Chapter 15. Solid State

1. Which is the incorrect statement?
(a) Density decreases in case of crystals with Schottky defect.
(b) $NaCl_{(s)}$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.
(c) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.
(d) $FeO_{0.98}$ has non-stoichiometric metal deficiency defect. *(NEET 2017)*

2. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are
(a) 4 and 2 (b) 6 and 6
(c) 8 and 4 (d) 4 and 8 *(NEET-II 2016)*

3. 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. ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(a) 527 pm (b) 264 pm
(c) 154 pm (d) 352 pm *(NEET-I 2016)*

4. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in *AB* is
(a) 8 (b) 2
(c) 6 (d) 4 *(NEET-I 2016)*

5. The vacant space in *bcc* lattice unit cell is
(a) 48% (b) 23%
(c) 32% (d) 26% *(2015)*

6. The correct statement regarding defects in crystalline solids is
(a) Frenkel defects decrease the density of crystalline solids
(b) Frenkel defect is a dislocation defect
(c) Frenkel defect is found in halides of alkaline metals
(d) Schottky defects have no effect on the density of crystalline solids. *(2015)*

7. A given metal crystallises out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?
(a) 80 pm (b) 108 pm
(c) 40 pm (d) 127 pm *(2015, Cancelled)*

8. 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
(a) $\frac{2}{\sqrt{3}}a$ (b) $\frac{4}{\sqrt{3}}a$
(c) $\frac{\sqrt{3}}{4}a$ (d) $\frac{\sqrt{3}}{2}a$ *(2014)*

9. A metal has a *fcc* lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72 g cm^{-3}. The molar mass of the metal is
(N_A Avogadro's constant = 6.02×10^{23} mol^{-1})
(a) 27 g mol^{-1} (b) 20 g mol^{-1}
(c) 40 g mol^{-1} (d) 30 g mol^{-1} *(NEET 2013)*

10. The number of carbon atoms per unit cell of diamond unit cell is
(a) 6 (b) 1
(c) 4 (d) 8 *(NEET 2013)*

11. A metal crystallises with a face-centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is
(a) 288 pm (b) 408 pm
(c) 144 pm (d) 204 pm *(2012)*

12. The number of octahedral void(s) per atom present in a cubic close-packed structure is
(a) 1 (b) 3
(c) 2 (d) 4 *(2012)*

13. Structure of a mixed oxide is cubic close packed (*ccp*). 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) ABO_2 (b) A_2BO_2
(c) $A_2B_3O_4$ (d) AB_2O_2 *(Mains 2012)*

14. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be
(a) 275.1 pm (b) 322.5 pm
(c) 241.5 pm (d) 165.7 pm
(Mains 2011)

15. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is
(a) 335 pm (b) 250 pm
(c) 200 pm (d) 300 pm *(2010)*

16. Lithium metal crystallises in a body-centred cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of lithium will be
(a) 151.8 pm (b) 75.5 pm
(c) 300.5 pm (d) 240.8 pm *(2009)*

17. Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm?
(a) 157 (b) 181
(c) 108 (d) 128 *(2009)*

18. Percentage of free space in a body centred cubic unit cell is
(a) 34% (b) 28%
(c) 30% (d) 32% *(2008)*

19. Which of the following statements is not correct?
(a) The number of carbon atoms in a 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 0.48.
(d) Molecular solids are generally volatile.
(2008)

20. With which one of the following elements silicon should be doped so as to give p-type of semiconductor?
(a) Selenium (b) Boron
(c) Germanium (d) Arsenic *(2008)*

21. 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
(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) $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$ *(2008)*

22. The fraction of total volume occupied by the atoms present in a simple cube is
(a) $\frac{\pi}{3\sqrt{2}}$ (b) $\frac{\pi}{4\sqrt{2}}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$ *(2007)*

23. If NaCl is doped with 10^{-4} mol % of $SrCl_2$, the concentration of cation vacancies will be ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(a) 6.02×10^{16} mol^{-1} (b) 6.02×10^{17} mol^{-1}
(c) 6.02×10^{14} mol^{-1} (d) 6.02×10^{15} mol^{-1}
(2007)

