Toppersnotes
Unleash the topper in you

CBSE

CLASS 12

CHEMISTRY

VOLUME- I

SIERRA INNOVATIONS
Private Limited

Contents

SOLID STATE

Solid are of two types:-

(1) amorphous (2) crystalline.

Property	Crystalline Solids	Amorphous solids
shape	Definite characteristic geometrical shape	Irregular shape
Melting pt	Melt at a sharp & characteristics temp.	gradually softens over a range of temp.
cleavage property	when cut with a sharp edge or tool, they split into pieces and new planes are smooth	when they are cut they split into irregular pieces.
Heat of fusion	They have characteristics heat of fusion	They do not have heat of fusion
Anisotropy	Anisotropic nature	Isotropic nature
Order of arrangement	Long range Order.	Only short range Order
Nature	True solid	Pseudo solid

ANISOTROPIC:-

They are those in which some of the physical properties like electric resistance, R.I shows diff properties in different directⁿ in the same crystals.

crystalline solids are senitropic because they have regular arrangement of particles. so, practical may differ from particles laying in other direct.

ISOTROPIC :-

They are those in which physical prop. have same value along all direct. Amorphous have no long ordered arrangement, so these are isotropic.

Ques:- Same glass from an ancient monuments are found to ue milky why?

Ans. Amorpheus solids becomes crystalline at some temp. Since glass in amosphous, its crystallisatic takes place to some extend during long period which make them milky.

Ques:- glass fired to old windows are tricker at bottom and tunner at top. why?

sol: Like liquids amorphous solids have

tendency to flow but way slowly. Hence glass flows from upper part to the down under the action of gravity, making it thicker.

Ques: Name amorphous solid used in photo Voltaic cell?

Ans. amorphous silicon is used to convert sunlight into electricity, so it is called protoveltaic material.

★ TYPES OF SOLIDS :-

1. Molecular solid
2. Ionic solid
3. Metallic solid
4. Covallent or Network solid.

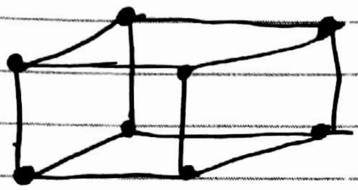
Types of solid	Constituent Particles	Bonding/Attra. Ex positive forces	Physical Nature	Electric conductivity	M.P.
1. Molecular					
(i). Non polar	Molecules	Dispersion or Ar, kcl, Tendor force H_2, I_2, CO_2	Soft	Insulator	Very low.
(ii) Polar		Dipole - Dipole HCl SO_2 interations	soft	Insulator	low.
(iii) Hydrogen bonded		Hydrogen, H_2O bonding (ice)	Hard	Insulator is solid conductor	low.

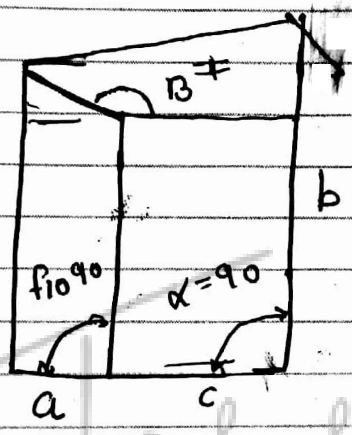
2. Ionic state	Ions	calombic or electrostatic force. NaCl, Mg, ZnS, CaF2,	Hard & brittle	Insulator in solid and conductor in liquid	High
3. Metallic solids	+ve ions in a sea of delocalised e⁻	Metallic Bonding Fe, Cu, Ag, Mg	Hard but Metallic and ductile	conductor solid & liquid Insulator	fairly high
4. Covalent or network Solids	Atoms	covalent bonding	SiO_2 (quartz) Si, c (diamond) AlN (graphite) Hard, soft	Exceptions Conductor	Very high.

★ **LATTICE** :-
The three dimensional arrangement of particles is called latice - Each particles of lattices is called lattice point - The small arrangement of lattice point which on repetition generates complete latice is called unit cell.

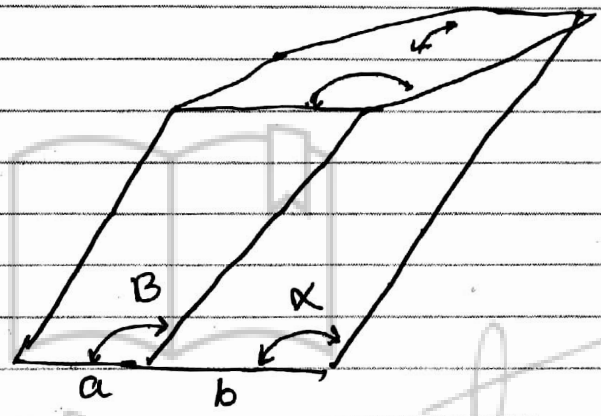
⇛ **Types of Unit Cell** :-

(1). Primitive or simple cubic - In this unit cell, One particle is present at each corner.



