Chemistry Part-1

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About the Tutorial

Chemistry is one of the disciplines of science under which, we study about the various aspects of the matters i.e. composition, properties, their reactions, and the use of such reactions to form new substances. In its given premises, Chemistry includes a wide range of topics such as organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry, biochemistry, etc.

Because of having wide range of topics, this tutorial is divided into two parts namely Chemistry Part 1 and Chemistry Part 2. Further, these two parts are divided into different chapters for an easy understanding.

Audience

This tutorial is designed exclusively for the students preparing for the different competitive exams including **civil services, banking**, **railway**, **eligibility test**, and all other competitive exams of such kind.

Prerequisites

This tutorial is partly based on **NCERT Chemistry** (class 8^{th} to 10^{th}) i.e. Part I and Part 2 is prepared from the different reliable sources and represents largely the significant facts and figures vital for the competitive exams.

This tutorial starts with the basic concepts of Chemistry; however, prior experience of reading the NCERT science (Chemistry) books is recommended for the easy understanding.

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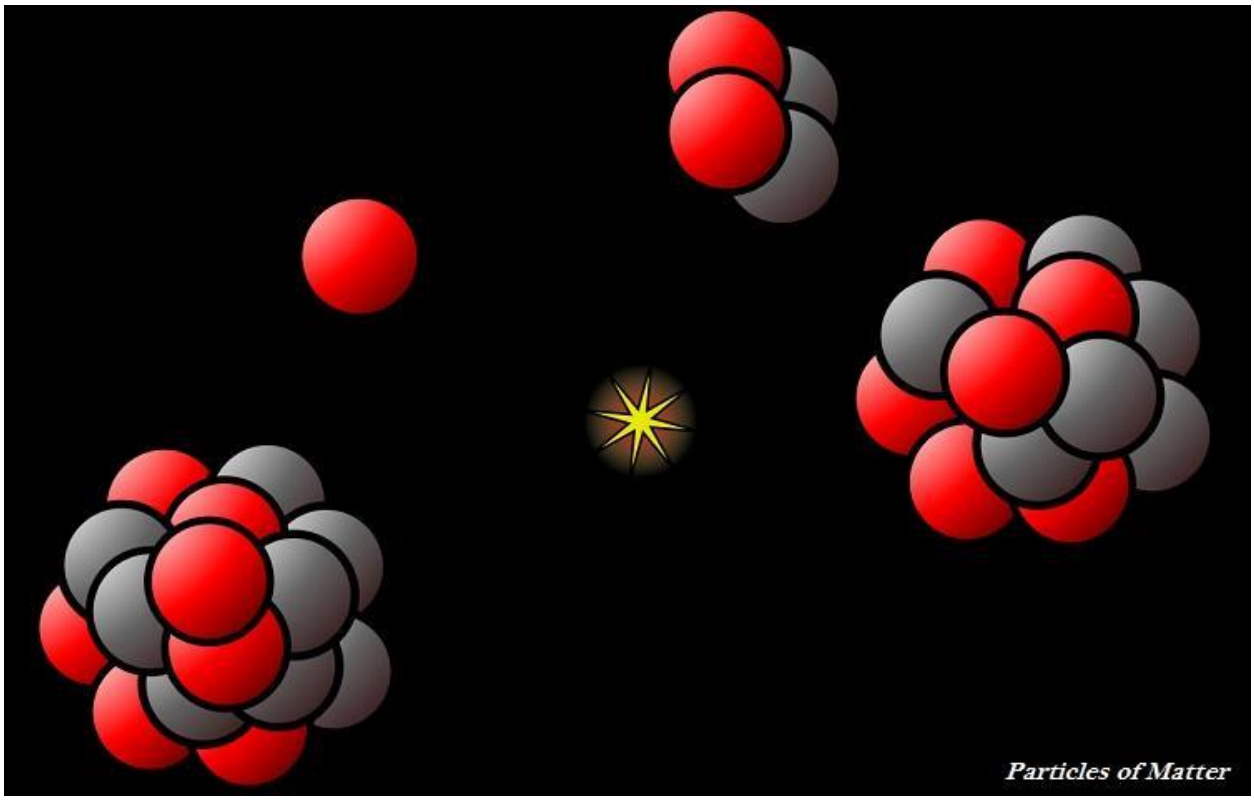
1. MATTER IN OUR SURROUNDINGS

Introduction

- Everything found in this universe is made up of some materials, scientists have named them as "**matter.**" For example, the food we eat, the air we breathe, stones, clouds, stars, plants, animals, water, dust, everything is categorized as matter.

