

Solid state (Assignment – III)

1.

(i) What is meant by the term 'coordination number'?

(ii) What is the coordination number of atoms:

(a) in a cubic close-packed structure?

(b) in a body-centred cubic structure?
2. How can you determine the atomic mass of an unknown metal if you know its density and the dimension of its unit cell? Explain.
3. 'Stability of a crystal is reflected in the magnitude of its melting point'. Comment. Collect melting points of solid water, ethyl alcohol, diethyl ether and methane from a data book. What can you say about the intermolecular forces between these molecules?
4. How will you distinguish between the following pairs of terms:

(i) Hexagonal close-packing and cubic close-packing?

(ii) Crystal lattice and unit cell?

(iii) Tetrahedral void and octahedral void?
5. How many lattice points are there in one unit cell of each of the following lattice?

(i) Face-centred cubic

(ii) Face-centred tetragonal

(iii) Body-centred
9. Explain

(i) The basis of similarities and differences between metallic and ionic crystals.

(ii) Ionic solids are hard and brittle.
6. Calculate the efficiency of packing in case of a metal crystal for

(i) simple cubic

(ii) body-centred cubic

(iii) face-centred cubic (with the assumptions that atoms are touching each other).
7. Silver crystallises in fcc lattice. If edge length of the cell is 4.07×10^{-8} cm and density is 10.5 g cm^{-3} , calculate the atomic mass of silver.

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8. A cubic solid is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound? What are the coordination numbers of P and Q?
9. Niobium crystallises in body-centred cubic structure. If density is 8.55 g cm^{-3} , calculate atomic radius of niobium using its atomic mass 93 u.
10. If the radius of the octahedral void is r and radius of the atoms in close packing is R , derive relation between r and R .
11. Copper crystallises into a fcc lattice with edge length $3.61 \times 10^{-8} \text{ cm}$. Show that the calculated density is in agreement with its measured value of 8.92 g cm^{-3} .
12. Analysis shows that nickel oxide has the formula $\text{Ni}_{0.98}\text{O}_{1.00}$. What fractions of nickel exist as Ni^{2+} and Ni^{3+} ions?
13. What is a semiconductor? Describe the two main types of semiconductors and contrast their conduction mechanism.
14. Non-stoichiometric cuprous oxide, Cu_2O can be prepared in laboratory. In this oxide, copper to oxygen ratio is slightly less than 2:1. Can you account for the fact that this substance is a p -type semiconductor?
15. Ferric oxide crystallises in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of the ferric oxide.
16. Classify each of the following as being either a p -type or an n -type semiconductor:
(i) Ge doped with In **(ii)** B doped with Si.
17. Gold (atomic radius = 0.144 nm) crystallises in a face-centred unit cell. What is the length of a side of the cell?
18. In terms of band theory, what is the difference
(i) Between a conductor and an insulator
(ii) Between a conductor and a semiconductor
19. Explain the following terms with suitable examples:
(i) Schottky defect
(ii) Frenkel defect
(iii) Interstitials and
(iv) F-centres