17. Solid State – Multiple Choice Questions

1. Types of Solid and their Properties

1. Which of the following is ferroelectric compound

(a) $BaTiO_3$ (b) $K_4[Fe(CN)_6]$

(c) Pb_2O_3 (d) $PbZrO_3$

2. The property of crystalline solid is not

(a) Anisotropic (b) Isotropic

(c) Hard (d) Dense

3. Given :

Column A		Column B	
A	Ionic Solid	I	*NaCl*
B	Metallic Solid	II	*Fe*
C	Covalent Solid	III	C (graphite)
D	Molecular Solid	IV	Dry ice

(a) A-II, B-I, C-IV, D-III (b) A-I, B-II, C-III, D-IV

(c) A-III, B-II, C-I, D-IV (d) A-II, B-IV, C-I, D-III

4. Among solids the highest melting point is established by

(a) Covalent solids (b) Ionic solids

(c) Pseudo solids (d) Molecular solids

5. Crystalline solids are

(a) Glass (b) Rubber

(c) Plastic (d) Sugar

6. Which one of the following metal oxides is antiferromagnetic in nature

(a) MnO_2 (b) TiO_2

(c) VO_2 (d) CrO_2

7. Malleability and ductility of metals can be accounted due to

(a) The capacity of layers of metal ions to slide over the other

(b) The interaction of electrons with metal ions in the other

(c) The presence of electrostatic force

(d) The crystalline structure in metal

8. Which of the following is not correct for ionic crystals

(a) They possess high melting point and boiling point

(b) All are electrolyte

(c) Exhibit the property of isomorphism

(d) Exhibit directional properties of the bond

9. Quartz is a crystalline variety of

(a) Silica (b) Sodium silicate

(c) Silicon carbide (d) Silicon

10. The ability of a given substance to assume two or more crystalline structure is called

(a) Amorphism (b) Isomorphism

(c) Polymorphism (d) Isomerism

11. Certain crystals produce electric signals on application of pressure. This phenomenon is called

(a) Pyroelectricity (b) Ferroelectricity

(c) Peizoelectricity (d) Ferrielectricity

12. What is the energy gap between valence band and conduction band in crystal of insulators

(a) Both the bands are overlapped with each other

(b) Very small

(c) Infinite

(d) Very large

13. Crystals of covalent compounds always have

(a) Atoms as their structural units

(b) Molecules as structural units

(c) Ions held together by electrostatic forces

(d) High melting points

14. Wax is an example of

(a) Ionic crystal (b) Covalent crystal

(c) Metallic crystal (d) Molecular crystal

15. Which of the following conditions favours the existence of a substance in the solid state

(a) High temperature (b) Low temperature

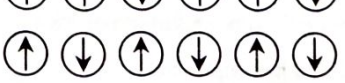
(c) High thermal energy (d) Weak cohesive forces

16. Which of the following arrangements shows schematic alignment of magnetic moments of antiferromagnetic substances

(a) 

(b) 

(c) 

(d) 

17. The sharp melting point of crystalline solids is due to.....

(a) A regular arrangement of constituent particles observed over a short distance in the crystal lattice

(b) A regular arrangement of constituent particles observed over a long distance in the crystal lattice

(c) Same arrangement of constituent particles in different directions

(d) Different arrangement of constituent particles in different directions

18. Which of the following is not the characteristic of ionic solids

(a) Very low value of electrical conductivity in the molten state

(b) Brittle nature

(c) Very strong forces of interactions

(d) Anisotropic nature

19. Which of the following statements is not true

(a) Paramagnetic substances are weakly attracted by magnetic field.

(b) Ferromagnetic substances cannot be magnetised permanently

(c) The domains in antiferromagnetic substances are oppositely oriented with respect to each other

(d) Pairing of electrons cancels their magnetic moment in the diamagnetic substances.

20. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because .....

(a) All the domains get oriented in the direction of magnetic field

(b) All the domains get oriented in the direction opposite to the direction of magnetic field

(c) Domains get oriented randomly

(d) Domains are not affected by magnetic field

21. Which of the following represents correct order of conductivity in solids

(a) $K_{metals} >> K_{insulators} < K_{semiconductors}$

(b) $K_{metals} << K_{insulators} < K_{semiconductors}$

(c) $K_{metals}, K_{semiconductors} > K_{insulators} = \text{zero}$

(d) $K_{metals} < K_{semiconductors} > K_{insulators} \neq \text{zero}$

22. The substance which does not show sharp melting point is

(a) KCl (b) Glass

(c) Ice (d) Diamond

23. Which of the following statements about amorphous solids is incorrect

(a) They melt over a range of temperature

(b) They are anisotropic

(c) There is no orderly arrangement of particles

(d) They are rigid and incompressible

24. Which of the following substance possess antiferromagnetic property

(a) Fe_3O_4 (b) CrO_2

(c) H_2O (d) MnO

25. Which is the most stable allotrope of sulphur

(a) Octahedral sulphur (b) Monoclinic sulphur

(c) Plastic sulphur (d) Colloidal sulphur

26. Which of the following is an amorphous solid

(a) Graphite (C) (b) Quartz glass (SiO_2)

