Exercise-1

✍ **Marked Questions may have for Revision Questions.**

ONLY ONE OPTION CORRECT TYPE

Section (A) : Basics of Solid State

1. Which of the following are not properties of solid?
(1) They have definite mass, volume and shape. (2) Intermolecular force are weak.
(3) Intermolecular distances are short. (4) They are incompresible and rigid.

2. Amorphous solids :
(1) Possess sharp melting points
(2) Undergo clean cleavage when cut with knife
(3) Do not undergo clean cleavage when cut with knife
(4) Possess orderly arrangement over long distances

3.✍ When molten form of crystalline solid is rapidly cooled, it changes into -
(1) crystalline solid (2) amorphous solid (3) insulator (4) superconductor

4. Amorphous solids is -
(1) Solid substances in real sense (2) Liquid in real sense
(3) Supercooled liquids (4) Substances with definite M.P.

5. Which of the following is not a crystalline solid ?
(1) Common salt (2) Sugar (3) Iron (4) Rubber

6. Solid CO_2 is an example of
(1) Ionic crystal (2) Covalent crystal (3) Metallic crystal (4) Molecular crystal.

7.✍ Tetraagonal crystal system has the following unit cell dimensions :
(1) $a = b = c$, $\alpha = \beta = \gamma = 90°$ (2) $a = b \neq c$, $\alpha = \beta = \gamma = 90°$
(3) $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$ (4) $a = b \neq c$, $\alpha = \beta = 90°$ $\gamma = 120°$

8.✍ Which of the following are the correct axial distance and axial angles for rhombohedral system?
(1) $a = b = c$, $\alpha = \beta = \gamma \neq 90^0$ (2) $a = b \neq c$, $\alpha = \beta = \gamma = 90^0$
(3) $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^0$ (4) $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90^0$

9. Number of Bravais lattice in 2 dimensions are :
(1) 2 (2) 3 (3) 4 (4) 5

10.✍ Which solid will have the weakest intermolecular forces :
(1) Ice (2) Phosphorus (3) Naphthalene (4) Sodium fluoride

11. 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
(1) I,III (2) II, III (3) III, IV (4) only III

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

Section (B) : Body Centered Cubic (BCC) & Simple Cubic

1. In a simple cubic cell, an atom at the corner contributes to the unit cell :
(1) 1 part (2) 1/2 part (3) 1/4 part (4) 1/8 part

2. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is :
(1) Simple cubic (2) Body centred cubic (3) Face centred (4) None of these

3. The number of close neighbour in a body centred cubic lattic of identical sphere is :
(1) 8 (2) 6 (3) 4 (4) 2

4. The vancant space in the bcc unit cell is :
(1) 32% (2) 23% (3) 26% (4) None of these

5. Sodium metal crystalizes as a body centred cubic lattice with the cell edge 4.29 Å. What is the radius of sodium atom :
(1) 1.857×10^{-8} cm (2) 2.371×10^{-7} cm (3) 3.817×10^{-8} cm (4) 9.312×10^{-7} cm

6. Potassium has a bcc structure with nearest neighbour distance 4.52 Å. Its atomic weight is 39. Its density (in kg m^{-3}) will be :
(1) 454 (2) 804 (3) 852 (4) 908

7. A metal has bcc structure and the edge length of its unit cell is 3.04 Å. 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

8. At room temperature, Polonium cryatsllises in Cubic primitive cell. If edge length is 3.0 Å, calculate the theoretical density of Po.(Atomic wt of Po = 207g)
(1) 25/3 amu/ $Å^3$ (2) 23/3 amu/ $Å^3$ (3) 21/3 amu/ $Å^3$ (4) 27/3 amu/ $Å^3$

Section (C) : Hexagonal Close Packing

1. How many number of atoms are present in an HCP unit cell :
(1) 8 (2) 2 (3) 1 (4) 6

2. How many number of tetrahedral voids are present in an HCP unit cell :
(1) 4 (2) 6 (3) 10 (4) 12

3. How many number of octahedral voids are present in an HCP unit cell :
(1) 4 (2) 6 (3) 10 (4) 12

4. What is the co-ordination number of an HCP unit cell :
(1) 4 (2) 6 (3) 10 (4) 12

5. What is the co-ordination number of an atom in its own layer in closed pack arrangement :
(1) 4 (2) 6 (3) 10 (4) 12

6. Fraction of empty space in ABAB type arrangement in 3D :
(1) 0.74 (2) 0.26 (3) 0.68 (4) 0.32

Section (D) : Face Centered Cubic (FCC)

1. In a face centered cubic unit cell, the contribution from the atom at the corner and face centre of the cube are respectively :
(1) $\frac{1}{4}, \frac{1}{2}$ (2) $\frac{1}{8}, \frac{1}{4}$ (3) $\frac{1}{4}, \frac{1}{2}$ (4) $\frac{1}{8}, \frac{1}{2}$

2. The edge length of face centred cubic unit cell is 508 pm. The nearest distance between two atoms is :
(1) 360 pm (2) 288 pm (3) 618 pm (4) 398 pm

