DPP - Daily Practice Problems

Date : | **Start Time :** | **End Time :**

CHEMISTRY CC15

SYLLABUS : The Solid State

Max. Marks : 120 **Marking Scheme :** (+ 4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 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. The cubic unit cell of a metal (molar mass = 63.55g mol^{-1}) has an edge length of 362 pm. Its density is 8.92g cm^{-3}. The type of unit cell is
(a) primitive (b) face centered
(c) body centered (d) end centered

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

4. A metal crystallizes in 2 cubic phases fcc and bcc whose unit cell lengths are 3.5 Å and 3.0Å respectively. The ratio of their densities is
(a) 0.72 (b) 2.04
(c) 1.46 (d) 3.12

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

5. Coordination numbers of Zn^{2+} and S^{2-} in the crystal structure of wurtzite are

(a) 4, 4 (b) 6, 6

(c) 8, 4 (d) 8, 8

6. The coordination number X (.....) of each ion in KBr is changed to Y (.....) by.....

(a) X = 6 to Y = 8 applying higher temperature

(b) X = 8 to Y = 6 applying high pressure

(c) X = 6 to Y = 8 applying high pressure

(d) None of these

7. The radius of Li^+ ion is 60pm 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. The number of carbon atoms per unit cell of diamond unit cell is :

(a) 8 (b) 6

(c) 1 (d) 4

9. 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) 5.96×10^{-3} (b) 5.96×10^{4}

(c) 5.96×10^{-2} (d) 5.96×10^{-1}

10. Which of the folliowing metal oxides is anti-ferromagnetic in nature?

(a) MnO_2 (b) TiO_2

(c) VO_2 (d) CrO_2

11. Which of the following solids is not an electrical conductor?

(a) Mg (s) (b) TiO (s)

(c) I_2 (s) (d) H_2O (s)

12. The r_+ / r_- ratio of ZnS is 0.402. Pick out the false statements of the following

(a) ZnS is 4 : 4 coordination compound.

(b) ZnS does not crystallize in rock salt type lattice because r_+ / r_- is too small to avoid overlapping of S^{2-} ions.

(c) Zn^{2+} ion is too small to fit precisely into the octahedral voids of S^{2-} ions.

(d) Zn^{2+} ion is too large to fit into the octahedral voids of S^{2-} ions.

13. The unit cell dimensions of a cubic lattice (edges a, b, c and the angles between them, α, β and γ) are

(a) $a = b = c, \alpha = \beta = \gamma = 90^0$

(b) $a = b \neq c, \alpha = \beta = \gamma = 90^0$

(c) $a = b = c, \alpha = \gamma = 90^0, \beta \neq 90^0$

(d) $a \neq b \neq c, \alpha = \beta = 90^0, \gamma \neq 90^0$

14. 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.

RESPONSE GRID					
	5. (a)(b)(c)(d)	6. (a)(b)(c)(d)	7. (a)(b)(c)(d)	8. (a)(b)(c)(d)	9. (a)(b)(c)(d)
	10. (a)(b)(c)(d)	11. (a)(b)(c)(d)	12. (a)(b)(c)(d)	13. (a)(b)(c)(d)	14. (a)(b)(c)(d)

15. To get a *n*-type semiconductor from silicon, it should be doped with a substance with valency ..... .

(a) 2 (b) 1

(c) 3 (d) 5

16. The second order Bragg diffraction of X-rays with $\lambda = 1.0\text{Å}$ 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) 0.575Å (b) 1.00Å

(c) 2.00Å (d) 1.15Å

17. Which of the following oxides shows electrical properties like metals ?

(a) SiO_2 (b) MgO

(c) SO_2 (s) (d) CrO_2

18. Al (at. wt 27) crystallizes in the cubic system with a cell edge of 4.05 Å . Its density is 2.7 g per cm^3. Determine the unit cell type calculate the radius of the Al atom

(a) fcc, 2.432 Å (b) bcc, 2.432 Å

(c) bcc, 1.432 Å (d) fcc, 1.432 Å

19. The ratio of inner planar distancess of three types of planes $(d_{100}, d_{110}, d_{111})$ for simple cubic lattice are

(a) $1:\frac{1}{\sqrt{2}}:\frac{1}{\sqrt{3}}$ (b) $\frac{1}{\sqrt{3}}:\frac{1}{\sqrt{2}}:1$

(c) $\sqrt{3}:\sqrt{2}:1$ (d) $1:\sqrt{2}:\sqrt{3}$

20. For a cubic geometry the limiting $\frac{r^+}{r^-}$ is :

(a) 0.414 (b) 0.155

(c) >0.731 (d) 0.731

21. The incorrect statement for the sulphur atom of ZnS is

(a) As S^{2-} is larger than Zn^{2+} only 4 rather than 6 or 8 S^{2-} can be packed around Zn^{2+}

(b) Its structure is similar to diamond except that alternate atoms are Zn and S

(c) As S^{2-} is larger than Zn^{2+} only 6 rather than 8 or 4 sulphide ions can be placed around Zn^{2+} ions

(d) ZnS is a covalent compound

22. 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

23. 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

24. 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					
	15. ⓐⓑⓒⓓ	**16.** ⓐⓑⓒⓓ	**17.** ⓐⓑⓒⓓ	**18.** ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ	**23.** ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ

