15

THE SOLID STATE

MCQs with One Correct Answer

1. The pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. This behaviour is a characteristic property of substance forming.

(a) Allotropic (b) Liquid
(c) Isomeric (d) Isomorphous

2. Which of crystal systems contains the maximum number of Bravais lattices?

(a) Cubic
(b) Hexagonal
(c) Triclinic
(d) Orthorhombic

3. How many unit cells are present in a cube-shaped ideal crystal of NaCl of mass 1.00 g ? [Atomic masses : Na = 23, Cl = 35.5]

(a) 5.14×10^{21} unit cells
(b) 1.28×10^{21} unit cells
(c) 1.71×10^{21} unit cells
(d) 2.57×10^{21} unit cells

4. The second order Bragg diffraction of X-rays with = 1.00 Å from a set of parallel planes in a metal occurs at an angle 60º. The distance between the scattering planes in the crystal is

(a) 0.575 Å
(b) 1.00 Å
(c) 2.00 Å
(d) 1.15 Å

5. A compound is formed by elements A and B. The crystalline cubic structure has the A atoms at the corners of the cube and B atoms at the body centre. The simplest formula of the compound is

(a) AB (b) A_6B
(c) AB_6 (d) A_8B_4

6. Total volume of atoms present in a face-centred cubic unit cell of a metal is (r is atomic radius)

(a) $\frac{12}{3}\pi r^3$ (b) $\frac{16}{3}\pi r^3$

(c) $\frac{20}{3}\pi r^3$ (d) $\frac{24}{3}\pi r^3$

7. If calcium crystallizes in bcc arrangement and the radius of Ca atom is 96 pm, then the volume of unit cell of Ca is
(a) $10.9 \times 10^{-36}\ m^3$
(b) $10.9 \times 10^{-30}\ m^3$
(c) $21.8 \times 10^{-30}\ m^3$
(d) $21.8 \times 10^{-36}\ m^3$

8. The number of unit cells in the Ca atom lies on the surface of a cubic crystal that is 1.0 cm in length is
(a) 9.17×10^{23}
(b) 9.17×10^{22}
(c) $2 \times 9.17 \times 10^{23}$
(d) $2 \times 9.17 \times 10^{22}$

9. The radii of Na^+ and Cl^- ions are 95 pm and 181 pm respectively. The edge length of NaCl unit cell is
(a) 276 pm (b) 138 pm
(c) 552 pm (d) 415 pm

10. An alloy of copper, silver and gold is found to have cubic lattice in which Cu atoms constitute *ccp*. If Ag atoms are located at the edge centres and Au atom is present at body centre, the alloy will have the formula
(a) CuAgAu
(b) Cu_4Ag_4Au
(c) Cu_4Ag_3Au
(d) Cu_4Ag_6Au

11. A solid is made of two elements X and Z. The atoms Z are in *ccp* arrangement while the atoms X occupy all the tetrahedral sites. What is the formula of the compound?
(a) XZ (b) XZ_2
(c) X_2Z (d) X_2Z_3

12. The pyknometric density of sodium chloride crystal is $2.165 \times 10^3\ kg\ m^{-3}$ while its X-ray density is $2.178 \times 10^3\ kg\ m^{-3}$. The fraction of unoccupied sites in sodium chloride crystal is
(a) 5.96×10^{-3}
(b) 5.96×10^{4}
(c) 5.96×10^{-2}
(d) 5.96×10^{-1}

13. The edge length of unit cell of a metal having molecular weight 75 g/mol is 5Å which crystallizes in cubic lattice. If the density is 2g/cc then find the radius of metal atom. ($N_A = 6 \times 10^{23}$). Give the answer in pm.
(a) 217 pm (b) 210 pm
(c) 220 pm (d) 205 pm

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

15. The cubic unit cell of a metal (molar mass = 63.55g mol^{-1}) has an edge length of 362 pm. Its density is 8.92g cm^{-3}.
The type of unit cell is
(a) primitive (b) face centered
(c) body centered (d) end centered

