CHEMISTRY

BOOKS - MODERN PUBLISHERS CHEMISTRY (HINGLISH)

SOLID STATE

Solved Examples

1. A cubic unit cell is made up of X and Y elements. If X are present on the corners of the cube and Y are present on centres of faces of cube, then find the formula of the compound .

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2. If three elements P, Q and R crystallise in a cubic unit cell with P atoms at the corners, Q atoms at the cubic centre and R atoms at the centre of each face of the cube, then write the formula of the compound.

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3. Calculate the number of unit cells in 8.1 g of aluminium if it crystallises in face-centred cubic (fcc) structure. (Atomic mass of Al = $27g \cdot mol^{-1}$)

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4. 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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5. Aluminium crystallizes in FCC structure. Atomic radius of the metalics 125 pm. Calculate the edge length of the unit cell. (Multiply the answer with 10)

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6. The radius of Na^{+} is 95 pm and that of Cl^{-} ions is 181 pm. Predict whether the coordination number of Na^{+} is 6 or4.

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7. Br^- ions form a close packed structure. If the radius of Br^- ions is 195 pm, calculate the radius of the cation that just fits into the tetrahedral hole. Can a cation A^+ having a radius of 82 pm be shipped into be octahedral hole of the crystal A^+Br^- ?

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8. A compound is formed by two elements P and Q. Atoms of Q (as anions) make hcp lattice and those of the element

P (as cations) occupy all the tetrahedral voids. What is the formula of the compound?

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9. Atoms of element B form hcp lattice and those of the element A occupy $2/3^{\text{rd}}$ of tetrahedral voids . What is the formula of the compound formed by the element A and B ?

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10. In a cubic close packed structure of mixed oxides, the lattice is made up of oxide ions, one-eighth of tetrahedral voids are occupied by trivalent ions $\left(B^{3+}\right)$. What is the formula of the oxide ?

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11. In the mineral, spinel, having the formula $MgAl_2O_4$ oxide ions ar arranged , in the cubic close packing, Mg^{2+} ions occupy the tetrahedrel voids while Al^{3+} ions occupy the octahedral voids.

(i) What precnetage of tetrahedral voids is occupied by Mg^{2+} ions ?

(ii) What precentage of octahedral voids is occupied by Al^{3+} ions ?

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12. A compound having bcc geometry has atomic mass 50. Calculate the density of the unit cell if its edge length is 290 pm.

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13. 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 u and Avogadro's number $N_A = 6.02 \times 10^{23} mol^{-1}$) Multiply the answer with 100

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14. Sodium has a bcc structure with nearest neighbour distance of 365.9 pm. Calculate its density. (Atomic mass of sodium $= 23$)

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15. An element crystallizes in a f.c.c. lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain 2×10^{24} atoms.

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16. A metal (atomic mass = 50) has a body centred cubic crystal structure. If the density of the metal is 5.96 g cm^{-3}, calculate the volume of the unit cell.

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17. The density of chromium metal is $7.2 gcm^{-3}$. If the unit cell is cubic with edge length of 289 pm, determine the type of unit cell (simple , body centred or face centred) [Atomic mass of $Cr = 52 a.m.u., N_A = 6.02 \times 10^{23} mol^{-1}]$.

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18. An element with molor mass $27 gmol^{-1}$ forms a cubic unit cell with edge length $4.05 \times 10^{-8} cm$. If its density is $2.7 gcm^{-3}$, what is the nature of the unit cell?

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19. An element crystallises in bcc lattice with cell edge of $3 \times 10^{-8} cm$. The density of the element is $6.89 gcm^{-3}$. Calculate the molar mass of the element.

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20. An element has a body-centred cubic (bcc) structure with a cell edge of 288 pm . The density of the element is 7.2 g/cm^3 . How many atoms are present in 208 g of the element ?

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21. An element E crystallizes in body centred cubic structure. If the edge length of the cell is $1.469 \times 10^{-10} m$ and the density is $19.3 gcm^{-3}$, calculate the atomic mass of this element. Also calculate the radius of an atom of the element.

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22. Calculate the value of Avogadro's number from the following data:

Density of $NaCl = 2.165 gcm^{-3}$

Distance between $Na^{\oplus}$ and Cl^{Θ} in $NaCl = 281$ pm

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23. The compound CuCl has Zns structure. Its density is 3.4 g cm^{-3}. What is the length of the edge of the unit cell ?

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24. An element A crystallises in fcc structure. 200 g of this element has 4.12×10^{24} atoms. If the density of A is $7.2 \mathrm{g\ cm}^{-3}$, calculate the edge length of the unit cell.

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25. Niobium crystallizes in body - centered cubic structure . If density is 8.55 g cm^{-3} , calculate atomic radius of niobium using its atomic mass 93 U .

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26. KF has NaCl structure. What is the distance between K^{+} and F^{-} in KF, if the density is $2.48 g cm^{-3}$?

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27. Aluminium crystallises in a cubic close-packed structure. Its metallic radius is 125 pm.

(a) What is the length of the side of the unit cell? (b) How many unit cells are there in 1.00 cm^3 of aluminium?

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28. Silver has atomic mass 108 a.m.u. and density $10.5 gcm^{-3}$. If the edge length of its unit cell is 409 pm, identify the type of unit cell. Also calculate the radius of an atom of silver.

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29. Silver metal crysatllises with a face centred cubic lattice. The length of the unit cell is found to be $4.077 \times 10^{-8} cm$. Calulate the atomic radius and density of silver.

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30. The density of lead is $11.35 g cm^{-3}$ and the metal crystallizes with fee unit cell. Estimate the radius of lead atom. (At. Mass of lead $= 207 g mol^{-1}$ and $NA = 6.02 \times 10^{23} mol^{-1}$)

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31. If NaCl is doped with 10^{-3} mol percent of $SrCI_2$, what is the concentration of cation vacancy?

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32. Analysis shows that nickel oxide has the formula $Ni_{0.98}O_{1.00}$. What fractions of nickel "exist" as Ni^{2+} and

Ni^{3+} ions?

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33. If Al^{3+} replaces Na^{+} at the edge centre of $NaCl$ lattice ,then the cation vacancies in 1 mole of $NaCl$ will be

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Practice Problems

1. A cubic solid is made up of two elements X and Y . Atoms Y are present at the corners of the cube and atoms X at the body centre. What is the formula of the compound ?

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2. When atom are placed at the corners of all 12 edges of a cube, how many atoms are present per unit cell?

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3. A unit cell consists of a cube in which there are A atoms at the corners and B atoms at the face centres. Two A atoms are missing from the two corners of the unit cell. What is the formula of the compound ?

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4. A compound formed by element X and Y crystallizes in the cubic structure when Y atoms are at the corners of the cube and X atoms are at the alternate faces. What is the formula of the compound?

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5. Gold crystallizes in the face centred cubic lattice. Calculate the approximate number of unit cells in 2 mg of gold. (Atomic mass of gold= 197u).

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6. Xenon crystallizes in the face-centred cubic lattice and the edge of the unit cell is 620 pm. What is the nearest neighbour distance and what is the redius of xenon atom?

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7. The length of the unit cell edge of a body $-$ centred cubic metal crystal is $352 pm$. Calculate he radius of an atom of the metal .

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8. Calculate the atomic radius of elementary silver which crystallises in face centred cubic lattice with unit cell edge length $4.086 \times 10^{-10} m$.

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9. A solid has a structure in which W atoms are located at the corners of the cubic lattice, O atoms at the centre of the edges and Na atom at the centre of the cube. The formula of the compound is

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10. In $CsCl$ with cubic structure, Cl^{-} ions are located at each corner and Cs^{+} ions at the centre of the unit cell. If $r_{Cs^{+}}$ and $r_{Cl^{-}}$ and 1.69Å and 1.81Å respectively. Find the value of edge length of cube.

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11. Tungsten crystallizes in body centred cubic lattice. Calculate the number of unit cells in 1.5 g of tungsten crystallizes in body centred cubic lattice . Calculate the number of unit cells in 1.5 g of tungsten (Atomic mass of tungsten = 184 u).

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12. Sodium crystallizes in a bcc unit cell. Calcuate the approximate number of unit cells in 9.2 g of sodium (Atomic mass of Na=23)

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13. An element crystallizes in face centred unit cell. What is the length of the side of the unit cell, if atomic radius of the element is 0.144 nm ?

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14. In the fcc arrangement of A and B atoms whose A atoms are at corners of the unit cell and B are at the face centres one of the A atom is missing from one corner in each unit cell. What is the simplest formula of the compound?

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15. The atomic radii of Cs^+ and Cl^- ions are 1.69Å and 1.81Å respectively. Predict the coordination number of Cs^+ ion and structure of CsCl.

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16. A solid AB has $NaCl$ structure. If the radius of the cation A is 100 pm, what is the radius of anion B?

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17. If the radius of Br^{-} ion is 0.182 nn, how large can a cation be fit in its tetrahedral holes ?

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18. A solid is made of two elements X and Y. Atoms X are in fcc arrangement and Y atoms occupy all the octahedral sites and alternate tetrahedral sites. What is the formula of compound ?

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19. A compound is formed by two elements X and Y. Atoms of the element Y (as anion) make ccp and those of element X (as cation) occupy all the octahedral voids. What is the formula of the compound?

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20. A comound is formed by two elements M and N. The element N froms ccp and atoms of M occupy 1/3rd of tetrahedral voids. What is the formula of the compound ?

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21. In a crystalline solid, anions B are arranged in ccp structure. Cations A are equally distributed between octahedral and tetrahedral voids if all the octahedral voids are occupied the formula of the ionic solids will be

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22. In solid, oxide ions are arranged in ccp. One sixth of the tetrahedral voids are occupied by the cations (A) while one third of the octahedral voids, are occupied by the cations (B). What is the formula of the compound ?

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23. In corrundum, oxid ions are arranged in $h. c. p.$ array and the aluminum ions occupy two $-$ thirds of octahedral voids. What is the formula of currundum ?

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24. An element crystallizes in fec lattice with a cell edge of 300 pm. The density of the element is 10.8 g cm^{-3}. Calculate the number of atoms in 108 g of the element.

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25. An element 'X' (At. Mass = 40 g mol^{-1}) having f.c.c structure has unit cell edge length of 400 pm . Calculate the density of 'X' and the number of unit cells in 4 g of 'X' . $(N_A = 6.022 \times 10^{23} mol^{-1})$.

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26. An element crystallizes in f.c.c. lattice with edge length of 400 pm. The density of the element is 7 g cm^{-3}. How many atoms are present in 280 g of the element ?

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27. CsCl has body centred cubic lattice with the length of a side of a unit cell 412.1 pm and aluminum is face centred cubic lattice with length of the side of unit cell 405 pm. Which of the two has larger density ? (Atomic mass of `Cs = 132.9, Al = 26.9 , Cl = 35.5)

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28. The unit cell of a metallic element of atomic mass ($108g / \text{mole}$) and density $10.5g / cm^3$ is a cube with edge length of 409 pm. The structure of the crystal lattice would be:

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29. Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of irong is $7.874gcm^{-3}$. Use this information to calculate Avogardo's number ?

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30. Gold (atomic mass = 197 u) has atomic radius = 0.144 nm. It crystallises in face centred unit cell. Calculate the density of gold. (No = $6.022 \times 10^{23} mol^{-1}$)

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31. An element having bcc geometry has atomic mass $60 gmol^{-1}$. Calculate the density of unit cell if edge length is 300 pm.

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32. An element with density 10 g cm^{-3} forms a cubic unit cell with edge length $3 \times 10^{-8} cm$. What is the nature of the cubic unit cell if the atomic mass of the element is 81 g mol^{-1}.

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33. A lead (II)sulphide crystals has an NaCl structure .What is its density ?The edge length of the unit cell is 500 pm . $N_0 = 6.023 \times 10^{23}$,atomic mass :Pb =207.2,S=32.

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34. Formula mass of $NaCl$ is $58.45 g mol^{-1}$ and density of its pure form is $2.167 g cm^{-3}$. The average distance between adjacent sodium and chloride ions in the crystal is $2.814 \times 10^{-8} cm$. Calculate Avogadro constant.

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35. Copper crystallizer into an fcc lattice with edge length $3.61 \times 10^{8} cm$, Show that the calculated density in in agreement with its measured value of $8.92 gcm^{3}$.

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36. Crystalline CsBr has a cubic structure. Calculate the unit cell edge length if the density of CsBr crystal is $4.24 gcm^{-3}$ (atomic masses : $Cs = 133$, $Br = 80$).

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37. The unit cell of a metallic element of atomic mass ($108g/\text{mole}$) and density $10.5g/cm^3$ is a cube with edge length of 409 pm. The structure of the crystal lattice would be:

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38. What is the distance between Na^+ and Cl^- ions in NaCl crystal if density is 2.165g cm^{-3} ? NaCl crystallises in fcc lattice.

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39. A compound AB crystallises in the b.c.c lattice with unit cell edge length of 390 pm. Calculate

(a) the distance between the oppsitely charged ions in the lattice.

(b) the radius of A^{+} ion if radius of B^{-} ion is 175 pm.

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40. Thallium chloride TlCl crystallises in either a simple cubic lattice or fcc lattice of Cl^{-} ions with Tl^{+} ions in voids. If the density of solid is $7\text{g}/\text{cm}^{3}$ and edge length of unit cell is 3.85×10^{-8} cm. What is the geometry of unit cell ? (At. number of Tl=204.37 & Cl=35.5)

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41. Cesium chloride crystallizes as cubic lattice and has a density of $4.0 g cm^{-3}$. Calculate the length of the edge of the unit cell of cesium chloride. (Molar of CsCl = $168.5 g mol^{-1}$)

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42. An element having atomic mass 107.9 u had FCC lattice. The edge length of its unit cell is 408.6 pm. Calculate density of the unit cell. [Given , $N_A = 6.022 \times 10^{23}$].

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43. An element with density $11.2 gcm^{-3}$ forms a f. c. c. 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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44. X-rays diffraction studies show that copper crystallizes in an fcc unit cell with cell edge of $3.608 \times 10^{-8} cm$. In a separte experiment, copper is determined to have a density of $8.92 gcm^{3}$. Calculate the atomic mass of copper.

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45. The element chromium crystallises in a body centred cubic lattice whose density is $7.20 g / cm^3$. The length of the edge of the unit cell is 288.4 pm. Calculate Avogadro's number (Atomic mas of Cr = 52).

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46. An element has atomic mass $93 gmol^{-1}$ and density $11.5 gcm^{-3}$. If the edge length of its unit cell is 300 pm, identify the type of unit cell.

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47. The composition of a sample of wustite is $Fe_{0.93}O_{1.00}$. What percentage of iron is present in the form of $Fe(III)$?

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48. A metal oxide has empirical formula $M_{0.96}O_{1.00}$ What will be the percentage of M^{2+} ion in the crystal ?

