EXERCISE-I (Conceptual Questions) Build Up Your Understanding

INTRODUCTION

1. $a \neq b \neq c$, $\alpha = \gamma = 90° \beta \neq 90°$ represents
(l) Tetragonal system (2) Orthorhombic system
(3) Monoclinic system (4) Triclinic system

2. The most symmetrical crystal system is :
(1) Cubic (2) Hexagonal (3) Triclinic (4) Orthorhombic

3. Bravais lattices are of
(1) 10 types (2) 8 types (3) 7 types (4) 14 types

4. The crystal system of a compound with unit cell dimensions a = 0.387, b = 0.387 and c = 0.504 nm and $\alpha = \beta = 90°$ and $\gamma = 120°$ is :
(1) Cubic (2) Hexagonal (3) Orthorhombic (4) Rhombohedric

ANALYSIS OF CUBIC CRYSTAL

5. In a simple cubic cell, each point on a corner is shared by
(1) 2unit cells (2) 1 unit cell (3) 8 unit cells (4) 4 unit cells

6. In a face centred cubic cell, an atom at the face contributes to the unit cell
(1) 1 part (2) 1/2 part (3) 1/4 part (4) 1/8 part

7. In a body centred cubic cell, an atom at the body centre is shared by
(1) 1 unit cell (2) 2 unit cell (3) 3 unit cells (4) 4 unit cells

8. Which of the following type of cubic lattice has maximum number of atoms per unit cell ?
(1) Simple cubic (2) Body centred cubic
(3) Face centred cubic (4) All have same

9. The number of atoms present in a unit cell of a monatomic element of a simple cubic lattice, body-centred cubic and face centred cubic respectively are
(1) 8, 9 and 14 (2) 1, 2 and 4
(3) 4, 5 and 16 (4) 2, 3 and 5

10. Which one of the following is a primitive unit cell?
(1) Simple cubic (2) BCC
(3) FCC (4) BCC and FCC both

11. In a body centred cubic unit cell, a metal atom at the centre of the cell is surrounded by how many other metal atoms :
(1) 8 (2) 6 (3) 12 (4) 4

12. A compound is formed by elements A and B. This crystallises in the cubic structure if when at the corners of the cubic and atoms B are at the centre of the body. The simplest formula of the compound is
(1) AB (2) AB_2 (3) A_2B (4) AB_4

13. A compound formed by elements A and B has cubic structure in which A atoms are at the corners of the cube and B atoms are at the face centres. The formula of the compound will be
(1) A_4B_3 (2) A_2B (3) AB_3 (4) A_2B_3

14. Sodium metal crystallises in BCC lattice with the cell edge length (a)= 42.29 A. What is the radius of sodium atom ?
(1) 1.86 Å (2) 1.90 Å (3) 18.3 Å (4) 1.12 Å

15. An element has BCC structure having unit cells 12.08×10^{23}. The number of atoms in these cells is
(1) 12.08×10^{23} (2) 24.16×10^{23}
(3) 48.38×10^{23} (4) 12.08×10^{22}

16. A metal has BCC structure and the edge length of its unit cell is 3.04Å. The volume of the unit cell in cm^3 will be
(1) 1.6×10^{-21} cm^3 (2) 2.81×10^{-23} cm^3
(3) 6.02×10^{-23} cm^3 (4) 6.6×10^{-24} cm^3

CRYSTAL DENSITY

17. An element having BCC geometry has atomic mass 50. Calculate the density of the unit cell, if its edge length is 290 pm.
(1) 6.81 g cm^{-3} (2) 3.40 g cm^{-3}
(3) 13.62 g cm^{-3} (4) 1.23 g cm^{-3}

18. A metal (atomic mass = 50) has a body centred cubic crystal structure. The density of metal is 5.96 g cm^{-3}. Find the volume of the unit cell.
(1) 13.9×10–24 cm^3 (2) 27.8×10^{-24} cm^3
(3) 6.95×10^{-24} cm^3 (4) 55.6×10^{-24} cm^3

19. An element crystallises in BCC structure. The edge length of its unit cell is 288 pm. If the density of the crystal is 7.2 g cm^{-3}, what is the atomic mass of the element?
(1) 51.8 (2) 103.6 (3) 25.9 (4) 207.2

