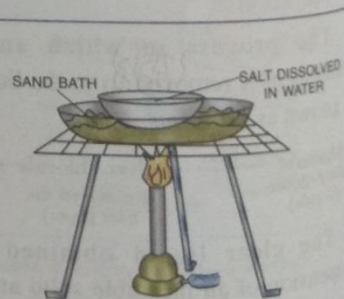
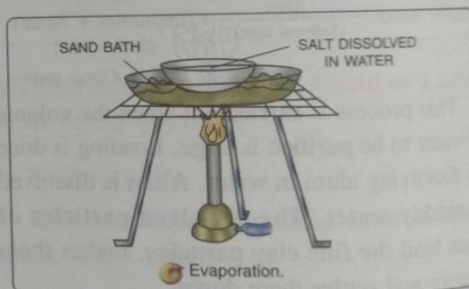
Did You Know ?

The process of centrifugation is widely used to remove water from the clothes in a washing machine. The washing machine also use this principle to squeeze out water from wet clothes. The drum of the machine has holes in it. When the drum is rotated at high speed then due to centrifugal force, clothes are pushed forcefully towards the wall of the drum and the water gets drained from the clothes into the holes of the drum.

6. Evaporation

The process in which a liquid changes into the vapour state on gentle heating is known as *evaporation*.

This process is used to separate those mixtures in which one of the component is non-volatile. The separation of water and common salt is done by this method.



Worksheet

I. Name the following process :

- The process of settling down of heavy liquids.
- The process in which an insoluble component is removed from the liquid mixture.
- The process in which an external agent is added to bring the process of sedimentation.
- The process in which a liquid changes into the vapour state.

II. Name the process used to separate the following mixtures :

- Muddy water →
- Silver chlorides from water →
- Cream from milk →
- Sodium chloride from water →
- Sawdust from water →

III. Answer the following questions with respect to diagram shown in the figure :



- Name the process shown in figure.
- Name one mixture separated by this method.
- Name the component which is left behind when sodium chloride solution is evaporated.

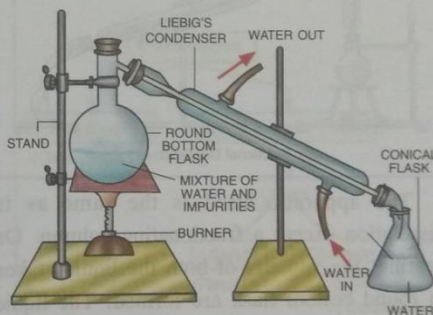
- Name one common compound which is separated by this method for commercial purpose.

DISTILLATION

It is the process of obtaining a pure liquid from a solution when two liquids differ abruptly in their boiling points.



To separate the water from impure water by using distillation process.

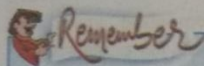


Using distillation process to separate a mixture of alcohol and water.

Method : Take the impure water in a round bottom flask and set the distillation apparatus as shown in the figure.

Now, heat the contents of the round bottom flask. The vapours of water pass through the internal tube of the condenser where they are cooled and changed into water and finally collected in the conical flask.

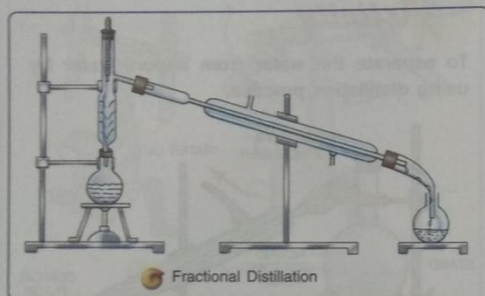
Result : The volatile component which gets collected in the flask is known as distillate. The other component which remains in the round bottom flask is known as residue. Thus, pure water is collected in conical flask and impurities are left in round bottom flask.



The pure water obtained after distillation is known as distilled water and this is used by doctors, chemists and scientists is made by distillation process.

FRACTIONAL DISTILLATION

The process of separating the mixture of two miscible liquids by using distillation carried out with the help of a long fractionating column is called fractional distillation.



Fractional Distillation

The apparatus used is the same as in distillation except a fractionating column. On heating, the vapours of both the liquids taken in round bottom flask are formed. The liquid with low boiling point escapes first and gets separated. It is obtained in distillation flask whereas the liquid having high boiling point remains in the same chamber. Thus, the two liquids get separated.

Example : Alcohol and water is easily separated by using fractional distillation.

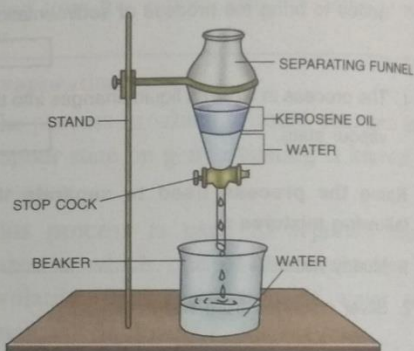
BY USING SEPARATING FUNNEL

This method is employed when a mixture consists of two liquids which are not miscible with each other. *e.g.*, a mixture of water and kerosene.

5 Activity

To separate kerosene oil from water by using a separating funnel.

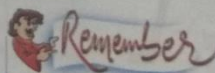
Method : Take a separating funnel, attach it to the clamp stand and pour the liquid mixture (water and kerosene). Allow it to stand for sometime. Two layers will be formed, the lower layer will be of water and upper layer will be of kerosene. Open the tap to extract water which is at the lower layer.



Separation of water and kerosene oil by using a separating funnel.

CHROMATOGRAPHY METHOD

Chromatography is a technique used to separate the constituents of a small quantity of a mixture of substances that dissolve in the same liquid. The substance is spread across the paper at different speeds. It is often used to separate the small quantities of mixture of liquids or gases and is based on the principle of *adsorption*.



Adsorption is the attachment of molecules of gases or liquids to the surface of another substance (usually a solid), it occurs mostly on substances like silica gel and activated carbon.

Advantages of chromatography :

1. It can be applied to separate a very small amount of mixture.
2. The components of mixture do not get wasted during separation.
3. It is used to purify a large number of industrial products.

Various terms associated with the process of chromatography :

1. **Moving phase** : Moving phase consists of mixture of the substances to be separated.

Example : Mixture of coloured ink.

2. **Stationary phase** : Stationary phase is the substance chosen for separation. It can be filter paper or any other material. It separates the components by principle of adsorption.

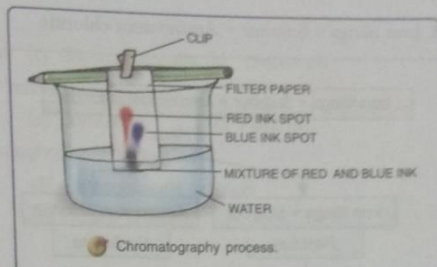
3. **Solvent** : It is the substance used to dissolve the substance to be separated. It is generally taken in a beaker. It dissolves the substance and carries the solute molecules ahead for easy separation.