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Conceptual Questions 1

1. A metal crystallizes in a body centred cubic structure. If 'a' is the edge length of its unit cell, 'r' is the radius of the sphere. What is the relationship between 'r' and 'a' ?

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2. If the radius of the octaheral void is r and the radius of the atoms in close-packing is R, derive relation between r and R

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3. In a close packing of N spheres, how many

(i) tetrahedral , and (ii) octahedral sites are present?

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4. Which of the following lattices has the highest packing efficency (a) simple cubic, (b) body-centred cubic, and (c) hexagonal close-packed lattice?

A. Simple cubic closed packed (ccp) lattice.

(b) body central cubic lattice.

(c) hexagonal closed packed (hcp) lattice.

B.

C.

D.

Answer: c

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5. What is meant by the term "coordination number"?

b. What is the coordination number of atoms:

i. in a cubic-packed structure?

ii. In a body-centreds structure?

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6. The ions of NaF and MgO have the same number of electrons and inter nuclear distances are about the same (235 pm and 215 pm). Why are then the melting points of NaF and MgO so different $(992^{\circ}C \text{ and } 2642^{\circ}C)$?

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7. The most unsysmmetrical and symmeterical systems are, respectively:

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8. How many atoms can be assigned to its unit cell if an element forms (i) a body centred cubic cell and ii) face centred cubic cell ?

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9. What is the maximum number of atoms in a hcp crystal structure of an element ?

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10. Which of the following network solids is an exceptionally good conductor of electricity ?

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11. How are unit cell and space lattice related ?

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12. Pick out the odd ones from the following sets: i) Sulphur, Argon, Solid CO_2, Diamond ,. (ii) SiC, Quartz,BaO,Graphite

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13. What is the two-dimensional coordination number of a molecule in square close-packed layer?

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14. Solid A is a very hard electrical insulator in solid as well as in molten state and melts at extermely high temperature. What type of solid is it?

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15. What type of solids are electrical conductors, malleable or ductile?

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16. How may octahedral voids are present in 1 mole of a compound having cubic close packed structure ?

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17. What is the total number of atoms per unit cell in a face centred cubic (fcc) structure ?

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18. Some of the very old glass objects appear slightly milky instead of being transparent. Why ?

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19. A compound AB_2 possesses the CaF_2 type crystal structure. The co-ordination number of A^{2+} and B^- ions is the crystal will be:

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20. Ferric oxide crystalliizes 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.

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21. If three elements X, Y and Z crystallize in a cubic solid with X atoms at the corners, Y atoms at the cube centres and Z atoms at the face of the cube, then write the formula of the compound.

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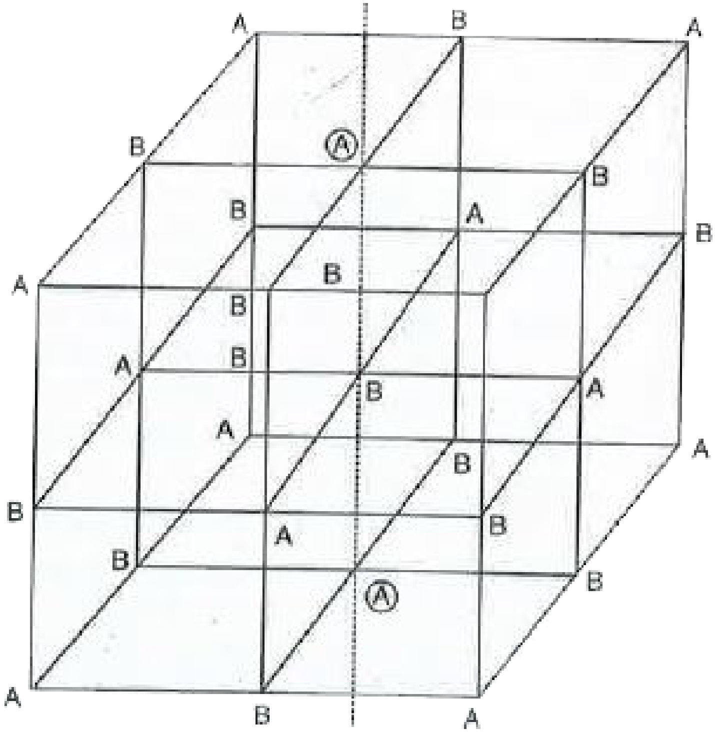
22. If a solid 'AB','A' atoms have ccp arrangement and B atoms occupy all the octahedral sites. If all the face centred atoms along one of the axes are removed, then what will be the resultant stoichiometry of the compound?



2Ⓐatoms along one axis are removed.

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23. Both diamond and rhombic sulphur are covalent solids but the latter has very low melting point than the former. Explain why ?

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24. Write a feature which will distinguish a metallic solid from an ionic solid.

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25. Write a distinguishing feature of metallic solids.

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26. What is the difference between glass and quartz while both are made up from SiO_4 tetrahedral? Under what conditions could quartz be converted into glass ?

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27. What is difference in bahavior between glass and sodium chloride would you expect to observe if you break off a piece of either cube ?

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28. KF has ccp structure. Calculate the radius of the unit cell if the edge length of the unit cell is 400 pm. How many F^{-} ions and octahedral voids are there in the unit cell ?

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29. If 'a' be the edge length of the unit cell and r be the radius of an atom, then for face centred cubic lattice, the correct relation is

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30. How will you show that glass is super cooled liquid ?

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Conceptual Questions 2

1. What change occurs when AgCl is doped with $CdCl_2$?

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2. What type of stoichiometric defect is shown by NaCl ? Explain.

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3. Analyses shows that FeO has a non-stoichiometric composition with formula $Fe_{0.95}O_{1.00}$. Give reason.

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4. Following is the schematic alignment of magnetic moments :

Identify the type of magnetism. What happens when these substances are heated?

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5. Name any one solid in which both Frenkel and Schottky defects occur.

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6. What is the effect of temperature on the conductivity of metals and semi-metals ?

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7. Why is Frenkel defect not found in pure alkali metal halides ?

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8. What is the effect of Schottky defect on the density of crystal ?

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9. What is the difference in the semi - conductors obtained by doping silicon with As or with Ga ?

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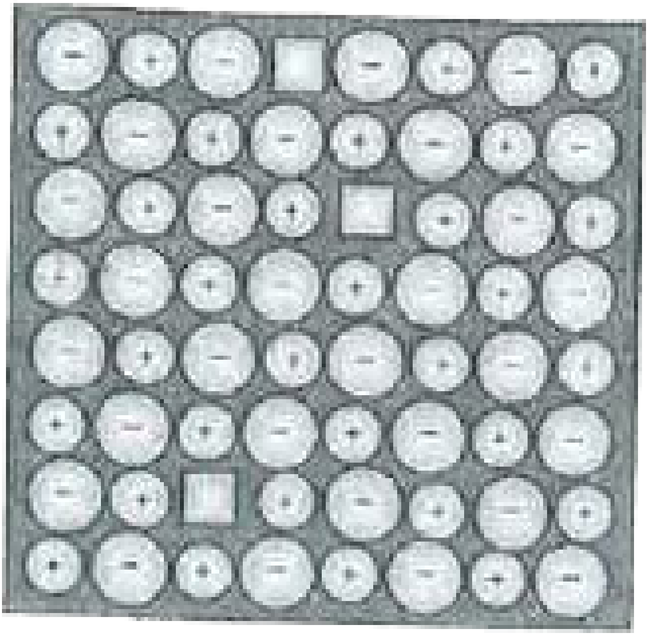
10. Identify the type of defect shows in the following figure

:

What type of substances show this defect ?



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11. What type of semiconductor is obtained when :

(i) Ge is doped with in.

(ii) SI is doped with P.

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12. Name the compound that can be added to $AgCl$ so as to produce cation vacancies.

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13. Which point defect lowers the density of a crystal?

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14. How does the electrical conductivity of super-conductors vary with temperature ?

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15. Name the non-stoichiometric point defect responsible for the colour of alkali metals halides.

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16. Give reason :

(a) Why is Frenkel defect found in AgCl ?

(b) What is the difference between silicon doped with phosphorus and doped with gallium semi-conductors ?

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17. Why does ZnO appear golden yellow at high temperature ? Explain.

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18. The electrical conductivity of a metal decreases with rise in temperature while that of semi-conductor increases. Justify.

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19. Why does zinc oxide exhibit enhanced electrical conducity on heating ?

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20. Out of NaCl and AgCl, which one shows Frenkel defect and why ?

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21. Why LiCl acquires pick colour when heated in Li vapours ?

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Advanced Level Problems

1. In a crystalline solid, anions Y^{-} are arranged in ccp. Cation X^{+} are equally distributed between octehedral and tetrahedral voids. If all the octahedral voids are occupied, what is the formula of the compound ?

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2. In a face centered lattice of X and Y, X atoms are present at the corners while Y atoms are at face centres.

(a) What is the formula of the compound ?

(b) What would be the formula of the compound if (i) one of the X atoms is missing from a corner in each unit cell

(ii) one of the X atoms at from a corner is replaced by Z atom. (also monovalent) ?

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3. In a normal spinel structure , O^{2-} ions form fcc packing and 1/8 of the tetrahedral sites are occupied by divalent metal , A^{2+} ions and half of the octahedral sites are occupied by trivalent metal B^{3+} ions, what is the ratio of tetrahedral/octahedral sites :

(i) occupied in spinel structure

(ii) not occupied in spinel structure .

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4. Lithium borohydride $(LiBH)_4$ crystallizes in an orthorohombic system having 4 molecules per unit cell. The unit cell dimensions are : $a = 6.81\text{Å}$ and $c = 7.17\text{Å}$. Calculate the density of the crystal (At. Mass of $Li = 7, B = 11, H = 1u)$.

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5. Iron crystallizes in several forms. At 1185 K , the body centred cubic α- form of iron changes to the face centred cubic γ- form of iron. Assuming that the distance betweem the nearest neighbours is the same in two forms at the transition temperature, calcuate the ratio of the density of α- form to that of γ- form at the transition temperature.

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6. KCl crystallizes in the same type of lattice as does $NaCl$. Given that

$$\frac{r_{Na^{\oplus}}}{r_{Cl^{\ominus}}} = 0.5 \text{ and } \frac{r_{Na^{\oplus}}}{r_{K^{\oplus}}} = 0.7$$

Calculate (a) the ratio of side of the unit cell for KCl to that for $NaCl$, and (b) the ratio of density of $NaCl$ to that KCl.

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7. A metal crystallizes in a face centred cubic unit cell with $a = 0.560nm$. Calculate the density of the metal if it contains 0.1% Schottky defects. (Atomic mass of metal = $40gmol^{-1}$)

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8. By X-ray diffraction method, the unit cell edge length of sodium chloride is found to be 562.6 pm. The density of NaCl is observed to be $2.158 g cm^{-3}$.

(i) Predict the type of defect present in the crystal.

(ii) Calculate the percentage of Na^{+} and Cl^{-} ions missing.

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Ncert File Solved Ncert In Test Questions

1. Why are solid rigid?

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2. Why do solids have a definite volume?

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3. Classify the following as amorphous or crystalline solids: polyurethane, naphtalene, benzoic acid, teflon, potassium nitrate, cellophane, polyvinyl chloride, fibre glass, copper.

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4. Why is glass considered a supercooled liquid?

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5. The refractive index of a solid is observed to have the same value along all direction. Comment on the nature of this solid. Would it show cleavage property?

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6. Classify the following solids in different categories based on the nature of intermolecular forces operating in them: ltbr. Potassium sulphate, tin, benzene, urea, ammonia, water, zinc sulphide,graphite, rubidium , argon, silicon carbide.

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7. Solid A is a very hard electrical insulator in solid as well as in molten state and melts at extermely high temperature. What type of solid is it?

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8. Ionic solids conduct electricity in the molten state but not is the solid state. Explain.

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9. What type of solids are electrical conductors, malleable or ductile?

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10. Give the significance of "lattice point."

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11. Name the parameters that characterized a unit cell.

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12. Distinguish between

a. Hexagonal and monoclinic unit cells

(b) Face-entred and end-centred unit cells

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13. Explain how much portin of an atom located at (a) corner and (b) body centre of a cubic unit cell is part of its neighouring unit cell.

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14. What is the two-dimensional coordination number of a molecule in square close-packed layer?

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15. A compound is formed hexagonal close-packed 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. A comound is formed by two elements M and N. The element N froms ccp and atoms of M occupy 1/3rd of tetrahedral voids. What is the formula of the compound ?

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17. Which of the following lattices has the highest packing efficency (a) simple cubic, (b) body-centred cubic, and (c) hexagonal close-packed lattice?

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18. An element with molar mass 2.7×10^{-2} kg per mole forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^{3} , what is the nature of the cubic unit cell ?

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19. What type of defect can arise when a solid is heated? Which physical property is affected by it and in what way?

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20. What type of stoichiometric defect is shown by:

(a) ZnS (b) $AgBr$

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21. Explain how vacancies are introduced in an ionic solid when a cation of higher valence is added as an impurity in it.

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22. Ionic solids, which have anioninc vacancies due to metal excess defect, developed colour. Explain with the help of a suitalbe example.

Watch Video Solution

23. A group-14 element is to be converted into n-type semiconductor by doping it with a suitalbe impurity. To which group this impurity belong?

Watch Video Solution

24. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic? Justify your answer.

Watch Video Solution

Ncert File Solved Ncert Textbook Exercises

1. Define the term "amorphous". Give a few example of amorphous solids.

Watch Video Solution

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

Watch Video Solution

3. Classify each of the following solids as ionic, metallic, molecular, network (covalent), or amorphoues.

a. Tetra phosphorus decoxide (P_4O_{10})

b. Graphite c. Brass

d. Ammonium phosphate $(NH_4)_3PO_4$

e. Sic f. Rb g. I_2 h. $LiBr$

i. P_4 j. Si k. Plastic

Watch Video Solution

4. What is meant by the term "coordination number"?

b. What is the coordination number of atoms:

i. in a cubic-packed structure?

ii. In a body-centreds structure?

Watch Video Solution

5. How can you determine the atoic mass of an unknown metal if you know its density and the dimension of its unit cell ? Explain.

Watch Video Solution

6. a. "Stability of a crystal is reflected is reflected in the magnitude of its melting points" Comment.

b. Melting points of some compounds are given below water $= 273K$, ethyl alcohol $= 153.7K$, diethyl ether $= 156.8K$, methane $= 90.5K$. What can you say about the intermolecular forces between the molecules of these compounds?

Watch Video Solution

7. How will you distinguish between the following pairs of terms?

a. Hexagonal close-packing and cubic close-packing

b. Crystal lattice and unit cell

c. Tetrahedral void octahedral void

Watch Video Solution

8. How many lattice points are there in one unit cell of each of the following lattice?

a. Face-centred cubic

b. Face-centred tetragonal

c. Body-centred

Watch Video Solution

9. Explain

a. The basic of sumilarities and differences between metallic and ionic crystals.

b. Ionic solids are hard and brittle.

