CHEMISTRY

BOOKS - OSWAAL PUBLICATION CHEMISTRY (KANNADA ENGLISH)

SOLID STATE

Example

1. A compound is formed by two elements x and y. Atoms of the elements y make ccp (cubic

close packing) and those of the element x occupy all the octahedral voids. What is the formula of the compound ?

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2. b) Atoms of element B form hep lattice and those of element A occupies $2/3^{rd}$ of tetrahedral voids. Calculate the formula of the compound formed by A and B.

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Topic 1 Very Short Answer Type Questions

1. What is the number of lattice particles per unit cell of sodium chloride ?

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2. What type of crystalline solid is graphite ?

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3. Define unit cell.

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4. Define co-ordination number for a particle in a crystal.

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5. How many particles are present in a unit cell of fcc ?

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6. Draw the unit cell of CsCI

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7. What is the contribution of a corner particle to a unit cell in a cubic crystal lattice ?

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8. What is the co-ordination number of a body centred cube ?

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9. Give the differences between crystalline and amorphous solids with respect to shape and melting point.

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10. What are interstitial in a crystal ?

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11. Define the term amorphous.

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12. a) Calculate the packing efficiency of particles in a body centred cube.

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13. Calculate the packing efficiency in a simple cubic lattice.

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14. The edge of the face-centred cubic unit cell of calcium is 556.5 pm. Calculate the radius of calcium atom.

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Topic 1 Short Answer Type Questions

1. Silver forms ccp lattice and x-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver. (Atomic mass of Ag = 107.9 u)

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2. An element having atomic mass 60 amu. has fcc unit cell. The edge length of the unit cell is 4×10^2 pm. Find the density of the unit cell.

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3. Calculate the number of particles per unit cell in fcc.

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4. A compound A_xB_y crystallises on a fcc lattice in which A occupies each corner of a cube and B occupies the centre of each face of

the cube. What is the formula of the compound ?

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5. Name any two crystal systems.

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6. What is meant by the term coordination number in solids? What is the coordination

number in a face centered cubic close packing structure?

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7. Aluminium crystallizes in an fcc structure. Atomic radius of the metal is 125 pm. Calculate the edge length of the unit cell of the metal.

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8. Give two difference between crystalline and amorphous solids.

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9. Define the term 'amorphous'. Give a few examples of amorphous solids.

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10. What makes a glass different from a solid such as quartz ? Under what condition could quartz be converted into glass ?

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11. Copper crystallizes into a fcc lattice with edge length 3.61×10^{-8} cm. Calculate the density of the crystal (Atomic mass of copper = 63.5 g/mol and Avogadro number = $6.022 \times 10^{23} mol^{-1}$)

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12. Silver crystallizes in a face centered cubic structure. If the edge length is 4.077×10^{-8} cm and density is 10.5 g/cm^3, calculate the atomic mass of silver.

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13. Define radius ratio what is the co-ordination number, if the radius ratio in a compound is 0.52 ?

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14. How many tetrahedral and octahedral voids are present if the number of close packed sphere in two layers is N ?

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15. A compound forms hcp structure. What is the total number of voids in 0.5 mol of it ? How many of these are tetrahedral voids ?

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16. An element crystallizes in a structure having fcc unit cell of an edge 200 pm. Calculate the density if 200 g of this element contains 24×10^{23} atoms.

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17. The unit cell of an element of atomic mass 108 u and density 10.5 g cm^{-3} is cube with edge length 409 pm. Find the type of unit cell

of the crystal. (Given : Avogadro's constant = 6.023×10^{23} mol)

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18. Iron (II) oxide has a cubic structure and each unit cell has a size of 5Å. If density of this oxide is 4 g cm^{-3}, calculate the number of Fe^{2+} and O^{2-} ions present in each unit cell. (Atomic mass of Fe = 56, O = 16, $N_A = 6.023 \times 10^{23}$ and $1\text{Å} = 10^{-8}$ cm)

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19. (a) What are intrinsic semiconductors ? Give an example.

(b) What is the distance between Na^+ and CI^- ions in NaCl crystal if tis density is 2.165 g cm^{-3} ?

[Atomic Mass of Na = 23u, Cl = 35.5 u, Avogadro's number = 6.023×10^{23}]

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20. Silver metal crystallises with a face centred cubic lattice. The length of unit cell is formed to be 4.077×10^{-8} cm. Calculate atomic radius and density of silver.

