

UNIT I: NUMERICALS

- Q1. A substance with face-centered cubic lattice has density 6250 kg/m^3 and molecular weight 60.2. Calculate the lattice constant a and the atomic radius r . Given Avogadro number $N = 6.02 \times 10^{26} (\text{kg.mole})^{-1}$.

Hints: $[a = \left(\frac{nM}{N\rho}\right)^{1/3}, a = \frac{4R}{\sqrt{2}}]$

[Ans: $a = 4 \times 10^{-10} \text{ m}$, $r = 1.414 \times 10^{-10} \text{ m}$].

- Q2. NaCl crystals have an *fcc* crystal structure. The density of NaCl is $2.18 \times 10^3 \text{ kg/m}^3$, the atomic weight of Na is 23 and that of Cl is 35.5. Find the lattice constant. Given Avogadro number $N = 6.02 \times 10^{23} \text{ mole}^{-1}$.

Hints: $a = \left(\frac{nM}{N\rho}\right)^{1/3}$

[Ans: 5.63 \AA].

- Q3. Assuming that the lattice points of lattice parameter a in a *bcc* structure are occupied by spherical atoms of radius r , calculate the free volume per unit cell.

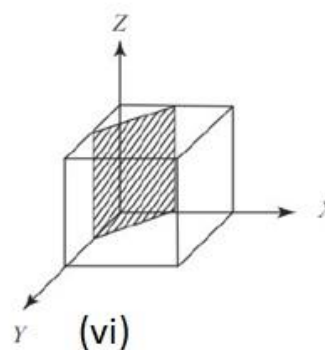
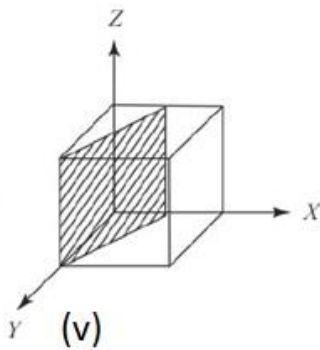
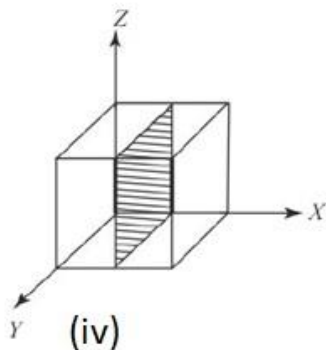
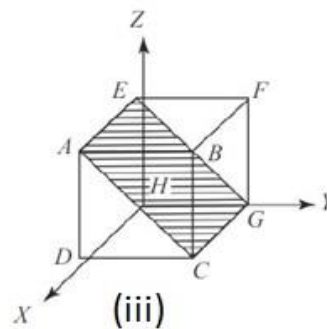
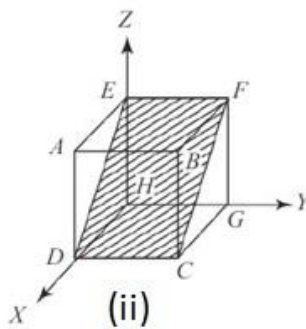
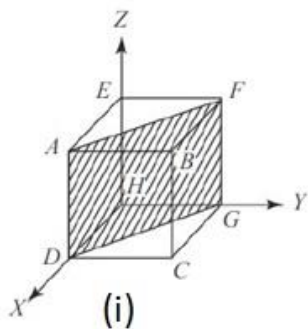
Hints: $a = 4r/\sqrt{3}$

[Ans: $a^3[1 - \frac{\pi\sqrt{3}}{8}]$].

- Q4. Cs metal (atomic weight 130) has a cubic unit cell of side 6 \AA . If the density of Cs is 2 g/cm^3 , determine whether the unit cell is simple, face centered or body centered.

[Ans: BCC].

- Q5. Find the Miller indices of the following shaded planes



Q6. Calculate the spacing between (1 0 0) and (1 1 1) planes of a cubic system of lattice parameter a .
[Ans: a , $a/\sqrt{3}$].

Q7. Draw the planes having miller indices (121), (231), (120), (030), (103).

Q8. Draw the directions $[1\ 2\ 3]$, $[0\ 1\ 2]$.

Q9. The inter-planar spacing of $[1\ 1\ 0]$ plane is 2 \AA for a FCC crystal. Find the atomic radius.

Hints: $[d = \frac{a}{\sqrt{h^2+k^2+l^2}}, a = \frac{4R}{\sqrt{2}}]$ [Ans: $r = 1\text{ \AA}$].

Q10. Find the perpendicular distance between the two planes indicated by the Miller indices (1 2 1) and (2 1 2) in a unit cell of a cubic lattice with a lattice constant parameter ' a '.

Hints: $d_1 = \frac{a}{\sqrt{h^2+k^2+l^2}}$; $d_2 = \frac{a}{\sqrt{h^2+k^2+l^2}}$; $d = d_1 - d_2$ [Ans: 0.0749 \AA].

Q 11. Aluminium is an *fcc* crystal with lattice constant $a = 0.405\text{ nm}$. Calculate the number of unit cells present in an aluminium foil of 0.005 cm thickness and two sides of 25 cm length.

[Ans. 4.7041×10^{22}].