DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | Start Time : | End Time :

CHEMISTRY CC15

SYLLABUS : The Solid State

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. If Germanium crystallises in the same way as diamond, then which of the following statement is not correct?
(a) Every atom in the structure is tetrahedrally bonded to 4 atoms.
(b) Unit cell consists of 8 Ge atoms and co-ordination number is 4.
(c) All the octahedral voids are occupied.
(d) All the octahedral voids and 50% tetrahedral voids remain unoccupied.

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

3. Packing efficiency by arrangement of atoms in two dimensional hexagonal close packing is
(a) 60.43 (b) 65.78
(c) 59.78 (d) 68.76

4. The radius of a calcium ion is 94 pm and of the oxide ion is 146 pm. The possible crystal structure of calcium oxide will be
(a) tetrahedral (b) trigonal
(c) octahedral (d) pyramidal

5. The interionic distance for cesium chloride crystal will be
(a) a (b) $\frac{a}{2}$
(c) $\frac{\sqrt{3}a}{2}$ (d) $\frac{2a}{\sqrt{3}}$

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

6. 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.

7. The radius of Li^+ ion is 60 pm and that of F^- is 136 pm. Structure of LiF and coordination number is
(a) Like NaCl, C.No. = 6 (b) Like CsCl, C.No. = 8
(c) Anti fluoride, C.No. = 8 (d) None of these

8. Among the following which is the best description of water in the solid phase?
(a) Covalent solid (b) Molecular solid
(c) Ionic solid (d) Network solid

9. Which one of the following statements about packing in solids is **incorrect** ?
(a) Coordination number in bcc mode of packing is 8.
(b) Coordination number in hcp mode of packing is 12.
(c) Void space in hcp mode of packing is 32%.
(d) Void space is ccp mode of packing is 26%.

10. The packing fraction for a body-centred cubic is
(a) 0.42 (b) 0.53
(c) 0.68 (d) 0.82

11. 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

12. Among solids, the highest melting point is exhibited by
(a) Covalent solids (b) Ionic solids
(c) Pseudo solids (d) Molecular solids

13. Which of the following solids is not an electrical conductor?
(a) Mg (s) (b) TiO(s)
(c) I_2 (s) (d) H_2O (s)

14. The range of radius ratio (cationic to anionic) for an octahedral arrangement of ions in an ionic solid is
(a) 0–0.155 (b) 0.155–0.225
(c) 0.225–0.414 (d) 0.414–0.732

15. Which of the following has Frenkel defects?
(a) Sodium chloride (b) Graphite
(c) Silver bromide (d) Diamond

16. The cubic unit cell of a metal (molar mass = 63.55 g mol^{-1}) has an edge length of 362 pm. Its density is 8.92 g cm^{-3}. The type of unit cell is
(a) primitive (b) face centered
(c) body centered (d) end centered

17. Which of the following metal oxides is anti-ferromagnetic in nature?
(a) MnO_2 (b) TiO_2
(c) VO_2 (d) CrO_2

18. Which of the following amorphous solid is used as photovoltaic material for conversion of sunlight into electricity?
(a) Quartz glass (b) Quartz
(c) Silicon (d) Both (a) and (b)

19. The number of octahedral voids present in a lattice is _A_. The number of closed packed particles, the number of tetrahedral voids generated is _B_ the number of closed packed particles
(a) A- equal, B- half (b) A- twice, B- equal
(c) A- twice, B- half (d) A- equal, B- twice

20. A metal crystallizes in 2 cubic phases fcc and bcc whose unit cell lengths are 3.5 Å and 3.0 Å respectively. The ratio of their densities is
(a) 0.72 (b) 2.04
(c) 1.26 (d) 3.12

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ

Space for Rough Work

21. Which of the following is not a crystalline solid?
(a) KCl (b) CsCl
(c) Glass (d) Rhombic S

22. The second order Bragg diffraction of X-rays with $\lambda = 1.0$ 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
(a) 0.575 Å (b) 1.00 Å
(c) 2.00 Å (d) 1.15 Å

23. 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.

