CHEMISTRY

Matter in Our Surroundings

Matter

- All things which we see around us and use in our everyday life together constitute matter.
- Anything which occupies space and has mass is called matter.
- Matter is made up of particles.

Types of Matter

There are two ways in which matter can be classified-

1. On the basis of its physical nature (physical state).
2. On the basis of its chemical constitution.

Characteristics of Particles of Matter

The particles of matter—

- are very small.
- have spaces between them.
- are continuously moving.
- attract each other.

Diffusion

- Intermixing of particles of two different types of matter on their own is called diffusion.
- The rate of diffusion increases on increasing the temperature of the diffusing substance (by heating).

Examples of diffusion in gases:

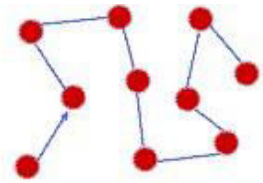
- The aroma of food being cooked in the kitchen reaches us even from a considerable distance due to diffusion.
- The fragrance of a burning incense stick spreads all around due to diffusion.
- The fragrance of a perfume spreads due to the diffusion of the perfume particles into air.

Examples of diffusion in liquids:

- Colour of potassium permanganate is acquired by water, on its own, due to the diffusion of potassium permanganate particles in water.
- The spreading of ink in water, on its own, is due to the diffusion of ink particles in the water.

Examples of diffusion in solids:

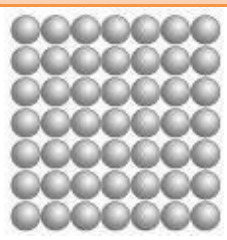
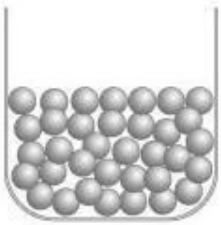
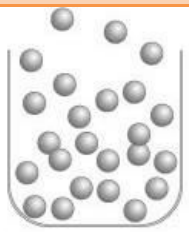
- If two metal blocks are bound together tightly and kept undisturbed for a few years, then the particles of one metal are found to have diffused into the other metal.
- If we write something on a blackboard and leave it undisturbed for atleast 10 to 15 days, we will find that it becomes quite difficult to clean the blackboard afterwards. This is due to the fact that some of the particles of chalk have diffused into the surface of the blackboard.



Brownian Movement of a Particle

Brownian movement
The random motion of particles suspended in a fluid (liquid or gas) results from their bombardment by the fast-moving atoms or molecules of the fluid (liquid or gas). This haphazard motion of the particles is known as Brownian motion.

States of Matter

Solid State	Liquid State	Gaseous State
		
The space between the particles is very less.	The space between the particles is slightly more as compared to solids, but still very less as compared to gases. The particles of a liquid can slip and slide over each other.	The particles are much farther apart from one another as compared to solids and liquids. They have a very disorderly arrangement of particles compared to the solids and liquids.
The force of attraction between the particles is strong. Thus, particles in a solid are closely packed.	The force of attraction between the particles is strong enough to hold the particles together but not strong enough to hold the particles in a fixed position.	The force of attraction between the particles is negligible, hence particles of a gas move freely in all the directions. Gases thus can mix or diffuse into other gases.
The kinetic energy of the particles is very less and so solids have an orderly arrangement of the particles. Therefore, solids have a fixed shape and volume.	The kinetic energy of the particles is more than that of solids. Thus, liquids have a disorderly arrangement of particles compared to solids.	The particles of a gas have maximum kinetic energy. They move with high speed in all directions and can exert pressure on the walls of its container.

Solids maintain their shape even when they are subjected to external force i.e. they are rigid.	Liquids do not have a fixed shape but have a fixed volume. Liquids take up the shape of the container in which they are poured.	Gases neither have a definite shape nor a definite volume. They fill up the container completely.
Solids cannot be compressed.	Liquids cannot be compressed much. The compressibility of liquids is almost negligible.	Gases can be compressed easily. Example: the LPG cylinders used at home and the CNG cylinders used in vehicles.

The relation between Kelvin scale and Celsius scale of temperature

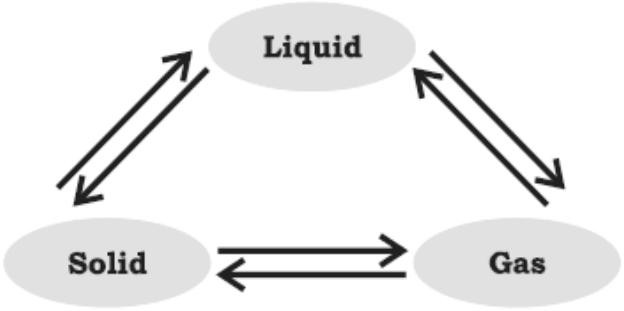
Temperature on Kelvin scale = Temperature on Celcius scale + 273

Thus, a temperature of 25^{o}C on the Celsius scale is equal to 298 K on the Kelvin scale.

