JANATA SHIKSHAN SANSTHA'S KISAN VEER MAHAVIDYALAYA, WAI

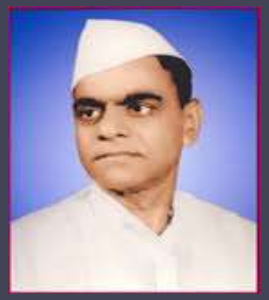
DEPARTMENT OF CHEMISTRY

B.Sc. PART III

SEMESTER VI

PAPER XV

PHYSICAL CHEMISTRY



Unit III Solid State

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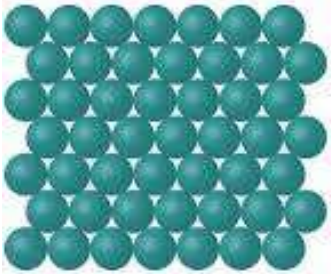
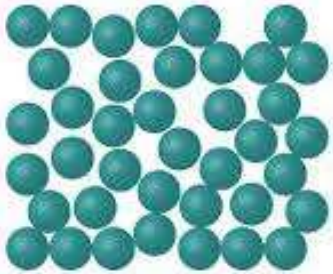
Amorphous and Crystalline Solids

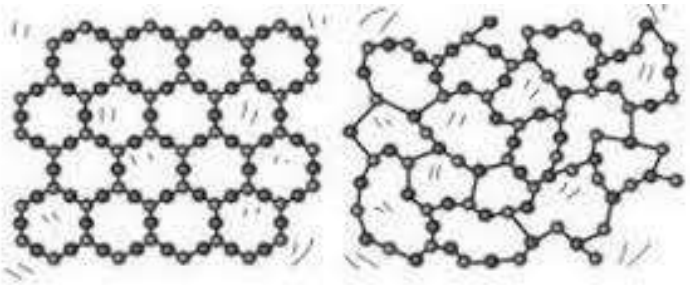
S. No.	Properties	Crystalline solids (True solids)	Amorphous solids (Pseudo solids)
1.	Crystal geometry	Definite crystal shape due to ordered arrangement	Indefinite geometrical shape due to irregular arrangement
2.	Symmetry	Have plane, centre and axis of symmetry	Do not have any type of symmetry
3.	Anisotropic or Isotropic nature	Properties are anisotropic, *i.e.*, direction dependent, *e.g.*, refractive index	Properties are isotropic, *i.e*, direction independent
4.	Melting point	Have sharp melting point	Have diffused melting point
5.	Physical state	Hard and rigid	Soft
6.	Crystal system	Have seven types of crystal systems	These do not have regular crystal system
7.	Cleavage	On cutting with a knife they give sharp and smooth edges.	They form diffused and irregular edges, when cut with a sharp knife.
	Examples	*e.g.*, Quartz, Diamond, NaCl, ZnS	*e.g.*, Rubber, Plastic, Glass



