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SOLID STATE XII (CHEMISTRY) CHAPTER - 1

Numericals

1. Predict the structure of the MgO crystal and the coordination number of its cation. The cation radius and the anion radius are 65 pm and 140 pm respectively.
2. A solid A^+B^- has an NaCl-type close-packed structure. If the anion has a radius of 241.5 pm, what should be the minimum radius of the cation? Can a cation C^+, with a radius of 50 pm, be fitted into the tetrahedral hole of the crystal A^+B^-?
3. In the compound AX, the radius of the A^+ ion is 95 pm and that of the X^- ion is 181 pm. Predict the crystal structure of AX and write the coordination number of each of the ions.
4. Predict the type of coordination in the following compounds using Paulings radius ratio rules. Also state the coordination number of the cation in each of them.

S. No.	Compound	Ionic radii	
		r^+ (cation)	r^- (anion)
(i)	BeO	27	135
(ii)	LiBr	59	196
(iii)	MgO	58	135
(iv)	TiO_2	60	135
(v)	CaF_2	100	128

5. What are the coordination numbers of each of the ions present in the cubic close-packed structure of Na_2O at ordinary temperature and pressure.
6. What are the coordination numbers of each of the ions in the cubic close-packed structure of CaF_2 at ordinary temperature and pressure.
7. Polonium has a simple cubic structure. Its density is 9.27 g cm^{-3}. What is the length of the edge of its unit cell in picometres? Atomic mass of Po = 210.
8. Barium crystallises in a bcc structure. Find its density if the edge length of its unit cell is 512 pm. Atomic mass of Ba = 138.
9. Molybdenum has a bcc structure. Calculate its atomic mass if its density is 10.3 g cm^{-3} and the edge length of its unit cell is 314 pm.
10. Barium metal has a bcc structure. Its density is 3.5 g cm^{-3}. Calculate the radius of the Ba atom if its atomic mass is 138.

    [**Hint:** In a bcc structure $a = \frac{4}{\sqrt{3}}r$.]
11. Aluminium has an fcc structure. Its density is 2.70 g cm^{-3} and its atomic radius is 148.5 pm. Find the volume of its unit cell and hence its atomic mass.
12. Sodium metal crystallises in a bcc structure. Its unit cell edge length is 420 pm. Calculate its atomic radius.
13. Diamond, which has an fcc structure, has a density of 3.51 g cm^{-3}. What is the dimension of its unit cell?
14. Silicon, which crystallises in an fcc structure, has a unit cell dimension of 542 pm. Calculate its density. Atomic mass of Si = 28.
15. Aluminium has an fcc structure. Its density is 2.7 g cm^{-3}. Find the distance between two aluminium atoms. Atomic mass of Al = 27.

    [**Hint:** Distance between two atoms is simply the edge length of a unit cell.]
16. Iron crystallises in an fcc structure. If the radius of the Fe atom is 1.26 Å, determine the length of its unit cell; also calculate its density. Atomic mass of Fe = 56.
17. Barium crystallises in a bcc structure. If the atomic radius of barium is 94 pm, find its density. Atomic mass of barium = 10.8.
18. A solid AB has structure similar to that of NaCl. If the radius of the cation A^+ is 170 pm, calculate the maximum possible value of the radius of the anion B^-.

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19. The ionic radii of Na^+ and Cl^- ions in NaCl are 102 and 181 pm respectively. Assuming close contact of Na^+ and Cl^- ions, calculate the edge length of a unit cell of NaCl.
20. The edge length of a unit cell of caesium chloride (CsCl) is 405.3 pm. Calculate the ionic radius of Cs^+ given that the ionic radius of the Cl^- ion is 181 pm. Molar mass of CsCl = 168.4 g mol^{-1}.
21. The edge length of a fluorite unit cell (Ca^{2+} ions form an fcc structure) is found to be 456 pm. Find the ionic radius of the Ca^{2+} ion if that of F^- is 128 pm.
22. The ionic radii of Ca^{2+} and F^- ions are 100 pm and 128 pm respectively. What will be the edge length of a unit cell of fluorite? Calculate its density. The atomic masses of Ca and F are 40 and 19 respectively.
23. MgO crystallises in an fcc structure. The radius of the Mg^{2+} ion is 58 pm and that of the O^{2-} ion is 135 pm. Find the edge length of a unit cell of MgO. Also calculate the Avogadro constant if the density of MgO is 4.65 g cm^{-3} and molar mass of MgO is 40.3 g.
24. The density of TlI (tellurium iodide) is 3.15 g cm^{-3}. It is known to form a bcc structure. Find the molar mass of TlI if the ionic radii of Tl^+ and I^- are 140 pm and 212 pm respectively.

Multiple-Choice Questions

1. Bonding in diamond is
   (a) covalent (b) ionic (c) dipole (d) metallic
2. During the formation of a solid,
   (a) some energy is lost
   (b) some energy is gained
   (c) energy remains constant
   (d) some energy may be gained or lost depending on the system
3. Tetrahedral bonding is characteristic of
   (a) ionic bonds (b) molecular bonds (c) metallic bonds (d) covalent bonds
4. Ionic solids have
   (a) a low melting point (b) a moderate melting point
   (c) a high melting point (d) none of these
5. The bond between ice moecules is
   (a) ionic (b) covalent (c) a hydrogen (d) metallic
6. Among the following, the strongest bond is the
   (a) ionic bond (b) hydrogen bond (c) metallic bond (d) covalent bond
7. Ionic bonds are mainly formed in
   (a) inorganic compounds (b) metals (c) organic compounds (d) none of these
8. Molecular solids have
   (a) very low melting points (b) very high melting points
   (c) fairly low melting points (d) none of these
9. Metallic solids are generally
   (a) hard and brittle (b) malleable and ductile
   (c) soft and plastically deformable (d) none of these
10. Among the following, the element which has a covalently bonded crystal structure is
    (a) Al (b) Pb (c) Ge (d) Bi
11. Materials having different properties along different directions are called
    (a) isotropic (b) anisotropic (c) amorphous (d) none of these
12. The tiny fundamental block which, when repeated in space indefinitely, generates a crystal is called
    (a) a primitive cell (b) a lattice (c) a unit cell (d) none of these
13. How many basic crystal systems are possible?
    (a) Four (b) Five (c) Six (d) Seven