INTRODUCTION :

Mater is any thing that has mass and occupies space. There are various kinds of matter, which includes their structure, composition and physical and chemical properties. Stones, clay, sand water, minerals, plants animals are all matter. It includes all living and non-living things in the universe.
Air is also called a matter as it has mass and occupies space but love is not a matter.

- Matter offers resistance too.

COMPOSITION OF MATTER : Ancient philosophers had different beliefs about the nature of matter. Greek philosophers believed that all kinds of matter is made up of fire, water, air and earth. While ancient Indian philosophers believed that all kinds of matter are made up of five elements – sky, air , fire and earth.Maharshi Kannada an Indian philosopher had first to suggest that matter is composed of very tiny particles called 'anu' (molecule) which is further composed of still smaller particles called 'paramanu'(atom).

Later on John Dalton suggested that all kinds of matter are composed of extremely small particles called 'ATOMS'. It exhibits all the properties of matter

They don't have independent existence.
They combine with each other to form molecules.
Both these particles are too small to be seen in naked eyes or ordinary microscope.

- However, the no of particles in matter can be very large like a tiny droplet of water contains 10^{12} particles of water.

- Physical classification: On the basis of physical properties, matter has been classified as solid, liquid and gas.
- Chemical classification: On the basis of chemical composition, matter has been classified as element, compound and mixture.

PARTICLE NATURE OF THE MATTER

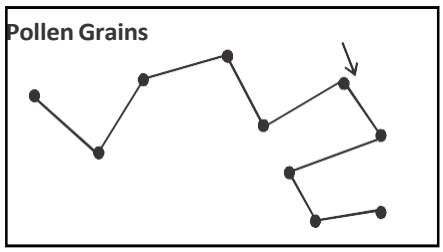
The concept about the nature of matter is very old. According to the ancient Hindu and Greek philosophers thematter is composed of very small particles which cannot be further sub-divided. John Dalton was the first person who gave scientific explanation about the nature and the composition of the matter

Evidences for particles in matter : Most of the evidence for the existence of particles in matter and their motion comes from the experiments on diffusion and Brownian motion.

(a) Dissolving a solid in a liquid :

Potassium permanganate is a purple coloured solid substance and water is a liquid. Take 2-3 crystals of potassium permanganate and dissolve them in 100 ml of water.Now take out 10 ml of this solution & put into another 90 ml of clear water.
Keep diluting the solution like this 5 to 8 times. Every time solution will become purple colour.
This experiment shows that just a few crystals of potassium permanganate can colour a large volume of water. It means a crystal of $KMnO_4$ is made up of millions of tiny particles. They dividing themselves into smaller &smaller particles.
Particles of $KMnO_4$ and particles of water spread into each other, it means they are moving.
This movement of different particles among each other, so they become mixed uniformly, is called **diffusion.**

Movement of pollen grains in water : Pollen grains move rapidly through out the water in a very irregular way (zig-zag way). The pollen grains move on the surface of water because they are constantly being hit by fast moving particles of water. This type of zig-zag movement of the small particles suspended in a liquid (or gas) is called Brownian motion. Brownian motion increases on increasing the temperature.



The existence of Brownian motion gives two conclusions.

(i) Matter is made up of tiny particles. **(ii)** Particles of matter are constantly moving.

Characteristics of Particles of Matter:

(i) The particles of matter are very, very small
(ii) The particles of matter have spaces between them
(iii) The particles of matter are constantly moving
(iv) The particles of matter attract each other

(i) The Particles of Matter are very, very small : The matter is composed of small particles : To understand particle nature of the matter, let us perform one experiment. Take a beaker full of water. Now place a small crystal of blue vitriol (copper sulphate) in the water. You will observe that the water begins to become blue coloured and slowly the size of the crystal becomes smaller and smaller. The crystal has divided itself into number of smaller particles and ultimately it dissolves in water. This experiment suggests that matter is composed of small particles.

(ii) The Particles of Matter have spaces between them : Is there vacant space between the particles of matter? Let us perform the following experiments –

Experiment (1) – Take a piece of chalk (used for writing on black board) and dip it into water. Some water is absorbed by the chalk. There are vacant spaces or pores in the chalk which are occupied by the water.

Experiment (2) – Take a wide mouthed test tube, almost half filled with water. Now put a sugar cube in the test tube and mark the water label with a glass marking pencil. The sugar cube will dissolve in water and the label of water will go down to a small extent. Why it so happened ? There is vacant space between the particles of water. This vacant space is occupied by the particles of the sugar and water label goes down.

Experiment (3) – Take a big sized test tube and fill it with water. And a few drops of phenolphthalein solution. Now tie a cellophane paper on the mouth of the test tube. Invert the test tube on the open mouth of a bottle containing ammonium hydroxide (Fig).

After sometime you will find that the colour of the water of the test tube becomes pink. This experiment suggests that there are very small holes (or vacant space) in the cellophane through which particles of ammonia penetrate and come in the contact of water (containing phenolphthalein).

The experiments discussed above support the view that there is a vacant space b matter.

(iii) The Particles of Matter are constantly moving :

This property can be explain by Brownian motion and diffusion.

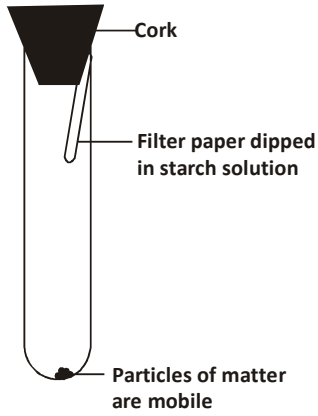
Diffusion : It is the phenomenon in which the movement of molecules or particles occur from their highest concentration towards the lower concentration. "Intermixing of particles of two different types of matter on their own is called diffusion.

For eg : When a perfume bottle is open in one corner of a room, its fragrance spreads in the whole room quickly. The particles of perfume move rapidly in all directions, mix with the moving particles of air in the room.

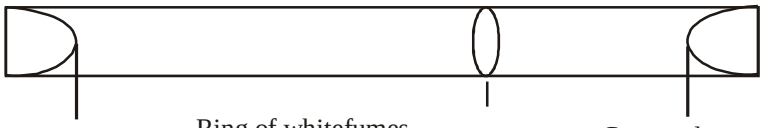
The particles of the matter are mobile :

Let us perform an experiment which will show whether the particles arestatic or mobile.

Take one glass test tube, place a small piece of iodine in it and corktightly. You will find the violet vapours of iodine everywhere in the test tube. Now bring a starch iodide paper near the mouth of the test tube.The starch iodide paper becomes blue. This indicates the presence of iodine at the mouth of the test tube. The iodine particles are mobile and therefore, they move and spread in whole of the test tube.

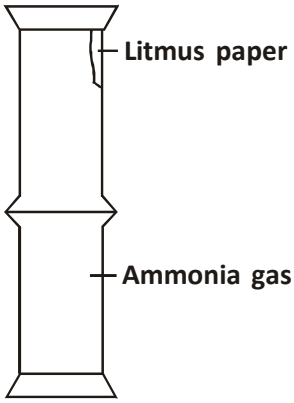


Let us perform another experiment. Take a glass tube of 50 cm length and cotton plug soaked in ammonia atone end and place another cotton plug soaked in concentrated hydrochloric acid at the other end. Now closeboth ends of the tube with corks. (See Fig)



Cotton plug soaked in ammonia — Ring of whitefumes — Cotton plug soaked in Conc. Hydrochloricacid

After sometime you will find that the mobile particles of ammonia and concentrated hydrochloric acid move towards each other and a whitering is formed in the middle of the glass tube. You will also observe thatthis white ring formed is not exactly in the middle of the tube but its position depends on the mobility of the particles of the substances.



You can perform another experiment to show that the particles of thematter are mobile. Take one gas jar filled with ammonia gas, Now take one empty gas jar. Place a piece of red litmus paper in it and invert it overthe jar filled with ammonia gas (Fig)After sometime you will find that the color of litmus paper (in the upper jar) becomes blue.

This indicates that particles of ammonia gas have moved in the upper gas air. Particles of Matter posses kinetic energy. As temperature rises, particles move faster.

We have seen that the particles of matter in liquid and gaseous state are mobile. But it is difficult to visualise thatthe particles of solid matter are also mobile. We do not find any movement of the particles in case of solid matter like wood, iron, gold, copper etc. even if these substances are placed in water or air. If you dip a zinc rod inmercury, you will find that after sometime the particles of mercury enters into the zinc metal. Similarly if a goldrod is placed in mercury, the mercury particles slowly enters into gold. This process is very slow.

Cause of motion : Both heat as well as temperature are responsible for the motion. When the temperature is increased there will be increase in the motion also. In order to understand this fact let us perform the following experiment.

Take two beakers. Now fill one beaker with cold water and the other with hot water. Now add 1-2 drops ofink in both the beakers. You will observe that the ink will spread quickly in hot water as compared to that in coldwater. This experiment proves that the increase in temperature, increases the motion of the particles.

We may conclude that particles of matter are mobile, whether the matter is in solid, liquid or gaseous state. The motion of the particles is fast in case of gaseous state, slow in liquid state and very slow in solid state.

(iv) Particles of MatterAttract each other : There are some forces of attraction between the particles of matter which bind them together.

Cohesive Force : The force of attraction between the particles of same substances is called Cohesive Force. **Adhesive force:** The force of attraction between the particles of different substances is called Adhesive Force. **For eg :** If we take a piece of chalk, a cube of ice and an iron nail and beat them with a hammer.

Observation : Chalk will easily break into smaller pieces.

More force is required to break a cube of ice. Iron nail does not break.

Conclusion : Force of attraction is quite weak in between the chalk particles. Force of attraction in between the particles of ice cube is a bit stronger.

Force of attraction in between the particles of iron is very, very strong.

INTER-MOLECULAR FORCES

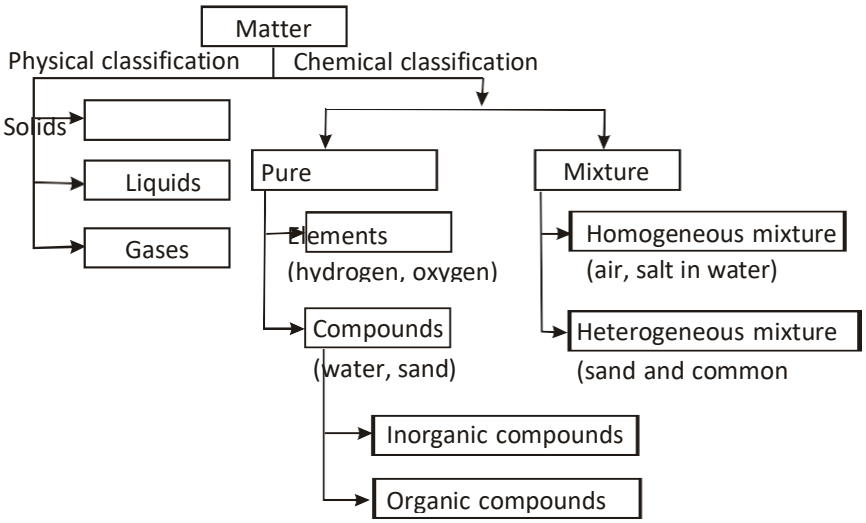
The particles of the matter are bonded together with a force called Inter-molecular force. In solid, the particles are bonded together with strong inter-molecular forces. When energy (say in the form of heat) is given, the bonds break, the arrangement of the molecules is disturbed and the solid is converted into liquid. If more energyis given, the inter-molecular forces are further decreased, the arrangement of the molecules is further disturbed and the liquid is

converted into gas. Different solids possess different inter-molecular force. If this force is more in any solid, more energy will be required to break the bonds between the molecules, i.e., more energy will be required to convert it into liquid. In other words the melting point of substance will be high. Therefore, the melting points of the solids depend on the inter-molecular force.

