# BASIC PRINCIPLES OF CHEMISTRY

## §§ PHSICAL CLASSIFICATION OF MATTER :

**§§ MATTER :** Matter may be defined as anything that occupies space, possesses mass and presence of which can be felt by any one or more of our five senses (i.e. sight, smell, taste, touch and hearing).**matter exist in three physical states viz. solid, liquid and gas.**

**¶¶ A comparison of the properties of matter in the three states:**

| S.No. | Property | Solid | Liquid | Gas |
|---|---|---|---|---|
| 1 | Packing | The particles are most closely packed. | The particles are less closely packed than solids. | Particles are at sufficient distances from each other. |
| 2 | Shape | Solids have definite shape. | Liquids do not have definite shape. They assume the shape of container. | Gases do not have a definite shape. They assume the shape of container. |
| 3 | Volume | Solids have definite volume. | Liquids have definite volume. | Gases do not have definite volume. They assume the volume of container. |
| 4 | Density | Solids have high density. | Liquids have less density than solids but more than gases. | Gases have the least density. |
| 5 | Diffusion | Solids have no tendency to diffuse. | Liquids have a tendency to diffuse slowly. | Gases diffuse rapidly. |
| 6 | Rigidity | Rigid. | Fluid. | Fluid. |
| 7 | Compressibility | Negligible. | Very low. | High. |
| 8 | Inter-molecular forces of attraction | Maximum. | Less than solids. | Negligible. |
| 9 | Kinetic energy of molecules | Least. | More than solids. | Very high. |

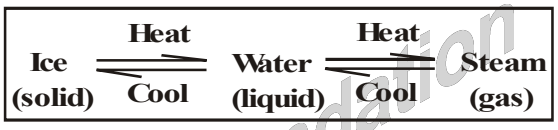
## §§ Change of state of matter-

A substance may exist in three states of matter i.e., solid, liquid or gas, depending upon the conditions of temperature and pressure. By changing the conditions of temperature and pressure, all three states could be obtained (solid, liquid, gas). On heating a solid changes into a liquid which on further heating changes into gas.

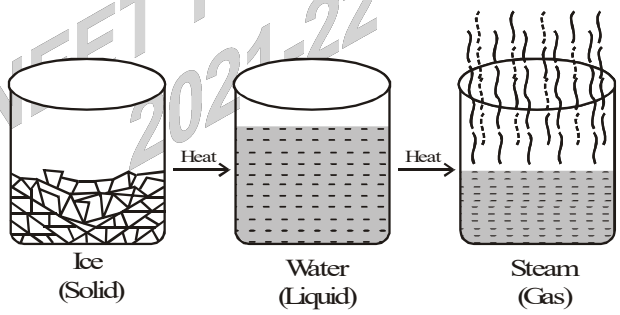
**Example – Water exists in all the three states.**

**Solid: ice** **Liquid : water.** **Gas : water vapour**

Ice is a solid state and may be melted to form water (liquid) which on further heating changes into steam (gas). These changes can also be reversed on cooling.






**Change in three states of matter**

### (1) Effect of change of temperature :–

The effect of temperature on three states of matter could be seen by performing the following activity.

**Activity :–**

**(i)** Take a piece of about 100–150g of ice in a beaker.

**(ii)** Hang a thermometer in it so that its bulb is in contact with ice.

**(iii)** Start heating the beaker slowly on a low flame.

**(iv)** Note down the temperature when ice starts changing of water & ice has been

converted to water.

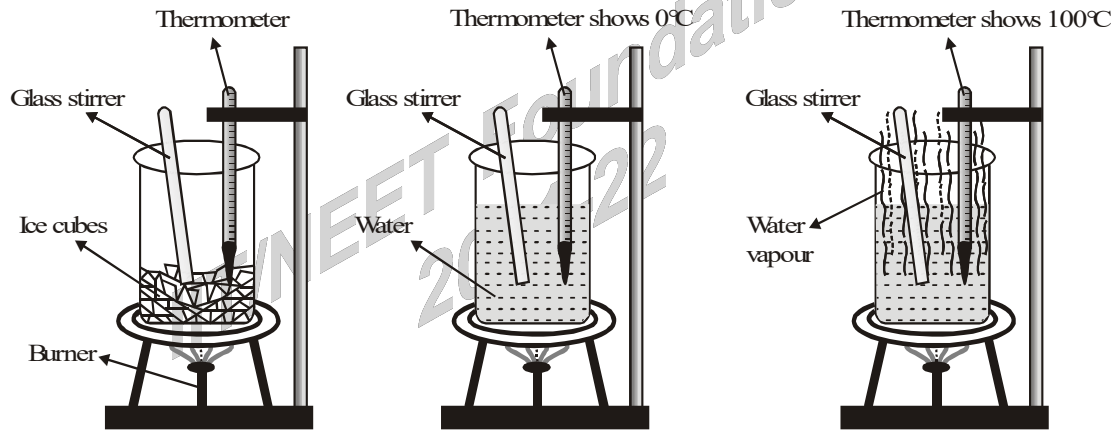
**(v)** Record all observations for the conversion of solid ice into liquid water.

**(vi)** Now, place a glass rod in the beaker and slowly heat the beaker with constant stirring with help of a glass rod.

**(vii)** Note the temperature when water starts changing into water vapours.

**(viii)** Record all observations for the conversion of water in the liquid state to vapour state.

**It is observed that as temperature increases, the ice starts changing into water. This change is called "Melting".** The temperature remains same till all the ice changes into water. The thermometer shows 0°C until all the ice has melted. On further heating, the temperature starts rising. At 373 K (or 100°C), water starts boiling. As the water continue boiling the temperature remains almost constant.




**Conversion of ice to water and water to water vapour**

**¶¶ Explaination about interconversion of different three state of matter:–**

**(A) Solid to liquid change (melting):–** Ice is a solid. In solids, the particles are tightly packed together. When we heat a solid, its particles become more energetic and kinetic energy of the particles increases. Dut to the increase in kinetic energy, the particles start vibrating more strongly with greater speed. The energy supplied by heat overcomes the intermolecular forces of attraciton between the particles. As a result, the particles leave their mean position and break away from each other. After this solid melts and a liquid is formed.

***"The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point". The process of melting is also called "Fusion".***

***The melting point of ice is 0°C. It may also be written as 273.16 K or 273 K.***

§§ **Latent Heat (Hidden Heat) :-**

It is observed that the temperature of the system does not change after melting point is achieved till all the ice melts, though we continue to heat the beaker. This is happen because the heat supplied is used up in changing the state by breaking the intermolecular forces of attraction which hold them in solid state. As a result, there is no change in temperature till all the ice melts. This energy required to change solid into liquid is called **"latent heat"**. The word **"latent"** means **"hidden"** because this energy is hidden into the contents of the beaker.

**Latent heat is of two types:–** (i) Latent heat of fusion

(ii) Latent heat of vaporization.

**(i) Latent heat of fusion :–**

Latent heat of fusion is defined as the amount of heat energy required to change 1 kg of a solid into a liquid at atmospheric pressure without any change in temperature at its melting point". The latent heat of fusion of ice is **$3.34 \times 10^5$ J/Kg.**



¶¶ **IMPORTANT DEFINITIONS**

1. **Melting or Fusion :** The process due to which a solid changes into liquid state at constant temperature, by absorbing heat energy, is known as **melting** or **fusion.**
2. **Freezing or Solidification :** The process due to which a liquid changes into solid state at constant temperature, by giving out heat energy, is known as **freezing** or **solidification.**
3. **Melting point :** The constant temperature at which a solid changes into liquid state by absorbing heat energy, is called **melting point.**
4. **Freezing point :** The constant temperature at which a liquid changes into solid state by giving out heat energy, is called **freezing point.**

**Note :** The numerical value of melting point and freezing point is the same. For example, if melting point of ice is 0°C (273 K), then the freezing point of water is 0°C (273 K).

**(B) Liquid to gas change (Boiling or vaporizations) :–**

In a liquid most of the particles are close together. When we supply heat energy to

the liquid, the particles of water start vibrating even faster. Some of the particles become so energetic that they can overcome the attractive forces of the particles around them. Therefore, they become free to move and escape from the liquid. Thus the liquid evaporates i.e., starts changing into gas.