24. Solid CH_4 is
(a) ionic solid (b) covalent solid
(c) molecular solid (d) does not exist

25. When electrons are trapped into the crystal in anion vacancy, the defect is known as :
(a) Schottky defect (b) Frenkel defect
(c) Stoichiometric defect (d) F-centre

26. 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) 30 g mol^{-1} (b) 27 g mol^{-1}
(c) 20 g mol^{-1} (d) 40 g mol^{-1}

27. If one end of a piece of a metal is heated the other end becomes hot after some time. This is due to
(a) Energised electrons moving to the other part of the metal
(b) resistance of the metal
(c) mobility of atoms, in the metal
(d) minor perturbation in the energy of atoms.

28. Among the following which one has the highest cation to anion size ratio?
(a) NaF (b) CsI
(c) CsF (d) LiF

29. Among the following the incorrect statement is
(a) Density of crystals remains unaffected due to Frenkel defect.
(b) In bcc unit cell the void space is 32%.
(c) Density of crystals decreases due to Schottky defect.
(d) Electrical conductivity of metals increases with increase in temperature.

30. Doping of AgCl crystals with $CdCl_2$ results in
(a) Frenkel defect
(b) Schottky defect
(c) Substitutional cation vacancy
(d) Formation of F - centres

31. 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]
(a) 5.14×10^{21} unit cells (b) 1.28×10^{21} unit cells
(c) 1.71×10^{21} unit cells (d) 2.57×10^{21} unit cells

32. Which of the following expression is correct for CsCl unit cell with lattice parameter a
(a) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$ (b) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}a}{2}$
(c) $r_{Cs^+} + r_{Cl^-} = \frac{a}{\sqrt{2}}$ (d) $r_{Cs^+} + r_{Cl^-} = 2a$

RESPONSE GRID					
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ
	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ
	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ			

Space for Rough Work

33. Which of the following compound is like metallic copper in its conductivity and appearance?
(a) VO_3 (b) TiO_3
(c) ReO_3 (d) CrO_2

34. Which of the following oxides shows electrical properties like metals ?
(a) SiO_2 (b) MgO
(c) $SO_2(s)$ (d) CrO_2

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

36. NaCl is doped with 2×10^{-3} mole % of $SrCl_2$. The concentration of cation vacancies is
(a) 12.04×10^{20} permole
(b) 3.01×10^{18} permole
(c) 6.02×10^{18} permole
(d) 12.04×10^{18} per mole

37. 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
(a) 4 and 2 (b) 9 and 14
(c) 14 and 9 (d) 2 and 4.

38. Copper crystallises in fcc with a unit length of 361pm. What is the radius of copper atom ?
(a) 157pm (b) 128pm
(c) 108pm (d) 181 pm

39. 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) $K_{metals} > K_{insulators} > K_{semiconductors} = zero$
(d) $K_{metals} < K_{semiconductors} > K_{insulators} \neq zero$

40. The number of carbon atoms per unit cell of diamond unit cell is :
(a) 8 (b) 6
(c) 1 (d) 4

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

42. The edge length of a face centered cubic cell of an ionic substance is 508 pm. If the radius of the cation is 110pm, the radius of the anion is
(a) 288pm (b) 398pm
(c) 618 pm (d) 144pm

43. The correct statement for the molecule, CsI_3 is:
(a) It is a covalent molecule.
(b) It contains Cs^+ and I_3^- ions.
(c) It contains Cs^{3+} and I^- ions.
(d) It contains Cs^+, I^- and lattice I_2 molecule.