As stated above there are forces of attraction between the molecules and these forces continuously scatter them because of their velocity. However, these forces are not uniform in the molecules of all the substances. In solids the force of attraction between the molecules is maximum and in gases it is minimum or negligible. In liquids the molecules are held together less firmly as compared to the solids. Therefore, liquid molecules get separated from one another easily. This explains that why some liquids evaporates even at low temperature.

CLASSIFICATION OF MATTER

Matter can be classified into different categories depending upon their physical or chemical nature.



STATES OF MATTER

There are five main states of matter. Solids, liquids, gases, plasmas, and Bose-Einstein condensates are all different states of matter.

Each of these states is also known as a phase. Elements and compounds can move from one phase to another phase when special physical forces are present. One example of those forces is temperature. The phase or state of matter can change when the temperature changes. Generally, as the temperature rises, matter moves to a more active state. Phase describes a physical state of matter. The key word to notice is physical. Things only move from one phase to another by physical means.

In the solid state, substances are rigid and have definite shapes.

Volumes of solids do not vary much with changes in temperature and pressure. In many solids, called **crystalline solids**, the individual particles that make [illegible] occupy definite positions in the crystal structure.

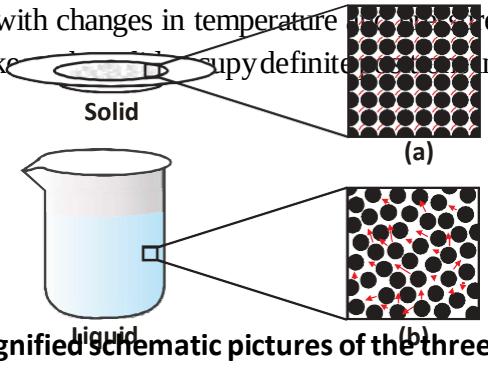


Figure : a, b and c show the magnified schematic pictures of the three states of matter. The motion of the particles can be seen and compared in the three states of matter.

The strengths of interaction between the individual particles determine how hard and how strong the crystalsare. In the liquid state, the individual particles are confined to a given volume. A liquid flows and assumes theshape of its container up to the volume of the liquid. Liquids are very hard to compress. Gases are much lessdense than liquids and solids. They occupy all parts of any vessel in which they are confined. Gases are capableof infinite expansion and are compressed easily. We conclude that they consist primarily of empty space, i.e., the individual particles are quite far apart.

Table : States of Matter

Solids	Liquids	Gases
Particles are very closely packed thus rigid.	Particles are loosely packed thus can flow.	Particles are very loosely packed and can flow.
Voids are extremely small thus incompressible.	Voids are extremely larger thus slightly compressible.	Voids are extremely large thus highly compressible.
Particle motion is restricted to vibratory motion.	Particle motion is very slow.	Particle motion is very rapid and also random.
Inter-particle force is very large thus very dense.	Inter-particle forces are intermediate resulting in low density.	Inter-particle forces are negligible. Thus imparting very low density.

SOLID

The solids are characterized by incompressibility, rigidity and mechanical strength. It indicates that the molecules, atoms or ions that make up a solid are closely packed or in other words they are held together by strong forcesand cannot move about. Thus in solids we have a well ordered molecular arrangements. Some solids like Sodium Chloride, Sulphur etc. have a typical geometrical forms. Such substances are known as **crystalline** substances and this property is known as **crystallinity.**

*A body bounded by surfaces, usually flat arranged on a definite plan which is an expression of the internal arrangement of the particles (molecules, atoms or ions) is known as a **crystal.**

The molecules, atoms or ions are the constituent particles of crystals. Shape and appearance of the crystal depend upon the arrangement of these constituent particles.

There are three types of crystals :

(i) Covalent crystals : These crystals are formed by molecules. Molecular forces of attraction are comparatively weaker in these crystals. Organic compounds form such type of crystals. However, some giant molecules are also known, e.g., diamond and graphite.

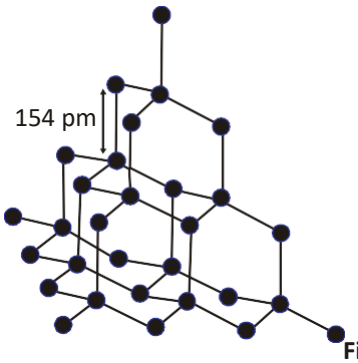


Figure : Network structure of diamond

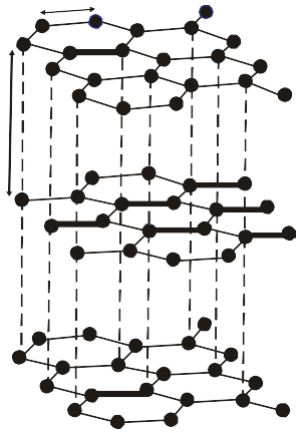


Figure : Structure of graphite

(ii) Ionic crystals : These crystals are formed by ions. Structural unit of these crystals is ion. There exists a strong force of attraction between the particles (i.e., ions). Crystals of sodium chloride, copper sulphate, potassium chloride etc. belong to this class.

(iii) Metallic crystals : These crystals are formed by the atoms of metals.

Amorphous Solids : Some solid substances like glass, plastic, rubber, resin etc. have the property of incompressibility to a great extent. But they do not have a definite geometric form. Such substances are called amorphous solids. Amorphous solids do not have any ordered arrangement of constituent particles in their internal structure. These particles are in the state of disorder as a liquid. These solids are considered as very viscous super cooled liquids.

Therefore, internal structure of particles crystalline solid have ordered arrangement. Theyhave a definite geometryand definite melting point. They are anisotropic.

Example: Glass and plastic. Glass is so presented/cited for it does not resist deformation very well. It softensrather than melts when heated and sags and flows on heating over a long period of time.

Interesting property of some solids :

Elasticity : When a piece of rubber is stretched its length is increased, but on removing the force, the rubbergains its original shape. Similarly if a weight is hanged with a spring, the length of the spring is increased, but onremoving the weight, the spring gets its original length.

This property of a material body by virtue of which it tends to regain its original state, when the deforming forcesare removed, is known as elasticity. The bodies in which complete restoration of the initial state takes place, are called perfectly elastic bodies, while those bodies which do not show any such tendency are termed as non-elastic or plastics.

Ice a unique solid : Because it is less dense as a solid than it is as a liquid. Normally, a liquid becomes denseras it freezes and its molecules pack closer together. However, as water freezes, its molecules form a latticework of hexagons that contain empty space. These hexagons cause water to expand 11% in volume when it freezes.

This expansion means that ice has fewer molecules per cubic centimeter than water has, so it is less dense thanwater. To be precise, ice's density is 0.917 g/cm^3 and water's maximum density is 1.00 g/cm^3 at 3.98° C.The unique properties of ice can cause problems on land and sea. The expansion of ice is responsible for theweathering of paved surfaces, such as roads and parking lots. Ice expands in crevices in these surfaces, openingcracks that spread and eventually create potholes. When ice floats in water, about 90% of it remains below thewater's surface. This is one reason why icebergs present a problem for ships at sea, especially at night or inweather that limits visibility

LIQUID

Liquids have definite volume but do not have definite shape. But they take the shape of the vessel in which they are kept. Molecules of liquid are more close to each other in comparison to the gas molecule due to strong attractive forces. Liquids have enough vacant space in comparison to solids. Thus liquid is an intermediate state between the complete disorder found in gas and highly ordered molecular state in solid.

Example: water and milk.

Properties of Liquids : Important properties of liquid can be described as follows :

(1) Shape and volume : Molecular forces between the liquid molecules are not so strong to keep molecules in a fixed position that is attraction between molecules is less than that of solids. Therefore liquids do not have a definite geometric shape. Due to strong attractive force they have definite volume in comparison to gas.

(2) Density : In comparison to the gas, in liquids the molecules are more close to each other. Therefore density of liquids is higher than that of gaseous state. For example, at one atmospheric pressure and 100°C the density of water is 0.958 gm cm^{-3} whereas under same conditions steam (gaseous water) has a density of 0.00059 gm cm^{-3}. That is water is almost 1600 times more dense than vapour.

It can be concluded that density of liquid is more in comparison to the gas due to their more closely packed molecules. There is negligible effect of temperature and pressure on the density of liquid. Liquids are incompressible.

(3) Diffusion : When two soluble liquids are placed close to each other then molecules of one liquid enter in between the molecules of the other and the two liquid mixed with each other. It is called diffusion. Diffusion is seen in liquids like gases.

It is a comparatively slow process, because the velocity of liquid molecules is very less in comparison to the gas molecules. The vacant space is comparatively quite less in liquid than gas.

(4) Compressibility : Due to very large vacant spaces between the molecules the property of compressibility is very high in gases. But the vacant space in between the molecules of liquid is very less, so the compressibility of liquid is very less, as compared to gas. For example at 300K when the pressure of an. ideal gas is changed from one atmosphere to two atmosphere then its volume reduces by 50% whereas when the same pressure is increased on water (liquid) its volume decreases by only 0.0045%.

(5) Evaporation : Though the molecules of liquid are bonded to each other by, attractive force still they have a tendency of evaporation. Therefore evaporation is that process in which liquid changes into vapour at room temperature.

The kinetic energy of all liquid molecules is not same. But it is equal to the average value or near about it i.e. some molecules have more or some less. That is it is known that kinetic energy of molecules of liquid opposes the intermolecular force of attraction which keeps them close. Therefore some molecules separate from the surface and go to the vapour state. We will learn more about evaporation later in this chapter.

(6) * Surface tension : It is an important property of liquids, which directly affects the intra molecular forces. Liquid surface feel stretched due to surface tension. Surface tension support mosquito to sit on water surface.

(7) Viscosity : When a liquid flows through a tube, the layer of liquid in contact with the wall of the tube is stationary where are liquid the centre has the highest velocity ; intermediate layer move with a gradation of velocities. The flowing liquid may, therefore, be regarded as composed of a number of concentric tubes sliding

past one another like the tubes of a telescope. Each layer exerts a drag on the next and the work must be done to maintain the flow. Similarly in a liquid flowing over a glass plate, the layer in contact with the plate remains stationary, the velocity of different layers increases continuously with the distance from the fixed surface, being the highest in the free surface of the liquid, On account of relative motion each layer experiences a frictional force and behaves as if it is being dragged in backward directions. This internal friction or resistance which resists the relative motion of its parts, i.e., the flow of the liquid, is known at viscosity.

Glycerine does not flow as easily as water or alcohol. Thus, glycerine is said to have more viscosity than water or alcohol.

