Date : **TEST ID: XIICH0102**
Marks : **CHEMISTRY**

THE SOLID STATE

Single Correct Answer Type

31. Which crystal is expected to be soft and have low melting point?
a) Covalent b) Metallic c) Molecular d) Ionic

32. The elements commonly used for making transistors are
a) C and Si b) Ga and In c) P and As d) Si and Ge

33. Silver (atomic weight $= 108$ g mol^{-1}) has a density of 10.5 g cm^{-3}. The number of silver atoms on a surface of area 10^{-12}m^2 can be expressed in scientific notation as $y \times 10^x$. The value of x is
a) 3 b) 5 c) 7 d) 9

34. The first order reflection $(n = 1)$ from a crystal of the X-ray from a copper anode tube $(\lambda = 1.54$ Å$)$occurs at an angle of 45°. What is the distance between the set of plane causing the diffraction?
a) 0.1089 nm b) 0.1089 m c) 0.905 Å d) 1.089×10^{-9}m

35. What is the number of tetrahedral voids per atom in a crystal?
a) 1 b) 2 c) 6 d) 8

36. Iodine is a
a) Electrovalent solid b) Atomic solid c) Molecular solid d) Covalent solid

37. In CsCl type structure the coordination number of $Cs^+$and Cl^- are
a) 6, 6 b) 6, 8 c) 8, 8 d) 8, 6

38. 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 :
a) $AB\ O_2$ b) A_2BO_2 c) $A_2B_3O_4$ d) AB_2O_2

39. The example of orthosilicate is :
a) $MgCaSi_2O_6$ b) Mg_2SiO_4 c) $Fe_2O_3SiO_2$ d) $Ba_3Al_2Si_6O_8$

40. A compound CuCl has face centred cubic structure. Its density is 3.4 g cm^{-3}. The length of unit cell is :
a) 5.783Å b) 6.783Å c) 7.783Å d) 8.783Å

41. The orthorhombic, the value of a, $b$and $c$are respectively 4.2 Å, $6.8A$ Å and 8.3 Å. Given the molecular mass of the solute is 155 g mol^{-1} and that of density is 3.3g/cc, the number of formula units per unit cell is
a) 2 b) 3 c) 4 d) 6

42. Which one of the following is a covalent crystal?
a) Rock salt b) Ice c) Quartz d) Dry ice

43. LiF is a/an :
a) Ionic crystal b) Metallic crystal c) Covalent crystal d) Molecular crystals

44. A binary solid (A^+B^-) has a rock salt structure. If the edge length is 400 pm and radius of cation is 75 pm the radius of anion is :
a) 100 pm b) 125 pm c) 250 pm d) 325 pm

45. The limiting radius ratio for tetrahedral shape is
a) 0 to 0.155 b) 0.255 to 0.414 c) 0.155 to 0.225 d) 0.414 to 0.732

46. A metallic element has a cubic lattice. Each edge of the unit of cell is 2Å. The density of the metal is 2.5 g cm^{-3}. The unit cells in 200 g of metal are
a) 1×10^{24} b) 1×10^{20} c) 1×10^{22} d) 1×10^{25}

47. Potassium has a bcc structure with nearest neighbour distance 4.52 Å. Its atomic weight is 39. Its density will be :

a) 454 kg m^{-3} b) 804 kg m^{-3} c) 852 kg m^{-3} d) 910 kg m^{-3}

48. Lithium forms body centred cube structure. The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be :
a) 300 pm b) 240 pm c) 152 pm d) 75 pm

49. Bragg's equation is :
a) $n\lambda = 2\theta \sin\theta$ b) $n\lambda = 2d \sin\theta$ c) $2n\lambda = d \sin\theta$ d) $\lambda = (2d/n) \sin\theta$

50. The intermetallic compound LiAg has a cubic crystalline structure in which each Li atom has 8 nearest neighbor silver atoms and $vice - versa$. What is the type of unit cell?
a) Body centred cubic
b) Face centred cubic
c) Simple cubic for either Li atoms alone or Ag atoms alone
d) None of the above

51. In the 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
a) A_2B b) AB_2 c) A_2B_2 d) A_2B_5

52. Which compound has highest lattice energy?
a) LiBr b) LiCl c) LiI d) LiF

53. In a face centred cubic cell, an atom at the face centre is shared by :
a) 4 unit cells b) 2 unit cells c) 1 unit cell d) 6 unit cells