3. The octahedral voids in a face-centred cubic (fcc or ccp) structure are located at
(1) at edge centres and 8 along diagonals (2) 12 at edge centres and one at a body centre
(3) 8 along body diagonal and 6 at edge centres (4) All the edge centres only

4. In a face centred lattice of X atoms, Y atoms occupy $\frac{1}{2}$ of tetrahedral holes and $\frac{1}{4}$ of octahedral holes. What is the possible formula of compound?
(1) X_4Y_6 (2) X_4Y_5 (3) X_4Y_8 (4) X_4Y_9

5. In a ccp structure of X atoms. Y atoms occupy half of octahedral holes. If one Y atom and X atom from each unit cell is replaced by Z, then the formula of compound will be -
(1) $X_4Y_2Z_2$ (2) X_3YZ_2 (3) $X_3Y_2Z_2$ (4) X_3Y_3Z

6. In a face centerd 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 is :
(1) XY_3 (2) X_2Y_3 (3) X_3Y (4) XY

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

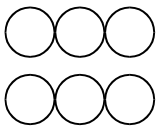
8. In the cubical close packing.
(1) 4 tetrahedral voids each of the which is shared by four adjacent unit cells.
(2) 4 tetrahedral voids within the unit cells.
(3) 8 tetrahedral voids each of the which is shared by four adjacent unit cells.
(4) 8 tetrahedral voids within the unit cells.

9. If 'Z' is the number of atoms in the unit cell that represents the closest packing sequence .... A B C A B C .... the number of tetrahedral voids in the unit cell is equal to :
(1) Z (2) 2Z (3) Z/2 (4) Z/4

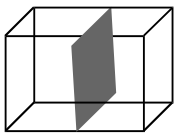
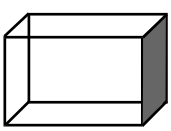
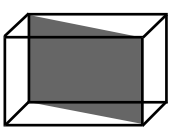
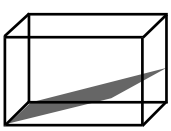
10. The number of octahedral voids in a unit cell of cubic closest packed structure is :
(1) 1 (2) 2 (3) 4 (4) 8

11. 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 :
(1) 4×10^{25} (2) 3×10^{25} (3) 2×10^{25} (4) 1×10^{25}

12. Which of the following shaded plane in fcc lattice contains arrangement of atoms as shown by circles :



Figure

(1)  (2)  (3)  (4) 

13. Copper crystallises in a structure of face centerd cubic unit cell. The atomic radius of copper is 1.28 Å. What is axial length on an edge of copper.
(1) 2.16 Å (2) 3.62 Å (3) 3.94 Å (4) 4.15 Å

14. Which one of the following schemes of ordering closed packed sheets of equal sized spheres does not generate close packed lattice.
(1) ABCABC (2) ABACABAC (3) ABBAABBA (4) ABCBCABCBC

Section (E) : Void

1. The void present in simple cubic crystal is :
(1) cubic (2) tetrahedral (3) octahedral (4) triangular

2. The coordination number of octahedral void is :
(1) 8 (2) 6 (3) 4 (4) 12

3. In a multi layered close-packed structure
(1) there are twice as many tetrahedral holes as there are close-packed atoms
(2) there are as many tetrahedral holes as there are closed packed atoms
(3) there are twice as many octahedral holes as there are close-packed atoms
(4) there are as many tetrahedral holes as there are octahedral holes

4. 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 by four spheres. (4) the void is surrounded by six spheres

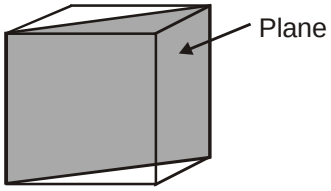
5. A double triangular void surrounded by three spheres above and three spheres below is called
(1) triangular void (2) tetrahedral void (3) octahedral void (4) trigonal bipyramidal void

6. In a closest packed lattice, the number of octahedral sites as compared to tetrahedral ones will be :
(1) Equal (2) Half (3) Double (4) None of these

7. The correct order of the packing efficiency in different types of unit cells is _____.
(1) fcc < bcc < simple cubic (2) fcc > bcc > simple cubic
(3) fcc < bcc > simple cubic (4) bcc < fcc > simple cubic

8. The arrangment of the first two layers. one above the other, in hcp and ccp arrangements is :
(1) Exactly same in both cases (2) partly same and partly different
(3) Diffrent from each other (4) Nothing definite

9. In a hypothetical solid C atoms form CCP lattice with A atoms occupying all the Tetrahedral Voids and B atoms occupying all the octahedral voids.A and B atoms are of the appropriate size such that there is no distortion in the CCP lattice.Now if a plane is cut(as shown) then type of voids and their numbers whic are present at the cross section would be.



CCP unit cell

(1) O.V = 3, T.V. = 4 (2) O.V. = 2, T.V. = 4 (3) O.V. = 1, T.V. = 2 (4) O.V. = 0, T.V. = 4

Section (F) : Radius Ratio & Ionic Structure

1. MgO exist in NaCl type lattice (rock salt structure). No. of nearest neighbour of Mg^{2+} ion are :
(1) 12 O^{-2} ions (2) 8 O^{-2} ions (3) 6 O^{-2} ions (4) 4 O^{-2} ions

2. 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

3. Which one of the following statements is incorrect about Rock salt type ?
(1) It has fcc arrangment of Cl^-
(2) Na^+ and Cl^- 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.