Change of State of Matter (Phase transition)

Interconversion of States of Matter

The phenomenon of change from one state of matter to another, and then back to the original state is called the interconversion of states of matter.



Interconversion of States of Matter

Change of state is affected by changes in conditions such as—

1. Changes in temperature.
2. Increasing or decreasing pressure.
3. Changes in both, the temperature and pressure.

Melting point (Solid → Liquid)

- The temperature at which a solid melts to become a liquid, at atmospheric pressure, is called its melting point.
- Melting point is the characteristic property of a substance. For example, melting point of ice is 0°C (273 K).
- The process, in which a liquid changes to its solid form, on cooling at a specific temperature, is called freezing or solidification.

Latent heat: The hidden heat which breaks the force of attraction between the molecules is known as the latent heat. Since, the heat energy is hidden in the bulk of the matter, it is called latent heat.

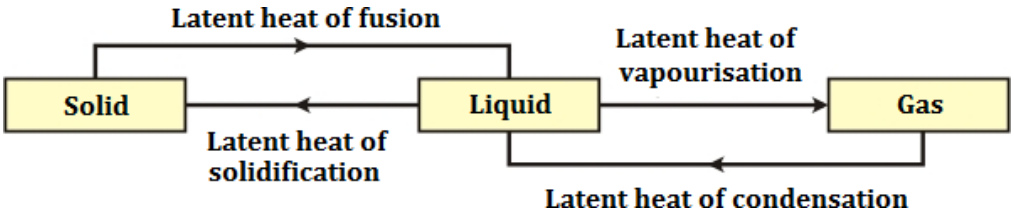
Latent heat of fusion: The heat energy required to convert 1 kilogram of a solid into liquid at atmospheric pressure, at its melting point, is known as the latent heat of fusion.

- When we supply heat energy to water, the particles start moving faster.
- At a certain temperature, a point is reached when the particles have enough energy to break free from the forces of attraction of each other.
- At this temperature, the liquid starts changing into a gas.

Boiling Point: (Liquid → Gas)

- The temperature at which a liquid starts boiling, at atmospheric pressure, is called its boiling point.
- Boiling is a bulk phenomenon.
- Particles from the bulk of the liquid gain energy to change into the gaseous state.
- For example, boiling point of water is 100^0C. (Or 100^0C = 273 + 100 = 373 K)

Latent heat of vapourisation: The heat energy required to convert 1 kilogram of liquid into gas, at atmospheric pressure, at its boiling point, is known as the latent heat of vapourisation.



Condensation (Gas → Liquid)

- The process, in which a gas, on cooling, turns into a liquid at a specific temperature is called condensation or liquefaction.
- Formation of clouds is due to the condensation of water vapour from the Earth's surface.
- The heat removed from the surface through evaporation is released into the atmosphere by the formation of clouds. This process cools the Earth's climate.

Sublimation (Solid ⇌ Gas)

- The change of state of a substance directly from a solid to gas, without changing into the liquid state (or vice versa) is called sublimation.
- The common substances which undergo sublimation are camphor, naphthalene, ammonium chloride, solid carbon dioxide and iodine.

Freezing point (Liquid → Solid)

The temperature at which the state of a substance changes from a liquid to a solid is called the freezing point of that substance.

Effect of Change of Pressure

- Gases can be liquefied by applying pressure and reducing the temperature.
- When a high pressure is applied to a gas, it gets compressed and if the temperature is lowered, the gas is liquefied.

Evaporation (Liquid → Gas)

The process of conversion of a substance from the liquid state to the gaseous state at any temperature below its boiling point is called **evaporation** or **vapourisation**.
Evaporation is a surface phenomenon.

Factors Affecting Evaporation

- The rate of evaporation increases on increasing the surface area of the liquid.
- The rate of evaporation increases with an increase in temperature.
- Decrease in the humidity increases the rate of evaporation.
- An increase in the wind speed increases the rate of evaporation.

Difference between Evaporation and Boiling

Evaporation	Boiling
• It is a surface phenomenon.	• It is a bulk phenomenon.
• It is a slow process.	• It is a rapid process.
• It takes place at all temperatures but below the boiling point.	• It takes place at a definite and constant temperature.

More to Know

Lately, scientists are talking about five states of matter or five phases of matter. These are - solids, liquids, gases, plasmas and the Bose–Einstein condensate.

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.

Bose - Einstein Condensate

Indian physicist Satyendra Nath Bose made a study regarding the fifth state of matter. Based on his study, Albert Einstein predicted a fifth state of matter called the Bose-Einstein Condensate. The Bose-Einstein Condensate or BEC is formed by cooling a gas of extremely low density to super low temperatures.