6 Activity

To separate a mixture of red and blue ink by chromatography.

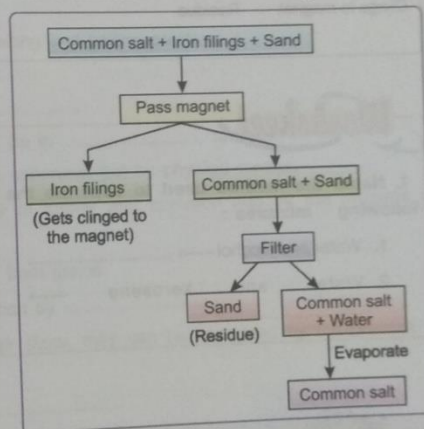
Method : Take a long strip of filter paper. Mix few drops each of red and blue ink and put a small drop of the mixture near the one end of the filter paper. Suspend the strip in water so that this end just dip in water. Secure it with the help of a clip.

Result : The ink starts rising up the filter paper along with water and the two inks separate out on the filter paper.

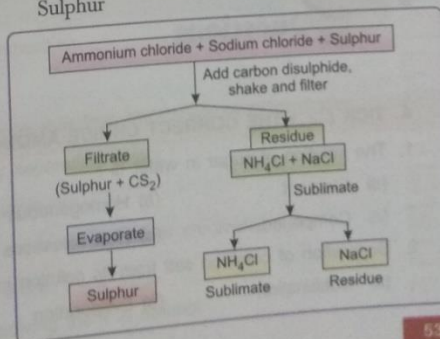


SCHEMATIC SCHEME FOR SEPARATION OF VARIOUS MIXTURES

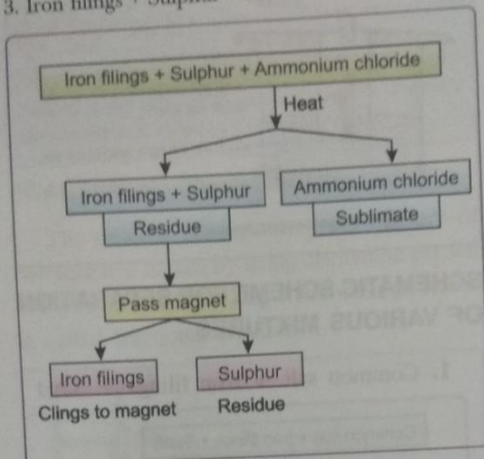
1. Common salt + Iron filings + Sand



2. Ammonium chloride + Common salt + Sulphur



3. Iron filings + Sulphur + Ammonium chloride



Worksheet

I. Name the method used to separate the following mixtures :

1. Water and alcohol →
2. Water and kerosene →

Objective Questions

A. TICK (✓) THE CORRECT CHOICE AMONGST THE FOLLOWING :

1. The solution of sugar in water is :

(a) Element	(b) Homogeneous mixture
(c) Compound	(d) Heterogeneous mixture.
2. Separation of common salt from its solution in water can be carried by :

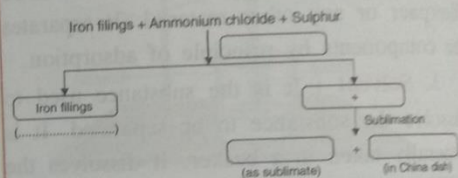
(a) Sublimation	(b) Evaporation	(c) Crystallization	(d) Filtration.
-----------------	-----------------	---------------------	-----------------

3. Mixture of red and blue ink →

II. Fill in the blanks with suitable words :

1. The volatile component which gets collected in the flask during distillation is known as
2. Chromatography is based on the principle of
3. Adsorption mostly occur on substances like and
4. is used in fractional distillation.

III. Complete the following schematic scheme :



3. Kerosene and water can be separated by :
 (a) Fractionating column (b) Separating flask (c) Chromatography (d) Distillation.
4. Iodine and camphor are separated from their mixtures by :
 (a) Liquefaction (b) Sublimation (c) Distillation (d) Filtration.
5. Solutions which have uniform composition throughout are known as :
 (a) Heterogeneous solution (b) Homogeneous solution
 (c) Colloidal solution (d) None of these.
6. Grain and husk are separated by :
 (a) Winnowing (b) Hand picking (c) Sieving (d) Sublimation.
7. Cream can be separated from milk by the process of :
 (a) Filtration (b) Evaporation (c) Centrifugation (d) Sieving.

B. FILL IN THE BLANKS :

1. A pure substance has melting and boiling points.
2. Mist is a mixture of in air.
3. Smog is a mixture of smoke and
4. The constituents of impure substance may be in ratio.
5. Constituents of a can be separated out by physical means.
6. Iodine can be separated from a mixture of iodine and common salt by the process of
7. is used to separate husk from grains.
8. Tea leaves can be separated from its solution by
9. When two solids components differ in their sizes, they can be separated by the process of
10. A pure substance has only one kind of

C. WRITE TRUE OR FALSE FOR EACH STATEMENT. REWRITE THE FALSE STATEMENTS CORRECTLY :

1. Heterogeneous mixtures have uniform composition.
2. Camphor sublimates on heating.
3. Soluble solid substances can easily be separated from their solvents by distillation.
4. Two miscible liquids can be separated by separating funnel.
5. Mixtures may be homogeneous or heterogeneous.
6. Mixtures of coloured substances can be separated by paper chromatography.
7. In a mixture, no chemical reaction takes place.
8. Salt and sugar can be separated by dissolving them in ethanol.

D. NAME THE TECHNIQUE USED TO SEPARATE THE FOLLOWING MIXTURES :

1. Kerosene oil and water.
2. Chalk and water.
3. Mercury and water.
4. Sawdust and water

E. ANSWER THE FOLLOWING QUESTIONS :

1. State the principle underlying (i) sublimation (ii) filtration.
2. What are homogeneous mixtures ?
3. How can you separate mixture of petrol and water ?
4. What is sedimentation ?
5. For which type of solutions is filtration carried ?
6. How will you separate a mixture of ammonium chloride and common salt ?
7. Give two differences between a compound and a mixture.
8. How will you separate a mixture of iodine, iron filings and salt from a mixture ?
9. What is loading ? Explain the process of loading with alum.
10. How chromatography is helpful in separating mixtures of liquids ?
11. Almost all the substances of our daily use are mixtures. Comment.
12. Demonstrate the separation of pure water from impure water by using distillation process.
13. Explain in detail separation of kerosene oil from water by using a separating funnel.

