PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 46

Total Marks : 48

Max. Time : 51 min.

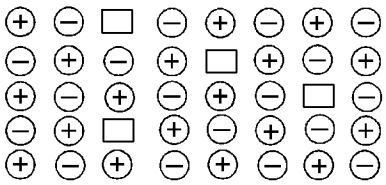
Topic : Solid State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.6	(4 marks 4 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.7 to Q.11	(3 marks 3 min.)	[12, 12]
Match the Following (no negative marking) Q.12	(8 marks 10 min.)	[8, 10]
Assertion and Reason (no negative marking) Q.13	(3 marks 3 min.)	[3, 3]
Integer Answer Type		
Subjective Questions ('–1' negative marking) Q.14	(4 marks 5 min.)	[4, 5]

1. A hypothetical ionic compound AB (mol. wt. = 240 g/mole), having co-ordination number of anion equal to 6, has a closest anion-anion distance of $4\sqrt{2}$ Å. Determine the density of ionic compound AB in gm/cc.

(A) 6.24 (B) 3.12 (C) 1.56 (D) 0.78

2. Which of the following is incorrect



(A) The defect is known as schottky defect

(B) Density of compound in the defect decreases

(C) NaCl(s) is example which generally shows this defect

(D) Stoichoimetry of compound will change slightly.

3. Analysis show that nickel oxide consist of nickel ion with 96% ions having d^8 configuration and 4% having d^7 configuration. Which amongst the following best represents the formula of the oxide.

(A) $Ni_{1.02}O_{1.00}$ (B) $Ni_{0.96}O_{1.00}$ (C) $Ni_{0.98}O_{0.98}$ (D) $Ni_{0.98}O_{1.00}$

4.* The correct statement(s) regarding defects solids is (are)

(A) Schottky defect is usually favoured by small difference in the sizes of cation and anion.

(B) Schottky defect lowers the density of solids.

(C) Compounds having F-centres are diamagnetic.

(D) Frenkel defect is a dislocation defect.

5.* Which of the following is/are incorrect for Rock salt crystal :

(A) If all Na^+ ions occupied at body centre are removed according to schottky defect then formula of resulting ionic compound would be Na_3Cl_4.

(B) If Na^+ ions would be present in alternate tetrahedral voids then formula would be Na_2Cl.

(C) If some Cl^- get displaced from the lattice in the presence of Na vapours then colour of compound will change.

(D) If interionic distance in crystal is 4.2 Å then edge length of unit cell becomes equal to 8.4 Å.

6.* Select the correct statement(s) related to hexagonal close packing of identical spheres in three dimensions:

(A) In one unit cell there are 12 octahedral voids and all are completely inside the unit cell

(B) In one unit cell there are six octahedral voids and all are completely inside the unit cell.

(C) In one unit cell there are six octahedral void and out of which three are completely inside the unit cell and other three are from contributions of octahedral voids which are partially inside the unit cell

(D) Co-ordination number of every sphere is 12 in hcp lattice.

Comprehension # (Q.7 to Q.11)

Sodium chloride structure is composed of Na^+ and Cl^-. Chloride ions are arranged in ccp while Na^+ ions are in octahedral holes. Each Na^+ is surrounded by six Cl^- ions while each Cl^- is surrounded by six Na^+. Cadamium oxide crystallizes in NaCl type of crystal lattice. The compound is however usually non stoichiometric with approximate formula $CdO_{0.95}$. The defect arise due to some cationic positions are occupied by neutral Cd-atom instead of Cd^{2+} ions and equivalent number of anion sites are vacant. (Mt.wt. of CdO = 128). Assume anion-anion contact.

7. What % of anion sites are vacant :

(A) 95% (B) 5% (C) 10% (D) 50%

8. If edge length of unit cell is 470 pm what would be the density of $CdO_{0.95}$ solid?

(A) $\frac{4\times128}{N_A\times(4.7)^3}$ gm/cc (B) $\frac{4\times128}{N_A\times(4.7)^3\times10^{-24}}$ gm/cc

(C) $\frac{4\times127.2}{N_A\times(4.7)^3}$ gm/cc (D) $\frac{4\times127.2}{N_A\times(4.7)^3\times10^{-24}}$ gm/cc

9. What will be the packing fraction of a NaCl type solid if ions along an axis connecting opposite face centres are absent :

(A) $\frac{\pi}{3\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (B) $\frac{\pi}{4\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (C) $\frac{\pi}{2\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{4\pi}{3}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

10. What will be the packing fraction of NaCl type solid if ions along an axis connecting opposite edge centres along one phase are absent :

(A) $\frac{7\pi}{24\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (B) $\frac{7\pi}{8\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (C) $\frac{7\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

11. What will be the packing fraction when ions along opposite edge centres are missing :

(A) $\frac{\pi}{12\sqrt{2}}\left[\frac{5}{2}\left(\frac{r^+}{r^-}\right)^3+4\right]$ (B) $\frac{\pi}{12\sqrt{2}}\left[\frac{5}{2}\left(\frac{r^+}{r^-}\right)^3+2\right]$ (C) $\frac{7\pi}{24\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$ (D) $\frac{7\pi}{12\sqrt{2}}\left[\left(\frac{r^+}{r^-}\right)^3+1\right]$

12.