***"The temperature at which a liquid changes into a gas or vapour at the atmospheric pressure is called its boiling point".***

***"Boiling" is a bulk phenomenon.***

***Example – For water, the boiling point is 100°C or 373 K. The particles in steam i.e., water vapour at 373 K have more energy than water at the same temperature.***

***Reason :– This is because the particle in steam have absorbed extra energy in the form of latent heat of vaporization.***

**(ii) Latent heat of vaporization :–** The latent heat of vaporization of a liquid is the quantity of heat in joules required to convert 1 kilogram of the liquid (at its boiling point) to vapour or gas, without any change in temperature. The latent heat of vaporization of water is **$22.5 \times 10^5$ joules per kilogram (or $22.5 \times 10^5$ J/kg).**



The boiling point of a liquid also indicates the strength of intermolecular force of attraction between particles. Volatile liquids such as alcohol, petrol and acetone have very weak intermolecular forces. Therefore, they boil at low temperature. On the other hand, water has stronger intermolecular forces of attraction and therefore, it boils at higher temperature. When steam is cooled, it condenses to water & when water is cooled, it changes to ice.

**¶¶ IMPORTANT DEFINITIONS**

1. **Boiling or Vaporisation :** The process due to which a liquid changes into a gaseous state at constant temperature, by absorbing heat energy, is known as **boiling or vaporisation.**
2. **Condensation or Liquefaction :** The process due to which a gas changes into a liquid state at constant temperature, by giving out, heat energy, is known as **condenstion or liquefaction.**
3. **Boiling point :** The constant temperature at which a liquid rapidly changes into its

gaseous state by absorbing heat energy, is known as **boiling point.**

**Note :** The numerical value of boiling point and liquefaction point is same.

For example , if boiling point of water is 100°C (373 K), then the liquefaction point of steam is 100°C (373K).

**Condensing is opposite to evaporating and freezing is opposite to melting.**

**4. Sublimation :** The process due to which a solid directly changes into gaseous state on heating, without changing first into liquid state and the gaseous state, directly changes into solid state on cooling, **is known as "Sublimation"**

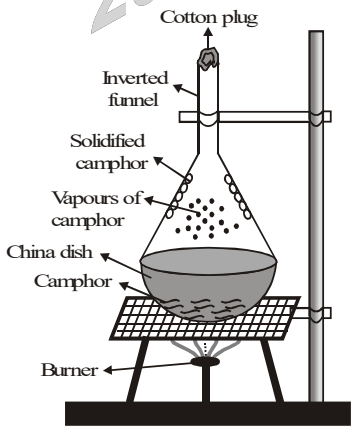
**Example :–** Ammonium chloride, camphor, iodine, naphthalene, solid carbon dioxide or (dry Ice), anthracene.

***Sublime :–*** *A gaseous form, directly formed from a solid on heating, is known as sublime.*

***Sublimate :–*** *A solid state of matter formed directly from its gaseous state on cooling, is called sublimate.*

**To understand sublimation process we can do an activity**






**Sublimation process**

1. Take some camphor or ammonium chloride.
2. Powder it and put in a china dish.
3. Place an inverted funnel over the china dish.
4. Heat the china dish slowly.

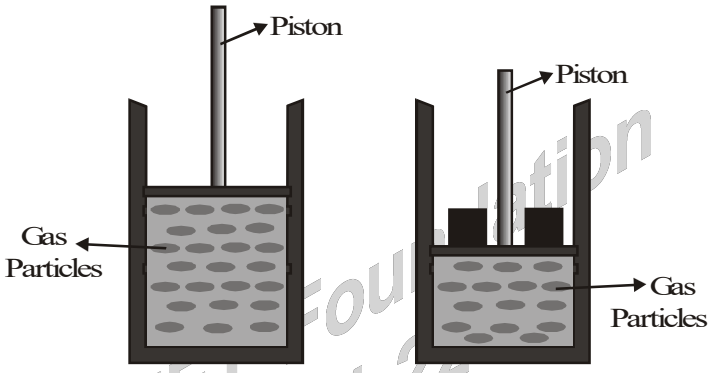
We observe that solid camphor on heating gets converted into vapour which gets condensed on the funnel.

***Solid state is directly converted into gaseous state. This experiment shows sublimation process.***

## (2) Effect of change of pressure:–

Gases are compressible because on applying pressure, the space between the gaseous particles decreases. Therefore gases can be compressed readily.

By applying pressure and reducing temperature, the gases can be converted into liquids i.e. gases will be **liquefied**.




**By applying pressure particles of matter can be brought close together**



**"This process of conversion of a gas into a liquid by increasing pressure or decreasing temperature is called liquefaction."**

Thus, we can conclude that temperature and pressure determine the state of a substance; solid, liquid or gaseous.

***Solid carbondioxide is also called dry ice. Solid $CO_2$ gets converted into gaseous state directly on decreasing pressure to 1 atmosphere without coming into liquid state.***

## §§ EVAPORATION

**"The process of a liquid changing into vapour (or gas) even below its boiling point is called evaporation".**

Evaporation of a liquid can take place even at room temperature, though it is faster at higher temperatures. It is **surface phenomenon** because it occurs at the surface of a liquid only.

Whatever be the temperature at which evaporation takes place, the latent heat of

vaporizations must be supplied whenever a liquid changes into vapour (or gas).

¶¶ **Explanation about Evaporation:–** Some particles in a liquid always have more kinetic energy than the others. So, even when a liquid is well below its boiling point, some of its particles have enough energy to break the forces of attraction between the particles and escape from the surface of the liquid in the form of vapour (or gas). Thus, the fast moving particles (or molecules) of a liquid are constantly escaping from the liquid to form vapour (or gas).

**Ex:– (i)** Water in ponds changes from liquid to vapour without reaching the boiling point.

**(ii)** Water when left uncovered slowly changes into vapour.

**(iii)**When we put wet clothes for drying, the water from the clothes goes to the atmosphere.

§§ **Factors Affecting Evaporation**

There are five factors which affects the rate of evaporation:–

**(i) Nature of liquid :–**

Different liquids have different rates of evaporation. A liquid having weaker interparticle attractive forces evaporates at faster rate because less energy is required to overcome the attractive forces.

**Example –** Acetone evaporates faster than water.

**(ii) Surface area of the liquid :–**

The evaporation depends upon the surface area. If the surface area is increased, the rate of evaporation increases because the high energy particles from liquid can go into gas phase only through surface.

**Ex :– (a)** The rate of evaporation increases when we put kerosene or petrol in an open china dish than in a test tube.

**(b)** Clothes dry faster when they are well spread because the surface area for evaporation increases.

**(iii) Temperature:–**

Rate of evaporation increases with increase in temperature. This is because with the increase in temperature more number of particles get enough kinetic energy to go into

the vapour state (or gaseous state).

**Ex –** Clothes dry faster in summers than in winters.

**(iv) Humidity in the air:–** The air around us contains water vapour or moisture. The amount of water present in the air is referred to as humidity. The air cannot hold more than a definite amount of water vapour at a given temperature. If the humidity is more, the rate of vaporization decreases. The rate of evaporation is more if the air is dry.

**Ex:–** Clothes do not dry easily during rainy season because the rate of evaporation is less due to high moisture content (humidity) in the air.

**(v) Wind speed :–**

The rate of evaporation also increases with increase in speed of the wind. This is because with increase in speed of wind, the particles of water vapour move away with wind resulting decrease in the amount of vapour in the atmosphere.

**Ex:– (i)** Clothes dry faster on a windy day.

**(ii)** In a desert cooler an exhaust fan sucks the moist air from the cooler chamber which results in greater rate of evaporation of water and hence greater cooling.



§§ **Evaporation causes cooling:–**

During evaporation, cooling is always caused. This is because evaporation is a phenomenon in which only the high energy particles leave the liquid surface. As a result, the particles having low energy are left behind. Therefore, the average molecular energy of the remaining particles left in the liquid state is lowered. As a result, there is decrease in temperature on the part of the liquid that is left. Thus evaporation causes cooling.

**Ex:– (i)** When we pour some acetone on our palm, we feel cold. This is because the particles gain energy from our palm or surroundings and leave the palm feeling cool.

**(ii)** We sprinkle water on the root or open ground after a sunny hot day. This cools the roof or open ground. This is because the large latent heat of vaporization of water helps to cool the hot surface.

**Some other examples of evaporation:–**

**(i) We should wear cotton clothes in hot summer days to keep cool and comfortable.**

This can be explained as follows. We get a lot of sweat on our body in hot summer days. Cotton is a good absorber of water, so it absorbs the sweat from our body and exposes it to the air for evaporation. The evaporation of this sweat cools our body. The synthetic clothes (made of polyester etc) do not absorb much of sweat, so they fail

to keep our body cool in summer.

**(ii) We see water droplets on the outer surface of a glass containing ice-cold water.**

Take some ice-cold water in a glass. Soon we will see water droplets on the outer surface of the glass. The water vapour present in air, on coming in contact with the cold glass of water loses energy and gets converted to liquid state, which we see as water droplets.

