CHEMISTRY

12th JEE

SOLID STATE

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THE SOLID STATE

DPP-1

[General Characteristics of Solid State]

1. A pure amorphous solid -
(A) contain well ordered spatial distribution of atoms, ions or molecules
(B) possess unique melting point
(C) does not contain any short range order; only long range order prevails
(D) is isotropic

2. Amorphous substances show-
(a) isotropic characteristics
(b) short range order
(c) long range order
(d) have no sharp melting point
(A) a and c are correct
(B) b and c are correct
(C) a, c and d are correct
(D) a, b and d are correct

3. Maximum number of Bravais lattices are possible for-
(A) cubic
(B) monoclinic
(C) orthorhombic
(D) hexagonal

4. The metallic solid among the following are-
NaCl(s), KCl(s), CO_2(s), Fe(s), Cu(s), SiC(s), K(s), Ca(s)
(A) Fe(s), Cu(s), K(s), Ca(s)
(B) NaCl(s), KCl(s)
(C) CO_2(s), Fe(s)
(D) SiC(s), K(s)

5. How many crystal systems have either a = b = c or $\alpha = \beta = \gamma = 90°$ (Cubic, Tetragonal, Orthorhombic, Monoclinic, Hexagonal, Rhombohedral, Triclinic)

6. A pure crystalline substance, on being heated gradually, first forms a turbid liquid at constant temperature and still at higher temperature, turbidity completely disappears. This behavior is the characteristic of substances forming-
(A) isomeric crystals
(B) liquid crystals
(C) isomorphous crystals
(D) allotropic crystals

7. Which of the following is/are pseudo solids?
I. KCl
II. Barium chloride dihydrate
III. Rubber
IV. Solid cake left after distillation of coal tar
(A) I, III (B) II, III
(C) III, IV (D) Only III

8. Which type of crystals contain more than one Bravais lattice?
(A) Hexagonal (B) Triclinic
(C) Rhombohedral (D) Monoclinic

9. The total number of elements of symmetry in a cubic crystal is-
(A) 9 (B) 23
(C) 13 (D) None of these

10. The number of solids which are covalent network solid among - S_8, Bronze, SiO_2, Diamond, $ZnSO_4$, Si, AlN, SiC, CO_2 - is-
(A) 5 (B) 4
(C) 2 (D) 1

DPP-2
[Close Packed Structures]

1. There are Five types of two-dimensional lattices possible. Which of the following is not among them?
(A) rectangle
(B) rhombic
(C) parallelogram.
(D) pentagonal

2. The close packing ABCABC ….. represents-
(A) Body centred cubic packing
(B) Face centred cubic packing
(C) Simple cubic packing
(D) Hexagonal cubic closed packing

3. In a multi layered close-packed structure-
(A) there are twice as many tetrahedral holes as many close-packed atoms
(B) there are as many tetrahedral holes as many closed packed atoms
(C) there are twice as many octahedral holes as many close-packed atoms
(D) there are as many tetrahedral holes as many octahedral holes

4. What is the coordination number in a square close packed structure and hexagonal packed structure in two dimensions respectively?
(A) 6, 12 (B) 4, 6
(C) 8,12 (D) 6,8

5. In which of the following arrangements octahedral voids are formed?
(A) HCP (B) bcc
(C) FCC (D) both HCP & FCC

6. ABAB type packing gives which type of unit cell?
(A) S.C.C. (B) H.C.P.
(C) B.C.C. (D) Both (B) and (C)

7. In a hcp arrangement, each atom at the corner contributes to the unit cell equal to
(A) (1/6) (B) (1/2)
(C) (1/8) (D) (1/4)

8. Which of the following statements is incorrect?
(A) A metal that crystallizes in the fcc structure has coordination number twelve.
(B) Cubic and rhombohedral are two primitive crystal systems.
(C) In orthorhombic crystal system, all axial (crystallographic) angles are identical.
(D) Number of next nearest neighbors in the fcc structure is twelve.