Watch Video Solution

10. Calculate the efficiency of packing in case of a metal crystal for

a. Simple cubic

b. Body-centred cubic

c. Face-centred cubic (with the assumptions that atoms are touching each other).

Watch Video Solution

11. Silver crystallizes in fcc lattic. If the edge length of the cell is $4.07 \times 10^{-8} cm$ and density is $10.5 gcm^{-3}$. Calculate the atomic mass of silver.

Watch Video Solution

12. 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 ?

Watch Video Solution

13. Niobium crystallizes in body-centred cubic structure. If the density is $8.55 gcm^{-3}$, calculate the atomic radius of niobium using its atomic mass $93u$.

Watch Video Solution

14. If the radius of the octaheral void is r and the radius of the atoms in close-packing is R, derive relation between r and R

Watch Video Solution

15. Copper crystallizer into an fcc lattice with edge length $3.61 \times 10^{8} cm$, Show that the calculated density in in agreement with its measured value of $8.92 gcm^{3}$.

Watch Video Solution

16. Analysis shows that nickel oxide has the formula $Ni_{0.98}O_{1.00}$. What fractions of nickel "exist" as Ni^{2+} and Ni^{3+} ions?

Watch Video Solution

17. What is a semiconductor? Describe the two main types of semiconductor and contrast their conduction mechanism.

Watch Video Solution

18. Non-stoichiometric cuprous oxide. Cu_2O can be perpared 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 semiconductors?

Watch Video Solution

19. Ferric oxide crystalliizes 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.

Watch Video Solution

20. Classify each of the following as being either a p-type or an n-type semiconductor

a. Ge doped with In

b. B doped with Si

Watch Video Solution

21. Gold (atomic radius = 0.154 nm) crystallizes in a face centred unit cell. What is the length of a side of the cell.

Watch Video Solution

22. In terms of band theory, what is the difference between

a. a condcutor and an insulator

b. a conductor and a semiconductor

Watch Video Solution

23. Explain the following terms with suitable example:

a. Schottky defect b. Frenkel defect

c. Interstitials d. F-centres

Watch Video Solution

24. Aluminium crystallises in a cubic close-packed structure. Its metallic radius is 125 pm.

(a) What is the length of the side of the unit cell? (b) How many unit cells are there in 1.00 cm^3 of aluminium?

Watch Video Solution

25. If NaCl is doped with 10^{-3} mol percent of $SrCI_2$, what is the concentration of cation vacancy?

Watch Video Solution

26. Example the following with suitable examples:

a. Ferromagnetism b. Paramagnetism

c. Ferrimagnetism d. Antiferromagnetism

e. 12 - 46 and 13 - 15 group compounds

Watch Video Solution

Ncert Exemplar Problems Multiple Choice Questions Type I

1. which of the following favours the existenence of a substance in the solid state ?

A. High temperature

B. Low temperature

C. High thermal energy

D. Weak cohesive forces

Answer: B

Watch Video Solution

2. which of the following is not a characteristic of a crystalline solid ?

A. Definite and characteristic heat of fusion.

B. Isotropic nature

C. A regular periodically repeated pattern of arrangment of constituent particles in the entire crystal.

D. A true solid

Answer: B

Watch Video Solution

3. Which of the following is an amorphous solid

A. Graphite (c)

B. Quartz glass (SiO_2)

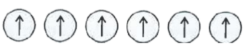
C. Chrome alum

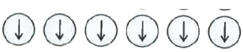
D. Silicon carbide (SiC)

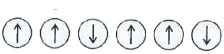
Answer: B

Watch Video Solution

4. Which of the following arrangements shows schematic alignment of magnetic moments of antiferromagnetic substances?

A. 

B. 

C. 

D. $\uparrow \downarrow \uparrow \downarrow \uparrow \downarrow$

Answer: D

Watch Video Solution

5. which of the following is true about the value of refractive index of quartz glass ?

A. same in all directions

B. Different in different directions

C. cannont be measured

D. always zero

Answer: A

Watch Video Solution

6. Which of the following statement is not true about amorphous solids?

A. On heating they may become crystalline at certain temperature.

B. They may become crystalline on keeping for long time.

C. Amorphous solids can be mouled by heating.

D. They are anisotropic in nature.

Answer: D

Watch Video Solution

7. The sharp melting point of crystalline solids compared to amorphous solids is due to

A. a regular arrangement of constituent particles observed over a short distance in the crystal lattice.

B. a regular arrangement of constituent particles observed over a long distance in the crystal lattice.

C. same arrangment of constituent particles in different directions.

D. different arrangment of constituent particles in different directions.

Answer: B

Watch Video Solution

8. Iodine molecules are held in the crystal lattice by:

A. London forces

B. dipole-dipole interactions

C. covalent bonds

D. coulombic forces

Answer: A

Watch Video Solution

9. which of the following is a network solid?

A. SO_2 (Solid)

B. I_2

C. Diamond

D. H_2O (Ice)

Answer: C

Watch Video Solution

10. which of the following solids is not an electrical conductor ?

(a) Mg(s) (b) TiO(s) (c) $I_2(s)$ (d) $H_2O(s)$

A. (A) Only

B. (B) Only

C. (C) and (D)

D. (B),(C) and (D)

Answer: C

Watch Video Solution

11. which of the following is not the characteristic of ionic solids?

A. Very low value of electrical conductivity in the molten state.

B. Brittle nature.

C. Very strong forces of interactions

D. Anisotropic nature

Answer: A

Watch Video Solution

12. Graphite is a good conductor of eletricity due to the presence of ....

A. lone pair of electrons

B. free valence electrons

C. cations

D. anions

Answer: B

Watch Video Solution

13. which of the following oxides behaves as conductor or insulator depending upon temperature ?

A. TiO

B. SiO_2

C. TiO_3

D. MgO

Answer: C

Watch Video Solution

14. Which of the following oxides shows electrical properties like metals ?

A. SiO_2

B. MgO

C. $SO_2(s)$

D. CrO_2

Answer: D

Watch Video Solution

15. The lattice site in a pure crystal cannot be occupied by :

A. molecule

B. ion

C. electron

D. atom

Answer: C

Watch Video Solution

16. graphite cannot be classifed as ....

A. conducting solid

B. network solid

C. covalent solid

D. ionic solid

Answer: D

Watch Video Solution

17. Cations are present in the interstitial sites in ....

A. Frenkel defect

B. Schottky defect

C. Vacancy defect

D. Metal deficiency defect

Answer: A

Watch Video Solution

18. Schottky defect is observed in crystals when ....

A. some cations move from their lattice site to iterstitial sites.

B. equal number of cations and anions are missing from the lattice

C. some lattice sites are occupied by electrons

D. some impurity is present in the lattice.

Answer: B

Watch Video Solution

19. Which of the following is true about the change the charge acquired by p- type semiconductors ?

A. positive

B. neutral

C. negative

D. depends on concentration of p impurity

Answer: B

Watch Video Solution

20. To get a n- type semiconductor from silicon , it should be doped with a sustance with valencyÃ¢â, Â¦Ã¢â, Â¦Ã¢â, Â¦.. .

A. 2

B. 1

C. 3

D. 5

Answer: D

Watch Video Solution

21. The total of tetrahedral voids in the face centred unit cell is ....

A. 6

B. 8

C. 10

D. 12

Answer: B

Watch Video Solution

22. Which of the following point defects are shown by AgBr

(s) crystals ?

(a) Schottky defect

(b) Frenkel defect

(c) metal ecxess defect

(d) Metal deficiency defect

A. (A) and (B)

B. (C) and (D)

C. (A) and (C)

D. (B) and (D)

Answer: A

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23. In which pair most efficient packing is present?

A. hcp and bcc

B. hcp and ccp

C. bcc and ccp

D. bcc and simple cubic cell

Answer: B

Watch Video Solution

24. The percentage of empty space in a body centred cubic arrangement is :

A. 74

B. 68

C. 32

D. 26

Answer: C

Watch Video Solution

25. Which of the following statements is not true about the hexagonal close packing ?

A. The coordination number is 12

B. It has 74% packing efficiency

C. Tetrahedral voids of the second layer are covered by the spheres of the third layer.

D. In this arrangement spheres of the fourth layer are exactly aligned with those of the first layer

Answer: D

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26. in which of the following structures coordination number for cations and anions in the packed structure will be same ?

A. Cl^{-} ions form fcc lattice and Na^{+} ions occupy all octahedral voids of the unit cell

B. Ca^{2+} ions form fcc lattice and F^{-} ions occupy all the eight tetrahedral voids of the unit cell.

C. O^{2-} ions form fcc lattice and Na^{+} ions occupy all the eight tetrahedral voids of the unit cell.

D. S^{2-} form fcc lattice and Zn^{2+} ions go into alternate tetrahedral voids of the unit cell

Answer: A::D

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27. What is the coordination number in a square close packed structures in two dimensions?

A. 2

B. 3

C. 4

D. 6

Answer: C

Watch Video Solution

28. which kind of defects are introduced by doping ?

A. Dislocation defect

B. Schottky defect

C. Frenkel defects

D. Electronic defects

Answer: D

Watch Video Solution

29. Silicon doped with electron rich impurity forms ....

A. $p-$ type semiconductor

B. $n-$ type semiconductor

C. intrinsic semiconductor

D. insulator

Answer: B

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30. Which of the following statements is not true ?

A. Paramagnetic substance are weakly attracted by magnetic field.

B. Ferromagnetic substances cannot be magnetised permanently.

C. The domains in antiferromagnetic substances are oppositely oriented with respect to each other.

D. Pairing of electrons cancels their magnetic moment in the diamagnetic substances .

Answer: B

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31. which of the following is not true about the ionic solids ?

A. Bigger ions form the close packed structure

B. Smaller ions occupy either the tetrahedral or the octahedral voids depending upon their size.

C. Occupation of all the voids is not necessary

D. The fraction of octahedral or tetrahedral voids occupied depends upon the radii of the ions occupying the voids.

Answer: D

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32. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because:

A. all the domians get oriented in the direction of magnetic field.

B. all the domains get oriented in the direction opposite to the direction of magnetic field.

C. domians get oriented randomly.

D. domains are not affected by magnetic field

Answer: A

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33. The correct order of the packing effeciency in different types of unit cells is ....

A. fcc $<$ bcc $<$ simple cubic

B. fcc $>$ bcc $>$ simple cubic

C. fcc $<$ bcc $>$ simple cubic

D. bcc $<$ fcc $>$ simple cubic

Answer: B

Watch Video Solution

34. which of the follwing defects is also known as dislocation defect ?

A. Frenkel defect

B. Schottky defect

C. Non-stoichiometric defect

D. Simple interstitial defect

Answer: A

Watch Video Solution

35. in the cubic packing , the unit cell has ....

A. 4 tetrahedral voids each of which is shared by four adjacent unit cells.

B. 4 tetrahedral voids within the unit cell.

C. 8 tetrahedral voids each of the which is shared by four adjacent unit cells

D. 8 tetrahedral voids within the unit cells.

Answer: D

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36. The edge lengths of the unit cells in terms of the radius of spheres constituting fcc, bcc and simple cubic unit cell respectively

A. $2\sqrt{2}r, \frac{4r}{\sqrt{3}}, 2r$

B. $\frac{4r}{\sqrt{3}}, 2\sqrt{2r}, 2r$

C. $2r, 2\sqrt{2}, \frac{4r}{\sqrt{3}}$

D. $2r, \frac{4r}{\sqrt{3}}, 2\sqrt{2r}$

Answer: A

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37. which of the following represents correct order of conductivity in solids ?

A. $K_{\text{metals}} > > K_{\text{insulators}} < K_{\text{semiconductors}}$

B. $K_{\text{metals}} < < K_{\text{insulators}} < K_{\text{semiconductors}}$

C. $K_{\text{metals}} = K_{\text{insulators}} > K_{\text{semiconductors}}$

D. $K_{\text{metals}} < K_{\text{insulators}} > K_{\text{semiconductors}}$

Answer: A

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Ncert Exemplar Problems Multiple Choice Questions Type Ii

1. Which of the following is not true about the voids formed in 3 dimensional hexagonal close packed structure?

A. A tetrahedral void is formed when a sphere of the second layer is present above trianglar void in the first layer.

B. All the triangular voids are not covered by the spheres of the second layer.

C. Tetrahedral voids are formed when the triangular voids in the second layer lie above the triangular voids in the first layer and the triangular shapes of these voids do not overlap.

D. Octahedral voids are formed when the triangular voids in the second layer exactly overlap with simlar voids in the first layer.

Answer: C::D

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2. the value of magnetic moment is zero in the case of antiferromagnetic substaence because the domains ....

A. get oriented in the direction of the applied magnetic field.

B. get oriented opposite to the direction of the applied magnetic field

C. are oppositely oriented with respect to each other without the application of magnetic field.

D. cancle out each other's magnetic moment

Answer: C::D

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3. Which of the following statements are not true?

A. Vacancy defect results in a decrease in the density of the substance.

B. Interstitial defects results in an increase in the density of the substance.

C. Impurity defect has no effect on the density of the substance.

D. Frenkel defect results in an increase in the density of the substance.

Answer: C::D

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4. Which of the following statements are true about metals ?

A. Valence band overlaps with conduction band

B. The gap between valence band and conduction band is negligible.

C. The gap between valence band and conduction band cannot be determined

D. Valence band may remain partially filled

Answer: A::B::D

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5. under the influence of electric field , which of the following statement is true about the movement of electrons and holes in p- type semiconducter ?

A. Electron will move towards the positively charged plate through electron holes.

B. Holes will apppear to be moving towards the negatively charged plate.

C. Both electrons and holes appear to move towards the postively chared plate

D. Movement of electrons is not related to the movement of holes.

Answer: A::B

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6. Which of the following statements are true about semiconductors?

A. Silicon doped with electron rich impurity is a p-type semiconductor.

B. Silicon doped with an electron rich impurity is an n-type semiconductor.

C. Delocalised electrons increase the conductivity of doped silicon.

D. An electron vacancy increase the conductivity of n-type semiconductor.

Answer: B::C

Watch Video Solution

7. An excess of potassium ions makes KCL crystals appear violet or lilac in colour since ....

A. some of the anionic sites are occupied by an unpaired electron.

B. Some of the anionic sites are occupied by a pair of electrons

C. there are vacancies at some anionic sites.

D. F- centres are created which impart colour to the crystals.

Answer: A::D

Watch Video Solution

8. the number of tetrahedral voids per unit cell in NaCl crystal is ....