(Atomic mass of Ag = 108 u, $N_A = 6.023 \times 10^{23} mol^{-1}$).

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21. Caleulate the packing efficiency in a unit cell of Cubic Close Packing(CCP) structure.

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22. Silver crystallises with face-centred cubic unit cells. Each side of the unit cell has a length of 409 pm. Calculate the radius of silver atom. (Assume the atoms just touch each other on the diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms.)

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23. The edge of the face-centred cubic unit cell of aluminium is 404 pm. Calculate the radius of almunium atom.

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24. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are 4 Ca^{2+} ions and $8F^{-}$ ions and that Ca^{2+} ions are arranged in a fcc-lattice. The F^{-} ions fill all

the tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge of the unit cell is 5.46×10^{-8} cm in length. The density of the solid is 3.18 g cm^{-3}. Use this information to calculate Avogadro's number. (Molar mass of CaF_2 = 78.08 g mol^{-1})

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25. An element with density 2.8 g cm^{-3} forms a fcc unit cell with edge length 4×10^{-8} cm.

Calculate the molar mass of the element. (Given : $N_A = 6.022 \times 10^{23} mol^{-1}$)

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26. Iron (II) oxide has a cubic structure and each unit cell has a size of 5Å. If density of this oxide is 4 g cm^{-3}, calculate the number of Fe^{2+} and O^{2-} ions present in each unit cell. (Atomic mass of Fe = 56, O = 16, $N_A = 6.023 \times 10^{23}$ and $1\text{Å} = 10^{-8}$ cm)

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27. Niobium crystallizes in body-centred cubic structure. If its density is 8.55 g cm^{-3}, calculate atomic radius of niobium, given its atomic mass 93 u.

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28. If NaCl is doped with 10^{-3} mole percent $SrCl_2$, what will be the concentration of cation vacancies ? ($N_A = 6.02 \times 10^{23} mol^{-1}$)

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29. What is the co-ordination number of an atom in each of the following types of cubic lattices ?

(a) Primitive (b) Body centred.

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30. An element with density 11.2 g cm^{-3} forms a fcc lattice with edge length of 4×10^{-8} cm.

Calculate the atomic mass of the element.

(Given : $N_A = 6.022 \times 10^{23} mol^{-1}$)

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Topic 1 Long Answer Type Questions I

1. (a) Calculate the packing efficiency in c ccp crystal lattice.

(b) What is the number of particles per unit cell of a simple cube.

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2. (a) Sodium metal crystallizes in bcc structure. Its unit cell edge length is 420 pm. Calculate its density. (Atomic mass of sodium = 23 u, $N_A = 6.022 \times 10^{23} mol^{-}$).

(b) What is Frenkel defect ? How does it affect the density of a crystal ?

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3. a) Calculate the packing efficiency of particles in a body centred cube.

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4. Calculate the packing efficiency in a simple cubic lattice.

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5. An element occurs in bcc structure. It has a cell edge length of 250 pm. Calculate the molar mass if its density is 8.0 g cm^{-3}. Also calculate radius of an atom of this element.

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6. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of Tungsten atom ?

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7. Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of Iron is 7.874 g cm^{-3}. Use this information to

calculate Avogadro's number. (At mass of Fe = 55.845 u).

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8. Copper crystallises with face-centred cubic unit cell. If the radius of copper atom is 127.8 pm, calculate the density of copper metal. (Atomic mass of Cu = 63.55 g/mol and Avogadro's number $N_A = 6.02 \times 10^{23} mol^{-1}$)

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9. Silver crystallies in face centred cubic (fcc) unit cell. If the radius of silver atom is 145 pm, what is the length of each side of the unit cell ?

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10. The density of lead is 11.35 g cm^{-3} and the metal crystallizes with fcc unit cell. Estimate the radius of lead atom.

[Atomic mass of lead = 207 g mol and $N_A = 6.02 \times 10^{23} mol^{-1}$]

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11. Calculate the packing efficiency in simple cubic lattice.

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12. Aluminium crystallies in a cubic close packed structure. Radius of the atom in the metal is 125 pm.

(i) What is the length of the side of the unit

cell ?

(ii) How many unit cells are there in 1 cm^3 of aluminium ?

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Topic 1 Long Answer Type Questions Ii

1. (a) Calculate the number of atoms per unit cell of fcc.