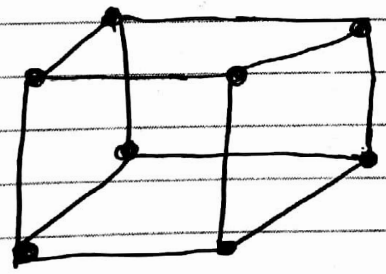


Monoclinic

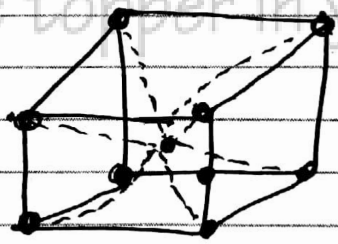


Triclinic

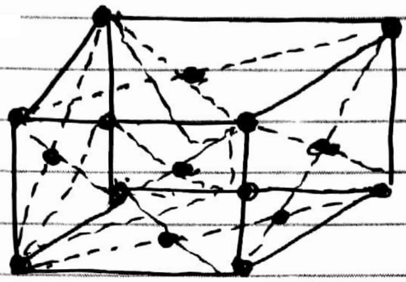
★ seven types of unit cells:



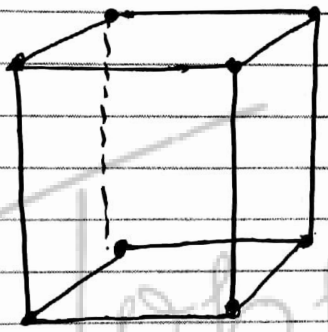
Primitive (or simple)



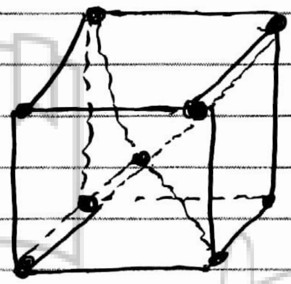
Body centered



The three cubic lattices - all side of same length angles b/w are faces 90°.

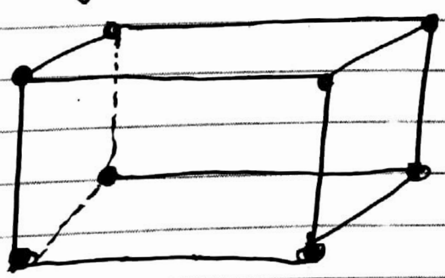


Primitive

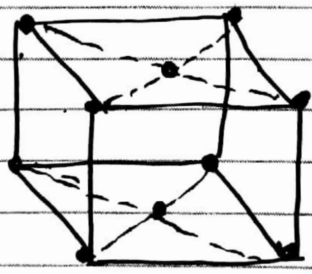


Body centered.

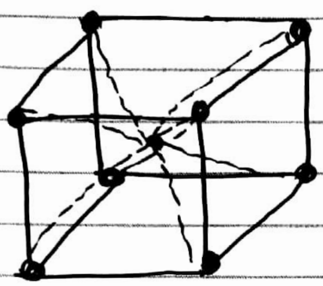
The two tetragonals latties - one side different in length to the osher two angles b/w faces 40°



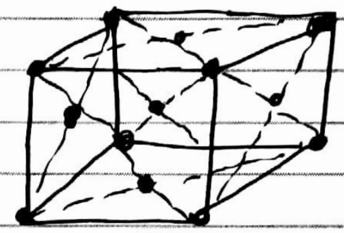
Primitive



End centered.

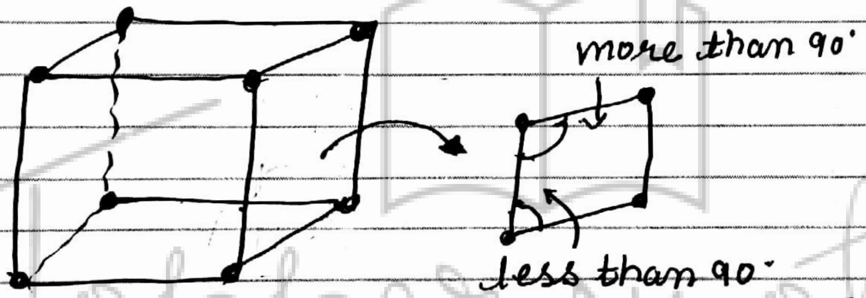


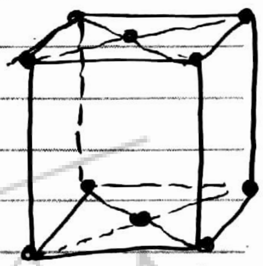
Body centered



Face centered.