9. What is the height of an HCP unit cell?
(a = edge length)
(A) $\frac{\sqrt{3}}{2}a$
(B) $\sqrt{\frac{2}{3}}a$
(C) $\sqrt{\frac{2}{3}}(2a)$
(D) $\frac{\sqrt{2}}{3}a$

10. In a FCC arrangement of given metallic atom, what is the relative ratio of the sizes of tetrahedral and octahedral voids?
(A) 0.543
(B) 0.732
(C) 0.414
(D) 0.637

DPP-3
[FCC, BCC, SC and HCP unit cells]

1. The vacant space in the bcc unit cell is-

(A) 32% (B) 23%
(C) 26% (D) 68%

2. In face centred cubic unit cell edge length is-

(A) $\frac{4}{\sqrt{3}}r$ (B) $\frac{4}{\sqrt{2}}r$

(C) 2r (D) $\frac{\sqrt{3}}{2}r$

3. What is the volume of an HCP unit cell?

(A) $\frac{12}{\sqrt{2}}r^3$

(B) $\frac{16}{\sqrt{2}}r^3$

(C) $24\sqrt{2}r^3$

(D) $\frac{64}{3\sqrt{3}}r^3$

4. Lithium forms body centered cubic structure. Atomic radius of the lithium is 152 pm, then length of the side of its unit cell is-

(A) 75 pm
(B) 351 pm
(C) 304 pm
(D) 152 pm

5. A solid has a b.c.c. structure. If the distance of closest approach between the two atoms is 3.46 Å. The edge length of unit cell is-

(A) $\sqrt{2}$ pm
(B) $\sqrt{(3/2)}$ pm
(C) 400 pm
(D) 142.2 pm

6. Fraction of the total volume occupied by atoms in a simple cube is-

(A) $\pi/6$
(B) $\sqrt{3\pi}/8$
(C) $\sqrt{2\pi}/6$
(D) $\pi/3$

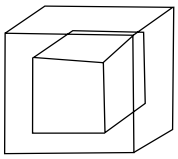
7. Aluminium crystallises in a cubic close-packed structure. Its metallic radius is 125 pm. What is the edge length of unit cell?

(A) 3.536 Å
(B) 1.768 Å
(C) 5.412 Å
(D) 2.706 Å

8. Consider a body centered cubic (bcc) arrangement, let d_e, d_{fd}, d_{bd} be the distances between successive atoms located along the edge, the face-diagonal, the body diagonal respectively in a unit cell. Their order is given by-

(A) $d_e < d_{fd} < d_{bd}$
(B) $d_{fd} > d_{bd} > d_e$
(C) $d_{fd} > d_e > d_{bd}$
(D) $d_e = d_{fd} = d_{bd}$

9. In an fcc unit cell, a cube is formed by joining the centers of all the tetrahedral voids to generate a new cube. Then the new cube would contain voids as effectively-



(A) 1 full tetrahedral void, 1 full octahedral void
(B) 1 full tetrahedral void only
(C) 8 full tetrahedral voids and 1 full octahedral void
(D) 1 full octahedral void only

10. What will be the distance between two nearest neighbours (d) in primitive (or simple cubic), fcc and bcc unit cell?
(a = edge length)

(A) For primitive, d = 0.5a
(B) For fcc, d = 0.707 a
(C) For bcc, d = 1.732 a
(D) For bcc, d = 1.414 a

DPP-4

[Density & radius ratio]

1. The formula for determination of density of unit cell is- (where N = Number of atoms per unit cell, M = Molar Mass of atom, N_0 = Avogadro Number and a = Edge length)

(A) $\frac{a^3 \times N_o}{N \times M}$ g cm^{-3}

(B) $\frac{N \times M}{a^3 \times N_o}$ g cm^{-3}

(C) $\frac{a^3 \times M}{N \times N_o}$ g cm^{-3}

(D) $\frac{M \times N_o}{a^3 \times N}$ g cm^{-3}

2. The radius of Ag^+ ion is 126 pm and that of I^- ion is 216 pm. The co-ordination number of Ag^+ ion is-

(A) 2 (B) 4

(C) 6 (D) 8

3. An element X with an atomic mass of 60 g/mol has a density of 6.23 g/cm^3. If the edge length of the unit cell is 400 pm. The type of unit cell is-

(A) Simple cubic

(B) BCC

(C) FCC

(D) Information is not sufficient

4. An element (atomic mass = 100 g/mole) having bcc structure has unit cell edge 400 pm. The density of the element is

(A) 2.144 g/cm^3

(B) 5.2 g/cm^3

(C) 7. 289 g/cm^3

(D) 10.376 g/cm^3

5. A metal crystalizes into two cubic phases, fcc and bcc whose unit cell lengths are 3.5 Å and 3.0 Å respectively. The ratio of densities of fcc and bcc is-