(c) Chrome alum (d) Silicon carbide (SiC)

27. Which of the following is true about the value of refractive index of quartz glass

(a) Same in all directions

(b) Different in different directions

(c) Cannot be measured

(d) Always zero

28. Iodine molecules are held in the crystals lattice by.....

(a) London forces (b) Dipole-dipole interactions

(c) Covalent bonds (d) Coulombic forces

29. Which of the following is a network solid

(a) SO_2(solid) (b) I_2

(c) Diamond (d) $H_2O(ice)$

30. Which of the following solids is not an electrical conductor

1. $Mg(s)$ 2. $TiO(s)$ 3. $I_2(s)$ 4. $H_2O(s)$

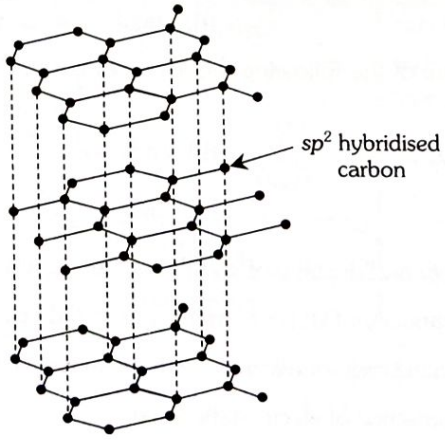
(a) Only 1 (b) Only 2

(c) 3 and 4 (d) 2, 3 and 4

31. Graphite is a good conductor of electricity due to the presence of.....

(a) Lone pair of electrons (b) Free valence electrons

(c) Cations (d) Anions



32. Which of the following oxides behaves as conductor or insulator depending upon temperature

(a) TiO (b) SiO_2

(c) TiO_3 (d) MgO

33. Which of the following oxides shows electrical properties like metals

(a) SiO_2 (b) MgO

(c) $SO_2(s)$ (d) CrO_2

34. Graphite cannot be classified as .....

(a) Conducting solid (b) Network solid

(c) Covalent solid (d) Ionic solid

35. Which of the following is not true about the ionic solids

(a) Bigger ions form the close packed structure

(b) Smaller ions occupy either the tetrahedral or the octahedral voids depending upon their size

(c) Occupation of all the voids is not necessary

(d) The fraction of octahedral or tetrahedral voids occupied depends upon the radii of the ions occupying the voids

2. Crystallography and Lattice

1. Which of the following is correct

	Crystal system	Axial distance	Axial angles	Examples
(a)	Cubic	$a \neq b = c$	$\alpha = \beta \neq \gamma = 90°$	Cu, KCl
(b)	Monoclinic	$a \neq b = c$	$\alpha = \beta = \gamma = 90°$	$PbCrO_2$, $PbCrO_4$
(c)	Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90°$	$CaCO_3$, HgS
(d)	Triclinic	$a = b = c$	$\alpha \neq \beta = \gamma \neq 90°$	$K_2Cr_2O_7$, $CuSO_4.5H_2O$

2. How many space lattices are obtainable from the different crystal systems

(a) 7 (b) 14

(c) 32 (d) 230

3. Example of unit cell with crystallographic dimensions $a \neq b \neq c$, $\alpha = \gamma = 90°$, $\beta \neq 90°$ is

(a) Calcite (b) Graphite

(c) Rhombic sulphur (d) Monoclinic Sulphur

4. The number of close neighbour in a body-centred cubic lattice of identical sphere is

(a) 8 (b) 6

(c) 4 (d) 2

5. The Lattice site in a pure crystal cannot be occupied by

(a) Molecule (b) Ion

(c) Electron (d) Atom

6. The correct statement in the following is

(a) The ionic crystal of *AgBr* has Schottky defect

(b) The unit cell having crystal parameters, $a = b \neq c$, $\alpha = \beta = 90°$, $\gamma = 120°$ is hexagonal

(c) In ionic compounds having Frenkel defect the ratio $\frac{r_+}{r_-}$ is high

(d) The coordination number of Na^+ ion in *NaCl* is 4

7. For tetrahedral coordination number, the radius ratio $\frac{r_{c^+}}{r_{a^-}}$ is

(a) 0.732 – 1.000 (b) 0.414 – 0.732

(c) 0.225 – 0.414 (d) 0.155 – 0.225

8. The number of nearest neighbour particles around each particle in a face centred cubic lattice/unit cell is

(a) 4 (b) 6

(c) 8 (d) 12

9. An *fcc* unit cell of aluminium contains the equivalent of how many atoms

(a) 1 (b) 2

(c) 3 (d) 4

10. The edge lengths of the unit cells in terms of the radius of spheres constituting *fcc*, *bcc* and simple cubic unit cells are respectively.....