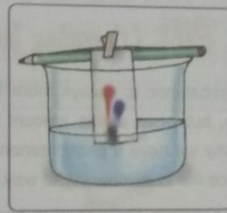
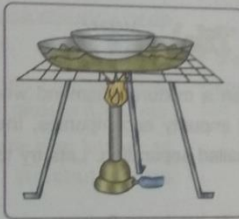
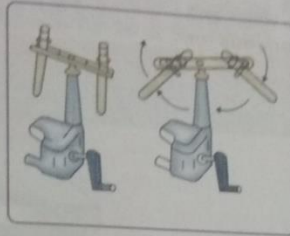
F. SHOW SCHEMATICALLY HOW THE FOLLOWING SEPARATIONS CAN BE CARRIED OUT:

- (i) Common salt + water + saw dust
- (ii) Iron filings + sulphur + charcoal
- (iii) Sulphur + iron + phosphorus
- (iv) Water + sodium chloride + iron filings
- (v) Sulphur + potassium chloride + ammonium chloride

G. FIND THE ODD ONE OUT GIVING REASON :

1. Iodine, camphor, naphthalene, iron
2. Hand picking, winnowing, sieving, sublimation
3. Solutions, compounds, suspensions, emulsions
4. Sugar solution, salt solution, milk, mud solution.

H. PLEASE HELP SANJAM TO IDENTIFY THE FOLLOWING TECHNIQUES :



Classify the following mixtures as homogeneous and heterogeneous.

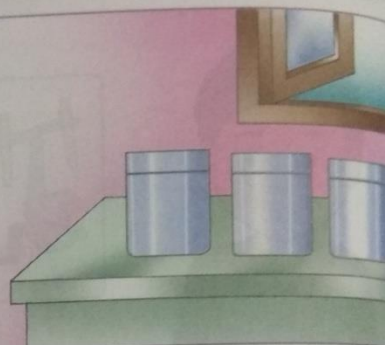
Mixtures	Homogeneous mixtures	Heterogeneous mixtures
Sugar solution	Alloys	
Salt and sand	Water and refined oil	
Honey and warm water	Milk and water	
Chalk powder and water	Acetic acid in water	



Home Assignment

Try to dissolve the following compounds in water and observe whether they form a homogeneous or heterogeneous mixture in water.

1. Turmeric →
2. Sugar →
3. Salt →
4. Refined oil →
5. Black pepper →



Skill Pill (Learning for Life)

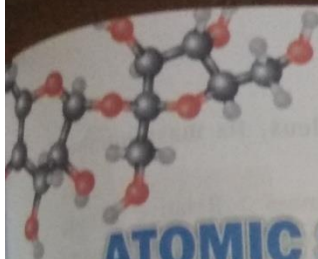
The value of pure substance is always more than a mixture. Diamond when pure is the most expensive substance on Earth, but when a little amount of impurity accompanies, the worth of diamond decreases. That's the reason why we have a phenomenon called separation. Lets try to separate negativities from our life so that we rejoice life in a meaningful way.

Q. How can we separate the negative aspects we have ?

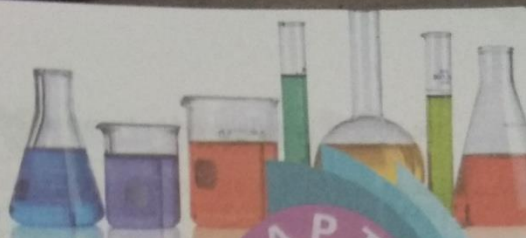
(i) By praying to God for strength and seeking the help of elders.

(ii) By showing attitude and doing what we feel like.

Compound	Observation	Type of Mixture
Turmeric		
Sugar		
Salt		
Refined oil		
Black pepper		



ATOMIC STRUCTURE



CHAPTER 4

INTRODUCTION

Just as a building is made-up of bricks similarly all elements are made-up of atoms. If same kind of atoms join together we get a homoatomic substance like oxygen (O_2), nitrogen (N_2) etc.

If different atoms join together we get a heteroatomic substance like water (H_2O), carbon dioxide (CO_2) etc.

These homoatomic substances are also known as elements and heteroatomic substances as compounds.

ATOM

An atom is the smallest particle of element that takes part in a chemical reaction.

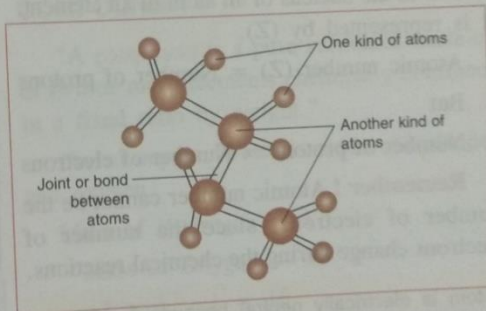
An Indian philosopher *Kanad* was one of the first person to propose that matter is made up of very small particles called *Parmanu*. *John Dalton* called these particles *atoms*. The word *atom* means *indivisible*. Inside the atom there are present a variety of even tinier particles called sub-atomic particles.

Atoms join together to form molecules :

Atoms do not exist independently. They combine with other atoms to stabilise themselves. They may combine with atoms of their own kind or of different kinds. These linked atoms are known as molecules.



Some of the stable atoms stay in isolated form, i.e., they remain monoatomic, e.g., Neon whereas unstable atoms join together to form group of linked atoms called *molecules*, e.g., Hydrogen.



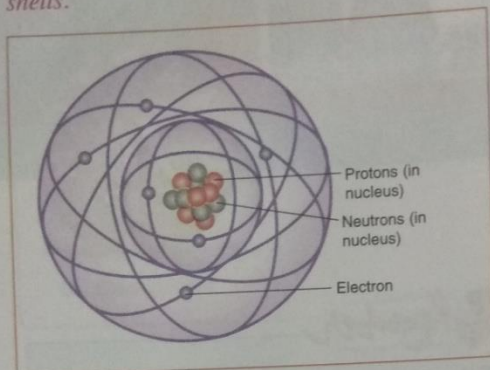
Ball and stick diagram to show three dimensional arrangement of atoms in a molecule.

Inside atoms

Atoms are the main building blocks of matter. Inside the atoms, there are present a variety of even tinier particles called sub-atomic particles. These are *protons*, *neutrons* and *electrons*.

An atom has a central part called nucleus containing the sub-atomic particles named proton and neutron. Electrons are present outside, the nucleus and they revolve around

the nucleus in definite *orbits* known as *energy shells*. neutrons in the nucleus. Its mass number is 23.



Structure of a typical atom (hypothetical).

ATOMIC NUMBER

Atomic number is the number of protons present in the nucleus of an atom of an element. It is represented by (Z).

Atomic number (Z) = Number of protons

But

Number of protons = Number of electrons

Remember ! Atomic number cannot be the number of electrons, since the number of electrons change during the chemical reactions.

Atom is electrically neutral because number of protons is equal to number of electrons. As a result, total positive charge is equal to negative charge.

MASS NUMBER

The total number of protons and neutrons inside the nucleus of an atom is known as *mass number* or *atomic mass* of the atom.

