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

$a = 405 \text{ pm}$

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

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

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

$$= \frac{(2.7 \times 10^3)(405 \times 10^{-12})^3 (6.022 \times 10^{23})}{2.7 \times 10^{-2}}$$

$$= 3.99 \simeq 4$$

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 $SrCl_2$ 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.

1.22.Ionic solids, which have anionic vacancies due to metal excess defect, develop colour. Explain with the help of a suitable example.
Ans: Let us take an example of NaCl. When NaCl crystal is heated in presence of Na vapour, some Cl^- ions leave their lattice sites to combine with Na to form NaCl. The e^{-1} s lost by Na to form Na^+ ($Na^+ + Cl^- \rightarrow NaCl$) then diffuse into the crystal to occupy the anion vacancies. These sites are called F-centres. These e^-s absorb energy from visible light, get excited to higher energy level and when they fall back to ground state, they impart yellow colour to NaCl crystal.

1.23. A group 14 element is to be converted into n-type semiconductor by doping it with a suitable impurity. To which group should this impurity belong?
Ans: Impurity from group 15 should be added to get n-type semiconductor.

1.24. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic. Justify your answer.
Ans: Ferromagnetic substances make better permanent magnets. This is because when placed in magnetic field, their domains get oriented in the directions of magnetic field and a strong magnetic field is produced. This ordering of domains persists even when external magnetic field is removed. Hence, the ferromagnetic substance becomes a permanent magnet.

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