24. The appearance of colour in solid alkali metal halides is generally due to
(a) interstitial positions
(b) F-centres
(c) Schottky defect
(d) Frenkel defect. *(2006)*

25. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being 6.02×10^{23} mol^{-1}, the density of CsBr is
(a) 4.25 g/cm^3 (b) 42.5 g/cm^3
(c) 0.425 g/cm^3 (d) 8.25 g/cm^3
(2006)

26. In a face-centered cubic lattice, a unit cell is shared equally by how many unit cells?
(a) 2 (b) 4
(c) 6 (d) 8 *(2005)*

27. A compound formed by elements X and Y crystallises in a cubic structure in which the X atoms are at the corners of a cube and the Y atoms are at the face-centres. The formula of the compound is
(a) XY_3 (b) X_3Y
(c) XY (d) XY_2 *(2004)*

28. The pyknometric density of sodium chloride crystal is 2.165×10^3 kg m^{-3} while its X-ray density is 2.178×10^3 kg m^{-3}. The fraction of unoccupied sites in sodium chloride crystal is
(a) 5.96 (b) 5.96×10^{-2}
(c) 5.96×10^{-1} (d) 5.96×10^{-3}
(2003)

29. When Zn converts from melted state to its solid state, it has hcp structure, then find the number of nearest atoms.
(a) 6 (b) 8
(c) 12 (d) 4 *(2001)*

30. Cation and anion combines in a crystal to form following type of compound
(a) ionic (b) metallic
(c) covalent (d) dipole-dipole. *(2000)*

31. In cube of any crystal *A*-atom placed at every corners and *B*-atom placed at every centre of face. The formula of compound is
(a) AB (b) AB_3
(c) A_2B_2 (d) A_2B_3 *(2000)*

32. In crystals of which one of the following ionic compounds would you expect maximum distance between centres of cations and anions?
(a) CsI (b) CsF
(c) LiF (d) LiI *(1998)*

33. The second order Bragg diffraction of X-rays with $\lambda = 1.00$ Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystal is
(a) 2.00 Å (b) 1.00 Å
(c) 0.575 Å (d) 1.15 Å *(1998)*

34. The edge length of face centred unit cubic cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is
(a) 144 pm (b) 398 pm
(c) 288 pm (d) 618 pm *(1998)*

35. Schottky defect in crystals is observed when
(a) density of the 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. *(1998)*

36. The high density of water compared to ice is due to
(a) dipole-induced dipole interactions
(b) induced dipole induced dipole interactions
(c) hydrogen bonding interactions
(d) dipole-dipole interactions. *(1997)*

37. For two ionic solids CaO and KI, identify the wrong statement among the following
(a) CaO has high melting point
(b) Lattice energy of CaO is much larger than that of KI
(c) KI has high melting point
(d) KI is soluble in benzene. *(1997)*

38. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
(a) face-centred cube (b) simple cube
(c) body-centred cube (d) none of these. *(1997)*

39. The *fcc* crystal contains how many atoms in each unit cell?
(a) 6 (b) 8
(c) 4 (d) 5 *(1996)*

40. If we mix a pentavalent impurity in a crystal lattice of germanium, what type of semiconductor formation will occur?
(a) *n*-type semiconductor
(b) *p*-type semiconductor
(c) both (a) and (b)
(d) None of these. *(1996)*

41. An element (atomic mass = 100 g/mol) having *bcc* structure has unit cell edge 400 pm. The density of element is
(a) 7.289 g/cm^3 (b) 2.144 g/cm^3
(c) 10.376 g/cm^3 (d) 5.188 g/cm^3 *(1996)*

42. The number of atoms in 100 g of a *fcc* crystal with density $d = 10$ g/cm^3 and cell edge equal to 100 pm, is equal to
(a) 2×10^{25} (b) 1×10^{25}
(c) 4×10^{25} (d) 3×10^{25} *(1994)*

43. Ionic solids, with Schottky defects, contain in their structure
(a) cation vacancies only
(b) cation vacancies and interstitial cations
(c) equal number of cation and anion vacancies
(d) anion vacancies and interstitial anions. *(1994)*

