SOLID STATE- ASSIGNMENT-1

1) Which one of the following is a molecular crystal ?
(a) Rock salt (b) Quartz **(c) Dry ice** (d) Diamond

2) Percentages of free space in cubic close packed structure and in body centered packed structure are respectively
(a) 32% and 48% (b) 48% and 26% (c) 30% and 26% **(d) 26% and 32%**

3) The number of octahedral sites per sphere in fcc structure is
(a) 8 (b) 4 (c) 2 **(d) 1**

4) Which of the following exists as covalent crystals in the solid state?
(a) Phosphorus (b) Iodine **(c) Silicon** (d) Sulphur

5) In a face-centered 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
(a) AB_2 (b) A_2B_3 **(c) A_2B_5** (d) A_2B

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

7) In a solid 'AB' having NaCl structure, 'A' atoms occupy the corners of the cubic unit cell.If all the face-centred atoms along one of the axes are removed,then the resultant stoichiometry of the solid is
(a) AB_2 (b) A_2B (c) A_4B_3 **(d) A_3B_4**

8) 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
(a) MX **(b) MX_2** (c) M_2X (d) M_5X_{14}

9) Perovskite,a mineral of titnium is found to contain calcium atoms at the corners,oxygen atoms at the face centres and titanium atoms at the centre of the cube.Oxidation number of titanium in the mineral is
(a) +2 (b) +3 **(c) +4** (d) +1

10) In an ionic compound A^+X^-,the radii of A^+ and X^- ions are 1.0pm and 2.0pm respectively.The volume of the unit cell of the crystal AX will be
(a) 27pm^3 (b) 64pm^3 (c) 125pm^3 **(d) 216pm^3**

11) Sodium metal crystallize in a body-centred cubic lattice with a unit cell edge of $4.29\overset{0}{A}$.The radius of sodium metal is approximately
(a) $5.72\overset{0}{A}$ (b) $0.93\overset{0}{A}$ **(c) $1.86\overset{0}{A}$** (d) $3.22\overset{0}{A}$

12) If a is the length of side of a cube,the distance between the body-centred atom and one corner atom in the will be
(a) $\frac{2}{\sqrt{3}}a$ (b) $\frac{4}{\sqrt{3}}a$ (c) $\frac{3}{\sqrt{4}}a$ **(d) $\frac{3}{\sqrt{2}}a$**

13) Edge length of a cube is 400pm,its body diagonal would be
(a) 500pm (b) 600pm (c) 566pm **(d) 693pm**

14) The number of atoms in 100g of a fcc crystal with density=10.0g/cm^3 and cell edge equal to 200pm is equal to
(a) 5×10^{24} (b) 5×10^{25} (c) 6×10^{23} (d) 2×10^{25}

15) Ice crystallizes in a hexagonal lattice having a volume of the unit cell as $132 \times 10^{-24} cm^{-3}$.If density of ice at the given temperature is $0.92 gcm^{-3}$, then number of H_2O molecules per unit cell is

(a) 1 (b) 2 (c) 3 **(d) 4**

16) The correct statement regarding defects in crystalline solids is

(a) Frenkel defect is a dislocation defect

(b) Frenkel defect is found in halids of alkaline metals

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

(d) Frenkel defects decrease the density of crystalline solids

17) 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.

18) Iodine molecules are held in the crystals lattice by.......................... .

(a) London forces (b) dipole-dipole interactions (c) covalent bonds

(d) coulombic forces.

19) The energy gap(E_8)between valence band and conduction band for diamond,silicon and germanium are in the order

(a) E_8(diamond) > E_8(silicon) > E_8(germanium)

(b) E_8(diamond) > E_8(silicon)< E_8(germanium) (c) E_8(diamond)=E_8(silicon)=E_8(germanium)

(d) E_8(diamond) > E_8(silicon) > E_8(germanium)

20) Which of the following is a network solid?

(a) SO_2 (Solid) (b) I_2 **(c) Diamond** (d) H_2O (Ice)

21) Which of the following oxides shows electrical properties like metals?