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

5. A solid AB has NaCl type structure. If the radius of the cation A is 100 pm, then the radius of the anion B, using octarahedral dimension will be :
(1) 241 pm (2) 414 pm (3) 225 pm (4) 44.4 pm

6. Antifluorite structure is derived from fluorite structure by :
(1) heating fluorite crystal lattice
(2) Inter changing the positions of positive and negative ions in the lattice
(3) subjecting fluorite structure to high pressure
(4) none of these

7. 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

8. In zinc blende structure the coordination number of Zn^{2+} ion is
(1) 2 (2) 4 (3) 6 (4) 8

9. Strontium chloride has a fluorite structure, which of the following statement is true for the structure of strontium chloride ?
(1) the strontium ions are in a body–centered cubic arrangement
(2) the strontium ions are in a face–centered cubic arrangement
(3) each chloride ion is at the center of a cube of 8 strontium ions
(4) each strontium ion is at the center of a tetrahedron of 4 chloride ions

10. The spinal structure (AB_2O_4) consists of an fcc array of O^{2-} ions in which the :
(1) A cation occupies one-eighth of the tetrahedral holes and B cation occupies one-half of octahedral holes
(2) A cation occupies one-fourth of the tetrahedral holes and the B cations the octahedral holes
(3) A cation occupies one-eighth of the octahedral hole and the B cation the tetrahedral holes
(4) A cation occupies one-fourth of the octahedral holes and the B cations the tetrahedral holes

11. In the crystal lattice of diamond, carbon atoms adopt :
(1) fcc arrangement along with occupancy of 50% tetrahedral holes
(2) fcc arrangement along with occupancy of 25% tetrahedral holes
(3) fcc arrangement along with occupancy of 25% octahedral hole
(4) bcc arrangement

Section (G) : Crystal Defects and Properties of Solid & Thier Magnetic Behaviour

1. In the schottky defect
(1) cations are missing from the lattice sites and occupy the interstitial sites
(2) equal number of cations and anions are missing
(3) anions are missing and electrons are present their place
(4) equal number of extra cations and electrons are present in the interstitial sites.

2. 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.

3. 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

4. Doping of silicon with P or Al increases the conductivity. The difference in the two cases is
(1) P is non-metal whereas Al is a metal
(2) P is a poor conductor while Al is a conductor
(3) P gives rise to extra electrons while Al gives rise to holes
(4) P gives rise to holes while Al gives rise to extra electrons.

5. In a solid lattice the cation has left a lattice site and is located at an interstitial position, the lattice defect is
(1) Interstitial defect (2) Vacancy defect (3) Frenkel defect (4) Schottky defect

6. In NaCl & AgCl, $r_{Na^+} > r_{Ag^+}$, so :
(1) NaCl has higher tendency to show Schottky defect than AgCl.
(2) NaCl has lower tendency to show Schottky defect than AgCl.
(3) NaCl has higher tendency to show Frenkel defect than AgCl.
(4) Both have equal tendency to show Frenkel defect and Schottky defect.

7. Which of the following statements are correct in context of point defects in a crystal ?
(1) AgCl has anion Frenkel defect and CaF_2 has Schottky defects
(2) AgCl has cation Frenkel defects and CaF_2 has anion Frenkel defects
(3) AgCl as well as CaF_2 have anion Frenkel defects
(4) AgCl as well as CaF_2 has Schottky defects

Exercise-2

Marked Questions may have for Revision Questions.

1. An example of a metallic crystalline solid is
(1) Si (2) C (3) P (4) W

2. Iodine crystal are :
(1) Metallic solid (2) Ionic solid (3) Molecular solid (4) Covalent solid

3. Ionic solids are characterised by
(1) Good conductivity in solid state (2) High vapour pressure
(3) Low melting point (4) Solubility in polar solvents.

4. Which one of the following will have a low heat of fusion ?
(1) a covalent solid (2) an ionic solid (3) a metallic solid (4) a molecular solid

5. Wax is an example of -
(1) Ionic crystal (2) Covalent crystal (3) Molecular crystal (4) Metallic crystal

6. A solid X melts slightly above 273 K and is a poor conductor of heat and electricity. To which of the following categories does it belong -
(1) Ionic solid (2) Covalent solid (3) Metallic (4) Molecular

7. Quartz is a crystalline variety of :
(1) Silica (2) Sodium silicate (3) Silicon carbide (4) Silicon

8. Example of unit cell with crystallographic dimensions $a \neq b \neq c$, $\alpha = \gamma = 90^o$, $\beta \neq 90^o$ is :
(1) Calcite (2) Graphite (3) Rhombic sulphur (4) Monoclinic sulphur