A. 4

B. 8

C. twice the number of octahedral voids

D. four times the number of octahedral voids

Answer: B::C

Watch Video Solution

9. Amorphous solids can also be callled ....

A. pseuo solids

B. true solids

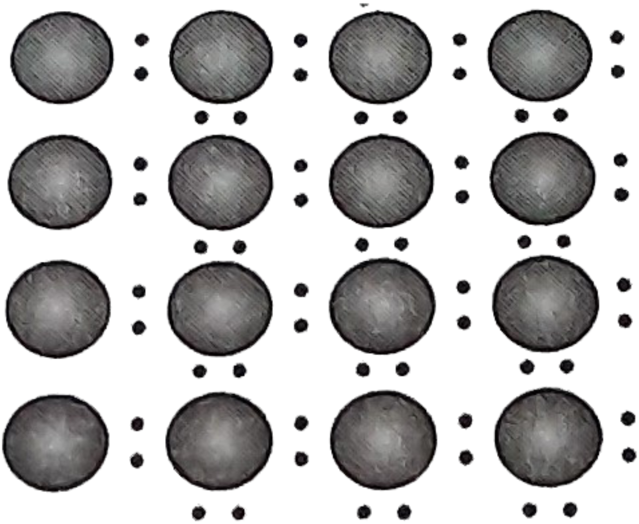
C. super cooled liquids

D. super cooled solids

Answer: A::C

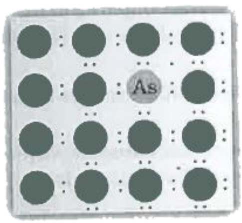
Watch Video Solution

10. A perfect crystal of silicon (fig) is doped with some elements as given in the options , which of these options shows n- type semiconductors ?

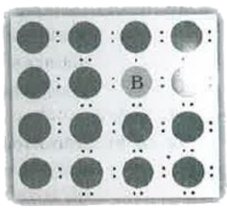


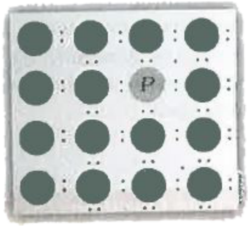
Pure crystal

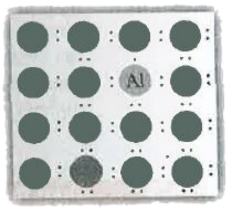
A.



B.



C. 

D. 

Answer: A::C

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11. Which of the following statements are correct ?

A. Ferrimagnetic substances lose ferrimagnetism on heating and become paramagnetic

B. Ferrimagnetic substances do not lose ferrimagnetis on heating and remain ferrimagnetic.

C. Antiferromagnetic substances have domain structures similar to ferromagnetic substances and their magnetic moments are not cancelled by each other.

D. In ferromagnetic substances all the domains get oriented in the direction of magnetic field and remain as such even after removing magnetic field.

Answer: A::D

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12. Which of the following features are not shown by quartz glass ?

A. This is a crystalline solid

B. Refractive index is same in all the directions

C. This has definite heat of fusion

D. This is also called super cooled liquid

Answer: A::C

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13. Which of the following cannot be regarded as molecular solid ?

A. SiC (Silicon carbide)

B. AlN

C. Diamond

D. I_2

Answer: A::B::C

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14. In which of the following arrangements, Octahedral voids are formed ?

A. hcp

B. bcc

C. simple cubic

D. fcc

Answer: A::D

Watch Video Solution

15. Frenkel defect is also known as ....

A. stoichiometric defect

B. dislocation defect

C. Impurity defect has no effect on the density of the substance.

D. non-stoichometric defect

Answer: A::B

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16. Which of the following defects decrease the density ?

A. Interstitial defect

B. Vacancy defect

C. Frenkel defects

D. Schottky defect

Answer: B::D

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Ncert Exemplar Problems Short Answer Type Questions

1. why are liquids and gases categorised as fuids ?

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2. why are solids incompressible ?

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3. Inspite of long range order in the arrangement of particles why are the crystals usually not perfect ?

Watch Video Solution

4. Why common salt $(NaCl)$ sometimes appear yellow?

Watch Video Solution

5. why is $Fe0(s)$ not formed in stoichiometric compostion ?

Watch Video Solution

6. why does white ZnO(s) becomes yellow upon heating ?

Watch Video Solution

7. why does the electrical conductivity of semiconductors increse with rise in temperature?

Watch Video Solution

8. Expalin why does conductivity of germainum crystals increase on doping with galium ?

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9. In a compound, nitrogen atoms (N) make cubic close packed lattice and metal atoms (M) occupy one-third of the tetrahedral voids present. Determine the formula of the compound formed by M and N ?

Watch Video Solution

10. Under which situations can an amorphous substance change to crystaline form?

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Ncert Exemplar Problems Matching Type Questions

1. Match the defects given in Column I with the statements in given Column II.

Column I	Column II
(a) Simple vacancy defect	(i) shown by non-ionic solids and increases density of the solid.
(b) Simple interstitial defect	(ii) shown by ionic solids and decreases density of the solid.
(c) Frenkel defect	(iii) shown by non ionic solids and density of the solid decreases.
(d) Schottky defect	(iv) shown by ionic solids and density of the solid remains the same.

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2. match the type of unit cell given column I with the features iven in Column II .

Column I	Column II
A. Primitive cubic unit cell	1. Each of the three perpendicular edges compulsorily have the different edge length *i.e.,* $a \neq b \neq c$
B. Body centred cubic unit cell	2. Number of atoms per unit cell is one
C. Face centred cubic unit cell	3. Each of the three perpendicular edges compulsorily have the same edge length *i.e.,* $a = b = c$
D. End centred orthorhombic unit cell	4. In addition to the contribution from the corner atoms the number of atoms present in a unit cell is one
	5. In addition to the contribution from the corner atoms the number of atoms present in a unit cell is three

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3. match the types of defect given in column I with the statement given in column II.

	Column I		Column II
A.	Impurity defect	1.	NaCl with anionic sites called F-centres
B.	Metal excess defect	2.	FeO with Fe^{3+}
C.	Metal deficiency defect	3.	NaCl with Sr^{2+} and some cationic sites vacant

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4. match the items given in column I with the items given in column II.

	Column I		Column II
A.	Mg in solid state	1.	p-type semiconductor
B.	$MgCl_2$ in molten state	2.	n-type semiconductor
C.	Silicon with phosphorus	3.	Electrolytic conductors
D.	Germanium with boron	4.	Electronic conductors

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5. Match the type of packing given in column I with the iterms given in column II.

Column I	Column II
A. Square close packing in two dimensions	1. Triangular voids
B. Hexagonal close packing in two dimensions	2. Pattern of spheres is repeated in every fourth layer
C. Hexagonal close packing in three dimensions	3. Coordination number = 4
D. Cubic close packing in three dimensions	4. Pattern of sphere is repeated in alternate layers

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Ncert Exemplar Problems Assertion And Reason Type Questions

1. Assertion :- (a) the total number of atoms present in a simple cubic unit cell is one .

Reasn :-(R) simple cubic cell has atoms at its corners , each of which is shered between eight adjecent adjeacent unit cells.

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2. Assertion :- (A) Graphite is good conductor of electricity however diamond belongs to the category of insulators .

Rason (R) Grapite is soft in anture on the hand diamond is very hard and brittle.

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3. Assertion :- (A) total number of octahedral voids present in unit cell of cubic close of each packing including the one that is present at the body centre . Is four .

Reason :- (R) Besides the body centre there is one octahedral void present at the centre of each of the six faces of the unit cell and each of which is shared between two adjeccent units cells.

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4. Assertion : The packing efficiency is maximum for the fcc structure.

Reason : The cordination number is 12 in fcc structure.

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5. Assertion :-(A) semiconductors are solids with conductivites in the intermediate range from

$10^{-6} - 10^4 ohm^{-1} m^{-1}$

Reason :-(R) internmediate conductivity in semiconductor Is due to partially filled valence band .

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Quick Memory Test A Say True Or False

1. Tetragonal and orthorhombic crystal systems have same axial angles.

Watch Video Solution

2. The percentage of vacant space in bcc unit cell and simple cubic unit cell are 26% and 32% respectively.

Watch Video Solution

3. Number of atoms per unit cell in fcc and bcc unit cells are 4 and 2 respectively. Given statement wrong or right?

Watch Video Solution

4. For bcc metallic unit cell, the edge length (a) and radius (r) of aotm are related as : $a = \frac{4}{\sqrt{3}}r$. True or false?

Watch Video Solution

5. Number of Na^+ and Cl^- ions associated with each a unit cell of $NaCl$ is:

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6. Why does Schottky defect decrease the desity of a crystal ?

Watch Video Solution

7. HCP unit cell number of atoms

Watch Video Solution

8. Ferromagnetic and antiferromagnetic solids change into paramagnetic at high temperature.

Watch Video Solution

9. There are 14 crystal systems.

Watch Video Solution

10. The conductivity of a semiconductor increases with increase in temperature because

Watch Video Solution

11. A group-14 element is to be converted into n-type semiconductor by doping it with a suitalbe impurity. To which group this impurity belong?

Watch Video Solution

12. In condcutors, the gap between filled valence band and empty conduction band is very large.

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Quick Memory Test B Complete The Missing Links

1. The number of atoms for primitive unit cell is _______, for body centred cubic unit cell is ______ and for face centred cubic unit cell is __________.

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2. The electrical conductivity of metals _______ with decrease in temperature.

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3. The substances which are strongly attracted by the magnetic field and slow permanent magnetism even when magneti field is removed are called _________ substances.

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4. The formula of a compound is ______in which atoms of elements B form hcp lattice and those of the element A occupy 2/3 rd of tetrahedral voids.

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5. A group-14 element is to be converted into n-type semiconductor by doping it with a suitalbe impurity. To which group this impurity belong?

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6. The coordination number of each sphere in hcp is _____, in ccp is ______and in bcc packing is ________.

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7. The packing fraction of a simple unit cell is _______.

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8. The empty space in hcp is _____ and that in bcc paking is ______.

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9. An octahedral void is ______times larger than a tetrahedral void.

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10. In a body centred cubic arrangement--------- atoms along the body diagonal touch each other.

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11. Which of the following exhibit both Frenkel & Schottky defect?

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12. In a body centred cubic crystal of an element, the ratio of edge of the unit cell to the radius of the atom is _______.

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13. NaCl crystals have some yellow colour. This is due to the presence of ....

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Quick Memory Test C Choose The Correct Alternative

1. Lithium, sodium, potassium and rubidium crystallize in the bcc/fcc structure.

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2. The most unsymmetrical system is

Watch Video Solution

3. Orthorhombic has 4/3 types of lattices.

Watch Video Solution

4. Total number of tetrahedral and octahedral voids in hcp arrangment are $\frac{12}{18}$.

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5. In a crystalline solid, anions B are arranged in a ccp. Cations A are equally distributed between octahedral and tetrahedral voids. If all the octahedral voids are occupied, the formula of the compound is A_2B / A_3B.

Watch Video Solution

6. In a body centred cubic unit cell of elements, the radius of an atom is $0.433/0.354$ times the edge length of the unit cell.

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7. HCP unit cell number of atoms

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8. $CdCl_2$ added to AgCl crystal will introduce Schottky defect/Frenkel defect.

View Text Solution

9. MnO_2 is antiferromagnetic/ferromagnetic substance.

View Text Solution

10. Ferrimagnetism/ferromagnetism arises due to unequal number of domains in oppsite direction resulting in net magnetic moment.

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11. The substance showing both Schottky defect and Frenkel defect is $AgBr / ZnS$.

Watch Video Solution

12. If arsenic is added as impurity to silicon, the type of semiconductor obtained is called .....

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Revision Exercises Objective Questions Multiple Choice Questions

1. The crystal system of a compound with unit cell dimensions a = 0.388 , b = 0.388 and c = 0.506 nm and $\alpha = \beta = 90^\circ$ and $\gamma = 120^\circ$ is

A. cubic

B. hexagonal

C. orthorhombic

D. rhombohedral

Answer: B

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2. In which of the following pairs, both the crystals are not of the same type ?

A. Ice solid CO_2

B. NaCl , BaO

C. SiC , diamond

D. Mg, Ar

Answer: D

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3. Which of the following statements is not true about crystalline solids?

A. Polar molecular solids have higher enthalpies of vaporisation than those of not-polar molecular solids.

B. Graphite , though covalent solid is a good conductor of electricity.

C. Ionic solids are condcutors in molten state.

D. Non-polar molecular solids have London forces between the constituents and have higher melting points than polar moelcular solids.

Answer: D

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4. A metal crystallizes in a ccp structure. Its metallic radius is 141.5 pm. The number of unit cells in $64 cm^3$ of the metal are

A. 2×10^{32}

B. 1.5×10^{23}

C. 1×10^{24}

D. 1.5×10^{22}

Answer: C

Watch Video Solution

5. In a face centred cubic unit cell of close packed atoms, the radius of atom (r) is related to the edge length (a) of the unit cell by the expression

A. $r = \frac{a}{\sqrt{2}}$

B. $r = \frac{a}{2}$

C. $r = \frac{a}{2\sqrt{2}}$

D. $r = \frac{\sqrt{3}a}{4}$

Answer: C

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6. The number of atoms present in a hexagonal close-packed unit cell is:

A. 4

B. 6

C. 8

D. 12

Answer: B

Watch Video Solution

7. In a hcp arrangement, each atom at the corner contributes to the unit cell equal to

A. $1/2$

B. $1/8$

C. $1/6$

D. $1/4$

Answer: C

Watch Video Solution

8. A metal crystallizes in fcc lattice and edge of the unit cell is 620 pm. The radius of metal atoms is

A. 265.6 pm

B. 310 pm

C. 219.2 pm

D. 438.6 pm

Answer: C

Watch Video Solution

9. A compound formed by elements A and B crystallizes in cubic structure where A atoms are at the corners of a cube and B atoms are at the face center . What is the formula of the compound ?

A. AB_3

B. A_2B

C. AB_2

D. A_2B_3

Answer: A

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10. Which of the following is not an example of 13-15 commpound ?