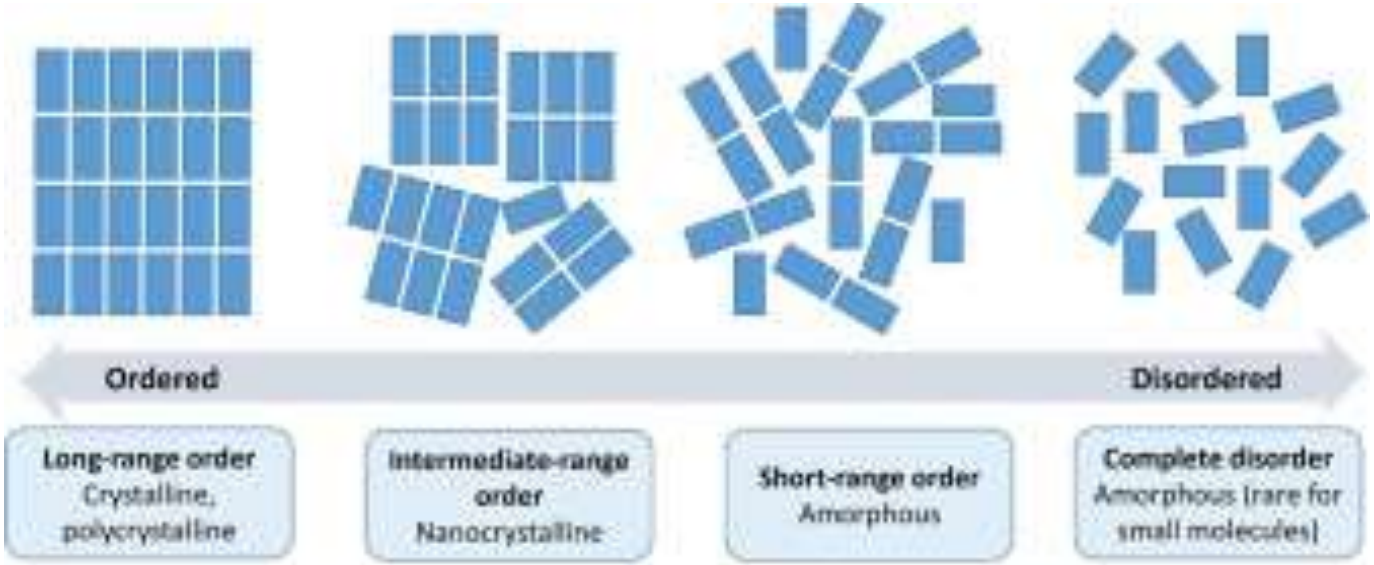
Crystalline



Amorphous



Crystalline solids **Amorphous solids**



SPACE LATTICE

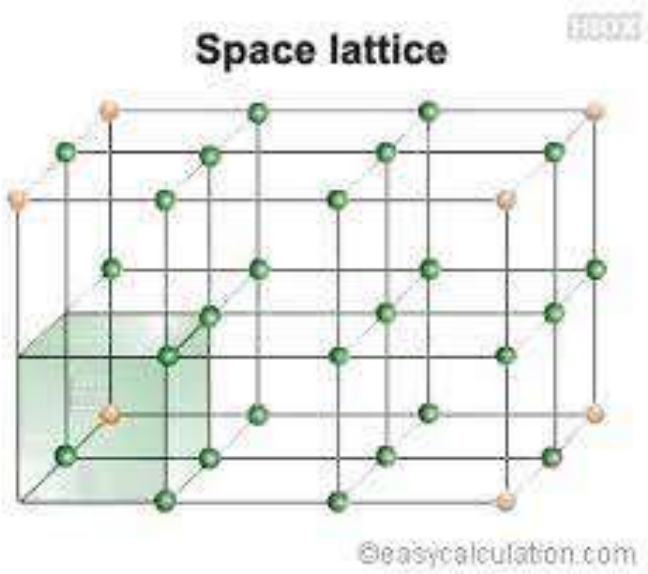
Lattice *means the systematic and symmetrical arrangement of points or particles in space.*

Space Lattice may be defined as an array of points showing how atoms, ions or molecules are arranged at different sites in three dimensional space.

Space Lattice is a three dimensional arrangement of identical points in a space.

Each point representing an atom or ion has the same surrounding as any point representing the same atom or ion.