9. An element (atomic mass = 100 g/mole) having BCC structure has unit cell edge 400 pm. The density of the element is (no. of atoms in BCC(Z) = 2).
(1) 2.144 g/cm^3 (2) 5.2 g/cm^3 (3) 7.289 g/cm^3 (4) 10.376 g/cm^3

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

11. If the radius of an atom of an element is 75 pm and the lattice is body centred cubic, the edge of the unit cell will be
(1) 32.475 pm (2) 173.2 pm (3) 37.5 pm (4) 212.1 pm

12. Find the difference between coordination number and effective number of atoms in bcc unit cell :
(1) 8 (2) 6 (3) 4 (4) 12

13. An alloy of copper, silver and gold is found to have copper consituting the ccp lattice. If silver atoms occupy the edge centres and gold present at body centre, the alloy has a formula
(1) Cu_4Ag_2Au (2) Cu_4Ag_4Au (3) Cu_4Ag_3Au (4) CuAgAu

14. Hexagonal close packed arrangement of ions is described as :
(1) ABC ABA (2) ABC ABC (3) ABABA (4) ABBAB

15. The number of octahedral sites per sphere in a fcc structure is
(1) 8 (2) 4 (3) 2 (4) 1

16. The face centered cubic lattice can be generated by :
(1) placing square packed sheets one over other in AAAA..... type arrangement
(2) placing square packed sheets one over the other in ABAB.... type arrangement
(3) placing hexagonal close packed sheets one over the other in AAAA.....type arrangement
(4) placing hexagonal close packed sheets one over the other in ABABAB.....type arrangement

17. In a FCC unit cell, a line is drawn from a corner such that it passes through no octahedral or tetrahedral void. The line could be :
(1) body diagonal (2) edge (3) face diagonal (4) none of these

18. In a fcc unit cell, a line is drawn from a corner such that it passes through two tetrahedral voids and one octahedral viod. The line is :
(1) body diagonal (2) edge (3) face diagonal (4) none of these

19. Number of unit cells in 100 g of fcc crystal with density 10 g/cm^3 and cell edge as 200 pm are :
(1) 1.25×10^{23} (2) 1.25×10^{24} (3) 2.5×10^{24} (4) 1.25×10^{30}

20. The radius of an atom of an element is 500 pm. If it crystallises as a face centred cubic lattice, the length of the side of unit cell is
(1) 176.8 pm (2) 1154.7 pm (3) 1414 pm (4) 1000 pm

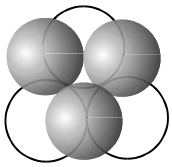
21. In the closest packed structure of a metallic lattice, the number of nearest neighbours of a metallic atom is
(1) Twelve (2) Four (3) Eight (4) Six

22. Find the sum of number of octahedral void and tetrahdral void present in fcc unit cell ?
(1) 8 (2) 12 (3) 4 (4) 6

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

24. In which pair most efficient packing is present?
(1) hcp and bcc (2) hcp and ccp (3) bcc and ccp (4) bcc and simple cubic cell

25. The empty space between the shaded balls and hollow balls as shown in the diagram is called



Figure

(1) hexagonal void (2) octahedral void (3) tetrahedral void (4) double triangular void

26. An ionic solid AB have anions in ccp lattice and 3 cations in octahedral voids. r_{B^-} = 1 Å, r_{A^+} = 0.5 Å. Then which of the following is correct ?
(1) edge length = $2\sqrt{2}$ Å (2) edge length = 3 Å
(3) edge length = $\frac{4}{\sqrt{3}}$ Å (4) edge length = 2 Å

27. In a sodium chloride structure, the percentage of the octahedral voids occupied by cations is :
(1) 100% (2) 74% (3) 33% (4) 26%

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

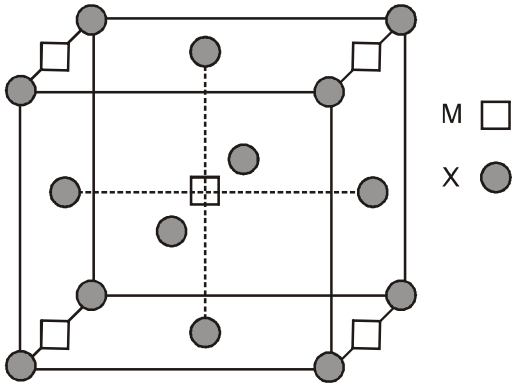
29. A solid X^+Y^- has a bcc structure. If the distance of closest approach between the two atoms is 173 pm, the edge length of the cell is
(1) 200 pm (2) $\sqrt{3}/\sqrt{2}$ pm (3) 142.2 pm (4) $\sqrt{2}$ pm

30. Which of the following defects is also known as dislocation defect?
(1) Frenkel defect (2) Schottky defect
(3) Non-stoichiometric defect (4) Simple interstitial defect

31. The flame colours of metal ions are due to
(1) Frenkel defect (2) Schottky defect
(3) Metal deficiency defect (4) Metal excess defect

32. In which of the following compounds the cations are present in alternate tetrahedral voids:
(1) NaCl (2) ZnS (3) CaF_2 (4) Na_2O