A. InSb

B. GaAs

C. CdSe

D. AIP

Answer: C

Watch Video Solution

11. If the alignment of magnetic moments in a subtance is in a compensatory way so as to give zero net magnetic moment, then the substance is said to be

A. ferromagnetism

B. anit-ferromagnetism

C. ferrimagnetism

D. dimagnetism

Answer: B

Watch Video Solution

12. Fe_3O_4 is ferrimagnetic at room temperature but at 850K it becomes::

A. diamagnetic

B. ferromagnetic

C. non-magnetic

D. paramagnetic

Answer: D

Watch Video Solution

13. The appearance of colour in solid alkali metal halides is generally due to

A. Schottky defect

B. Frenkel defect

C. Interstitial position

D. F-centres

Answer: D

Watch Video Solution

14. An example of a ferromagnetic oxide is

A. CrO_2

B. TiO_2

C. Fe_3O_4

D. Mn_2O_7

Answer: A

Watch Video Solution

15. Close packing is maximum in the crystal lattice of :

A. bcc

B. fcc

C. simple cubic

D. end centred cubic

Answer: B

Watch Video Solution

16. In a solid lattice the cation has left a lattice sirte and is located at an interstital position , the lattice defect is

A. n - type

B. p - type

C. Frenkel defects

D. Schottky defect

Answer: C

Watch Video Solution

17. The coordination number of a metal crystallizing in a hexagonal close-packed structure is

A. 12

B. 4

C. 8

D. 10

Answer: A

Watch Video Solution

18. In a body centred unit cell, the number of atoms present is

A. 1

B. 2

C. 3

D. 4

Answer: B

Watch Video Solution

19. In a trigonal crystal

A. $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$

B. $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$

C. $a \neq b \neq c, \alpha = \beta = \gamma = 90^\circ$

D. $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$

Answer: A

Watch Video Solution

20. The appearance of colour in solid alkali metal halides is generally due to

A. Schottky defect

B. Frenkel defect

C. F-centre

D. Interstitial position

Answer: C

Watch Video Solution

21. In a body centred cubic structure, the space occupied is about

A. 0.74

B. 0.2

C. 0.68

D. 0.524

Answer: C

Watch Video Solution

22. Some polar crystals when heated produce small electrical current. The phenomenon is called

A. Ferroelectricity

B. Anti-ferroelectricity

C. Pyroelectricity

D. Piezoelectricity

Answer: C

Watch Video Solution

23. The empty space within hcp arrangment is

A. 0.34

B. 47.6%

C. 32%

D. 26%

Answer: D

View Text Solution

24. The crystal system in which $a \neq b \neq c$ and the angles $\alpha \neq \beta \neq \gamma$ is:

A. monoclinic

B. triclinic

C. cubic

D. tetragonal

Answer: B

Watch Video Solution

25. The number of Cl^{-} ions present around each Na^{+} ion in NaCl crystal lattice is

A. 3

B. 4

C. 8

D. 6

Answer: D

26. To get a n- type semiconductor from silicon , it should be doped with a sustance with valencyÃ¢â, Â¦Ã¢â, Â¦Ã¢â, Â¦.. .

A. 2

B. 1

C. 3

D. 5

Answer: D

27. The fraction of volume occupied by atoms in a face centered cubic unit cell is:

A. 0.74

B. 0.68

C. 52.4%

D. 75%

Answer: A

Watch Video Solution

28. The percentage of empty space in a body centred cubic arrangement is :

A. 74%

B. 68%

C. 32%

D. 26%

Answer: C

Watch Video Solution

29. To get p-type semiconductor , impurity to be added to silicon should have wihich of the following number of valence electrons?

A. 2

B. 3

C. 1

D. 5

Answer: B

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30. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because:

A. all the domians get oriented in the direction of magnetic field.

B. all the domains get oriented in the direction opposite to the direction of magnetic field.

C. domains get oriented randomly

D. domains are not affected by magnetic field

Answer: A

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31. The presence of F-centres in a crystal makes it

A. conducting

B. non - conducting

C. coloured

D. colourless

Answer: C

Watch Video Solution

32. Calculate the number of tetrahedral voids in the unit cell of a face-centred cubic lattice of similar atoms.

A. 4

B. 6

C. 8

D. 10

Answer: C

Watch Video Solution

33. Fe, Co and Ni are

A. ferrimagnetic materials

B. anti-ferromagnetic materials

C. ferromagnetic materials

D. diamagnetic materials

Answer: C

Watch Video Solution

34. Due to Frenkel defect, the density of the ionic solids

A. increases

B. decreases

C. does not change

D. depends on pressure

Answer: C

Watch Video Solution

35. Which of the following is an amorphous solid

A. graphite

B. glass

C. Chrome alum

D. silicon carbide

Answer: B

Watch Video Solution

36. In a face- centred cubic unit cell, the edge length is

A. $\frac{4}{\sqrt{3}}r$

B. $\frac{4}{\sqrt{2}}r$

C. $2r$

D. $\frac{\sqrt{3}}{2}r$

Answer: B

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37. For a hcp lattice, the edge length is equal to

A. $2\sqrt{2}r$

B. $2r$

C. $\frac{\sqrt{3}}{4}r$

D. $\frac{4}{\sqrt{3}}r$

Answer: B

View Text Solution

38. For a body centred lattice, edge length is equal to

A. $2\sqrt{2}r$

B. $2r$

C. $\frac{\sqrt{3}}{4}r$

D. $\frac{4}{\sqrt{3}}r$

Answer: D

Watch Video Solution

39. The fraction of total volume occupied by the atom present in a simple cubic is

A. $\frac{\pi}{4}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{3\sqrt{2}}$

D. $\frac{\pi}{4\sqrt{2}}$

Answer: B

Watch Video Solution

1. Match the crystal system (column I) with its characteristics (column II)

Column-I	Column-II
(i) Monoclinic	(A) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90^\circ$
(ii) Cubic	(B) $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$
(iii) Tetragonal	(C) $a \neq b \neq c, \alpha = \gamma = 90^\circ, \beta \neq 90^\circ$
(iv) Triclinic	(D) $a = b = c, \alpha = \beta = \gamma = 90^\circ$

A. (i) - (C), (ii) - (D) , (iii) - (A), (iv) - (B)

B. (i) - (A), (ii) - (D) , (iii) - (C), (iv) - (B)

C. (i) - (C), (ii) - (D) , (iii) - (B), (iv) - (A)

D. (i) - (C), (ii) - (D) , (iii) - (B), (iv) - (A)

Answer: C

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Watch Video Solution

2. Match the unit cell (column I) with radius of its atoms in terms of 'a' (column II)

Column-I	Column-II
(i) bcc (ii) fcc	(A) $\frac{a}{2\sqrt{2}}$ (B) $\frac{a}{2}$ (C) $\frac{\sqrt{3}a}{4}$

A. (i) - (C) - (ii) - (A)

B. (i) - (C) , (ii) - (B)

C. (i) - (B) , (ii) - (A)

D. (i) - (A), (ii) - (B)

Answer: A

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3. Match the close packed arrangment (column I) with its empty space (column II)

Column-I	Column-II
(*i*) Simple cubic	(*A*) 68%
(*ii*) bcc	(*B*) 26%
	(*C*) 47.6%
	(*D*) 32%

A. (i) - (C) - (ii) - (D)

B. (i) - (B) , (ii) - (D)

C. (i) - (C) , (ii) - (B)

D. (i) - (A), (ii) - (B)

Answer: A

4. Match the unit cell (column I) with number of atoms per unit cell (column II)

Column-I	Column-II
(*i*) fcc	(*A*) 1
(*ii*) bcc	(*B*) 6
(*iii*) simple cubic	(*C*) 4
(*iv*) hcp	(*D*) 2

A. (i) - (D), (ii) - (C) , (iii) - (B), (iv) - (A)

B. (i) - (C), (ii) - (D) , (iii) - (B), (iv) - (A)

C. (i) - (C), (ii) - (D) , (iii) - (A), (iv) - (B)

D. (i) - (B), (ii) - (D) , (iii) - (C), (iv) - (A)

Answer: C

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5. Match the arrangment of P and Q (column I) with its formula (column II)

Column-I	Column-II
(i) Q = ccp P = all octahedral sites	(A) P_4Q_3
(ii) Q = ccp P = 2/3rd tetrahedral sites	(B) P_2Q
	(C) PQ_2
	(D) PQ

A. (i) - (D) - (ii) - (B)

B. (i) - (B) , (ii) - (A)

C. (i) - (C) , (ii) - (B)

D. (i) - (D), (ii) - (A)

Answer: D

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6. Match the impurity doped semiconductor (column I) with its type (column II)

Column-I	Column-II
(*i*) Si doped with As	(*A*) *n*-type
(*ii*) Ge doped with Ga	(*B*) *p*-type
	(*C*) both n-and p-type

A. (i) - (C) - (ii) - (B)

B. (i) - (A) , (ii) - (B)

C. (i) - (B) , (ii) - (A)

D. (i) - (A), (ii) - (C)

Answer: B

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1. In a close packed structure, the atoms stack together occupying maximum space and leaving minimum vacant space. The close packing arrangment may be hcp (ABABA....) or ccp (ABCABCA....). In these arrangments, there is one octahedral void and two tetrahedral voids. Depending upon the ratio of size of cation and anion, the ions of one type occupy the voids of other ions. This results in different types of crystalline structures.

A metal oxide crystallises with metal ions in 2/3 of octahedral voids and 1/3 voids remain vacant in a closed packed array of oxide ions. What is the formula of metal oxide.

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2. In a close packed structure, the atoms stack together occupying maximum space and leaving minimum vacant space. The close packing arrangment may be hcp (ABABA....) or ccp (ABCABCA....). In these arrangments, there is one octahedral void and two tetrahedral voids. Depending upon the ratio of size of cation and anion, the ions of one type occupy the voids of other ions. This results in different types of crystalline structures.

A metal crystallises into two cubic phases, fcc and bcc. Which phase has lesser packing efficiency and how much ?

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3. In a close packed structure, the atoms stack together occupying maximum space and leaving minimum vacant space. The close packing arrangment may be hcp (ABABA....) or ccp (ABCABCA....). In these arrangments, there is one octahedral void and two tetrahedral voids. Depending upon the ratio of size of cation and anion, the ions of one type occupy the voids of other ions. This results in different types of crystalline structures.

Predict the coordination number of Cs^+ ion and structure of CsCl , if radii of Cs^+ and Cl^- ions are 1.69Å and 1.81Å respectively.

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4. In a close packed structure, the atoms stack together occupying maximum space and leaving minimum vacant space. The close packing arrangment may be hcp (ABABA....) or ccp (ABCABCA....). In these arrangments, there is one octahedral void and two tetrahedral voids. Depending upon the ratio of size of cation and anion, the ions of one type occupy the voids of other ions. This results in different types of crystalline structures.

If edge length of a fcc unit cell of a metallic element is q, then the radius of an atom is ....

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5. In solid, oxide ions are arranged in ccp. One sixth of the tetrahedral voids are occupied by the cations (A) while one third of the octahedral voids, are occupied by the cations (B). What is the formula of the compound ?

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6. What is point defect in crystals ?

Watch Video Solution

7. What are point defects ? Describe Schottky defects in crystals.

Watch Video Solution

8. What are point defects ? Describe Schottky defects in crystals.

Watch Video Solution

9. What are point defects ? Describe Schottky defects in crystals.

Watch Video Solution

10. An ideal crystal has the same unit cell containing the same lattice points throughout the whole of crystal. But such ideal crystals exist only at 0 K temperature. However, during the formation of crystal structure, certain defects are produced. These defects are point defects, line defects, vacancy defects, interstitial defects or impurity defects. Due to these defect, the crystals exhibit different properties. Presence of delocalised electrons make the metals conductor of electricity . Germanium and silicon are the most important commericial semiconductors. By adding impurities such as arsenic and boron, n and p - type semiconductors can be synthesised. Various combinations of n and p type semiconductors are used to make electronic components.

Name the type of point defect that occurs in a crystal of zinc sulphide. Will it increase, decrease or not change the density ?

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1. Statement 1: In any ionic solid [MX] withschotty defects, the number of positive and negative ions are same

Statement 2: Equals number of cation and anion vacancies are present .

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: A

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2. Assertion : ZnS has a body centred cubic arrangement.

Reason : In ZnS, Zn^{2+}, ions occupy alternate tetrahedral sites while S^{2-} ions form cubic close packed structure.

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3. Assertion (A) : $CsCl$ crystal, the coordination number of $Cs^{\oplus}$ ion is 8.

Reason (R) : $Cl^{\ominus}$ ion in $CsCl$ adopt b type of packing,

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4. Assertion : In ZnO, the excess Zn^{2+} ions are present in interstitial sites.

Reason : Metal excess crystals have either missing cation or anion in interstitial site.

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5. STATEMENT -1 : FeO is non-stoichiometric with formula $Fe_{0.95}O$.

STATEMENT -2 : Some Fe^{2+} ions are replaced by Fe^{3+} as

$3Fe^{3+} = 2Fe^{3+}$ to mainatain

electrons neutrally .

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6. Assertion : In CaF_2, F^- ions occupy all the tetrahedral sites.

Reason : The number of Ca^{2+} is double the number of F^- ions.

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7. Assertion (A) : Frenkel defects are shown by AgX.

Reason (R) : $Ag^{\oplus}$ ions have small size.

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8. Assertion : In Frenkel defect, density of the crystalline solid does not change.

Reason : In Frenkel defect, no cation or anion leaves the crystal.

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9. Assertion (A) Both Frenkel and Schottky defects are stoichiometric defects.

Reason (R) Both defects change the density of the crystalline solid.

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10. Assertion : Non-polar molecular solids have higher melting points than polar molecular solids.

Reason : Non-polar molecular solids have weak London or dispersion forces between their molecules while polar molecules have strong dipole-dipole forces between their molecules.

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Revision Exercises Very Short Answer Questions

1. How many atoms are present in a simple cubic unit cell?

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2. In a close placed arrangement of N spheres, how many (i) tetrahedral and (ii) octahedral sites are present ?

Watch Video Solution

3. What is the coordination number of hcp and ccp?

Watch Video Solution

4. State the type of crystal defects shown by AgBr.

Watch Video Solution

5. For tetrahedral co-ordination the radius ratio (r^+ / r^-) should be

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6. Name the crystal defect produced when sodium crystal is doped with $MgCl_2$?

View Text Solution

7. What is the effect of Frenkel defect on the electrical conductivity of crystalline solids ?

Watch Video Solution

8. What makes alkali metal halides sometimes coloured which are othersise colourless ?

Watch Video Solution

9. How does electrical cocductivity of semi-conductors vary with temperature ?

Watch Video Solution

10. Which of following shows anti-ferromagnetism ?

Watch Video Solution

11. Name an element with which silicon should be doped to given n-type of semiconductor.

Watch Video Solution

12. How does electrical conductivity vary in metals with temperature?

Watch Video Solution

13. In face -centered cubic unit cell, edge length is

Watch Video Solution

14. Which point defect in crystals does not alter the density of the relevant solid ?

Watch Video Solution

15. Write a point of distinction between a metallic solid and ionic solid other than the metallic lustre.

Watch Video Solution

16. How many lattice points are there in one unit cell of each of the following lattices?

(i) Face centred cubic lattice.

(ii) Body centred cubic lattice.

Watch Video Solution

17. How many atoms are there in a unit cell of a metal crystallizing in fcc structure?

Watch Video Solution

18. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic? Justify your answer.

Watch Video Solution

19. What is the formula of a compound in which the element Y forms ccp lattice and atoms X occupy 1/3rd of tetrahedral voids ?

