

Chapter 01: Matter In Our Surroundings

MATTER

Matter is anything that has mass and volume which occupies space and can be felt by one of our sense organs is called matter.

The SI Unit Of Mass Is KG

The SI unit of volume is Cubic metre, a common unit for measuring volume is litre.

THE CLASSIFICATION OF MATTER

Earlier Indian philosophers classified matter into five basic elements called Panch Tatva.

They are:

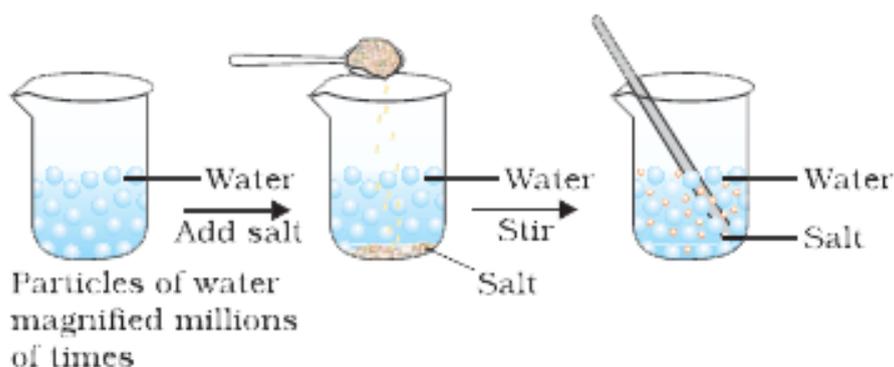
1. Air
2. Water
3. Earth
4. Sky
5. Fire

According to Indian philosophers, every living or nonliving was made up of these five basic elements.

Now matter is also classified into groups according to its physical properties and chemical nature.

1. That is solid, liquid and gas- based on the particle arrangement of their physical property
2. For elements, compounds and mixtures - based on chemical nature

PHYSICAL NATURE OF MATTER



When we study the physical composition of matter we find

1. Every matter is made up of particles with different shape, size and nature from different types of matter.

2. Particles of matter are very small or tiny, which is beyond human vision.

THE CHARACTERISTICS OF PARTICLES OF MATTER

Important Characteristics of Particles of Matter are:

1. Particles have space between them.

2. Particles of matter are in a state of continuous movement, which proves that they possess some form of energy which is called Kinetic Energy.

As temperature rises kinetic energy of particles increases and hence the particles move faster.

3. The particles of matter have a tendency to diffuse, that is, to mingle freely with one another. They do so by penetrating the spaces between the particles; this process of intermixing particles of two distinct kinds of matter is referred to as diffusion.

4. Particles of matter are attracted to one another, and this attraction is referred to as the intermolecular force of attraction.

This force is responsible for holding the particles together

The intensity of the force of attraction varies according to the nature of the substance.

STATES OF MATTER

Matter around us exists in three different states which are liquid, solid and gas.

The state of matter occurs due to the variation in the characteristics of the particles of matter.

SOLID-STATE

Solid-state is defined as a form of matter which possesses rigidity, is incompressible and has a definite shape and definite volume.

Characters and properties of solid-state are:

1. Solids have a definite shape, distinct boundaries and fixed volumes that is they have very low compressibility.

This means that you cannot compress a solid easily using pressure.

2. Solids have a tendency to maintain their shape when an outside force is applied.

3. Solids do not diffuse generally or diffuse at a very slow rate.

4. Solids may break under force but it is difficult to change their shape because they are rigid.

5. Solids have a higher density compared to liquid or gas matter.

Examples of solid are: Sand, wood, gold silver metal

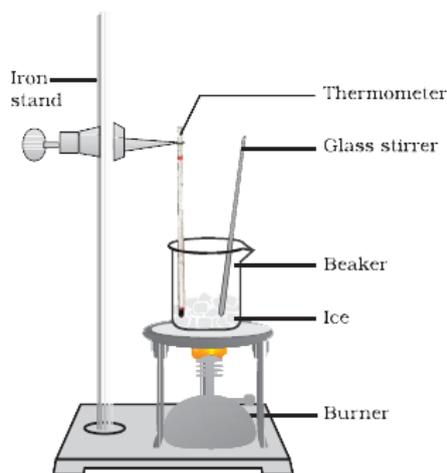
LIQUID STATE

The liquid is defined as a form of matter which possesses a fixed volume but doesn't have a fixed shape.