**(iii) Water keeps cool in the earthen pot (matki) during summer:–**

When the water oozes out of the pores of an earthen pot, during hot summer, it evaporates rapidly. As the cooling is caused by evaporation, therefore, the temperature of water within the pot falls and hence it becomes cool.

**(iv) Rapid cooling of hot tea:–**

If tea is too hot to sip, we pour it in the saucer. In doing so, we increase the surface area and the rate of evaporation. This, in turn, causes cooling and the tea attains a desired temperature for sipping

**(v)** A wet handkerchief is placed on the fore head of a person suffering from high fever. The logic behind placing wet cloth is that as the water from the wet cloth evaporates,it takes heat from the skull and the brain within it. This, in turn, lowers the temperature of brain and protects it from any damage due to high temperature.

**(vi)** We often sprinkle water on the road in summer. The water evaporates rapidly from the hot surface of the road, there by taking heat away from it. Thus, the road becomes cool.



**Differences between evaporation and boiling.**

| S.No | Evaporation | Boiling |
|---|---|---|
| 1 | Evaporation process takes place spontaneously at all temperatures. | Boiling takes place only at definite temperature (boiling point) at which the vapour pressure of the liquid is equal to atmospheric pressure. |
| 2 | Evaporation takes place only at the surface of the liquid | Boiling takes place even below the surface of the liquid in the form of bubbles. |
| 3 | It always causes cooling | No cooling |

## §§ Comparision Charts on change of states of matter

| Melting | Vaporization |
|---|---|
| The process of conversion of matter from solid to liquid is known as Melting | The process of conversion of matter from Liquid to Gas is known as Vaporization |
| On heating solids – temperature rises | On heating liquids- temperature rises |
| particles gain energy. | Particles gain energy |
| Intermolecular attractions decreases | Intermolecular attractions decreases |
| intermolecular space between molecules of solid increases | intermolecular space between molecules of liquid increases |



| Liquefaction | Solidification |
|---|---|
| The process of conversion of gas to liquid is known as Liquefaction | The process of conversion of liquid to solid is known as Solidification |
| On cooling gases: temperature falls | On cooling liquids: temperature falls |
| Attraction between molecules (intermolecular attraction) increases | Attraction between molecules (intermolecular attraction) increases |
| space between (intermolecular space) molecules of gases decreases | space between (intermolecular space) molecules of gases decreases |
| particles lose energy | particles lose energy |
| at liquefaction point, particles slow down, come close and convert into a liquid | At solidification [freezing] point, particles slow down and convert into a solid. |

| | Evaporation | Boiling |
|---|---|---|
| 1 | Evaporation process takes place | Boiling takes place only at definite |
| 2 | Evaporation takes place only at the | Boiling takes place even below the |
| 3 | It always causes cooling | No cooling |

| The terms involved | Process of change of state at a particular temperature |
|---|---|
| • Melting | Solid state changes to liquid state |
| • Vaporization | liquid state changes to Gaseous state |
| • Liquefaction | Gaseous state changes to liquid state |
| • Solidification | liquid state changes to solid state |
| • Sublimation | Solid state changes to Gaseous state |

| The terms involved | Temperature at which…. |
|---|---|
| • Melting Point | Solid state converts to liquid state |
| • Boiling Point | liquid state converts to Gaseous state |
| • Liquefaction Point | Gaseous state converts to liquid state |
| • Freezing Point | liquid state converts to solid state |

## §§ PROPERTIES OF MATTER AND THEIR MEASUREMENT

Every substance has unique or characteristic properties. These properties can be classified into two categories . **a)**physical properties **b)**chemical properties.

### a) Physical properties

Physical properties are those properties which can be measured or observed without changing the identity or the composition of the substance. Some examples of physical properties are colour, odour, melting point, boiling point, density etc.



### ¶¶ Mass and Weight

Mass of a system represents the amount of matter present in a system, while weight represents the force that gravity exert on that system (or object). These terms are often used interchangeably, although strictly speaking, they are different quantities.

The SI base unit of mass is kilogram (kg) but in chemistry unit gram (g) is more convenient and frequently used.

$$1 \text{ kg} = 1000 \text{ g} = 1 \times 10^3 \text{ g}$$

### ¶¶ Common Unit of Mass and Weight

1 pound = 453.59 grams
1 pound = 453.59 grams
= 0.45359 kilogram
1 kilogram = 1000 grams
= 2.205 pounds
1 gram = 10 decigrams
= 100 centigrams

= 1000 milligrams

1 gram = $6.022 \times 10^{23}$ atomic mass units or u

1 atomic mass unit = $1.6606 \times 10^{-24}$ gram

1 metric tonne = 1000 kilograms = 2205 pounds

**¶¶ Volume**

Volume has the units of (length)$^3$.

In SI system, volume has units of $m^3$.

But again, in chemistry laboratories, smaller volumes are used. Hence, volume is often denoted in $cm^3$ or $dm^3$ units.

A common unit, litre (L) which is not an SI unit, is used for measurement of volume of liquids.

1 L = 1000 mL , 1000 $cm^3$ = 1 $dm^3$

In the laboratory, volume of liquids or solutions can be measured by graduated cylinder, burette, pipette etc.

A volumetric flask is used to prepare a known volume of a solution.

**¶¶ Common Unit of Volume**

| | |
|---|---|
| 1 quart | = 0.9463 litre |
| 1 litre | = 1.056 quarts |
| 1 litre | = 1 cubic decimetre |
| | = 1000 cubic centimetres |
| | = 0.001 cubic metre |
| 1 millilitre | = 1 cubic centimetre |
| | = 0.001 litre |
| | = $1.056 \times 10^{-3}$ quart |
| 1 cubic foot | = 28.316 litres |
| | = 29.902 quarts = 7.475 gallons |

**¶¶ Density**

Density of a substance is its amount of mass per unit volume.

$$\text{Density (d)} = \frac{\text{Mass (m)}}{\text{Volume (V)}}$$

The SI unit of density is $kg/m^3$ but $g/cm^3$ or g/mL are more commonly used, for expressing the densities of solids and liquids.

1 $g/cm^3$ = 1 g/mL = 1000 $kg/m^3$

1 g/L = 0.001 g/mL

**¶¶ Temperature**

Temperature is a measure of hotness or coldness of a body.There are three

common scales to measure temperature:-$^{o}$C (degree celsius),$^{o}$F (degree fahrenheit) and K (kelvin). Here, K is the SI unit.

**(a)** **Degree Farenheit (°F) :** On this scale, freezing and boiling points of water are 32°F and 212°F respectively. These two limits are divided into 180 divisions.

**(b)** **Degree Celsius (°C) :** On this scale, freezing and boiling points of water are 0°C and 100°C respectively and this range between freezing and boiling points of water is divided into 100 parts.

**(c)** **Kelvin (K and not °K) :** It is absolute temperature scale and is SI unit of temperature. 0 K is the lowest temperature that can be attained theoretically.

Following relations can be used directly to interconvert temperature in different units.

$$\frac{C}{5} = \frac{F-32}{9}$$

Here C and F are temperatures in °C and °F respectively.

Also, K = C + 273.15

It is interesting to note that temperature below 0 C (i.e. negative values) are possible in Celsius scale but in Kelvin scale, negative temperature is not possible.

§§ **Other useful conversion factors**

¶¶ **Common Units of Energy**

| | |
|---|---|
| 1 joule | = 1 × $10^{7}$ ergs |
| 1 thermochemical calorie | = 4.184 joules |
| | = 4.184 × $10^{7}$ ergs |
| | = 4.129 × 102 litre-atmospheres |
| | = 2.612 × 1019 electron volts |
| 1 ergs | = 1 × $10^{-7}$ joule |
| | = 2.3901 × 108 calorie |
| 1 electron volt | = 1.6022 × $10^{19}$ joule |
| | = 1.6022 × 1012 erg |
| | = 96.487 kJ/mol |
| 1 litre-atmosphere | = 24.217 calories |
| | = 101.32 joules |
| | = 1.0132 ×109 ergs |
| 1 British thermal unit | = 1055.06 joules |
| | = 1.05506 ×1010 ergs |
| | = 252.2 calories |

**¶¶ Common Units of Length**

| | |
|---|---|
| 1 inch | = 2.54 centimetres (exactly) |
| 1 mile | = 5280 feet |
| | = 1.609 kilometres |
| 1 yard | = 36 inches |
| | = 0.9144 metre |
| 1 metre | = 100 centimetres |
| | = 39.37 inches |
| | = 3.281 feet |
| | = 1.094 yards |
| 1 kilometre | = 1000 metres |
| | = 1094 yards |
| | = 0.6215 mile |
| 1 Angstrom | = 1.0 × 108 centimetre |
| | = 0.10 nanometre |
| | = 1.0 × 1010 metre |
| | = 3.937 × 109 inch |

**¶¶ Common Units of Force and Pressure**

| | |
|---|---|
| 1 atmosphere | = 760 millimetres of mercury |
| | = 1.013 × $10^5$ pascals |
| | = 14.70 pounds per square inch |
| 1 bar | = 105 pascals |
| 1 torr | = 1 millimetre of mercury |
| 1 pascal | = 1 kg/$ms^2$ |
| | = 1 N/$m^2$ |



## TEACHING TASK

**I) Single correct choice type**

**1.** Based on the statements given here choose the correct answer.

(1) If we increase the temperature of a gas inside a container, its pressure also increases.