(a) $2\sqrt{2}r, \frac{4r}{\sqrt{3}}, 2r$ (b) $\frac{4r}{\sqrt{3}}, 2\sqrt{2}r, 2r$

(c) $2r, 2\sqrt{2}r, \frac{4r}{\sqrt{3}}$ (d) $2r, \frac{4r}{\sqrt{3}}, 2\sqrt{2}r$

11. The number of tetrahedral voids in the unit cell of a face centered cubic lattice of similar atoms is

(a) 4 (b) 6

(c) 8 (d) 10

12. Which metal crystallizes in a simple cubic structure

(a) Polonium (b) Copper

(c) Nickel (d) Iron

13. If at cubic cell, atom A presents all corners and atom B at the centre of each face. What will be the molecular formula of the compounds, if all the atoms present on one body diagonal are replaced by atom C

(a) ABC_3 (b) $A_3B_{12}C_4$

(c) $A_3B_{12}C$ (d) $AB_{12}C_3$

14. The metal that crystallises in simple cubic system is

(a) *Po* (b) *Na*

(c) *Cu* (d) *Ag*

15. The packing efficiency of the face centered cubic (*fcc*), body centered cubic (*bcc*), and simple / primitive cubic (*pc*) lattices follows the order

(a) fcc > bcc > pc (b) bcc > fcc > pc

(c) pc > bcc > fcc (d) bcc > pc > fcc

3. Crystal Packing

1. The arrangement *ABC ABC ABC* ..... is referred as

(a) Octahedral close packing (b) Hexagonal close packing

(c) Tetragonal close packing (d) Cubic close packing

2. The ratio of close-packed atoms to tetrahedral holes in cubic close packing is

(a) 1 : 1 (b) 1 : 2

(c) 1 : 3 (d) 2 : 1

3. Three elements *A*, *B* and *C* crystallize into a cubic solid lattice. Atoms *A* occupy the corners, *B* atoms, the cube centres and *C* atoms, the edge centres. The formula of the compound is

(a) *ABC* (b) ABC_2

(c) ABC_3 (d) ABC_4

4. The contribution of particle at the edge centre of a particular unit cell is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

(c) 1 (d) $\frac{1}{8}$

5. In face centred cubic unit cell, what is the volume occupied

(a) $\frac{4}{3}\pi r^3$ (b) $\frac{8}{3}\pi r^3$

(c) $\frac{16}{3}\pi r^3$ (d) $\frac{64r^3}{3\sqrt{3}}$

6. In which pair most efficient packing is present

(a) *hcp* and *bcc* (b) *hcp* and *ccp*

(c) *bcc* and *ccp* (d) *bcc* and simple cubic cell

7. Which of the following statement is not true about the hexagonal close packing

(a) The coordination number is 12

(b) It has 74% packing efficiency

(c) Tetrahedral voids of the second layer are covered by the spheres of the third layer

(d) In this arrangement spheres of the fourth layer are exactly aligned with those of the first layer

8. The correct order of the packing efficiency in different types of unit cells is.....

(a) *fcc* < *bcc* < simple cubic (b) *fcc* > *bcc* > simple cubic

(c) *fcc* < *bcc* > simple cubic (d) *bvv* < *fcc* > simple cubic

9. Suppose the mass of a single Ag atom is 'm'. Ag metal crystallizes in fcc lattice with unit cell of length 'a'. The density of Ag metal in terms of 'a' and 'm' is

(a) $\frac{4m}{a^3}$ (b) $\frac{2m}{a^3}$

(c) $\frac{m}{a^3}$ (d) $\frac{m}{4a^3}$

10. Which is not the correct statement for ionic solids in which positive and negative ions are held by strong electrostatic attractive forces

(a) The radius r^+/r^- increases as coordination number increases

(b) As the difference in size of ions increases, coordination number increases

(c) When coordination number is eight, the r^+/r^- ratio lies between 0.225 to 0.414

(d) In ionic solid of the type *AX* (*ZnS*, Wurtzite) the coordination number of Zn^{2+} and S^{2-} respectively are 4 and 4

11. The number of octahedral sites per sphere in a *fcc* structure is

(a) 8 (b) 4

(c) 2 (d) 1

12. A solid is made of two elements X and Z. The atoms Z are in CCP arrangement while the atom X occupies all the tetrahedral sites. What is the formula of the compound

(a) XZ (b) XZ_2

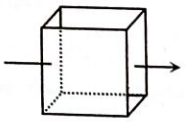
(c) X_2Z (d) X_2Z_3

13. Given that the radius of Na^+ ion is $0.95\,\text{Å}$ and that of Cl^- ion is $1.81\,\text{Å}$, hence in the close packed lattice of Cl^- ions Na^+ ions prefer to occupy

(a) Tetrahedral site (b) Octahedral site

(c) Cubic site (d) Trigonal site

14. In *NaCl* unit cell, all the ions lying along the axis as shown in the figure are removed. Then the number of Na^+ and Cl^- ions remaining in the unit cell are



(a) 4 and 4 (b) 3 and 3

(c) 1 and 1 (d) 4 and 3

15. Total no. of voids in 0.5 mole of a compound forming hexagonal closed packed structure are

(a) 6.022×10^{23} (b) 3.011×10^{23}

(c) 9.033×10^{23} (d) 4.516×10^{23}

16. In the cubic close packing, the unit cell has.....

(a) 4 tetrahedral voids each of which is shared by four adjacent unit cells

(b) 4 tetrahedral voids within the unit cell

(c) 8 tetrahedral voids each of which is shared by four adjacent unit cells

(d) 8 tetrahedral voids within the unit cells

17. In metallic solids, the number of atoms for the face–centered and the body– centered cubic unit cells, are respectively