Space lattice is also called as ***Crystal Lattice***



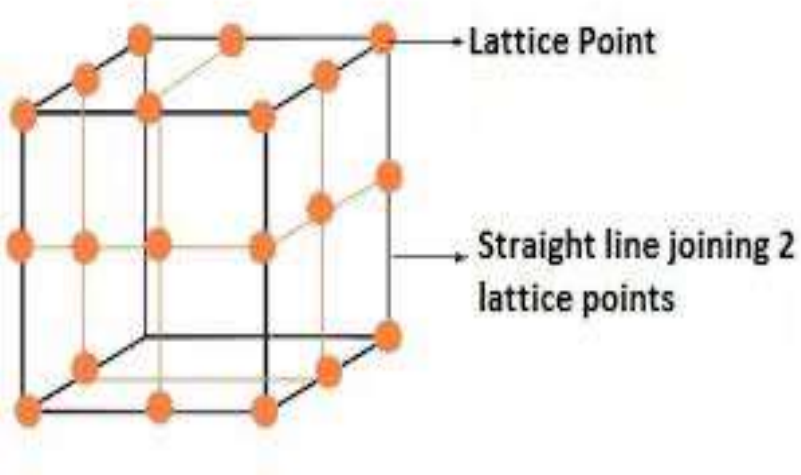
LATTICE SITES

The position occupied by a point or particle in crystal lattice is called as ***lattice site*** *or* ***lattice point***.

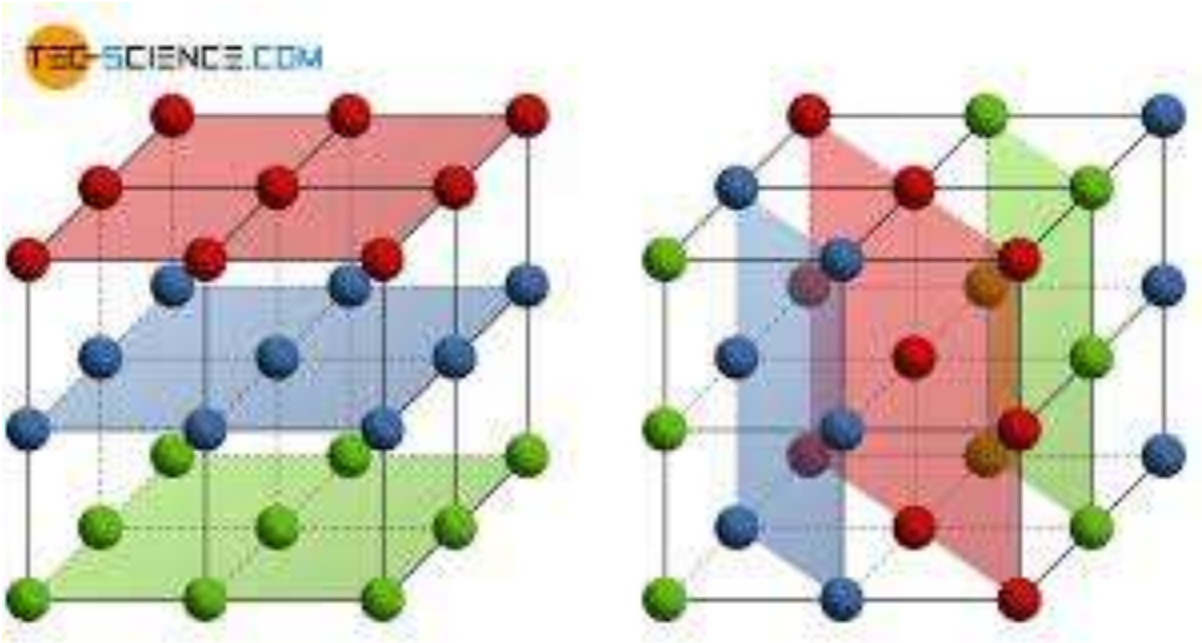
Lattices sites are occupied by atoms, ions or molecules of the crystal; these are either of the same type or different types.

Lattice sites or points are together joined by a straight line in a crystal lattice.

If the lattice sites contain atoms of the same type, then we call it a ***monatomic crystal lattice***, and if there are different types of atoms, then it is a ***polyatomic crystal lattice***.

