Crystal Structure :-

Structure of metals -

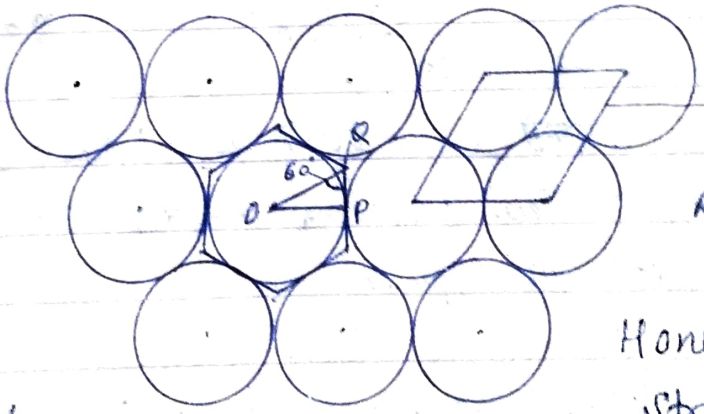
As Metallic bonds are non-directional, each metal atom in a crystal tends to surround itself with as many neighbours as possible. for minimizing the pot. energy.

Approximation for metal atom

1. Spherical atom
2. Hard & incompressible
3. Non-directional bonds.

To consider some of the ways that spheres can be packed together in 3-D arrays.

first consider the arrangement of spheres in a plane



unit cell
~~Rhombohe-~~ dral
Rhombus

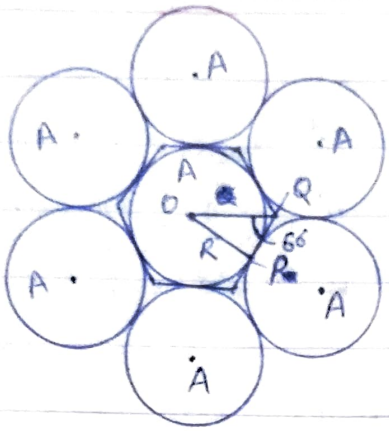
this is the array in which max" available space is occupied.

This array is called hexagonal ~~closed~~ closest-packed layer or simply closest-packed layer

Honey-comb Structure

no. of nearest neighbours = 6

$$\text{packing fraction} = \frac{\text{Volume Occupied}}{\text{Volume Available}}$$



$$\tan 60 = \frac{R}{PQ}$$

$$PQ = \frac{R}{\tan 60} = \frac{R}{\sqrt{3}}$$

$$\text{Area } \Delta POQ = \frac{1}{2} \cdot R \cdot \frac{R}{\sqrt{3}} = \frac{R^2}{2\sqrt{3}}$$

$$\text{Packing fraction} = \frac{\text{Area of circle}}{\text{Area of Hexagonal}}$$

$$\text{Area of Hexagonal} = 12 \times \frac{R^2}{2\sqrt{3}} = 2\sqrt{3}R^2$$

$$\text{Area of circle} = \pi R^2$$

$$\therefore P.f = \frac{\pi R^2}{2\sqrt{3}R^2} = \frac{\pi}{2\sqrt{3}} = .907$$

$= 90.7\%$ Space occupied

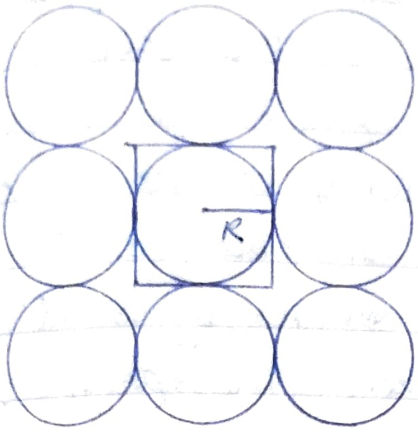
ie. the circles occupy max^m 90.7% of available space.

the unit cell of the plane lattice of this array is shown in fig.

$a = b \quad \gamma = 120^\circ$ Rhombus

~~Rhombohedral~~

each unit cell contains two void spaces, B & C the three alternative placements of spheres can be distinguished, namely A, B or C each of which results in a ~~closed~~ closest-packed layers of spheres



Packing fraction

$$= \frac{\text{Area of circle}}{\text{Area of square}}$$

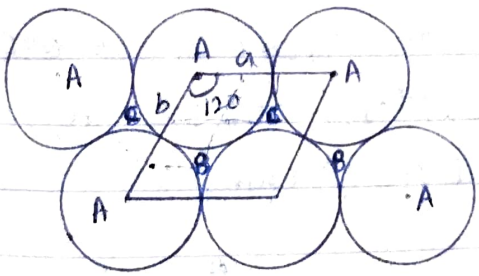
$$= \frac{\pi R^2}{4R^2} = \frac{\pi}{4}$$

$$= 0.785$$

$$= 78.5\% \text{ space occupied.}$$

nearest neighbour 4.

In square lattice unit cell - square.



Center	A	0	0
center	B	$\frac{1}{3}$	$\frac{2}{3}$
Center	C	$\frac{2}{3}$	$\frac{1}{3}$

B layer displaced by

$$\frac{1}{3}\bar{a} + \frac{2}{3}\bar{b}$$

C layer displaced by

$$\frac{2}{3}\bar{a} + \frac{1}{3}\bar{b}$$