Characteristics of Particles of Matter

- Particles of matter are very small, normally, not visible from naked eye.



- Particles of matter keep moving continuously, which is known as the "**kinetic energy**."

- Kinetic energy of particles directly depends on the temperature, as temperature increases, the speed of the movement also increases.

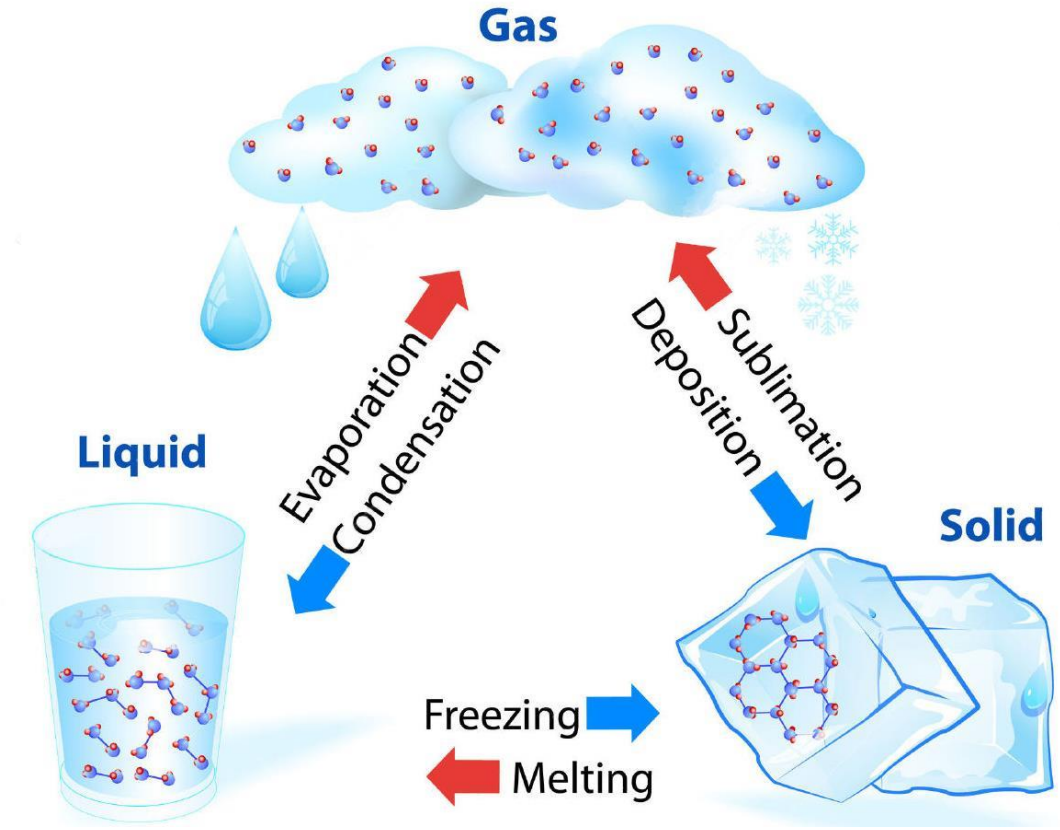
- The particles of matter have attracting force; therefore, they attract each other.

- The attracting force of the particles keeps the particles together; however, the strength of the attracting force varies from one kind of matter to another.

States of Matter

- Matter has three following states:

  1. **Solid State**
  2. **Liquid State**
  3. **Gaseous State**



- Let's discuss them in brief:

Solid State

- All the solid materials have a definite shape, distinct boundaries, and fixed volumes.
- Most of the solid materials have negligible compressibility.
- All the solid materials have a natural tendency to maintain their shape when subjected to outside force.

- The solid materials can be broken under applied force, but it is very difficult to change their shape, as they are rigid.