20. An element; density 6.8 g cm^{-3} occurs in BCC structure with cell edge 290 pm. Calculate the number of atoms present in 200 g of the element.
(1) 2.4×10^{42} (2) 1.2×10^{42}
(3) 1.2×10^{24} (4) 2.4×10^{24}

21. An element A crystallises in fcc structure. 200 g of this element has 4.12×10^{24} atoms. The density of A is 7.2 g cm^{-3} Calculate the edge length of the unit cell.
(1) 26.97×10^{-24}cm (2) 299.9 pm
(3) $5\times1D^{-12}$cm (4) 2.99 cm

22. Density of U atom is 0.53 g cm^{-3}. The edge length of Li is 3.5Å. Find out the number, of Li atoms in an unit cell. ($N_A = 6.023\times10^{23}$), (M= 6.94 g mol^{-1})
(1) 2 (2) 8 (3) 4 (4) 6

CLOSE PACKING OF IDENTICAL SOLID SPHERES

23. The coordination number of hexagonal closest packed (HCP) structure is-
(1) 12 (2) 10 (3) 8 (4) 6

24. The ABAB close packing and ABC ABC close packing are respectively called as
(1) hexagonal close packing (hcp) and cubic close packing (ccp)
(2) ccp and hcp
(3) body centred cubic (bcc) packing and hexagonal close packing (hcp)
(4) hcp and bee

25. The space occupied in BCC arrangement is
(1) 74% (2) 70% (3) 68% (4) 60.4%

26. The vacant space in BCC unit cell is
(1) 32% (2) 10% (3) 23% (4) 46%

27. The space occupied by spheres of equal size in three dimensions in both HCP and CCP arrangement is
(1) 74% (2) 70% (3) 60.4% (4) 52.4%

28. The empty space in the HCP and CCP is about
(1) 26% (2) 30% (3) 35% (4) 40%

29. Which one of the following is not a close packing ?
(1) hcp (2) ccp (3) bcc (4) fcc

30. Close packing is maximum in the crystal lattice of
(1) Simple cubic (2) Face centred
(3) Body centred (4) Simple cubic and body centred

31. Which of the following has HCP structure?
(1) Al (2) Mg (3) Cu (4) Ni

32. All noble gases crystallise in the CCP structure except.
(1) Helium (2) Neon (3) Argon (4) Krypton

33. If the coordination number· of an element in its crystal lattice is 8, then packing is:
(1) FCC (2) HCP (3) BCC (4) None of the above

HOLES/VOIDS IN CRYSTALS

34. A tetrahedral void in a crystal implies that
(1) shape of the void is tetrahedral
(2) molecules forming the void are tetrahedral in shape
(3) the void is 'surrounded tetrahedrally by four spheres
(4) the void is surrounded by six spheres

35. In a closest packed lattice, the number of octahedral sites as compared to tetrahedral ones will be
(1) Equal (2) Half (3) Doll (4) One fourth

36. The coordination' number of a cation occupying an octahedral hole is
(1) 4 (2) 6 (3) 8 (4) 12

37. The size of an octahedral void formed in a closest packed lattice as compared to, tetrahedral void is
(1) Equal (2) Smaller (3) Larger (4) Not definite

38. The coordination number of a cation occupying a tetrahedral hole is
(1) 4 (2) 6 (3) 8 (4) 12

39. Number of tetrahedral voids, per atom in a Crystal lattice is :-
(1) 1 (2) 2 (3) 4 (4) 8

40. A compound contains P and Q elements. Atoms Q are in CCP arrangement while P occupy all tetrahedral sites. Formula of compound is :
(1) PQ (2) PQ_2 (3) P_2Q (4) P_3Q

41. If 'Z' is the number of atoms in the unit cell that represents the closest packing sequence ABCABC---, the number of tetrahedral voids in the unit cell is equal to
(1) Z (2) 2Z (3) Z/2 (4) Z/4

IONIC CRYSTAL

42. The limiting radius ratio for tetrahedral shape is
(1) 0 to 0.155 (2) 0.155 to 0.225
(3) 0.225 to 0.414 (4) 0.414 to 0.732

