**CHAPTER I: NUMERICALS**

Q1. A substance with face-centered cubic lattice has density 6250 kg/m3 and molecular weight 60.2. Calculate the lattice constant a and the atomic radius r. Given Avogadro number N = 6.02 x 1026 (kg.mole)-1.

Formulas: [a = a = ] **[Ans: a = 4 x 10-10 m, r = 1.414 x 10-10 m].**

Q2. CsCl crystals have simple cubic structure. The atomic weight of Cs is 132.9 and that of Cl is 35.5. If the lattice constant of CsCl is 4.12 Å, determine its density. Given Avogadro number N = 6.02 x 1026 (kg.mole)-1 .

Formula: a = **[Ans: 3.997 x 103 kg/m3].**

Q3. Urbium (Ub) is an upscale element found in large cities. Its unit cell is cubic. Using the values of its molar volume and lattice constant, determine the crystal structure of Ub.

DATA: molar volume, *V*mol = 9.41 cm3/mol, lattice constant, *a* = 3.15 Å.

Formula: a = **[Ans: BCC].**

Q4. An element has atomic mass 120 and BCC structure. Density of the element is 5.2 gm/cm3. Calculate the number of unit cells in 20 gm.

Formulas: [a = , Density = Mass/Volume]. **[Ans: 5.02 x 1022].**

Q5. An element whose atomic mass is 100 has a bcc structure. Its unit cell parameter is 4 Å, calculate the density of the element, the number of unit cells and the number of atoms in 10 gm of the element.

Formulas:[ a = ,

Density = Mass/Volume, No. of unit cells = Vol. of the element/ Vol. of unit cell, No. of atoms in the element = (No. of atoms/unit cell) x No. of unit cells].

**[Ans: 5188 kg/m3; 3 x 1022 unit cells; 6 x 1022 atoms].**

Q6. An element crystallizes into fcc structure with its unit cell parameter as 2 Å. Calculate its density if 0.2 kg of the element contains 24 x 1023 atoms.

Formulas: [ No. of unit cells = Vol. of the element/ Vol. of unit cell,

Volume of the substance = No. of unit cells x Vol. of the unit cell,

Density = Mass/Volume]. **[Ans: 4.17 x 104 kg/m3].**

Q7. Draw the planes having miller indices (121), (231), (120), (030), (103), (1 ), ( 1).

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

Q.9 A sample of BCC chromium (Cr) is analyzed by x-ray diffraction using copper Kα radiation for which λKα = 1.5418 Å. Determine the Miller indices of the plane from which the angle of reflection, θ, is 31.4º. The lattice constant of Cr, a, is 2.96 Å. Report your answer in the form (hkl).

Formulas: d =  **[Ans: (hkl) = (002)].**

Q10. The interplanar spacing of [1 1 0] plane is 2 Å for a FCC crystal. Find the atomic radius.

Formulas: [d = , a = ] **[Ans: r = 1 Å].**

Q11. 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’.

Formulas: [d1 = ; d2 = ; d = d1 - d2] **[ Ans: 0.0749 Å].**

Q12. Calculate θ for cubic crystal λ=1.54 Å, **a**=5Å for (100) reflection.

Formula: 2d sin θ = nλ].

**[Ans. n=1, θ=8.86o; n=2,θ=17.93o; n=3, θ=27.52o; n=4, θ=38.02o; n=5, θ=50.35o; n=6, θ=67.52o].**