Watch Video Solution

20. What are the coordination number of Na^{+} and Cl^{-} ions in NaCl ?

View Text Solution

21. The coordination number of the fcc structure for metals is

Watch Video Solution

22. Out of NaCl and AgCl, which one shows Frenkel defect and why ?

Watch Video Solution

23. Why does the conductivity of silicon increase upon doping with phosphorus ?

Watch Video Solution

24. What type of stoichiometric defecit is shoen by ZnS ?

Watch Video Solution

1. Which point defect lowers the density of a crystal?

Watch Video Solution

2. What type of semi-conductors is produced when silicon is doped with arsenic?

Watch Video Solution

3. What type of interactions hold together the molecules in a polar crystalline solid ?

Watch Video Solution

4. Which stoichiometric defect in crystals increses the density a solid?

Watch Video Solution

5. What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy 2/3 of tetrahedral voids ?

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Revision Exercises Short Answer Questions

1. What do you understand by the terms 'space lattice' and 'unit cell' ?

Watch Video Solution

2. Explain with the help of diagrams the structrual differences between three types of cubic crystals.

Watch Video Solution

3. Crystalline solids and Amorphous solids.

Watch Video Solution

4. $CaCl_2$ will introduce schottky defect if added to AgCl crystal. Explain.

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5. If the radius of the octahedral void is r and radius of the atom in closet packed structure is R then

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6. What is meant by the term "coordination number"?

b. What is the coordination number of atoms:

i. in a cubic-packed structure?

ii. In a body-centreds structure?

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7. What is the radius $\left(r^{+}/r^{-}\right)$ for an ion to occupy :

(i) tetrahedral void. (ii) octahedral void?

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8. Write the difference between Frenkel and Schottky defects.

Watch Video Solution

9. Explain Schottky defect in Stoichiometric crystals. What are the consequences of Schottky and Frenkel defects in crystals ?

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10. DISTINCTION BETWEEN N-TYPE AND P-TYPE SEMICONDUCTORS

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11. The crystal with metal deficiency defect is:

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12. Name the types of semiconductors produced when germanium (Ge) is doped separately with boron (B) and arsenic (As). Which one will be a better semiconductor and why ?

Watch Video Solution

13. Explain on brief Schottky defect.

Watch Video Solution

14. What is the packing fraction in face centred cubic lattice ?

Watch Video Solution

15. In terms of band theory, what is the difference between

a. a condcutor and an insulator

b. a conductor and a semiconductor

Watch Video Solution

16. Explain the following :

(i) Why is Frenkel defect not found in pure alkali metal halides?

(ii) Anti-ferromagnetic substances have unpaired electrons but their dipole moment is zero.

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17. why does the electrical conductivity of semiconductors increse with rise in temperature?

Watch Video Solution

18. What are paramagnetism and ferromagnetism ? What type of substances would make batter permanent magnets, ferromagnetic or ferrimagnetic?

Watch Video Solution

19. How does antiferromagnetism differ from ferromagnetism in terms of magnetic domains?

Watch Video Solution

20. Explain the following terms :

(i) Schottky defects

(ii) Frenkel defects

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21. IMPERFECTIONS IN SOLIDS

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22. (a) Define ferromagnetism and ferrimagnetism.

(b) Differentiate between metals, insulators and semiconductors on the basis of band theory .

Watch Video Solution

23. why does the electrical conductivity of semiconductors increse with rise in temperature?

Watch Video Solution

24. (i) What is a semiconductor ? Mention two main types of semiconductors.

(ii) Sodium crystallizes in a body centred cubic (bcc) unit cell. Calculate the approximate number of unit cells in 9.2 g of sodium. (Atomic mass of Na = 23 u)

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25. (a) Give two differences between ferromagnetic and anti-ferromagnetic substances.

(b) Tungsten crystallizes in body centred cubic lattice. Calculate the number of unit cells in 1.5 g of tungsten. (At mass of tungsten = 184 u)

Watch Video Solution

26. (a) NaCl has fcc structure. Calculate the number of NaCl units in a unit cell of NaCl.

(b) Calculate the density of NaCl if edge length of NaCl unit cell is 564 pm. (Molar mass of NaCl = $58.5 g mol^{-1}$)

Watch Video Solution

27. What type of semi-conductor is produced when silicon is doped with boron ?

Watch Video Solution

28. Examine the given defective crystal

$$\begin{array}{ccccc} A^+ & B^- & A^+ & B^- & A^+ \\ B^- & O & B^- & A^+ & B^- \\ A^+ & B^- & A^+ & O & A^+ \\ B^- & A^+ & B^- & A^+ & B^- \end{array}$$

Answer the following question :

(i) What type of stoichimetic 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 ?

Watch Video Solution

29. Explain the following

(i) F - centres

(ii)Doping .

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30. Write two points of distinction between crystalline and amorphous solids.

Watch Video Solution

31. Distinguish between crystal lattice and unit cell.

Watch Video Solution

32. (a) Briefly discuss Schottky defect and give examples.

(b) Calculate the density of copper crystal which crystallises in fcc arrangment with edge length of $3.61 \times 10^{-8} cm$.

Watch Video Solution

33. Define ferromagnetism and ferrimagnetism .

Watch Video Solution

34. Unit cells can be divided into two categories, primitive and centred unit cells.

(a) Differentiate between unit cell and crystal lattice.

(b) Calcualte the number of atoms per unit cell in the following:

(i) body centred cubic unit cell (bcc)

(ii) face centred cubic unit cell (fcc) .

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35. Calculate the percentage of packing efficiency in simple cubic unit cell.

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36. Example the following with suitable examples:

a. Ferromagnetism b. Paramagnetism

c. Ferrimagnetism d. Antiferromagnetism

e. 12 - 46 and 13 - 15 group compounds

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37. (a) Defince the following terms :

(i) F-centre

(ii) Unit cell

(b) Explain Schottky defect with an example .

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38. Write two points of distinction between Schottky and Frenkel defects.

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39. Write two points of distinction between crystalline and amorphous solids.

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40. Which of the following lattices has the highest packing efficency (a) simple cubic, (b) body-centred cubic, and (c) hexagonal close-packed lattice?

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41. (a) Based on the nature of intermolecular forces, classify the following solids?

$(i) SiO_2$ $(ii) Ice$

(b) ZnO turns yellow on heating. Why ?

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42. What are non-stoichiometry defects in crystals ? Explain.

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Revision Exercises Short Answer Questions Cbse Qs

1. 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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2. Explain the following properties with suitable examples:

(i) ferromagnetism (ii) paramagnetism

(iii) ferrimagnetism.

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3. How do metallic and ionic substances differ in conducting electricity ?

Watch Video Solution

4. Explain how can you determine the atomic mass of an unknown metal if you know its mass density and the dimensions of unit cell of its crystal.

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5. Calculate the packing efficiency of a metal crystal for a simple cubic lattice.

Watch Video Solution

6. Account for the following :

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

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

Watch Video Solution

7. What change occurs when AgCl is doped with $CdCl_2$?

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

(i) Tetrahedral and octahedral voids

(ii) Crystal lattice and unit cell

Watch Video Solution

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

(i) Tetrahedral and octahedral voids

(ii) Crystal lattice and unit cell

Watch Video Solution

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

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

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11. (a) Based on the nature of the intermolecular foces, classify solids benzene and silver.

(b) AgCl shows frenkel defect while NaCl does not. Give reason.

(c) What type of semi-conductor is formed when Ge is doped with Al ?

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12. An element 'X' (At. Mass = 40 g mol^{-1}) having f.c.c structure has unit cell edge length of 400 pm . Calculate the density of 'X' and the number of unit cells in 4 g of 'X' . $\left(N_A = 6.022 \times 10^{23} mol^{-1}\right)$.

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Revision Exercises Long Answer Questions

1. What do you understand by imperfections in ionic crystals ? Name the types of imperfections which occur in ionic crystals.

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2. MAGNETIC PROPERTIES

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3. (a) An element has atomic mass $93 g mol^{-1}$ and density $11.5 g cm^{-3}$. If the edge length of its unit cell is 300 pm, identify the type of unit cell.

(b) Write any two differences between amorphous solids and crystalline solids.

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4. Give reasons :

(i) In stoichiometric dfects. NaCl exhibits Schottky defect and not Frenkel defect.

(iii) Ferrimagnetic substances show better magnetism than antiferromagnetic substances.

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5. (a) If the radius of octahedral void is 'r' and the radius of the atoms in close packing is 'R' what is the relation between 'r' and 'R' ?

(b) A metal crystallises in body centred cubic structure. If 'a' is the edge length of its unit cell, 'r' is the radius of the sphere, what is the relation between 'r' and 'a' ?

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6. An element with molar mass 2.7×10^{-2} kg per mole forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^3 , what is the nature of the cubic unit cell ?

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Revision Exercises Numerical Problems

1. Potassium iodide has cubic unit cell with cell edge of 705 pm. The density of KI is $3.12 gcm^{-3}$. How many K^+ and I^- ions are contained in the unit cell ?

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2. The unit of an element of atomic mass 96 and density $10.3 gcm^{-3}$ is a cube with edge length of 314 pm. Find the structure of the crystal lattice (simple cubic, FCC or BCC) (Avogadro's constant , $N_0 = 6.023 \times 10^{23} mol^{-1}$)

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3. KCl and NaCl have fcc lattice. Calculate the ratio of density of NaCl to that of KCl if the ratio of edge of NaCl to that of KCl is 0.875.

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4. Lithium metal has a body centred cubic lattice structure with edge length of unit cell 352 pm. Calculate the density of lithium metal (Given : Atomic mass of Li = $7gmol^{-1}$)

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5. Iron has body centred cubic cell with a cell edge of 286.5 pm. The density of iron is 7.87 g cm^{-3}. Use this information to calculate Avogadro's number. (Atomic mass of Fe = 56 mol^{-3})

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6. An element crystallizes in a structure having fcc unit cell of an edge 300 pm. Calculate its density if 180 g of this element contains 3.708×10^{24} atoms.

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7. An element (density $7.2 gcm^{-3}$) crystallizes in a body centred cubic structure having its unit cell edge length 2.88Å. Calculate the number of atoms present in 156 g of the element.

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8. Silver crystalilises in a fcc lattice. The edge length of its unit is $4.077 \times 10^{-8} \times cm$ and its density is $10.5 gcm^{-3}$. Claculate on this basis the atomic mass of silver $\left(N_A = 6.02 \times 10^{23} \text{mol}^{-1}\right)$

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9. Chromium metal (atomic mass = 52) has body centred cubic structure. The radius of chromium atom is 124.3 pm. Calculate the density of chromium metal.

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Revision Exercises Numerical Problems Cbse Qs

1. The well know mineral flourite is chemically calcium fluoride. It is a well known fact that in one unit cell of this mineral, there are four Ca^{2+} ions and eight F^{-} ions and Ca^{2+} ions are arranged in f.c.c. lattice. The F^{-} ions fill all the tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge length of the unit cell is 5.46×10^{-8} cm. The density of the solid is 3.18g cm^{-3}. Use this information to calculate Avogadro's number (Molar mass of $CaF_2 = 78.0 \text{g mol}^{-1}$)

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2. The density of copper metal is 8.95 g cm^{-3}. If the redius of copper atom be 127.8 pm, is the copper unit cell simple cubic, body - centred or face- centred cubic ?

(Given : atomic mass of Cu = 63. 5 g/mol)

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3. 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 u and Avogadro's number $N_A = 6.02 \times 10^{23} mol^{-1}$)

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4. Aluminium crystallizes in an fcc structure. Atomic radius of the metal is 125 pm. What is the length of the side of the unit cell of the metal?

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5. An element with density 10 g cm^{-3} forms a cubic unit cell with edge length $3 \times 10^{-8} cm$. What is the nature of the cubic unit cell if the atomic mass of the element is 81 g mol^{-1}.

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6. An element crystallizes in f.c.c. lattice with edge length of 400 pm. The density of the element is 7 g cm^{-3}. How many atoms are present in 280 g of the element ?

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Hots Higher Order Thinking Skills Advanced Level

1. Diamond and solid rhombic sulphur both are covalent solids but the latter has very low melting point than the former. Explain why ?

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2. Why do the window glass of old old building (a) look milky and (b) become thick at the bottom?

Watch Video Solution

3. Can cubic lattice have end-centred unit cell?

Watch Video Solution

4. AgI crystallises in a cubic close-packed ZnS structure. What fraction of tetrahedral sites is occupied by Ag^{+} ions ?

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5. An element 'X' has bcc lattice as shown below :

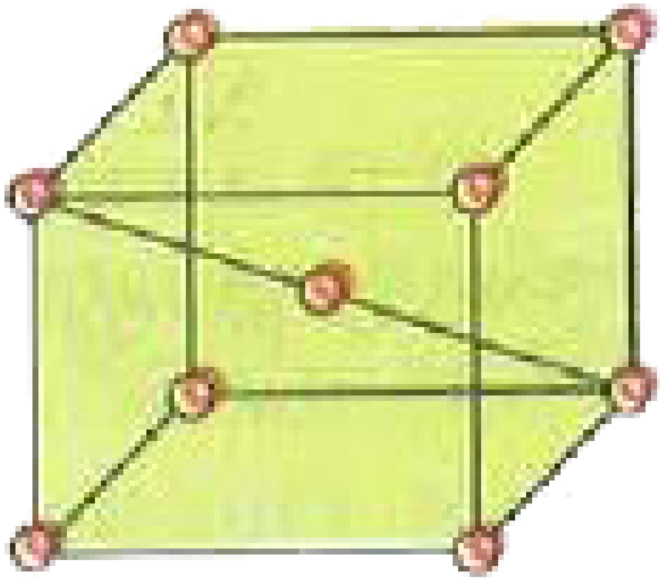
The unit cell length, a is 306 pm.

(a) What is the distance between nearest neighbours?

(b) What is the distance between next nearest neighbours?

(c) How many nearest neighbours does each X atom have ?

(d) How many next nearest neighbours does each X have ?



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6. For a cubic crystal, the face diagonal is 4.25Å. Calculate its face length.

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7. In an atomic bcc lattice what fraction of edge is not covered by atoms?

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8. A face centred cubic lattice of a single type of atoms has same defects and its one corner and one face centre is left unoccupied per unit cell. Calculate the packing fraction of such solid.

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9. CsCl has cubic structure of ions in which Cs^{+} ion is present in the body -centre of the cube. If density is 3.99 g cm^{-3} :

(a) Calculate the length of the edge of a unit cell.

(b) What is the distance between Cs^{+} and Cl^{-} ions ?

(c) What is the radius of Cs^{+} ion if the radius of Cl^{-} ion is 180 pm ?

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10. A metal crystallizes into two cubic phases, face-centred cubic and body-centred cubic, which have unit cell lengths 3.5 and $3.0A$, respectively. Calculate the ratio of densities of fcc and bcc.

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11. You are given marbles of diameter $10mm$. They are to be placed such that their centres are laying in a square bound by four lines each of length $40mm$. What will be the arrangements of marbles in a plane so that maximum number of marbles can be placed inside the area? Sketch the diagram and derive expression for the number of molecules per unit area.