44. Which of the following type of substances can be permanently magnetised?
(a) Diamagnetic (b) Ferromagnetic
(c) Ferrimagnetic (d) Antiferromagnetic

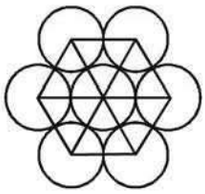
45. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is :
(a) 335pm (b) 250pm
(c) 200pm (d) 300pm

RESPONSE GRID					
	33.ⓐⓑⓒⓓ	34.ⓐⓑⓒⓓ	35.ⓐⓑⓒⓓ	36.ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ
	38.ⓐⓑⓒⓓ	39.ⓐⓑⓒⓓ	40.ⓐⓑⓒⓓ	41.ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ
	43.ⓐⓑⓒⓓ	44.ⓐⓑⓒⓓ	45.ⓐⓑⓒⓓ		

Space for Rough Work

DAILY PRACTICE PROBLEMS — CHEMISTRY SOLUTIONS — DPP/CC15

1. **(c)**
2. **(b)** n-Type, since electron is set free.
3. **(a)**



Let radius of the sphere = r

Area occupied by sphere in hexagonal close packing

$$\pi r^2 + 6\times\left(\frac{1}{6}\times\pi r^2\right) = 2\pi r^2$$

$$\text{Area of hexagonal} = 6\times\left[\frac{\sqrt{3}}{4}\times(2r)^2\right]$$

$$= 6\times\frac{\sqrt{3}}{4}\times 4r^2$$

$$= 6\sqrt{3}\times r^2$$

$$\%\text{ occupied by} = \frac{2\pi r^2}{6\times\sqrt{3}\times r^2}\times 100$$

$$= \frac{2\times 3.14}{6\times\sqrt{3}}\times 100 = 60.43\%$$

4. **(c)** As per formula,

$$\text{radius ratio} = \frac{\text{radius of cation}}{\text{radius of anion}}$$

$$= \frac{94}{146} = 0.643$$

Since the value is between 0.414 – 0.732 hence the coordination no. will be 6 and geometry will be octahedral.

5. **(c)** As CsCl is body-centred, $d = \sqrt{3}a/2$.
6. **(b)** It is the property of liquid crystal.
7. **(a)** $\frac{r+}{r-}$ ratio is $\frac{60}{136} = 0.441$, Hence LiF has NaCl structure with C.N. = 6.
8. **(b)** Molecular solid is the best description of water in the solid phase. For example ice is hydrogen bonded molecular solid.
9. **(c)** The hcp arrangement of atoms occupies 74% of the available space and thus has 26% vacant space.
10. **(c)** The p.f. for body centred cube = 0.68
11. **(d)** When insulators (non metal atoms) interact to form a solid, their atomic orbitals mix to form two bunch of orbitals, separated by a large band gap. Electrons cannot therefore be promoted to an empty level, where they could move freely.
12. **(a)** Covalent solids as in case of diamond.
13. **(c)**
14. **(d)** For octahedral $r^+/r^- = 0.414 - 0.732$.
15. **(c)** AgBr exhibits Frenkel defect.
16. **(b)** $\rho = \frac{zM}{N_A V}$

$$z = \frac{\rho N_A V}{M} = \frac{8.92\times 6.02\times 10^{23}\times(362)^3\times 10^{-30}}{63.55}$$

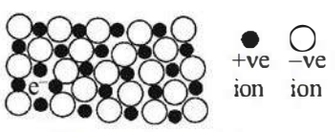
$= 4$

$\therefore$ It has fcc unit cell

17. **(a)** MnO_2.
18. **(c)** Amorphous silicon is used as best photovoltaic material available for conversion of sunlight into electricity.
19. **(d)**
20. **(c)** $\frac{d_1}{d_2} = \frac{(a_2)^3}{(a_1)^3}\times\frac{z_1}{z_2} = \left(\frac{3}{3.5}\right)^3\times\frac{4}{2} = 1.26$
21. **(c)** Glass is amorphous solid.
22. **(d)** $n\lambda = 2d\sin\theta$;

$$2\times 1\text{Å} = 2\times d\sin 60 \Rightarrow d = 1.15\text{Å} \because \left(\sin 60 = \frac{\sqrt{3}}{2}\right)$$

23. **(b)**
24. **(c)** Solid CH_4 is a molecular solid. In this, the constituent molecules are held together by van der Waal's forces.
25. **(d)** When electrons are trapped in anion vacancies, these are called F-centre.



