Chapter 15

Solid State

1. Which is the incorrect statement?
(a) Density decreases in case of crystals with Schottky defect.
(b) $NaCl_{(s)}$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.
(c) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.
(d) $FeO_{0.98}$ has non-stoichiometric metal deficiency defect. *(NEET 2017)*

2. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are
(a) 4 and 2 (b) 6 and 6
(c) 8 and 4 (d) 4 and 8
(NEET-II 2016)

3. Lithium has a *bcc* structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculate the edge length of a unit cell of lithium metal. ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(a) 527 pm (b) 264 pm
(c) 154 pm (d) 352 pm
(NEET-I 2016)

4. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in *AB* is
(a) 8 (b) 2
(c) 6 (d) 4 *(NEET-I 2016)*

5. The vacant space in *bcc* lattice unit cell is
(a) 48% (b) 23%
(c) 32% (d) 26% *(2015)*

6. The correct statement regarding defects in crystalline solids is
(a) Frenkel defects decrease the density of crystalline solids
(b) Frenkel defect is a dislocation defect
(c) Frenkel defect is found in halides of alkaline metals
(d) Schottky defects have no effect on the density of crystalline solids. *(2015)*

7. A given metal crystallises out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?
(a) 80 pm (b) 108 pm
(c) 40 pm (d) 127 pm
(2015, Cancelled)

8. If *a* is the length of the side of a cube, the distance between the body centered atom and one corner atom in the cube will be
(a) $\frac{2}{\sqrt{3}}a$ (b) $\frac{4}{\sqrt{3}}a$
(c) $\frac{\sqrt{3}}{4}a$ (d) $\frac{\sqrt{3}}{2}a$ *(2014)*

9. A metal has a *fcc* lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72 g cm^{-3}. The molar mass of the metal is
(N_A Avogadro's constant = 6.02×10^{23} mol^{-1})
(a) 27 g mol^{-1} (b) 20 g mol^{-1}
(c) 40 g mol^{-1} (d) 30 g mol^{-1}
(NEET 2013)

10. The number of carbon atoms per unit cell of diamond unit cell is
(a) 6 (b) 1
(c) 4 (d) 8 *(NEET 2013)*

11. A metal crystallises with a face-centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is
(a) 288 pm (b) 408 pm
(c) 144 pm (d) 204 pm *(2012)*

12. The number of octahedral void(s) per atom present in a cubic close-packed structure is
(a) 1 (b) 3
(c) 2 (d) 4 *(2012)*

13. Structure of a mixed oxide is cubic close packed (*ccp*). The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal *A* and the octahedral voids are occupied by a monovalent metal *B*. The formula of the oxide is
(a) ABO_2 (b) A_2BO_2
(c) $A_2B_3O_4$ (d) AB_2O_2
(Mains 2012)

14. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be
(a) 275.1 pm (b) 322.5 pm
(c) 241.5 pm (d) 165.7 pm
(Mains 2011)

15. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is
(a) 335 pm (b) 250 pm
(c) 200 pm (d) 300 pm *(2010)*

16. Lithium metal crystallises in a body-centred cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of lithium will be
(a) 151.8 pm (b) 75.5 pm
(c) 300.5 pm (d) 240.8 pm *(2009)*

17. Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm?
(a) 157 (b) 181
(c) 108 (d) 128 *(2009)*

18. Percentage of free space in a body centred cubic unit cell is
(a) 34% (b) 28%
(c) 30% (d) 32% *(2008)*

19. Which of the following statements is not correct?
(a) The number of carbon atoms in a unit cell of diamond is 4.
(b) The number of Bravais lattices in which a crystal can be categorized is 14.
(c) The fraction of the total volume occupied by the atoms in a primitive cell is 0.48.
(d) Molecular solids are generally volatile.
(2008)

20. With which one of the following elements silicon should be doped so as to give p-type of semiconductor?
(a) Selenium (b) Boron
(c) Germanium (d) Arsenic *(2008)*

21. If a stands for the edge length of the cubic systems: simple cubic, body centred cubic and face centred cubic, then the ratio of radii of the spheres in these systems will be respectively
(a) $\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a$
(b) $1a : \sqrt{3}a : \sqrt{2}a$
(c) $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$
(d) $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$ *(2008)*

22. The fraction of total volume occupied by the atoms present in a simple cube is
(a) $\frac{\pi}{3\sqrt{2}}$ (b) $\frac{\pi}{4\sqrt{2}}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$ *(2007)*

23. If NaCl is doped with 10^{-4} mol % of $SrCl_2$, the concentration of cation vacancies will be ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(a) 6.02×10^{16} mol^{-1} (b) 6.02×10^{17} mol^{-1}
(c) 6.02×10^{14} mol^{-1} (d) 6.02×10^{15} mol^{-1}
(2007)

24. The appearance of colour in solid alkali metal halides is generally due to
(a) interstitial positions
(b) F-centres
(c) Schottky defect
(d) Frenkel defect. *(2006)*

25. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being 6.02×10^{23} mol^{-1}, the density of CsBr is
(a) 4.25 g/cm^3 (b) 42.5 g/cm^3
(c) 0.425 g/cm^3 (d) 8.25 g/cm^3
(2006)

26. In a face-centered cubic lattice, a unit cell is shared equally by how many unit cells?
(a) 2 (b) 4
(c) 6 (d) 8 *(2005)*

27. A compound formed by elements X and Y crystallises in a cubic structure in which the X atoms are at the corners of a cube and the Y atoms are at the face-centres. The formula of the compound is
(a) XY_3 (b) X_3Y
(c) XY (d) XY_2 *(2004)*

