SOLID STATE

1. Which premitive unit cell has unequal edge lenghs ($a \neq b \neq c$) and all axial angles different from 90°

(1) Tetragonal (2) Hexagonal

(3) Monoclinic (4) Triclinic

2. A solid having density of 9×10^3 kg m^{-3} forms face centred cubic crystals of edge length $200\sqrt{2}$ pm. What is the molar mass of the solid ?

(Avogadro constant $\cong 6 \times 10^{23}$ mol^{-1}, $\pi \cong 3$)

(1) 0.0216 kg mol^{-1}

(2) 0.0305 kg mol^{-1}

(3) 0.4320 kg mol^{-1}

(4) 0.0432 kg mol^{-1}

3. The radius of the largest sphere which fits properly at the centre of the edge of body centred cubic unit cell is : (Edge length is represented by 'a') :-

(1) 0.134 a (2) 0.027 a

(3) 0.067 a (4) 0.047 a

4. At 100°C, copper (Cu) has FCC unit cell structure with cell edge length of x Å. What is the approximate density of Cu (in g cm^{-3}) at this temperature ?

[Atomic Mass of Cu = 63.55u]

(1) $\frac{105}{x^3}$ (2) $\frac{211}{x^3}$

(3) $\frac{205}{x^3}$ (4) $\frac{422}{x^3}$

5. The statement that is **INCORRECT** about the interstitial compounds is :

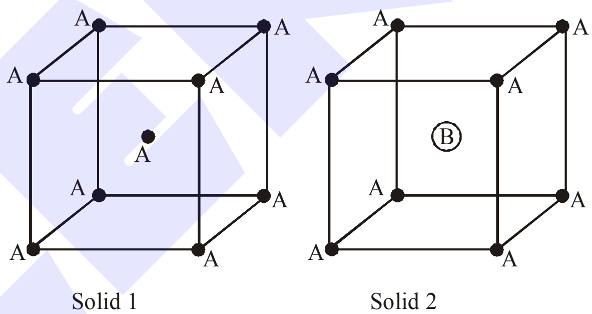
(1) They have high melting points

(2) They are chemically reactive

(3) They have metallic conductivity

(4) They are very hard

6. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?



(1) 45% (2) 65%

(3) 90% (4) 75%

7. An element has a face-centred cubic (fcc) structure with a cell edge of a. The distance between the centres of two nearest tetrahedral voids in the lattice is :

(1) $\frac{a}{2}$ (2) a

(3) $\frac{3}{2}$ a (4) $\sqrt{2}$ a

8. The ratio of number of atoms present in a simple cubic, body centered cubic and face centered cubic structure are, respectively :

(1) 1 : 2 : 4 (2) 8 : 1 : 6

(3) 4 : 2 : 1 (4) 4 : 2 : 3

9. A compound of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms :

(1) hcp lattice-A, $\frac{2}{3}$ Tetrachedral voids-B

(2) hcp lattice-B, $\frac{1}{3}$ Tetrachedral voids-A

(3) hcp lattice-B, $\frac{2}{3}$ Tetrachedral voids-A

(4) hcp lattice-A $\frac{1}{3}$ Tetrachedral voids-B

SOLUTION

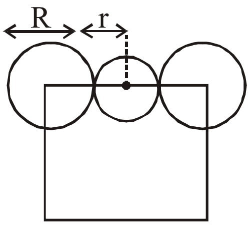
1. **Ans. (4)**

In Triclinic unit cell

$a \neq b \neq c$ & $\alpha \neq \beta \neq \gamma \neq 90°$

2. **Ans. (2)**

3. **Ans. (3)**



$a = 2(R + r)$

$\frac{a}{2} = (R + r)$ ...(1)

$a\sqrt{3} = 4R$ ...(2)

Using (1) & (2)

$\frac{a}{2} = \frac{a\sqrt{3}}{4} = r$

$a\left(\frac{2-\sqrt{3}}{4}\right) = r$

$r = 0.067\ a$

4. **Ans. (4)**

FCC unit cell Z = 4

$d = \frac{63.5 \times 4}{6 \times 10^{23} \times x^3 \times 10^{-24}}\ g/cm^3$

$d = \frac{63.5 \times 4 \times 10}{6}\ g/cm^3$

$d = \frac{423.33}{x^3} \simeq \left(\frac{422}{x^3}\right)$

5. **Ans. (2)**

Sol. Generally interstitial compounds are chemicaly inert.

6. **Ans. (3)**

Sol. $p.f. = \frac{\left(z_{eff} \times \frac{4}{3}\pi r_A^3\right)_A + \left(z_{eff} \times \frac{4}{3}\pi r_B^3\right)_B}{a^3}$

$2(r_A + r_B) = \sqrt{3}a$

$\Rightarrow 2(r_A + 2r_A) = \sqrt{3}a$

$\Rightarrow 2\sqrt{3}\, r_A = a$

$\Rightarrow p.f. = \frac{1 \times \frac{4}{3}\pi r_A^3 + \frac{4}{3}\pi\left(8r_A^3\right)}{8 \times 3\sqrt{3}\, r_A^3} = \frac{9 \times \frac{4}{3}\pi}{8 \times 3\sqrt{3}} = \frac{\pi}{2\sqrt{3}}$

p. efficiency = $\frac{\pi}{2\sqrt{3}} \times 100 \simeq 90\%$

7. **Ans. (1)**

Sol. Distance between two nearest tetrahedral void

$= \left(\frac{a}{2}\right)$

8. **Ans. (1)**

Sol. SC : BCC : FCC

1 : 2 : 4

9. **Ans. (2)**

A_2B_3 has HCP lattice

If A form HCP, then $\frac{3}{4}^{th}$ of THV must occupied by B to form A_2B_3

If B form HCP, then $\frac{1}{3}^{th}$ of THV must occupied by A to form A_2B_3