F- centre in crystal

26. **(b)** Density is given by

$$d = \frac{z\times M}{N_A a^3}$$; where z = number of formula units present in unit cell, which is 4 for fcc

a = edge length of unit cell. M = Molecular mass

$$2.72=\frac{4\times M}{6.02\times10^{23}\times\left(404\times10^{-10}\right)^3}$$

$(\because\ 1\,pm=10^{-10}\,cm)$

$$M=\frac{2.72\cdot\ 6.02\cdot\ (404)^3}{4\cdot\ 10^7}=26.99$$

$=27\ g\ mol^{-1}$

27. (a) It is due to movement of energised electrons (KE $\propto$ T).

28. (c) $\frac{M^+}{X^-}$ is highest in CsF

$\therefore$ correct choice : (c)

29. (d) The electrical resistance of metals depends upon temperature. Electrical resistance decreases with decrease in temperature and becomes zero near the absolute temperature. Material in this state is said to possess super conductivity.

30. (c)

31. (d) Number of formulas in cube shaped crystals

$=\frac{1.0}{58.5}\times6.02\times10^{23}$ since in NaCl type of structure 4 formula units form 'a' cell

$$\therefore\ \text{unitscells}=\frac{1.0\times6.02\times10^{23}}{58.5\times4}=2.57\times10^{21}\ \text{unitcells.}$$

32. (b) CsCl has a bcc structure ions touching along body diagonal.

33. (c) Rhenium oxide ReO_3 is like metallic copper in conductivity.

34. (d)

35. (b) Among the given crystals, only silicon exists as a covalent solid. It has diamond like structure.

36. (d) The addition of one Sr^{2+} replaces $2Na^+$ and one cationic vacancy is created.

No. of cationic vacancy $=2\times10^{-3}$ mole % of NaCl

$=\frac{2\times10^{-3}}{100}mol^{-1}$ of NaCl

$=2\times10^{-5}\times6.02\times10^{23}\,mol^{-1}$

$=12.04\times10^{18}mol^{-1}$ of NaCl

37. (d) In bcc - points are at corners and one in the centre of the unit cell.

Number of atoms per unit cell $=8\times\frac{1}{8}+1=2$.

In fcc - points are at the corners and also centre of the six faces of each cell.

Number of atoms per unit cell $=8\times\frac{1}{8}+6\times\frac{1}{2}=4$.

38. (b) For fcc,

$$r=\frac{\sqrt{2}a}{4}=\frac{a}{2\sqrt{2}}=0.3535a$$

given $a=361$ pm

$r=0.3535\times361$

$=128$ pm

39. (a)

40. (a) Diamond is like ZnS. In diamond cubic unit cell, there are eight corner atoms, six face centered atoms and four more atoms inside the structure.

Number of atoms present in a diamond cubic cell

$=8\cdot\frac{1}{8}\cdot\ 6\cdot\frac{1}{2}\cdot\ 4\cdot\ 8$

(corners) (face centered) (inside body)

41. (b) Packing fraction is defined as the ratio of the volume of the unit cell that is occupied by the spheres to the total volume of the unit cell.

P.F. for ccp and bcc are 0.74 and 0.68 respectively.

So, the free space in ccp and bcc are 26% and 32% respectively.

42. (d) For an Fcc crystal

$$r_{cation}+r_{anion}=\frac{\text{edge length}}{2}$$

$$110+r_{anion}=\frac{508}{2}$$

$r_{anion}=254-110=144$ pm

43. (b) CsI_3 dissociates as $CsI_3\rightarrow Cs^++I_3^-$

44. (b)

45. (a) For bcc lattice body diagonal $=a\sqrt{3}$.

The distance between the two oppositely charged ions

$=\frac{a}{2}\sqrt{3}$

$=\frac{387\times1.732}{2}=335$pm