Some properties of liquid state are:

1. liquids lack a fixed shape, they might take on the shape of the container in which they are kept.
2. Because liquids move and alter shape, they are not stiff and may be referred to as fluid.
3. Solids, liquids and gases can diffuse into liquid, the gases from the atmosphere diffuse and dissolve in water which helps organisms and animals living and water to survive.
For example, Oxygen and Carbon dioxide diffuses in water from the atmosphere in a gaseous form which helps animals breathe underwater.
4. Liquids are almost incompressible.
5. The attraction force between particles in a liquid is less than solids but greater than gas.
6. The rate of diffusion of liquids is faster than that of solids owing to the fact that particles in the liquid state move freely and have more space between them than particles in the solid-state.
7. Density of liquid is less compared to solid matter. There are some exceptions for example ice has less density compared to water hence you will see ice cubes will float on the water surface

GASEOUS STATE



(a)

Gas can be defined as that form of matter which possesses high compressibility and does not have any definite shape or volume

Some important properties and characters of gas are:

1. Gases have a tendency to flow like liquids and therefore they are also called fluids.
2. Gases show the property of diffusing very fast into Each Other due to the high speed of particles and large spaces between them. The speed of diffusion is much higher compared to liquid matter.

3. Gases are highly compressible for example oxygen tanks and liquefied petroleum tanks are filled with compressed gases which are used for day to day activities.

4. In the gaseous state the particles move about at random direction at high speed which creates random movement and creates pressure on the walls of the container within which it is kept.

5. Density of gaseous matter is very low and has a low weight compared to liquid or solid.

CHANGE OF STATES OF MATTER

In our daily life, you will discover that various substances exist in three states: solid, liquid and gas. What is the most common example which exists in three states?

Ice - Solid State

Water - Liquid State

Water Vapour - Gaseous State

INTERCONVERSION OF STATES OF MATTER

Interconvertible states of matter Interconversion of states of matter refers to the process or phenomena of matter changing from one state to another and then returning to its original state as a result of changing environmental variables such as temperature and pressure.

The two factors make it possible for conversion from one state to another:

1. Change in temperature
2. Change in pressure

THE TERMS INVOLVED IN CHANGE OF STATE

Following terms are used in change of state:

1. FUSION OR MELTING POINT

The process by which matter is converted from its solid form to its liquid state under specified temperature and pressure conditions is referred to as fusion or melting.

The precise temperature at which a solid begins to melt is referred to as its melting point.

For example, ice has a Melting Point of Zero Degrees Centigrade or 273.16 k.

Keep in mind that the higher a substance's melting point, the stronger the force of attraction between its particles.

2. BOILING AND BOILING POINT

The process of conversion of a matter from its liquid state to a gaseous state at a specific condition of temperature and pressure is called boiling.

It is a bulk phenomenon and the temperature at which the liquid starts to boil at atmospheric pressure is known as its boiling point.

3. SUBLIMATION

This is a process of change of solid-state directly into GASEOUS state without passing through the liquid state upon heating and vice versa on cooling and this process is known as sublimation

Many solids change their state from solid to gas such as naphthalene, camphor, iodine.

4. VAPOURIZATION

This is a process of conversion of liquid state to gaseous state at a specific condition of temperature and pressure and this process is called vaporization.

5. FREEZING AND FREEZING POINT

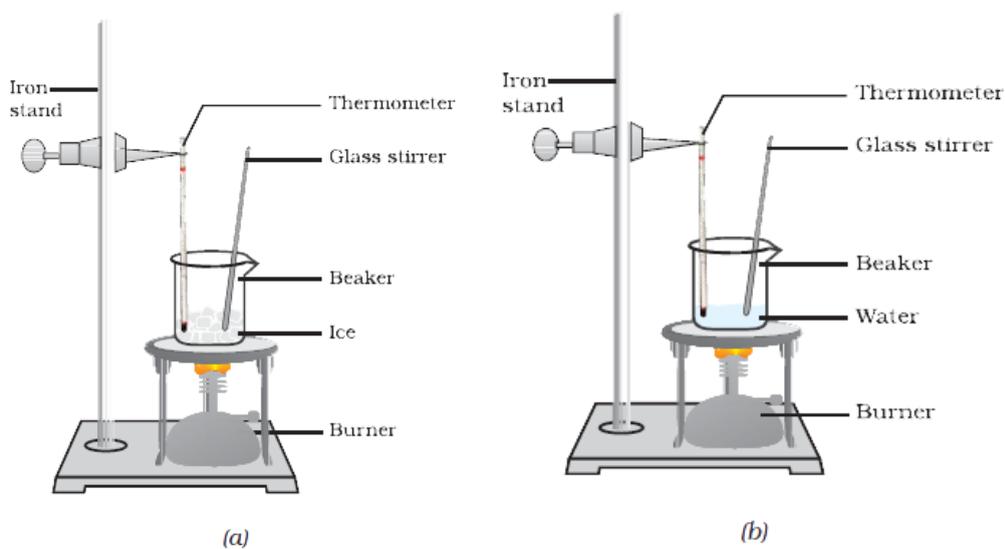
The process of conversion of matter from its liquid state to solid state at a specific temperature and pressure is called freezing.

