9. Amorphous substances show
(A) Short and long range order
(B) Short range order
(C) Long range order
(D) Have no sharp M.P.
(a) A and C are correct (b) B and C are correct
(c) C and D are correct (d) B and D are correct

10. The characteristic features of solids are [AMU 1994]
(a) Definite shape
(b) Definite size
(c) Definite shape and size
(d) Definite shape, size and rigidity

11. Which one of the following is a good conductor of electricity [MP PMT 1994; AFMC 2002]
(a) Diamond (b) Graphite
(c) Silicon (d) Amorphous carbon

12. A crystalline solid [Kerala CET (Med.) 2003]
(a) Changes abruptly from solid to liquid when heated
(b) Has no definite melting point
(c) Undergoes deformation of its geometry easily
(d) Has an irregular 3-dimensional arrangements
(e) Softens slowly

13. Diamond is an example of [MP PET/PMT 1998; CET Pune 1998]
(a) Solid with hydrogen bonding
(b) Electrovalent solid
(c) Covalent solid
(d) Glass

14. The solid $NaCl$ is a bad conductor of electricity since [AIIMS 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

15. The existence of a substance in more than one solid modifications is known as **or** Any compound having more than two crystal structures is called [MP PMT 1993; MP PET 1999]
(a) Polymorphism (b) Isomorphism
(c) Allotropy (d) Enantiomorphism

16. Which is not a property of solids [MP PET 1995]
(a) Solids are always crystalline in nature
(b) Solids have high density and low compressibility
(c) The diffusion of solids is very slow
(d) Solids have definite volume

17. Which solid will have the weakest intermolecular forces
(a) Ice (b) Phosphorus
(c) Naphthalene (d) Sodium fluoride

18. Dulong and Petit's law is valid only for [KCET 2004]
(a) Metals (b) Non-metals
(c) Gaseous elements (d) Solid elements

19. Which of the following is an example of metallic crystal solid
(a) C (b) Si
(c) W (d) $AgCl$

20. Under which category iodine crystals are placed among the following
(a) Ionic crystal (b) Metallic crystal
(c) Molecular crystal (d) Covalent crystal

21. Among solids the highest melting point is established by [Kerala CET (Med.) 2002]
(a) Covalent solids (b) Ionic solids
(c) Pseudo solids (d) Molecular solids

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

23. Which of the following is non-crystalline solid
(a) $CsCl$ (b) $NaCl$
(c) CaF_2 (d) Glass

24. The lustre of a metal is due to [AFMC 1998]
(a) Its high density (b) Its high polishing
(c) Its chemical inertness (d) Presence of free electrons

25. A crystalline solid have [DCE 2001]
(a) Long range order (b) Short range order
(c) Disordered arrangement (d) None of these

26. Crystalline solids are [Pb. PMT 1999]
(a) Glass (b) Rubber
(c) Plastic (d) Sugar

27. Davy and Faraday proved that [Kerala CET (Med.) 2002]
(a) Diamond is a form of carbon
(b) The bond lengths of carbon containing compounds are always equal
(c) The strength of graphite is minimum compared to platinum
(d) Graphite is very hard

28. Which one of the following metal oxides is antiferromagnetic in nature [MP PET 2002]
(a) MnO_2 (b) TiO_2
(c) VO_2 (d) CrO_2

29. In graphite, carbon atoms are joined together due to [AFMC 2002]
(a) Ionic bonding (b) Vander Waal's forces
(c) Metallic bonding (d) Covalent bonding

30. Which of the following is not correct for ionic crystals [Orissa JEE 2002]
(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

31. Which of the following is a molecular crystal
(a) SiC (b) $NaCl$
(c) Graphite (d) Ice

32. Quartz is a crystalline variety of [Pb. PMT 2000]
(a) Silica (b) Sodium silicate
(c) Silicon carbide (d) Silicon

33. Which type of solid crystals will conduct heat and electricity [RPET 2000]
(a) Ionic (b) Covalent
(c) Metallic (d) Molecular

34. Which of the following is an example of covalent crystal solid
(a) Si (b) NaF
(c) Al (d) Ar

35. Which of the following is an example of ionic crystal solid
(a) Diamond (b) LiF
(c) Li (d) Silicon

36. Which one is an example of amorphous solid
(a) Glass (b) Salt
(c) Cesium chloride (d) Calcium fluoride

37. Silicon is [MHCET 2004]

(a) Semiconductor (b) Insulator
(c) Conductor (d) None of these

38. Which of the following statements about amorphous solids is incorrect **[KCET 2004]**

(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

39. The ability of a given substance to assume two or more crystalline structure is called **[DCE 2004]**

(a) Amorphism (b) Isomorphism
(c) Polymorphism (d) Isomerism

40. Glass is

(a) Supercooled liquid (b) Crystalline solid
(c) Amorphous solid (d) Liquid crystal