(2) Upon heating, the rate of collisions of the gas molecules increase and increases the impact of force on the walls of the container.

(A) (1) and (2) are true

(A) (1) and (2) are False

(C) Only (1) is true

(D) Only (2) is true

**2.** Based on the statements given here choose the correct answer.

(1) Same sugar can be added to a full glass of water without causing overflow.

(2) A liquid is contianuous even-though space is present between the molecules.

(A) (1) and (2) are true (B) (1) and (2) are False

(C) Only (1) is true (D) Only (2) is true

**3.** Select the properties for, X, Y, Z.

X ⟶ a piece of stone.

Y ⟶ a water droplet.

Z ⟶ Oxygen gas.

| | X | Y | Z |
|---|---|---|---|
| 1 | Minimum intermolecular space. | Particles are free to move. | Force of attraction between particles is negligible. |
| 2 | Maximum intermolecular space. | Force of attraction between particles is negligible. | Particles are free to move |
| 3 | Particles are free to move. | Force of attraction between particles is negligible | Minimum inter molecular space. |
| 4 | Force of attraction between particles is negligible. | Minimum intermolecular space. | Particles are free to move. |



**4.** Which is more effective in cooling ?

(A) Water at 0°C (B) Water at 100°C (C) Ice at 0°C (D) All of these

**5.** The temperature at which Celsius and Fahrenheit scales show the same reading is :-

(A) 40° K (B) 100° F (C) – 40° C (D) – 100°C

**6.** Based on the statements given here choose the correct answer.

(1) Boiling point of a liquid increases with increase in temperature.

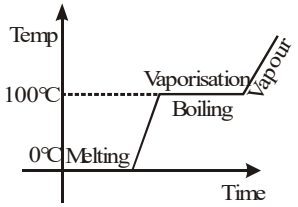
(2) The volume of liquids increases on boiling and the vaporisation curve shows the variation of the boiling point of a liquid with pressure and expands the equilibrium state between liquid and vapour phase.

(A) (1) and (2) are true and (2) explains (1)

(B) (1) and (2) are true but (2) does not explain (1)

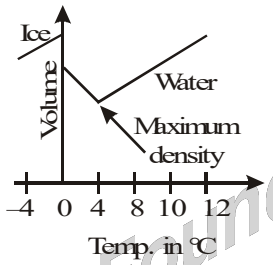
(C) Only (1) is true (D) Only (2) is true

7. In an experiment of conversion of ice into water and water into vapour, observations were recorded and a graph plotted for temperature against time as shown below. From the graph it can be concluded that :-




(A) Ice takes time to heat up to 0°C
(B) During melting and boiling temperature does not rise
(C) Process of boiling takes longer time than the process of melting
(D) All the above

**8.** Study the graph given below and select the correct statement :-




(A) When water is cooled to 4°C it contracts
(B) At 0°C water freezes
(C) The volume of ice is more than that of water
(D) All of these

**9.** The solid state of $CO_2$ is called :-
(A) Tear gas (B) Cooking gas (C) Dry ice (D) Laughing gas

**10.** Corresponding temperature in the Kelvin scale for 104°C F is :-
(A) 313 K (B) 203 (C) 308 K (D) 377 K

**11.** When the vapour pressure of a liquid is equal to its atmospheric pressure, then it :-
(A) Freezes (B) Evaporates
(C) Boils (D) Does not undergo any change

**12.** When ice is converted into water :-
(A) Heat is absorbed (B) Heat is released
(C) Temperature increases (D) Temperature decreases

**13.** Which of the following is the SI unit of volume ?
(A) $mm^3$ (B) $cm^3$ (C) $m^3$ (D) litre

**14.** Which of the following is not a unit of distance ?
(A) light year (B) parsec (C) leap year (D) angstrom

**15.** Which of the following is not a fundamental unit ?

(A) metre (B) litre (C) kilogram (D) second

**II) Multi correct choice type**

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which **ONE or MORE** is correct. Choose the correct options*

**1.** Which of the following statement is incorrect

1. Air, water, chair, table and smell are examples of matter.
2. Gases have highest rate of diffustoin among all the three states of matter.
3. Evaporation causes heating.
4. Camphor changes to gaseous state without changing into liquid.

A) 1,2,3 B) 1,3,4 C) 1,2,3,4 D) 3,4

**2.** Which of the following statement is incorrect

1. Intermolecular forces are maximum in solids and minimum in gases.
2. Condensing is opposite to evaporating and freezing is opposite to melting.
3. The large volumes of gases can be put into small volumes of cylinders because of their property known as compressibility.
4. Increase in humidity is out of the factor which increases the rate of evaporation.

A) 1,3,4 B) 1,3,4 C) 1,2,3,4 D) 1,2,3,

**III) Assertion & Reason type**

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

**1.** Based on the statements given here choose the correct answer.

**Statement-I :** If we increase the temperature of a gas inside a container, its pressure also increases.

**Statement-II :** Upon heating, the rate of collisions of the gas molecules increase and increases the impact of force on the walls of the container.

A) Both Statements are true, Statement II is the correct explanation of Statement I.

B) Both Statements are true, Statement II is not correct explanation of Statement I.

C) Statement I is true, Statement II is false.

D) Statement I is false, Statement II is true.

**2.** Based on the statements given here choose the correct answer.

**Statement-I :** In polar regions aquatic life is safe in water under frozen ice.

**Statement-II :** Water has a high latent heat of fusion and the upper portion of ice does not allow the heat of the water to escape to the surroundings.

A) Both Statements are true, Statement II is the correct explanation of Statement I.

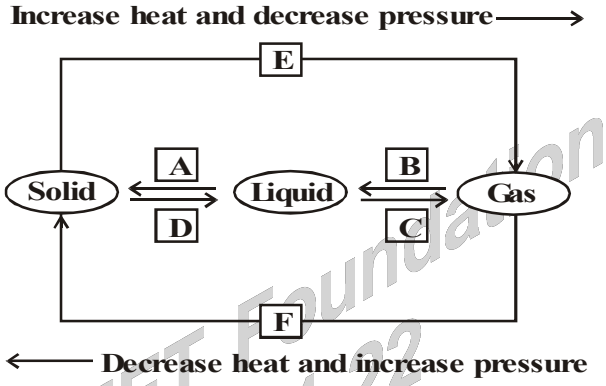
B) Both Statements are true, Statement II is not correct explanation of Statement I.

C) Statement I is true, Statement II is false.

D) Statement I is false, Statement II is true.

**IV) Comprehension type**

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C ) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*






**1.** Which of the following statements are correct

A) If the melting point of a substance is above the room temperature at the atmospheric pressure, it is called solid.

B) If the boiling point of a substance is above room temperature under atmospheric pressure, it is classified as liquid.

C) If the boiling point of the substance is below the room temperature at the atmospheric pressure it is called gas.