33. A compound $M_P X_q$ has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is :



(1) MX (2) MX_2 (3) M_2X (4) M_5X_{14}

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. A compound formed by elements A and B crystallises in the cubic structure, where A atoms are present at the corners of a cube and B atoms are present at the face centres. The formula of the compound is : **[AIPMT 2000]**

(1) A_2B_2 (2) AB_3 (3) AB (4) A_3B

2. When molten zinc is cooled to solid state, it assumes hcp structure,. Then the number of nearest neighbours of zinc atom will be : **[AIPMT 2001]**

(1) 4 (2) 8 (3) 12 (4) 6

3. 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 : **[AIPMT 2004]**

(1) XY_3 (2) X_3Y (3) XY (4) XY_2

4. In a face centred cubic lattice, unit cell is shared equally by how many unit cells ? **[AIPMT 2005]**

(1) 4 (2) 2 (3) 6 (4) 8

5. 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 : **[AIPMT 2006]**

(1) 8.25 g /cm^3 (2) 4.25 g /cm^3 (3) 42.5 g / cm^3 (4) 0.425 g /cm^3

6. The appearance of colour in solid alkali metal halides is generally due to : **[AIPMT 2006]**

(1) F-centres (2) Schottky defect (3) Frenkel defect (4) Interstitial positions

7. The fraction of the total volume occupied by the atoms present in a simple cube is : **[AIPMT 2007]**

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{6}$ (3) $\frac{\pi}{3\sqrt{2}}$ (4) $\frac{\pi}{4\sqrt{2}}$

8. 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}) **[AIPMT 2007]**

(1) 6.02×10^{14} mol^{-1} (2) 6.02×10^{15} mol^{-1} (3) 6.02×10^{16} mol^{-1} (4) 6.02×10^{17} mol^{-1}

9. Which of the following statements is not correct ? **[AIPMT 2008]**
(1) The fraction of the total volume occupied by the atoms in a primitive cell is 0.48.
(2) Molecular solids are generally volatile
(3) The number of carbon atoms in a unit cell of Diamond is 8
(4) The number of Bravais lattices in which a crystal can be categorized is 14

10. If 'a' stands for the edge length of the cubic systems : simple cubic, body centred cubic and face centred cubic, then ratio of the radii of the spheres in these systems will be respectively : **[AIPMT 2008]**

(1) $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$ (2) $\frac{1}{2}\ a : \sqrt{3}\,a : \frac{1}{\sqrt{2}}a$

(3) $\frac{1}{2}a : \frac{\sqrt{3}}{2} : \frac{\sqrt{2}}{2}\ a$ (4) $1a : \sqrt{3}\ a : \sqrt{2}\,a$

11. A metallic crystal has the bcc type stacking pattern. What percentage of volume of this lattice in empty space ? **[AIPMT 08,Gujrat CET 08]**
(1) 68 % (2) 32 % (3) 26 % (4) 74 %

12. 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 ? **[AIPMT 2009]**
(1) 128 (2) 157 (3) 181 (4) 108

13. 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 the lithium will be : **[AIPMT 2009]**
(1) 240.8 pm (2) 151.8 pm (3) 75.5 pm (4) 300.5 pm

14. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositively charged ions in the lattice is: **[AIPMT 2010]**
(1) 335 pm (2) 250 pm (3) 200 pm (4) 300 pm

15. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be : **[AIPMT 2011]**
(1) 275.1 pm (2) 322.5 pm (3) 241.5 pm (4) 165.7 pm

16. A metal crystallizes with a face-centered cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is: **[AIPMT 2012]**
(1) 288 pm (2) 408 pm (3) 144 pm (4) 204 pm

17. The number of octahedral void(s) per atom present in a cubic close-packed structure is : **[AIPMT 2012]**
(1) 1 (2) 3 (3) 2 (4) 4

18. Structure of a mixed oxide is cubic close - packed (c.c.p). 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 : **[AIPMT 2012]**
(1) ABO_2 (2) A_2BO_2 (3) $A_2B_3O_4$ (4) AB_2O_2

19. 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}) **[NEET 2013]**
(1) 30 g mol^{-1} (2) 27 g mol^{-1} (3) 20 g mol^{-1} (4) 40 g mol^{-1}

20. The number of carbon atoms per unit cell of diamond unit cell is : **[NEET 2013]**
(1) 8 (2) 6 (3) 1 (4) 4

21. A given metal crystallizes 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 **[AIPMT 2015]**
(1) 127 pm (2) 80 pm (3) 108 pm (4) 40 pm

22. Lithium has 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}) **[NEET-1 2016]**
(1) 264 pm (2) 154 pm (3) 352 pm (4) 527 pm

23. 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 **[NEET-1 2016]**
(1) 2 (2) 6 (3) 4 (4) 8

24. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are **[NEET-2 2016]**
(1) 4 and 8 (2) 4 and 2 (3) 6 and 6 (4) 8 and 4

25. Which of the incorrect statement? **[NEET- 2017]**
(1) $FeO_{0.98}$ has non stoichiometric metal deficiency defect.
(2) Density decreases in case of crystals with Schottky's defect.
(3) NaCl(s) is insulator, silicon is semiconductor, silver is conductor, quartz is piezo electric crystal.
(4) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.