(a) SiO_2 (b) MgO (c) SO_2 (s) **(d) CrO_2**

22) Each rubidium halide crystallising in the NaCl type lattice has a unit cell length 0.30 $\overset{0}{A}$ greater than for corresponding potassium salt ($r_{K^+}=1.33\overset{0}{A}$) of the same halogen.Hence,ionic radius of Rb^+ is

(a) $1.03\overset{0}{A}$ (b) $1.18\overset{0}{A}$ **(c) $1.48\overset{0}{A}$** (d) $1.63\overset{0}{A}$

23) To get an n-type semiconductor from silicon, it should be doped with a substance with valence......................... .

(a) 2 (b) 1 (c) 3 **(d) 5**

24) In which of the following structures coordination number for cations and anions in the packed structure will be same?

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

(b) Ca^{2+} ions from 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 from fcc lattice and Zn^{2+} ions go into alternate tetrahedral voids of the unit cell.

25) If the position of Na^+ and Cl^- are interchanged in NaCl having fcc arrangement of Cl ions then in the unit cell of Nacl $^-$ ions then in the unit cell of Nacl

(a) Na^+ ions will decrease by 1 while Cl^- ions will increase by 1

(b) Na^+ ions will increase by 1 while Cl^- ions will decrease by 1

(c) Number of Na^+ and Cl^- ions will remain the same

(d) The crtystal structure of NaCl will change

26) 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.

27) The correct order to 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) bcc < fcc > simple cubic

28) Which of the following defects id is also known as dislocation defect?
(a) Frenkel defect (b) Schottky defect (c) Non-stoichiometric defect
(d) Simple interstitial defect

29) The density of KBr is 2.75g/cm^3.The length of the unit cell is 654pm.Atomic mass of K=39,Br=80.Then what is true about the predicted nature of the solid?
(a) It has 4K^+ and 4 Br^- ions per cell (b) It is face-centred
(c) It has rock-salt type structure (d) It can have Schottky defects

30) Which one of the following defects does not affect density of the cruystal?
(a) Schottky defect (b) Interstitial defect **(c) Frenkel defect** (d) Both in (b) and (c)

31) An element with molar mass $2.7 \times 10^{-2} kg$mol^{-1}forms a cubic unit cell with edge length 405 pm. If its density is$2.7 \times 10^3 kg$ m^{-3} , what is the nature of the cubic unit cell?
Answer : Density, $\rho = \frac{Z \times M}{a^3 \times N_A} \quad or \quad Z = \frac{\rho \times a^3 \times N_A}{M}$ ....(i)
Here, M (molar mass of the element) = 2.7×10kg mol^{-1}
a(edge length) =405×10^{-12}m = 4.05×10^{-10}m
ρ (density) = 2.7×10^3 kg m^{-3}
N_A (Avogadro's number) = 6.022×10^{23} mol^{-1}
Substituting these values in expression (i), we get
Thus, there are 4 atoms of the element present per unit cell. Hence, the cubic unit cell must be facecentre or cubic close packed.

32) Calculate the packing efficiency in case of a metal crystal for simple cubic lattice.
Answer : Suppose the edge length of the unit cell = a and radius of the sphere = r Since the spheres are touching each other, a = 2 r Now, there are eight spheres at the corners of the cube: Each sphere at the corner is shared by eight unit cells and the contribution per unit cell is 1/8 so that number of spheres per unit cell is 8 x 1/8 = 1 Volume of cube = a^3 = $(2r)^3$ = $8r^3$
Since simple cubic unit cell has only one atom per unit cells the volume of space occupied is $\frac{4}{3}\pi r^3$

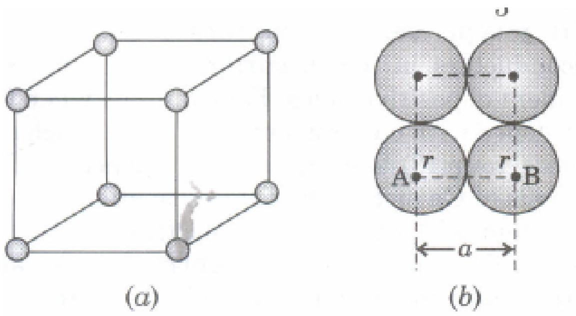

Fig. Simple Cubic Unit Cell

$$Packing \quad efficiency = \frac{Volume \quad of \quad one \quad sphere}{Volume \quad of \quad cubic \quad unit \quad cell} \times 100$$

$$\frac{\frac{4}{3}\pi r^3}{8r^3} \times 100$$

$$= 52.37$$

$$or \quad 52.4$$