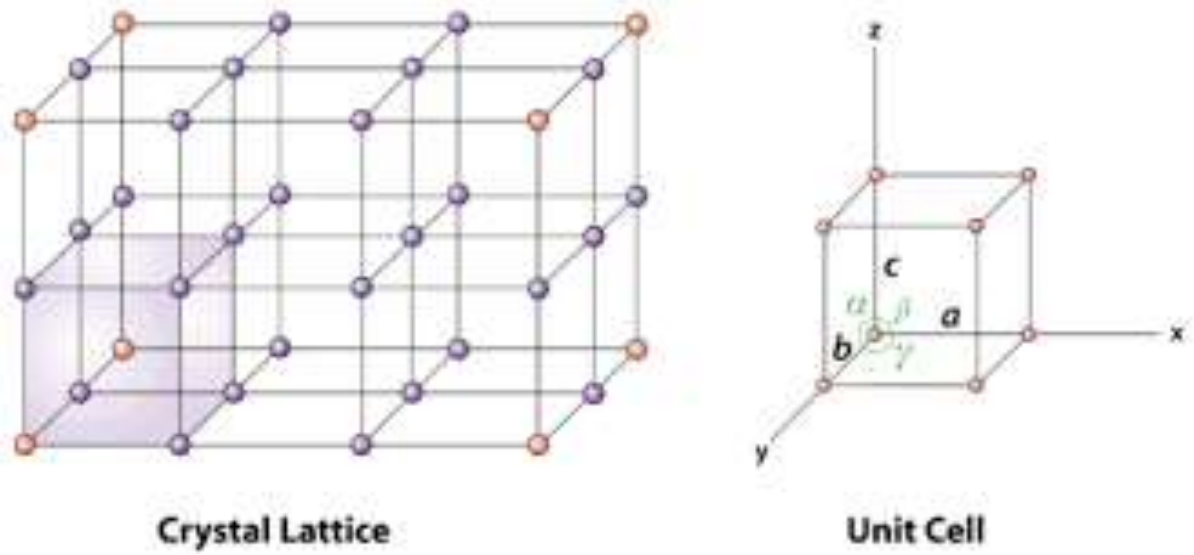


LATTICE PLANES



The points in a space lattice can be arranged in a number of parallel and equidistant planes which are called as ***lattice planes****.*

UNIT CELL



Crystal Lattice

Unit Cell

A unit cell is the smallest structural unit in space lattice which when repeated in three dimensions results in a crystal of the given substance.

The crystal may consist of infinite number of unit cells.

This fundamental elementary pattern of a crystal is known as unit cell or lattice unit.

LAWS OF CRYSTALLOGRAPHY

1. Law of Constancy of Interfacial Angles

The law states that the shape of a crystal of given compound or element may vary with the conditions under which the crystallization occurs but the angles between the faces are always constant.

2. Law of Rational Indices

The law states that the intercepts made by any given plane of a crystal along the three crystallographic axes are either equal to the unit intercepts made by standard or unit plane or some simple whole numbers multiples of them.

3. Law of Crystal Symmetry

Law of Symmetry states that all crystals of same substance possess the same elements of symmetry.

Following are the types of Symmetry-

- Plane of Symmetry
- Axis of Symmetry
- Centre of Symmetry

WEISS INDICES

The coefficients of unit intercepts a, b and c are known as Weiss Indices

Weiss Indices of any plane are defined as the coefficients of intercepts made by a plane along three co-ordinate axes.

If a plane is parallel to any axis then its intercept on that axis is taken as infinity.

MILLER INDICES

Miller Indices of a plane are obtained by taking the reciprocals of the Weiss Indices and multipying by the least common multiple to obtain integral value.

The Miller Indices are also called as (h k l) values.

