Class: 12
Subject: Chemistry
Topic: Solid state
No. of Questions: 28

1.   How can you convert NaCl structure into CsCl structure and vice-versa?

2.   AgI crystallizes in cubic close packed ZnS structure. What fraction of tetrahedral sites are occupied by Ag^+ ions?

3.   What is Frenkel defect?

4.   What type of crystal defect is produced when sodium chloride is doped with $MgCl_2$?

5.   A compound AB_2 possesses the CaF_2 type crystal structure. Write the co-ordination number of A^{++} and B^- ions in its crystals.

6.   A solid between A and B has the following arrangement of atoms
        (i)   Atoms A are arranged in ccp array
        (ii)   Atoms B occupy all the octahedral voids and half the tetrahedral voids. What is the formula of the compound?

7.   In corundum, oxide ions are arranged in hcp array and the aluminium ions occupy two thirds of octahedral voids. What is the formula of corundum?

8.   Calculate the ratio of the alkali metal bromides on the basis of the data given below and predict the form of the crystal structure in each case. Ionic radii (in pm) are given below
        $Li^+ = 74$, $Na^+ = 102$, $K^+ = 138$
        $Rb^+ = 148$, $Cs^+ = 170$, $Br^- = 195$

9.   In the close packed cation in an AB type solid have a radius of 75 pm, what would be the maximum and minimum sizes of the anions filling the voids?

10. NH_4Cl crystallizes in a body centered cubic lattice, with a unit cell distance of 387 pm. Calculate (a) the distance between the oppositely charged ions in the lattice, and (b) the radius of the NH_4^+ ion if the radius of the Cl^- ion is 181 pm.

11. Copper has the fcc crystal structure. Assuming an atomic radius of 130pm for copper atom (Cu = 63.54):
    (a) What is the length of unit cell of Cu?
    (b) What is the volume of the unit cell?
    (c) How many atoms belong to the unit cell?
    (d) Find the density of Cu.

12. The density of CaO is 3.35 gm/cm^3. The oxide crystallises in one of the cubic systems with an edge length of 4.80 Å. How many Ca^{++} ions and O^{-2} ions belong to each unit cell, and which type of cubic system is present?

13. A metal crystallizes into two cubic system-face centred cubic (fcc) and body centred cubic (bcc) whose unit cell lengths are 3.5 and 3.0Å respectively. Calculate the ratio of densities of fcc and bcc.

14. Copper crystal has a face centred cubic structure. Atomic radius of copper atom is 128 pm. What is the density of copper metal? Atomic mass of copper is 63.5.

15. The first order reflections of a beam of X – rays of wavelength of 1.54A° from the (100) face of a crystal of the simple cubic type occurs at an angle 11.29°. Calculate the length of the unit cell.

16. In a crystalline solid, having formula AB_2O_4, oxide ions are arranged in cubic close packed lattice while cations A are present in tetrahedral voids and cations B are present in octahedral voids
    (i) What percentage of the tetrahedral voids is occupied by A?
    (ii) What percentage of the octahedral voids is occupied by B?

17. In a solid, oxide ions are arranged in ccp. Cations A occupy one – sixth of the tetrahedral voids and cations B occupy one third of the octahedral voids. What is the formula of the compound?

18. Br^- ion forms a close packed structure. If the radius of Br^- ions is 195 pm. Calculate the radius of the cation that just fits into the tetrahedral hole. Can a cation A^+ having a radius of 82 pm be slipped into the octahedral hole of the crystal A^+Br^-?

19. CsCl has bcc structure with Cs^+ at the centre and Cl^- ion at each corner. If r_{Cs^+} = 1.69Å and r_{Cl^-} = 1.81Å, what is the edge length "a" of the cube?
    (A) 3.50Å   (B) 3.80Å
    (C) 4.04Å   (D) 4.50Å

Transsweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

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20   A substance has density of 2 kg dm^{-3} & it crystallizes to fcc lattice with edge-length equal to 700pm, then the molar mass of the substance is
(A) 74.50gm mol^{-1} (B) 103.30gm mol^{-1}
(C) 56.02gm mol^{-1} (D) 65.36gm mol^{-1}

21   The electrical conductivity of a metal decreases with rise in temperature while that of a semiconductor increases. Explain.

22   What type of substance would make better permanent magnets, ferromagnetic or ferrimagnetic, why?

23   In terms of band theory what is the difference between a conductor, an insulator and a semiconductor?

24.   In compound atoms of element Y forms ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. What is the formula of the compound?

25. $CaCl_2$ will introduce Schottky defect if added to AgCl crystal. Explain

26..   Classify each of the following as either a p-type semi-conductor or an n-type semiconductor:
A) Ge doped with In
B) B doped with Si
A. Ge is group 14 elements and In is group 13 element. Therefore, an electron deficit hole is created. Thus semi-conductor is p-type.
B. Since B group belong to group 13 element and Si is group 14 elements, there will be a free electron, thus is n-type semi-conductor.

27.   Gold crystallizes in an FCC unit Cell. What is the length of a side of the cell (r=0.144mm)

28.   Calculate the number of atoms in a cubic unit cell having one atom on each corner and two atoms on each body diagonal.