26. Iron exhibits bcc structure at room temperature. Above 900ºC, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900ºC (assuming molar mass and atomic radii of iron remains constant with temperature) is : **[NEET- 2018]**
(1) $\frac{\sqrt{3}}{\sqrt{2}}$ (2) $\frac{1}{2}$ (3) $\frac{3\sqrt{3}}{4\sqrt{2}}$ (4) $\frac{4\sqrt{3}}{3\sqrt{2}}$

27. A compound is formed by cation C and anion A. The anions form hexagonal close packed (hcp) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is : **[NEET-1- 2019]**
(1) C_4A_3 (2) C_2A_3 (3) C_3A_2 (4) C_3A_4

28. Formula of nickel oxide with metal deficiency defect in its crystal is $Ni_{0.98}O$. The crystal contains Ni^{2+} and Ni^{3+} ions. The fraction of nickel existing as Ni^{2+} ions in the crystal is - **[NEET-1- 2019]**
(1) 0.96 (2) 0.04 (3) 0.50 (4) 0.31

PART - II : AIIMS QUESTION (PREVIOUS YEARS)

1. An AB_2 type of structure is present in : **[AIIMS 2002]**
(1) NaCl (2) N_2O (3) Al_2O_3 (4) CaF_2

2. Schottky defect defines imperfection in the lattice structure of a : **[AIIMS 2002]**
(1) gas (2) plasma (3) liquid (4) solid

3. 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 : **[AIIMS 2004]**
(1) cubic (2) hexagonal (3) orthorhombic (4) rhombohedral

4. If 'Z' is the number of atoms in the unit cell that represents the closest packing sequence .... ABC, ABC....., the number of tetrahedral voids in the unit cell is equal to **[AIIMS 2005]**
(1) Z (2) 2 Z (3) Z/2 (4) Z/4

5. The Ca^{2+} and F^- ions are located in CaF_2 crystal, respectively at body centred cubic lattice points and in : **[AIIMS 2006]**
(1) tetrahedral voids (2) half of tetrahedral voids
(3) octahedral voids (4) half of octahedral voids

6. If AgI crystallises in zinc blende structure with I^- ions at lattice points. What fractions of tetrahedral voids is occupied by Ag^+ ions ? **[AIIMS 2007]**
(1) 25 % (2) 50 % (3) 100 % (4) 75 %

7. **Assertion :** No compound has both Schottky and Frenkel defects. **[AIIMS 2008]**
Reason : Both defects change the density of the solid.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.
(5) If assertion is false but reason is true.

8. Sodium crystallises in bcc arrangements with the interfacial sepration between the atoms at the edge 53 pm. The density of the solid is : **[AIIMS 2009]**
(1) 1.23 g/cc (2) 485 g/cc (3) 4.85 g/cc (4) 123 g/cc

9. **Assertion :** If edge length of unit cell of LiCl, having NaCl type structure is 5.14 Å, the ionic radius of Cl^- ion is 1.82 Å. **[AIIMS 2010]**
Reason : Anion-anion contact is retained in LiCl structure because anions constitute the lattice.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.
(5) If assertion is false but reason is true.

10. In a face centred cubic lattice, a unit cell is shared equally by how many unit cells ? **[AIIMS 2012]**
(1) 8 (2) 4 (3) 2 (4) 6

11. **Assertion :** Semiconductors are solids with conductivities in the intermediate range from 10^{-6}–$10^4 ohm^{-1}m^{-1}$. **[AIIMS 2013]**
Reason : Intermediate conductivity in semiconductor is due to partially filled valence band.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.
(5) If assertion is false but reason is true.

12. **Assertion :** When 1.0 mol of NaCl is doped with 10^{-3} $SrCl_2$, the number of cationic sites remaining vacant is 10^{-3}. **[AIIMS 2014]**
Reason : Each $SrCl_2$ unit produces two cationic vacancy.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.
(5) If assertion is false but reason is true.

13. **Assertion :** Both Frenkel and Schottky defects are stoichiometric defects **[AIIMS 2015]**
Reason : Both defects change the density of the crystalline solid.
(1) If both assertion and reason are true and reason is a correct explanation of assertion.
(2) If both assertion and reason are true but reason is not a correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.
(5) If assertion is false but reason is true.

14. In a gas lighter, mechanical energy is converted into electrical energy by using crystals of barium titanate. Barium titanate is **[AIIMS 2016]**
(1) piezoelectric but not ferroelectric (2) both piezoelectric as well as ferroelectric
(3) ferroelectric (4) neither ferroelectric nor piezoelectric

15. Which of the following arrangement correctly shows the magnetic moment of anti-ferromagnetic substance ? **[AIIMS 2017]**
(1)  (2) 
(3)  (4) 

16. f-centre is **[AIIMS 2018]**
(1) anion vacancy occupied by unpaired electron
(2) anion vacancy occupied by electron
(3) cation vacancy occupied by electron
(4) anion present in interstitial site

17. What is impact on benzene in magnetic field : **[AIIMS 2018]**
(1) Strong attract (2) Weakly attract (3) Strongly repel (4) weak repel