Mass number (A) = Number of protons + Number of neutrons

For example, oxygen atom has 8 protons and 8 neutrons in the nucleus. Its mass number is 16. Sodium atom has 11 protons and 12

Relative atomic mass : Relative atomic mass is the number which tells how many times an atom of that element is heavier than an atom of hydrogen.

Example : The atomic weight of nitrogen is 14. This means that one atom of nitrogen is fourteen times heavier than one atom of hydrogen. As atomic weight is in ratio, hence it does not have any unit.

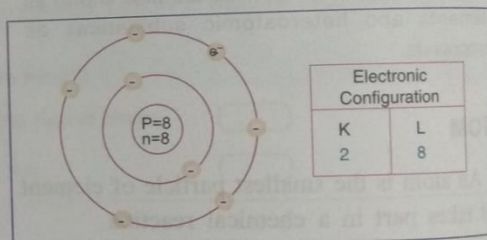
Arrangement of sub-atomic particles in atoms :

Oxygen atom (8) = 2, 6

Number of protons = 8

Number of electrons = 8

Number of neutrons = 8



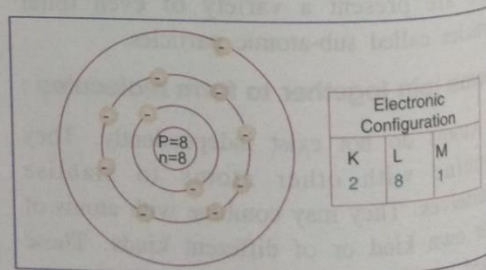
Oxygen atom.

Sodium atom (11) = 2,8,1

Number of protons = 11

Number of electrons = 11

Number of neutrons = 12

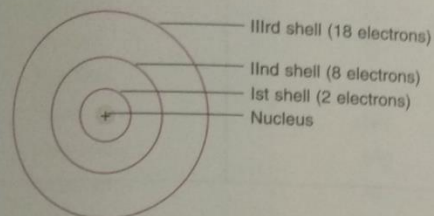


Sodium atom.



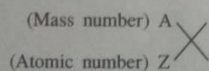
Memory Focus

Niels Bohr, a Danish scientist was the first person who gave the idea of electron shells and indicated that each shell can hold a limited number of electrons.



This arrangement is called electronic configuration.

For any element, atomic numbers are shown as subscript and mass number as superscript.

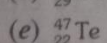
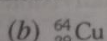


For example, ${}_{11}^{23}\text{Na}$, ${}_{8}^{16}\text{O}$



Brain Twisting Problems

1. An atom has 4 protons, 4 electrons and 5 neutrons. What is the atomic number and mass number?
2. How many protons, electrons and neutrons are present in the following atoms? Also indicate the atomic number and mass number.



Curiosity Capsule

- **Inside a nucleus**—we know that the nucleus of every atom contains protons and neutrons. These in turn are made-up of smaller particles called **quarks**. The quarks are held together by other particles called **gluons**.
- The proton, neutron and electron that make-up of an atom are just three of 200 sub-atomic particles that are now known.

ELEMENT

“An *element* is the simplest form of a pure substance which cannot be divided into any other simpler substance.” Elements contain similar kinds of atoms identical in all respects.

Example : Oxygen gas with only oxygen atoms.

COMPOUND

“A *compound* is a pure substance made-up of two or more elements chemically combined in a fixed ratio by weight.”

For example : Water is made of hydrogen and oxygen.

Mass of Hydrogen = 1

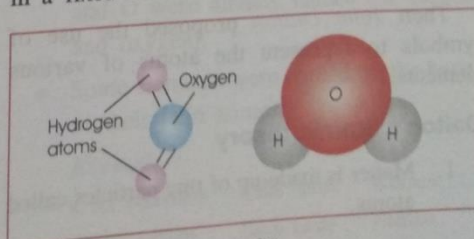
Mass of Oxygen = 16

$$2 \times 1 : 1 \times 16$$

$$2 : 16$$

$$1 : 8$$

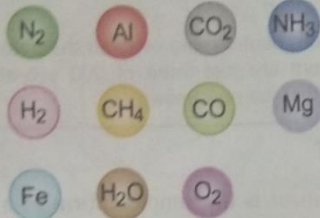
Thus, water contains hydrogen and oxygen in a fixed ratio of 1 : 8.



Molecule of water.

Skill Fill

Choose the elements and compounds by looking at their formulas and write them in the correct place.



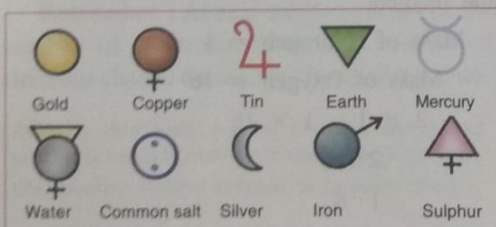
Elements


Compounds

CHEMICAL SYMBOLS

There are many examples where we use short names or abbreviations in daily life situations. In the similar way, in chemistry shortened forms of names of elements are present which are known as *symbols*.

Ancient alchemists were using few difficult and complicated symbols for elements and compounds which are shown below :

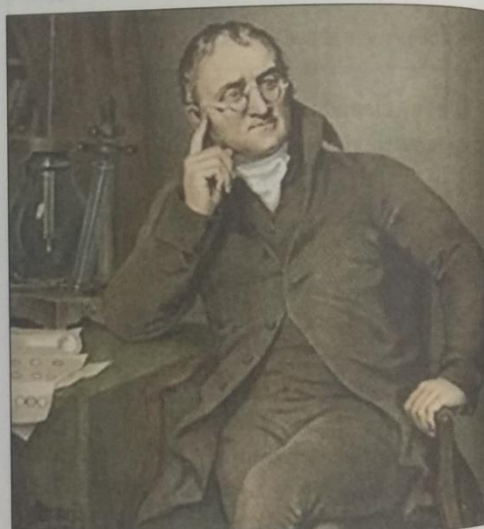



 Symbols used by alchemists.

Then *John Dalton* proposed the use of symbols to represent the atoms of various elements.

Dalton's atomic theory

1. Matter is made-up of tiny particles called atoms.



 John Dalton was the first one to give a figural representation for various elements.

2. Atoms are indivisible.
3. Atoms cannot be created or destroyed.
4. Atoms of the same element are identical in mass and other properties.
5. Atoms of different elements differ in their masses and properties.

