

**CLASS –XII**  
**CHEMISTRY - SOLID STATE**

Q.1 Iron has body centered cubic lattice structure. The edge length of the unit cell is found to be 286 pm. What is the radius of an iron atom?

Q.2 Cesium chloride forms a body centered cubic lattice. Cesium and chloride ions are in contact along the body diagonal of the unit cell. The length of the side of the unit cell is 412 pm and  $\text{Cl}^-$  ion packed has a radius of 181 pm. Calculate the radius of  $\text{Cs}^+$  ion.

Q.3 In a cubic closed structure of mixed oxides the lattice is made up of oxide ions, one eighth of tetrahedral voids are occupied by divalent ions ( $\text{A}^{2+}$ ) while one half of the octahedral voids are occupied by trivalent ions ( $\text{B}^{3+}$ ). What is the formula of the oxide?

Q.4 A solid  $\text{A}^+$  and  $\text{B}^-$  had NaCl type closed packed structure. If the anion has a radius of 250 pm, what should be the ideal radius of the cation? Can a cation  $\text{C}^+$  having a radius of 180 pm be slipped into the tetrahedral site of the crystal of  $\text{A}^+\text{B}^-$ ? Give reasons for your answer.

Q.5 Calculate the value of Avogadro's number from the following data: Density of NaCl =  $2.165 \text{ g cm}^{-3}$ . Distance between  $\text{Na}^+$  and  $\text{Cl}^-$  in NaCl = 281 pm.

Q.6 If the radius of  $\text{Mg}^{2+}$  ion,  $\text{Cs}^+$  ion,  $\text{O}^{2-}$  ion,  $\text{S}^{2-}$  ion and  $\text{Cl}^-$  ion are 0.65 Å, 1.69 Å, 1.40 Å, 1.84 Å, and 1.81 Å respectively. Calculate the co-ordination numbers of the cations in the crystals of MgS, MgO and CsCl.

Q.7 Iron occurs as bcc as well as fcc unit cell. If the effective radius of an atom of iron is 124 pm. Compute the density of iron in both these structures.

Q.8 KCl crystallizes in the same type of lattice as does NaCl. Given that

$r_{\text{Na}^+}/r_{\text{Cl}^-} = 0.5$  and  $r_{\text{K}^+}/r_{\text{Cl}^-} = 0.7$  Calculate: The ratio of the sides of unit cell for KCl to that of NaCl.

Q.9 An element A (Atomic weight = 100 u) having bcc structure has unit cell edge length 400 pm. Calculate the density of A and number of unit cells and number of atoms in 10 gm of A.

Q.10 Prove that the void space percentage in zinc blende structure is 25%.

Q.11 A unit cell of sodium chloride has four formula units. The edge length of the unit cell is 0.564 nm. What is the density of sodium chloride.

Q.12 In a cubic crystal of CsCl (density =  $3.97 \text{ gm/cm}^3$ ) the eight corners are occupied by  $\text{Cl}^-$  ions with  $\text{Cs}^+$  ion at the centre. Calculate the distance between the neighboring  $\text{Cs}^+$  and  $\text{Cl}^-$  ions.

Q.13 KF has NaCl structure. What is the distance between  $\text{K}^+$  and  $\text{F}^-$  in KF if density of KF is  $2.48 \text{ gm/cm}^3$

Q.14 The composition of a sample of wustite is  $\text{Fe}_{0.93}\text{O}_{1.0}$  What percentage of iron is present in the form of Fe(III)?

Q.15 BaTiO<sub>3</sub> crystallizes in the perovskite structure. This structure may be described as a cubic lattice with barium ions occupying the corner of the unit cell, oxide ions occupying the face-centers and titanium ion occupying the center of the unit cell.

- (a) If titanium is described as occupying holes in BaO lattice, what type of holes does it occupy?
- (b) What fraction of this type hole does it occupy?

Q.16 RbI crystallizes in bcc structure in which each Rb<sup>+</sup> is surrounded by eight iodide ions each of radius 2.17 Å. Find the length of one side of RbI unit cell.

Q.17 If NaCl is doped with 10<sup>-3</sup> mol % SrCl<sub>2</sub>, what is the numbers of cation vacancies?

Q.18 Find the size of largest sphere that will fit in octahedral void in an ideal FCC crystal as a function of atomic radius 'r'. The insertion of this sphere into void does not distort the FCC lattice. Calculate the packing fraction of FCC lattice when all the octahedral voids are filled by this sphere.

Q.19 A cubic unit cell contains manganese ions at the corners and fluoride ions at the center of each edge.

- (a) What is the empirical formula of the compound?
- (b) What is the co-ordination number of the Mn ion?
- (c) Calculate the edge length of the unit cell, if the radius of Mn ion is 0.65 Å and that of F<sup>-</sup> ion is 1.36 Å.

Q.20 NaH crystallizes in the same structure as that of NaCl. The edge length of the cubic unit cell of NaH is 4.88 Å.

- (a) Calculate the ionic radius of H<sup>-</sup>, provided the ionic radius of Na<sup>+</sup> is 0.95 Å.
- (b) Calculate the density of NaH.