# Chemistry Study Materials for Class 12
# (NCERT Based Key Points of Chapter- 01)

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## The Solid State

1. HCP and CCP have equal efficiency *i.e.,* 74% of space is occupied and coordination number is 12. CCP arrangement has FCC lattice.
2. Coordination number is the number of nearest neighbouring points surrounding a particular lattice point (point may be atom, ions or molecules).
3. Packing efficiency in simple cubic unit cell is 52.4%, in bcc arrangement is 68% and in fcc is 74%.
4. Unoccupied spaces in solids are called interstitial voids or interstitial sites.
5. Two types of interstitial voids are :

   **(i)** tetrahedral void

   **(ii)** octahedral void

   * No. of tetrahedral voids = 2 x N

     (where N is number of closed packed particles).

   * No. of octahedral voids = N.
6. Valency defect lowers the density of a crystal.
7. Interstitial defect increases the density of a crystal.
8. Point defects in the ionic crystal may be classified as :

   **(i)** Stoichiometric defect also known as intrinsic or thermodynamic defect. Ratio of cations and anions is the same in defective crystal as in ideal crystal.

   **(ii)** In non-stoichiometric defect ratio of cations to anions is the difference in defective crystal from the ideal crystal.

   **(iii)** Impurity defect (due to presence of some other ions at the lattice sites).
9. Schottky defect arises due to missing of equal number of cations and anions from lattice sites in the crystalline solid of the type $A^+B^-$ and it lowers and density of alkali metal halides, *e.g.,* NaCl, KCl etc.

10. Frenkel defect is the combination of vacancy and interstitial defects. Cations leave their actual lattice sites and occupy the interstitial space in the solid. Density remains the same in Frenkel defect.

+AgBr is the compound which shows both Schottky defect as well as Frenkel defect.

11. Non-stoichiometric defect

**(i)** Metal excess defect due to anion vacancies.

**(ii)** Metal excess defect due to presence of extra cations.

**(iii)** Metal deficiency due to absence of cations.

12. **F-Center :** In metal excess defect, electrons are trapped in the anion vacancies which act as colour centres, *e.g.,* NaCl gives yellow colour when heated in sodium vapour.

13. Doping is the process of increasing the conductivity of intrinsic semiconductors by adding an appropriate amount of suitable impurity in Si or Ge.

* **n-type semiconductors :** Silicon or Germanium (group 14) doped with electron rich impurity (group 15 element like P or As). Here, conductivity is due to the extra electrons or delocalized electrons.

* **p-type semiconductors :** Silicon or Germanium (group 14) doped with group 13 elements like B or Al. Here, conductivity is due to positively charged electron holes.

* 13-15 group compounds, *e.g.,* InSb, AlP, GaAs.

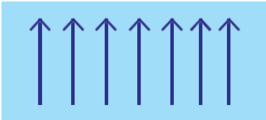
* 12-16 group compounds, *e.g.,* ZnS, CdS, CdSe, HgTe.

* These compounds have average valence of four and are used in semiconductor devices.

**14. Magnetic Properties**

* **Ferromagnetic substances :** A few substances like iron, cobalt, nickel and $CrO_2$ etc. are attracted very strongly by a magnetic field. Such substances are called ferromagnetic substances.

All molecular domains are arranged permanently in the same direction under influence of magnetic field.



* **Antiferromagnetism :** Substances like MnO showing antiferromagnetism have domain structure similar to ferromagnetism substances, but their domains are oppositely oriented and cancel out each other's magnetic moment and so cannot be attracted towards magnet.

* **Ferrimagnetism :** When the magnetic moments of the domains in the substances are aligned in parallel and anti parallel directions in unequal number.

These are weakly attracted by magnetic field as compared to ferromagnetic substances. For example, $Fe_3O_4$, $MgF_2O_4$ etc.

* Paramagnetic substances are weakly attracted by a magnetic field. Examples are $O_2$, $Cu^{2+}$, $Fe^{3+}$, $Cr^{3+}$ which are paramagnetic due to the presence of unpaired one or more electrons. They lose their magnetism in the absence of magnetic field.

* Diamagnetic substances are weakly repelled by a magnetic field. Examples are $H_2O$, NaCl, $C_6H_6$ because they have all the electrons paired.

## 1. Calculation of number of particles/atoms/ions in a unit cell :

| Type of unit cell | Number of particles per unit cell | Relationship between edge length ($a$) and radius ($r$) of atom/ion |
|---|---|---|
| Simple cubic (SC) | 1 | $a = 2r$ |
| Body centred cubic (BCC) | 2 | $a = \frac{4}{\sqrt{3}} r$ |
| Face centred cubic (FCC) | 4 | $a = 2\sqrt{2}r$ |

**2. Density of unit cell :**

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

where Z is rank of unit cell (number of atoms per unit cell), M is molar mass/ atomic mass, *a* is edge length of the cube, $a^3$ is volume of cubic unit cell and N A is Avogadro constant.

$$PE = \frac{Z \times \frac{4}{3}\pi r^3}{a^3} \times 100$$

**3. Packing efficiency,**

Here, M is molar mass, *r* is radius of atom, *d* is density and $N_A$ is Avogadro's constant ($6.022 \times 10^{23}$ $mol^{-1}$).

Rank of unit cell can be computed by packing efficiency value :

| Type of unit cell | Packing efficiency | Rank of unit cell (Z) |
|---|---|---|
| SC | 52.4 % | 1 |
| BCC | 68% | 2 |
| FCC | 74% | 4 |

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