54. Extremely pure samples of Ge and Si are non-conductors, but their conductivity increases suddenly on introducing ....in their crystal lattice.
a) As b) B c) Both (a) and (b) d) None of these

55. Iodine crystals are :
a) Metallic solid b) Ionic solid c) Molecular solid d) Covalent solid

56. 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

57. The number of atoms present in a simple cubic unit cell are :
a) 4 b) 3 c) 2 d) 1

58. An AB_2 type structure is found in :
a) NaCl b) CaF_2 c) Al_2O_3 d) N_2O

59. A cubic crystal possesses in all .....elements of symmetry.
a) 9 b) 13 c) 1 d) 23

60. A solid compound contains X, Y and Z atoms in a cubic lattice with X atom occupying the corners. Y atoms in the body centred positions and Z atoms at the centres of faces of the unit cell. What is the empirical formula of the compound?
a) XY_2Z_3 b) XYZ_3 c) $X_2Y_2Z_3$ d) X_8YZ_6

Date :
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TEST ID: XIICH01/002
CHEMISTRY

THE SOLID STATE

ANSWER KEY

31)	c	32)	d	33)	c	34)	c
35)	b	36)	c	37)	c	38)	d
39)	b	40)	a	41)	c	42)	c
43)	a	44)	b	45)	b	46)	d
47)	d	48)	c	49)	b	50)	a
51)	d	52)	d	53)	b	54)	c
55)	c	56)	b	57)	d	58)	b
59)	d	60)	b				

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: HINTS AND SOLUTIONS :

31 **(c)**
Follow characteristics of molecular solids.

32 **(d)**
Si and Ge are used for making transistors.

33 **(c)**
Volume of one mole of silver atoms $= \frac{108}{10.5}\text{cm}^3/\text{mol}$
Volume of one silver atom $= \frac{108}{10.5} \times \frac{1}{6.022 \times 10^{23}}\ \text{cm}^3$
So, $\frac{4}{3}\pi r^3 = \frac{108}{10.5} \times \frac{1}{6.022 \times 10^{23}} = 1.708 \times 10^{-23}$
$r^3 = 0.407 \times 10^{-23}\text{cm}^3 = 0.407 \times 10^{-29}\text{m}^3$
Area of each silver atom,
$\pi r^2 = \pi(0.407 \times 10^{-29}\ \text{m}^3)^{2/3}$
So, number of silver atoms in given area
$$= \frac{10^{-12}}{(0.407 \times 10^{-29}\ \text{m}^3)^{2/3}} = \frac{10^8}{\pi \times 2}$$
$$= 1.6 \times 10^7 = y \times 10^x$$
So, $x = 7$

34 **(c)**
$n\lambda = 2d\ \sin\theta$
$1 \times 1.54 = 2d\ \sin 45°$
$1 \times 1.54 = 2d \times 0.850$
$$2d = \frac{1.54}{0.850} = 0.905\ \text{Å}$$

35 **(b)**
In the close packing of 'n' atoms, the number of tetrahedral voids are '$2n$'. Hence, their number per atom is 2.

37 **(c)**
The coordination number is 8 : 8 in $Cs^+ : Cl^-$
The coordination number is 6 : 6 in $Na^+ : Cl^-$

38 **(d)**
In a cubic close packing, the number of octahedral voids is equal to number of atoms and number of tetrahedral voids is equal to the twice the number of atoms
Number of atoms is a ccp array = 1

	A^{2+}	B^+	O^{2-}
$\therefore$	$1 \times 2 \times \frac{1}{4}$	1	1
	$\frac{1}{2}$	1	1
or	1	2	2

AB_2O_2

39 **(b)**
In orthosilicate SiO_4^{2-} ion exist as discrete unit.

40 **(a)**
Molecular mass of CuCl = 99
$n = 4$ for face centred cubic cell

$\because$ $Density = \dfrac{n \times \text{mol. wt.}}{V \times \text{av. no.}}$

$= \dfrac{4 \times 99}{a^3 \times 6.023 \times 10^{23}}$

Or $3.4 = \dfrac{4 \times 99}{a^3 \times 6.023 \times 10^{23}}$

$\therefore$ $a = 5.783 \times 10^{-8}$ cm

$= 5.783$Å

41 **(c)**

$Z = \dfrac{V \times N \times d}{m}$

$= \dfrac{4.2 \times 8.6 \times 8.3 \times 10^{-21} \times 6.023 \times 10^{23} \times 3.3}{155}$

$= 3.14$

≈ 4

42 **(c)**

Quartz (SiO_2) is a covalent crystal.