It is the reverse process of fusion or melting and The Definite temperature at which liquid changes into solid-state by giving out energy as heat at 1 atmospheric pressure or 1 ATM is called freezing point.

6. CONDENSATION

Condensation is the process by which matter is converted from a gaseous state to a liquid state at a certain temperature and pressure. It is the reversal of the vaporisation process.

THE EFFECTS OF CHANGE OF TEMPERATURE



(a) Conversion of ice to water, (b) conversion of water to water vapour

When a solid is heated, the kinetic energy of which particles increases due to this increase of kinetic energy the particles start vibrating with greater speed

The energy supplied by the heat exceeds the forces of attraction between the particles .

Then the particles leave their position and started moving more freely and randomly at a certain stage that is melting point solid melts and converts into liquid state

At a specific temperature a point is reached when the particles have enough energy to break free from their forces of attraction to each other at this temperature that is boiling point the liquid starts to change its shape from liquid to gas and by decreasing the temperature or by cooling a gas can be converted into liquid state and a liquid can be converted into a solid state.

This Is Effect Of Change Of Temperature On The Physical State Can Be Summarised As

Solid state - when heated becomes - liquid

Liquid state - when heated becomes - gas

Gas - when cooled becomes - liquid

Liquid - when cooled becomes - solid

It can be concluded that one state of matter can be changed into another by changing the temperature.

SCALES OF MEASURING TEMPERATURE

There are three scales of measuring temperature which are as follows:

1. Temperature On Kelvin Scale

Temperature [on Kelvin scale] = Temperature on Celsius scale + 273.16

For convenience we take, zero degree centigrade= 273K

2. Temperature On Celsius Scale

Temperature [on Celsius scale] = Temperature on Kelvin scale + 273.16

3. Temperature On Fahrenheit Scale

Celsius and Fahrenheit temperatures are related to each other by the relation;

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

LATENT HEAT

When heat is given to a substance its temperature increases. However when heat is supplied to change the physical state of a substance there is no increase in temperature of the substance and no change in the state of the matter.

Thus, the heat energy required to alter the state of a material is referred to as latent heat.

The meaning of the word latent is hidden, latent heat does not raise the temperature but latent heat is always supplied to change the state of a substance.

There Are Two Types Of Latent Heat:

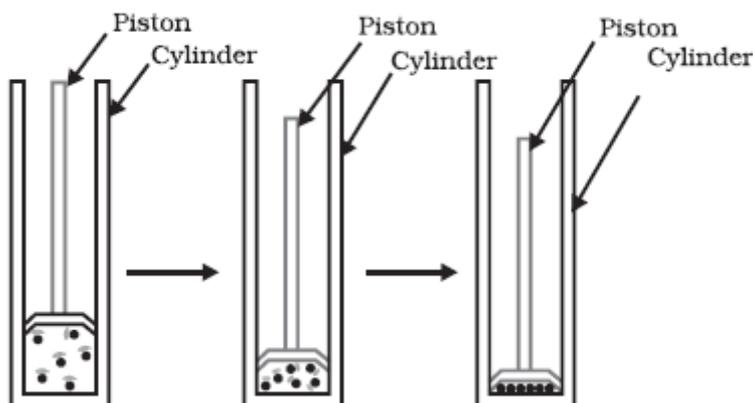
1. LATENT HEAT OF FUSION - which helps to convert solid into liquid

The latent heat of fusion is the amount of heat energy necessary to transform 1 kilogramme of solid into liquid at atmospheric pressure and its melting temperature.

2. LATENT HEAT OF VAPORIZATION - which helps convert liquid to gas

The amount of heat energy required to convert 1 kg of liquid into gas at its boiling point without any rise in temperature is known as latent heat of vaporization

THE EFFECTS OF CHANGE OF PRESSURE



The physical state of a substance or matter can be changed by changing the pressure.

Increase in pressure brings particles together and increases the force of attraction between them which brings the change that is when high pressure is applied to a gas its temperature is reduced the gas is converted into liquid that is the gas changes its shape to liquefied form.

The pressure exerted by gas is measured in atmospheric (atm) units.

The pressure of air in atmosphere is called atmospheric pressure

Atmospheric pressure at sea level is taken as one ATM which is also normal atmospheric pressure, as we go higher in altitude the atmospheric pressure decreases

Pressure of 1 Atm = 1.013×10^5 Pa.

EVAPORATION

Evaporation is the process by which a liquid transforms into a vapour at any temperature below its boiling point.

The particles in a liquid have varying quantities of kinetic energy, and the particles near the liquid's surface have a relatively large quantity of kinetic energy in comparison to those in the bulk.