The reason of this internal resistance (viscosity) is molecular force working between the molecules of the liquid. It depends on cohesive force between the molecules.

***Importance of viscosity :** Study of viscosity helps in many ways :

(i) The shape of ships, aeroplanes, rockets etc. is designed in such a manner, so that they may have least effect on their velocity due to the friction of water, air etc.

(ii) In order to decrease the friction in the various types of machines, a suitable lubricants are selected on the basis of viscosity.

(iii) Viscosity is very helpful in determining the pressure required for sending liquids like petrol, water etc. through pipe lines.

***Solubility :** Substance like sugar, common salt, common alum, copper sulphate, potassium permanganate etc. dissolve in water and form a solution. We may say that these substances are soluble in water. On the other hand substances like, sand, clay etc. do not dissolve in water and, therefore, we say that these substances are insoluble in water.

GAS

Gas is one of the three states of matter - the other two being liquid and solid. A gas differs from a solid and a liquid in a number of ways. A gas fills entire space available to it and therefore it has no definite shape or volume. The molecules in a gas are in a continuous motion in all possible directions in the complete space available within the container in which it is enclosed.

The behavior of the gases can be explained by showing the certain quantitative relationship between mass, pressure, volume and temperature. The state of a gas can be explained by these four variables. Their relationships are known by laws of gases.

PLASMA

The state consists of super energetic and super excited particles. These particles are in the form of ionised gases. The fluorescent tube and neon sign bulbs consist of plasma. Inside a neon sign bulb there is neon gas and inside a fluorescent tube there is helium gas or some other gas.

The gas gets ionised, that is, gets charged when electrical energy flows through it. This charging up creates a plasma glowing inside the tube or bulb. The plasma glows with a special colour depending on the nature of gas. The Sun and the stars glow because of the presence of plasma in them. The plasma is created in stars because of very high temperature.

BOSE-EINSTEIN CONDENSATES

In 1920, Indian physicist Satyendra Nath Bose had done some calculations for a fifth state of matter. Building on his calculations, Albert Einstein predicted a new state of matter – the Bose-Einstein Condensate (BEC). In 2001, Eric A.

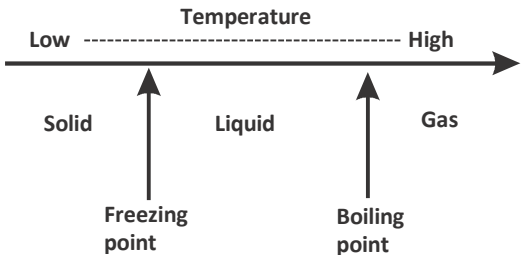
Cornell, Wolfgang Ketterle and Carl E. Wieman of USAreceived the Nobel prize in physics forachieving "Bose-Einstein condensation". The BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to super low temperatures.

INTERCONVERSION OF MATTER INTO DIFFERENT STATE

The phenomenon of change of matter from one state to another state and back to original state, by altering the condition of temperature and pressure, is called interconversion of matter.

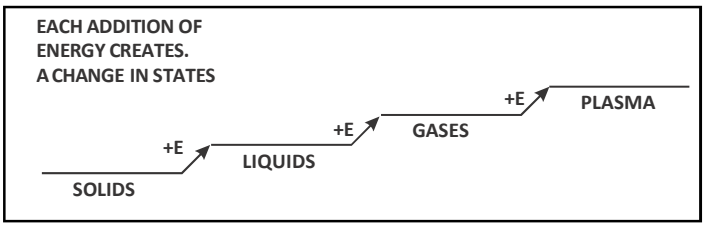
All matter can move from one state to another. It may require very low temperatures or very high pressures, butit can be done. Phase changes happen when certain points are reached. Sometimes a liquid wants to become a solid. Scientists use something called a freezing point to measure when that liquid turns into a solid. There are physical effects that can change the freezing point. Pressure is one of those effects. When the pressure surrounding a substance goes up, the freezing point also goes up. That means it's easier to freeze the substance at higherpressures. When it gets colder, most solids shrink in size. There are a few which expand but most shrink.

If you have a solid (cube of ice) and want to make it liquidwater. You need some energy. Atoms in a liquid have moreenergy than the atoms in a solid. The easiest energy aroundis probably heat. There is a magic temperature for every substance called the melting point. When a solid reaches thetemperature of its melting point it can become a liquid.



For water the temperature has to be a little over zero degrees Celsius. If you have salt, sugar, or wood melting point would be higher than water. The reverse is trueif you have a gas. You need to lose some energy from very excited gas atoms. The easy answer is to lower thesurrounding temperature. When the temperature drops, energy will be sucked out of gas atoms. When thetemperature of the condensation point is achieved it become a liquid. If you have the steam of a boiling pot ofwater and it hit the wall, the wall would be so cool that steam would quickly become a liquid.

A plasma can be made from a gas if a lot of energy is pushed inside. All of this extra energy makes the neutralatoms break apart into positively and negatively charged ions and free electrons. They wind up in a big gaseous ball. If energy is added (like increasing the temperature or increasing pressure) or if energy is taken away (like freezing something or decreasing pressure) you have created a physical change.



The various state of matter can be interchanged into one another by altering the conditions of :

(1) Temperature (2) Pressure.

Altering the temperature of matter :

(a) Interconversion of solid into liquid & vice versa:. The solids can be converted into liquids by heating them. Similarly liquids can be cooled to form solids.

For eg. : Ice at 0°C changes into water at 0°C, when heat energy is supplied to it. The water at 0°C changes into ice at 0°C on freezing.

(i) Melting or Fusion : The process due to which a solid changes into liquid state by absorbing heat energy is called melting or fusion. The constant temperature at which a solid changes into liquid state at atmospheric

pressure by absorbing heat energy is called **melting point.**

(ii) Freezing or Solidification : The process due to which a liquid changes into solid state by giving heat energy is called freezing or solidification. The constant temperature at which liquid changes into a solid state by giving out heat energy is called **freezing point**. The numerical value of freezing point and melting point is same.

Melting point of ice is 0°C (273.16 K). Freezing point of water is 0°C.

Explanation : On increasing the temperature of solids, the kinetic energy (K.E.) of particles increases. Due to increase in K.E., the particles start vibrating with greater speed. The energy supplied by heat overcomes the force of attraction between the particles. Then particles leave their fixed positions & start moving freely and thus solid melts.

Latent Heat of Fusion : The amount of heat energy that is required to change 1 kg of solid into liquid at atmospheric pressure at its melting point is known as the latent heat of fusion. (Latent means Hidden) Latent heat of fusion of ice = 3.34×10^5 J/kg.

Particles of water at 0°C (273 K) have more energy as compared to particles in ice at the same temperature.

Interconversion of liquid into gaseous state & vice versa:

Liquids can be converted into gases by heating them. Similarly, gases can be converted into liquids by cooling them.

Boiling or Vapourisation: The process due to which a liquid changes into gaseous state by absorbing heat energy is called boiling.

Boiling Point: The constant temperature at which a liquid rapidly changes into gaseous state by absorbing heat energy at atmospheric pressure is called boiling point.

For water, the vapour pressure reaches the standard sea level atmospheric pressure of 760 mmHg at 100°C. Since the vapour pressure increases with temperature, it follows that for pressure greater than 760 mmHg (e.g., in a pressure cooker), the boiling point is above 100°C and for pressure less than 760 mmHg (e.g., at altitudes above sea level), the boiling point will be lower than 100°C. As long as a vessel of water is boiling at 760 mm Hg, it will remain at 100°C until the phase change is complete. Rapidly boiling water is not at a higher temperature than slowly boiling water. The stability of the boiling point makes it a convenient calibration temperature for temperature scales.

Condensation or Liquefaction : The process due to which a gas changes into liquid state by giving out heat energy is called condensation.

Condensation Point : The constant temperature at which a gas changes into liquid state by giving out heat energy at atmospheric pressure. The numerical value of condensation point and boiling point is same.

Water changes into steam at 100°C (273 + 100) = 373 K. Steam changes into water at 100°C.

Explanation : When heat is supplied to water, particles start moving faster. At a certain temperature, a point is reached when the particles have enough energy to break the forces of attraction between the particles. At this temperature the liquid starts changing into gas. Boiling is a bulk phenomena. Condensation is the opposite of evaporation. It takes place when water vapour in the air condenses from a gas, back into a liquid form, and leaves the atmosphere, returning to the surface of the Earth.

You must have seen water droplets on glass containing ice cubes, it is due to condensation.

Latent heat of Vapourisation : The amount of heat which is required to convert 1 kg of the liquid (at its boiling point) to vapour or gas without any change in temperature.

Latent heat of vapourisation of water 2260 KJ/kg.
Particles in steam, that is water vapour at 373 K have more energy than water at the same temperature. Because steam have absorbed extra energy in the form of latent heat of vapourisation. Steam at 100°C will be more dangerous than water at 100°C

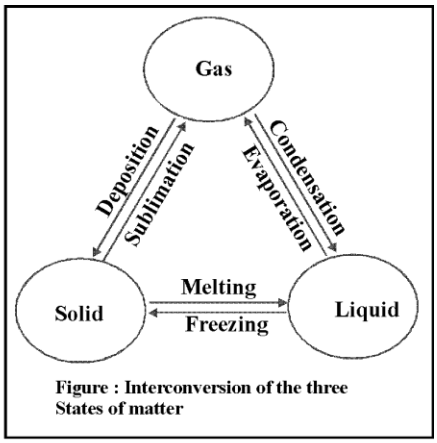


Figure : Interconversion of the three States of matter

Direct interconversion of solid into gaseous state & vice versa

Sublimation: Certain substances when heated, pass directly from the solid state to vapour state without being converted into liquid. The vapours when cooled give back the solid substance. This phenomenon is known as **sublimation** and the substance is called **sublimate.**

$$\text{Solid} \underset{\text{on cooling}}{\overset{\text{on heating}}{\rightleftharpoons}} \text{Vapours}$$

The examples of substances which can easily sublime are camphor, iodine, napthalene, ammonium chloride etc.
The force of attraction is not uniform in the molecules of all the solids. In some solids, the molecules are bonded together with stronger inter-molecules forces and in the other, the molecules are bonded together with comparatively weak inter-molecular forces.
The solids, having weak inter-molecular forces, when heated are directly converted into vapours (gaseous state) without being converted into liquids. Small amount of energy is sufficient to make the inter-molecular force of attraction negligible. This increases the inter molecular distance to a very great extent.
Therefore, the solid is directly converted into vapours.

Experiment : Take ammonium Chloride in a China dish. Cover the dish with a perforated filter paper. Now place an inverted funnel over the dish as shown in Figure. The upper open end of the funnel is plugged with cotton. The vapour rising from the solid pass through the holes of the filter paper and are deposited on the cold walls of the funnel. The substance deposited on the cold walls of upper part of the funnel is nothing but ammonium chloride.
This experiment can be repeated with camphor, iodine, naphthalene etc. These all substance are sublimates.
The perforated filter paper in the above experiment has two functions – (i) It keeps the funnel cool by cutting off the direct heat and (ii) It does not allow the sublimed substance to drop back in the dish. The process of sublimation is very helpful in separating a mixture of solids and also in the purification of the substances.