16. In A^+B^- ionic compound, radii of A^+ and B^- ions are 180 pm and 187 pm respectively. The crystal structure of this compound will be
(a) NaCl type (b) CsCl type
(c) ZnS type (d) similar to diamond

17. Which set of following characteristics for ZnS crystal is correct?
(a) Coordination number (4 : 4); *ccp*; Zn^{2+} ion in the alternate tetrahedral voids
(b) Coordination number (6 : 6); *hcp*; Zn^{2+} ion in all tetrahedral voids.
(c) Coordination number (6 : 4); *hcp*; Zn^{2+} ion in all octahedral voids
(d) Coordination number (4 : 4); *ccp*; Zn^{2+} ion in all tetrahedral voids.

18. In a normal spinel type structure , the oxide ions are arranged in *ccp* whereas 1/8 tetrahedral holes are occupied by Zn^{2+} ions and 50% of octahedral holes are occupied by Fe^{3+} ions .The formula of the compound is
(a) $Zn_2Fe_2O_4$ (b) $ZnFe_2O_3$
(c) $ZnFe_2O_4$ (d) $ZnFe_2O_2$

19. A molecule A_2B (Mwt. = 166.4) occupies triclinic lattice with a 5 Å, b = 8 Å, and c = 4 Å. If the density of AB_2 is 5.2 g cm^{-3}, the number of molecules present in one unit cell is
(a) 2 (b) 3
(c) 4 (d) 5

20. A mineral having the formula AB_2 crystallizes in ccp lattice with A atoms occupying the lattice points. Pick out the correct statements of the following
(a) 100% occupancy of tetrahedral voids, C.N. of B = 4
(b) 100% occupancy of octahedral voids, C.N. of B = 4
(c) 50% occupancy of tetrahedral voids, C.N. of A = 4
(d) 100% occupancy of octahedral voids, C.N. of A = 4

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

22. To get a *n*- type semiconductor, the impurity to be added to silicon should have which of the following number of valence electrons
(a) 1 (b) 2
(c) 3 (d) 5

23. Non stoichiometric defects are formed by
(a) *s*- block elements
(b) *p*-block elements
(c) either *s*-block elements or *d*-block elements
(d) only *d*-block elements.

24. 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}

25. In a solid lattice the cation has left a lattice site and is located at an interstitial position, the lattice defect is
(a) Interstitial defect (b) Vacancy defect
(c) Frenkel defect (d) Schottky defect

Numeric Value Answer

26. Pottasium has a *bcc* structure with nearest neighbour distance 4.52 Å. Its atomic weight is 39. Its density (in kg m^{-3}) will be

27. KCl crystallises in the same type of lattice as does NaCl. Given that $r_{Na^+} / r_{Cl^-} = 0.55$ and $r_{K^+} / r_{Cl^-} = 0.74$. Calculate the ratio of the edge length of the unit cell for KCl to that of NaCl.

28. 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})

29. The edge length of unit cell of a metal having molecular weight 75 g/mol is 5Å which crystallizes in cubic lattice. If the density is 2 g/cc and the radius of metal atom is 4.33 xpm. ($N_A = 6 \times 10^{23}$). Find the value of x.

30. In face centred cubic (fcc) crystal lattice, edge length is 400 pm. The diameter of greatest sphere is 29.29 d pm which can be fit into the interstitial void without distortion of lattice. Find the value of d.?

ANSWER KEY																			
1	(b)	**4**	(d)	**7**	(b)	**10**	(c)	**13**	(a)	**16**	(b)	**19**	(b)	**22**	(d)	**25**	(c)	**28**	(27)
2	(d)	**5**	(a)	**8**	(b)	**11**	(c)	**14**	(d)	**17**	(a)	**20**	(a)	**23**	(d)	**26**	(910)	**29**	(5)
3	(d)	**6**	(b)	**9**	(c)	**12**	(a)	**15**	(b)	**18**	(c)	**21**	(d)	**24**	(b)	**27**	(1.123)	**30**	(4)