4 orthorhombic lattices = unequal sides, angle b/w faces all 90°





End Centered

The two monoclinic lattics : unequal sides two faces have angles different point 90°

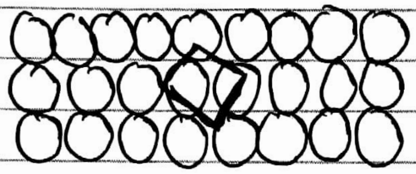
CLOSE PACKING IN ONE DIMENSION

In one dimension, particles can be packed by arranging them in a row.

co-ordination no. = 2

CLOSE PACKING IN TWO DIMENSION

(1). square closed packing - There is arrangement of sphere in Verticle as well as horizontal rows, Efficitively is 52.4%.



co-ordination no-4.

CLOSED PACKING IN THREE (3) DIMENSION :-

(1). Square closed :→ Square closed packing of 2 dimension is repeated 1 over the other. to form the lattics. In this simple cubic unit cell in present.
All layers are same, this arrangement is called 'AAA' arrangement.

(2). Hexgonal called packing: spheres of first layer are arrangeds in HCP and spheres of IInd layer lie of the depression of Ist layer.

The spheres of IIIrd layer above IInd layer.

in such a manner that I^{st} and III^{rd} layers spheres coinside.
Hence I^{st} and III^{rd} layers are same
Similarly, II^{nd} & IV^{th} layer are same.

If I^{st} layer is 'A', II^{nd} is B. then third is A and packing is called ABAB--- of hexagonal closed packing.
Efficiency is 74% co-ordination no. = 12
unit cell = Hexagonal.

CUBIC CLOSED PACKING:-

First and second layers are same, as in HCP but spheres of third layer lies over the voids, which are present in both I^{st} & II^{nd} layer both. Hence, third layer is different. this is called ABC, ABC closed packing or cubic closed packing, co-ordination no. 12. Efficiency - 74% unit cell - FCC

INTERSTITIAL VOIDS:-

space remained occupied by solid particles is called Industrial void. It is of fall. types:-

(1) cubic Void:- It is present in simple cubic structure AAA. It is surrounded by 8 shapes.

(2) Tetrahedral Void:- In H.C.P, sphere in second layer is placed over 3 sphere of 1st layer. The space among these four layers touching each other is called tetrahedral Void. It is surrounded by 4 spheres.

(3) ~~Octho~~ Octahedral Void:- In CCP (ABC) all the voids of Ist layer are not Occupied by the spheres of IInd layer of layer. so there is void which is in Ist as well as IInd layer, It is surrounded by 6 particles.

No. of Octahedral voids are equal to no. of spheres, but no. of tetrahedral Void is double.

★ <u>Position of Voids</u>:-

In FCC tetrahedral Voids are at body digonals. Each body diagonal contains and two tetrahedral Voids.

As there are 4 body diagonals. so, tetrahedral Voids are 8.

No. of sphere in FCC is only 4, hence, No. of tetrahedral voids is double the no. of sphere.

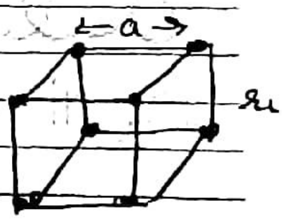
Octahedral Voids are at each H also at body centre. 12H Voids make theme Complete voids. Now including body centre Voids, there are 4 voids.

In FCC, 4 spheres are there and 4 voids are present i.e. there are equal no. of Voids and spheres.

CALCULATION OF EFFICIENCY OF VARIOUS UNIT CELLS -

(1) simple cubic - Let us consider unit cell with edge length 'a' and radius of sphere 'r' then it ~~called~~ will be 2r because all 4 corner spheres touch each other.