Crystallography and Lattice

1. The correct statement in the following is **[MP PET 1997]**

(a) The ionic crystal of $AgBr$ has Schottky defect
(b) The unit cell having crystal parameters, $a = b \neq c$, $\alpha = \beta = 90^o$, $\gamma = 120^o$ is hexagonal
(c) In ionic compounds having Frenkel defect the ratio $\frac{\gamma_+}{\gamma_-}$ is high
(d) The coordination number of Na^+ ion in $NaCl$ is 4

2. Which of the following is correct **[DPMT 1997]**

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

3. Tetragonal crystal system has the following unit cell dimensions **[MP PMT 1993]**

(a) $a = b = c$ and $\alpha = \beta = \gamma = 90^o$
(b) $a = b \neq c$ and $\alpha = \beta = \gamma = 90^o$
(c) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^o$
(d) $a = b \neq c$ and $\alpha = \beta = 90^o$, $\gamma = 120^o$

4. Rhombic sulphur has the following structure

(a) Open chain
(b) Tetrahedral
(c) Puckered 6-membered ring
(d) Puckered 8-membered ring

5. Space lattice of CaF_2 is **[MP PMT 1993]**

(a) Face centred cubic
(b) Body centred cubic
(c) Simple cubic
(d) Hexagonal closed packing

6. For cubic coordination the value of radius ratio is

(a) $0.732 - 1.000$ (b) $0.225 - 0.414$
(c) $0.000 - 0.225$ (d) $0.414 - 0.732$

7. How many space lattices are obtainable from the different crystal systems **[MP PMT 1996; MP PET/PMT 1998]**

(a) 7 (b) 14
(c) 32 (d) 230

8. Example of unit cell with crystallographic dimensions $a \neq b \neq c$, $\alpha = \gamma = 90^o$, $\beta \neq 90^o$ is **[AFMC 1998]**

(a) Calcite (b) Graphite
(c) Rhombic sulphur (d) Monoclinic sulphur

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

(a) 8 (b) 4
(c) 2 (d) 6

10. The maximum radius of sphere that can be fitted in the octahedral hole of cubical closed packing of sphere of radius r is

(a) 0.732 r (b) 0.414 r
(c) 0.225 r (d) 0.155 r

11. The unit cell of a $NaCl$ lattice

(a) Is body centred cube (b) Has $3Na^+$ ions
(c) Has $4NaCl$ units (d) Is electrically charged

12. For tetrahedral coordination number, the radius ratio $\frac{r_{c^+}}{r_{a^-}}$ is **[KCET 2000]**

(a) $0.732 - 1.000$ (b) $0.414 - 0.732$
(c) $0.225 - 0.414$ (d) $0.155 - 0.225$

13. What type of lattice is found in potassium chloride crystal **[MP PMT 1996]**

(a) Face centred cubic (b) Body centred cubic
(c) Simple cubic (d) Simple tetragonal

14. The three dimensional graph of lattice points which sets the pattern for the whole lattice is called

(a) Space lattice (b) Simple lattice
(c) Unit cell (d) Crystal lattice

15. Crystals can be classified into ...... basic crystal habits **[MP PMT 1994]**

(a) 3 (b) 7
(c) 14 (d) 4

16. How many molecules are there in the unit cell of sodium chloride **[MP PMT 199**

(a) 2 (b) 4
(c) 6 (d) 8

17. In a crystal, the atoms are located at the position of **[AMU 1985]**

(a) Maximum P.E. (b) Minimum P.E.
(c) Zero P.E. (d) Infinite P.E.

18. The total number of lattice arrangements in different crystal systems is **[KCET (Engg.) 2001]**

(a) 3 (b) 7
(c) 8 (d) 14

19. Monoclinic crystal has dimension **[DCE 2000]**

(a) $a \neq b \neq c, \alpha = \gamma = 90°, \beta \neq 90°$
(b) $a = b = c, \alpha = \beta = \gamma = 90°$
(c) $a = b \neq c, \alpha = \beta = \gamma = 90°$
(d) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90°$

20. The low solubility of $BaSO_4$ in water can be attributed to **[CBSE PMT 1991]**

(a) High lattice energy (b) Dissociation energy
(c) Low lattice energy (d) Ionic bond

