

SOLID STATE

1. The coordination number of an atom in a body-centered cubic structure is _____.
[Assume that the lattice is made up of atoms.]
2. The unit cell of copper corresponds to a face centered cube of edge length 3.596 \AA with one copper atom at each lattice point. The calculated density of copper in kg/m^3 is _____.
[Molar mass of Cu : 63.54 g ; Avogadro Number = 6.022×10^{23}]
3. The number of octahedral voids per lattice site in a lattice is _____. (Rounded off to the nearest integer)
4. A certain element crystallises in a bcc lattice of unit cell edge length 27 \AA . If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in Å will be _____. (Round off to the Nearest Integer).
[Assume each lattice point has a single atom]
[Assume $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$]
5. Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is _____ $\times 10^{21}$. (Round off to the Nearest Integer).
6. KBr is doped with 10^{-5} mole percent of SrBr_2 . The number of cationic vacancies in 1 g of KBr crystal is _____ 10^{14} . (Round off to the Nearest Integer).
[Atomic Mass : K : 39.1 u , Br : 79.9 u ,
 $N_A = 6.023 \times 10^{23}$]
7. In a binary compound, atoms of element A form a hcp structure and those of element M occupy $2/3$ of the tetrahedral voids of the hcp structure. The formula of the binary compound is :
(1) M_2A_3 (2) M_4A_3 (3) M_4A (4) MA_3
8. A hard substance melts at high temperature and is an insulator in both solid and in molten state. This solid is most likely to be a / an :
(1) Ionic solid (2) Molecular solid
(3) Metallic solid (4) Covalent solid
9. Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is _____.
10. A copper complex crystallising in a CCP lattice with a cell edge of 0.4518 nm has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be 7.62 g cm^{-3} . The molar mass of copper complex is _____ g mol^{-1} . (Nearest integer)
[Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]
11. The parameters of the unit cell of a substance are $a = 2.5$, $b = 3.0$, $c = 4.0$, $\alpha = 90^\circ$, $\beta = 120^\circ$, $\gamma = 90^\circ$. The crystal system of the substance is :
(1) Hexagonal (2) Orthorhombic
(3) Monoclinic (4) Triclinic
12. Select the correct statements.
(A) Crystalline solids have long range order.
(B) Crystalline solids are isotropic.
(C) Amorphous solid are sometimes called pseudo solids.
(D) Amorphous solids soften over a range of temperatures.
(E) Amorphous solids have a definite heat of fusion.
Choose the most appropriate answer from the options given below.
(1) (A), (B), (E) only
(2) (B), (D) only
(3) (C), (D) only
(4) (A), (C), (D) only

13. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : Sharp glass edge becomes smooth on heating it upto its melting point.

Reason R : The viscosity of glass decreases on melting.

Choose the most appropriate answer from the options given below.

- (1) **A** is true but **R** is false
- (2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.
- (3) **A** is false but **R** is true.
- (4) Both **A** and **R** are true and **R** is the correct explanation of **A**.

14. Given below are two statements.

Statement I: Frenkel defects are vacancy as well as interstitial defects.

Statement II: Frenkel defect leads to colour in ionic solids due to presence of F-centres.

Choose the **most appropriate** answer for the statements from the options given below:

- (1) **Statement I** is false but **Statement II** is true
- (2) Both **Statement I** and **Statement II** are true
- (3) **Statement I** is true but **Statement II** is false
- (4) Both **Statement I** and **Statement II** are false

15. Match items of **List-I** with those of **List-II** :

List-I (Property)	List-II (Example)
(a) Diamagnetism	(i) MnO
(b) Ferrimagnetism	(ii) O ₂
(c) Paramagnetism	(iii) NaCl
(d) Antiferromagnetism	(iv) Fe ₃ O ₄

Choose the **most appropriate** answer from the options given below :

- (1) (a)–(ii), (b)–(i), (c)–(iii), (d)–(iv)
- (2) (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii)
- (3) (a)–(iii), (b)–(iv), (c)–(ii), (d)–(i)
- (4) (a)–(iv), (b)–(ii), (c)–(i), (d)–(iii)

