

# CHEMISTRY STUDY MATERIALS FOR CLASS 12 (NCERT BASED QUESTIONS WITH ANSWERS)

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## The Solid State

### SA-(I) Type Question (2 Marks)

**Q1. Explain how electrical neutrality is maintained in compounds showing Frenkel and Schottky defect.**

**Ans.** In compound showing Frenkel defect, ions just get displaced within the lattice, while in compounds showing Schottky defect, equal number of anions and cations are removed from the lattice. Thus, electrical neutrality is maintained in both cases.

**Q2. Calculate the number of atoms in a cubic unit cell having one atom on each corner and two atoms on each body diagonal.**

**Ans.** 8 corner  $\times$  1/8 atom per unit cell = 1 atom

There are four body diagonals in a cubic unit cell and each has two body centre atoms.

So,  $4 \times 2 = 8$  atoms therefore, total number of atoms per unit cell =  $1 + 8 = 9$ .

**Q3. Gold crystallizes in an FCC unit cell. What is the edge length of unit cell ( $r = 0.144$  nm) ?**

**Ans.**  $r = 0.144$  nm

$$a = 2\sqrt{2}r$$

$$= 2 \times 1.414 \times 0.144 \text{ nm}$$

$$= 0.407 \text{ nm}$$

**Q4. Classify each of the following as either a p-type or n-type semi-conductor:**

(a) Ge doped with In

(b) B doped with Si

**Ans.** *Hint* : (a) Ge is group 14 element and In is group 13 element. Therefore, an electron deficit hole is created. Thus semi-conductor is p-type.

(b) Since B is group 13 element and Si is group 14 element, there will be a free electron, thus, it is n-type semi-conductor.

**Q5. In terms of band theory, what is the difference between a conductor, an insulator and a semi-conductor**

**Ans.** The energy gap between the valence band and conduction band in an insulator is very large while in a conductor, the energy gap is very small or there is overlapping between valence band and conduction band.

**Q6.  $\text{CaCl}_2$  will introduce Schottky defect if added to  $\text{AgCl}$  crystal. Explain.**

**Ans.** Two  $\text{Ag}^+$  ions will be replaced by one  $\text{Ca}^{2+}$  ion to maintain electrical neutrality. Thus, a hole is created at the lattice site for every  $\text{Ca}^{2+}$  ion introduced.

**Q7. The electrical conductivity of a metal decreases with rise in temperature while that of a semi-conductor increases. Explain.**

**Ans.** In metals with increase of temperature, the kernels start vibrating at faster rate and thus offer resistance to the flow of electrons. Hence, conductivity decreases. In case of semi-conductors, with increase of temperature, more electrons can shift from valence band to conduction band. Hence conductivity increases.

**Q8. What type of substances would make better permanent magnets – ferromagnetic or ferromagnetic? Why?**

**Ans.** Ferromagnetic substances make better permanent magnets. This is because the metal ions of a ferromagnetic substance are grouped into small regions called domains. Each domain acts as tiny magnet and get oriented in the direction of magnetic field in which it is placed. This persists even in the absence of magnetic field.

**Q9. In a crystalline solid, the atoms A and B are arranged as follows :**

**(c) Atoms A are arranged in ccp array.**

**(d) Atoms B occupy all the octahedral voids and half of the tetrahedral voids. What is the formula of the compound?**

**Ans.** No. of A (ccp) = 4

$$\text{No. of B} = \text{octahedral voids} + \frac{\text{Tetrahedral}}{2}$$

$$= 4 + \frac{8}{2} = 8$$

A : B, therefore, formula of the compound is  $\text{AB}_2 = 4 : 8 = 1 : 2 = \text{AB}_2$

**Q10. In compound atoms of element Y forms ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. What is the formula of the compound?**

**Ans.** No. of Y atoms per unit cell in ccp lattice = 4

$$\text{No. of tetrahedral voids} = 2 \times 4 = 8$$

$$\text{No. of tetrahedral voids occupied by X} = \frac{2}{3} \times 8 = \frac{16}{3}$$

Therefore, Formula of the compound =  $\text{X}_{16/3}\text{Y}_4$

$$= \text{X}_{16}\text{Y}_{12}$$
$$= \text{X}_4\text{Y}_3$$

### VALUE BASED QUESTIONS (4 Marks) (Try to Solve These Questions)

Q1. Radha suggested that the conductivity of the semiconductors can be increased by heating. Her friend Mira advised her to dope the semiconductor with either group 13 or group 15 elements to increase the conductivity.

- (a) Explain the cause of increase in conductivity by doping.
- (b) Which type of semiconductor is formed if it is doped with group 13 or group 15 elements?
- (c) What are intrinsic semiconductors?
- (d) What values are associated with the suggestion of Mira?

Q2. Students of class XII Chemistry wanted to prepare magnets. They have substances like iron, cobalt, nickel,  $\text{CrO}_2$  and  $\text{MnO}$ . Kapil tried best to prepare the magnets from  $\text{MnO}$  but attempt failed. Veena suggested that except  $\text{MnO}$ , all the above mentioned substances can be used to prepare magnets.

- (a) Why did Kapil fail to prepare magnet from  $\text{MnO}$ ?
- (b) What values are associated with the suggestion of Veena?
- (c) Define antiferromagnetism.
- (d) How can a ferromagnetic substance be made a permanent magnet ?

Q3. Vinay and Manish are provided with 50 oranges each with a tray. They are asked to arrange them in an ordered manner within 5 minutes. Vinay successfully arranged the oranges with minimum empty space but Manish does not.

- (a) What type of crystal packing had Vinay attempted?
- (b) What is the % empty space that remains in such type of arrangement of oranges?
- (c) Name the values associated with the Vinay's attempt for arranging oranges.
- (d) How many tetrahedral and octahedral voids are formed in the packing of 50 oranges?

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