Problem 01:

Show that for cubic lattice, the latice constant a is given by $a = \left(\frac{nM}{\rho N_A}\right)^{1/3}$, *where n is number of lattice points per unit cell, M is gm molecular weight of the molecules at lattice points,* ρ *is the density of crystal and* N_A *is Avogadro's number.*

Solution:

We have

$$\text{Density } (\rho) = \frac{\text{Mass of Unit Cell}}{\text{Volume of Unit Cell}}$$

$$= \frac{\text{Number of lattices per unit cell} \times \text{Mass of one molecule}}{a^3}$$

$$= \frac{n \times \text{Mass of one molecule}}{a^3}$$

$$= \frac{n \times \frac{M}{N_A}}{a^3}$$

$$= \frac{nM}{a^3 N_A}$$

$$\therefore a = \left(\frac{nM}{\rho N_A}\right)^{1/3}$$

Problem: 02

Molybdenum has the ***bcc*** *crystal structure, a density of* $10 gm\ cm^{-3}$, *and an atomic mass of* $95.94 gm\ mol^{-1}$. *What is atomic concentraion, lattice parameter a and atomic radius of molybdenum?*

Hint:

- Find a using *Problem 01*.
- For *bcc* crystal structure, $4r = \sqrt{3}a$. This gives r.
- *atomic concentration* $= Number\ of\ atoms\ in\ unit\ cell / Volume\ of\ unit\ cell = \boxed{6.41 \times 10^{28} atoms/m^3}$

Problem 03:

Calculate the number of atoms per unit cell of a metal having lattice parameter of 2.9Å *and density of* $7.87 gm/cc$. *Atomic weight of the metal is* $55.85 gm/mol$ *and* $N_A = 6.023 \times 10^{23} per\ mol$.

Hint:

- Same as above.