(b) What is ferromagnetism ? Give an example

for ferromagnetic substance.

(c) Give an example for molecular solid.

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2. What is packing efficiency in a crystal ? Draw the unit cell of a simple cubic lattice and calculate the packing efficiency in a simple cubic lattice.

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3. (a) Calculate the packing efficiency in hexagonal close packing arrangement.

(b) Mention one consequence of metal excess defect.

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Topic 2 Very Short Answer Type Questions

1. Name the crystal defect which lowers the density in an ionic crystal

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2. What is Frenkel defect? Give an example.

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3. Define radius ratio.

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4. Mention one property which is caused due to the presence of F-centre in a solid.

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5. What are paramagnetic materials ? Give examples.

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6. Define ferromagnetism.

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7. Which point defect decreases the density of a solid ?

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8. Express the relationship between atomic radius (r) and edge length (a) in the bcc unit cell.

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9. What type of stoichiometric defect is shown by AgCl ?

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10. What type substances would make better permanent magnets, ferromagnetic or ferrimagnetic ?

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11. On heating a crystal of KCl in potassium vapour, the crystal starts exhibiting a violet colour. What is this due to ?

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12. Which type of ionic substances show Schottky defect in solids ?

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13. What is meant by 'doping' in a semiconductor ?

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14. How is the conductivity of an intrinsic semiconductor be increased ?

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15. Which stoichiometric defect increases the density of a solid ?

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16. What type of stoichiometric defect is shown by AgBr and AgI ?

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17. What type of defect can arise when a solid is heated ?

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18. Why does LiCl acquire pink colour when heated in Li vapours ?

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19. What are n-type semiconductors ?

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20. Which type of substance wxhibit anti ferromagnetism ?

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21. What type of semiconductor is obtained when silicon is doped with arsenic ?

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22. Give an example of an ionic compound which shows Frenkel defect.

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23. Which point defect in crystals of a solid does not change the density of the solid ?

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Topic 2 Short Answer Type Questions

1. Give two differences between p-type & n-type semiconductors.

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2. Give any two differences between Frenkel and Schottky defects.

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3. Based on electron gas theory explain why metals are malleable.

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4. Account for the malleability and ductility of metals on the basis of electron gas theory.

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5. Based on electron gas theory explain why metals are malleable.

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6. Describe the one major type of semiconductors and contrast their conduction mechanism.

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7. Define antiferromagnetism with example.

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8. Define ferrimagnetism with suitable examples.

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9. Examine the given defective crystal and

$$\begin{array}{lllll} A^+ & B^- & A^+ & B^- & A^+ \\ B^- & 0 & B^- & A^+ & B^- \\ A^+ & B^- & A^+ & 0 & A^+ \\ B^- & A^+ & B^- & A^+ & B^- \end{array}$$

Answer the following questions :

(i) What type of stoichiometirc defect is shown by the crystal ?

(ii) How is the density of the crystal affected by this defect ?

(iii) What type of ionic substances show such defect ?

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10. (i) What type of non-stoichiometric point defect is responsible for the pink colour of LiCl ?

(ii) What type of stoichiometric defect is shown by NaCl ?

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11. How will you distinguish between the following pairs of terms :

Tetrahedral and octahedral voids.

Crystal lattice and unit cell.

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12. (i) Write the type of magnetism observed when the magnetic moments are oppositely aligned and cancel out each other.

(ii) Which stoichiometric defect does not change the density of the crystal ?

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13. (i) Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel directions in unequal numbers.

(ii) Which stoichiometric defect decreases the density of the crystal ?

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14. Account for the following :

(i) Schottky defects lower the density of related solids.

(ii) Conductivity of silicon increases on doping it with phosphorus.

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15. (a) Why does presence of excess of lithium makes LiCl crystals pink ?

(b) A solid with cubic crystal is made of two

elements P and Q. Atoms of Q are the corners of the cube and P at the body centre. What is the formula of the compound ?

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16. (a) What change occurs when AgCl is doped with $CdCl_2$?

(b) What type of semiconductor is produced when silicon is doped with boron ?

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17. Explain the following terms with suitable examples : Ferromagnetism and Ferrimagnetism.

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18. What is a semiconductior ? Give names the two main types of Semi-conductors ?

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19. What are intrinsic semiconductors ? Give an example.

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20. Explain the Schottky defect terms with suitable examples.

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21. Explain the 12-16 compounds terms with one suitable example :

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