CUBIC LATTICE

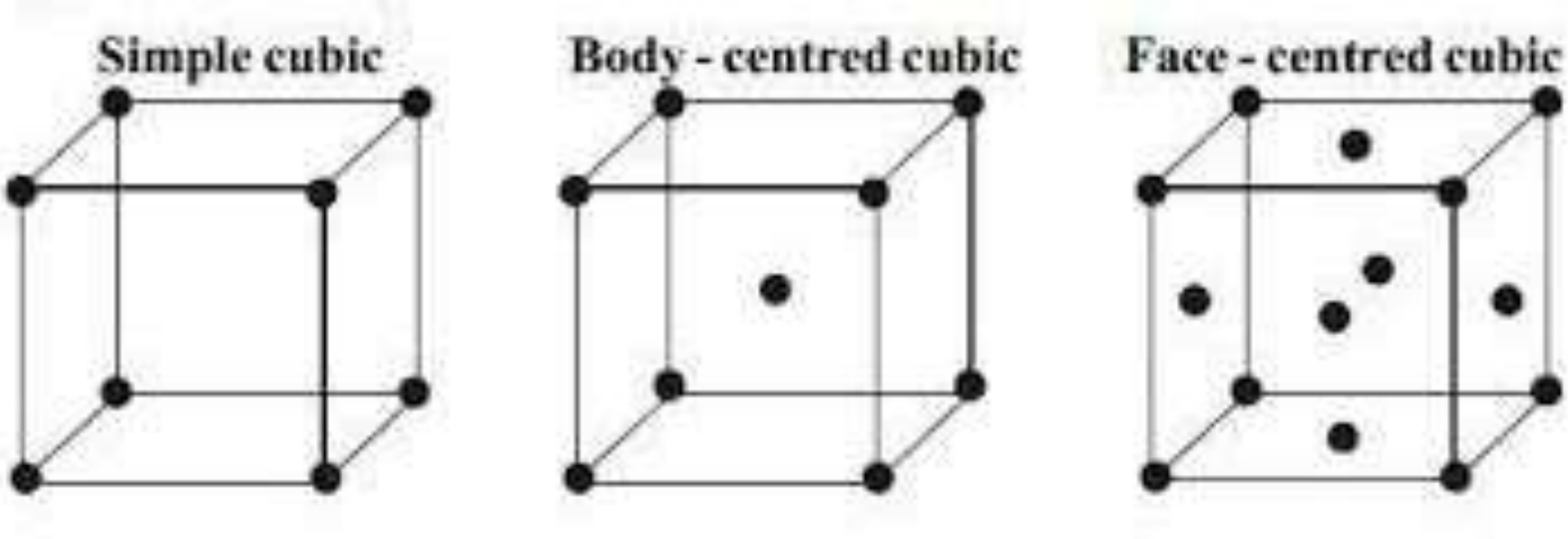
In crystallography, the **cubic crystal system** is a crystal system where the unit cell is in the shape of a cube.

This is one of the most common and simplest shapes found in crystals and minerals.

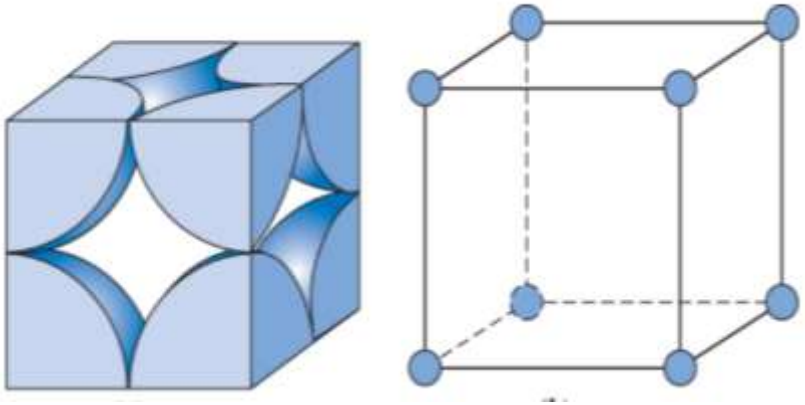
There are three main varieties of these crystals:

- Primitive cubic (simple cubic)
- Body-centered cubic (bcc)
- Face-centered cubic (fcc)

TYPES OF CUBIC LATTICE

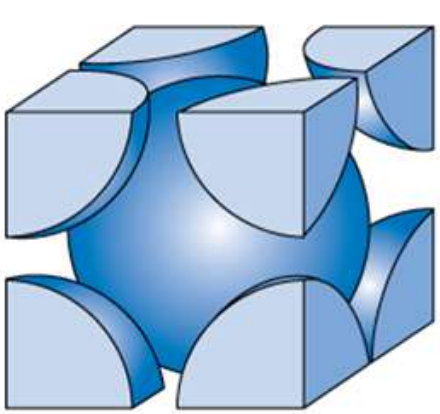


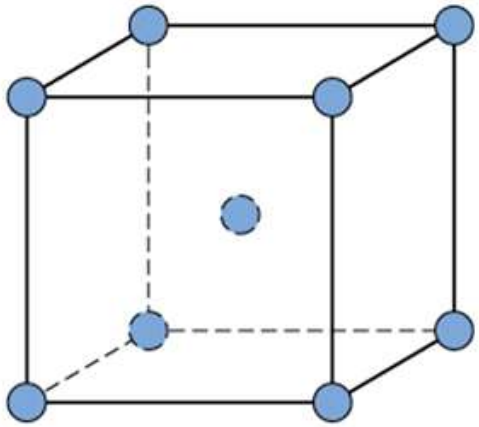
SIMPLE CUBIC LATTICE



- In a simple cubic lattice, atoms are present at the corners only, each atom at the corner is shared equally by eight other unit cells. Hence the contribution of each atom to the unit cell is 1/8.
- The total number of atoms per unit cell = Nc /8 = 8/8 = 1
- Nc is the number of atoms at the corners.

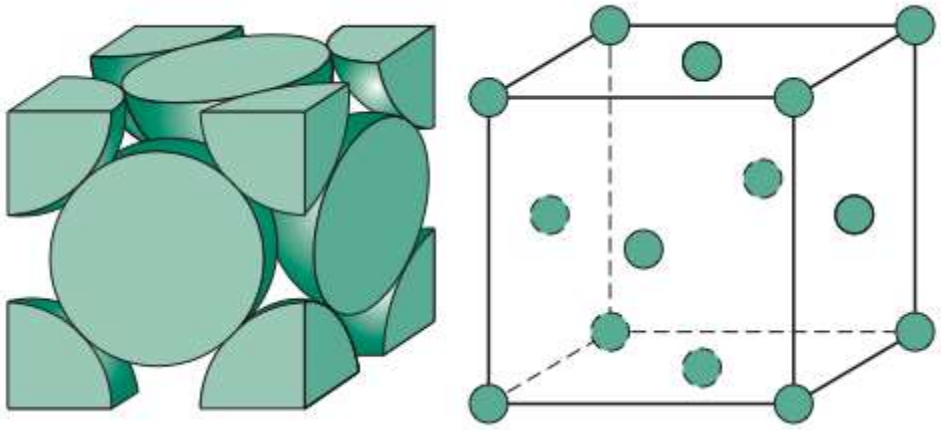
BODY CENTRED CUBIC LATTICE





- In a bcc lattice, the body centred atom belongs exclusively to the unit cell.
- The total number of atoms per unit cell in bcc
  = (Nc/8) + (Nb/1) = (8/8) + (1/1) = 1+1 = 2
- Nb = Number of atoms inside the body

FACE CENTRED CUBIC LATTICE



- A face atom is shared equally between two unit cells and therefore a face atom contributes only ($N_f/2$) to the unit cell.
- The number of atoms per unit cell in fcc
  = Nc/8 + Nf/2 = (8/8) + (6/2) = 4
- Nf = Number of atoms at the faces.
- Nf = Number of atoms at the faces

THANK YOU!