28. The pyknometric density of sodium chloride crystal is 2.165×10^3 kg m^{-3} while its X-ray density is 2.178×10^3 kg m^{-3}. The fraction of unoccupied sites in sodium chloride crystal is
(a) 5.96 (b) 5.96×10^{-2}
(c) 5.96×10^{-1} (d) 5.96×10^{-3}
(2003)

29. When Zn converts from melted state to its solid state, it has hcp structure, then find the number of nearest atoms.
(a) 6 (b) 8
(c) 12 (d) 4 *(2001)*

30. Cation and anion combines in a crystal to form following type of compound
(a) ionic (b) metallic
(c) covalent (d) dipole-dipole. *(2000)*

31. In cube of any crystal A-atom placed at every corners and B-atom placed at every centre of face. The formula of compound is
(a) AB (b) AB_3
(c) A_2B_2 (d) A_2B_3 *(2000)*

32. In crystals of which one of the following ionic compounds would you expect maximum distance between centres of cations and anions?
(a) CsI (b) CsF
(c) LiF (d) LiI *(1998)*

33. The second order Bragg diffraction of X-rays with $\lambda = 1.00$ Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystal is
(a) 2.00 Å (b) 1.00 Å
(c) 0.575 Å (d) 1.15 Å *(1998)*

34. The edge length of face centred unit cubic cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is
(a) 144 pm (b) 398 pm
(c) 288 pm (d) 618 pm *(1998)*

35. Schottky defect in crystals is observed when
(a) density of the crystal is increased
(b) unequal number of cations and anions are missing from the lattice
(c) an ion leaves its normal site and occupies an interstitial site
(d) equal number of cations and anions are missing from the lattice. *(1998)*

36. The high density of water compared to ice is due to
(a) dipole-induced dipole interactions
(b) induced dipole induced dipole interactions
(c) hydrogen bonding interactions
(d) dipole-dipole interactions. *(1997)*

37. For two ionic solids CaO and KI, identify the wrong statement among the following
(a) CaO has high melting point
(b) Lattice energy of CaO is much larger than that of KI
(c) KI has high melting point
(d) KI is soluble in benzene. *(1997)*

38. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
(a) face-centred cube (b) simple cube
(c) body-centred cube (d) none of these. *(1997)*

39. The *fcc* crystal contains how many atoms in each unit cell?
(a) 6 (b) 8
(c) 4 (d) 5 *(1996)*

40. If we mix a pentavalent impurity in a crystal lattice of germanium, what type of semiconductor formation will occur?
(a) n-type semiconductor
(b) p-type semiconductor
(c) both (a) and (b)
(d) None of these. *(1996)*

41. An element (atomic mass = 100 g/mol) having *bcc* structure has unit cell edge 400 pm. The density of element is
(a) 7.289 g/cm^3 (b) 2.144 g/cm^3
(c) 10.376 g/cm^3 (d) 5.188 g/cm^3 *(1996)*

42. The number of atoms in 100 g of a *fcc* crystal with density d = 10 g/cm^3 and cell edge equal to 100 pm, is equal to
(a) 2×10^{25} (b) 1×10^{25}
(c) 4×10^{25} (d) 3×10^{25} *(1994)*

43. Ionic solids, with Schottky defects, contain in their structure
(a) cation vacancies only
(b) cation vacancies and interstitial cations
(c) equal number of cation and anion vacancies
(d) anion vacancies and interstitial anions. *(1994)*

44. The pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. The behaviour is a characteristic of substance forming
(a) allotropic crystals
(b) liquid crystals
(c) isomeric crystals
(d) isomorphous crystals. *(1993)*

45. On doping Ge metal with a little of In or Ga, one gets
(a) p-type semiconductor
(b) n-type semiconductor
(c) insulator
(d) rectifier. *(1993)*

46. In the fluorite structure, the coordination number of Ca^{2+} ion is
(a) 4 (b) 6
(c) 8 (d) 3 *(1993)*

47. The number of atoms contained in a *fcc* unit cell of a monoatomic substance is
(a) 1 (b) 2
(c) 4 (d) 6 *(1993)*

48. For orthorhombic system axial ratios are $a \neq b \neq c$ and the axial angles are
(a) $\alpha = \beta = \gamma \neq 90^o$
(b) $\alpha = \beta = \gamma = 90^o$
(c) $\alpha = \gamma = 90^o$, $\beta \neq 90^o$
(d) $\alpha \neq \beta \neq \gamma \neq 90^o$ *(1991)*

49. Most crystals show good cleavage because their atoms, ions or molecules are
(a) weakly bonded together
(b) strongly bonded together
(c) spherically symmetrical
(d) arranged in planes. *(1991)*

Answer Key

1.	(c, d)	**2.**	(c)	**3.**	(d)	**4.**	(c)	**5.**	(c)	**6.**	(b)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(d)
11.	(a)	**12.**	(a)	**13.**	(d)	**14.**	(c)	**15.**	(a)	**16.**	(a)	**17.**	(d)	**18.**	(d)	**19.**	(c)	**20.**	(b)
21.	(c)	**22.**	(d)	**23.**	(b)	**24.**	(b)	**25.**	(a)	**26.**	(c)	**27.**	(a)	**28.**	(d)	**29.**	(c)	**30.**	(a)
31.	(b)	**32.**	(a)	**33.**	(d)	**34.**	(a)	**35.**	(d)	**36.**	(c)	**37.**	(d)	**38.**	(c)	**39.**	(c)	**40.**	(a)
41.	(d)	**42.**	(c)	**43.**	(c)	**44.**	(b)	**45.**	(a)	**46.**	(c)	**47.**	(c)	**48.**	(b)	**49.**	(d)		