Chapter 01

The Solid State

Very Short Answer Type Questions

01. How many atoms constitute one unit cell of a face-centered cubic (fcc) crystal?

02. What are non-stoichiometric compounds?

3. The analysis shows that FeO has a non-stoichiometric composition with formula $Fe_{0.95}O$. Give reason.

04. Account for the following.The conductivity of silicon increases by doping it with phosphorous.

05. What is the maximum possible coordination number of an atom in an hcp crystal structure of an element?

06. What type of semiconductor is obtained when silicon is doped with boron?

07. Express the relationship between the atomic radius and the edge length (a) in the bcc unit cell.

08. What change occurs when AgCl is doppedwith $CaCl_2$.

09. Write the type of magnetism observed when the magnetic moment is oppositely aligned and cancel out each other.

10. What is meant by an intrinsic semiconductor?

11. What type of magnetism is shown in the following alignment of magnetic moments

12. What type of stoichiometric defect is shown by $AgCl$?

13. State the difference between Schottky and Frenkel defects. Which of these two changes the density of the solid?

14. (i) Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel direction in un-equal numbers.

15. Account for the following:

(i) Phosphorus doped with silicon is a semiconductor.

(ii) Some of the glass objects recovered from ancient monuments look milky instead of being transparent.

(iii) Schottky defect lowers the density of a solid.

16. (i) What type of non-stoichiometric point defect is responsible for the pink color of LiCl?

(ii) What type of stoichiometric defect is shown by NaCl?

17. How would you account for the following:

(i) Frenkel defects are not found in alkali metal halides.

(ii) Impurity doped silicon is a semiconductor.

18. Explain with suitable examples the following:

(a) n-type and p-type semiconductors

(b) F-centres

(c) Ferromagnetism.

19. How are the following properties of crystals affected by Schottky and Frenkel defects?

(i) Density (ii) Electrical conductivity.

20. (i) What type of stoichiometric defect is shown by KCl and why?

(ii) What type of semiconductor is formed when silicon is doped with As.

(iii) Which one of the following is an example of a molecular solid: CO_2 or SiO_2.

(iv) What type of substance would make better magnet; ferromagnetic or Ferrimagnetic?

Long Answer Type Questions

21. (i) Based on the nature of intermolecular forces, classify the following solids: Sodium Sulphate, Hydrogen.

(ii) What happens when is doped with AgCl?

(iii) Why do ferromagneticsubstances show better magnetism than antiferromagnetic substances?

22. Aluminum crystallizes in an fcc structure. The atomic radius of the metal is 125 pm. What is the length of the side of the unit cell of the metal?

23. An element with density 2.8g cm^{-3} forms anfcc unit cell with edge length $4\times10^{-8}\text{cm}$. Calculate the molar mass of the element.

24. An element 'x' $\left(\text{At mass} = 40\text{g mol}^{-1}\right)$ having f.c.cstructures, has a unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. $\left(N_0 = 6.022\times10^{23}\text{mol}^{-1}\right)$

25. Iron has a body-centered cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.87 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of Fe = 56 g mol^{-1})

26. An element with density 10g cm^{-3} forms a cubic unit cell with an edge length of $3\times10^{-8}\text{cm}$. What is the nature of the cubic unit cell if the atomic mass of the element is 81 g mol^{-1}.

27. An element with density 11.2g cm^{-3} forms anfcc lattice with an edge length of $4\times10^{-8}\text{cm}$. Calculate the atomic mass of the element. Given $N_A = 6.022\times10^{23}\text{mol}^{-1}$

28. The well-known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are $4Ca^{2+}$ ions and $8F^-$ ions and that Ca^{2+} ion are arranged in anf.c.c. lattice. The F ions fill all the tetrahedral holes in the face-centered cubic lattice of Ca^{2+} ions. The edge of the unit cell is 5.46 x 10^{-8} cm in length. The density of the solid is 3.18 g cm^{-3}. Use this information to calculate Avogadro's number (Molar mass of CaF_2 = 78.08 g mol^{-1})

29. Copper crystallizes with a face-centered cubic unit cell. If the radius of the copper atom is 127.8 pm. Calculate the densityof the copper metal. (Atomic mass of Cu = 63.55u and Avogadro's number N_A = 6.02 x 10^{23} mol^{-1})

30. An element with molar mass 27g mol^{-1} forms a cubic unit cell with edge length $4.05\times10^{-8}\text{cm}$. If its density is 2.7g cm^{-3} , what is the nature of the cubic unit cell?