43 **(a)**

LiF is an ionic crystal. An ionic solid has ions as constituent units at lattice points held by oppositely charged ions.

44 **(b)**

Edge $= 2r^+ + 2r^-$

$\therefore$ $400 = 2 \times 75 + 2r^-$

$\therefore$ $r^- = 125$ pm

45 **(b)**

For tetrahedral shape, limiting radius ratio is $0.225 - 0.414$.

46 **(d)**

Number of unit cells $= \dfrac{\text{mass of metal}}{\text{mass of one unit cell}}$

Given, edge length of unit cell $= 2\text{Å} = 2 \times 10^{-8}$ cm

Mass of metal $= 200$ g

Density of metal $= 2.5$ g cm^{-3}

Volume of unit cell $= (\text{edge length})^3 = (2 \times 10^{-8})^3$

$= 8 \times 10^{-24}$ cm^3

Mass of one unit cell $=$ volume $\times$ density

$= 8 \times 10^{-24} \times 2.5$

$= 20 \times 10^{-24}$

$\therefore$ No. of unit cells in 200 g metal $= \dfrac{\text{mass of metal}}{\text{mass of one unit cell}}$

$= \dfrac{200}{20 \times 10^{-24}}$

$= 10 \times 10^{24} = 1.0 \times 10^{25}$

47 **(d)**

For bcc, $r = \dfrac{\sqrt{3}}{2} = a$

Or $a = \dfrac{2r}{\sqrt{3}} = \dfrac{2 \times 4.52}{1.732}$

$= 5.219\ \text{Å} = 522$ pm.

Density $= \dfrac{n \times M}{a^3 \times N_A \times 10^{-30}}$

$= \dfrac{2 \times 39}{(522)^3 \times (6.02 \times 10^{23}) \times 10^{-30}}$

$= 0.91 \text{g/cm}^3 = 910$ kg m^{-3}

48 **(c)**

For bcc structure

49 **(b)**

Bragg's equation is $n\lambda = 2d \sin\theta$

50 **(a)**

The bcc structure has co-ordination no. of eight.

51 **(d)**

Number of atoms (A) per unit cell $= 8 \times \frac{1}{8} = 1$

Number of atoms (B) per unit cell $= (6-1) \times \frac{1}{2} = \frac{5}{2}$

(One atom B is missing)

Thus, formula is $A_1B_{5/2} = A_2B_5$

52 **(d)**

Due to small anion, it possess maximum ionic nature.

53 **(b)**

The fcc unit cell has 8 atoms at the eight corners and one atom at each of six faces. The atom at the face is shared by two unit cells.

54 **(c)**

Doping of elements of group 14 (Ge and Si) with group 15 (As) elements produces excess of electrons and shows n -type conduction, the symbol n indicating flow of negative charge in them. Doping of elements of group 14 (Ge and Si) with group 13 (B) elements products hole (electron deficiency) in the crystal and shows p-type conduction, the symbol p indicating flow of positive charge.

55 **(c)**

Molecular solids are the substances having molecules as constituent units having interparticle forces such as van der waal's forces or hydrogen bonds.

57 **(d)**

The number of atoms present in sc, fcc and bcc unit cell are 1, 4, 2 respectively.

58 **(b)**

N_2O is gas; CaF_2 is AB_2 type crystalline solid.

59 **(d)**

These are characteristic elements of symmetry of a cubic crystal.

60 **(b)**

Since atom X is present at corner and one corner is shared by eight unit cells,

Number of X atoms per unit cell $= \frac{1}{8} \times 8 = 1$

Atom Y is present at body centred position and used by only one unit cell. So, number of Y atoms per unit cell $= 1$

Atom Z is present at the center of each face, so shared by two unit cells,

Thus, number of Z atoms per unit cell $= \frac{1}{2} \times 6 = 3$

Hence, the formula of compound $= XYZ_3$