(A) 0.26

(B) 0.56

(C) 1.26

(D) 2.56

6. At room temperature, Polonium crystallises in cubic primitive cell. If edge length is 3.0 Å, calculate the theoretical density of Po- (atomic weight of Po = 207 amu)

(A) (25/3) amu/Å^3

(B) (23/3) amu/Å^3

(C) (21/3) amu/Å^3

(D) (27/3) amu/Å^3

7. 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-

(A) 30 g mol^{-1}

(B) 27 g mol^{-1}

(C) 20 g mol^{-1}

(D) 40 g mol^{-1}

8. In FCC unit cell, what fraction of edge length is not covered by atoms ?

(A) 0.134

(B) 0.24

(C) 0.293

(D) None of these

9. In an ionic solid r(+) = 1.6 Å and r(–) = 1.864 Å Use the radius ratio rule to determine the edge length of the cubic unit cell in Å.

10. Lead metal has a density of 11.34 g/cm^3 and crystallizes in face-centered lattice. The atomic radius is- (Atomic mass of Pb = 207)

(A) 150 pm

(B) 175 pm

(C) 200 pm

(D) 250 pm

DPP-5

[Structure of Ionic Crystals-I]

1. In zinc blende structure the coordination number of Zn^{2+} ion is-
(A) 2 (B) 4
(C) 6 (D) 8

2. The compound AB crystallizes in a cubic lattice in which both A and B atoms have coordination numbers of 8. To what crystal class does the unit cell belong ?
(A) CsCl structure
(B) NaCl structure
(C) ZnS structure
(D) Al_2O_3 structure

3. Which of the following statements is correct in the rock-salt structure of ionic compounds ?
(A) co-ordination number of cation is four whereas that of anion is six.
(B) co-ordination number of cation is six whereas that of anion is four.
(C) co-ordination number of each cation and anion is four.
(D) co-ordination number of each cation and anion is six.

4. The co-ordination number ratio of calcium fluoride (CaF_2) type structure is-
(A) 1 : 2 (B) 4 : 4
(C) 4 : 8 (D) 8 : 4

5. The tetrahedral voids formed by CCP arrangement of Cl^- ions in rock salt structure are-
(A) occupied by Na^+ ions
(B) occupied by Cl^- ions
(C) occupied by either Na^+ or Cl^- ions
(D) vacant

6. Antifluorite structure is derived from fluorite structure by-
(A) heating fluorite crystal lattice
(B) subjecting fluorite structure to high pressure
(C) inter changing the positions of positive and negative ions in the lattice
(D) None of these

7. Strontium chloride has a fluorite structure. Which of the following statement is true for the structure of strontium chloride?
(A) The strontium ions are in a body centered cubic arrangement
(B) The strontium ions are in a face centered cubic arrangement
(C) Each chloride ion is at the center of a cube of 8 strontium ions
(D) Each strontium ion is at the center of a tetrahedron of 4 chloride ions

8. In the spinel structure, oxide ions are cubic close packed whereas $1/8^{th}$ of tetrahedral voids are occupied by A^{2+} cations and 1/2 of octahedral voids are occupied by B^{3+} cations. The general formula of the compound having spinel structure is-
(A) $A_2B_2O_4$
(B) AB_2O_4
(C) $A_2B_4O_2$
(D) $A_4B_2O_2$

9. A solid 'AB' having Rock salt structure has edge length 320 pm. If radius of cation A^+ is 60 pm then the radius of anion B^- is-
(A) 144.92 pm
(B) 81.96 pm
(C) 100 pm
(D) 200 pm

10. KCl crystallizes in the same type of lattice as does NaCl. Given that $\frac{r_{Na^+}}{r_{Cl^-}} = 0.50$ and $\frac{r_{Na^+}}{r_{K^+}} = 0.70$, calculate the ratio of the side of the unit cell for KCl to that of NaCl.
(A) 1.143
(B) 1.224
(C) 1.414
(D) 0.875

DPP-6
[Structure of Ionic Crystals-II]