(a) 2, 4 (b) 2, 2

(c) 4, 2 (d) 4, 4

18. An ionic compound is formed between a metal M and a non-metal Y. If M occupies half the octahedral voids in the cubic close-packed arrangement formed by Y, the chemical formula of the ionic compound is

(a) MY (b) MY_2

(c) M_2Y (d) MY_3

19. In a cubic close packed structure, fractional contributions of an atom at the corner and at the face in the unit cell are, respectively

(a) 1/8 and 1/2 (b) 1/2 and 1/4

(c) 1/4 and 1/2 (d) 1/4 and 1/8

4. Mathematical Analysis of Cubic System and Bragg's Equation

1. Bragg's law is given by the equation

(a) $n\lambda = 2\theta \sin\theta$ (b) $n\lambda = 2d \sin\theta$

(c) $2n\lambda = d \sin\theta$ (d) $n\frac{\theta}{2} = \frac{d}{2}\sin\theta$

2. To obtain a diffraction peak, for a crystalline solid with inter plane distance equal to the wavelength of incident X–ray radiation, the angle of incidence should be

(a) 90° (b) 0°

(c) 30° (d) 60°

3. If the angle of incidence of X-ray of wavelength 3Å which produces a second order diffracted beam from the (100) planes in a simple cubic lattice with interlayer spacing $a = 6$ Å is 30°, the angle of incidence that produces a first-order diffracted beam from the (200) planes is

(a) 15° (b) 45°

(c) 30° (d) 60°

5. Crystal Structure and Coordination Number

1. The interionic distance for cesium chloride crystal will be

(a) a (b) $\frac{a}{2}$

(c) $\frac{\sqrt{3}a}{2}$ (d) $\frac{2a}{\sqrt{3}}$

2. A solid has a structure in which 'W' atoms are located at the corners of a cubic lattice 'O' atoms at the centre of edges and 'Na' atoms at the centre of the cube. The formula for the compound is

(a) $NaWO_2$ (b) $NaWO_3$

(c) Na_2WO_3 (d) $NaWO_4$

3. The unit cell of a binary alloy composed of A and B metals, has a *ccp* structure with A atoms occupying the corners and B atoms occupying centres of each face of the cube. If during the crystallization of this alloy, in the unit cell two A atom are missed, the overall composition per unit cell is

(a) AB_6 (b) AB_4

(c) AB_8 (d) AB_{24}

4. Radius ratio of an ionic compound is 0.93. The structure of the above ionic compound is of

(a) $NaCl$ type (b) $CsCl$ type

(c) ZnS type (d) None of these

5. In the closest packed structure of a metallic lattice, the number of nearest neighbours of a metallic atom is

(a) Twelve (b) Four

(c) Eight (d) Six

6. The ionic radii of Rb^+ and I^- are 1.46 Å and 2.16Å. the most probable type of structure exhibited by it is

(a) $CsCl$ type (b) ZnS type

(c) $NaCl$ type (d) CaF_2 type

7. In which of the following structures coordination number for cations and anions in the packed structure will be same

(a) Cl^- ions form *fcc* lattice and Na^+ ions occupy all octahedral voids of the unit cell

(b) Ca^{2+} ions form *fcc* lattice and F^- ions occupy all the eight tetrahedral voids of the unit cell

(c) O^{2-} ions form *fcc* lattice and Na^+ ions occupy all the eight tetrahedral voids of the unit cell

(d) S^{2-} ions form *fcc* lattice and Zn^{2+} ions go into alternate tetrahedral voids of the unit cell

8. What is the coordination number in a square close packed structure in two dimensions

(a) 2 (b) 3

(c) 4 (d) 6

9. Which of the following statements is not true about $NaCl$ structure

(a) Cl^- ions are in *fcc* arrangement

(b) Na^+ ions has coordination number 4

(c) Cl^- ions has coordination number 6

(d) Each unit cell contains $4\,NaCl$ molecules

10. Which set of characteristics of ZnS crystal is correct

(a) Coordination number (4 : 4); *ccp*; Zn^{++} ion in the alternate tetrahedral voids

(b) Coordination number (6 : 6); *hcp*; Zn^{++} ion in all tetrahedral voids

(c) Coordination number (6 : 4); *hcp*; Zn^{++} ion in all octahedral voids

(d) Coordination number (4 : 4); *ccp*; Zn^{++} ion in all tetrahedral voids

11. In Na_2O having antifluorite structure

(a) Oxide ions have a cubic close packed arrangement and Na^+ occupy all the eight tetrahedral voids

(b) Oxide ions have a cubic close packed arrangement and Na^+ occupy all the octahedral voids

(c) Na^+ ions have a cubic close packed arrangement and O^{2-} occupy all the octahedral voids

(d) Na^+ ions have a cubic close arrangement and O^{2-} occupy all the tetrahedral voids