25. For *fcc* if AB is just like the rock salt like structure then, A^+ and B^- are located at –

(a) A^+ - Tetrahedral voids ; B^- - Corner

(b) A^+ - Corner and faces ; B^- - Octahedral voids

(c) A^+ - Octahedral voids ; B^- - Corner and faces

(d) A^+ - Corner and faces ; B^- - Octahedral and tetrahedral voids

26. Which of the following exists as covalent crystals in the solid state ?

(a) Iodine (b) Silicon

(c) Sulphur (d) Phosphorus

27. The packing fraction for a body-centred cubic is

(a) 0.42 (b) 0.53

(c) 0.68 (d) 0.82

28. Consider the radii 0.095 nm (Na^+), 0.181 nm (Cl^-), 0.074 nm (Zn^{2+}), 0.184 nm (S^{2-}), 0.068 nm (Ti^{4+}), 0.140 nm (O^{2-}), 0.169 nm (Cs^+). Choose the correct option from among the following. (Use radius ratio rules)

(a) Na^+ ions are packed in octahedral holes between the planes of close-packed Cl^- ions.

(b) Zn^{2+} ions are packed in tetrahedral holes

(c) Cs^+ ions are packed in a simple cubic array of Cl^- ions

(d) All of these

29. What type of crystal defect is indicated in the diagram below?

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

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

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

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

(a) Interstitial defect

(b) Schottky defect

(c) Frenkel defect

(d) Frenkel & Schottky defects

30. What is the coordination number of sodium in Na_2O?

(a) 6 (b) 4

(c) 8 (d) 2

RESPONSE GRID	**25.** ⓐⓑⓒⓓ **26.** ⓐⓑⓒⓓ **27.** ⓐⓑⓒⓓ **28.** ⓐⓑⓒⓓ **29.** ⓐⓑⓒⓓ **30.** ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 15 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	35	Qualifying Score	50
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

1. **(c)**

2. **(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

3. **(c)**

4. **(c)** $\frac{d_1}{d_2} = \frac{(a_2)^3}{(a_1)^3} \times \frac{z_1}{z_2} = \left(\frac{3}{3.5}\right)^3 \times \frac{4}{2} = 1.46$

5. **(a)** Wurtzite has *face centred cubic* structure in which each Zn^{2+} ion is attached to four S^{2-} ions and each S^{2-} ion remains in contact with four Zn^{2+} ions. Hence coordination number of each ion is 4.

6. **(c)** The increase in pressure results in decrease in size of ions (more in case of anion than cation), the r^+/r^- increases and the coordination number also increase.

7. **(a)** $\frac{r+}{r-}$ ratio is $\frac{60}{136} = 0.441$, Hence LiF has NaCl structure with CN = 6.

8. **(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

$$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} + 4 = 8$$

(corners) (face centered) (inside body)

9. **(a)** Fraction of unoccupied sites in NaCl crystal

$$= 1 - \frac{2.165 \times 10^3}{2.178 \times 10^3}$$

$$= \frac{2.178 \times 10^3 - 2.165 \times 10^3}{2.178 \times 10^3} = \frac{0.13 \times 10^3}{2.178}$$

$$= \frac{130}{2178} = 5.96 \times 10^{-3}$$

10. **(a)** MnO_2

11. **(c)** I_2 (s)

12. **(d)**

13. **(a)**

14. **(b)** It is the property of liquid crystal.

15. **(d)** To get a *n* – type semiconductor from silicon, it should be doped with a substance with valency 5.

e.g., silicon is doped with phosphorus to form a *n* – type semiconductor.

16. **(d)** $n\lambda = 2d \sin\theta$;

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

17. **(d)**

18. **(d)** $\rho = \frac{Z \times M}{N_o \times a^3}$,

$$2.7 = \frac{Z \times 27}{6.02 \times 10^{23} \times (4.05)^3 \times 10^{-24}} \quad \therefore Z = 4$$

Hence it is face centred cubic unit lattice.

Again $4r = a\sqrt{2} = 5.727$ Å

$\therefore$ r = 1.432 Å

19. **(a)** $d_{hkl} = \frac{a}{(h^2 + k^2 + l^2)^{1/2}}$

Hence $d_{100} = 1$, $d_{110} = \frac{1}{\sqrt{2}}$, $d_{111} = \frac{1}{\sqrt{3}}$

20. **(c)** For cubic geometry the limiting ratio is

$\frac{r^+}{r^-} > 0.731$ i.e., (c)

21. **(a)** Statement (a) is correct.

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

The distance between the two oppositely charged ions

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

$$= \frac{387 \times 1.732}{2} = 335\text{pm}$$

23. **(d)** Number of formulas in cube shaped crystals

$= \frac{1.0}{58.5} \times 6.02 \times 10^{23}$ since in NaCl type of structure 4 formula units form 'a' cell

$$\therefore \text{units cells} = \frac{1.0 \times 6.02 \times 10^{23}}{58.5 \times 4} = 2.57 \times 10^{21} \text{ unit cells.}$$

24. **(c)** As CsCl is body-centred, $d = \sqrt{3}a/2$.

25. **(c)** AB is just like NaCl. Thus twelve A^+ are at edges and 1 within body of *fcc* i.e. in octahedral voids and six B^- at faces and 8 at corner.

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

27. **(c)** The p.f. for body centred cube = 0.68 (see text).

28. **(d)** Calculate the $\frac{r+}{r-}$ ratio to get the limiting ratio value and consult the table. All are correct.

29. **(c)**

30. **(b)** In Na_2O there is antifluorite structure. Here negative ions form the ccp arrangement so that each positive ion is surrounded by 4 negative ions and each negative ion is surrounded by 8 positive ions. So coordination no. of Na^+ is 4.