21. Bravais lattices are of **[MP PMT 1997]**

(a) 8 types (b) 12 types
(c) 14 types (d) 9 types

22. The structure of $TlCl$ is similar to $CsCl$. What would be the radius ratio in $TlCl$

(a) $0.155-0.225$ (b) $0.225-0.414$

(c) $0.414-0.732$ (d) $0.732-1.000$

23. Structure similar to zinc blende is found in

(a) $AgCl$ (b) $NaCl$

(c) $CuCl$ (d) $TlCl$

24. The structure of Na_2O crystal is

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

(c) ZnS type (d) Antifluorite

25. Structure of ZnS is

(a) Body centred cubic (b) Face centred cubic

(c) Simple cube (d) Fluorite structure

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

(a) Cubic (b) Hexagonal

(c) Orthorhombic (d) Rhombohedral

27. The number of tetrahedral voids in the unit cell of a face centered cubic lattice of similar atoms is [Kerala PMT 2004]

(a) 4 (b) 6

(c) 8 (d) 10

28. An fcc unit cell of aluminium contains the equivalent of how many atoms [DCE 2003]

(a) 1 (b) 2

(c) 3 (d) 4

Crystal packing

1. 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 [AIIMS 2005]

(a) Z (b) 2 Z

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

2. The close packing represents ABC ABC...... order of

(a) Body centred cubic packing

(b) Face centred cubic packing

(c) Simple cubic packing

(d) Hexagonal cubic closed packing

3. The arrangement *ABC ABC ABC* ..... is referred as [MP PET 2001]

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

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

4. The number of close neighbour in a body-centred cubic lattice of identical sphere is [MP PET 2001]

(a) 8 (b) 6

(c) 4 (d) 2

5. The number of equidistant oppositely charged ions in a sodium chloride crystal is [MP PET 2001]

(a) 8 (b) 6

(c) 4 (d) 2

6. 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]

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

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

7. An AB_2 type structure is found in [AIIMS 2002]

(a) $NaCl$ (b) Al_2O_3

(c) CaF_2 (d) N_2O

8. Potassium crystallizes with a [MP PET/PMT 1998]

(a) Face-centred cubic lattice

(b) Body-centred cubic lattice

(c) Simple cubic lattice

(d) Orthorhombic lattice

9. If the number of atoms per unit in a crystal is 2, the structure of crystal is

(a) Octahedral

(b) Body centred cubic *bcc*

(c) Face centred cubic fcc

(d) simple cubic

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

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

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

11. The number of octahedral sites per sphere in a *fcc* structure is [MP PMT 2000,

(a) 8 (b) 4

(c) 2 (d) 1

12. Hexagonal close packed arrangement of ions is described as [MP PMT 1994]

(a) ABC ABA (b) ABC ABC

(c) ABABA (d) ABBAB

13. An example of a body cube is [AIIMS 1996]

(a) Sodium (b) Magnesium

(c) Zinc (d) Copper

14. An example of fluorite structure is

(a) NaF (b) SrF_2

(c) $AlCl_3$ (d) SiF_4

15. In which of the following crystals alternate tetrahedral voids are occupied? [IIT 2005]

(a) $NaCl$ (b) ZnS

(c) CaF_2 (d) Na_2O

16. Which of the following contains rock salt structure

(a) SrF_2 (b) MgO

(c) Al_2O_3 (d) All

17. In the fluorite structure, the coordination number of Ca^{2+} ion is

(a) 4 (b) 6

(c) 8 (d) 3

18. The ratio of close-packed atoms to tetrahedral holes in cubic close packing is [Pb. PMT 1998]

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

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

19. A solid is made of two elements X and Z. The atoms Z are in CCP arrangement while the atom X occupy all the tetrahedral sites. What is the formula of the compound [UPSEAT 2004]

(a) XZ (b) XZ_2

(c) X_2Z (d) X_2Z_3

20. 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 [CBSE PMT 2004; AIEEE 2005]

(a) AB (b) A_2B

(c) AB_3 (d) A_3B

21. The vacant space in the bcc unit cell is

(a) 32% (b) 23%

(c) 26% (d) None of these

22. The number of octahedral voids in a unit cell of a cubical closest packed structure is

(a) 1 (b) 2

(c) 4 (d) 8

23. In the closest packed structure of a metallic lattice, the number of nearest neighbours of a metallic atom is [JIPMER 2002]

(a) Twelve (b) Four

(c) Eight (d) Six

24. In the rock salt structure, the number of formula units per unit cell is equal to

(a) 1 (b) 2

(c) 3 (d) 4

25. Hexagonal close packing is found in crystal lattice of [MH CET 2002]

(a) Na (b) Mg

(c) Al (d) None of these

26. Which ion has the largest radius from the following ions

(a) Na^+ (b) Mg^{2+}

(c) Al^{3+} (d) Si^{4+}

Mathematical analysis of cubic system and Bragg's equation

1. The formula for determination of density of unit cell is

(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. Potassium fluoride has $NaCl$ type structure. What is the distance between K^+ and F^- ions if cell edge is $a\ cm$