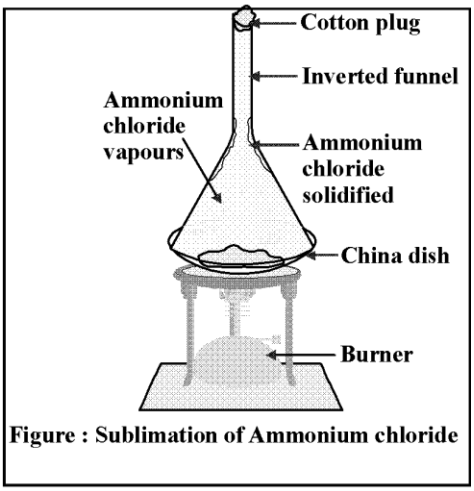


Figure : Sublimation of Ammonium chloride

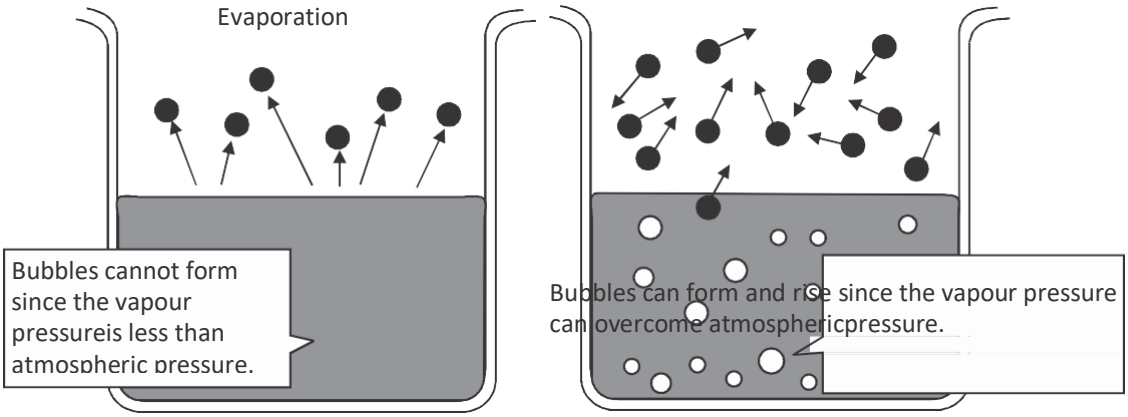
By Altering Pressure: The difference in various state of matter is due to the different intermolecular spaces between their particles. So when a gas is compressed the intermolecular space between its particles get decreases & ultimately it will converted into liquid. So high pressure & low temperature can liquefy gases.
For eg : Carbon dioxide (CO_2) is gas under normal conditions of temperature and pressure. It can be liquefied by compressing it to a pressure 70 times more than atmospheric pressure.

Applying pressure and reducing temperature can liquefy gases. Solid carbon dioxide (CO_2) is stored under high pressure. Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere without coming into liquid state. This is the reason that solid carbon dioxide is also known as **dry ice.**

(i) Pressure & temperature determine the state of a substance.

(ii) Solid CO_2 is extremely cold and used to 'deep freeze' food and to keep ice-cream cold.

When pressure is lowered the boiling point of liquid is lowered. This helps in rapid change of liquid into gas.



QUESTION BANK

EXERCISE - 1

Q.1 Define matter. Give four examples of matter.

Q.2 Name the three states of matter. Give one example of each.

Q.3 What are the two ways in which the physical state of matter can be changed ?

Q.4 Draw the 'states of matter triangle' to show the interconversion of states of matter.

Q.5 Explain how gases can be liquified ?

Q.6 What is sublimation ? Give examples.

Q.7 Why solid carbon dioxide is called 'Dry ice' ?

Q.8 Define latent heat of fusion.

Q.9 Define latent heat of vaporization.

Q.10 What is condensation ? How is the condensation of a gas carried out ?

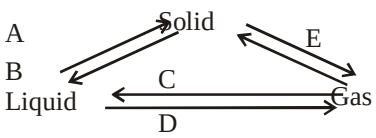
Q.11 What produces more severe burns, boiling water or steam?

Q.12 Define : (i) Melting point (ii) Boiling point (iii) Vapourisation (iv) Freezing

Q.13 When a jar of coffee is opened, people in all parts of the room soon notice the smell. Explain why this happens.

Q.14 Why do solids not diffuse ?

Q.15 The following diagram shows the three states of matter and how they can be interchanged. Name the changes A to E.



Q.16 Explain why?

(i) You feel cool when you touch a piece of ice.

(ii) A gas fill a vessel completely.

(iii) Camphor disappears without leaving any residue.
(iv) The temperature does not rise during the process of melting and boiling, though heat energy is constantly supplied.
(v) Water stored in an earthen vessel becomes cool.
(vi) We can get the smell of perfume sitting several metres away.
(vii) An iron almirah is a solid at room temperature.

Q.17 How can the boiling point of a liquid be raised, without adding any impurity ?

Q.18 Which phenomenon occurs during the following changes:
(i) Size of napthalene balls decrease. **(ii)** Wax melts in the sun.
(iii) Drying of wet clothes. **(iv)** Formation of clouds.

Q.19 Convert the following Kelvin temperatures to degrees Celsius.
(a) 175 K (b) 295 K (c) 300 K (d) 225 K (e) 873 K

Q.20 Convert the following temperature to Kelvin.
(a) 47°C (b) 23°C (c) – 73°C (d) – 12°C (e) 65°F (f) –20°F

Q.21 Describe why a drop of food coloring in a glass of water slowly becomes evenly distributed without the need for stirring.

Q.22 What is implied by the word "equilibrium" in equilibrium vapour pressure ?

Q.23 A given compound has a boiling point of 845°C. Is it likely to have a comparatively high or low melting point?

Q.24 If water is boiling and the flame supplying the heat is turned up, does the water become hotter ? What happens?
Q.25 Why is ice at 273 K more effective in cooling than water at the same temperature ?
Q.26 What produces more severe burns, boiling water or steam?
Q.27 In how many forms did the earlier Indian Philosophers classify matter ?
Q.28 Why we close the bottle of nail polish remover immediately after using it ?
Q.29 Why do the doctors advice to put strips of wet cloth on the forehead of a person having high temperature?
Q.30 Calcium, an element, is a dull, gray solid that melts at 839°C and has a density of 1.54 g/mL. When it is placed in water, bubbles form, and the calcium slowly dissolves in the water. When the water is evaporated, element calcium is not recovered. Which are the physical properties of calcium ? Which is a chemical property ?
Q.31 Explain the diffusion of copper sulphate into water.
Q.32 Why does a desert cooler cools better on hot dry day ?

EXERCISE - 2

Q.1 A handul of sand has a mass of 208 g and displaces a volume of 80.0 mL. What is its density ?
Q.2 Helium takes up 5.71 liters at 0°C and 3.95 atmospheres. What is the volume of the same helium at 32°F and 800 mmHg?
Q.3 An enormous (57,400 cubic meter) expandable helium balloon at 22°C is heated up by a fire under it and the action of the sun on the dark plastic covering on top. There will be a small increase in pressure from 785mm Hg to 790 mmHg, but the major effect wanted is an increase in volume so the balloon can lift its cargo. To what temperature must the balloon get in order to fill out to 60,500 cubic meters?
Q.4 A constant pressure tank of gas at 1.01 Atm has propane in it at 15°C when it is at 255 cubic meters. What is its volume at 48°C?
Q.5 Which diffuses faster, the bad smell from a cat-pan due to ammonia or an expensive French perfume with an average molecular weight of 170 g/mol ? How much faster does the faster one diffuse?
Q.6 What is the mass of 15 liters of chlorine gas at STP?
Q.7 How many liters of ammonia at STP are produced when 10 g of hydrogen is combined with nitrogen?
Q.8 How many milliliters of hydrogen at 0°C and 1400 mmHg are produced if 15g of magnesium reacts with sulfuric acid?
Q.9 What is the mass of 25 liters of fluorine gas at 2.85 atm, 450°C?
Q.10 A nine liter tank has 150 atmospheres of bromine in it at 27°C. What is the added mass of the tank due to the gas?
Q.11 A 250 Kg tank of liquid butane (C_4H_{10}) burns to produce carbon dioxide at 120°C. What volume of carbon dioxide is produced at 1 Atm?
Q.12 How many liters of product at 950 mmHg and 0°C is produced by the burning of three liters of acetylene (C_2H_2) at 5 atm and 20°C?
Q.13 If 0.515g of magnesium is added to HCl, it makes hydrogen gas and magnesium chloride. The hydrogen is collected at 23°C and 735mmHg. What is the volume of hydrogen?
Q.14 A fixed quantity of gas at 23°C exhibits pressure of 748 torr and occupies a volume of 10.3 L.
(a) Use Boyle's law to calculate the volume the gas will occupy at 23°C if the pressure is increased to 1.88atm.
(b) Use Charles's law to calculate the volume the gas will occupy if the temperature is increased to 165°C while the pressure is held constant.
Q.15 (a) Write the ideal-gas equation, and give the units used for each term in the equation when R = 0.0821 L-atm/mol-K. (b) What is an ideal gas ?

Q.16 Calculate each of the following quantities for an ideal gas: (a) the volume of the gas, in liters, if 2.46 mol has a pressure of 1.28 atm at a temperature of –6°C; (b) the absolute temperature of the gas at which 4.79×10^{-2} mol occupies 135 mL at 720 torr; (c) the pressure, in atmospheres, if 5.52×10^{-2} mol occupies 413 mL at 88°C; (d) the quantity of gas, in moles, if 88.4 L at 54°C has a pressure of 9.84 kPa.

Q.17 Chlorine is widely used to purify municipal water supplies and to treat swimming pool waters. Suppose that the volume of a particular sample of Cl_2 gas is 9.22 L at 1124 torr and 24°C. (a) How many grams of Cl_2 are in the sample? (b) What volume will the Cl_2 occupy at STP? (c) At what temperature will the volume be 15.00 L if the pressure is 8.76×10^2 torr? (d) At what pressure will the volume equal 6.00 L if the temperature is 58°C ?

Q.18 A certain volume of a gas is under a pressure of 900 mm of Hg. When the pressure is increased by 300mm, the gas occupies 2700 ml. If this change occurs at a constant temperature, calculate the initial volume of the gas.

Q.19 The volume of a given mass of gas, at 150°C is 400 ml. At what temperature, will it occupy a volume of 600 ml at the same pressure?

Q.20 A gas occupies 500 ml at 40°C and 800 mm pressure. What volume will it occupy at 353°C and 600 mm pressure?

EXERCISE - 3

Fill in the blanks

Q.1 Matter is made up of small .....

Q.2 The forces of attraction between the particles are ..... in solids, ... in liquids and ..... in gases.

Q.3 is the change of gaseous state directly to solid state without going through liquid state, and vice versa.

Q.4 Evaporation causes .....

Q.5 Latent heat of fusion is the amount of heat energy required to change 1 kg of solid into liquid at its .....

Q.6 Solid, liquid and gas are called the three .....of matter.

Q.7 The smell of perfume gradually spreads across a room due to .....