44. The pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. The behaviour is a characteristic of substance forming
(a) allotropic crystals
(b) liquid crystals
(c) isomeric crystals
(d) isomorphous crystals. *(1993)*

45. On doping Ge metal with a little of In or Ga, one gets
(a) *p*-type semiconductor
(b) *n*-type semiconductor
(c) insulator
(d) rectifier. *(1993)*

46. In the fluorite structure, the coordination number of Ca^{2+} ion is
(a) 4 (b) 6
(c) 8 (d) 3 *(1993)*

47. The number of atoms contained in a *fcc* unit cell of a monoatomic substance is
(a) 1
(b) 2
(c) 4
(d) 6 *(1993)*

48. For orthorhombic system axial ratios are $a \neq b \neq c$ and the axial angles are
(a) $\alpha = \beta = \gamma \neq 90^\circ$
(b) $\alpha = \beta = \gamma = 90^\circ$
(c) $\alpha = \gamma = 90^\circ, \beta \neq 90^\circ$
(d) $\alpha \neq \beta \neq \gamma \neq 90^\circ$ *(1991)*

49. Most crystals show good cleavage because their atoms, ions or molecules are
(a) weakly bonded together
(b) strongly bonded together
(c) spherically symmetrical
(d) arranged in planes. *(1991)*

Answer Key

1.	(c, d)	**2.**	(c)	**3.**	(d)	**4.**	(c)	**5.**	(c)	**6.**	(b)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(d)
11.	(a)	**12.**	(a)	**13.**	(d)	**14.**	(c)	**15.**	(a)	**16.**	(a)	**17.**	(d)	**18.**	(d)	**19.**	(c)	**20.**	(b)
21.	(c)	**22.**	(d)	**23.**	(b)	**24.**	(b)	**25.**	(a)	**26.**	(c)	**27.**	(a)	**28.**	(d)	**29.**	(c)	**30.**	(a)
31.	(b)	**32.**	(a)	**33.**	(d)	**34.**	(a)	**35.**	(d)	**36.**	(c)	**37.**	(d)	**38.**	(c)	**39.**	(c)	**40.**	(a)
41.	(d)	**42.**	(c)	**43.**	(c)	**44.**	(b)	**45.**	(a)	**46.**	(c)	**47.**	(c)	**48.**	(b)	**49.**	(d)		

EXPLANATIONS

1. (c, d) : Frenkel defect is favoured in those ionic compounds in which there is large difference in the size of cations and anions.
Non-stoichiometric defects due to metal deficiency is shown by Fe_xO where $x = 0.93$ to 0.96.

2. (c) : In fluorite structure, Ca^{2+} ions are in the face centred cubic arrangement. Each Ca^{2+} is connected to 4 F^- ions below it and to another set of 4 F^- ions above it *i.e.* Ca^{2+} has a coordination number of 8 and each F^- ion has a coordination number 4.

3. (d) : For *bcc*, $Z = 2$, $\rho = 530$ kg m^{-3}, at. mass of Li = 6.94 g mol^{-1}, $N_A = 6.02 \times 10^{23}$ mol^{-1}

$$\rho = 530 \text{ kg m}^{-3} = \frac{530 \times 1000 \text{ g}}{1 \times (100)^3 \text{ cm}^3} = 0.53 \text{ g cm}^{-3}$$

$$\rho = \frac{Z \times \text{At. mass}}{N_A \times a^3}$$

$$a^3 = \frac{Z \times \text{At. mass}}{N_A \times \rho} = \frac{2 \times 6.94}{6.02 \times 10^{23} \times 0.53}$$

$$= 43.5 \times 10^{-24} \text{ cm}^3$$

$$\Rightarrow \quad a = 352 \times 10^{-10} \text{ cm} = 352 \text{ pm}$$

4. (c) : Radius ratio, $\dfrac{r^+}{r^-} = \dfrac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.541$

It lies in the range of 0.414 to 0.732 hence, coordination number of each ion will be 6 as the compound will have NaCl type structure *i.e.*, octahedral arrangement.

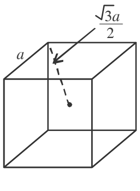
5. (c) : Packing efficiency of *bcc* lattice = 68%
Hence, empty space = 32%.

