# Unit: Solid State

# B.Sc-I

# Paper-1



# By

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## Solids

Solids are the chemical substances which are characterized by define shape and volume, rigidity, high density, low compressibility. The constituent particles (atoms, molecules or ions) are closely packed and held together by strong interparticle forces.

## Types of Solids

The solids are of two types: Crystalline solids and amorphous solids.

## Distinction between Crystalline and Amorphous Solids

| S.No | Crystalline solid | Amorphous solids |
|---|---|---|
| 1 | These have definite and regular arrangement of the constituent particles in space. | These don't have any regular arrangement of the constituent particles in space. |
| 2 | These are true solids. | These are super cooled liquids or pseudo solids. |
| 3 | These have long order arrangement of the particles. | These have short order arrangement of particle. |
| 4 | These are anisotropic in nature, i.e., their physical properties are different in different directions. | These are isotropic in nature i.e., their physical properties are same in all the directions. |
| 5 | They have sharp melting points. | They melt over a certain range of temperature. |
| 6 | They undergo a clean cleavage when cut. | They undergo irregular cleavage when cut. |

**Classification of Crystalline Solids**

The classification of crystalline solids is based on their property. The crystalline property depends o n the nature of interactions between the constituent particles, and therefore these solids are divided into four different categories:

- Ionic solids
- Covalent or Network solids
- Molecular solids
- Metallic solids

**Ionic solids—**Made up of positive and negative ions and held together by electrostatic attractions. They're characterized by very high melting points and brittleness and are poor conductors in the solid state. An example of an ionic solid is table salt, NaCl.

**Molecular solids—**Made up of atoms or molecules held together by London dispersion forces, dipole-dipole forces, or hydrogen bonds. Characterized by low melting points and flexibility and are poor conductors. An example of a molecular solid is sucrose.

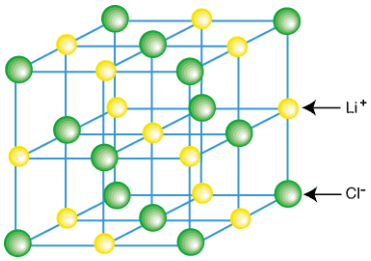
**Covalent-network (also called atomic) solids—**Made up of atoms connected by covalent bonds; the intermolecular forces are covalent bonds as well. Characterized as being very hard with very high melting points and being poor conductors. Examples of this type of solid are diamond and graphite, and the fullerenes. As you can see below, graphite has only 2-D hexagonal structure and therefore is not hard like diamond. The sheets of graphite are held together by only weak London forces!

**Metallic solids**—Made up of metal atoms that are held together by metallic bonds. Characterized by high melting points, can range from soft and malleable to very hard, and are good conductors of electricity.

**Crystal Lattice**

Crystal Lattice is a three-dimensional representation of atoms and molecules arranged in a specific order/pattern. In other words, a crystal lattice can be defined as a geometrical

arrangement of constituent particles of matter (atoms, ions or molecules) as points in space. There are total 14 possible three-dimensional lattices. Crystal lattices are also known by **Bravais Lattices**, named after the scientist Auguste Bravais.




***Example of a crystal lattice***

**Characteristics of Crystal Lattices**

The following characteristics are depicted by Bravais lattices:

- Each point in a lattice represents a lattice site or we can say lattice point
- Each point denotes a particular type of constituent particles of matter be it an atom, molecule or an ion
- By joining the lattices points inside the lattice we can define geometry of the lattice