12. A unit cell of calcium fluoride has four calcium ions. The number of fluoride ions in the unit cell is

(a) 2 (b) 4

(c) 6 (d) 8

13. A mineral consists of a cubic close–packed structure formed by O^{2-} ions where half the octahedral voids are occupied by Al^{3+} and one eight of the tetrahedral voids are occupied by Mn^{2+}. The chemical formula of the mineral is

(a) $Mn_3Al_2O_6$ (b) $MnAl_2O_4$

(c) $MnAl_4O_7$ (d) $Mn_2Al_2O_5$

6. Defects in Crystal

1. Due to Frenkel defect, the density of ionic solids

(a) Increases (b) Decreases

(c) Does not change (d) Changes

2. When electrons are trapped into the crystal in anion vacancy, the defect is known as

(a) Schotky defect (b) Frenkel defect

(c) Stoichiometric defect (d) *F*-centres

3. Which of the following is true about the charge acquired by *p* -type semiconductors

(a) Positive

(b) Neutral

(c) Negative

(d) Depends on concentration of *p* impurity

4. Which of the following defects is also known as dislocation defect

(a) Frenkel defect

(b) Schottky defect

(c) Non-stoichiometric defect

(d) Simple interstitial defect

5. Schottky defects occurs mainly in electrovalent compounds where

(a) Positive ions and negative ions are of different size

(b) Positive ions and negative ions are of same size

(c) Positive ions are small and negative ions are big

(d) Positive ions are big and negative ions are small

6. The white ZnO turns yellow on heating because of

(a) Frenkel defect (b) Metal excess defect

(c) Metal deficiency defect (d) Schottky defect

7. Schottky defect generally appears in

(a) $NaCl$ (b) KCl

(c) $CsCl$ (d) All of these

8. The following is not a function of an impurity present in a crystal

(a) Establishing thermal equilibrium

(b) Having tendency to diffuse

(c) Contributing to scattering

(d) Introducing new electronic energy levels

9. If a non-metal is added to the interstitial sites of a metal then the metal becomes

(a) Softer (b) Less tensile

(c) Less malleable (d) More ductile

10. In $AgBr$ crystal, the ion size lies in the order $Ag^+ << Br^-$. The $AgBr$ crystal should have the following characteristics

(a) Defectless (perfect) crystal

(b) Schottky defect only

(c) Frenkel defect only

(d) Both Schottky and Frenkel defects

11. Which of the following defect is seen in FeO

(a) Metal excess defect (b) Metal deficiency defect

(c) Displacement defect (d) Impurity defect

12. To get a *n*-type semiconductor from silicon, it should be doped with a substance with valency.....

(a) 2 (b) 1

(c) 3 (d) 5

13. Which one of the following crystals does not exhibit Frenkel defect

(a) $AgBr$ (b) $AgCl$

(c) KBr (d) ZnS

14. Which kind of defects are introduced by doping

(a) Dislocation defect (b) Schottky defect

(c) Frenkel defect (d) Electronic defect

15. Silicon doped with electron rich impurity forms.....

(a) p-type semiconductor (b) n-type semiconductor

(c) Intrinsic semiconductor (d) Insulator

16. The defect that is more likely to occur in almost all types of ionic crystals is

(a) Non-stoichiometric defects

(b) Schottky defect

(c) Frenkel defect

(d) All the above

17. Schottky defect in a crystal arises due to

(a) Creation of equal number of cation and anion vacancies

(b) Creation of unequal number of cation and anion vacancies

(c) Migration of cations to interstitial voids

(d) Migration of anions to interstitial voids

7. IIT-JEE/ AIEEE

1. Which of the following is an example of covalent crystal solid **[2013]**

(a) Si (b) NaF

(c) Al (d) Ar

2. 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 **[2002]**

(a) 4 and 2 (b) 9 and 14

(c) 14 and 9 (d) 2 and 4

3. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre position. If one atom of B is missing from one of the face centred points, the formula of the compound is **[2011]**

(a) A_2B (b) AB_2

(c) A_2B_3 (d) A_2B_5

4. $CsBr$ crystal has bcc structure. It has an edge length of 4.3 Å. The shortest interionic distance between Cs^+ and Br^- ions is **[1995]**

(a) 1.86 Å (b) 3.72 Å

(c) 4.3 Å (d) 7.44 Å

5. Sodium metal crystallizes in a body centred cubic lattice with a unit cell edge of 4.29Å. The radius of sodium atom is approximately **[2015]**

(a) 1.86Å (b) 3.22Å

(c) 5.72Å (d) 0.93Å

6. 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 **[2009; 2012]**

(a) $75pm$ (b) $300pm$

(c) $240pm$ (d) $152pm$

7. $CsCl$ crystallizes in body centred cubic lattice. If 'a' its edge length then which of the following expressions is correct **[2014]**

(a) $r_{Cs^+} + r_{Cl^-} = 3a$ (b) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

(c) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$ (d) $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

8. In which of the following crystals alternate tetrahedral voids are occupied **[2005]**

(a) $NaCl$ (b) ZnS

(c) CaF_2 (d) Na_2O

9. In a compound, atoms of Y form ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. The formula of the compound will be **[2008]**