6. (b) : Frenkel defect is a dislocation defect as smaller ions (usually cations) are dislocated from normal sites to interstitial sites. Frenkel defect is shown by compounds having large difference in the size of cations and anions hence, alkali metal halides do not show Frenkel defect. Also, Schottky defect decreases the density of crystal while Frenkel defect has no effect on the density of crystal.

7. (d) : $Z = 4$, *i.e.*, structure is *fcc*.

Hence, $r = \dfrac{a}{2\sqrt{2}} = \dfrac{361}{2\sqrt{2}} = 127.65 \text{ pm} \approx 127 \text{ pm}$

8. (d) : The distance between the body centered atom and one corner atom is $\dfrac{\sqrt{3}a}{2}$ *i.e.* half of the body diagonal.



9. (a) : $d = \dfrac{ZM}{N_A a^3}$ ($Z = 4$ for *fcc*)

$$M = \frac{d \times N_A \times a^3}{Z} = \frac{2.72 \times 6.023 \times 10^{23} \times (404 \times 10^{-10})^3}{4}$$

$M = 26.99 \approx 27$ g mol^{-1}

10. (d) : Diamond is like ZnS (Zinc blende).
Carbon forming *ccp* (*fcc*) and also occupying half of tetrahedral voids.
Total no. of carbon atoms per unit cell

$$= \underset{\text{(Corners)}}{8 \times \frac{1}{8}} + \underset{\text{(Face centrered)}}{6 \times \frac{1}{2}} + \underset{\text{(Terahedral void)}}{4} = 8$$

11. (a) : For a face centred cubic (*fcc*) structure,
$r = \dfrac{a}{2\sqrt{2}}$, $a = 408$ pm, $r = \dfrac{408}{2\sqrt{2}} = 144$ pm
Diameter = $2r = 2 \times 144 = 288$ pm

12. (a) : Number of octahedral voids is same as number of atoms.

13. (d) : Number of atoms in *ccp* = 4 = O^{2-}
Number of tetrahedral voids = $2 \times N = 2 \times 4$

Number of A^{2+} ions $= 8 \times \dfrac{1}{4} = 2$

Number of octahedral voids
= Number of B^+ ions = $N = 4$
Ratio, $O^{2-} : A^{2+} : B^+ = 4 : 2 : 4 = 2 : 1 : 2$
Formula of oxide = AB_2O_2

14. (c) : For NaCl, $\dfrac{r^+}{r^-} = 0.414$
Given radius of cation = 100 pm

$$\frac{100}{r^-} = 0.414 \Rightarrow \frac{100}{0.414} = r^- \Rightarrow r^- = 241.5 \text{ pm}$$

15. (a) : For a *bcc* lattice, $2(r^+ + r^-) = \sqrt{3}a$
where r^+ = radius of cation, r^- = radius of anion
a = edge length

$$\therefore \quad (r^+ + r^-) = \frac{\sqrt{3} \times 387}{2} = 335.142 \text{ pm} \approx 335 \text{ pm}$$

16. (a) : Since Li crystallises in body-centred cubic crystal, atomic radius, $r = \dfrac{\sqrt{3}a}{4}$ (a = edge length)

$$\therefore \quad r = \frac{\sqrt{3}}{4} \times 351 = 151.8 \text{ pm} \quad (\text{given } a = 351 \text{ pm})$$

17. (d) : Since Cu crystallises in a face-centred cubic lattice,

Atomic radius, $r = \frac{a}{2\sqrt{2}}$ (a = edge length = 361 pm)

$\therefore\ r = \frac{361}{2\sqrt{2}} = 127.6 \approx 128$ pm

18. (d) : The ratio of volumes occupied by atoms in unit cell to the total volume of the unit cell is called as packing fraction or density of packing. For body centred cubic structure, packing fraction = 0.68 *i.e.*, 68% of the unit cell is occupied by atoms and 32% is empty.

19. (c) : Packing fraction for a cubic unit cell is given by $f = \frac{z \times \frac{4}{3}\pi r^3}{a^3}$

where a = edge length, r = radius of cation and anion. Efficiency of packing in simple cubic or primitive cell = π/6 = 0.52 *i.e.* 52% of unit cell is occupied by atoms and 48% is empty.

