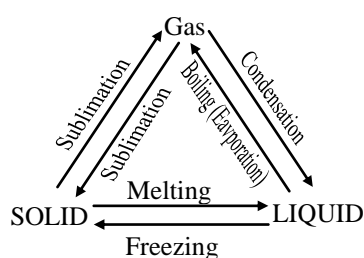


Change of States of Matter

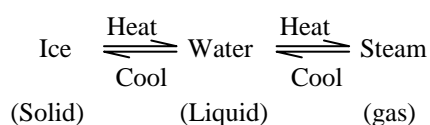
- A substance may exist in any of the three states of matter (i.e. solid, liquid or gas) depending upon the conditions of temperature and pressure.
- By changing the conditions of temperature and pressure, a substance can be made to exist as solid, liquid or a gas.
- A solid on heating usually changes into a liquid which on further heating changes into gas. Similarly, a gas on cooling condenses into a liquid which on further cooling changes into a solid.



The most familiar and common example is water. It exists in all the three states:

- (a) Solid : ice
- (b) Liquid : water and
- (c) Gas : water vapour.

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



Effect of Temperature Change

By increasing the temperature (by heating), a solid can be converted into liquid state; and the liquid can be converted into gaseous state (or vapour state). And by

decreasing the temperature (by cooling), a gas can be converted into liquid state; and a liquid can be converted into solid state.

Solid to liquid change: Melting

- ❓ **Defination** : The process in which a solid substance changes into a liquid on heating, is called melting (or fusion).
- ❓ **Melting point** : The temperature at which a solid substance melts and changes into a liquid at atmospheric pressure, is called melting point of the substance.
- ❓ Ice is a solid. In solids, the particles are tightly packed together. When we heat a solid, its particles become more energetic and kinetic energy of the particles increases. Due to the increase in kinetic energy, the particles start vibrating more strongly with greater speed. The energy supplied by heat overcomes the intermolecular forces of attraction between the particles. As a result, the particles leave their mean position and break away from each other. When this happens, the solid melts and a liquid is formed.

Ex. Melting point of ice = 0°C

Melting point of wax = 63°C

Melting point of iron = 1535°C

The melting point of a solid is a measure of the force of attraction between its particles. Higher the melting point of a solid substance, greater will be the force of attraction between its particles.

Liquid to gas change : Boiling (or vaporisation)

- ❓ **Defination** : The process in which a liquid substance changes into a gas rapidly on heating, is called boiling.
- ❓ **Boiling point** : The temperature at which a liquid boils and changes rapidly into a gas at atmospheric pressure, is called boiling point of the liquid.
- ❓ In a liquid most of the particles are close together. When we supply heat energy to the liquid, the particles of water start vibrating even faster. Some of the particles become so energetic that they can overcome the attractive forces of the particles around them.

Therefore, they become free to move and escape from the liquid. When this happens, the liquid evaporates i.e., starts changing into gas.

Ex. Boiling point of water = 100°C

Boiling point of alcohol = 78°C

Boiling point of mercury = 357°C

The boiling point of a liquid is a measure of the force of attraction between its particles. Higher the boiling point of a liquid, greater will be the force of attraction between its particles.

When a liquid is heated, the heat energy makes its particles move even faster. At the boiling point the particles of a liquid have sufficient kinetic energy to overcome the forces of attraction holding them together and separate into individual particles. And the liquid boils to form a gas.

Gas to liquid change : Condensation

The process of changing a gas to a liquid by cooling, is called condensation. Condensation is the reverse of boiling.

Liquid to solid change : Freezing

The process of changing a liquid into a solid by cooling, is called freezing. Freezing means solidification. Freezing is the reverse of melting. So, the freezing point of a liquid is the same as the melting point of its solid form.

Ex. Melting point of ice = 0°C

Freezing point of water = 0°C

Effect of Change of Pressure

- ☐ The three states of matter differ in the intermolecular forces and intermolecular distances between the constituent particles.
- ☐ Gases are compressible because on applying pressure, the space between the gaseous particles decreases. Therefore, gases can be compressed readily.
- ☐ When we apply pressure and reduce temperature the gases can be converted into liquids i.e., gases will be liquefied.

- ❓ The process of conversion of a gas into a liquid by increasing pressure or decreasing temperature is called **liquefaction**.

A substance may exist in any of the three different states of matter depending upon the conditions of temperature and pressure.

- (1) If the melting point of a substance is above the room temperature at the atmospheric pressure, it is said to be a solid.
- (2) If the boiling point of a substance is above room temperature under atmospheric pressure, it is classified as liquid.
- (3) If the boiling point of the substance is below the room temperature at the atmospheric pressure, it is called a gas.

Latent Heat

- ❓ **Defination** : The heat energy which has to be supplied to change the state of a substance is called its latent heat.
- ❓ Latent heat does not raise the temperature but latent heat has always to be supplied to change the state of a substance. The word 'latent' means 'hidden'
- ❓ Every substance has some forces of attraction between its particles which hold them together. Now, if a substance has to change its state, then it is necessary to break these forces of attraction between its particles. The latent heat does not increase the kinetic energy of the particles of the substance, the temperature of a substance does not rise during the change of state.

Latent heat is of two types

- ❓ **Latent heat of fusion** : The heat required to convert a solid into the liquid state is called latent heat of fusion. In other words 'The latent heat of fusion of a solid is the quantity of heat in joules required to convert 1 kilogram of the solid to liquid, with out any change in temperature.

Ex. The latent heat of fusion of ice = 3.34×10^5 J/kg

- ❓ **Latent heat of vaporisation** : The heat required to convert a liquid into the vapour state is called latent heat of vaporisation.

- ☐ The other words 'The latent heat of vaporisation of a liquid is the quantity of heat in joules required to convert 1 kilogram of the liquid to vapour or gas, without any change in temperature.

Ex. Latent heat of vaporisation of water

$$= 22.5 \times 10^5 \text{ J/kg}$$