(a) $2a\ cm$ (b) $a/2\ cm$

(c) $4a\ cm$ (d) $a/4\ cm$

3. An element occurring in the bcc structure has 12.08×10^{23} unit cells. The total number of atoms of the element in these cells will be [MP PET 1994]

(a) 24.16×10^{23} (b) 36.18×10^{23}

(c) 6.04×10^{23} (d) 12.08×10^{23}

4. If an atom is present in the centre of the cube, the participation of that atom per unit cell is

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

(c) $\frac{1}{2}$ (d) $\frac{1}{8}$

5. For an ionic crystal of the general formula AX and coordination number 6, the value of radius ratio will be [MP PMT 1993]

(a) Greater than 0.73

(b) In between 0.73 and 0.41

(c) In between 0.41 and 0.22

(d) Less than 0.22

6. The number of spheres contained (i) in one body centred cubic unit cell and (ii) in one face centred cubic unit cell, is

(a) In (i) 2 and in (ii) 4 (b) In (i) 3 and in (ii) 2

(c) In (i) 4 and in (ii) 2 (d) In (i) 2 and in (ii) 3

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

(a) $1.86\ Å$ (b) $3.72\ Å$

(c) $4.3\ Å$ (d) $7.44\ Å$

8. In octahedral holes (voids)

(a) A simple triangular void surrounded by four spheres

(b) A bi-triangular void surrounded by four spheres

(c) A bi-triangular void surrounded by six spheres

(d) A bi-triangular void surrounded by eight spheres

9. Bragg's law is given by the equation [MP PMT 1995, 2002]

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

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

10. 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[CBSE PMT 1994;

(a) 4×10^{25} (b) 3×10^{25}

(c) 2×10^{25} (d) 1×10^{25}

11. In the crystals of which of the following ionic compounds would you expect maximum distance between centres of cations and anions[CBSE PMT 199

(a) LiF (b) CsF

(c) CsI (d) LiI

12. The number of unit cells in $58.5\,g$ of $NaCl$ is nearly [MP PMT 2000, 01]

(a) 6×10^{20} (b) 3×10^{22}

(c) 1.5×10^{23} (d) 0.5×10^{24}

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

14. In the Bragg's equation for diffraction of X-rays, n represents for [MP PMT 2000]

(a) Quantum number (b) An integer

(c) Avogadro's numbers (d) Moles

15. In a face centred cubic cell, an atom at the face contributes to the unit cell [Karnataka (Engg./Med.) 2000; AFMC 2001]

(a) 1/4 part (b) 1/8 part

(c) 1 part (d) 1/2 part

16. The interionic distance for cesium chloride crystal will be [MP PET 2002]

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

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

17. Sodium metal crystallizes as a body centred cubic lattice with the cell edge 4.29 Å. What is the radius of sodium atom [AIIMS 1999]

(a) $1.857\times10^{-8}cm$ (b) $2.371\times10^{-7}cm$

(c) $3.817\times10^{-8}cm$ (d) $9.312\times10^{-7}cm$

18. For an ionic crystal of the type AB, the value of (limiting) radius ratio is 0.40. The value suggests that the crystal structure should be

(a) Octahedral (b) Tetrahedral

(c) Square planar (d) Plane triangle

19. 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 [AIIMS 1991]

(a) 454 (b) 804

(c) 852 (d) 908

20. If the value of ionic radius ratio $\left(\frac{r_c}{r_a}\right)$ is 0.52 in an ionic compound, the geometrical arrangement of ions in crystal is

(a) Tetrahedral (b) Planar

(c) Octahedral (d) Pyramidal

21. The number of atoms/molecules contained in one face centred cubic unit cell of a monoatomic substance is [CPMT 1989, 94; CBSE PMT 1989, 96; NCERT 1990; MP PET 1993; KCET 1999]

(a) 1 (b) 2

(c) 4 (d) 6

22. The number of atoms/molecules contained in one body centered cubic unit cell is

(a) 1 (b) 2

(c) 4 (d) 6

23. It the distance between Na^+ and Cl^- ions in sodium chloride crystal is X pm, the length of the edge of the unit cell is [KCET 2004]