D) All the above

**2.** A, B, D, and F in the above diagram

A) A : Fusion, B : Vaporizations, D : Solidification, F : Sublimation

B) A : Sublimation , B : Vaporizations, D : Solidification, F : Fusion

C) A : Fusion, B : Solidification, D : Vaporizations, F : Sublimation

D) A : Sublimation , B : Vaporizations, D :Fusion, F : Solidification

**V) Matrix Match Type:**

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column–I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

**4.**

| | Column-I | Column-II |
|---|---|---|
| a) | The molecules are made up of smaller particles | 1) Molecules |
| b) | Matter is made up of | 2) Liquefaction point |
| c) | The constant temperature at which gas changes into a liquid state | 3) Atoms |
| d) | Solids vapourise without melting | 4) Sublimation |
| | | 5) Ions |

## KEY

**ΦΦ TEACHING TASK**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **I.** | 1-A, | 2-A | 3-A, | 4- C | 5-C | 6-A | 7-D | 8-D | 9-C | 10-A |
| | 11-C | 12-A | 13.C | 14.C | 15.D | | | | | |
| **II.** | 1- A | 2- D | | **III.** | 1. A | 2. A | | | | |
| **IV.** | 1. A | 2. D | | **V.** | a-,3 b-1,3, c-2, d-4, | | | | | |

## LEARNER'S TASK

### BEGINNERS ( Level - I )

**I) Single Correct Choice Type:**

**1.** Which of the following has the strongest interparticle force at the room temperature?

(A) Nitrogen (B) Mercury (C) Iron (D) Chalk

**2.** What is volume of gases?

(A) Definite (B) Almost Nil

(C) Large (D) Take the volume of container

**3.** The change of state from solid to liquid known as –

(A) Fusion (B) Boiling (C) Melting (D) None of these

**4.** Dry ice is –

(A) Water in solid state (B) Water in gaseous state

(C) $CO_2$ in liquid state (D) $CO_2$ in solid state

**5.** The boiling point of water on kelvin scale is –

(A) 573 K (B) 273 K (C) 373 K (D) 100 K

**6.** The process of change of a liquid into vapour at any temperature is called –

(A) Diffusion (B) Evaporation (C) Cooling (D) Heating

**7.** Which factor affecting Evaporation –
(A) Temperature (B) Surface area (C) Both (A) & (B) (D) None of these

**8.** On increasing the temperature of the liquid the rate of evaporation is –
(A) Increase (B) Decreases (C) No change (D) None of these

**9.** Fluids are –
(A) Liquids and gases (B) Solids and gases
(C) Liquids and solids (D) Only solids

**10.** Which substance undergo sublimation process –
(A) Naphthalene (B) $CO_2$ (C) Ice (D) $N_2$

**11.** Condensation process is –
(A) Change of state from gas to liquid (B) Change of state from liquid to gas
(C) Change of state from gas to solid (D) Change of state from solid to liquid

**12.** The temperature at which liquid starts boiling at atmospheric pressure known as
(A) Melting point (B) Boiling point (C) Latent heat (D) Condensation

**13.** The melting point of ice is –
(A) 0°C (B) 4°C (C) 5°C (D) None of these

**14.** The physical state of matter which can be easily compressed –
(A) Liquid (B) Gas (C) Solid (D) None of these

**15.** Name the process by which a drop of ink spreads in a beaker of water –
(A) Diffusion (B) Vaporization (C) Condensation (D) Sublimation

**16.** The temperature at which a solid changes into liquid at atmospheric pressure is called
(A) Melting point (B) Boiling point (C) Diffusion (D) Evaporation

**17.** Convert the temperature of 373°C to the kelvin scale ?
(A) 646 K (B) 546 K (C) 300 K (D) 500 K

**18.** Convert the temperature of 270 K to the celsius scale –
(A) – 3°C (B) – 4°C (C) 2°C (D) 5°C

**19.** The process for the change of a solid directly into its vapour is called –
(A) Evaporation (B) Ebullition (C) Condensation (D) Sublimation



## ACHIEVERS ( Level - II )

**Solve the following :**

**1.** Naphthalene balls disappear with time without leaving any solid why?

**2.** Convert the following temperatures to the celsius scale.
(a) 300 K (b) 573 K

**3.** Convert the following temperature to the Kelvin scale.

(a) 25°C (b) 373°C

**4.** Why ice floats on water?

**5.** Write differences between evaporation and Boiling

**6.** Write differences between three changes of matter

**7.** Write the differences between liquifaction and solidification ?

**8.** Write the differences between melting and vaporisation ?

## EXPLORERS ( Level - III )

### I) Multi Correct Choice Type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), ( C),(D),out of which **ONE or MORE** is correct. Choose the correct options*

**1.** Which of the following is correct statement?

A) Matter is made up of tiny particles called molecules.

B) Molecules of matter are in constant vibration.

C) Matter can exist in two states.

D) Matter may change from one state to another state when there is change in temperature and pressure.

**2.** Water can exist in:

A) Solid B) Liquid C) Gas D) Neutral

### II) Assertion - Reasoning Type:

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

**1.** ***Statement I :*** The change in state from solid to liquid is known as melting.

***Statement II :*** The temperature at which a solid melts is called the melting point of the solid.

A. Both Statements are true,Statement II is the correct explanation of Statement I.

B.Both Statements are true, Statement II is not correct explanation of Statement I.

C.Statement I is true, Statement II is false.

D.Statement I is false, Statement II is true.

### III) Comprehension Type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C ) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

**a)** Interconversion of matter involves change of state of matter from one state to another state and back to its original state due to change in temperature and pressure.

**1.** The temperature at which a gas changes into a liquid state is called:

1) Boiling point 2) Freezing point 3) Liquefaction point 4) Melting poinht

**2.** The change in state from liquid to gaseous is known as:

A) Evaporation B) Vapourisation

C) Both 1 and 2 D) Condensation

**b)** Solids have fixed shape and fixed volume. A liquid has no fixed shape. A gas has neither a fixed volume nor a fixed shape.

**1.** Which of the following has a fixed volume but not a fixed shape?

A) Milk B) A book C) A pen D) Oxygen

**2.** You all are familiar with three states of matter. Recent research has led to the discovery of fourth and fifth states. They are :

A) Condensate state, Gaseous state.

B) Plasma state, Bose Einstein condensate. C) Alpha state, Gamma state.

D) None of the above.

**IV) Matrix Match Type:**

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*



**1.**

| | Column-I | Column-II |
|---|---|---|
| a) | Liquifaction | 1) Solid state to direct gaseous state |
| b) | Melting point | 2) Liquid changes into solid |
| c) | Freezing point | 3) Solid changes into liquid |
| d) | Sublimation | 4) Gaseous states to liquid state |
| | | 5) Liquid to gaseous state |

**KEY**

**ΦΦ LEARNER'STASK :**

☐ **BEGINNERS :**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. C | 2. D | 3. C | 4. D | 5. C | 6. B | 7. C | 8. A |
| 9. A | 10. A | 11. A | 12. B | 13. A | 14. B | 15. A | 16. A |
| 17. A | 18.A | 19. D | | | | | |

☐ **EXPLORERS :**

**I.** 1-1 2 4 2-1,2,3

**II.** 1-1

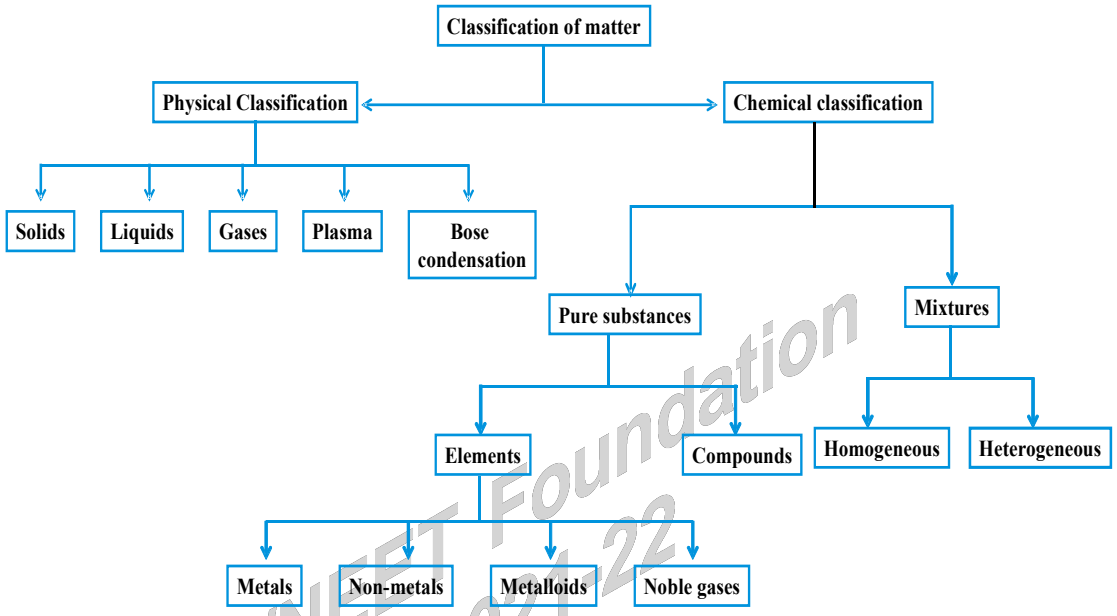
**III** 1) 1-3 2-2 2) 1-1 2-2

**IV.** 1-a-3,b-4,c-2,d-1

## §§ CHEMICAL CLASSIFICATION OF MATTER :

We can classify matter on the basis of purity into pure and impure substances.

Matter which is pure contains elements and compounds and the matter which is impure contains mixtures.