Q.8 Rapid evaporation depends on the..... area exposed to atmosphere.

Q.9 Matter has mass and occupies ..... Two types of matter are elements and..... These are known as ..... substances, and they have unique..... The ratio of the mass and the volume of a sample is known as its ..... and is a ..... property. A.....change transforms one substance into another.

Q.10 In the liquid state, ... causes water to form spherical drops ..... is a property relating to the rate of flow. When evaporation of a liquid occurs, the remaining liquid becomes .....The equilibrium .....
..... is the pressure exerted by the vapor at a given ..... The vaporization of a solid is known as .....
The normal boiling point is the temperature at which the .....is equal to 760 torr. The energy required to melt one gram of a solid is known as the ..... and the energy required to vaporize one gram of liquid is known as the ..... A heating curve represents the time of .....
on one axis and the ..... on the other. When a pure solid is melting the .....does not change.

True-False Statements –

Q.11 Boiling is a bulk phenomenon.

Q.12 Evaporation is a surface phenomenon.

Q.13 The rate of evaporation depends only on the surface area exposed to the atmosphere.

Q.14 Latent heat of vaporisation is the heat energy required to change 1 kg of a liquid to gas at atmospheric pressure at its melting point.

Q.15 Water at room temperature is a liquid.

Q.16 When a liquid is cooled very quickly, it always forms a crystal.
Q.17 Atoms in a liquid are farther apart than the atoms in a gas.
Q.18 The molecules in a gas are in constant motion.
Q.19 Gases have the same pressure throughout the entire atmosphere.
Q.20 All materials move from solid to liquid to gas as the temperature increases.
Q.21 Gas molecules are always evenly distributed in the atmosphere.
Q.22 Because electrons have been stripped away from atoms in plasma, plasmas have a negative charge.
Q.23 It is just as easy to compress a liquid, as it is to compress a gas.
Q.24 Evaporation and boiling are the same process because molecules move from a liquid to gas state.
Q.25 If we pour liquid nitrogen (N_2) into a glass, it will change its state to a solid.
Q.26 You may find plasma in a star.
Q.27 A system that changes from a solid state to a liquid state gains energy.
Q.28 Plasmas are all made of the same ions. They have different colors due to different amounts of electricity.

EXERCISE - 4

Q.1 The quantity of matter present in an object is called its –
(A) Weight (B) Gram (C) Mass (D) Density

Q.2 The metal which is liquid at room temperature –
(A) Sulphur (B) Sodium (C) Silver (D) Mercury

Q.3 At higher altitudes –
(A) Boiling point of a liquid increases (B) Boiling point of a liquid decreases
(C) No change in boiling point (D) Melting point of solid increases

Q.4 The boiling point of alcohol is 78°C. What is this temperature in Kelvin scale–
(A) 373 K (B) 351 K (C) 375 K (D) 78 K

Q.5 In which phenomena water changes into water vapour below its B.P. –
(A) Evaporation (B) Condensation (C) Boiling (D) No such phenomena exist

Q.6 The boiling point of water on celsius and Kelvin scale respectively is :
(A) 373, 273 (B) 0, 273 (C) 273, 373 (D) 100, 373

Q.7 Which of the following substances can sublime ?
(A) camphor (B) solid carbon dioxide
(C) ammonium chloride (D)All

Q.8 The correct statement amongst the following is
(A) gases diffuse at different rates (B) diffusion also takes place in liquids
(C) diffusion of liquid and a gas is known as intimate mixing (D) all are correct

Q.9 The liquid which has the highest rate of evaporation is
(A) petrol (B) nail-polish remover (C) water (D) alcohol

Q.10 When we put some crystals of potassium permanganate in a beaker containing water, we observe that after some time whole water has turned pink. This is due to
(A) boiling (B) melting of potassium permanganate crystals
(C) sublimation of crystals (D) diffusion

Q.11 The state of matter which consists of super energetic particles in the form of ionized gases is called
(A) gaseous state (B) liquid state (C) Bose-Einstein condensate (D) Plasma state

Q.12 The process of evaporation causes –
(A) heating (B) cooling (C) increase in temperature (D) none of these

Q.13 The force that binds the particles of matter together is known as –
(A) intermolecular space (B) bond (C) intermolecular force (D) nuclear force

Q.14 The change of a liquid into vapour is called –
(A) vaporization (B) solidification (C) sublimation (D) None of these

Q.15 Which of the following describes the liquid phase –
(A) It has a definite shape and a definite volume
(B) It has a definite shape but not a definite volume
(C) It has a definite volume but not a definite shape
(D) It has neither a definite shape nor a definite volume

Q.16 When a teaspoon of solid sugar is dissolved in a glass of liquid water, what phase or phases are present after mixing–
(A) liquid only (B) still solid and liquid (C) solid only (D) None of these

Q.17 Volume of a gas at a particular temperature and on atmosphere pressure is 200 ml. Keeping the temperature constant if pressure is increased 5 atmosphere, then volume of the gas will be –
(A) 100 ml. (B) 40 ml. (C) 200 ml. (D) 205 ml.

Q.18 The value of gas constant R in SI unit in ideal gas equation is –
(A) Newton meter per kelvin per mole (B) Joule per kelvin per mole
(C) Dyne cm per degree per mole (D) Litre per mole

Q.19 Crystals which are good conductors of heat and electricity are –
(A) Covalent (B) Metallic (C) Molecular (D) Ionic

Q.20 Which of the following properties of liquid increases with increase of temperature –
(A) vapour pressure (B) viscosity
(C) surface tension (D) both surface tension & viscosity

Q.21 Which of the following statements best explains why a closed balloon filled with helium gas rises in air?
(A) Helium is an monatomic gas, whereas nearly all the molecules that make up air, such as nitrogen and oxygen, are diatomic.
(B) The average speed of helium atoms is higher than the average speeds of air molecules, and the higher speed of collisions with the balloon walls propels the balloon upward.
(C) Because the helium atoms are of lower mass than the average air molecule, the helium gas is less dense than air. The balloon thus weighs less than the air displaced by its volume.
(D) Because helium has a lower molar mass than the average air molecule, the helium atoms are in faster motion. This means that the temperature of the helium is higher than the air temperature. Hot gases tend to rise.

Q.22 Which of the following properties is different for solids liquids and gases –
(A) movement of molecules (B) particle size of the substance
(C) mass of the substance (D) energy exchanges

Q.23 Equal volumes of all gases under similar conditions of temperature and pressure contain equal numbers of molecules. This statement was made by –
(A) Gay-Lussac (B) Avogadro (C) Berzilius (D) John Dalton

Q.24 The total number of molecules in one litre of an ideal gas at 136.5°A (or 273 K) and 3 atmospheres is –
(A) 6.023×10^{23} (B) 5.255×10^{23}
(C) 5.376×10^{20} (D) 5.376×10^{22}

Q.25 Boyle's law states that the –
(A) pressure of a gas is directly proportional to the temperature at constant volume
(B) pressure of a gas is inversely proportional the volume at constant temperature
(C) volume is directly proportional to the temperature at constant pressure
(D) none of the above

Q.26 All gases will occupy zero volume when the temperature is reduced to –
(A) 273°C (B) 273°A (C) –273°C (D) 0°C

Q.27 Non-reacting gases have a tendency to mix with each other. This phenomenon is known as –
(A) chemical reaction (B) diffusion (C) effusion (D) explosion

Q.28 A gas which obeys the gas laws is known as –
(A) an ideal gas (B) a heavier gas (C) a lighter gas (D) a real gas

Q.29 200ml of a gas weights 0.230g at 7.4×10^2 mm of Hg pressure. The molecular weight of the given gas is
(A) 32 (B) 44 (C) 27 (D) None of the above

Q.30 Gases can be liquified either by lowering the temperature, applying pressure to lowering the temperature and simultaneously applying pressure. This shows that –
(A) molecules of a gas repel each other
(B) there exists a kind of intermolecular attraction between molecules of a gas
(C) molecules of a gas are in a state of random motion
(D) None of these

Q.31 A gas can be compressed to a fraction of its volume. The same volume of a gas can be spread all over a room. The reason for this is that –
(A) the volume occupied by molecules of a gas is negligible as compared to the total volume of the gas.
(B) gases consists of molecules which are in a state of random motion
(C) gases consist of molecules having very large inter-molecular space which can be reduced or increased under ordinary conditions.
(D) one mole of each gas occupies 22.4 litre at STP.

Q.32 What is the term used to describe the phase change of a liquid to a gas –
(A) Boiling (B) Condensation (C) Melting (D) None of the Above

Q.33 Which of these statements is true –
(A) Gases have high density. (B) Gases can be compressed more than solids.
(C) Gases have very specific shapes. (D) All of the Above

Q.34 How many states of matter are there –
(A) Two (B) Three (C) Four (D) Five

Q.35 Which of these choices is defined as "Standard Pressure?"
(A) 14.7 psi (B) 1 atm (C) 760 torr (D) All of the Above

Q.36 What term is used to describe the phase change of a solid to a liquid –
(A) Freezing (B) Melting (C) Boiling (D) None of the Above

Q.37 All liquids have same –
(A) Density (B) Viscosity (C) Solubility (D) None of the Above

Q.38 Amorphous solids –
(A) Are more flexible at higher temperatures. (B) Include glasses.
(C) Do not have specific melting points. (D) All of the Above

Q.39 Solids usually –
(A) Expand large amounts when the temperature rises. (B) Change shape easily.
(C) Have a low density. (D) None of the Above

Q.40 What is the term used to describe the phase change as a liquid becomes a solid?
(A) Evaporation (B) Condensation (C) Freezing (D) None of the Above

Q.41 Which has the least energetic molecules?
(A) Solids (B) Liquids (C) Gases (D) Plasmas

Q.42 What force pulls liquids towards the ground?
(A) Pressure (B) Temperature (C) Gravity (D) Centrifugal

Q.43 What phase of matter would you expect to find this compound at room temperature?
(A) Solid (B) Liquid (C) Gas (D) Plasma

Q.44 Which of these choices is NOT an example of a plasma?
(A) Aurora Borealis (B) Fluorescent Light Bulb
(C) Neon Sign (D) Incandescent Light Bulb

Q.45 Which of these choices will not change the state of matter?
(A) Temperature (B) Crushing a Crystal (C) Pressure (D) Electricity

Q.46 If you leave water in a glass and some molecules turn into a gas, it is called...
(A) Egasoration (B) Evaporation (C) Extinction (D) Solidification

Q.47 As of the 1990s, scientists have proved the existence of how many states of matter –
(A) Two (B) Three (C) Four (D) Five

Q.48 Which of these choices will not change the state of matter?
(A) Temperature (B) Crushing a Crystal (C) Pressure (D) Electricity

EXERCISE - 5

MATCH THE COLUMN

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**.

Q.1 Column II gives how rate of evaporation changes for factors given in column I match them correctly.

Column I	**Column II**
(A) increase in surface area	(p) Increases
(B) decrease in temperature	(q) decreases
(C) decrease in humidity	(r) unchange
(D) Increase in wind speed	(s) may increase or decrease

Q.2 Column II give properties for matter mention in column I match them correctly.

