

The Solid State

1. Solids are substances which have fixed shape and volume. They are characterised by rigidity, incompressibility, slow diffusion and mechanical strength. They are classified as:

- (a) Crystalline solids
- (b) Amorphous solids .

2. The crystalline solids are further classified as:

- (a) Metallic solids
- (b) Ionic solids
- (c) Covalent solids
- (d) Molecular solids

3. A regular three dimensional arrangement of points in space is called a space lattice or crystal lattice. There are only 14 three-dimensional lattices known as Bravais lattices. The basic difference between the 14 Bravais lattices are the angles between the faces and the relative proportion of the sides.

4. A unit cell is the smallest unit of the crystal which when repeated again and again gives the crystal of the given substance.

5. There are three types of unit cells based on the cube. These are:

- (a) Primitive or simple cube** which has one constituent at each corner.
- (b) Body-centred cube** in which one constituent at the centre of the cube as well as one at each corner.
- (c) Face-centred cube** in which there is one constituent at the centre of each face as well as one at each corner.

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6. A pure metal in the solid crystalline state is composed of atoms that are identical in shape and size. The identical spheres can be packed in a number of ways.

7. The number of nearest neighbours of an atom, ion or a molecule is called its coordination number.

8. In the hcp and ccp structures, about 74 percent of the available space is occupied by the spheres. In bcc arrangement, about 68 percent of the available space is filled up. In simple cubic structures, about 52.4 percent of the available space is occupied by the spheres.

9. The density of the unit cell,

$$d = \frac{ZM}{a^3 N_A}$$

10. Any departure from perfectly ordered arrangement of atoms or ions in crystals is called imperfection or defects. These are of two types:

(a) Point defects (b) Line defects

11. **Schottky defects** occurs when a pair of ions of opposite charge, i.e., cations and anions are missing from the ideal lattice. The presence of a large number of schottky defects lowers the density of a crystal, e.g., AgBr.

12. The atoms or ions which occupy the normally vacant interstitial sites in a crystal are known as interstitials. It results in increase in density of crystal.

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13. Frenkel defects is a combination of schottky defects and interstitials. It occurs when an ion leaves its position in the lattice and occupies an interstitial site leaving a gap in the crystal.

14. Non-stoichiometric defects are a large number of inorganic solids in which the ratio of the number of atoms of one kind to the number of atoms of the other kind does not correspond to the ideal whole number ratio. Such compounds are called non-stoichiometric compounds.

15. When there is an excess of metal ions in non-stoichiometric compounds, the crystal lattice has vacant anion sites. These sites are occupied by electrons. The anion sites occupied by electrons are called **F-centres**.

16. Based on their electrical conductivity, solids are classified as:

- (a) Conductors
- (b) Insulators
- (c) Semi conductors

17. Pure substances that show conducting behaviour like that of silicon and germanium are called intrinsic semiconductors.

18. When solid substances are placed in a magnetic field, they do not show the same behaviour. Depending on their response to magnetic field, the substances are classified as:

(a) Diamagnetic substances:

(i) These substances are weakly repelled by a magnetic field.

(ii) The electrons are paired.

(b) Paramagnetic substances:

(i) These substances are weakly attracted by the magnetic field.

(ii) These substances have permanent magnetic dipoles due to the presence of atoms, molecules or ions containing unpaired electrons.

19. Substances having unpaired electrons are classified as:

(a) Ferromagnetic substances ↑↑↑↑↑↑↑↑

(b) Antiferromagnetic substances ↑↓↑↓↑↓↑↓

(c) Ferrimagnetic substances ↑↑↓↑↑↓↑↓