Liquid State

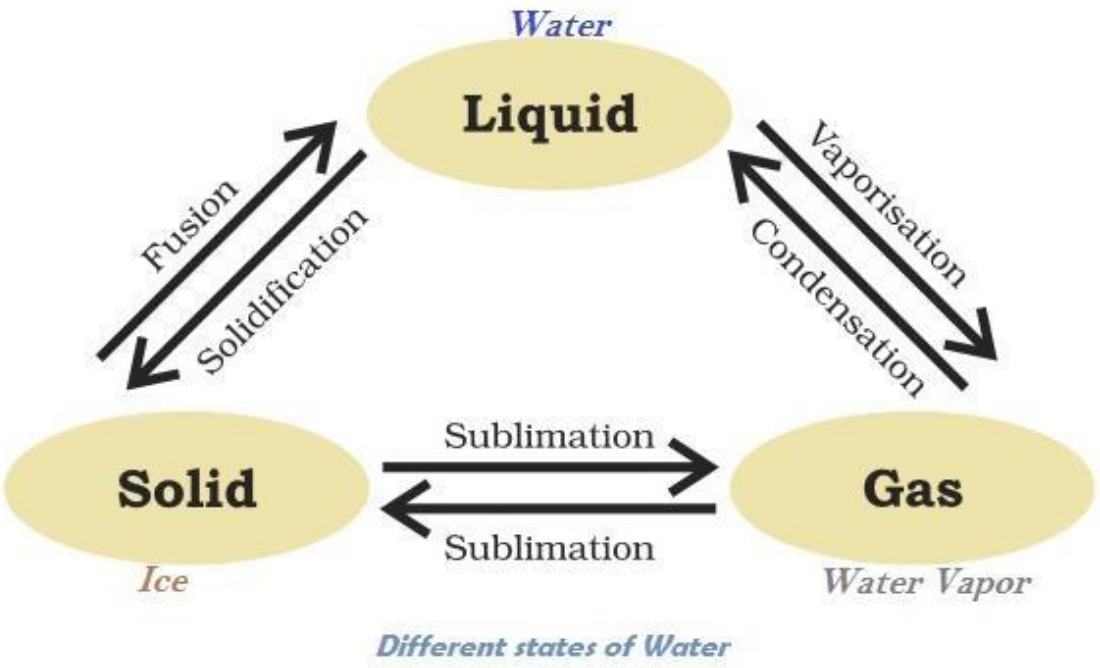
- Unlike solids, liquids have no fixed shape; however, they have a fixed volume.
- Liquids take up the shape of the container in which they are kept.
- Liquids have the property to flow and change shape.

Gaseous State

- Matter in the form of air, which is neither solid nor liquid, is known as gas. For example, oxygen, nitrogen, hydrogen, etc.
- Unlike solid, gas has not definite size and shape.
- The gases, such as liquefied petroleum gas (LPG – used in cooking); compressed natural gas (CNG – used as fuel in vehicles), etc. have high compressibility; therefore, large volume of a gas can be compressed into a small cylinder and can be transported easily.
- Gases, normally, show the property of diffusing very fast into other gases. This is the reason that we can smell (either good or bad) from the distance.

Matter Can Change its State

- Water can exist in all three states, e.g. Ice as solid; water (H_2O) as liquid; and water vapor as gas. The following diagram illustrates the transformation of water in different states:



Different states of Water

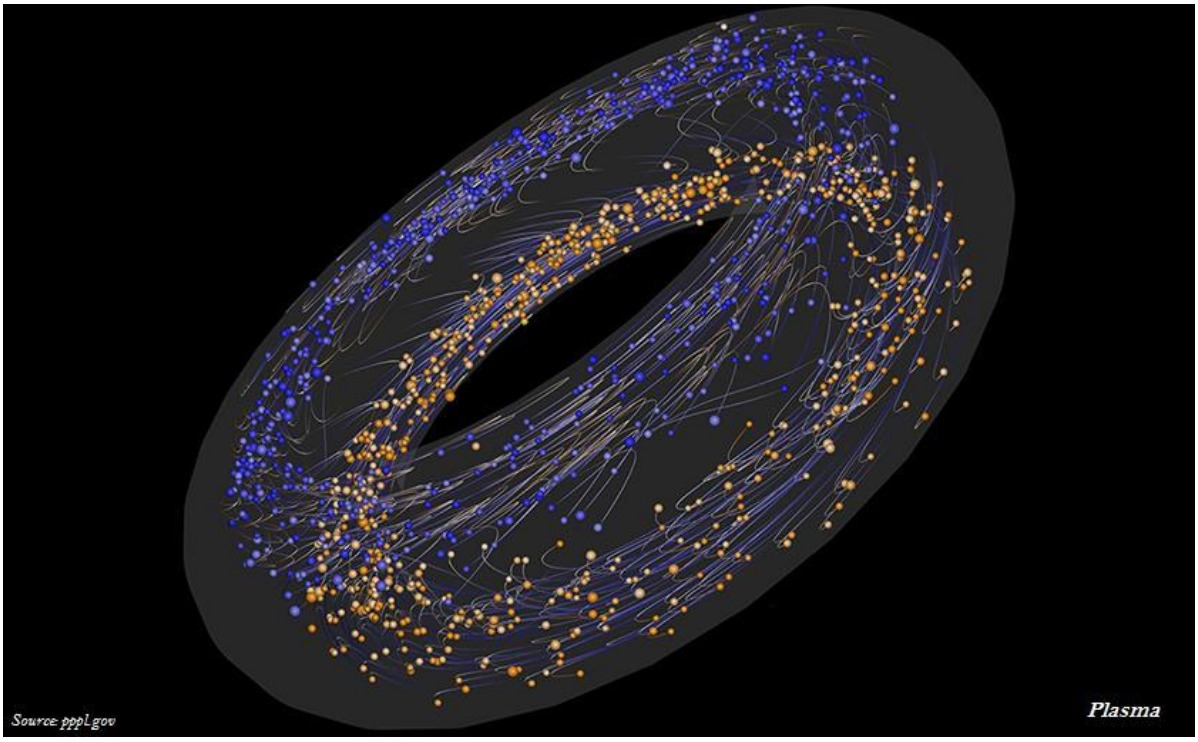
- The temperature, at which solid melt and transform into the liquid (at the given atmospheric pressure), is known as "**melting point**."
- The melting point of a solid is an indication of the strength of the force of attraction between its particles.
- The melting point of ice is 273.16 K, i.e. 0^0 C.
- The process of melting (i.e. change of solid state into liquid state) is known as **fusion**.
- The amount of heat energy, which is required to change 1 kg of a solid materials into liquid materials at a given atmospheric pressure, is known as the **latent heat** of fusion.
- The temperature at which a liquid starts boiling at the given atmospheric pressure is known as "**boiling point**."
- The boiling point of water is 373 K i.e. 100^0C.
- A change of state of a matter directly from solid to gas without changing into liquid state (or vice versa) is known as "**sublimation**."
- The phenomenon i.e. change of a liquid into vapors at any temperature below its boiling point is known as "**evaporation**."
- Solid carbon dioxide (CO_2) is stored under high pressure.