Column I	**Column II**
(A) liquid	(p) definite shape
(B) solid	(q) definite volume
(C) plasma	(r) super low density
(D) Bose-Einstein condensate	(s) super energetic

ASSERTION & REASON TYPE

Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each questionhas 5 choices (A), (B), (C), (D) and (E) out of which ONLY ONE is correct.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is not a correct explanation for Statement-1.
(C) Statement -1 is True, Statement-2 is False.
(D) Statement -1 is False, Statement-2 is True.
(E) Statement -1 is False, Statement-2 is False.

Q.3 **Statement 1 :** Density is an intensive property.
Statement 2 : Density does not depend on the size of the sample.

Q.4 **Statement 1 :** Gases combine in simple ratio of their volume but, not always.
Statement 2 : Gases deviate from ideal behaviour.

Q.5 **Statement 1 :** Ideal gas equation is valid at low pressure and high temperature.
Statement 2 : Molecular interactions are negligible under this condition.

Q.6 **Statement 1 :** It is difficult to cook food at hill.
Statement 2 : The boiling point of water increases at hill.

Q.7 **Statement 1 :** During evaporation of liquid the temperature of the liquid remains unaffected.
Statement 2 : Kinetic energy of the molecules is directly proportional to absolute temperature.

EXERCISE - 6 PREVIOUS YEAR COMPETITION PROBLEMS

Q.1 Which one of the following statements is wrong for gases –
(A) Gases do not have a definite shape and volume
(B) Volume of the gas is equal to the volume of the container confining the gas
(C) Confined gas exerts uniform pressure on the walls of its container in all directions
(D) Mass of the gas cannot be determined by weighing a container in which it is enclosed

Q.2 At constant temperature, in a given mass of an ideal gas –
(A) The ratio of pressure and volume always remains constant
(B) Volume always remains constant
(C) Pressure always remains constant
(D) The product of pressure and volume always remains constant

Q.3 Densities of two gases are in the ratio 1 : 2 and their temperatures are in the ratio 2 : 1, then the ratio of their respective pressures is –
(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1

Q.4 Which of the following expression at constant pressure represents Charle's law –

(A) $V \propto 1/T$ (B) $V \propto 1/T^2$ (C) $V \propto T$ (D) $V \propto d$

Q.5 "One gram molecule of a gas at NTP occupies 22.4 litres." This fact was derived from –
(A) Dalton's theory (B) Avagadro's hypothesis
(C) Berzelius hypothesis (D) Law of gaseous volume

Q.6 For an ideal gas number of moles per litre in terms of its pressure P, gas constant R and temperature T is–
(A) PT/R (B) PRT (C) P/RT (D) RT/P

Q.7 Rate of diffusion of a gas is –
(A) Directly proportional to its density
(B) Directly proportional to its molecular mass
(C) Directly proportional to the square root of its molecular mass
(D) Inversely proportional to the square root of its molecular mass

Q.8 According to Grahman's law at a given temperature, the ratio of the rates of diffusion r_A/r_B of gases Aand B is given by –

(A) $(P_A / P_B)(M_A / M_B)^{1/2}$ (B) $(M_A / M_B)(P_A / P_B)^{1/2}$

(C) $(P_B / M_B)(P_A / M_A)^{1/2}$ (D) $(M_A / M_B)(P_B / P_A)^{1/2}$

Q.9 A bottle of ammonia and a bottle of dry hydrogen chloride connected through a long tube are opened simultaneously at both ends, the white ammonium chloride ring first formed will be –
(A) At the centre of the tube (B) Near the hydrogen chloride bottle
(C) Near the ammonia bottle (D) Throughout the length of the tube

EXERCISE - 7

PREVIOUS YEARS SA (SUMMATIVE ASSESSMENT) QUESTIONS

Q.1 When a drop of blue ink is put in water, the blue colour spreads and the whole solution becomes blue. Name the phenomenon due to which this happens.

Q.2 A spoonful of sugar when added to a glass of milk and stirred disappears after some time. State the characteristic of matter which explains this observation.

Q.3 2mL of dettol is added to a beaker containing 500mL of water and stirred. State four observations that you make.

Q.4 With the help of labelled diagram describe an activity to show that the particles of matter are very small. Use the following material that has been provided to you : Four beakers, spatula, four test tubes, distilled water and a few crystals of potassium permanganate.

OR

Write in brief an activity to show the particulate nature of matter. List any two characteristics of particles of matter.

Q.5 If the food is being cooked in the kitchen, name the process which brings smell to us.

Q.6 A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?

Q.7 Sugar and salt when kept in different jars take the shape of the jar. Are they solid ?
Justify your answer.

Q.8 The smell of hot sizzling food reaches you several metres away. List two properties of particles of matter responsible for this observation and explain this observation.

OR

Why does the smell of hot sizzling food reach you several metres away but to get the smell from cold food you have to go close ?

Q.9 Arrange the following substances in the increasing order of force of attraction between their particles:
Oxygen, salt, milk.

Q.10 A rubber band can change its shape on stretching. Will you classify it as solid or not ? Justify your answer.

Q.11 Name the state of matter in which :
(i) layers of particles can slip and slide on each other.
(ii) particles just move around randomly.

Q.12 Name the property of gases that helps aquatic plants and animals to survive in water.

Q.13 Give reasons for the following :
(a) Gases fill completely the vessel in which they are kept.
(b) Gases exert pressure on the walls of the containing vessel.

Q.14 Give reasons for the following :
(a) Water at room temperature is liquid.
(b) A gas cylinder cannot be half filled.

Q.15 Write the physical state of matter that shows the property given below :
(a) Most compressible form of water. (b) Has definite shape and volume.
(c) Has definite volume but no fixed shape. (d) Rigid and incompressible.

Q.16 Rate of diffusion is faster in gases. Why ?

Q.17 (a) Write the full form of (i) LPG (ii) CNG
(b) Give one use for each.

Q.18 A gas jar containing air is placed upside down on a gas jar of bromine vapour. It is observed that after some time, the gas jar containing air also becomes completely reddish brown.
(a) Explain why this happens.
(b) Name the process involved.

Q.19 Show by an activity that the gases are highly compressible as compared to solids and liquids.

Q.20 Compare in tabular form the properties of solids, liquids and gases with respect to :
(i) Volume (ii) Compressibility (iii) Diffusion (iv) Fluidity or Rigidity
(v) Density (vi) Shape (vii) Intermolecular attraction
(viii) Kinetic energy of particles at a given temperature.

Q.21 Define melting point.

Q.22 Define latent heat of fusion.

Q.23 The molecules of water have more energy as compared to molecules of ice at same temperature. Justify this statement.

Q.24 State one difference between gas and vapour.

Q.25 Write the boiling point and freezing point of water in Kelvin scale.

Q.26 What is evaporation ? In the following examples state which factor is responsible for the change in rate of evaporation and how ?

(i) Clothes dry faster on a windy day.
(ii) Wet clothes dry faster on spreading them.
(iii) Clothes dry faster in sun than in shade.
(iv) Clothes take longer time to dry on a rainy day.

Q.27 Which of the following two will give you more severe burns and why ?

(a) Steam at 373 K (b) water at 373 K

Q.28 Design an experiment to show that air contains water vapours.

Q.29 Ice, water and steam are three states of a substance and not different substance. Justify.

Q.30 Mention the physical quantities and the manner in which these need to be altered for liquefying gases.

Q.31 Define sublimation. Draw a labelled diagram to illustrate the process of sublimation.

Q.32 5mL of water was taken in a test tube and china dish separately. These samples were then kept under different conditions as below :

(a) Both the samples are kept under a fan.
(b) Both the samples are kept inside a cupboard.

State in which case evaporation will be faster ? Give reason to support your answer.
How will the rate of evaporation change if above activity is carried out on a rainy day. Justify your answer.

Q.33 Carbon dioxide was taken in an enclosed cylinder and compressed by applying pressure.

(a) Which state of matter will be obtain after completion of the process?
(b) Name and define this process.
(c) What is the common name of the product obtained in the above process ?

Q.34 Draw a flow diagram to illustrate interconversion of three states of matter. Name the process for each interconversion.

Q.35 Give reasons to explain why it takes longer to dry wet clothes in humid weather.

Q.36 Water kept in an earthen pot becomes cool during summer. Why ?

Q.37 Why should we wear cotton clothes during summer ?

Q.38 Why does a desert cooler cool better on a hot dry day ?

Q.39 Why do people sprinkle water on the roof after a hot sunny day ?

Q.40 Give reasons for the following :

(a) Thermometer reading remains constant for a while during melting of a solid even though we continue to heat the solid.
(b) We are able to sip hot tea/coffee/milk faster from a saucer rather than a cup.

Q.41 (i) Why is ice at 273 K more effective in cooling than water at 273 K ?
(ii) Awet handkerchief is placed on the forehead of a person suffering from high fever. Explain.

Q.42 (a) Define evaporation.
(b) Explain how the following factors affect the rate of evaporation of liquid :
(i) Temperature of the liquid (ii) Area of the exposed surface.
(iii) Moisture in the surrounding air. (iv) Increase in wind speed.

Q.43 (a) "Evaporation causes cooling". Explain the reason for this effect.
(b) Explain two examples from our daily life where we feel the effect of cooling due to evaporation.

Q.44 Write any three differences between evaporation and boiling.

VALUE BASED QUESTIONS

Q.45 While heating ice in a beaker with a thermometer suspended in it, a student recorded the following observations:

Time (in min.)	0	1	2	3	4	5	6	7	8	10	15	20	25	30	35
Temp. (in °C)	−3	−1	0	0	5	8	12	15	19	22	30	50	73	100	100

Based on the above observations, answer the following questions :

(a) State the change(s) observed between 2 min. to 3 min. and name the process involved.

(b) Between 30 min. to 35 min, the temperature remains constant. State the reason for this. Name the heat involved in the process and define it.

Q.46 (a) You want to wear your favourite shirt to a party, but the problem is that it is still wet after a wash. Mention three steps with reason that you would take to dry it faster.

(b) (i) It is a hot summer day, Priyanshi and Ali are wearing cotton and nylon clothes respectively. Who do you think would be more comfortable and why ?

(ii) During rainy season we feel sticky and incomfortable even under the fan. Why ?

ANSWER KEY

EXERCISE - 1

15. A–freezing, B–melting, C–condensation, D–evaporation, E–sublimation

19. (a) –98°C (b) 22°C (c) 27°C (d) – 48°C (e) 600°C

20. (a) 320 K (b) 296 K (c) 200 K (d) 261 K (e) 291 K (f) 244 K

EXERCISE - 2

1. 2.60 g/mL **2.** 21.4 L **3.** 39.9°C **4.** 284 cubic meters

5. Ammonia diffuses 3.16 times faster **6.** 47.5 g **7.** 74.7 L

8. 7.51 L **9.** 45.6 g **10.** 8.76 kg **11.** 6.56 L

12. 33.5 L **13.** 532 ml **14.** (a) 5.39 L (b) 15.2 L

15. (a) PV = nRT; P in atmospheres, V in liters, n in moles, T in kelvins.

(b) An ideal gas exhibits pressure, volume, and temperature relationships described by the equation PV = nRT.