18. Atom 'A' crystallised in HCP crystal structure and $\frac{1}{3}$ of tetrahedral are occupied by B. What is the formula for compound: **[AIIMS 2018]**
(1) A_2B_3 (2) A_3B_2 (3) AB_3 (4) A_2B

PART - III : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Na and Mg crystallize in BCC and FCC type crystals respectively, then the number of atoms of Na and Mg present in the unit cell of their respective crystal is **[AIEEE-2002]**
(1) 4 and 2 (2) 9 and 14 (3) 14 and 9 (4) 2 and 4

2. How many unit cells are present in a cube-shaped ideal crystal of NaCl of mass 1.00g?
[Atomic masses : Na = 23, Cl = 35.5] **[AIEEE-2003]**
(1) 2.57×10^{21} (2) 5.14×10^{21} (3) 1.28×10^{21} (4) 1.71×10^{21}.

3. What type of crystal defect is indicated in the diagram below? **[AIEEE-2004]**

Na^+	Cl^-	Na^+	Cl^-	Na^+	Cl^-
Cl^-	□	Cl^-	Na^+	□	Na^+
Na^+	Cl^-	□	Cl^-	Na^+	Cl^-
Cl^-	Na^+	Cl^-	Na^+	□	Na^+

(1) Frenkel defect (2) Schottky defect
(3) interstitial defect (4) Frenkel and Schottky defects

4. An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions on the centers of the faces of the cube. The empirical formula for this compound would be **[AIEEE-2005]**
(1) AB (2) A_2B (3) AB_3 (4) A_3B

5. Total volume of atoms present in a face-center cubic unit cell of a metals (r is atomic radius) **[AIEEE-2006]**
(1) $\frac{20}{3}\pi r^3$ (2) $\frac{24}{3}\pi r^3$ (3) $\frac{12}{3}\pi r^3$ (4) $\frac{16}{3}\pi r^3$

6. In a compound, atoms of element Y form ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. The formula of the compound will be **[AIEEE - 2008, 3/105]**
(1) X_2Y_3 (2) X_2Y (3) X_3Y_4 (4) X_4Y_3

7. Copper crystallises in fcc with a unit cell length of 361 pm. What is the radius of copper atom ? **[AIEEE - 2009, 8/144]**
(1) 127 pm (2) 157 pm (3) 181 pm (4) 108 pm

8. Percentages of free space in cubic close packed structure and in body centered packed structure are respectively. **[AIEEE - 2010, 4/144]**
(1) 30% and 26% (2) 26% and 32% (3) 32% and 48% (4) 48% and 26%

9. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre positions. If one atom of B is missing from one of the face centred points, the formula of the compound is: **[AIEEE-2011, 4/120]**
(1) A_2B (2) AB_2 (3) A_2B_3 (4) A_2B_5

10. Lithium forms body centred cubic structure. The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be : **[AIEEE-2012, 4/120]**
(1) 75 pm (2) 300 pm (3) 240 pm (4) 152 pm

11. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M, present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be : **[JEE(Main) 2013, 4/120]**
(1) 7.01% (2) 4.08% (3) 6.05% (4) 5.08%

12. CsCl crystallises in body centred cubic lattice. If 'a' its edge length then which of the following expressions is correct ? **[JEE Mains 2014]**
(1) $r_{Cs^+} + r_{Cl^-} = 3a$ (2) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$ (3) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$ (4) $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

13. Sodium metal crystallizes in a body centred cubic lattice with a unit cell edge of 4.29Å. The radius of sodium atom is approximately: **[JEE Mains 2015]**
(1) 1.86Å (2) 3.22Å (3) 5.72Å (4) 0.93Å

14. Which of the following compounds is metallic and ferromagnetic ? **[JEE Mains 2016]**
(1) CrO_2 (2) VO_2 (3) MnO_2 (4) TiO_2

15. A metal crystallises in a face centred cubic structure. If the edge length of its unit cell is 'a', the closest approach between two atoms in metallic crystal will be : **[JEE Mains 2017]**

(1) $2\sqrt{2}$ a (2) $\sqrt{2}$ a (3) $\frac{a}{\sqrt{2}}$ (4) 2a

16. Which type of 'defect' has the presence of cations in the interstitial sites ? **[JEE Mains 2018]**

(1) Frenkel defect (2) Metal deficiency defect
(3) Schottky defect (4) Vacancy defect

17. The one that is extensively used as a piezoelectric material is : **[JEE Mains 2019]**

(1) tridymite (2) amorphous silica (3) quartz (4) mica

18. At 100ºC, copper (Cu) has FCC unit cell structure with cell edge length of x Å. What is the approximate density of Cu (in g cm^{-3}) at this temperature? [Atomic mass of Cu = 63.55 u] **[JEE Mains 2019]**

(1) $\frac{205}{x^3}$ (2) $\frac{105}{x^3}$ (3) $\frac{422}{x^3}$ (4) $\frac{211}{x^3}$

19. Which premitive unit cell has unequal edge lengths ($a \neq b \neq c$) and all axial angles different from 90º ? **[JEE Mains 2019]**