List of some symbols derived from English names of the elements

Name of the element	Symbol	Name of the element	Symbol
Hydrogen	H	Sulphur	S
Helium	He	Chlorine	Cl
Lithium	Li	Argon	Ar
Carbon	C	Calcium	Ca
Nitrogen	N	Manganese	Mn
Oxygen	O	Nickel	Ni
Fluorine	F	Zinc	Zn
Neon	Ne	Bromine	Br
Magnesium	Mg	Krypton	Kr
Aluminium	Al	Iodine	I
Silicon	Si	Barium	Ba
Phosphorus	P	Radium	Ra

List of some symbols derived from Latin names of the elements

English name of the element	Symbol	Latin name of the element
Sodium	Na	Natrium
Potassium	K	Kalium
Iron	Fe	Ferrum
Copper	Cu	Cuprum
Silver	Ag	Argentum
Gold	Au	Aurum
Mercury	Hg	Hydrargyrum
Lead	Pb	Plumbum
Tin	Sn	Stannum
Tungsten	W	Wolfram

J. J. Berzelius introduced the modern system of naming elements by their symbols.

- Some elements were named on the basis of their starting letter.
- Some elements were named on the basis of their first two letters when the first letter was already chosen.

Example : Co for cobalt, Os for osmium

[Two letters were chosen because C and O were already named for carbon and oxygen].

- Some elements were named on the basis of their latin names.

Example :

K for potassium Latin name Kallium
Na for sodium Latin name Natrium.

Significance of symbols

Symbol of an element signifies :

- (i) Name of the element.
- (ii) An atom of the element.
- (iii) Convenience to write the name of the element.
- (iv) Requires of less time and space.

ATOMICITY

Atomicity is defined as the number of atoms present in a molecule of an element.

Two or more atoms of same kind combine together to form a molecule of an element. For example, H_2 , Cl_2 , Br_2 , I_2 , N_2 , etc.

Those molecules which contain only one atom like He, are known as monoatomic molecules and those which contain more than one atom are called polyatomic molecules. These polyatomic molecules are known as di, tri, tetra and so on.

Monoatomic molecules : (Exist in isolated form). *e.g.*, Helium (He), neon (Ne), argon (Ar), krypton (Kr).

Diatomic molecules : (Contain two atoms combined together). *e.g.*, Hydrogen (H_2), nitrogen (N_2), oxygen (O_2), chlorine (Cl_2).

Triatomic molecules : (Contain three atoms combined together). *e.g.*, Ozone (O_3).

Tetraatomic molecules : (Contain four atoms combined together). *e.g.*, Phosphorus (P_4).

Worksheet

I. Name the scientist who

1. Proposed that matter is made-up of small particles called parmanus.
2. First used the term 'atom'.
3. Gave the modern system of naming elements.

II. Complete the table by giving symbols and Latin names :

	English name	Symbol	Latin name
1.	Sodium		
2.	Potassium		
3.	Iron		
4.	Silver		
5.	Lead		

III. Give example of following :

1. Monoatomic molecule.
2. Diatomic molecule.
3. Triatomic molecule.
4. Tetraatomic molecule.

IV. "An atom is electrically neutral". Explain.

.....
.....

V. Fill ups :

1. is defined as the number of atoms present in a molecule of element.
2. The short form of elements are known as

VI. Complete the following table :

Element/ion	Atomic number	Mass number	Protons	Electrons	Neutrons
${}^{12}_6\text{C}$					
${}^{35}_{17}\text{Cl}^-$					
P^{-3}		31		18	
${}^{23}_{11}\text{Na}^{+1}$					
${}^{16}_8\text{O}^{2-}$					

PERIODIC TABLE

It is a table or chart in which all the known elements are arranged in such a way that the elements with similar properties are grouped together in the same vertical column and dissimilar elements are separated from each other.

Importance of the periodic table :

1. It helps to systematize the study of elements.
2. It makes the study of elements simple and easy.
3. It helps to correlate the properties of different elements.

Modern periodic table consists of 18 vertical **groups** and seven horizontal rows called **periods**.

The group number of periodic table is used to write down the electronic configuration, calculate the valence electrons and then the valency. Let's step by step understand how to write the electronic configuration.

Orbits :

The electrons revolve around the nucleus in definite energy shells which are known as orbits.

Electronic configuration :

The arrangement in which electrons arrange themselves in various orbits is called electronic configuration.

Valence shell :

The last shell is known as valence shell.

Valence electrons :

The electrons present in the valence shell are known as valence electrons.

To understand the electronic structures of first 20 elements in periodic table, let's remember a magic number. (Details to be done in higher classes).

2,	8,	8,	2
K	L	M	N

THE PERIODIC TABLE OF ELEMENTS

THE MAIN FEATURES

- The table is arranged generally from smallest to largest atomic number and the short periods between are the noble gases.
- The elements are arranged in the order of increasing atomic number.
- There are seven periods in the table. The first period contains two elements (H and He) and the last period contains 32 elements (Fr and Uuo).
- The elements are arranged in the order of increasing atomic number.
- The elements are arranged in the order of increasing atomic number.

INDEX

Atomic Number	23	58-63	145	273
Element Symbol	Ni			
Crystal Structure	fcc			
Category	Transition Metals	Alkaline Earth Metals	Alkali Metals	Non-Metals

PERIODIC TABLE OF ELEMENTS

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	H	He																	
2	Li	Be	B	C	N	O	F	Ne											
3	Na	Mg	Al	Si	P	S	Cl	Ar											
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Uup	Lv	Uus	Uuo	

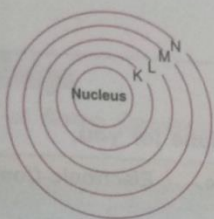
MOIST COMMON STRUCTURES

Alkali Metals	Alkaline Earth Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals	Transition Metals
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ACTIVITIES

The table of elements is known as the Periodic Table of Elements. It is a tabular arrangement of the elements of the periodic table. The elements are arranged in the order of increasing atomic number. The elements are arranged in the order of increasing atomic number. The elements are arranged in the order of increasing atomic number.

The simplest representation to explain the structure of first twenty elements is as follow. There are four energy levels where :



- K being closest to nucleus has minimum energy. It can hold only 2 electrons.
- The next shell is L which is at slightly higher energy than K. It can accommodate 8 electrons.
- The next shell is M which has more energy than L. It can accommodate 8 electrons.
- The last shell is N. This has maximum energy compared to other shells and can accommodate 2 electrons only.

Note : Unless the lower energy shells are completely filled, electrons cannot move on to higher energy levels.

Example : If K shell is not completely filled, electron cannot move to L shell.

Electronic structures of the elements :

Figure shows the first 20 elements in periodic table order. The atomic number and electronic structure of each element is written below its symbol. When the first shell is full at helium, electrons move to the second shell. So, the electronic structure of lithium is 2, 1 ; beryllium is 2,2 ; boron is 2,3 ; etc. When the second shell is full at neon, electrons start to fill the third shell and so on.

Period 1	H							He
Atomic No.	1							2
Electronic structure	1							2
Period 2	Li	Be	B	C	N	O	F	Ne
Atomic No.	3	4	5	6	7	8	9	10
Electronic structure	2, 1	2, 2	2, 3	2, 4	2, 5	2, 6	2, 7	2, 8
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar
Atomic No.	11	12	13	14	15	16	17	18
Electronic structure	2, 8, 1	2, 8, 2	2, 8, 3	2, 8, 4	2, 8, 5	2, 8, 6	2, 8, 7	2, 8, 8
Period 4	K	Ca						
Atomic No.	19	20						
Electronic structure	2, 8, 8, 1	2, 8, 8, 2						

The electronic structures of the first 20 elements in the periodic table.