1. A cubic solid is made by atoms A forming close packed arrangement, B occupying one fourth of tetrahedral voids and C occupying half of the octahedral voids. What is the formula of the compound?
(A) $A_4B_2C_2$ (B) $A_3B_3C_2$
(C) $A_4B_3C_4$ (D) AB_2C_2

2. In a face centered lattice of X and Y, X atoms are present at the corners while Y atoms are at face centers. Then the formula of the compound if two atoms of X are missing from the corners would be-
(A) X_4Y (B) X_3Y_4
(C) XY_4 (D) X_2Y_4

3. A mineral having the formula AB_2, crystallises in the cubic close-packed lattice, with the A atoms occupying the lattice points. The co-ordination number of the A atoms, that of B atoms and the fraction of the tetrahedral sites occupied by B atoms are most probably-
(A) 8, 4, 100% (B) 2, 6, 75%
(C) 3, 1, 25% (D) 6, 6, 50%

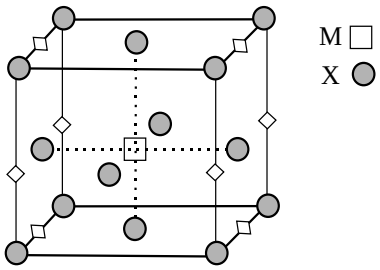
4. In a compound, oxide ions are arranged in cubic close packing arrangement. Cations A occupy one-sixth of the tetrahedral voids and cations B occupy one-third of the octahedral voids. The formula of the compound is-
(A) A_2BO_3 (B) AB_2O_3
(C) $A_2B_2O_2$ (D) ABO_3

5. In a CCP lattice of X and Y, X atoms are present at the corners while Y atoms are at face centers. Then the formula of the compound would be if one of the X atoms from a corner is replaced by Z atoms (having same valency)?
(A) $X_7Y_{24}Z_2$ (B) $X_7Y_{24}Z$
(C) $X_{24}Y_7Z$ (D) $XY_{24}Z$

6. A crystal is made of particles X, Y and Z. X forms fcc packing. Y occupies all the octahedral voids of X and Z occupies all the tetrahedral voids of X. If all the particles along one body diagonal are removed, then the formula of the crystal would be
(A) XYZ_2 (B) X_2YZ_2
(C) $X_8Y_4Z_5$ (D) $X_5Y_4Z_8$

7. The inverse spinal structure (AB_2O_4) consist of an fcc array of O^{2-} ions in which the-
(A) A cation occupies one-eighth of the tetrahedral holes and B cation occupies one-half of octahedral holes
(B) A cation occupies one-fourth of the tetrahedral holes and the B cation occupies the octahedral holes
(C) A cation occupies one-eighth of the octahedral hole and the B cation occupies the tetrahedral holes
(D) A cation occupies one-fourth of the octahedral holes and half of the B cations occupy one fourth of octahedral sites & the other half of B cations occupy tetrahedral sites

8. A compound M_pX_q has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below then p + q is : (p & q are positive integers).



(A) 2 (B) 3
(C) 7 (D) 9

9. Fe_3O_4 has inverse spinel structure. What is not true about this solid?
(A) Fe^{3+} ions are equally distributed between octahedral and tetrahedral voids
(B) Octahedral voids are equally distributed between Fe^{2+} and Fe^{3+}
(C) The ratio of (T.V./O.V.) occupied in inverse spinel structure is 1:2
(D) Coordination number of Fe^{3+} = 8 throughout the unit cell

10. In the crystal lattice of diamond, carbon atoms adopt-
(A) fcc arrangement along with occupancy of 50% tetrahedral holes
(B) fcc arrangement along with occupancy of 25% tetrahedral holes
(C) fcc arrangement along with occupancy of 25% octahedral hole
(D) bcc arrangement

DPP-7
[Defect in Crystals]

1. In the Schottky defect-
(A) cations are missing from the lattice sites and occupy the interstitial sites
(B) cations and anions are missing from the lattice in stoichiometric ratio
(C) anion are missing and electrons are present in their place
(D) equal number of extra cations and electrons are present in the interstitial sites

2. A neutral crystal of NaCl, which has sodium ions and chloride ions missing from the lattice points is said to exhibit-
(A) Surface defect
(B) Lattice defect
(C) Frenkel defect
(D) Schottky defect

3. F-centres are-
(A) the electrons trapped in anionic vacancies
(B) the electrons trapped in cationic vacancies
(C) non-equivalent sites of stoichiometric compound
(D) all of the above

4. Which of the following is a correct statement regarding defects in crystalline solids?
(A) Frenkel defect is a dislocation defect.
(B) Frenkel defect is a found in halides of alkaline metals.
(C) Schottky defects have no effect on the density of crystalline solids.
(D) Frenkel defects decrease the density of crystalline solids.