43. For an octahedral arrangement the lowest radius ratio limit is
(1) 0.155 (2) 0.732 (3) 0.414 (4) 0.225

44. If the radius ratio is in the range of 0.414 – 0.732 then the co-ordination number will be :
(1) 2 (2) 4 (3) 6 (4) 8

45. In NaCl crystal r^+/r^- ratio is:
(1) 0.4 (2) 0.98 (3) 1.0 (4) 0.52

46. Which one of the following statements is incorrect about rock salt type ?
(1) It has fcc arrangement of Na^+
(2) Na^+ and CI-ions have a co-ordination number of 6: 6
(3) A unit cell of NaCl consists of four NaCl units
(4) All halides of alkali metals have rock-salt type structure

47. In sodium chloride, Cl^- ions form ccp arrangement. Which site does Na^+ ions will occupy in this structure?
(1) Cubic (2) Tetragonal
(3) Octahedral (4) Trigonal bipyramidal

48. The positions of Cl^- ions in NaCl structure are
(1) Corners of the cube
(2) Centres of faces of the cube
(3) Corners as well as centres of the faces of the cube
(4) Edge centres of the cube

49. The number of NaCl units present in a unit cell of NaCl ae:
(1) 1 (2) 2 (3) 4 (4) 8

50. The tetrahedral voids formed by ccp arrangement of Cl^- ions in rock salt structure are
(1) Occupied by Na^+ ions
(2) Occupied by Cl^- ions
(3) Occupied by either Na^+ or Cl^- ions
(4) Vacant.

51. The structure of MgO is similar to NaCl. The co-ordination number of Mg is
(1) 2 (2) 6 (3) 4 (4) 8

52. The co-ordination number of Cs^+ and Cl^- ions in CsCl structure is
(1) 4 : 4 (2) 6 : 6 (3) 8 : 8 (4) 4 : 8

53. A unit cell of CsCl consists of
(1) one CsCl unit (2) two CsCl units
(3) four CsCl units (4) eight CsCl units

54. The NaCl structure can be converted into CsCl structure
(1) by application of high pressure (2) by heating to 760 K
(3) both by heat and pressure (4) the conversion is not possible

55. TlCl has structure similar to CsCl. The co-ordination number of Tl^+ is-
(1) 4 (2) 6 (3) 10 (4) 8

56. The co-ordination number of Zn^{2+} and S^{2-} ions in the zinc blende (ZnS) type structure is
(1) 4 : 4 (2) 6 : 6 (3) 8 : 8 (4) 4 : 8

57. The co-ordination number of calcium fluoride (CaF_2) type structure is
(1) 1 : 2 (2) 4 : 4 (3) 4 : 8 (4) 8 : 4

58. The number of formula units in an unit cell of fluorite is
(1) 2 (2) 4 (3) 6 (4) 8

59. 4 : 4 Co-ordination is found in
(1) ZnS (2) CuCl (3) AgI (4) All

60. Antifluorite structure is derived from fluorite structure by
(1) Heating fluorite crystal lattice.
(2) Subjecting fluorite structure to high pressure.

(3) Interchangipg the positions of positive and negative ions in the lattice.
(4) All of the above

61. A binary solid (A^+B^-) has a zinc blend structure with B^- ions constituting the lattice and A^+ ions occupying 25% tetrahedral holes. The formula of solid is.
(1) AB (2) A_2B (3) AB_2 (4) AB_4

62. The radius of Na^+ is 95 pm and that of Cl^- ion is 181 pm. Hence the co-ordination number of Na^+ will be
(1) 4 (2) 6 (3) 8 (4) 12

63. The ionic radii of Rb^+ and I^- are 1.46 and 2.16Å respectively. The most probable type of structure exhibited by it is
(1) CsCl type (2) NaCl type (3) ZnS type (4) CaF_2 type

64. A binary solid (A^+B^-) has a rock salt structure if the edge length is 400 pm and radius of cation (A^+) is 75 pm, the radius of anion (B^-) is
(1)100 pm (2) 125 pm (3) 250 pm (4) 325 pm

65. A solid XY has a bcc structure. If the distance of closest approach between the two ions is 173 pm, the edge length of the cell is
(l) 200 pm (2) $\frac{\sqrt{3}}{\sqrt{2}}$ pm (3) 142.2 pm (4) $\sqrt{2}$ pm

66. If the distance between Na^+ and Cl^- ions in NaCl crystal is 'a' pm, what is the length of the cell edge?
(1) 2a pm (2) a/2 pm (3) 4a pm (4) a/4 pm