20. (b) : If silicon is doped with any of the element of group III (B, Al, Ga, In, Th) of the periodic table, *p*-type of semiconductor will be obtained.

21. (c) : For Simple cubic : $r^+ + r^- = a/2$

For Body centred : $r^+ + r^- = a\sqrt{3}/4$

where a = edge length, $r^+ + r^-$ = interatomic distance.

For Face centered: $r^+ + r^- = \frac{a}{2\sqrt{2}}$

$\therefore$ Ratio of radii of the three will be $\frac{a}{2} : \frac{a\sqrt{3}}{4} : \frac{a}{2\sqrt{2}}$

22. (d) : The maximum properties of the available volume which may be filled by hard sphere in simple cubic arrangement is π/6 or 0.52.

23. (b) : As each Sr^{2+} ion introduces one cation vacancy, therefore, concentration of cation vacancies = mole % of $SrCl_2$ added.

$\therefore$ Concentration of cation vacancies

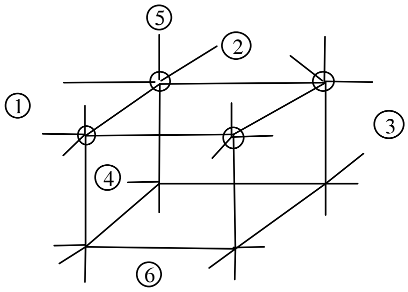
$= 10^{-4}$ mole% $= \frac{10^{-4}}{100} \times 6.023 \times 10^{23} = 6.023 \times 10^{17}$

24. (b) : *F*-centres are the sites where anions are missing and instead electrons are present. They are responsible for colours.

25. (a) : Density of CsBr $= \frac{Z \times M}{V \times N_A}$

$$= \frac{1 \times 213}{(436.6 \times 10^{-10})^3 \times 6.023 \times 10^{23}} = 4.25 \text{ g/cm}^3$$

26. (c) : Here given unit cell is shared equally by six faces in the *fcc* which is shared equally by six different unit cells.



27. (a) : In a unit cell, X atoms at the corners $= \frac{1}{8} \times 8 = 1$

Y atoms at the face centres $= \frac{1}{2} \times 6 = 3$

Ratio of X and Y = 1 : 3. Hence formula is XY_3.

28. (d) : Molar volume from pyknometric density

$$= \frac{M}{2.165 \times 10^3} \text{ m}^3$$

Molar volume from X-ray density

$$= \frac{M}{2.178 \times 10^3} \text{ m}^3$$

Volume unoccupied $= \frac{M}{10^3}\left(\frac{1}{2.165} - \frac{1}{2.178}\right) \text{m}^3$

Fraction unoccupied

$$= \left(\frac{0.013\,M \times 10^{-3}}{2.165 \times 2.178}\right) \Big/ \left(\frac{M \times 10^{-3}}{2.165}\right) = 5.96 \times 10^{-3}$$

29. (c) : *hcp* is a closed packed arrangement in which the unit cell is hexagonal and co-ordination number is 12.

30. (a) : The electrostatic force of attraction which exists between oppositely charged ions is called as ionic bond.

31. (b) : 'A' atoms are at '8' corners of the cube. Thus,

no. of 'A' atoms per unit cell $= 8 \times \frac{1}{8} = 1$

'B' atoms are at the face centre of six faces. Thus, no. of 'B' atoms per unit cell $= 6 \times \frac{1}{2} = 3$

The formula is AB_3.

32. (a) : As Cs^+ ion has larger size than Li^+ and I^- has larger size than F^-, so maximum distance between centres of cations and anions is in CsI.

33. (d) : According to Bragg's equation.

$n\lambda = 2d \sin\theta$

As, $n = 2$, $\lambda = 1.00$Å, $\theta = 60°$, d = ?

$\Rightarrow\ d = \frac{1}{\sin 60°} = \frac{2}{\sqrt{3}} = 1.15$Å

34. (a) : In the face centred cubic lattice, the edge length of the unit cell, $a = r + 2R + r$
where r = Radius of cation
R = Radius of anion
$\Rightarrow$ $508 = 2 \times 110 + 2R \Rightarrow R = 144$ pm

35. (d) : In Schottky defect equal no. of cations and anions are missing from the lattice. So the crystal remains neutral. Such defect is more common in highly ionic compounds of similar cationic and anionic size, *i.e.* NaCl.