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12. A compound AB has a rock salt type structure with $A:B=1:1$. The formula weight of AB is $6.023Y amu$ and the closed $A-B$ distance is $Y^{1/3}nm$.

(i) Find the density of lattice.

(ii) If the density of lattice is found to be $20 kgm^{-3}$, then predict the type of defect.

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Competition File Objective Type Questions A Multiple Choice Questions

1. The most unsymmetrical and symmetrical systems are, respectively :

A. tetragonal , cubic

B. triclinic, cubic

C. rhombohedral, hexagonal

D. orthorhombic , cubic

Answer: B

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2. The packing fraction for a body-centred cube is

A. 0.42

B. 0.54

C. 0.68

D. 0.74

Answer: C

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3. The number of atoms in bcc and fcc arrangement are respectively :

A. 1,2

B. 2,4

C. 4,2

D. 2,1

Answer: B

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4. What is the coordination number of hcp and ccp?

A. 6,6

B. 12,6

C. 8,6

D. 12,12

Answer: D

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5. The portion of edge length not occupied by atoms for simple cubic, fcc and bcc are respectively (a is edge length)

A. $0, a\left(1-\frac{\sqrt{3}}{2}\right), a\left(1-\frac{1}{\sqrt{2}}\right)$

B. $a\left(1-\frac{\sqrt{3}}{2}\right), 0, a\left(2-\frac{1}{\sqrt{2}}\right)$

C. $0, a\left(1-\frac{1}{\sqrt{2}}, a\left(1-\frac{\sqrt{3}}{2}\right)\right.$

D. $a, 2\sqrt{2}a, \frac{\sqrt{3}}{2}a$

Answer: C

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6. The volume of atom present in a face-centred cubic unit cell of a metal (r is atomic radius) is

A. $\frac{24}{3}\pi r^3$

B. $\frac{12}{3}\pi r^3$

C. $\frac{16}{3}\pi r^3$

D. $\frac{20}{3}\pi r^3$

Answer: C

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7. A metal crystallizes in b lattice. The percent fraction of edge length not covered by atom is

A. $12.4\,\%$

B. $13.4\,\%$

C. $87.6\,\%$

D. $50.0\,\%$

Answer: B

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8. How many unit cell are present in a cubic-shaped ideal crystal of $NaCl$ of mass $1.0g$?

A. 2.57×10^{21}

B. 1.28×10^{21}

C. 1.71×10^{21}

D. 5.14×10^{21}

Answer: A

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9. For tetrahedral co-ordination the radius ratio $\left(r^{+}/r^{-}\right)$ should be

A. $0.155 - 0.225$

B. $0.225 - 0.414$

C. $0.414 - 0.732$

D. $0.732 - 1$

Answer: B

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10. The number of second nearest Na^+ ions neighbour of a Na^+ ion in NaCl structure is

A. 12

B. 6

C. 8

D. 4

Answer: A

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11. The cubic unit cell of Al (molar mass 27 g mol^{-1}) has an edge length of 405 pm. Its density is $2.7 gcm^{-3}$. The cubic unit cell is :

A. body centred

B. primitive

C. edge centred

D. face centred

Answer: D

Watch Video Solution

12. In magnetite , O^{2-} have ccp arrangement with Fe^{2+} ions in $1/8^{th}$ tetrahedral voids and Fe^{3+} occupy half of octahedral void .The formula of magnetite is

A. Fe_3O_4

B. Fe_2O_3

C. FeO

D. Fe_3O_8

Answer: A

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13. An alloy of Cu, Ag and Au is found to have copper constituting the $c.c.p.$ lattice. If Ag atom occupy the edge centres and Au atom is present at body centre, the formula of this alloy is :

A. Cu_4, Ag_2Au

B. Cu_4Ag_4Au

C. Cu_4Ag_3Au

D. $CuAgAu$

Answer: C

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14. In spinel structure, O^{2-} ions are cubic-closed packed, wherease 1/8th of the tetrahedral holes are occupied by A^{2+} cations and 1/2 of the octahedral holes are occupied by cations B^{3+} . The general formula of this compound is

A. A_2BO_4

B. AB_2O_4

C. A_2B_4O

D. A_4B_2O

Answer: B

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15. A crystalline solid has a cubic structure in which tungsten (W) atoms are located at the cubic corners of the unit cell, oxygen atoms at the edges of the cube and sodium atoms at the cube centre. The molecular formula of the compound is

A. Na_2WO_3

B. $NaWO_4$

C. $NaWO_3$

D. Na_2WO_4

Answer: C

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16. A mineral of titanium (perovskite) is found to contain calcium ions at the corners, oxygen atoms at the face centres and titanium atoms at the centre of the cube. The oxidation state of titanium in the mineral is

A. $+1$

B. $+3$

C. $+4$

D. $+2$

Answer: C

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17. The number of terrahedral and octahedral holes in a hexagonal primitive unit cell are respectively:

A. 8,4

B. 6,12

C. 2,1

D. 12,6

Answer: D

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18. In which of the following structures, the anion has maximum coordination number?

A. NaCl

B. ZnS

C. CaF_2

D. Na_2O

Answer: D

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19. In a fcc arrangement of P and Q atoms, where P atoms are at the corners of the unit cell, Q atoms at the face centres and two atoms are missing from two corners in each unit cell, then the formula of the compound is

A. P_2Q_3

B. P_4Q

C. P_4Q_5

D. PQ_4

Answer: D

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20. The pyknometric density of sodium chloride crystal is $2.165 \times 10^3 kgm^{-3}$ while its X ray density is $2.178 \times 10^3 kgm^{-3}$ the fraction of unoccupied sites in $NaCl$ crystal is

A. 5.96

B. 5.96×10^{-2}

C. 5.96×10^{-1}

D. 5.96×10^{-3}

Answer: D

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21. Three element A, B, C crystallize into a cubic solid lattice.Atoms A occupy the corners B atoms the cube centres and atom C the edge .The formula of the compound is

A. ABC

B. ABC_2

C. ABC_3

D. ABC_4

Answer: C

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22. A element cystallizes in fcc lattice and edge length of unit cell is 400 pm. If density of unit cell is $11.2 gcm^{-3}$, then atomic mass of the element is

A. 215.6

B. 431.2

C. 107.8

D. 98.6

Answer: C

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23. An element with atomic mass 60 having fcc structure has a density of $6.23 \mathrm{g/cm}^3$.What is the edge length of unit cell ?

A. 300 pm

B. 250 pm

C. 400 pm

D. 160 pm

Answer: C

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24. The cell edge of a fcc crystal is 100 pm and its density is $10.0 gcm^{-3}$. The number of atoms in 100 g of this crystal is

A. 1×10^{25}

B. 2×10^{25}

C. 3×10^{25}

D. 4×10^{25}

Answer: D

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25. Copper crystallizes in a cubic lattice structure. Atomic radius of copper is 128 pm and its atomic mass is 63.5. The density of copper is

A. $10.71 gcm^{-3}$

B. $4.93 gcm^{-3}$

C. $8.9 gcm^{-3}$

D. $11.2 gcm^{-3}$

Answer: C

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26. Ferrous oxide (FeO) crystal has a cubic structure and each edge of the unit cell is $5.0A^{\circ}$ Taking density of the oxide as $4.0gcm^{-3}$. The number of Fe^{2+} and O^{2-} ions present in each unit cell is:

A. 1

B. 2

C. 4

D. 6

Answer: C

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27. Which type of 'defect' has the pressence of cations in the interstitial sites?

A. Schottky defect

B. Vacancy defect

C. Frenkel defects

D. Metal deficiency defect

Answer: C

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28. ZnO shows yellow colour on heating due to

A. Frenkel defect

B. Metal excess defect

C. Metal deficiency defect

D. Schottky defect

Answer: B

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29. Ionic solids with Schottky defect may contain in their structure

A. cation vacancies only

B. cation vacancies and interstitial cations

C. equal number of cation and anion vacancies

D. anion vacancies and interstitial anions

Answer: C

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30. Which of the following pair contains both anitferromagnetic substances ?

A. V_2O_5, MnO_2

B. CuO, Fe

C. NiO, CrO_2

D. Mn_2O_3, MnO

Answer: D

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Competition File Objective Type Questions B Multiple Choice Questions

1. If $NaCl$ is doped with $10^{-4} mol\,\%$ of $SrCl_2$ the concentration of cation vacancies will be $(N_A = 6.02 \times 10^{23} mol^{-1})$

A. $6.02 \times 10^{16} mol^{-1}$

B. $6.02 \times 10^{17} mol^{-1}$

C. $6.02 \times 10^{14} mol^{-1}$

D. $6.02 \times 10^{15} mol^{-1}$

Answer: B

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2. If $'a'$ stands for the edge length of the cubic systems: simple cubic,body centred cubic and face centred cubic then the ratio of radii of the spheres inthese systems will be respectively,

A. $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$

B. $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$

C. $\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a$

D. $1a : \sqrt{3}a : \sqrt{2}a$

Answer: A

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3. Lithium metal crystallizes in a body centred cubic crystals. If the length of the side of the unit cell of lithium is $351pm$ the atomic radius of the lithium will be

A. 151.8 pm

B. 75.5 pm

C. 300.5 pm

D. 240.8 pm

Answer: A

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4. Total no. of voids in 0.5 mole of a compound forming hexagonal closed packed structure are :

A. 6.022×10^{23}

B. 3.011×10^{23}

C. 9.033×10^{23}

D. 4.516×10^{23}

Answer: C

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5. Which of the following exhibit both Frenkel & Schottky defect?

A. NaCl

B. AgCl

C. AgBr

D. AgI

Answer: C

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6. A metal crystallizes with a face -centred cubic lattice.The edge of the unit cells is 408 pm.The dimeter of the metal atoms is

A. 288 pm

B. 408 pm

C. 144 pm

D. 204 pm

Answer: A

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7. The mass percentage of iron present as Fe(III) in $Fe_{-.93}O_{1.0}$ is

A. 8.3%

B. 9.6%

C. 11.5%

D. 17.7%

Answer: C

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8. A metal has an fcc latticed.The edge length of the unit cell is 404 pm .The density of the metal is $2.72g / cm^{-3}$ .The molar mass of the metal is

$(N_A$ Avogadro's constant $= 6.2 \times 10^{23} mol^{-1})$

A. $27 gmol^{-1}$

B. $20 gmol^{-1}$

C. $40 gmol^{-1}$

D. $30 gmol^{-1}$

Answer: A

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9. The number of carbon atoms per unit cell of diamond unit cell is

A. 6

B. 1

C. 4

D. 8

Answer: D

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10. If a is the length of the side of a cube, the distance between the body centred atom and one corner atom in the cube will be:

A. $\frac{2}{\sqrt{3}}a$

B. $\frac{4}{\sqrt{3}}a$

C. $\frac{\sqrt{3}}{4}a$

D. $\frac{\sqrt{3}}{2}a$

Answer: D

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11. The correct statement regarding defects in crystalling solids.

A. Frenkel defect is a dislocation defect

B. Frenkel defect is found in halides of alkaline earth metals.

C. Schottky defects have no effect on the density of crystalline solids.

D. Frenkel defects decrease the density of crystalline solids.

Answer: A

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12. A given metal crystalline out with a cubic structure having edge length of 361 pm .if there are four metal atoms in one unit cell, what is the radius of metal atom?

A. 80 pm

B. 108 pm

C. 40 pm

D. 127 pm

Answer: D

Watch Video Solution

13. Lithium has a bcc structure .Its density is $530kgm^{-3}$ and its atomic mass is $6.94gmol^{-1}$ .Calculate the edge length of a unit cell of lithium metal $(N_A = 6.02 \times 10^{23} mol^{-1})$

A. 527 pm

B. 264 pm

C. 154 pm

D. 352 pm

Answer: D

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14. The ionic radii of A^{+} and B^{-} ions are 0.98×10^{-10} and $1.81 \times 10^{-10} m$ .The coordinatyion number of each ion in AB is

A. 8

B. 2

C. 6

D. 4

Answer: C

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15. In calcium, fluoride having the florite structures. The coordination number for calcium ion (Ca^{2+}) and fluoride ion (F^{-}) are

A. 4 and 2

B. 6 and 6

C. 8 and 4

D. 4 and 8

Answer: C

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16. Which is the incorrect statement?

A. Density decreases in case of crystals with Schottky defect.

B. NaCl(s) is insulator, silicon is semiconductor , silver is conductor, quartz is piezoelectric crystal.

C. Frenkel defect is favoured in those ionic compounds in which sizes of cations and anions are almost equal.

D. $FeO_{0.98}$ has non-stoichiometric metal deficiency defect.

Answer: C::D

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17. Iron exhibits b structure at roomj temperature. Above $9000^\circ C$, it transformers to f structure. The ratio of density of iron at room temperature to that at $900^\circ C$ (assuming molar mass and atomic radius of iron remains constant with temperature) is

A. $\frac{\sqrt{3}}{\sqrt{2}}$

B. $\frac{4\sqrt{3}}{3\sqrt{2}}$

C. $\frac{4\sqrt{3}}{4\sqrt{2}}$

D. $\frac{1}{2}$

Answer: C

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18. A compound is compound by cation C and anion A. The anions hexagonal close packed (hcp) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is

A. C_2A_3

B. C_3A_2

C. C_3A_4

D. C_4A_3

Answer: C

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1. An ionic compound is expected to have tetrahedral structure if r_x / r_- lies in the range of

A. $0.155 \text{ to } 0.225$

B. $0.732 \text{ to } 1$

C. $0.414 \text{ to } 0.732$

D. $0.225 \text{ to } 0.414$

Answer: D

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2. A solid compound contains X,Y and Z atoms in a cubic lattice with X atoms occupying the corners,Y atoms in the body centred positions and Z atoms at the centres of faces of the unit cell. What is the empirical formula of the compound

A. XY_2Z_3

B. XYZ_3

C. $X_2Y_2Z_3$

D. X_8YZ_6

Answer: B

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3. KCl crystallises in the same type of lattices as does NaCl. Given that $r_{Na^+}/r_{Cl^-} = 0.55$ and $r_{K^+}/r_{Cl^-} = 0.74$.

Calculate the ratio of the side of the unit cell of KCl to that of NaCl.

A. 1.123

B. 0.891

C. 1.414

D. 0.414

Answer: A

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4. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centred positions. If one atom of B is missin from one of the face centred points,, the formula of the compound is :

A. A_2B

B. AB_2

C. A_2B_3

D. A_2B_5

Answer: D

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5. Lithium forms body centred cubic structure. The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be

A. 300 pm

B. 240 pm

C. 152 pm

D. 75 pm

Answer: C

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6. Experimentally it was found that a metal oxide in formula $M_{0.98}O$. Metal M is present as M^{2+} and M^{3+} in its oxide ,Fraction of the metal which exists as M^{3+} would be

A. 5.08%

B. 7.01%

C. 4.08%

D. 6.05%

Answer: C

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7. In a face centred cubic lattice unit cell is shared equally by how many unit cells?