67. Potassium fluoride has $NaCl^-$ type structure. What is the distance between K^+ and F^- ions if it's cell edge length is 'a' cm ?
(1) 2a cm (2) a/2 cm (3) 4a cm (4) a/4 cm

68. KF has NaCl structure. What is the distance between K^+ and F^- in KF if density is 2.48 g cm^{-3}?
(1) 268.8 pm (2) 537.5 pm (3) 155.3×10^{-24} cm (4) 5.375 cm

69. In a NaCl type crystal distance between Na^+ and Cl^- ion is 2.814Å and the density of solid is 2.167 g cm^{-3} then find out the value of Avogadro constant.
(1) 6.05×10^{23} (2) 3.02×10^{23} (3) 12.10×10^{23} (4) 9.6×10^{24}

70. The density of crystalline sodium chloride is 5.85 g cm^{-3}. What is the edge length of the unit cell.
(1) 4.06×10^{-8} cm. (2) 1.32×10^{-14} cm (3) 7.8×10^{-23}cm (4) $9.6\times l0^{-24}$cm

71. A unit cell of sodium chloride has four formula units. The edge length of unit cell is 0.6 nm. What is the density of sodium chloride ?
(1) 7.60 g cm^{-3} (2) 1.80 g cm^{-3} (3) 9.60 g cm^{-3} (4) 6.38 g cm^{-3}

IMPERFECTIONS IN SOLIDS

72. At zero kelvin, most of the ionic crystals posses
(1) Frenkel defect (2) Schottky defect
(3) Metal excess defect (4) No defect

73. As a result of Schottky defect
(1) there is no effect on the density (2) density of the crystal increases
(3) density of the crystal decreases (4) any of the above three can happen

74. Schottky as well as frenkel defects are observed in the crystal of
(1) NaCl (2) AgBr (3) AgCl (4) $MgCl_2$

75. Which one of the following is correct?
(1) Schottky defect lowers the density
(2) Frenkel defect increases the dielectric constant of the crystals
(3) Stoichiometric defects make the crystals good electrical conductors
(4) All the three

76. Frenkel defect is generally observed in
(1) AgBr (2) AgI (3) Zn (4) All of these

77. Frenkel defect is found in crystals in which the radius ratio is :
(1) low (2) 1.3 (3) 1.5 (4) slightly less than unity

78. F-centres in an ionic crystal are
(1) lattice sites containing electrons (2) interstitial sites containing electrons
(3) lattice sites that are vacant (4) interstitial sites containing cations

79. The correct statement regarding F-centre is
(1) Electrons are held in the lattice site of crystals
(2) F-centre imparts colour to the crystal
(3) Conductivity of the Crystal increases due to F-centre
(4) All the three above

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(3)	**2.**	(3)	**3.**	(4)	**4.**	(2)	**5.**	(3)	**6.**	(2)	**7.**	(1)
8.	(3)	**9.**	(2)	**10.**	(1)	**11.**	(1)	**12.**	(1)	**13.**	(3)	**14.**	(3)
15.	(2)	**16.**	(2)	**17.**	(1)	**18.**	(2)	**19.**	(1)	**20.**	(4)	**21.**	(2)
22.	(1)	**23.**	(1)	**24.**	(1)	**25.**	(3)	**26.**	(1)	**27.**	(1)	**28.**	(1)
29.	(3)	**30.**	(2)	**31.**	(2)	**32.**	(1)	**33.**	(3)	**34.**	(3)	**35.**	(2)
36.	(2)	**37.**	(3)	**38.**	(1)	**39.**	(2)	**40.**	(3)	**41.**	(2)	**42.**	(3)
43.	(3)	**44.**	(3)	**45.**	(4)	**46.**	(4)	**47.**	(3)	**48.**	(3)	**49.**	(3)
50.	(4)	**51.**	(2)	**52.**	(3)	**53.**	(1)	**54.**	(1)	**55.**	(4)	**56.**	(1)
57.	(4)	**58.**	(2)	**59.**	(4)	**60.**	(3)	**61.**	(3)	**62.**	(2)	**63.**	(2)
64.	(2)	**65.**	(1)	**66.**	(1)	**67.**	(2)	**68.**	(1)	**69.**	(1)	**70.**	(1)
71.	(2)	**72.**	(4)	**73.**	(3)	**74.**	(2)	**75.**	(4)	**76.**	(4)	**77.**	(1)
78.	(1)	**79.**	(4)										