16. The empirical formula for a compound with a cubic close packed arrangement of anions and with cations occupying all the octahedral sites in A_xB. The value of x is _____
(Integer answer)

SOLUTION

1. Official Ans. by NTA (8)

Sol. 8

2. Official Ans. by NTA (9076)

Sol. FCC,

$$d = \frac{Z \times M}{N_A \times a^3} = \frac{4 \times 63.54}{1000 \times 6.022 \times 10^{23} \times (3.596 \times 10^{-10})^3}$$

$$= 9076 \text{ kg/m}^3$$

3. Official Ans by NTA (1)

Sol. If number of lattice points are N.
then effective octahedral voids = N
So, octahedral voids / lattice site = 1

4. Official Ans. by NTA (33)

Sol. For BCC $\sqrt{3} a = 4r$

$$\text{so } r = \frac{\sqrt{3}}{4} \times 27$$

for FCC $a = 2\sqrt{2} r$

$$= 2 \times \sqrt{2} \times \frac{\sqrt{3}}{4} \times 27$$

$$= \frac{\sqrt{3}}{\sqrt{2}} \times 27$$

$$= 33$$

5. Official Ans. by NTA (15)

Sol. HCP structure : Per atom, there will be one octahedral void (OV) and two tetrahedral voids (TV).

Therefore total three voids per atom are present in HCP structure.

→ therefore total no of atoms of Ga will be-

$$= \frac{\text{Mass}}{\text{Molar Mass}} \times N_A = \frac{0.581 \text{g}}{70 \text{g/mol}} \times 6.023 \times 10^{23}$$

→ Now, total Number of voids = 3 × total no. of atoms

$$= 3 \times \frac{0.581}{70} \times 6.023 \times 10^{23} = 14.99 \times 10^{21}$$

$$\approx 15 \times 10^{21}$$

6. Official Ans. by NTA (5)

Sol. 1 mole KBr (= 119 gm) have $\frac{10^{-5}}{100}$ moles SrBr_2

and hence, 10^{-7} moles cation vacancy
(as 1 Sr^{2+} will result 1 cation vacancy)

∴ Required number of cation vacancies

$$= \frac{10^{-7} \times 6.023 \times 10^{23}}{119} = 5.06 \times 10^{14} \approx 5 \times 10^{14}$$

7. Official Ans. by NTA (2)

Sol. $M_{12 \times \frac{2}{3}} A_6$

$M_8 A_6$

$M_4 A_3$

8. Official Ans. by NTA (4)

Sol. Covalent or network solid have very high melting point and they are insulators in their solid and molten form.

9. Official Ans. by NTA (8)

Sol. Carbon atoms occupy FCC lattice points as well as half of the tetrahedral voids
therefore number of carbon atoms atoms per unit cell = 8

10. Official Ans. by NTA (106)

Sol. $d \left(\frac{\text{gm}}{\text{cc}} \right) = \frac{4 \times \frac{M}{N_A}}{(a \text{ cm})^3}$

$$7.62 = \frac{4 \times M / 6.022 \times 10^{23}}{(0.4518 \times 10^{-7} \text{ cm})^3} \Rightarrow M = 105.8 \text{ g/mol}$$

11. Official Ans. by NTA (3)

Sol. $a \neq b \neq c$ and $\alpha = \gamma = 90^\circ \neq \beta$
are parameters of monoclinic unit cell.

12. Official Ans. by NTA (4)

Sol. (A) Crystalline solids have definite arrangement of constituent particles and have long range order.
(C), (D) Different constituent particles of an amorphous solid have different bond strengths and soften over a range of temperatures.

13. Official Ans. by NTA (2)

Sol. Hence given statement (A) is not correct

But statement (B) is correct

14. Official Ans. by NTA (3)

Sol. Theory based.

15. Official Ans. by NTA (3)**16. Official Ans. by NTA (1)**

Sol. Anions froms CCP or FCC (A^-) = 4 A^- per unit cell

Cations occupy all octahedral voids (B^+) = 4 B^+ per unit cell

cell formula $\rightarrow A_4B_4$

Empirical formula $\rightarrow AB$

$$\rightarrow (x = 1)$$