(a) 4X pm (b) X/4 pm

(c) X/2 pm (d) 2X pm

24. The edge of unit cell of FCC Xe crystal is $620\,pm$. The radius of Xe atom is [MP PET 2004]

(a) 219.25 Pm (b) 235.16 Pm

(c) 189.37 Pm (d) 209.87 Pm

25. In orthorhombic, the value of a, b and c are respectively $4.2Å, 8.6Å$ and $8.3Å$. given the molecular mass of the solute is $155\,gm\,mol^{-1}$ and that of density is $3.3\,gm/cc$, the number of formula units per unit cell is [Orrisa JEE 2005]

(a) 2 (b) 3

(c) 4 (d) 6

26. A metal has bcc structure and the edge length of its unit cell is $3.04Å$. The volume of the unit cell in cm^3 will be [Orrisa JEE 2005]

(a) $1.6\times10^{21}cm^3$ (b) $2.81\times10^{-23}cm^3$

(c) $6.02\times10^{-23}cm^3$ (d) $6.6\times10^{-24}cm^3$

27. In face centred cubic unit cell edge length is [DPMT 2005]

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

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

Crystal structure and Coordination number

1. 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 [KCET 1996]

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

(c) Na_2WO_3 (d) $NaWO_4$

2. Potassium crystallizes in a bcc lattice, hence the coordination number of potassium in potassium metal is [KCEE 1993]

(a) 0 (b) 4

(c) 6 (d) 8

3. Body centered cubic lattice has a coordination number of [AIIMS 1996; MP PMT 2002]

(a) 4 (b) 8

(c) 12 (d) 6

4. A compound is formed by elements A and B. This crystallizes in the cubic structure when atoms A are the corners of the cube and atoms B are at the centre of the body. The simplest formula of the compounds is [KCET 1993; CBSE PMT 2000; Kerala PMT 2002]

(a) AB (b) AB_2

(c) A_2B (d) AB_4

5. Coordination number for Cu is [AMU 1982]

(a) 1 (b) 6

(c) 8 (d) 12

6. In the crystal of $CsCl$, the nearest neighbours of each Cs ion are[MP PET 19

(a) Six chloride ions (b) Eight chloride ions

(c) Six Cs ions (d) Eight Cs ions

7. In a cubic structure of compound which is made from X and Y, where X atoms are at the corners of the cube and Y at the face centres of the cube. The molecular formula of the compound is [AIIMS 2000]

(a) X_2Y (b) X_3Y

(c) XY_2 (d) XY_3

8. Ferrous oxide has a cubic structure and each edge of the unit cell is 5.0 Å. Assuming density of the oxide as $4.0g-cm^{-3}$, then the number of Fe^{2+} and O^{2-} ions present in each unit cell will be [MP PET 200

(a) Four Fe^{2+} and four O^{2-}

(b) Two Fe^{2+} and four O^{2-}

(c) Four Fe^{2+} and two O^{2-}

(d) Three Fe^{2+} and three O^{2-}

9. Which of the following statements is not true about $NaCl$ structure [DCE 2001]

(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 $4NaCl$ molecules

10. In $CsCl$ structure, the coordination number of Cs^+ is [MP PMT 2001]

(a) Equal to that of Cl^-, that is 6

(b) Equal to that of Cl^-, that is 8

(c) Not equal to that of Cl^-, that is 6

(d) Not equal to that of Cl^-, that is 8

11. 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 **[IIT Screening 2001]**

(a) AB_2 (b) A_2B
(c) A_4B_3 (d) A_3B_4

12. In solid $CsCl$ each Cl is closely packed with how many Cs **[MP PET 2003]**

(a) 8 (b) 6
(c) 10 (d) 2

13. In A^+B^- ionic compound, radii of A^+ and B^- ions are $180\ pm$ and $187\ pm$ respectively. The crystal structure of this compound will be

(a) $NaCl$ type (b) $CsCl$ type
(c) ZnS type (d) Similar to diamond

14. In which of the following substances the carbon atom is arranged in a regular tetrahedral structure **[NCERT 1978]**

(a) Diamond (b) Benzene
(c) Graphite (d) Carbon black

15. The coordination number of a metal crystallizing in a hexagonal close packed structure is **[NCERT 1978; IIT 1999]**

(a) 4 (b) 12
(c) 8 (d) 6

16. The structure of MgO is similar to $NaCl$. What would be the coordination number of magnesium

(a) 2 (b) 4
(c) 6 (d) 8

17. How many chloride ions are there around sodium ion in sodium chloride crystal **[NCERT 1979, 80; CPMT 1988; BHU 1982, 87; MP PET 1995, 99]**

(a) 3 (b) 8
(c) 4 (d) 6

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

(a) Weakly bonded together
(b) Strongly bonded together
(c) Spherically symmetrical
(d) Arranged in planes

