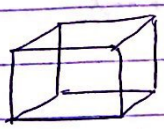
Chapter 3:- Atomic and Ionic Arrangements

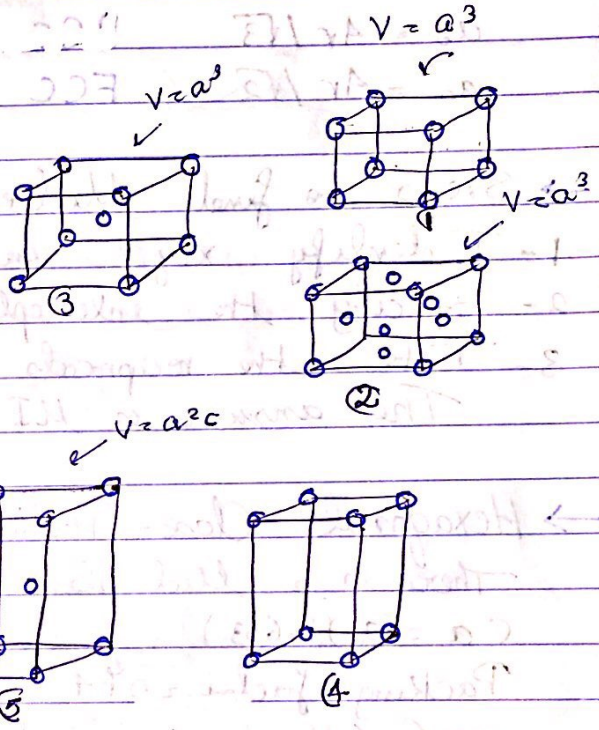
Unit Cell



→ Crystalline materials = Long and Short Range Order

→ Types of Bravais lattices:-

1- Simple Cubic
2- Face Centered Cubic
3- Body Centered Cubic
4- Simple tetragonal
5- Body Centered tetragonal
6- Hexagonal : $V = a^2 C \cos 30$



→ Number of lattice Points in Cubic Crystal Sys:-

SC = 1
BCC = 2
FCC = 4

• The rule: $\frac{\text{lattice Point}}{\text{corner}} \times \frac{\text{corner}}{\text{cell}}$

→ Packing Factor :-

$= \left(\frac{\text{\# of Atoms}}{\text{cell}}\right)\left(\frac{\text{V of each atom}}{}\right) / \left(\text{volume of U.C} \rightarrow (a_0)^3\right)$

cut into 2D and collect atoms

largest value of Packing factor = 0.71

→ Density (ρ) = $\frac{(\text{\# of atoms / cell})(\text{atomic mass})}{(\text{V. of unit cell})(\text{Av number})}$

→ For each arrangement The relation between r and (a_o) is:- (a_o) ↓ lattice parameter

$a_o = 2r$ S.C

$a_o = 4r/\sqrt{3}$ BCC

$a_o = 4r/\sqrt{2}$ FCC

→ Steps to find Miller indices :-

1- Identify x, y, z intercepts

2- Specify the intercepts fractional Coordinals ↓ specified in ① (x/a , y/b , z/c)

3- Take the reciprocals for frac. Coo

The answer is MI

The Cube it self

→ Hexagonal Close-Packed :

There is a Mid plane with three atoms

$c_{o} = (a)(1.633)$

Packing factor = 0.74

n = 6 (Number of atoms)

→ Crystal Structure of ionic materials :-

- ensure electrical neutrality
- Ions of different sizes should be packed effecently.
- Anions are placed at the normal sites.
- Cations are placed at one or more of intersitial sites

Note:- Correction Factor

- Bragg's law:- X-Ray diffraction

integer → $n\lambda = 2d \sin\theta$

λ → the wave length of x-ray length

d → distance between atomic layers