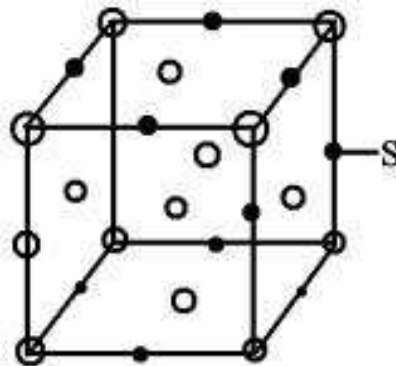


UNIT - 1

THE SOLID STATE

1-Mark Questions

- 1) In the normal spinel structure, the oxide ions are arranged in CCP pattern. The Zn^{2+} ions occupy one eighth of the tetrahedral holes and one half of the octahedral voids are occupied by Al^{3+} . Give the formula of the spinel.
- 2) Metallic gold crystallizes in FCC lattice. How many nearest neighbours do each gold atom has?
- 3) When a crystal of NaCl is heated in sodium vapour, it acquires a yellow colour. The yellow colour is due to non stoichiometric defect. Name the defect.
- 4) In the face centered cubic arrangement of A and B atoms where A atoms are at the corner of the unit cell and B atoms at the face centres. One of the A atom is missing from one corner in the unit cell. What is the simplest formula of the compound?
- 5) For the structure given below identify the site marked as S.



- 6) In BCC lattice, what are the numbers of the nearest and next nearest neighbours?
- 7) What type of magnetism is shown by the substance whose magnetic moments are aligned as given below:



- 8) A solid 'X' conducts electricity in solid state as well as in molten state. Its conductance decreases with increase in temperature. Identify the solid X.
- 9) In Chromium(III) Chloride, $CrCl_3$, chloride ions have cubic close packed arrangement and $Cr(III)$ ions are present in the octahedral holes. What is the fraction of octahedral holes occupied? What is the fraction of total number of holes occupied?

2 Marks Questions

- 10) A compound AB crystallizes in BCC lattice with unit cell edge length of 480Pm. If the radius of B is 225Pm. Calculate the radius of A⁺.

Hint:

$$\text{For BCC structure: } 2(r_A+r_B) = \sqrt{3} a$$

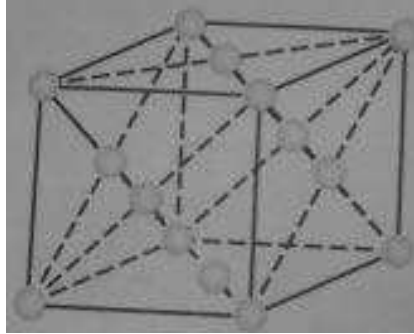
- 11) In the close packing arrangement of atoms does a face centred atom touch the face centred atom of an adjacent face? Give reason for your answer.

- 12) Identify the crystal systems which have the following crystallographic dimensions:

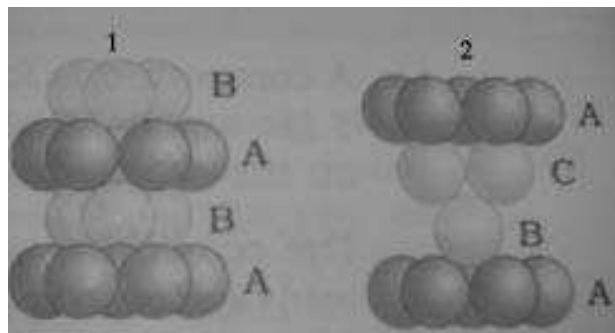
$$a \neq b \neq c \quad \alpha = \beta = \gamma = 90^\circ$$

$$a = b \neq c \quad \alpha = \beta = 90^\circ \quad \gamma = 120^\circ$$

- 13) Identify the unit cell and calculate the number of atoms per unit cell.



- 14)



- What are the types of close packing shown in figure 1 and 2?
- Write one example for each type of close packing in metals.

- 15) The composition of a sample of wustite is $\text{Fe}_{0.93}\text{O}_{1.00}$. What percentage of Fe is present as Fe(III)?
- 16) Iron changes its crystal structure from body centred to cubic close packed structure when heated to 916°C . Calculate the ratio of the density of the BCC crystal to that of CCP crystal. Assume that the metallic radius of the atom does not change.
Hint:
Volume same, so ratio of density is also same
i.e. $d(\text{bcc})/d(\text{ccp})$
- 17) A compound forms hexagonal close packed structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?
- 18) The electrical conductivity of Zinc oxide increases on heating. Give reason.
- 19) Both the ionic solids NaF and MgO have the same number of electrons and about the same inter nuclear distances. But the melting point of NaF is 992°C and that of MgO is 2642°C . Give plausible reason for this observation.
Hint:- charge of ions and lattice enthalpy.
- 20) The concentration of cation vacancies in NaCl crystal doped with CdCl_2 is found to be $6.02 \times 10^{16} \text{ mol}^{-1}$. What is the concentration of CdCl_2 added to it?

3 Marks Questions

- 21) Calcium crystallizes in a face centred cubic unit cell with $a=0.556\text{nm}$. Calculate the density if
- It contains 0.1% Frenkel defects.
 - It contains 0.1% Schottky defects.

Hint:

Frenkel defect does not affect density.

$$d = zM/a^3N_A$$

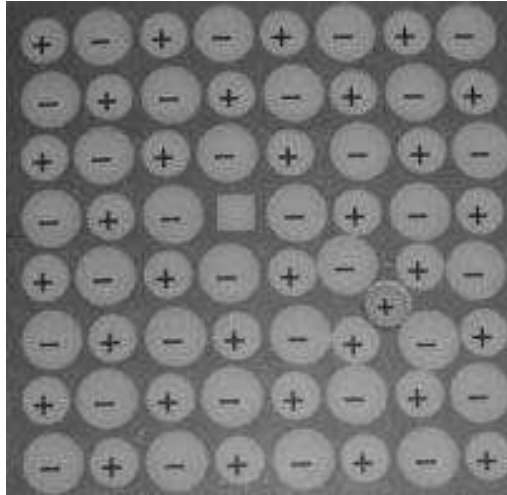
Schottky defect reduces the density by 0.1%, assuming that volume remains constant.

$$d' = d(1 - 0.1/100)$$

$$d' = 0.999d$$

- 22) You are given marbles of diameter 10mm. They are to be placed such that their centres are lying in a square bound by four lines each of length 40mm. What will be the arrangements of the marbles in a plane so that maximum number of marbles can be placed inside the area? Sketch the diagram and calculate the number of spheres per unit area.

23)



- i. Name the defect shown in the figure.
- ii. How does it affect the density of the solid?
- iii. Name a solid which shows this defect.

24) In the mineral, spinel, having the formula $MgAl_2O_4$, oxide ions are arranged in the cubic close packing. Mg^{2+} ions occupy the tetrahedral voids while Al^{3+} ions occupy the octahedral voids.

- (i) What is the percentage of tetrahedral voids occupied by Mg^{2+} ions?
- (ii) What is the percentage of octahedral voids occupied by Al^{3+} ions?

25) Metallic magnesium has a hexagonal close packed structure and has a density 1.74 g cm^{-3} . Assuming magnesium atoms to be spherical, calculate the radius of magnesium atom. (Atomic mass of Magnesium = 24.3).

Hints: Consider 1 cm^3 Mg and calculate mass of 1 cm^3 of Mg. Then calculate the No. of atoms in that much mass of Mg. Calculate the volume occupied by the Mg Atoms and that occupied by 1 Mg atom. Then using the formula $\frac{4}{3}\pi r^3$ radius of Mg, r can be calculated