19. An example of a non-stoichiometric compound is **[NCERT 1983]**

(a) Al_2O_3 (b) Fe_3O_4
(c) NiO_2 (d) PbO

20. If the radius ratio is in the range of $0.731-1$, then the coordination number will be

(a) 2 (b) 4
(c) 6 (d) 8

21. If the radius ratio is in the range of $0.414-0.732$, then the coordination number will be

(a) 2 (b) 4
(c) 6 (d) 8

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

(a) 6 (b) 4
(c) 8 (d) 2

23. The ratio of cationic radius to anionic radius in an ionic crystal is greater than 0.732. Its coordination number is **[KCET 2003]**

(a) 6 (b) 8
(c) 1 (d) 4

24. In $CsCl$ lattice the coordination number of Cs^+ ion is

(a) 2 (b) 4
(c) 8 (d) 12

25. Crystal structure of $NaCl$ is **[NCERT 1982; BHU 1995]**

(a) fcc (b) bcc
(c) Both (a) and (b) (d) None

26. In $NaCl$ lattice the coordination number of Cl^- ion is

(a) 2 (b) 4
(c) 6 (d) 8

27. In zinc blende structure the coordination number of Zn^{2+} ion is

(a) 2 (b) 4
(c) 6 (d) 8

28. Coordination number of Na^+ ion in rock salt is **[BVP 2004]**

(a) 12 (b) 4
(c) 8 (d) 6

29. The number of Cl^- ions around one Na^+ in $NaCl$ crystal lattice is **[MP PET 1996; BVP 2004]**

(a) 12 (b) 4
(c) 8 (d) 6

30. The number of atoms present in unit cell of a monoatomic substance of simple cubic lattice is **[Pb. PMT 2004]**

(a) 6 (b) 3
(c) 2 (d) 1

31. The coordination number of a metal crystallizing in a hexagonal close packed chep structure is **[MP PMT 2004]**

(a) 12 (b) 8
(c) 4 (d) 6

32. Which of the following statement(s) is(are) correct **[IIT 1998]**

(a) The coordination number of each type of ion in $CsCl$ crystal is 8
(b) A metal that crystallizes in bcc structure has a coordination number of 12
(c) A unit cell of an ionic crystal shares some of its ions with other unit cells
(d) The length of the unit cell in $NaCl$ is 552 pm $(r_{Na^+}=95\ pm;\ r_{Cl^-}=181\ pm)$

33. The co-ordination number of Na^+ in $NaCl$ is **[Orrisa JEE 2005]**

(a) 6 (b) 8
(c) 4 (d) 1

34. In the calcium fluoride structure the co-ordination number of the cation and anions are respectively **[J & K 2005]**

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

Defects in crystal

1. Certain crystals produce electric signals on application of pressure. This phenomenon is called **[BHU 2005]**

(a) Pyroelectricity (b) Ferroelectricity
(c) Peizoelectricity (d) Ferrielectricity

2. Which defect causes decrease in the density of crystal **[KCET 2000, 05]**

(a) Frenkel (b) Schottky

(c) Interstitial (d) $F-$centre

3. The correct statement regarding $F-$centre is
(a) Electron are held in the voids of crystals
(b) $F-$centre produces colour to the crystals
(c) Conductivity of the crystal increases due to $F-$centre
(d) All

4. Doping of silicon (Si) with boron (B) leads to [UPSEAT 2004]
(a) n-type semiconductor (b) p-type semiconductor
(c) Metal (d) Insulator

5. If $NaCl$ is doped with $10^{-3} mol\ \%\ SrCl_2$, then the concentration of cation vacancies will be
(a) $1\times10^{-3} mol\%$ (b) $2\times10^{-3} mol\%$
(c) $3\times10^{-3} mol\%$ (d) $4\times10^{-3} mol\%$

6. In the laboratory, sodium chloride is made by burning the sodium in the atmosphere of chlorine which is yellow in colour. The cause of yellow colour is
(a) Presence of Na^+ ions in the crystal lattice
(b) Presence of Cl^- ions in the crystal lattice
(c) Presence of electron in the crystal lattice
(d) Presence of face centered cubic crystal lattice

7. Frenkel defect is caused due to [MP PET 1994]
(a) An ion missing from the normal lattice site creating a vacancy
(b) An extra positive ion occupying an interstitial position in the lattice
(c) An extra negative ion occupying an interstitial position in the lattice
(d) The shift of a positive ion from its normal lattice site to an interstitial site

8. Which one of the following has Frenkel defect [MP PMT 2000]
(a) Sodium chloride (b) Graphite
(c) Silver bromide (d) Diamond

