Spacing of Planes : —

The distance between successive lattice Planes of the same type is called the Spacing of Planes or Inter-Planer distance between the planes.

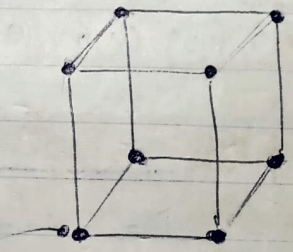
The Crystal belonging to Cubic System have three kinds of Bravais lattices, depending upon the shape of the unit cells.

These are.

(1) **Simple Cubic lattices : —** (Cubic - P - lattices).

When one unit is situated only at each corner of the Cubic cell. It is called a simple cubic lattice, as shown in fig.

In this case



(d_{100}) is the length of the face or 1, If the cube is of unit length.

(d_{110}) is equal to half diagonal of a face or $\frac{\sqrt{2}}{2}$ or $1/\sqrt{2}$

(d_{111}) is equal to one third of the diagonal of cube i.e $\frac{\sqrt{3}}{3}$ or $\frac{1}{\sqrt{3}}$

So, the ratio between these distances is given by.

$$d_{100} : d_{110} : d_{111} :: 1 : 1/\sqrt{2} : 1/\sqrt{3}$$

or $$\frac{1}{d_{100}} : \frac{1}{d_{110}} : \frac{1}{d_{111}} = 1 : \sqrt{2} : \sqrt{3}$$

(2) **Face Centred Cubic lattice or Cubic I - lattices : —**

When one unit is situated at each corner and one at the centre of each of the faces, then it is known as face centred cubic lattices.

In this case

d_{100} is same as the Simple Cubic lattices i.e 1

d_{110} is also same as the Simple Cubic lattice i.e $1/\sqrt{2}$

but d_{111} is double the value of d_{111} of the Simple Cubic lattice i.e $2/\sqrt{3}$

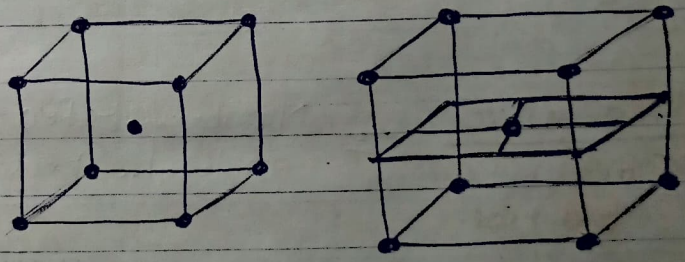
$\therefore d_{100} : d_{110} : d_{111} = 1 : 1/\sqrt{2} : 2/\sqrt{3}$

$= 1 : .707 : 1.154$

or, $\frac{1}{d_{100}} : \frac{1}{d_{110}} : \frac{1}{d_{111}} = 1 : \sqrt{2} : \sqrt{3}/2$

(iii) **One body Centred Cubic lattices :—**

In a body Centred Cubic lattices, One unit is situated at each Corner and One at the Centre of the Cube, as shown in fig.



In this Case.

d_{100} is same as in Simple Cubic lattice i.e 1

d_{110} is double as the value of d_{110} in Simple Cubic lattice $2/\sqrt{2}$ i.e $2/\sqrt{2} \times \sqrt{2}$

d_{111} is same as in Simple Cubic lattice i.e. $1/\sqrt{3}$

$\therefore d_{100} : d_{110} : d_{111} = 1 : 2/\sqrt{2} : 1/\sqrt{3}$

$= 1 : \sqrt{2} : 1/\sqrt{3}$

or $1/d_{100} : 1/d_{110} : 1/d_{111} = 1 : 1/\sqrt{2} : \sqrt{3}$.

Example:- Iron II Oxide, FeO, crystal has a cubic structure and each edge of the unit cell is $5.0\,A^0$. Taking density of the oxide as 4 gr per cc. Calculate the Number of Fe^{++} and O_2^{-2} ions present in each unit cell.

∵ Edge of the unit cell $= 5A^0 = 5\times10^{-8}$ cm

Volume of the unit cell $= (5\times10^{-8}\text{ cm})^3$

$= 125\times10^{-24}$ cc $= 1.25\times10^{-22}$ cc

∵ density of FeO = 4 gr. per cc.

$d = \frac{M}{V}$ ∴ Mass of unit cell = Density × Volume

$= 1.25\times10^{-22}\times4$

$= 5.00\times10^{-22}$

$= 5\times10^{-22}$ gr.

∴ Mass of FeO (one molecule) $= \frac{\text{Molecular wt}}{\text{Avogadro Number}}$

$= \frac{72}{6.023\times10^{23}} = 1.195\times10^{-22}$ gr

$\frac{\text{Mass of unit cell}}{\text{Mass of one molecule of unit cell.}}$ ∴ Number of FeO molecules per unit cell $= \frac{5\times10^{-22}}{1.195\times10^{-22}}$

$= \frac{5}{1.196} = 4.19 = 4$

Hence, there are Four (Fe^{++}) ions and Four (O^{--}) ions in Each unit Cell.