(a) X_2Y_3 (b) X_2Y

(c) X_3Y_4 (d) X_4Y_3

10. The correct statement for the molecule, CsI_3, is **[2014]**

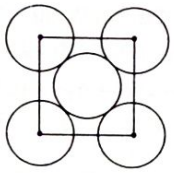
(a) It is a covalent molecule

(b) It contains Cs^+ and I_3^-

(c) It contains Cs^{3+} and I^- ions

(d) It contains Cs^+, I^- and lattice I_2 molecule

11. The packing efficiency of the two dimensional square unit cell shown below is



[2010]

(a) 39.27% (b) 68.02%

(c) 74.05% (d) 78.54%

12. Total volume of atoms present in face-centred cubic unit cell of a metal is (r is atomic radius) **[2006]**

(a) $\frac{20}{3}\pi r^3$ (b) $\frac{24}{3}\pi r^3$

(c) $\frac{12}{3}\pi r^3$ (d) $\frac{16}{3}\pi r^3$

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 2*g/cc* then find the radius of metal atom. $(N_A = 6\times10^{23})$. Give the answer in *pm* **[2006]**

(a) 217 *pm* (b) 210 *pm*

(c) 220 *pm* (d) 205 *pm*

14. How many unit cells are present in a cube-shaped ideal crystal of *NaCl* of mass 1.00 *g* [Atomic masses: $Na = 23, Cl = 35.5$] **[2003]**

(a) 2.57×10^{21} unit cells (b) 5.14×10^{21} unit cells

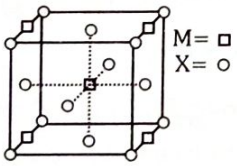
(c) 1.28×10^{21} unit cells (d) 1.71×10^{21} unit cells

15. A metal crystallizes 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 **[2017]**

(a) $2\sqrt{2}a$ (b) $\sqrt{2}a$

(c) $\frac{a}{\sqrt{2}}$ (d) $2a$

16. A compound M_PX_q has cubic close packing (ccp) arrangement of *X*. Its unit cell structure is shown below. The empirical formula of the compound is **[2012]**



(a) *MX* (b) MX_2

(c) M_2X (d) M_5X_{14}

17. In a solid '*AB*' having the *NaCl* structure, '*A*' atoms occupy the corners of the cubic unit cell. If all the face-centered atoms along one of the axes are removed, then the resultant stoichiometry of the solid is **[2001]**

(a) AB_2 (b) A_2B

(c) A_4B_3 (d) A_3B_4

18. What type of crystal defect is indicated in the diagram below **[2004]**

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

Cl^- □ Cl^- Na^+ □ Na^+

Na^+ Cl^- □ Cl^- Na^+ Cl^-

Cl^- Na^+ Cl^- Na^+ □ Na^+

(a) Interstitial defect

(b) Schottky defect

(c) Frenkel defect

(d) Frenkel and Schottky defects

19. 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 **[2013]**

(a) 7.01% (b) 4.08%

(c) 6.05% (d) 5.08%

20. Which type of 'defect' has the presence of cations in the interstitial sites **[2018]**

(a) Frenkel defect (b) Metal deficiency defect

(c) Schottky defect (d) Vacancy defect

8. NEET/ AIPMT/ CBSE-PMT

1. Most crystals show good cleavage because their atoms, ions or molecules are **[1991]**

(a) Weakly bonded together (b) Strongly bonded together

(c) Spherically symmetrical (d) Arranged in planes

2. In a face-centered cubic lattice, a unit cell is shared equally by how many unit cells **[2005]**

(a) 8 (b) 4

(c) 2 (d) 6

3. 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 **[2014]**

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

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

4. 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 **[2008;]**

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

5. The number of carbon atoms per unit cell of diamond unit cell is **[2013]**

(a) 1 (b) 4

(c) 8 (d) 6

6. The vacant space in bcc lattice cell is **[2015]**

(a) 26% (b) 48%

(c) 23% (d) 32%

7. An ionic compound has a unit cell consisting of *A* ions at the corners of a cube and *B* ions on the centres of the faces of the cube. The empirical formula for this compound would be **[2004; 2005]**

(a) AB (b) A_2B

(c) AB_3 (d) A_3B

8. The number of octahedral void (s) per atom present in a cubic close-packed structure is **[2012]**

(a) 1 (b) 3

(c) 2 (d) 4

9. Copper crystallises in *fcc* with a unit cell length of 361*pm*. What is the radius of copper atom **[2009; 2009; 2015]**

(a) 108 *pm* (b) 127 *pm*

(c) 157 *pm* (d) 181 *pm*

10. 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 **[2010]**

(a) 300 *pm* (b) 335 *pm*

(c) 250 *pm* (d) 200 *pm*

11. 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 **[2012]**

(a) 288 *pm* (b) 408 *pm*

(c) 144 *pm* (d) 204 *pm*

12. The edge length of face centred unit cubic cell is 508 *pm*. If the radius of the cation is 110 *pm*, the radius of the anion is **[1998; 2010]**