9. Schottky defect generally appears in [DCE 2004]
(a) $NaCl$ (b) KCl
(c) $CsCl$ (d) All of these

10. Schottky defect in crystals is observed when [CBSE PMT 1998; KCET 2002]
(a) Density of crystal is increased
(b) Unequal number of cations and anions are missing from the lattice
(c) An ion leaves its normal site and occupies an interstitial site
(d) Equal number of cations and anions are missing from the lattice

11. Ionic solids, with Schottky defects, contain in their structure [CBSE PMT 1994]
(a) Equal number of cation and anion vacancies
(b) Anion vacancies and interstitial anions
(c) Cation vacancies only
(d) Cation vacancies and interstitial cations

12. The following is not a function of an impurity present in a crystal[MP PET 1995]
(a) Establishing thermal equilibrium
(b) Having tendency to diffuse
(c) Contributing to scattering
(d) Introducing new electronic energy levels

13. Due to Frenkel defect, the density of ionic solids [MP PET 1996; MP PMT 2002]
(a) Increases (b) Decreases
(c) Does not change (d) Changes

14. Point defects are present in [MP PMT 1997]
(a) Ionic solids (b) Molecular solids
(c) Amorphous solids (d) Liquids

15. If a non-metal is added to the interstitial sites of a metal then the metal becomes [DCE 2001]
(a) Softer (b) Less tensile
(c) Less malleable (d) More ductile

16. 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

17. Frenkel and Schottky defects are [BHU 2003]
(a) Nucleus defects (b) Non-crystal defects
(c) Crystal defects (d) None of these

18. Which one of the following is the most correct statement
(a) Brass is an interstitial alloy, while steel is a substitutional alloy
(b) Brass is a substitutional alloy, while steel is an interstitial alloy
(c) Brass and steel are both substitutional alloys
(d) Brass and steel are both interstitial alloys

19. The flame colours of metal ions are due to [KCET 2003]
(a) Frenkel defect (b) Schottky defect
(c) Metal deficiency defect (d) Metal excess defect

20. Which one of the following crystals does not exhibit Frenkel defect [MP PET 200
(a) $AgBr$ (b) $AgCl$
(c) KBr (d) ZnS

21. In a solid lattice the cation has left a lattice site and is located at an interstitial position, the lattice defect is [AIIMS 1982, 1991; DCE 2002; J & K 2005]
(a) Interstitial defect (b) Valency defect
(c) Frenkel defect (d) Schottky defect

22. When electrons are trapped into the crystal in anion vacancy, the defect is known as [BHU 2005]
(a) Schotky defect (b) Frenkel defect
(c) Stoichiometric defect (d) F-centres

23. Schottky defect defines imperfection in the lattice structure of a [AIIMS 2002]
(a) Solid (b) Liquid
(c) Gas (d) Plasma

CT Critical Thinking

Objective Questions

1. Amorphous solids are
(a) Solid substance in real sense
(b) Liquid in real sense
(c) Supercooled liquid
(d) Substance with definite melting point

2. Silicon is found in nature in the form of [MH CET 2002]
(a) Body centered cubic structure
(b) Hexagonal close-packed structure
(c) Network solid
(d) Face centered cubic structure

3. A match box exhibits [MP PET 1993, 95]
(a) Cubic geometry (b) Monoclinic geometry
(c) Orthorhombic geometry (d) Tetragonal geometry

4. Which has no rotation of symmetry [Orrisa JEE 2004]
(a) Hexagonal (b) Orthorhombic

(c) Cubic (d) Triclinic

5. Which of the following molecules has three-fold axis of symmetry [UPSEAT 2004]

(a) NH_3 (b) C_2H_4

(c) CO_2 (d) SO_2

6. Which one possess a antifluorite structure

(a) Na_2O (b) MgO

(c) Fe_2O_3 (d) Al_2O_3

7. Which one of the following is the biggest ion [MP PET 1993]

(a) Al^{+3} (b) Ba^{+2}

(c) Mg^{+2} (d) Na^{+}

8. 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 [CBSE PMT 1998]

(a) $285\ pm$ (b) $398\ pm$

(c) $144\ pm$ (d) $618\ pm$

9. An element (atomic mass $100g/mol$) having bcc structure has unit cell edge $400\ pm$. Then density of the element is [CBSE PMT 1996; AIIMS 2002]

(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. If the pressure on a $NaCl$ structure is increased, then its coordination number will [AFMC 2000]