Worksheet

Fill and complete the table, the first one is done for you.

S.No.	Element	Symbol	Atomic no.	Electronic Configuration	Number of Shells
1.	Carbon	C	6	2, 4 K L	2
2.	Aluminium				3
3.	Oxygen		8		
4.		Mg		2, 8, 2 K L M	
5.				2, 8, 8, 1 K L M N	4
6.		Ca	20		
7.	Nitrogen			2, 5 K L	
8.		P	15		
9.	Helium			2 K	
10.		H		1 K	1

CHEMICAL FORMULAE OF ELEMENTS

We have studied earlier that a molecule is the smallest particle of an element or a compound which has independent existence.

Just as a symbol represents one atom, the chemical formula represents one molecule of element or a compound. For representation of chemical formula we are concerned only with the number of atoms present in a molecule. For example, one molecule of hydrogen element contains two atoms of hydrogen, so, the formula of hydrogen is H_2 . The 2 in the

formula indicates that one molecule of hydrogen element contains 2 atoms of hydrogen.

The chemical formula of an element is the formula that shows the actual number of atoms in one molecule of the element.



O	means	1 atom of oxygen
O ₂	means	1 molecule of oxygen
2O ₂	means	2 molecules of oxygen
2O	means	2 atoms of oxygen
O ₃	means	1 molecule of ozone



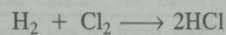
Add to Your Knowledge

List of Molecular Formulae of Some Common Elements

Element	Formula	Atomicity
Hydrogen	H ₂	2
Helium	He	1
Oxygen	O ₂	2
Sulphur	S ₈	8
Phosphorus	P ₄	4
Nitrogen	N ₂	2
Bromine	Br ₂	2
Chlorine	Cl ₂	2

CHEMICAL FORMULAE OF COMPOUNDS

The molecular formula of a compound is the actual number of atoms of different elements present in molecule of the compound. For example, water is a compound whose molecule contains two atoms of hydrogen and one atom of oxygen. So the formula is H₂O. In this, the symbol H₂ indicates two atoms of hydrogen and O represents one atom of oxygen. The number in front of a formula shows the number of molecules. For example, 2H₂O means 2 molecules of water. Similarly, one molecule of H₂ and one molecule of Cl₂ make two molecules of HCl.



FORMULAE OF SOME COMMON COMPOUNDS

Compound	Formula	Constituting elements	Number of atoms of each element combining
Carbon dioxide	CO ₂	Carbon (C)	1
		Oxygen (O)	2
Ammonia	NH ₃	Nitrogen (N)	1
		Hydrogen (H)	3
Sulphuric acid	H ₂ SO ₄	Hydrogen (H)	2
		Sulphur (S)	1
		Oxygen (O)	4

Names of some common compounds :

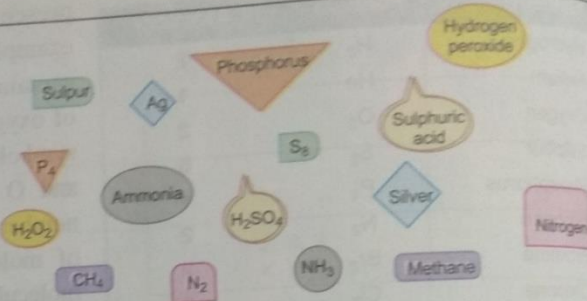
1. Carbon monoxide \longrightarrow CO
2. Carbon dioxide \longrightarrow CO₂
3. Sulphur dioxide \longrightarrow SO₂
4. Sulphur trioxide \longrightarrow SO₃
5. Carbon tetrachloride \longrightarrow CCl₄
6. Phosphorus pentaoxide \longrightarrow P₂O₅

7. Ammonia \longrightarrow NH₃
8. Hydrogen peroxide \longrightarrow H₂O₂
9. Hydrochloric acid \longrightarrow HCl
10. Nitric acid \longrightarrow HNO₃
11. Sulphuric acid \longrightarrow H₂SO₄
12. Phosphorus pentachloride \longrightarrow PCl₅

Skill Fill

Match the formulas with their corresponding elements and compounds and then answer the questions given below.

- Which of the one is monoatomic element ?
- Which of the one has five atoms in its molecule ?
- Name any diatomic gas shown above.
- Any polyatomic molecule.
- What is the formula of methane ?



Or

RADICALS

A radical is a positively or negatively charged component of a compound consisting of a single atom or group of atoms.



Add to Your Knowledge

FORMULAE OF SOME COMMON RADICALS

Name of the radical	Formula of the radical	
Chloride	Cl^-	Simple Radicals
Bromide	Br^-	
Iodide	I^-	
Fluoride	F^-	
Oxide	O^{2-}	Complex Radicals
Sulphate	SO_4^{2-}	
Carbonate	CO_3^{2-}	

VALENCY

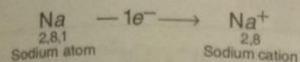
Valency is the number of electrons, an atom can donate or accept. Valency is always a whole number.

Valency is a measure of the combining capacity of an element. Generally, valency of elements ranges from 0 to 4.



- Elements with valency **one** are known as **Monovalent**. e.g., Na, K, Li, Rb.
- Elements with valency **two** are known as **Divalent**. e.g., Cu, Zn, Mg, Ca.
- Elements with valency **three** are known as **Trivalent**. e.g., Fe, Al.
- Elements with valency **four** are known as **Tetravalent**. e.g., C and S.

When a neutral atom enters into chemical reaction, it loses its neutral nature and becomes an ion because of loss or gain of electron to become stable. If it loses electron, then it is called **cation**.



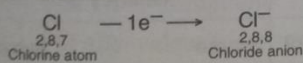
[Sodium has 1 electron more than noble gas configuration and hence it loses one electron to form a cation with stable electronic configuration].

If an atom loses one electron, it means that

1. The atom has one electron less than the neutral atom, which implies an increase in positive charge.
2. Due to the increase in positive charge, the atom is known as cation.

Sodium atom	Sodium cation
$\text{Na} - 1e^- \longrightarrow \text{Na}^+$	
(2,8,1)	(2,8)
Atomic no. = 11	Atomic no. = 11
(11 protons)	(11 protons)
(11 electrons)	(10 electrons)

If it gains electron, then it is called an anion.



[Chlorine atom has 1 electron less than noble gas configuration hence it gains one electron to form an anion with stable electronic configuration].

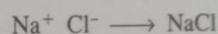
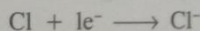
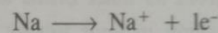
If an atom gains one electron, it means that

1. The atom has one electron more than the neutral atom, which implies an increase in negative charge.
2. Due to the increase in negative charge the atom is known as anion.