36. (c) : Due to polar nature, water molecules are held together by intermolecular hydrogen bonds. The structure of ice is open with large number of vacant spaces. Thus the density of ice is less.

37. (d) : KI is an ionic compound while benzene is not.

38. (c) : A body centred cubic unit cell consists of 8 atoms at the corners and one atom at the centre.

39. (c) : The contribution of eight atoms of face centred cubic unit cell $= 8 \times \frac{1}{8} = 1$ atom. There is one atom at each of six faces, which is shared by 2 unit cells each. The contribution of 6 face centred atoms $= 6 \times \frac{1}{2} = 3$. Therefore $n = 1 + 3 = 4$

40. (a) : When an impurity atom with 5 valence electrons (as arsenic) is introduced in a germanium crystal, it replaces one of the germanium atoms. Four of the five valence electrons of the impurity atom form covalent bonds with each valence electron of four germanium atoms and fifth valence electron becomes free to move in the crystal structure. This free electron acts as a charge carrier. Such as an impure germanium crystal is called *n*-type semiconductor because in it charge carriers are negative (free electrons).

41. (d) : Cell edge = 400 pm; Number of atoms in *bcc* (Z) = 2 and atomic mass = 100 g/mol.

Since atomic mass is 100 g/mol, therefore mass of each atom $(m) = \frac{100}{6.023 \times 10^{23}} = 16.6 \times 10^{-23}$ g

We know that volume of unit cell = $(400\text{ pm})^3$
$= (64 \times 10^6)\text{pm}^3 = 64 \times 10^{-24}\text{ cm}^3$ and
mass of unit cell $= Z \times m = 2 \times (16.6 \times 10^{-23})$
$= 33.2 \times 10^{-23}$ g

Therefore density $= \frac{\text{Mass of unit cell}}{\text{Volume of unit cell}}$

$$= \frac{33.2 \times 10^{-23}}{64 \times 10^{-24}} = 5.188\text{ g/cm}^3$$

42. (c) : Mass (m) = 100 g; Density (d) = 10 g/cm^3 and length (l) = 100 pm = 100×10^{-12} m
$= 100 \times 10^{-10}$ cm

We know that volume of the unit cell
$= (l)^3 = (100 \times 10^{-10}\text{ cm})^3 = 10^{-24}\text{cm}^3$

and volume of 100 g of element $= \frac{\text{Mass}}{\text{Density}} = \frac{100}{10} = 10\text{ cm}^3$

Therefore number of unit cells $= \frac{10}{10^{-24}} = 1 \times 10^{25}$

Since each *fcc* cube contains 4 atoms, therefore total number of atoms in 100 g
$= 4 \times (1 \times 10^{25}) = 4 \times 10^{25}$

43. (c) : When an atom is missing from its normal lattice site, a lattice vacancy is created. Such a defect, which involves equal number of cation and anion vacancies in the crystal lattice is called a Schottky defect.

44. (b) : Liquid crystals on heating first become turbid and then on further heating turbidity completely disappears.

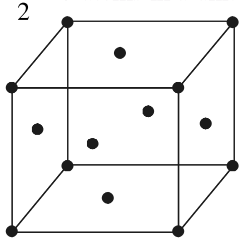
45. (a) : *p*-type of semiconductors are produced (a) due to metal deficiency defects (b) by adding impurity containing less electrons (*i.e.* atoms of group 13). Ge belongs to Group 14 and In to Group 13. Hence on doping *p*-type semiconductor is obtained.

This doping of Ge with In increase the electrical conductivity of the Ge crystal.

46. (c) : In fluorite (CaF_2) structure, C.N. of $Ca^{2+} = 8$, C.N. of $F^- = 4$.

47. (c) : *fcc* crystal contains

$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$ atoms in a unit cell



48. (b) : For orthorhombic system $\alpha = \beta = \gamma = 90°$

49. (d) : Crystals show good cleavage because their constituent particles are arranged in planes.