Hence particles at the surface with high kinetic energy is able to break away from the forces of attraction between other particles and converts into paper

You are wet clothes become dry because of this reason

FACTORS AFFECTING EVAPORATION

1. Surface Area

Evaporation is a surface phenomenon that means it occurs on the surface of a liquid hence when the surface area is increased the rate of evaporation also increases.

2. Temperature

The rate of evaporation of a liquid increase with the rise in temperature. With an increase in temperature more particles Get Enough kinetic energy to transform themselves into a vapour state that's why high-temperature results in higher evaporation.

3. Humidity

Humidity is the amount of water vapour available in the atmosphere, our atmosphere can hold a certain amount of water beyond which it can not observe any water through evaporation

If the amount of water is higher we call it Higher humidity and then the evaporation rate is very low and it's the opposite when the amount of water vapour in the air that is the humidity is low then evaporation will be much higher.

4. Wind Speed

With increase in wind speed the particles of water vapour move away quickly with the wind decreasing the amount of water in the surrounding which reduces humidity that is the reason why high wind speed causes more evaporation

The liquids which evaporate faster are called volatile liquids

EVAPORATION CAUSES COOLING EFFECT

If you keep an open vessel the liquids keep on evaporating because the surface area absorbs the energy and hence the surface particles evaporate in the air which reduces the energy e in the liquid and keeps it cool. This absorption of energy from the surrounding makes the surrounding cold.

Some Daily Life Examples Of The Cooling Effect Of Evaporation Are Given:

1. When Ice cold water is kept in a glass tumbler for some time water droplets are observed on its outer surface.

This happens because the water vapour present in the air comes in contact with the glass tumbler which is cooled by the Ice cold water and then it loses its heat and condenses to form small water droplets. This formation of droplets of water on the outside surface confirms that water vapour is present in the air.

2. Cotton clothes are used throughout the summer season.

Cotton is an excellent absorber of water, which aids in the absorption of perspiration from the human body. When this sweat evaporates, it absorbs the latent heat of the vaporisation from the body, which cools the body and makes the individual feel comfortable.

3. People Sprinkle water on their rooftops or open ground on hot sunny days.

When water is sprinkled on a hot surface it gets evaporated by absorbing the heat energy available on the surface and when the water evaporates it takes away the heat energy which reduces the temperature of the surface and hence makes it cool.

4. Liquids like acetone and alcohol placed on our skin provide a cooling effect.

Acetone and alcohol are volatile liquids and when it is rubbed on our skin it gains energy and takes away the heat from our body and evaporates which gives us a feeling of cooling.

PLASMA AND BOSE EINSTEIN CONDENSATE - TWO MORE STATES OF MATTER

PLASMA

This state of matter consists of super energetic and super excited particles. These particles are in the form of ionized gases.

FORMATION OF PLASMA

In light bulbs for fluorescent lights, there is helium gas

The gas gets ionised when electric current or electric energy is flowing through it and it charges up creating plasma glowing inside the bulb or tube.

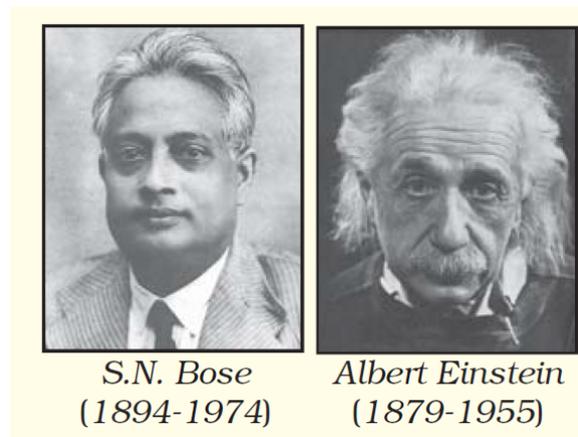
The plasma glows with a special colour depending on the nature of the gas present.

The sun and the stars glow because of the presence of Plasma in them

BOSE-EINSTEIN CONDENSATE

In 1920, Satyendra Nath Bose, an Indian Bengali physicist, calculated the fifth state of matter based on his calculations. Albert Einstein predicted the existence of a new form of matter known as Bose-Einstein condensate.

Bose-Einstein condensate is formed by cooling a gas of extremely low density about one hundred thousand the density of normal air to super low temperature.



Some measurable quantities and their units to remember:

Quantity	Unit	Symbol
Temperature	kelvin	K
Length	metre	m
Mass	kilogram	kg
Weight	newton	N
Volume	cubic metre	m ³
Density	kilogram per cubic metre	kg m ⁻³
Pressure	pascal	Pa

Quantity	Unit	Symbol
Temperature	kelvin	K
Length	metre	M
Mass	kilogram	Kg
Weight	newton	N
Volume	Cubic metre	M ³
Density	Kilogram per cubic metre	Kg M ⁻³
Pressure	pascal	Pa