(a) 285 *pm* (b) 398 *pm*

(c) 144 *pm* (d) 618 *pm*

13. The intermetallic compound *LiAg* crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is **[1997]**

(a) Simple cube (b) Body-centred cube

(c) Face-centred cube (d) None of these

14. 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 **[2012]**

(a) ABO_2 (b) A_2BO_2

(c) $A_2B_3O_4$ (d) AB_2O_2

15. Which of the following statements is not correct **[2008]**

(a) The number of carbon atoms in an 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 0.52

(d) Molecular solids are generally volatile

16. Iron exhibits bcc structure at room temperature. Above $900^\circ C$, it transforms to *fcc* structure. The ratio of density of iron at room temperature to that at $900^\circ C$ (assuming molar mass and atomic radii of iron remains constant with temperature) is **[2018]**

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

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

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

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3\sqrt{2}}$

(c) $\frac{\pi}{4\sqrt{2}}$ (d) $\frac{\pi}{4}$

18. *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 $= 6.023 \times 10^{23} mol^{-1}$. *CsBr*, the density of *CsBr* is **[2006]**

(a) $8.25 g / cm^3$ (b) $4.25 g / cm^3$

(c) $42.5 g / cm^3$ (d) $0.425 g / cm^3$

19. 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 **[1994]**

(a) 4×10^{25} (b) 3×10^{25}

(c) 2×10^{25} (d) 1×10^{25}

20. 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 **[2013]**

(a) $20g\,mol^{-1}$ (b) $40g\,mol^{-1}$

(c) $30g\,mol^{-1}$ (d) $28g\,mol^{-1}$

21. 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. $(N_A = 6.02\times10^{23}mol^{-1})$ **[2016]**

(a) 154 pm (b) 352 pm

(c) 527 pm(d) 264 pm

22. The second order Bragg's diffraction of $X-$rays with $\lambda = 1$ Å from a set of parallel planes in a metal occurs at an angle of 60°. The distance between the scattering planes in the crystal is **[1998]**

(a) 0.575 Å (b) 1.00 Å

(c) 2.00 Å (d) 1.15 Å

23. Percentages of the free space in cubic close packed structure and in body centered packed structure are respectively **[2008]**

(a) 48% and 26% (b) 30% and 26%

(c) 26% and 32% (d) 32% and 48%

24. The pyknometric density of sodium chloride crystal is $2.165\times10^3\,kg\,m^{-3}$ while its X-rays density is $2.178\times10^3\,kg\,m^{-3}$. The fraction of unoccupied sites in sodium chloride crystal is **[2003]**

(a) 5.96×10^{-3} (b) 5.96

(c) 5.96×10^{-2} (d) 5.96×10^{-1}

25. A solid compound XY has $NaCl$ structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be **[2011]**

(a) 241.5 pm (b) 165.7 pm

(c) 275.1 pm (d) 322.5 pm

26. The ionic radii of A^+ and B^- ions are $0.98\times10^{-10}m$ and $1.81\times10^{-10}m$. The coordination number of each ion in AB is **[2016]**

(a) 6 (b) 4

(c) 8 (d) 2

27. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are **[2016]**

(a) 6, 6 (b) 8, 4

(c) 4, 4 (d) 4, 8

28. The correct statement regarding defects in crystalline solid is **[2015]**

(a) Schottky defects have no effect on the density of crystalline solids

(b) Frenkel defects decrease the density of crystalline solids

(c) Frenkel defect is a dislocation defect

(d) Frenkel defect is found in halides of alkaline metals

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

(a) Frenkel defect (b) Interstitial positions

(c) F-centres (d) Schottky defects

30. With which one of the following elements silicon should be doped so as to give p-type of semiconductor **[2008]**

(a) Selenium (b) Boron

(c) Germanium (d) Arsenic

31. If $NaCl$ is doped with 10^{-4} mol% of $SrCl_2$, the concentration of cation vacancies will be **[2007]**

$(N_A = 6.02\times10^{23}mol^{-1})$

(a) $6.02\times10^{15}mol^{-1}$ (b) $6.02\times10^{16}mol^{-1}$

(c) $6.02\times10^{17}mol^{-1}$ (d) $6.02\times10^{14}mol^{-1}$

32. Which is the incorrect statement **[2017]**

(a) $FeO_{0.98}$ has non stoichiometric metal deficiency defect

(b) Density decreases in case of crystals with Schottky's defect

(c) $NaCl(s)$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezo electric crystal

(d) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal

9. AIIMS

1. The solid $NaCl$ is a bad conductor of electricity since **[1980]**

(a) In solid $NaCl$ there are no ions

(b) Solid $NaCl$ is covalent

(c) In solid $NaCl$ there is no velocity of ions

(d) In solid $NaCl$ there are no electrons

2. The crystal system of a compound with unit cell dimensions $a = 0.387$, $b = 0.387$ and $c = 0.504nm$ and $\alpha = \beta = 90^\circ$ and $\gamma = 120^\circ$ is **[2004]**