16. (a) 42.1 L (b) 32.5 K (c) 3.96 atm (d) 0.320 mol **17.** (a) 39.7 g Cl_2 (b) 12.5 L (c) 377 K (d) 2.53 atm

18. 3600ml3600 ml **19.** 159°C. **20.** 1333.33 ml.

EXERCISE - 3

(1) Particles **(2)** maximum, intermediate, minimum **(3)** Sublimation **(4)** cooling

(5) Melting point **(6)** states **(7)** diffusion **(8)** surface

(9) Space, compounds, pure, properties, density, physical, chemical

(10) Surface tension, viscosity, cooler vapor pressure, temperature, sublimation, vapor pressure, heat of fusion, heat of vaporization, heating, temperature, temperature

(11) True **(12)** True **(13)** False **(14)** False **(15)** True
(16) False **(17)** False **(18)** True **(19)** False **(20)** False
(21) False **(22)** False **(23)** False **(24)** False **(25)** False
(26) True **(27)** True **(28)** False

EXERCISE - 4																				
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	D	B	B	A	D	D	D	A	D	D	B	C	A	C	A	B	A	B	A
Q	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
A	C	A	B	D	B	D	C	A	C	B	C	A	B	D	D	B	D	D	D	C
Q	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**												
A	A	C	B	D	B	B	D	D												

EXERCISE - 5

(1) (A) ⍰ p (B) ⍰ q (C) ⍰ p (D) ⍰ p **(2)** (A) ⍰ q (B) ⍰ p, q (C) ⍰ s (D) ⍰ r
(3) A **(4)** A **(5)** A
(6) C **(7)** D

EXERCISE - 6									
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A	D	D	A	C	B	C	D	C	B

EXERCISE - 7

(1) Diffusion **(2)** Particles of matter have space between them.
(5) Diffusion **(9)** Oxygen < milk < salt
(11) (i) Liquid (ii) Gas
(12) Diffusion. Oxygen diffuses in water, which aquatic plants and animals take into them.
(15) (a) Gas (b) Solid (c) Liquid (d) Solid
(16) The molecules of gases have larger intermolecular space and higher speed . So they diffuse fastly.
(21) Melting point of a solid is an indication of the strength of the force of attraction between its particles.
(22) The amount of heat that is required to change 1 kg of a solid into liquid at atmospheric pressure, at its melting point, is called the latent heat of fusion.
(23) Water has more energy than ice at same temperature because particles in water have absorbed more energy during the change of state.
(24) Gas is a stable state of matter whereas vapour is its unstable state.
(25) Boiling point = 373 K, Freezing point = 273 K
(33) (a) Solid (b) Sublimation (c) Dry ice
(34) (A) Melting (Fusion), (B) Vapourisation, (C) Condensation, (D) Sublimation, (E) Solidification
(45) (a) Between 2 min. to 3 min., ice converted into the water and this process is fusion.
(b) Between 30 min. to 35 min. heat is used for converting water (liquid) to vapour (gas), so temperatureduring this period remains contant. It is due to the latent heat of vapourisation.

Chapter-1

Matter in our Surrounding

STUDY NOTES

STATES OF MATTER - There are five main states of matter. Solids, liquids, gases, plasma, and

Bose-Einstein condensates are alldifferent states of matter.
In thesolidstate, substances are rigid and have definite shapes.
Volumes of solids do not vary much with changes in temperature and pressure. In manysolids,

called **crystalline solids**, the individual particles that make up the solid occupy definite positions

in thecrystal struc ture.

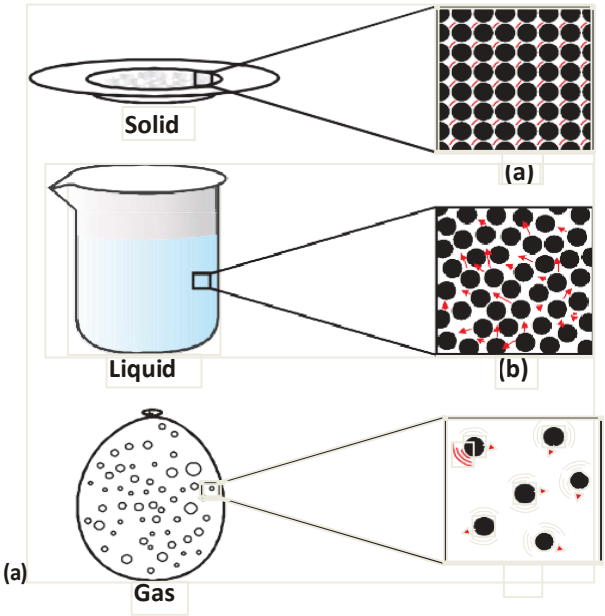


Figure : a, b and c show the magnified schematic pictures of the three states of matter. The motionof the particles can be seen and compared in the three states of matter.

Table : States of Matter

Solids	Liquids	Gases
Particles are very closely packed thus rigid.	Particles are loosely packed thus can flow.	Particles are very loosely packed and can flow.
Voids are extremely small thus incompressible.	Voids are extremely larger thus slightly compressible.	Voids are extremely large thus highly compressible.
Particle motion is restricted to vibratory motion.	Particle motion is very slow.	Particle motion is very rapid and also random.
Inter-particle force is very large thus very dense.	Inter-particle forces are intermediate resulting inlow density.	Inter-particle forces are negligible. Thus imparting very low density.

PLASMA

The state consists of super energetic and super excited particles. These particles are in the form of ionisedgases. Thefluorescent tubeandneonsignbulbs consist of plasma. Inside a neon sign bulb there is neon gas and inside a fluorescent tube there is helium gas or some other gas.

The gas gets ionised, that is, gets charged when electrical energy flows through it. This charging up creates a plasma glowing inside the tube or bulb. The plasma glows with a special colour depending on the nature of gas. The Sun and the stars glow because of the presence of plasma in them. The plasma is created in stars because of very high temperature.

BOSE-EINSTEIN CONDENSATES

In 1920, Indian physicist Satyendra Nath Bose had done some calculations for a fifth stateof matter. Building on his calculations, Albert Einstein predicted a new state of matter – the Bose-Einstein Condensate (BEC). In 2001, Eric A. Cornell, Wolfgang Ketterle and Carl E. Wieman of USAreceived the Nobel prize in physics for achieving “Bose-Einstein condensation”. The BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normalair, to super low temperatures.

INTERCONVERSION OFMATTER INTO DIFFERENT STATE

The phenomenon of change of matter from one state to another state and back to original state, by altering the condition of temperature and pressure, is called interconversion of matter

The various state of matter can be interchanged into one another by altering the conditions of :

(1) Temperature (2) Pressure.

STUDY NOTES

| CHEMISTRY | STUDY NOTES-1

Latent Heat of Fusion : The amount of heat energy that is required to change 1 kg of solid into liquid atatmospheric pressure at its melting point is known as the latent heat of fusion. (Latent means Hidden) Latentheat of fusion of ice = 3.34×10^5 J/kg.

Particles of water at 0°C (273 K) have more energy as compared to particles in ice at the same temperature.

Interconversion of liquid into gaseous state & vice versa:

Liquids can be converted into gases by heating them. Similarly, gases can be converted into liquids by coolingthem.

Boiling or Vapourisation: The process due to which a liquid changes into gaseous state by absorbing heatenergy is calledboiling.

Boiling Point: Theconstant temperatureatwhichaliquidrapidlychanges into gaseous state by absorbing heatenergyatatmospheric pressure is calledboiling point.

For water, the vapour pressure reaches the standard sea level atmospheric pressure of 760 mmHg at 100°C. Since the vapour pressure increases with temperature, it follows that for pressure greater than 760 mmHg (e.g., in a pressure cooker), the boiling point is above 100°C and for pressure less than 760 mmHg (e.g., at altitudesabove sea level), the boiling point will be lower than 100°C. As long as a vessel of water is boiling at 760 mmHg, it will remain at 100°Cuntil the phasechange is complete. Rapidlyboiling water is not at a highertemperaturethan slowly boiling water. The stability of the boiling point makes it a convenient calibration temperature fortemperature scales.

Condensation or Liquefaction : The process duetowhichagas changes into liquidstate by givingout heatenergy is called condensation.

Condensation Point : The constant temperature at which a gas changes into liquid state by giving out heat energy at atmospheric pressure. The numerical value of condensation point and boiling point is same.

Water changes into steam at 100°C (273 + 100) = 373 K. Steam changes into water at 100°C.

Explanation : When heat is supplied to water, particles start moving faster. At a certain temperature, a point is reached when the particles have enough energy to break the forces of attraction between the particles. At this temperature the liquid starts changing into gas. Boiling is a bulk phenomena. Condensation is the opposite of evaporation. It takes place when water vapour in the air condenses from a gas, back into a liquid form, andleaves the atmosphere, returning to the surface of the Earth. You must haveseen water droplets on glass containingicecubes, it is due to condensation.

Latent heat of Vapourisation : The amount of heat which is required to convert 1 kg of the liquid (at its boiling point) to vapo**Latent Heat of Fusion :** The amount of heat energy that is required to change 1 kg of solid into liquid atatmospheric pressure at its melting point is known as the latent heat of fusion. (Latent means Hidden) Latentheat of fusion of ice = 3.34×10^5 J/kg.

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Determination of Melting Point of Ice :

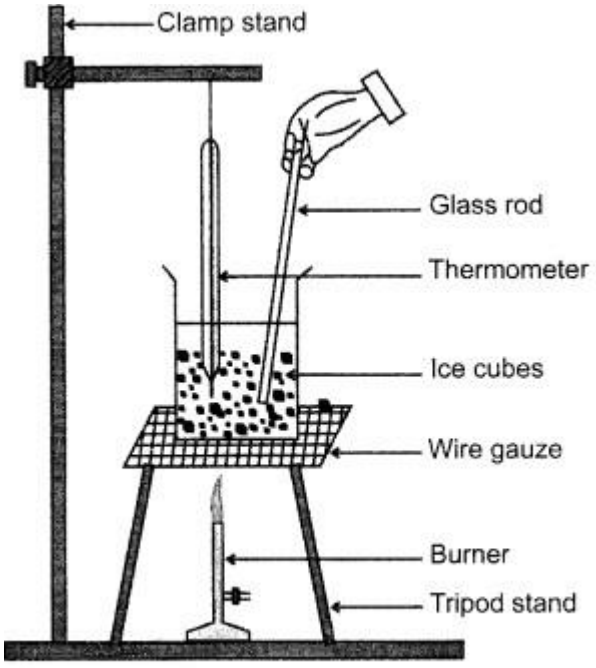


Fig. 8.1. Determination of melting point of ice

Latent heat of Vapourisation : The amount of heat which is required to convert 1 kg of the liquid (at its boilingpoint) to vapouror gas without anychange in temperature.