### §§ Pure substances:

A homogeneous material which contains particles of only one kind and has a definite set of properties, is called a pure substance. OR A pure substance is a distinct type of matter that can not be separated into other types of matter by any physical process e.g. oxygen, sulphur, iron etc. are pure substance however,if a substance is composed of two or more different kinds of particles combined together in fixed proportion by weight, then the substance is also regarded as pure substance. e.g.Sodium chloride is a pure substance, because it has a fixed number of sodium and chloride ions, combined together in fixed proportion by weight. Similarly, magnesium oxide (MgO),carbon dioxide ($CO_2$), copper sulphate ($CuSO_4$) etc. are pure substances

### §§ Properties of pure substaces:

Pure substance have sharp melting point and boiling points.pure substances has a fixed composition with distinct chemical properties.Also, the constituents of pure substances cannot be separated by simple physical methods.

**Pure substances can be further classified into:- a)elements b)compounds.**

### §§ Element:-

Robert Boyle was the first scientist to use the term element is 1661. Elements are

the basic building block of matter, every substances on the earth made from one or more elements.There are 119 elements discovered so far, amongst these elements , 92 elements occur in nature, whereas 27 have been made in nuclear laboratories, majority of the element are solid. Eleven elements are in gaseous state at room temperature. Two elements are liquid at room temperature -mercury and bromine. Antoine Laurent Lavoiser (1743-94). A french chemist, defined an element as a basic form of matter that can not be broken down into simpler substances by chemical reactions. Element also can be defined as a substance made up of the atoms with same atomic number.

**§§ Defnition :**

Any pure substance which cannot be broken into two or more simpler substances by any known physical or chemical means is called an element.

**EX:** Hydrogen is an element because it cannot be split into two or more simpler substances by any physical or chemical method.

Water is not an element because it can be split into two simpler substances.

**¶¶ Characteristics of element:-**

i) An element is a pure substance, made up of only one kind of atoms.

ii) Except during nuclear reactions, an element cannot be broken into two or more smaller parts.

iii) An atom is the smallest unit of an element. It shows all the properties of that element.

(iv) Most of the elements occur in free state in nature and some are found in the form of their compounds.

(v) Elements are further classified broadly into metals and non-metals.



**§§ Metals**

If an element is a metal, it should have the following characteristics:

(i) It should have lustre, i.e., it should have metallic glow.

(ii) It should be a good conductor of heat and electricity.

(iii) It should be ductile, i.e., it should be drawn into wires.

(iv) It should be malleable, i.e., it should be beaten into sheets.

(v) It should be a solid at room temperature.

(vi) It should produce a sonorous sound on being hit.

**Exceptions:**

Mercury and Gallium are liquid metals at $30^0$C.

Zinc is not malleable and ductile at room temperature.

**§§ Non-metals**

An element is a non-metal, if it has the following characteristics:

(i) It has no lustre, i.e., it cannot be polished.

(ii) It is a bad conductor of heat and electricity.

(iii) It is not ductile, i.e., it cannot be drawn into wires.

(iv) It is not malleable, i.e., it cannot be beaten into sheets.

(v) It is a gas or a brittle solid at room temperature.

(vi) It does not produce a sonorous sound on being hit.

**Exceptions:**

Graphite (form of carbon) has a lustre and is a good conductor of heat and electricity.

Bromine is a liquid non-metal.

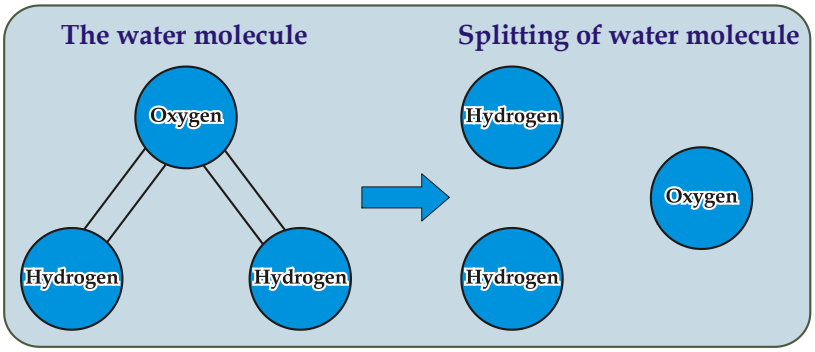
¶¶ **Differences between Metals and Non-Metals**

| | Properties of metals : | Properties of non-metals : |
|---|---|---|
| 1 | They have generally silver grey colour, However some metal or their alloys have golden yellow colour. **Excepltion is copper, which is reddish in colour**. | They exist in solid, liquid and gaseous state. |
| 2 | Metals have a lusture, the freshly cut surface has a shine on it. | They display variety of colour. |
| 3 | They easily conduct heat and electricity. | They are generally neither malleable nor ductile. |
| 4 | They are malleable i.e. they can be beaten into sheets. | They are poor conductors of heat and electricity. |
| 5 | They are sonorous. eg. Gold, silver, copper, iron, sodium, potassium etc. Mercury is the only metal that is liquid at room temperature. | They are not sonorous. eg. Hydrogen, oxygen, iodine, carbon etc. |



§§ **Metalloids :** Some element have intermediate properties of the metals and non-metals.The elements which exhibit the properties of metals as well as non-metals, are called metalloids.**Example :** Boron, Silicon, Germanium etc.

§§ **COMPOUND:** A compound is a pure substance formed from two or more elements combined together in a definite proportion by weight.For example, coal mainly contains Carbon and air contains Oxygen. But a heap of coal, lying in the open air does not form Carbon dioxide unless it is burnt.Burning of Carbon in Oxygen is a chemical change. Carbon and Oxygen chemically combine together to form the compound Carbon dioxide. For example, Water is a compound as it can be split up into the elements Hydrogen and Oxygen.




Similarly, Carbon dioxide can be split up into the elements Carbon and Oxygen, Sugar can be broken down into Carbon, Hydrogen and Oxygen, and salt can be split into Sodium and Chlorine. Thus Carbondioxide, sugar and common salt are compounds.

**§§ Properties of compounds:**

**i.** *A compund cannot be separated into its constituent elements by mechanical or physical methods.*

**Ex:** Iron sulphide is a compund of iron and sulphur.Put a magnet close to a sample of iron sulphide, the iron present in the iron sulphide does not get attracted towards the magnet bcoz iron has no identity in iron sulphide. Also, sulphur dissolves in carbon disulphide. But if we add carbon disulphide to iron suphide, the sulphur present in iron sulphide does not dissolve in it, because sulphur has no individual property in iron sulphide.These clearly show that the constituents( Fe and S) present in iron sulphide cannot be separated by physical methods.



**ii.** *The properties of a compound differ entirely from those of its constituent elements.*

**Ex:** water is a compound made up of hydrogen and oxygen. But, the properties of water are different from those of hydrogen and oxygen. Water is a liquid, while hydrogen and oxygen are gases.

**iii.** *When a compound is formed , energy is usually released or absorbed( in the form of heat or light) during the chemical reaction.*

**Ex:** The constituent elements of water are hydrogen and oxygen- both are gases and do not react with each other unless an electric spark is provided ,i.e., energy is supplied.

**iv.** *In a compound, the constituent elements are present in a definite proportion by weight.*

In water, hydrogen and oxygen are present in a fixed ratio of 1:8 by weight.

**v.** *A compound has a fixed melting point, a fixed boiling point, etc.*

**Ex:** Ice always melts at $0^{o}$ c.

**vi.** *A compound is a homogenous substance, ie., a compound is such a substance*

*which is same through out in its properties and composition.*

**Ex:** Iron sulphide is a compound of iron and sulphur. if we see iron sulphide throug a microscope , particles of iron or sulphur cannot be separately identified.

Since compunds are formed by chemical combination of elements, they are also called **chemical compounds.**

¶¶ **Differences between elements and compounds**

| ELEMENTS | COMPOUNDS |
|---|---|
| An element is a substance whichcannot be split into two two or more different substances. | A compound can be split into 2 or more different substances. |
| An element is formed from atoms of the same kind | A compound is formed from atoms of different kinds. |



§§ **MIXTURES:** A mixture is a material containing 2 or more elements or compounds that are in close contact and mixed together in any proportion. The components of a mixture can be separated by simple mechanical means.

**Ex:** i) Air is a mixture if N, O, $CO_2$ , watervapour and a small amount of the substances.

ii) Gun powder is a mixture of nitre($KNO_3$) sulphur and coal.

§§ **PROPERTIES OF MIXTURES:**

**1.** *A mixture homogenous or heterogenous.*

A homogenous mixture has uniform composition throughout its mass.

**Ex:** Sugar solution is a mixture of sugar in water. Any portion of this solution contains the same proportion of sugar and water.A heterogenous mixture of does not have a uniform composition throughout its mass.

**Ex:** a mixture of sand and common salt. The composition of different parts of this mixture have different proportions of sand and common salt.