$a = 2r$



Vol of unit cell = $(\text{edge})^3$

$= a^3$

$= (2r)^3 = 8r^3$

Volume occupied by sphere = Vol. of 1 sphere × no. of Sphere

$= \frac{4}{3}\pi r^3 \times 1 = \frac{4}{3}\pi r^3$

Efficiency = $\frac{\text{Vol. Occupied}}{\text{Total Volume}} \times 100 = \frac{\frac{4}{3}\pi r^3 \times 100}{8 r^3}$

$= 52.4\%$

★ [let us consider a unit cell with edge length 'a' and radius of sphere 'r' each will 2r because all convers spheres touch each other] r

(2). Body centered (BCC) - Let us consider a BCC having edge 'a' and radius is r. The sphere at body centre will touch above and below sourcirs sphere such that body diagonal consists of 4r

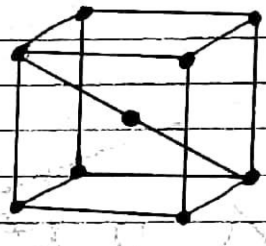
Body diagonal = $\sqrt{3}a$ --- (i)

Body diagonal = 4r --- (ii)

From (i) & (ii)

$\sqrt{3}a = 4r$

$a = \frac{4}{\sqrt{3}} r$ --- (iii)



Vol. of unit cell = a^3

$= \left(\frac{4r}{\sqrt{3}}\right)^3 = \frac{64r^3}{3\sqrt{3}}$

Vol occupied by sphere = Vol. of 1 sphere × No. of sphere

$= \frac{4}{3}\pi r^3 \times 2 = \frac{8\pi r^3}{3}$

Efficiency = $\frac{\text{Vol. Occupied}}{\text{Total Vol.}} \times 100$

$= \frac{3\pi r^3/3}{64r^3/3\sqrt{3}} \times 100 = 68\%$

3. Face centered (FCC) - let us consider FCC having edge length 'a' and radius 'r'. Here face centered particles will touch 4 corner particle but corner particles will not touch each other. Hence, face diagnols will consists of:

Face diagonal $= \sqrt{2}a$ ---(i)

Face diagonal $= 4r$ --- (ii)

From (i) & (ii)

$$\sqrt{2}a = 4r$$

$$a = 4r/\sqrt{2}$$

Vol. of unit cell $= a^3$

$$= \left(4r/\sqrt{2}\right)^3 = 64r^3/2\sqrt{2}$$

Vol. occupied by sphere = Vol. of 1 sphere X No. of sphere

$$= \frac{4}{3}\pi r^3 \times 4 = \frac{16}{3}\pi r^3$$

$$\text{Efficiency} = \frac{\text{Vol. Occupied}}{\text{Total vol.}} \times 100$$

$$= \frac{16\pi r^3/3}{\frac{64r^3}{2\sqrt{2}}} = \frac{16 \times 2\sqrt{2}\,\pi}{3 \times 64} = \frac{\pi}{3\sqrt{2}}$$

$$3 \times 2\sqrt{2}$$

Relation B/w Edge of Cube, Radius of Sphere and Distance B/w Nearest Neighbour.

(1). Simple cube :→ In this all four corner spheres are in contact with each others so the edge will be twice the radius of shere.

Edge = $a = 2r$ ∴ $\boxed{a = 2r}$

(2) FCC → In this all four corner sphere are touch each other, so the edges will be 4 times in radius, If edge then diagonal Face diagonal by $\sqrt{2}a$

— " — $= 4r$

$\sqrt{2}a = 4r$

$\sqrt{2}a = 4r$

$a = 4r/\sqrt{2} \times \sqrt{2}/\sqrt{2} = 2\sqrt{2}\,r$.

Nearest neighbour = $d = \frac{1}{2} \times$ diagonal

$= \frac{1}{2} \times \sqrt{2}a = \sqrt{2}a/2$

Moreover = $d = 2r$

(3). Body centered : (BCC) :— In this body sphere touches corner sphere. hence, body sphere & corner spheres.

will be nearest neighbour.

Body diagonal = $\sqrt{3}a$ $\qquad$ $\sqrt{3}a = 4r$

$\quad$ —11— $= 4r$ $\qquad$ $a = 4r/\sqrt{3}$

Nearest neighbour = $d = \frac{1}{2} \times$ body diagonal

$= \frac{1}{2} \times \sqrt{3}a = \sqrt{3}/2\, a$

Moreover = $d = 2r$

It is the ratio of radius of Void so the radius of sphere. In ionic compound it is ratio of

6.) Tetrahedral voids - It is surrounded by 4 spheres, hence, its co-Ordination no. is 4. Radius Ratio is 0.225, If size of tetrahedral void increases, it leads to opening of structure and resuts in Octahedral void.