Latent heat of vapourisation of water 2260 KJ/kg.
Particles in steam, that is water vapour at 373 K have more energy than water at the same temperature. Because steam have absorbed extra energy in the form of latent heat of vapourisation. Steam at 100°C will be more dangerous than water at 100°C

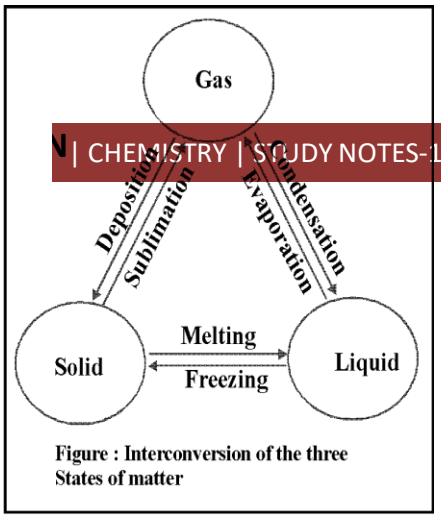


Figure : Interconversion of the three States of matter

Direct interconversion of solid into gaseous state & vice versa

Sublimation: Certain substances when heated, pass directly from the solid state to vapour state without being converted into liquid. The vapours when cooled give back the solid substance. This phenomenon is known as **sublimation** and the substance is called **sublimate.**

$$\text{Solid} \underset{\text{on cooling}}{\overset{\text{on heating}}{\rightleftharpoons}} \text{Vapours}$$

The examples of substances which can easily sublime are camphor, iodine, napthalene, ammonium chloride etc.
The force of attraction is not uniform in the molecules of all the solids. In some solids, the molecules are bonded together with stronger inter-molecules forces and in the other, the molecules are bonded together with comparatively weak inter-molecular forces.
The solids, having weak inter-molecular forces, when heated are directly converted into vapours (gaseous state) without being converted into liquids. Small amount of energy is sufficient to make the inter-molecular force of attraction negligible. This increases the inter molecular distance to a very great extent.
Therefore, the solid is directly converted into vapours.

Experiment : Take ammonium Chloride in a China dish. Cover the dish with a perforated filter paper. Now place an inverted funnel over the dish as shown in Figure. The upper open end of the funnel is plugged with cotton. The vapour rising from the solid pass through the holes of the filter paper and are deposited on the cold walls of the funnel. The substance deposited on the cold walls of upper part of the funnel is nothing but ammonium chloride.
This experiment can be repeated with camphor, iodine, naphthalene etc. These all substance are sublimates.
The perforated filter paper in the above experiment has two functions – (i) It keeps the funnel cool by cutting off the direct heat and (ii) It does not allow the sublimed substance to drop back in the dish. The process of sublimation is very helpful in separating a mixture of solids and also in the purification of the substances.

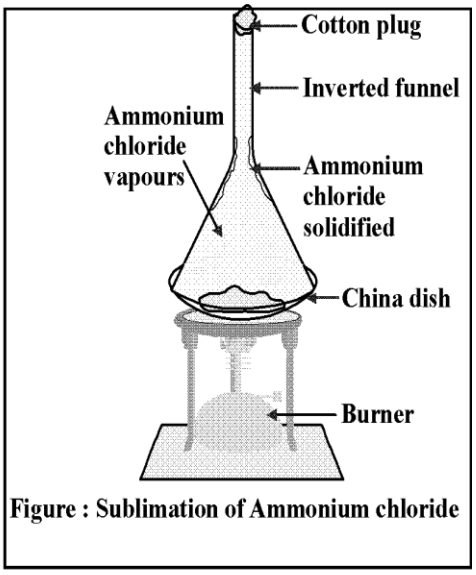


Figure : Sublimation of Ammonium chloride

By Altering Pressure: The difference in various state of matter is due to the different intermolecular spaces between their particles. So when a gas is compressed the intermolecular space between its particles get decreases & ultimately it will converted into liquid. So high pressure & low temperature can liquefy gases.
For eg : Carbon dioxide (CO_2) is gas under normal conditions of temperature and pressure. It can be liquefied by compressing it to a pressure 70 times more than atmospheric pressure.

Applying pressureandreducing temperature can liquefygases. Solid carbon dioxide (CO_2) is stored under high pressure. Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere withoutcoming into liquid state. This is the reason that solid carbon dioxide is also known as **dryice.**

- Pressure & temperature determine thestate of asubstance.
- Solid CO_2 is extremely cold and used to 'deep freeze' food and to keepice-cream cold.

When pressure is loweredthe boilingpoint of liquid is lowered. This helps in rapidchange of liquid

Into gas.

EVAPORATION

Perhaps one of the most accepted facts of life is that wet things eventually become dry. The liquid water has changed to the gaseous state in a process known as vapourization. When this process occurs below the boiling point, it is known as evaporation. In order for a molecule of a liquid to escape to the vapour state, however, it must overcome the intermolecular forces attracting it to its neighbours in the liquid. Two conditions allow amolecule in a liquid to escape the liquid state to the gaseous state. First, it must be at or near the surface of the liquid. Second, it must have at least the minimum amount of kinetic energyto overcome the intermolecular forces. Evaporation is important to life on Earth. The heat of the sun evaporates water from earth's surface. The evaporated water goes high into the air. Then it cools down, forms clouds, and falls from the sky as rain or snow. Evaporation is important for people too. When we sweat, water on our skin evaporates. The evaporationmakes the skin feel cooler.

Why Evaporation occurs : Molecules in the liquid state are constantly moving, but at different speeds. Faster moving molecules at the surface of a liquid break away from the attraction of the other molecules, and escape into the air. Furthermore, heating makes liquids evaporate faster because there aremorefastmovingmoleculesand, therefore, more molecules can escape.

As faster moving water molecules escape from a cup of water, the temperature of the water in the cup willdecrease, and fewer molecules will have sufficient energy to escape, slowing down evaporation. However, this will happen only in a cup of water that is insulated from the rest of the environment. The external environment (i.e., the air, the cup itself, the desk the cup is on, etc.) will continuously provide enough heat to keep the waterat a steadytemperature and evaporation will continue.

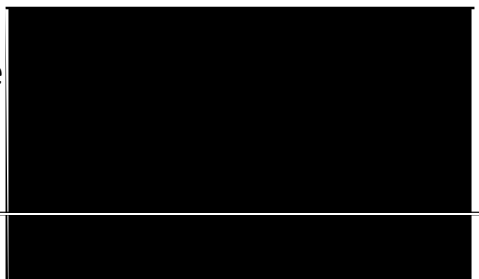
Factors Affecting Evaporation :

(i) Temperature (ii) SurfaceArea (iii) Humidity (iv) Wind Speed (v) Pressure

(i) **Temperature:** Withtheincrease in temperature therate of evaporationincreases.

Rate of evaporation □ : Temperature

Reason: On increasing temperature more number of particle



enough kinetic energy to go, into the vapourstate.

An increase in heat makes things evaporate faster. For example, if a person put the pan of water on the stove and then turned on the heat, the water would soon begin to boil. The person might see steam rise off he top of the water. Steam is water turninginto vapour.

(ii) Surface Area : Rate of evaporation □ Surface area

Since evaporation is a surface phenomena. If the surface area is increased, the rate of evaporation increases.So, white puttingclothes for drying up we spread them out.

(iii) **Humidity of Air : Rate of evaporation**

(iv) Humidity is the amount of water-vapourpresent in air.

When humidity of air is low, the rate of evaporation is high and waterevaporates more readily.When humidityof air is high, the rate of evaporation is low and waterevaporate very slowly.

(v) Wind Speed : Rate of evaporation □ wind speed

With the increase in wind speed, the particles of water-vapour move awaywith the wind.So the amount of water-vapour decreases in the surrounding.

(vi) **Pressure :** The rate of evaporation can also increase with adecrease in the gas pressure around a liquid. Molecules like to movefrom areas of higherpressuretolower pressure.

The molecules are basically sucked into the surrounding area to even out the pressure. Once the vapour pressure of the area increases to aspecificlevel, therate of evaporationwillslowdown.

Pressur

STUDY NOTES

Cooling caused by evaporation : When the molecules with the highest kinetic energyof the molecules remaining in the liquid state is lowered. This means that the liquid water will be cooledandthegas abovethewaterwill becorrespondingly heated.

The cooling effect of evaporating water is important to health maintenance in warm climates.

Perspiration covers our bodies with a layer of water when it is warm. The evaporation of this liquid cools the water on our bodies and us along with it. The cool feeling after a hot shower is not just a feeling but a reality. Our perspiration cools us but can make life more miserable for the next person in a crowded room. Evaporation cools the liquid but heats the air. If water is allowed to evaporate under a vacuum, the evaporation processoccurs faster. Infact, the water cools enough to freeze.

Evaporative coolers : Also called air, swamp, or desert coolers are cooling devices which use simple evaporation of water in air. Evaporative cooling is especially well suited for climates where the air is hot and humidity is low. Residential evaporative coolers use direct evaporation and can be described as an enclosed metal or plastic box with vented sides containing a centrifugal fan or 'blower', electric motor, and a water pump to wet the evaporative cooling pads. The units can be mounted on the roof, or exterior walls or windows of buildings. To cool, the fan draws ambient air through vents on the unit's sides and through the damp pads. Heat in the air evaporates water from the pads which are constantly re-dampened to continue the cooling process. Thus cooled, moist air is then delivered to the buildingvia a vent in the roof or wall.

Difference between boiling and evaporation :

Evaporation and boiling are both examples of liquids changing into gases. Ordinary evaporation is a surface phenomenon - since the vapour pressure is low and since the pressure inside the liquid is equal to atmosphericpressure plus the liquid pressure, bubbles of water vapour cannot form. But at the boiling point, the saturated vapour pressure is equal to atmospheric pressure, bubbles form, and the vapourization becomes a volume

phenomena.

Why should we wear cotton clothes in summer ?

Duringsummer, we perspire more becauseof the mechanism of our bodywhich keeps us cool. During evaporating, the particles at the surface of liquid gain energy from the surroundings or body surface. Theheat energyequal to latent heat of vapourisation is absorbed from thebodyleavingthe body cool. Cotton, beinga good absorber of water helps in absorbing the sweat.

Why do we see water droplets on the outer surface of a glass containing Ice-cold water ?

If we take some ice-cold water in a tumbler then we observed water droplets on the outer surface of tumbler. **Reason:** The water vapour present in air on coming in contact with cold glass of water, loses energy. So watervapour gets converted to liquid state, which we see as water droplets.

Why is the grass wet early in the morning? Even when it hasn't rained ?

Transpiration : The process by which plants eliminate water drawn through their bodies through their leaves. Covers the surfaces of the leaves in a layer of saturated air. If the temperature falls, the saturated air reaches thedew point and dew condenses on the surface of these plants.

Condensation nuclei : Theatmosphere contains bits of dust, particles of smoke, and various othersmall bitsthat can act as surfaces for condensation.

When water vapour condenses on these nuclei, fog, mist, and clouds are produced.

Evaporation and Smells : Smells are made of molecules of the substance that has escaped and mixed in with the air. This is a form of evaporation. Not all molecules that evaporate from substances are smelly, though. Some students attribute smell to a "scent" that leaves the substance, but don't recognize that the amount of substance decreases as the "scent" leaves it. They most likely do not understand that the "scent" is actuallymolecules of the substance.

Differences between Evaporation and Boiling :

Evaporation	Boiling
-It is a surface phenomenon	- It is bulk phenomenon.
- It is a slow process	- It is a fast process.
- No external heat is required	- External heat is required.
- It causes cooling	- It causes burning.