Column-I	Column-II
(A) Zinc blende structure	(p) Coordination number of cation and anion are equal.
(B) Rock salt structure	(q) $r_+ + r_- = \frac{a_{fcc}\sqrt{3}}{4}$
(C) Antifluorite structure	(r) Coordination number of cation < 6
(D) Cesium chloride structure	(s) $r_+ + r_- = \frac{a_{sc}\sqrt{3}}{2}$
	(t) Anion forms fcc lattice.

13. **Statement-1 :** In NaCl crystal each Na^+ ion is touching 6 Cl^- ions but these Cl^- ions do not touch each other.

Statement-2 : The radius ratio r_{Na^+}/r_{Cl^-} is greater than 0.414, required for exact fitting.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

Integer Answer Type

14. This section contains 2 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

(i) In F.C.C. arrangement of identical spheres, distance between two nearest octahedral void is 8.51Å. The distance between two nearest tetrahedral voids would be ?

(ii) How many of the following ionic compounds have coordination number of either cation or anion equal to 6 or more : ZnS, KCl, K_2O, CsBr, NaBr, CaF_2

Answer Key

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1.	(B)	**2.**	(D)	**3.**	(D)	**4.***	(A,B,D)	**5.***	(A,B)
6.*	(B,D)	**7.**	(B)	**8.**	(D)	**9.**	(B)	**10.**	(A)
11.	(A)	**12.**	(A → p,q,r,t) ; (B → p,t) ; (C → q,r,t) ; (D → p,s)	**13.**	(A)				
14.	**(i)** 6Å **(ii)** 5								

Hints & Solutions

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1. $$d = \frac{Z \times M}{N_A a^3} = \frac{4 \times 240}{6.02 \times 10^{23} \times 8^3 \times 10^{-24}} = 3.12$$

3. $d^8 \rightarrow Ni^{2+}$, $d^7 \rightarrow Ni^{3+}$.

Total charge of nickel.

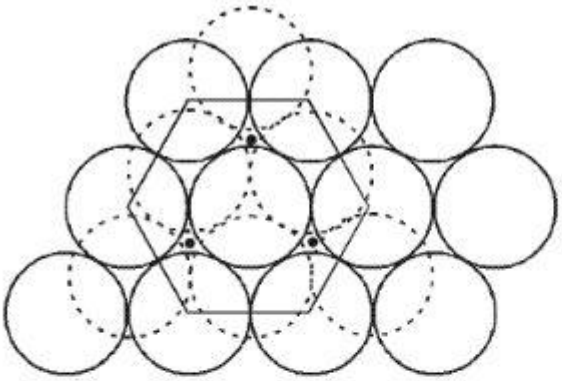
$(0.96 \times 2) + (0.04 \times 3) = 2.04$.

No. of O^{2-} ion $= \frac{2.04}{2} = 1.02$.

Formula of solid $= NiO_{1.02} = Ni_{0.98}O$.

5.* In schottky defect equal no. of cation and anion removes and formula would remain same.
If Na^+ would present in tetrahedral void then as NaCl formula must remain same.
Due to F-centre colour of compound changes
$a = 2(r^+ + r^-) = 2 \times$ inter ionic distance $= 8.4$ Å

6.*



hcp = AB AB AB .....pattern repeat
For calculating voids between two layers A and B.
Octahedral voids = 3 = represented by (•).
So total octahedral voids = 6 = All are completely inside.

14. (i) Distance between two octahedral void = $\frac{a}{\sqrt{2}}$ = 8.51

$a = 8.51 \times 1.41 = 12Å$

Distance between two tetrahedral void = a/2 = 6Å

(ii) ZnS → Zinc blende structure, C.N. = 4
KCl → Rock salt, CN = 6
K_2O → Antifluorite structure, CN of K^+ = 4
CsBr → CN = 8
NaBr → Rock salt, CN = 6
CaF_2 → Fluorite structure, CN of F^- = 4 CN of Ca^{2+} = 8.