**2.** *The constuents of mixture can be separated by physical methods such as filtration, evaporation ,sublimation and magnetic separation.*

**Ex:** When a magnet is put in the mixture of iron filings and sulphur, the iron particles get attracted to the magnet. When we add carbon disulphide to the mixture, sulphur dissolves in it but iron particles remain unaffected. On filtration, iron can be obtained as aresidue.

**3.** *In the preparation of a mixture , energy is usually neither given out nor absorbed.*

**Ex:** when sugar and sand is mixed together, there is no energy change, i.e., energy is neither released nor absorbed.

**4.** *The composition of a mixture is not fixed.*

**Ex:** Composition of a mixture varies from one part to another. The constituents of the mixture may be present in any proportion by weight.

**5.** *A mixture has no definite melting and boiling point etc.*

**6.** *In the formation of a mixture, no chemical reaction occur.*

The constituents of a mixture do not undergo any change in composition.

**§§ Types of mixtures:** Mixtures can be categorised into various types, depending on the physical states of the constituents. Some of these types are.

**i)** Solid-solid mixture**, ex:** sugar and sand

**ii)** Solid-liquid**, ex:** mixture of iodine and ethanol(tincture of iodine)

**iii)** Solid-gas **,ex:** air trapped in pores of soil particles .

**iv)** Liquid-gas**, ex:** all gases are partially miscible with liquids.

**v)** Gas-gas, **ex:** air is a mixture of several gases.

**vi)** Liquid-liquid**, ex:** water-alcohol, water-oil mixture.



| Mixtures | Compounds |
|---|---|
| Elements or compounds just mix together to form a mixture and no new compound is formed | Elements react to form new compounds. |
| A mixture has variable composition. | The composition of each new substance is always fixed. |
| A mixture shows the properties of the constituent substances. | The new substance has totally different properties. |
| The constituents can be separated fairly easily by physical methods | The constituents can be separated only by chemical or electrochemical methods. |

## §§ ATOMS AND MOLECULES

**An atom is the smallest particle of an element** that takes part in a chemical reaction. Atoms of most of the have no free existance .However, they exist in the combined state as molecules or ions.The noble gases only have free existance.

**Atoms have the following characteristics:**

**i)All atoms of a given element are similar, i.e., they have the same properties.**

For example, the atoms of Hydrogen are all alike and so are those of Oxygen or

Carbon.

**ii)The atoms of an element are different from those of others.**

For example, the atoms of Hydrogen are different from those of Oxygen or Carbon.

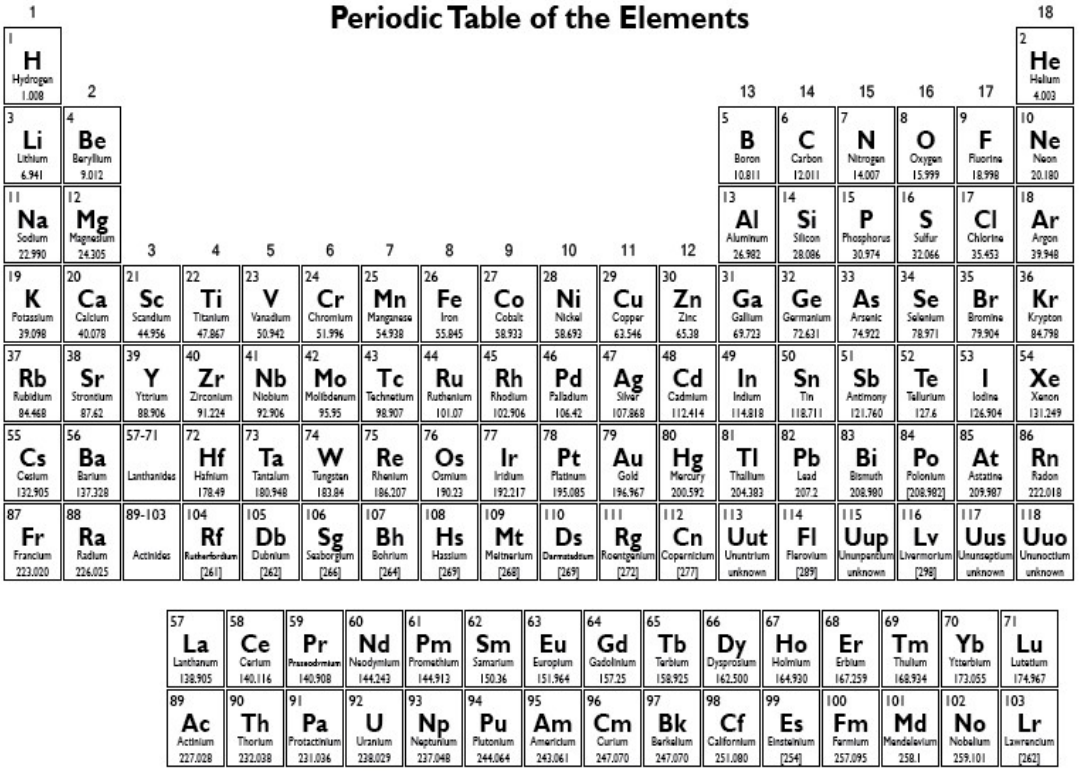
**iii)The atoms of an element show all the properties of the element.**

For example, every atom of Hydrogen will show all the properties of Hydrogen. And every atom of Oxygen will show all the properties of Oxygen.

**§§ How is an atom represented?**

An atom of an element is represented by the symbol of the element. In other words, the symbol of an element represents one atom of the element.

For example, H, C, N, O, Na, Mg, Ca and Fe represent an atom of Hydrogen, Carbon, Nitrogen, Oxygen, Sodium, Magnesium, Calcium and Iron respectively.




**§§ MOLECULES**:

**The smallest particle of matter or substance (element or compound)** which can exist in a free state is called a molecule.Atoms generally do not exist independently. An atom combines with atom(s) of the same element or other element(s) to form **molecules**.

**Molecules** can exist **independently**, i.e., they can stand on their own.

**When an atom of an element combines with atom(s) of the same element,i.e., atom(s) of the same kind, a molecule of an element** is formed.

For example, an atom of Hydrogen combines with another atom of Hydrogen to form a molecule of the element Hydrogen.

In other words, a molecule of Hydrogen is made up of two atoms of Hydrogen. The molecules of Oxygen, Nitrogen and Chlorine also contain two atoms each of the corresponding element.

**When, an atom of an element combines with atom(s) of different element(s), a molecule of a compound** is formed.

For example, an atom of Oxygen combines with two atoms of Hydrogen to form a molecule of the compound Water.

A molecule is the smallest particle of an element or a compound that can exist independently.

**Atoms join together to build a molecule**

Atoms chemically join together in whole numbers to build a molecule.

**Chemically combined atoms** are held together by a strong force of attraction,called a **chemical bond,** and can be separated only by a chemical means.

**How are molecules represented?**

Molecules are represented by formulae.

**§§ The formula of an element :**

The formula of an element shows how many of its atoms have combined together to form a molecule.

For example, two atoms of Hydrogen combine to form a molecule of Hydrogen. So the formula of the Hydrogen molecule is $H_2$.

The number of atoms present in a molecule of an element is known as the atomicity of the element.

Thus, the atomicity of Hydrogen ($H_2$), Nitrogen ($N_2$), Oxygen ($O_2$) and Chlorine ($Cl_2$) etc., is 2, and so they are said to be diatomic. Similarly, Ozone ($O_3$) is triatomic.

The formula of an element represents one molecule of the element. Hence, the formulae $H_2$, $N_2$, $O_2$, $Cl_2$ and $O_3$ represent one molecule of Hydrogen, Nitrogen, Oxygen, Chlorine and Ozone respectively.

**§§ The formula of a compound**

The formula of a compound indicates the number of atoms of the different elements making up a molecule of the compound.

Also, the formula of a compound represents one molecule of it.One atom of Carbon combines with two atoms of Oxygen to form a molecule of Carbon dioxide. So, the formula of Carbon dioxide is $CO_2$. Also, two atoms of Hydrogen and one atom of Oxygen

chemically combine among themselves to form a Water molecule. So, the formula of Water is $H_2O$

¶¶ **Types of molecules:**

Based upon atomicity we can classify molecules as follows.

**1.Monoatomic molecules:** Noble gases like heilum, neon, argon, krypton,etc, exist in atomic forms,i.e., they are mono atomic.

**2.Diatomic molecules:** These molecules consists of two atoms. EX:CO, HCl, NaCl etc

**3.Triatomic molecules:**These molecules consists of 3 atoms.EX: $H2_S$, $CO_2$, $O_3$.

**4.Tetraatomic molecules:** These molecules consists of 4 atoms.EX: $P_4$.

**5. Polyatomic molecules:** Any molecule containing more than four atoms is called a polyatomic molecule. EX: $S_8$, $C_2H_5OH$, $H_2SO_4$, $HNO_3$ etc.