- Solid CO_2 gets converted directly into gaseous state once the pressure decreases to 1 atmosphere.

- **Atmosphere** (atm) is a unit of measuring pressure exerted by the gas and the unit of pressure is Pascal (Pa); 1 atmosphere = 1.01 × 105 Pa.

The Fourth State of Matter

- **Plasma** is the state that consists of super energetic and super excited particles.



- The super excited particles are found in the form of ionized gases. E.g. the fluorescent tube (which contains helium gas) and neon sign bulbs (which contain neon gas) consist of plasma.

2. IS MATTER AROUND US PURE

Introduction

- A pure substance is that that consists of single type of particle or particles.

Source: Science NCERT, Class IX

- Mixtures of two or more pure components without any undesirable substance are known as **Mixtures**, for example, water, minerals, soil etc.

- A homogeneous mixture of two or more substances is known as **solution**. For example, lemonade, soda water etc.

- Solution could be in any form such as – it could be in liquid, solid, or gaseous.

- **Alloys** are another example of mixture that contain homogeneous mixtures of metals; they cannot be separated into their components by physical methods. E.g. For example, brass is a mixture of zinc (approximately 30%) and copper (about 70%).

Significant Features of Solution

- Solution is normally a homogeneous mixture.
- The particles of a solution are even smaller than 1 nm (10-9 meter) in diameter and hence, these are not visible from the naked eyes.
- The path of light is not visible in a solution.
- The dissolved particles cannot be separated from the mixture by the simple process of filtration.
- The dissolved particles do not settle down when it left undisturbed.
- At a given temperature, when no more solute can be dissolved in a solution, it is known as '**saturated solution**.'

- At a given temperature, the amount of the dissolved particles present in the saturated solution, is known as '**solubility**.'

Suspension

- A suspension is a heterogeneous mixture in which the solute particles do not dissolve, but rather remain suspended throughout the bulk of the medium, is known as '**suspension**.'

Significant features of Suspension

- Particles of a suspension are clearly visible from the naked eye.

Suspended particles

- The particles of a suspension scatter a beam of light that passes through it and likewise, its path is visible.

- The salute particles can be separated from the mixture by the simple process of filtration.

Colloid

- A heterogeneous mixture is known as '**colloid**.' E.g. mist, fog, smoke, face cream, etc.

- The size of colloid particles is too small to see from the naked eye.
- Colloid particles are big enough to scatter a beam of light passing through it and make the path visible.
- Colloid particles cannot be separated from the mixture by the simple process of filtration.
- The special filtration technique i.e. **centrifugation**, can be used to separate the colloidal particles.

Chromatography

- The process of separation of components of a mixture is called as **chromatography**; normally it is used for the color separation.
- Chromatography technique is used for separation of those solutes that dissolve in the same solvent.

Distillation

- The process of purifying a liquid by heating and cooling means is known as distillation.