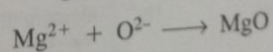
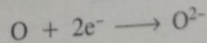
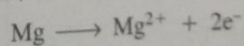
Chlorine atom	Chloride anion
$\text{Cl} + 1e^- \longrightarrow \text{Cl}^-$	
(2,8,7)	(2,8,8)
Atomic no. = 17	Atomic no. = 17
(17 electrons)	(18 electrons)
(17 protons)	(17 protons)

Examples of Valency :

1. Sodium atom shows its valency of one by losing one electron and chlorine atom gaining one electron to achieve by gas configuration. When sodium and chlorine atoms combine, then the unipositive charge of sodium cancels the uninegative charge on chloride ion to form stable compound.

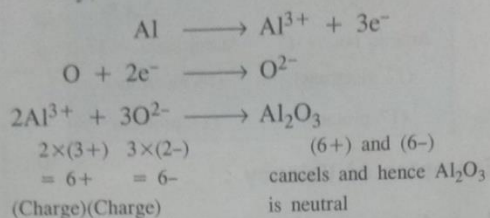


2. Magnesium atom loses two electrons and oxygen gains two electrons. When magnesium and oxygen atoms combine, then the bipositive charge of magnesium cancels the binegative charge on oxide ion. As a result of this, the MgO formed is neutral.



3. One aluminium has got 3 (+ve) charge. Hence, two aluminium ions will have 6 (+ve) charge. One oxygen has 2 (-ve) charge. Hence, three oxide ions will have 6 (-ve) charge.

Thus, the molecule becomes stable only, if charge is neutralised and it can be brought only, if 2Al^{3+} ions combine with 3O^{2-} ions.

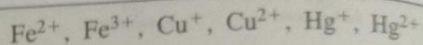


Variable valency

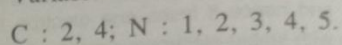
If any metallic element show more than one valency, then it is known as *variable valency*.

It means that metallic element can lose electron from its inner orbits also. About this you will study in your higher classes.

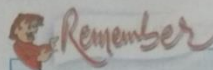
For example :



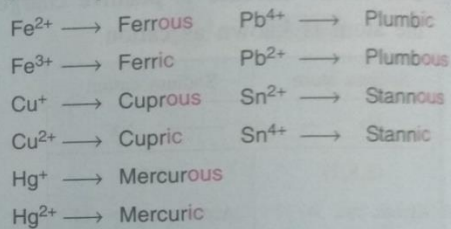
Variable valencies of metals.



Variable valencies of non-metals.



For lower valency of metal ions suffix *ous* is used and for higher valency suffix *ic* is used. e.g.,



POSITIVE RADICALS

Valency 1		Valency 2		Valency 3	
Name	Symbol	Name	Symbol	Name	Symbol
Hydrogen	H^+	Iron (Ferrous)	Fe^{2+}	Iron (III) (Ferric)	Fe^{3+}
Copper (I) (Cuprous)	Cu^+	Copper (II) (Cupric)	Cu^{2+}	Auric (Gold)	Au^{3+}
Mercury (I) (Mercurous)	Hg^+	Mercury (II) (Mercuric)	Hg^{2+}	Aluminium	Al^{3+}
Sodium	Na^+	Calcium	Ca^{2+}		
Potassium	K^+	Zinc	Zn^{2+}		
Silver	Ag^+	Lead (II) (Plumbous)	Pb^{2+}		
Ammonium	NH_4^+	Magnesium	Mg^{2+}		
		Manganese (II) (Manganous)	Mn^{2+}		

NEGATIVE RADICALS

Valency 1		Valency 2		Valency 3	
Name	Symbol	Name	Symbol	Name	Symbol
Hydride	H ⁻	Oxide	O ²⁻	Nitride	N ³⁻
Hydroxide <small>(Hydroxyl)</small>	OH ⁻	Carbonate	CO ₃ ²⁻	Phosphate	PO ₄ ³⁻
Chloride	Cl ⁻	Sulphide	S ²⁻		
Bromide	Br ⁻	Sulphite	SO ₃ ²⁻		
Iodide	I ⁻	Sulphate	SO ₄ ²⁻		
Nitrite	NO ₂ ⁻	Dichromate	Cr ₂ O ₇ ²⁻		
Nitrate	NO ₃ ⁻				
Bicarbonate	HCO ₃ ⁻				
Bisulphite	HSO ₃ ⁻				
Bisulphate	HSO ₄ ⁻				
Chlorate	ClO ₃ ⁻				
Permanganate	MnO ₄ ⁻				



Memory Focus

CRISS-CROSS METHOD OF WRITING FORMULA

- STEP I :** Write the symbol of positive radical to the left and negative radical to the right side of a compound.
- STEP II :** Put the valency on top, right side of both the radicals.
- STEP III :** Ignore the positive and negative signs and shift the valency to the lower right side of the radical.

For example :	STEP I	STEP II	STEP III
Magnesium chloride	Mg ²⁺ Cl ⁻¹	$\begin{array}{cc} \text{Mg}^{2+} & \text{Cl}^{-1} \\ \text{Mg}_1 & \text{Cl}_2 \end{array}$	MgCl ₂
Copper sulphate	Cu ²⁺ SO ₄ ²⁻ Or Cu ¹⁺ SO ₄ ¹⁻	$\begin{array}{cc} \text{Cu}^{2+} & \text{SO}_4^{2-} \\ \text{Cu}_2 & (\text{SO}_4)_2 \end{array}$	CuSO ₄
<p>Note : When same valency comes, then both valencies get cancelled. Like in CuSO₄ both 2's get cancelled.</p>			

For example :	STEP I	STEP II	STEP III
Aluminium chloride	$Al^{3+} Cl^{-1}$	$\begin{array}{c} Al^{3+} \quad Cl^{-1} \\ \swarrow \quad \searrow \\ Al_1 \quad Cl_3 \end{array}$	$AlCl_3$
Aluminium sulphate	$Al^{3+} SO_4^{2-}$	$\begin{array}{c} Al^{3+} \quad SO_4^{2-} \\ \swarrow \quad \searrow \\ Al_2 \quad (SO_4)_3 \end{array}$	$Al_2(SO_4)_3$
Ammonium phosphate	$NH_4^{+1} PO_4^{3-}$	$\begin{array}{c} NH_4^{+1} \quad PO_4^{+3} \\ \swarrow \quad \searrow \\ (NH_4)_3 \quad PO_4 \end{array}$	$(NH_4)_3PO_4$



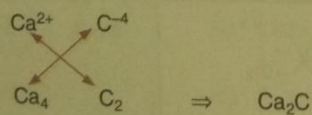
Add to Your Knowledge

Significance of Formula of a Substance

1. It represents the name of the substance.
2. It represents one molecule of the substance.
3. It gives the names of atoms of the elements.
4. It gives number of atoms of each of the elements.
5. It gives molecular mass expressed in grams.