## TEACHING TASK



**I) Single Correct Choice Type:**

**1.** Choose the false statement.

1) Metals are good conductors of heat and electricity.
2) Iodine has a characteristic of lustre and it is considered as a metal.
3) Metalloids may or may not have lustre.
4) Non metals are bad conductors of heat and electricity.

**2.** Choose the false statement.

1) Metals generally occur as solids and Mercury is the best example.
2) Gallium is a liquid metal. 3) Bromine is liquid at room temperature.
4) Graphite is a good conductor of electricity.

**3.** Choose the false statement:

1) Atoms generally exist independently
2) Molecules can exist independently
3) Oxygen, Nitrogen and Chlorine are all elements
4) Water and Carbondioxide are compounds

**4.** Which of the following statements is correct ?

(A) Compounds can be sepearated into constituents by physical processes

(B) The boiling points and melting points of compounds are not fixed

(C) The composition of compounds are not fixed

(D) The properties of compounds are entirely different from those of its

constituents

**5.** Which of the following statements is not correct-

(A) A compound is a pure substance

(B) Compound is homogeneous in nature

(C) Compound always contains two or more elements

(D) Compound can be separated into constituent elements by some physical process.

**II) Multi correct Answers:-**

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which **ONE or MORE** is correct. Choose the correct options*

**1.** Identify the element which the atomicity is two

A) Hydrogen B) Fluorine C) chlorine D) Bromine

**2.** Metallic properites are

A) Ductility B) Malleability C) sonorous D) lustre

**3.** Characteristic properties of atoms are

A) The atoms of an element are all alike

B) All atoms have same properties

C) The atoms of an element are different from those of others d) None

**4.** Colourless gases are

A) Hydrogen B) Oxygen C) nitrogen D) Carbondioxide

**5.** Which of the following statements are correct

A) Constituents of a mixture can be separated by physical methods.

B) Milk, coffee and brass are example of mixtures.

C) Digestion of food is a physical change.

**III) Assertion - Reasoning Type:**

- *This section contains certain number of questions.Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

**1.** ***Statement I :*** The short hand representation of an element is symbol.

***Statement II :*** The symbol for Manganese is Mg.

A. Both Statements are true, Statement II is the correct explanation of Statement I.

B. Both Statements are true, Statement II is not correct explanation of Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

**IV) Comprehensive type:-**

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C ) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

i)An element is a pure substance, made up of only one kind of atoms.

ii)Except during nuclear reactions, an element cannot be broken into two or more smaller parts.

iii)An atom is the smallest unit of an element. It shows all the properties of that element.

(iv)Most of the elements occur in free state in nature and some are found in the form of their compounds.

(v)Elements are further classified broadly into metals and non-metals.

**1.** The pure substance of an element made up of only one kind of

A) Molecule B) Atoms C) Compounds D) Mixtures

**2.** An element can be broken in to two or more smaller parts by

A) Nuclear reactions B) light reactions

C) Combustion reactions D) Addition reactions

**3.** The smallest unit of an element is

A) Matter B) Atom C) Molecule D) Compound

**4.** The element which occur in free state in nature

A) Sodium B) Potassium C) Calcium D) Gold

**5.** Metal is not malleable and duetile at room temperature

A) Magnesium B) Zinc C) Gallium D) Tin



**V) Matrix Matching**

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column–I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

**1.**

| **Column-I** | | **Column-II** | |
|---|---|---|---|
| a) | Sulphur dioxide | 1) | MgS |
| b) | Nitrogen dioxide | 2) | CO |
| c) | Carbon dioxide | 3) | $NO_2$ |
| d) | Carbon monoxide | 4) | $SO_2$ |
| | | 5) | $CO_2$ |

## KEY

**ΦΦ TEACHING TASK :**

**I.** 1-2 2-1 3-2 4-D 5-C

II. 1-A,B,C,D 2-A,B,C,D 3-A,B,C 4-A,B,C,D 5) A,B

**III.** 1-C

**IV.** 1-B 2-A 3-B 4-D 5-C

**V.** 1- a-4,b-3,c-5,d-2

## LEARNER'S TASK

### BEGINNERS ( Level - I )

**I) Single Correct Choice Type:**

**1.** Choose the correct statement

A) An impure substance contains particles of the same kind.

B) A pure substance contains particles of different kind.

C) A solution of sugar in water is impure because it is neither pure sugar nor pure water.

D) Water is a pure substance.

**2.** In carbon dioxide the ratio of carbon and oxygen by mass is respectively:

A) 2:8 B) 3:8 C) 8:3 D) 4:8

**3.** Chemists have discovered around _____ elements so far.

A) 115 B)116 C) 119 D) 114

**4.** Choose the correct symbols for the following elements:

i) Potassium ii) Copper iii) Mercury iv) Tin

A) [i] $\rightarrow$ Cu, [ii] $\rightarrow$ Hg, [iii] $\rightarrow$ Sn, [iv] $\rightarrow$ k

B) [i] $\rightarrow$ K, [ii] $\rightarrow$ Cu, [iii] $\rightarrow$ Hg, [iv] $\rightarrow$ Sn

C) [i] $\rightarrow$ Cu, [ii] $\rightarrow$ Sn, [iii] $\rightarrow$ k, [iv] $\rightarrow$ Hg

D) [i] $\rightarrow$ Hg, [ii] $\rightarrow$ k, [iii] $\rightarrow$ Sn, [iv] $\rightarrow$ Cu

### ACHIEVERS ( Level - II )

**Answer the following:**

**1.** Write the properties of metals and non-metals ?

**2.** Write the differences between mixtures and compounds ?

**3.** Explain the properties of compounds

**4.** Explain basic differences between formula of an element and a compound

## EXPLORERS ( Level - III )

**II) Multi Correct Choice Type:**

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

**1.** Which metals are liquid metals at 30°C.

A) Mercury B) Gallium C) Zinc D) Gold

**2.** Identify the element which the atomicity is 2.

A) Chlorine B) Ozone C) Nitrogen D) Oxygen

**III) Assertion - Reasoning Type:**

- *This section contains certain number of questions.Each question contains Statement– 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

**1.** ***Statement I :*** Bromine is a liquid metal

***Statement II :*** Graphite has a lustre and is a good conductor of heat and electricity.

A) Both Statements are true, Statement II is the correct explanation of Statement I.

B)Both Statements are true, Statement II is not correct explanation of Statement I.

C) Statement I is true, Statement II is false.

D) Statement I is false, Statement II is true.

**IV) Comprehension Type:**

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C ) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

**A)** The symbol is the short hand representation of an element or it represents one atom of that element.

**1.** The latin name for antimony is:

A) Cuprum B) Plumbum C) Stibium D) Hydragyrum

**2.** The symbol for Tungsten is:

A) K B) Sn C) Hg D) W

**B)** A compound is a substance that can be split up into simpler substances (i.e., element) by chemical means. A compound is made up of element. When two elements are put together, they do not always combine to form a compound. Sometimes they just mix together to form mixture.

**1.** Find out the homogenous mixture from the following:

A) Sugar solution B) Salt solution

C) Sand and water D) Both 1 and 2

**2.** Choose the correct statement(s):

A) A compound is a single substance, but a mixture contains two or more substances.

B) The properties of a mixture are similar to the properties of the substances in it.

C) The properties of a compound are usually quite different from the properties of the elements in it.

D) All the above

**3.** In a compound, atoms are held together by a strong force of attraction known as:

A) Atomic bond B) Chemical bond

C) Molecular bond D) Chemical compound

**V) Matrix Match Type:**

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

**A.**

| **Column-I** | **Column-II** |
|---|---|
| a) Potassium | 1) Cuprum |
| b) Iron | 2) Stannum |
| c) Copper | 3) Kalium |
| d) Tin | 4) Ferrum |
| | 5) Argentum |

**B .**

| ***Column - I*** | ***Column - II*** |
|---|---|
| a) Phosporous | 1) Monoatomic |
| b) Helium | 2) Diatomic |
| c) Oxygen | 3) Triatomic |
| d) Ozone | 4)Terta atomic |



**KEY**

**ΦΦ LEARNER'STASK :**

☐ **BEGINNERS :**

**I.** 1-C 2-B 3-C 4-B

☐ **EXPLORERS:**

**II.** 1-A,B 2-A,B,C,D

**III.** 1-B

**IV** A) 1-C, 2-D B) 1-D , 2-D, 3-C

**V.** A) a-3,b-4,c-1,d-2 B)a-4,b-1,c-2,d-3