UNIT:-1; SOLID STATE(other questions)

1.15. 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?

Ans:

No. of atoms in close packings 0.5 mol $=0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$

No. of octahedral voids = No. of atoms in packing $=3.011 \times 10^{23}$

No. of tetrahedral voids = 2 x No. of atoms in packing

$= 2 \times 3.011 \times 10^{23} = 6.022 \times 10^{23}$

Total no. of voids $= 3.011 \times 10^{23} + 6.022 \times 10^{23}$

$= 9.033 \times 10^{23}$

1.16. A compound is formed by two elements M and N. The element N forms ccp and atoms of M occupy l/3rd of tetrahedral voids. What is the formula of the compound?

Ans: Atoms of N from ccp, therefore, if the lattice points are n, then

No . of atoms of N = n

No. of oct voids = n

No. of td voids = 2n= 2 x 1n/3 = 2n/3

∴ Formula of compound is: M : N

2/3 n : n

2n: 3n

2: 3

i.e., M_2N_3

1.17. Wh ich of the following lattices has the highest packing efficiency (i) simple cubic (ii) body- centred cubic and (iii) hexagonal close-packed lattice?

Ans: Packing efficiency of:

Simple cubic = 52.4% bcc = 68% hcp = 74%

hcp lattice has the highest packing efficiency.

1.18. An element with molar mass 2.7×10^{-2} kg mol^{-1} forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^{3} kg m^{-3}, what is the nature of the cubic unit cell?

Ans:

$$d = \frac{Z \times M}{a^3 N_A}$$

Given: Density, $d = 2.7 \times 10^3\ \text{kg m}^{-3}$

$a = 405\ \text{pm}$

$= 405 \times 10^{-12}\ \text{m}$

$M = 2.7 \times 10^{-2}\ \text{kg mol}^{-1}$

$$\Rightarrow Z = \frac{d\, a^3 N_A}{M}$$

$$= \frac{(2.7\times10^3)(405\times10^{-12})^3\,(6.022\times10^{23})}{2.7\times10^{-2}}$$

$= 3.99 \simeq 4$

Therefore, it is a *fcc* unit cell.

1.19. What type of defect can arise when a solid is heated? Which physical property is affected by it and in what way?

Ans: When a solid is heated, vacancy defect is produced in the crystal. On heating, some atoms or ions leave the lattice site completely, i.e., lattice sites become vacant. As a result-of this defect, density of the substances decreases.

1.20.What type of stoichiometric defect is shown by:
(i)ZnS (ii)AgBr

Ans: (i) ZnS shows Frenkel defect
(ii)AgBr shows Frenkel as well as Schottky defect.

1.21. Explain how vacancies are introduced in an ionic solid when a cation of higher valence is added as an impurity in it.

Ans: Let us take an example NaCl doped with SrCl, impurity when SrCl2 is added to NaCl solid as an impurity, two Na+ ions will be replaced and one of their sites will be occupied by Sr21- while the other will remain vacant. Thus, we can say that when a cation of higher valence is added as an impurity to an ionic solid, two or more cations of lower valency are replaced by a cation of higher valency to maintain electrical neutrality. Hence, some cationic vacancies are created.