(1) Monoclinic (2) Triclinic (3) Hexagonal (4) Tetragonal

20. A compounds of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms; **[JEE Mains 2019]**

(1) hcp lattice –A, $\frac{2}{3}$ Tetrahedral voids-B (2) hcp lattice –B, $\frac{1}{3}$ Tetrahedral voids-A

(3) hcp lattice –B, $\frac{2}{3}$ Tetrahedral voids-A (4) hcp lattice –A, $\frac{1}{3}$ Tetrahedral voids-B

21. The radius of the largest sphere which fits properly at the centre of the edge of a body centred cubic unit cell is : (Edge length is represented by 'a') **[JEE Mains 2019]**

(1) 0.047 a (2) 0.027 a (3) 0.134 a (4) 0.067 a

22. A solid having density of 9×10^3 kg m^{-3} forms face centred cubic crystals of edge length $200\sqrt{2}$ pm. What is the molar mass of the solid? [Avogadro constant $\cong 6 \times 10^{23}$ mol^{-1}, $\pi \cong 3$] **[JEE Mains 2019]**

(1) 0.0432 kg mol^{-1} (2) 0.0305 kg mol^{-1} (3) 0.4320 kg mol^{-1} (4) 0.0216 kg mol^{-1}

Answers

EXERCISE - 1

SECTION (A)

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(3)	**5.**	(4)	**6.**	(4)	**7.**	(2)
8.	(1)	**9.**	(4)	**10.**	(1)	**11.**	(3)	**12.**	(2)				

SECTION (B)

1.	(4)	**2.**	(2)	**3.**	(1)	**4.**	(1)	**5.**	(1)	**6.**	(4)	**7.**	(2)
8.	(2)												

SECTION (C)

1.	(4)	**2.**	(4)	**3.**	(2)	**4.**	(4)	**5.**	(2)	**6.**	(2)		

SECTION (D)

1.	(4)	**2.**	(1)	**3.**	(2)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(3)
8.	(4)	**9.**	(2)	**10.**	(3)	**11.**	(1)	**12.**	(3)	**13.**	(2)	**14.**	(3)

SECTION (E)

1.	(1)	**2.**	(2)	**3.**	(1)	**4.**	(3)	**5.**	(3)	**6.**	(2)	**7.**	(2)
8.	(1)	**9.**	(1)										

SECTION (F)

1.	(3)	**2.**	(1)	**3.**	(4)	**4.**	(3)	**5.**	(1)	**6.**	(2)	**7.**	(4)
8.	(2)	**9.**	(2)	**10.**	(1)	**11.**	(1)						

SECTION (G)

1.	(2)	**2.**	(3)	**3.**	(1)	**4.**	(3)	**5.**	(3)	**6.**	(1)	**7.**	(2)

EXERCISE - 2

1.	(4)	**2.**	(3)	**3.**	(4)	**4.**	(4)	**5.**	(3)	**6.**	(4)	**7.**	(1)
8.	(4)	**9.**	(2)	**10.**	(2)	**11.**	(2)	**12.**	(2)	**13.**	(3)	**14.**	(3)
15.	(4)	**16.**	(2)	**17.**	(3)	**18.**	(1)	**19.**	(2)	**20.**	(3)	**21.**	(1)
22.	(2)	**23.**	(1)	**24.**	(2)	**25.**	(2)	**26.**	(2)	**27.**	(1)	**28.**	(2)
29.	(1)	**30.**	(1)	**31.**	(4)	**32.**	(2)	**33.**	(2)				

EXERCISE - 3

PART-I

1.	(2)	**2.**	(3)	**3.**	(1)	**4.**	(3)	**5.**	(2)	**6.**	(1)	**7.**	(2)
8.	(4)	**9.**	(1)	**10.**	(1)	**11.**	(2)	**12.**	(1)	**13.**	(2)	**14.**	(1)
15.	(3)	**16.**	(1)	**17.**	(1)	**18.**	(4)	**19.**	(2)	**20.**	(1)	**21.**	(1)
22.	(3)	**23.**	(2)	**24.**	(4)	**25.**	(1,4)	**26.**	(3)	**27.**	(4)	**28.**	(1)

PART-II

1.	(4)	**2.**	(4)	**3.**	(2)	**4.**	(2)	**5.**	(1)	**6.**	(2)	**7.**	(4)
8.	(1)	**9.**	(1)	**10.**	(4)	**11.**	(3)	**12.**	(4)	**13.**	(3)	**14.**	(2)
15.	(4)	**16.**	(1)	**17.**	(4)	**18.**	(2)						

PART-III

1.	(4)	**2.**	(1)	**3.**	(2)	**4.**	(3)	**5.**	(4)	**6.**	(4)	**7.**	(1)
8.	(2)	**9.**	(4)	**10.**	(4)	**11.**	(2)	**12.**	(3)	**13.**	(1)	**14.**	(1)
15.	(3)	**16.**	(1)	**17.**	(3)	**18.**	(3)	**19.**	(2)	**20.**	(2)	**21.**	(4)
22.	(2)												