(a) Cubic (b) Hexagonal

(c) Orthorhombic (d) Rhombohedral

3. An example of a body centred cube is **[1996]**

(a) Sodium (b) Magnesium

(c) Zinc (d) Copper

4. 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 **[2005]**

(a) Z (b) $2Z$

(c) $Z/2$ (d) $Z/4$

5. An AB_2 type structure is found in **[2002]**

(a) $NaCl$ (b) Al_2O_3

(c) CaF_2 (d) N_2O

6. The Ca^{2+} and F^- are located in CaF_2 crystal, respectively at face centred cubic lattice points and in **[2006]**

(a) Tetrahedral voids (b) Half of tetrahedral voids

(c) Octahedral voids (d) Half of octahedral voids

7. If AgI crystallises in zinc blende structure with I^- ions at lattice points. What fraction of tetrahedral voids is occupied by Ag^+ ions **[2007]**

(a) 25% (b) 50%

(c) 100% (d) 75%

8. 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 **[1991]**

(a) 454 (b) 804

(c) 852 (d) 908

9. An element (atomic mass 100 *g/mol*) having *bcc* structure has unit cell edge 400 *pm*. Then density of the element is **[2002, 15]**

(a) $10.376\,g/cm^3$ (b) $5.188\,g/cm^3$

(c) $7.289\,g/cm^3$ (d) $2.144\,g/cm^3$

10. Body centered cubic lattice has a coordination number of **[1996]**

(a) 4 (b) 8

(c) 12 (d) 6

11. If the pressure on a $NaCl$ structure is increased, then its coordination number will **[2015]**

(a) Increase (b) Decrease

(c) Remain the same (d) Either (b) or (c)

12. What is the coordination number of sodium in Na_2O **[2003]**

(a) 6 (b) 4

(c) 8 (d) 2

13. In a solid lattice the cation has left a lattice site and is located at an interstitial position, the lattice defect is **[1982,91]**

(a) Interstitial defect (b) Valency defect

(c) Frenkel defect (d) Schottky defect

10. Assertion and Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Diamond is a precious stone.
Reason : Carbon atoms are tetrahedrally arranged in diamond. **[AIIMS 1994]**

2. Assertion : In crystal lattice, the size of the cation is larger in a tetrahedral hole than in an octahedral hole.
Reason : The cations occupy more space than anions in crystal packing. **[AIIMS 1996]**

3. Assertion : Crystalline solids have short range order.
Reason : Amorphous solids have long range order. **[AIIMS 1999]**

4. Assertion : Quasi-crystals form when certain molten alloys cool very slowly.
Reason : Quasi-crystals have shorts-range as well as long-range order in their arrangements. **[MP PMT 2008]**

5. Assertion : No compound has both Schottky and Frenkel defects.
Reason : Both defects change the density of the solid. **[AIIMS 2008]**

6. Assertion : Graphite is an example of tetragonal crystal system.
Reason : For a tetragonal system, $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$ **[AIIMS 2006]**

17. Solid State – Answers Keys

1. Types of Solid and their Properties

1	a	2	b	3	b	4	b	5	d
6	a	7	a	8	d	9	a	10	c
11	c	12	d	13	a	14	d	15	b
16	d	17	b	18	a	19	b	20	a
21	a	22	b	23	b	24	d	25	a
26	b	27	a	28	a	29	c	30	c
31	b	32	c	33	d	34	d	35	d

2. Crystallography and Lattice

1	c	2	b	3	d	4	a	5	c
6	b	7	c	8	d	9	d	10	a
11	c	12	a	13	c	14	d	15	a

3. Crystal Packing

1	d	2	b	3	c	4	b	5	c
6	b	7	d	8	b	9	a	10	c
11	d	12	c	13	b	14	b	15	c
16	d	17	c	18	b	19	a		

4. Mathematical Analysis of Cubic System and Bragg's Equation

1	b	2	c	3	c				

5. Crystal Structure and Coordination Number

1	c	2	b	3	b	4	b	5	a
6	c	7	a	8	c	9	b	10	a
11	a	12	d	13	b				

6. Defects in Crystal

1	c	2	d	3	b	4	a	5	b
6	b	7	d	8	a	9	b	10	d
11	b	12	d	13	c	14	d	15	b
16	b	17	a						

7. IIT-JEE/ AIEEE

1	a	2	d	3	d	4	b	5	a
6	d	7	c	8	b	9	d	10	b
11	d	12	d	13	a	14	a	15	c
16	b	17	d	18	b	19	b	20	a

8. NEET/ AIPMT/ CBSE-PMT

1	d	2	d	3	b	4	c	5	c
6	d	7	c	8	a	9	b	10	b
11	a	12	c	13	b	14	d	15	a
16	c	17	a	18	b	19	a	20	d
21	b	22	d	23	c	24	a	25	a
26	a	27	b	28	c	29	c	30	b
31	c	32	ad						

9. AIIMS

1	c	2	b	3	a	4	b	5	c
6	a	7	b	8	d	9	b	10	b
11	a	12	b	13	c				

10. Assertion & Reason

1	b	2	d	3	d	4	b	5	d
6	d								