(a) Increase (b) Decrease

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

11. The pyknometric density of sodium chloride crystal is $2.165 \times 10^3 kg\,m^{-3}$ while its X-rays density is $2.178 \times 10^3 kg\,m^{-3}$. The fraction of unoccupied sites in sodium chloride crystal is [CBSE PMT 2003]

(a) 5.96×10^{-3} (b) 5.96

(c) 5.96×10^{-2} (d) 5.96×10^{-1}

12. Which of the following statements is correct for $CsBr_3$ [IIT 1996]

(a) It is a covalent compound

(b) It contains Cs^{3+} and Br^- ions

(c) It contains Cs^+ and Br_3^- ions

(d) It contains Cs^+, Br^- and lattice Br_2 molecule

13. In which compound 8 : 8 coordination is found [EAMCET 1984]

(a) $CsCl$ (b) MgO

(c) Al_2O_3 (d) All of these

14. If the coordination of Ca^{2+} in CaF_2 is 8, then the coordination number of F^- ion would be

(a) 3 (b) 4

(c) 6 (d) 8

15. For some crystals, the radius ratio for cation and anion is 0.525, its coordination number will be

(a) 2 (b) 4

(c) 6 (d) 8

16. The basic building unit of all silicates is [UPSEAT 2002]

(a) SiO_4 square planar (b) $[SiO_4]^{4-}$ tetrahedron

(c) SiO_4 octahedron (d) SiO_4 linear

17. What type of crystal defect is indicated in the diagram below [AIEEE 2004]

$Na^+\ Cl^-\ Na^+\ Cl^-\ Na^+\ Cl^-$

$Cl^-\ \square\ Cl^-\ Na^+\ \square\ Na^+$

$Na^+\ Cl^-\ \square\ Cl^-\ Na^+\ Cl^-$

$Cl^-\ Na^+\ Cl^-\ Na^+\ \square\ Na^+$

(a) Interstitial defect

(b) Schottky defect

(c) Frenkel defect

(d) Frenkel and Schottky defects

18. Which of the following is a three dimensional silicate [MHCET 2003]

(a) Mica (b) Spodumene

(c) Zeolite (d) None of these

(e) 12

Assertion & Reason

For AIIMS Aspirants

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 : In any ionic solid (MX) with Schottky defects, the number of positive and negative ions are same.

Reason : Equal number of cation and anion vacancies are present. [IIT Screening 2001]

5. Assertion : Space or crystal lattice differ in symmetry of the arrangement of points.

Reason : $n\lambda = 2d\sin\theta$, is known as Bragg's equation.

6. Assertion : In close packing of spheres, a tetrahedral void is surrounded by four spheres whereas an octahedral void is surrounded by six spheres.

Reason : A tetrahedral void has a tetrahedral shape whereas an octahedral void has an octahedral shape.

7. Assertion : Cyclic silicates and chain silicates have the same general molecular formula.

Reason : In cyclic silicates, three corners of each SiO_4 tetrahedron are shared while in chain silicates only two are shared with other tetrahedra.

8. Assertion : The presence of a large number of Schottky defects in $NaCl$ lowers its density.

Reason : In $NaCl$, there are approximately 10^6 Schottky pairs per cm^3 at room temperature.

9. Assertion : Anion vacancies in alkali halides are produced by heating the alkali halide crystals with alkali metal vapour.
Reason : Electrons trapped in anion vacancies are referred to as F-centres.

10. Assertion : Electrical conductivity of semiconductors increases with increasing temperature.
Reason : With increase in temperature, large number of electrons from the valence band can jump to the conduction band.

11. Assertion : On heating ferromagnetic or ferrimagnetic substances, they become paramagnetic.
Reason : The electrons change their spin on heating.

12. Assertion : Lead zirconate is a piezoelectric crystal.
Reason : Lead zirconate crystals have no dipole moment.

Answers

Type of solid and Their properties

1	a	2	b	3	a	4	a	5	b
6	c	7	c	8	b	9	d	10	d
11	b	12	a	13	c	14	c	15	a
16	a	17	a	18	d	19	c	20	c
21	b	22	d	23	d	24	d	25	a
26	d	27	a	28	a	29	d	30	d
31	d	32	a	33	c	34	a	35	b
36	a	37	a	38	b	39	c	40	ac

Crystallography and Lattice

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

Crystal packing

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

Mathematical analysis of cubic system and Bragg's equation

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

Crystal structure and Coordination number

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

Defects in crystal

1	c	2	b	3	d	4	d	5	a
6	c	7	d	8	c	9	d	10	d
11	a	12	a	13	c	14	a	15	b
16	c	17	c	18	c	19	d	20	c
21	c	22	d	23	a				

Critical Thinking Questions

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

Assertion & Reason

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