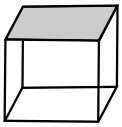
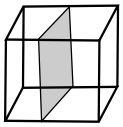
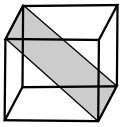
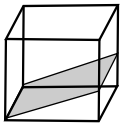
5. Which one of the following is correct ?
(A) Schottky defect lowers the density
(B) Frenkel defect increases the dielectric constant of the crystals
(C) Stoichiometic defects make the crystals good electrical conductors
(D) All of these

6. NaCl shows Schottky defects and AgCl Frenkel defects. Their electrical conductivity is due to-
(A) motion of ions and not the motion of electrons
(B) motion of electrons and not the motion of ions
(C) lower co-ordination number of NaCl
(D) higher co-ordination number of AgCl

7. Zinc oxide, white in colour at room temperature, acquires yellow colour on heating due to-
(A) Zn being a transition element.
(B) paramagnetic nature of the compound.
(C) trapping of electrons at the site vacated by oxide ions.
(D) Both (A) & (B).

8. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M is present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be-
(A) 7.01% (B) 4.08%
(C) 6.05% (D) 5.08%

9. A crystal is made up of metal ions 'M_1' and 'M_2' and oxide ions. Oxide ions from a ccp lattice structure. The cation 'M_1' occupies 50% of octahedral voids and the cation 'M_2' occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation numbers of 'M_1' and 'M_2' are respectively-
(A) +3, + 1 (B) +4, + 2
(C) +1, + 3 (D) +2, + 4

10. Which of the following planes of FCC are identical ?
(i)  (ii) 
(iii)  (iv) 
(A) (i), (ii) and (iii) (B) (i) and (iv)
(C) (i) and (ii) (D) None

DPP-8

[Applications of p-Type and n-Type Semiconductors]

1. Which of the following is not ferromagnetic?
(A) Fe (B) Co
(C) Y (D) Ni

2. The metal which is anti ferromagnetic in nature is-
(A) Co (B) Ni
(C) Cu (D) MnO

3. Which of the following substance is antiferromagnetic?
(A) MnO (B) CrO_2
(C) Fe_3O_4 (d) NaCl

4. Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate?
(A) The number of free electrons for conduction is significant only in Si and Ge but small in C
(B) The number of free conduction electrons is significant in C but small in Si and Ge
(B) The number of free conduction electrons is negligibly small in all the three
(D) The number of free electrons for conduction is significant in all three

5. Which is an example of anti-ferro-magnetic material?
(A) Salts of transition elements
(B) Rare earth elements
(C) Transition metals
(D) Ferrites

6. An n-type semiconductor is-
(A) Neutral
(B) Positively charged
(C) Negatively charged
(D) Negatively or positively charged depending on the amount of impurity added

7. A p–type semiconductor can be obtained by adding-
(A) Arsenic to pure silicon
(B) Gallium to pure silicon
(C) Antimony to pure germanium
(D) Phosphorous to pure germanium

8. When n-type of semiconductor is heated-
(A) Number of electrons increases while that of holes decreases
(B) Number of holes increases while that of electrons decrease
(C) Number of electrons and holes remains same
(D) Number of electrons and holes increases equally

9. Which statement is correct for p-type semiconductor-
(A) The number of electrons in conduction band is more than number of holes in valence band at room temperature
(B) The number of holes in valence band is more than number of electrons in conduction band at room temperature.
(C) There are no holes and electrons at room temperature
(D) number of holes and electron is equal in valence and conduction band

10. Which is incorrect statement?
(A) Non-stoichiometric Cu_2O is a p-type semiconductor.
(B) Fe_3O_4 and ferrites like $MgFe_2O_4$ are ferrimagnetic.
(C) Gd and CrO_2 are anti-ferromagnetic.
(D) TiO, CrO_2 and ReO_3 behave like metals.