Calcium carbide !!

The valency of calcium is Ca^{2+} and carbide is C^{4-} . Thus the formula is :



But it does not exist in nature as Ca_2C but exists as CaC_2 . Thus, the actual compound does not match with the theoretical formula.

Worksheet

Write the chemical formula of the following compounds (use criss-cross method) :

1. Aluminium oxide
2. Sodium chloride
3. Magnesium sulphate
4. Ammonium sulphate
5. Zinc carbonate
6. Potassium bisulphite
7. Calcium bicarbonate
8. Aluminium nitride
9. Cuprous chloride
10. Ferric sulphate
11. Manganese (IV) oxide
12. Lead (II) hydroxide
13. Silver bromide
14. Silver nitrate
15. Ammonium nitrate

Objective ? Questions

A. TICK (✓) THE CORRECT CHOICE AMONGST THE FOLLOWING :

- Sub-atomic particles of atoms are :
(a) Protons (b) Electrons (c) Neutrons (d) All of these.
- Na is a symbol of :
(a) Nitrogen (b) Nickel (c) Sodium (d) Neon.
- Symbol of potassium is :
(a) Pb (b) P (c) Pu (d) K.
- Latin name of iron is :
(a) Natrium (b) Ferrum (c) Aurum (d) Stannum.
- The valency of aluminium is :
(a) + 1 (b) + 2 (c) + 3 (d) None of these.
- Which of the following are liquid elements ?
(a) Ga (b) Br₂ (c) Rb (d) Fr.

B. WRITE TRUE OR FALSE FOR EACH STATEMENT. REWRITE THE FALSE STATEMENTS CORRECTLY :

- Atoms of the different elements differ from each other.
- The molecular weight of a compound is just the weight of a molecule.
- A balanced chemical equation is an agreement with law of conservation of mass.
- The substances formed during a chemical reaction are called products.
- The molecular formula of bromine is Br₃.
- Bromine is the only liquid non-metal.
- Neutron is a neutral particle.
- The number of atoms in a single molecule of an element is known as atomicity.
- A molecule of an element consists of atoms of same kind.
- There are 80 non-metals discovered so far.

C. NAME THE FOLLOWING COMPOUNDS :

- | | | | |
|--------------|-------|--------------------|-------|
| 1. P_2O_5 | ..... | 2. PCl_3 | ..... |
| 3. CO | ..... | 4. SO_3 | ..... |
| 5. CCl_4 | ..... | 6. SO_2 | ..... |
| 7. NH_3 | ..... | 8. H_2S | ..... |
| 9. NO_2 | ..... | 10. HCl | ..... |
| 11. CH_4 | ..... | 12. $CuSO_4$ | ..... |
| 13. $AuCl_3$ | ..... | 14. $Zn_3(PO_4)_2$ | ..... |

D. MATCH THE ENTRIES OF COLUMN A WITH APPROPRIATE ENTRIES OF COLUMN B :

Column A

1. A molecule of an element.
2. A molecule of a compound.
3. An atom of a metal.
4. An atom of a non-metal.
5. A substance containing same type of atoms.
6. A substance in which different elements combine in a fixed ratio.

Column B

- (a) N
- (b) Na
- (c) N_2
- (d) NH_3
- (e) compound
- (f) element

E. ANSWER THE FOLLOWING QUESTIONS :

1. What substance is made of only one kind of atoms ?
2. Name two gaseous elements.
3. When two or more elements combine in a fixed ratio then what is the resultant product called ?
4. Name the scientist who introduced the modern system of naming elements.
5. Name one tetraatomic molecule.
6. Define atomicity.
7. What do you understand by chemical formula of an element ?
8. What is the difference between $2O$ and O_2 ?
9. What is a radical ?
10. Differentiate between a cation and an anion.
11. State main postulates of Dalton's atomic theory.
12. Explain the modern system of naming elements by their symbols introduced by Berzelius.
13. What is variable valency ? Explain giving examples.

F. SELECT THE ODD ONE OUT GIVING REASON :

1. Electron, Proton, Neutron, Nucleus, Compound.
2. Natrium, Kalium, Ferrum, Cuprum, Calcium.
3. Nitrogen, Oxygen, Fluorine, Bromine, Ozone.
4. Sodium, Potassium, Lithium, Aluminium, Rubidium.
5. Fluorine, Chlorine, Bromine, Iodine, Oxide.

G. PLEASE HELP SANJAM TO FIND THE TERMS USED IN LESSON :



X	N	E	O	N	Z	Q
J	Y	M	N	G	P	I
Z	O	A	T	O	M	J
B	N	K	D	L	M	L
C	L	E	A	D	T	S
T	P	R	O	T	O	N

Answers : Neon, Atom, Gold, Lead, Proton.

O	X	Y	G	E	N	S
N	I	C	K	E	L	E
X	A	R	G	O	N	V
B	N	D	B	I	D	X
A	S	M	D	J	L	N
D	Y	O	J	L	Z	M
S	Y	M	B	O	L	I

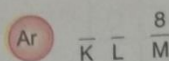
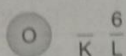
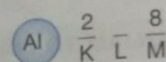
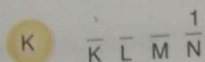
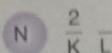
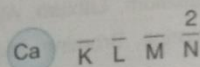
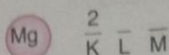
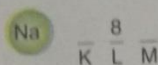
Answers : Oxygen, Nickel, Argon, Symbol.

H. WRITE THE FORMULAE OF THE FOLLOWING SALTS BY CRISS-CROSS METHOD.

1. Lead nitrate
2. Zinc hydroxide
3. Copper sulphate
4. Potassium sulphate
5. Ferrous sulphate
6. Sodium bisulphate
7. Copper nitrate
8. Aluminium oxide
9. Ammonium phosphate
10. Silver sulphide
11. Potassium chlorate
12. Mercury (II) bromide
13. Copper (II) nitrate
14. Iron (III) chloride

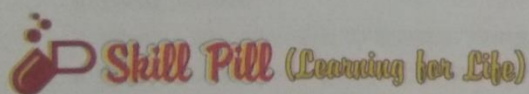


Complete the electronic configuration of the given elements.



Make a list of the following in your scrap book.

- (i) Four elements \longrightarrow
- (ii) Four compounds \longrightarrow
- (iii) Four simple radical \longrightarrow
- (iv) Four complex radical \longrightarrow
- (v) Two diatomic gases \longrightarrow
- (vi) Two polyatomic elements \longrightarrow
- (vii) Two inert gases \longrightarrow



When two reactants combine; a synthesis reaction takes place leading to the formation of a compound which is more stable and stronger as compared to the individual elements.

What do you think can make you stronger ?

1. Your team
2. When you stand alone with all your strength