A. 6

B. 4

C. 2

D. 8

Answer: A

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8. $CsCl$crystallizes in body centred cubic lattice. If $'a'$ is its edge length then which of the following expressions is correct ?

A. $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

B. $r_{Cs^+} + r_{Cl^-} = 3a$

C. $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

D. $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$

Answer: D

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9. Suppose the mass of a single Ag atoms is 'm' Ag metal crystallises in fcc lattice with unit cell edge length 'a' The density of Ag metal in terms of 'a' and 'm' is:

A. $\frac{4m}{a^3}$

B. $\frac{2m}{a^3}$

C. $\frac{m}{a^3}$

D. $\frac{m}{4a^3}$

Answer: A

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10. Sodium metal crystallises in body centred cubic lattic with cell edge 4.29Å .What is the radius of sodium atom ?

A. 5.72Å

B. 0.93Å

C. 1.86Å

D. 3.22Å

Answer: C

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11. In a face centred cubic unit cell, what is the volume occupied ?

A. $\frac{4}{3}\pi r^3$

B. $\frac{8}{3}\pi r^3$

C. $\frac{16}{3}\pi r^3$

D. $\frac{64r^3}{3\sqrt{3}}$

Answer: C

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12. An element crystallising in body centred cublic lattice has edge length of 500 pm. If the density is 4 g cm^{-3}, the atomic mass of the element $\left(\text{in g mol}^{-1}\right)$ is (consider $N_A = 6 \times 10^{23}$)

A. 100

B. 250

C. 125

D. 150

Answer: D

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13. The contribution of a particle at the edge centre of a particular unit cell is ,

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. 1

D. $\frac{1}{8}$

Answer: B

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14. Which of the following compounds is metallic and ferromagnetic ?

A. TiO_2

B. CrO_2

C. VO_2

D. MnO_2

Answer: B

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15. The corrent statement regarding defects is solids in solids is

A. Schottky defect has no effect on the physical properties of solids

B. Frenkel defect is a dislocation defect

C. Frenkel defect is usually favoured by a very small difference in the sizes of cations and anions

D. Trapping of proton in the lattice leads to the formation of F-centres.

Answer: B

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16. In a face centred cubic arrangement of A and B atoms whose A atoms are at the corner of the unit cell and B atoms at the face centres. Once of the A atom is missing from one corner in unit cell. The simplest formula of compound is

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17. A metal crystallises in a face centred cubic structure. If the edge length of its unit cell is 'a' the closest approach between two atoms in metallic crystal will be

A. 2a

B. $2\sqrt{2}a$

C. $\sqrt{2}a$

D. $\frac{a}{\sqrt{2}}$

Answer: D

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18. Edge length of cube is 300 pm. Its body diagonal would be:

A. 600 pm

B. 423 pm

C. 519.9 pm

D. 450.5 pm

Answer: C

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19. An example of a non-stoichiometric oxide when heated is

A. BeO

B. ZnO

C. MgO

D. CaO

Answer: B

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20. A given metal crystallises out with a cubic structure having edge length of 361pm .If there are metal atoms in one cell, what is the radius of one atoms?

A. Density of the structure II is lower than structure I.

B. Density of the structure II is higher than structure I.

C. The pore volume in structure I is 1.2 times higher than that of structure II .

D. The pore volume of both the structures are equal .

Answer: A

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21. The number of atoms in 2.4 g of body centred cubic crystal with edge length 200 pm is (density $= 10gcm^{-3}, N_A = 6 \times 10^{23}$ atoms/mol)

A. 6×10^{22}

B. 6×10^{20}

C. 6×10^{23}

D. 6×10^{19}

Answer: A

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22. Which among the following statement is true about Schottky defect ?

A. In the defect cation and anion are lacking in stoichiometric proportion.

B. Formation of metal alloy is example of this defect.

C. In this, regular cation is replaced by different cation

D. In this cation or anion moves from regular site to place between lattice site.

Answer: A

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23. If a metal crystallises in bcc structure with edge length of unit cell $4.29 \times 10^{-8} cm$, the radius of metal atom is

A. $1.07 \times 10^{-7} cm$

B. $1.07 \times 10^{-8} cm$

C. $1.86 \times 10^{-8} cm$

D. $3.2 \times 10^{-7} cm$

Answer: C

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24. At $100^{\circ} C$, copper (Cu) has FCC unit cell structure will cell edge length of $x \text{Å}$. What is the approximate density of Cu (in g cm^{-3}) at this temperature? [Atomic mass of Cu = 63.55 u]

A. $\frac{105}{x^3}$

B. $\frac{211}{x^3}$

C. $\frac{205}{x^3}$

D. $\frac{422}{x^3}$

Answer: D

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

A. Tetragonal

B. Hexagonal

C. Monoclinic

D. Triclinic

Answer: D

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26. 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

A. hcp lattice - A , $\frac{2}{3}$ Tetrahedral voids - B

B. hcp lattice - B , $\frac{1}{3}$ Tetrahedral voids - A

C. hcp lattice - B, $\frac{2}{3}$ Tetrahedral voids-A

D. hcp lattice - A, $\frac{1}{3}$ Tetrahedral voids - B

Answer: B

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27. A solid having density of $9 \times 10^3 kgm^{-3}$ forms face centred cubic crystals of edge length $200\sqrt{2}$ pm. What is the molar mass of the solid ? [Avogadro constant $\cong 6 \times 10^{23} mol^{-1}, \pi \cong 3$]

A. $0.0216 kgmol^{-1}$

B. $0.0305 kgmol^{-1}$

C. $0.4320 kgmol^{-1}$

D. $0.4320 kgmol^{-1}$

Answer: B

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

A. $0.134a$

B. $0.027a$

C. $0.067a$

D. $0.047a$

Answer: C

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29. Element 'B' forms ccp structure and 'A' occupies half of the octahedral voids , while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is :

A. A_2BO_4

B. AB_2O_4

C. A_2B_2O

D. A_4B_2O

Answer: B

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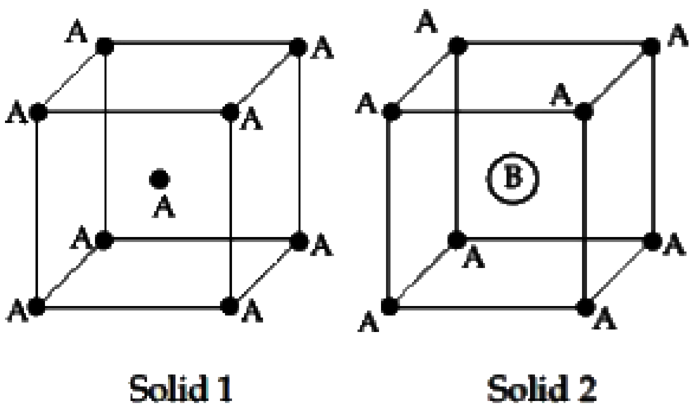
30. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. the unit cell edge length is 50% more in soild 2 than in 1 . What is the approximate packing efficiency in solid 2?



A. 45%

B. 65%

C. 90%

D. 75%

Answer: C

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

A. $1:2:4$

B. $8:1:6$

C. $4:2:1$

D. $4:2:3$

Answer: A

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32. 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:

A. $\frac{a}{2}$

B. a

C. $\frac{3}{2}a$

D. $\sqrt{2}a$

Answer: A

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1. In a solid AB having the $NaCl$ structure, A atom occupies the corners of the cubic unit cell. If all the face-centred atoms along one of the axes are removed, then the resultant stoichiometry of the solid is

A. AB_2

B. A_2B

C. A_4B_3

D. A_3B_4

Answer: D

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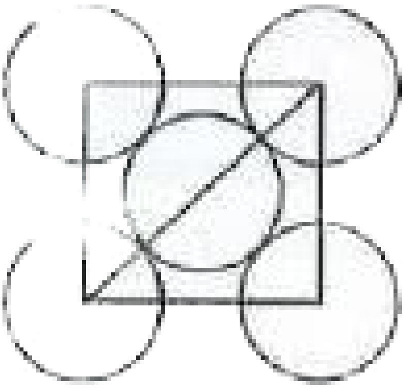
2. The packing efficiency of the two dimensional square unit cell shown is :



A. $39.27\ \%$

B. $68.02\ \%$

C. $74.05\ \%$

D. $78.54\ \%$

Answer: D

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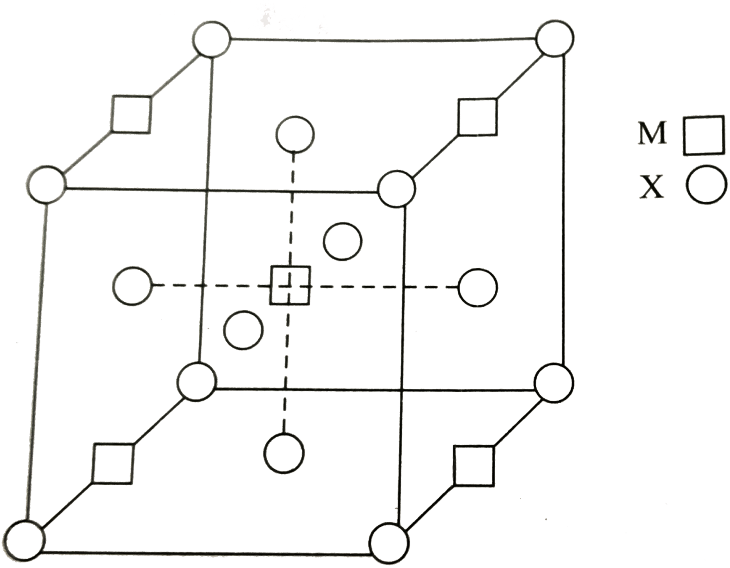
3. A compound M_pX_q has cubic close packing (p) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



a. MX b. MX_2 c. M_2X

A. MX

B. MX_2

C. M_2X

D. M_5X_{14}

Answer: B

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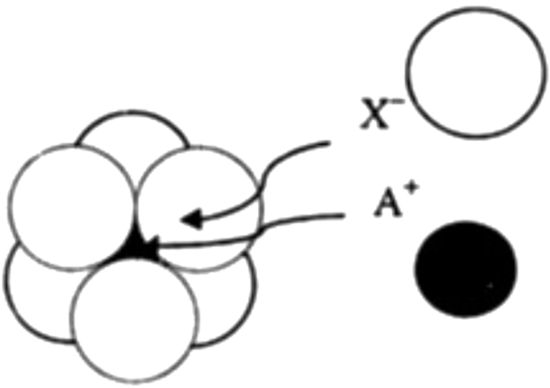
4. The arrangement of X^- ions around A^+ ion in solid AX is given in the figure (not drawn to scale). If the radius of X^- is 250 pm, the radius of A^+ is



A. 104 pm

B. 125 pm

C. 183 pm

D. 57 pm

Answer: A

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5. If the unit cell of a mineral has cubic close packed (ccp) array of oxygen atoms with m fraction of octahedral holes occupied by aluminium ions and n fraction of tetrahedral holes occupied by magnesiums ions, m and n respectively, are

A. $\frac{1}{2}, \frac{1}{8}$

B. $1, \frac{1}{4}$

C. $\frac{1}{2}, \frac{1}{2}$

D. $\frac{1}{4}, \frac{1}{8}$

Answer: A

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Competition File Objective Type Questions C Multiple Choice Questions

1. Which of the following are not true about hexagonal close packing ?

A. It has 26% empty space

B. In this arrangment, third layer is identical to the first layer.

C. The coordination number in this arrangment is 6.

D. It is as closely packed as body centred cubic packing.

Answer: C::D

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2. Which of the following statements are correct?

A. The coordination number of each type of ion in CsCl crystal is 8

B. A metal that crystallizes in bcc structure has coordination number 12.

C. A unit cell of an ionic crystal shares some of its ions with other unit cells.

D. The length of the unit cell in NaCl is 552 pm

$(r_{Na^+} = 95 \text{ pm}, r_{Cl^-} = 181 \text{ pm})$.

Answer: A::C::D

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3. In which of the following structures, the coordination number of both the ions are same ?

A. Cesium chloride

B. Sodium chloride

C. Zinc sulphide

D. Sodium oxide

Answer: A::B::C

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4. Which of the following is not correct for Frenkel defect in crystals?

A. It is due to equal number of cations and anions missing from lattice sites.

B. It has no effect on density of the crystal.

C. It occurs in crystals where the difference in the size of cations and anions is small.

D. Silver halides show Frenkel defect.

Answer: A::C

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5. The coordination number of eight for cation is found in

A. $CsCl$

B. $NaCl$

C. CaF_2

D. Na_2O

Answer: A::C

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6. Which of the following systems do not give correct discription of axial lengths and axial angles ?

A. Hexagonal : $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$

B. Tetragonal : $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 90^\circ$

C. Monoclinic : $a \neq b \neq c, \alpha = \beta = \gamma \neq 90^\circ$

D. Cubic : $a = b = c, \alpha = \beta = \gamma = 90^\circ$

Answer: B::C

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7. The correct statement(s) regarding defects in solids is (are)

A. Frenkel defect is usually favoured by a very small difference in the sizes of cation and anion

B. Frenkel defect is a dislocation defect

C. Trapping of an electron in the lattice leads to the formation of F-centre

D. Schottky defects have no effect on the physical properties of solids

Answer: B::C

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8. With respect to graphite and diamond, which of the statements is (are) correct ?

A. Graphite is harder than diamond

B. Graphite has higher electrical conductivity than diamond

C. Graphite has higher thermal conductivity than diamond .

D. Graphite has higher C-C bond order than diamond.

Answer: B::D

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9. Which type of defects are present in AgBr and ZnS crystal systems ?

A. Frenkel and Schottky

B. Schottky and Frenkel

C. Frenkel and Frenkel

D. Schottky and Schottky

Answer: B::C

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10. The correct statement (s) for cubic close packed (ccp) three dimensional structure is (are)

A. The number of the nearest neighbours of an atom present in the top most layer is 12.

B. The efficiency of atom packing is 74%

C. The number of octahedral and tetrahedral voids per atom are 1 and 2, respectively.

D. The unit cell edge length is $2\sqrt{2}$ times the radius of the atom.

Answer: B::C::D

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Competition File Objective Type Questions D Multiple Choice Questions

1. In the crystalline solids the smallest repeating part in the lattice is known as unit cell. The unit cells are described as simple (points at all corners), body centred (points at all the corners and it the centre), face centred (points at all the corners and centre of all faces), and end centred (points at all hte corners and centres of two opposite and faces) unit cells. In two common tyupes of packing ccp and hcp, 26% of space is left unoccupied in the form of interstitial sites. For the stable ionic crystalline structures, there is difinite radius ratio limit for a cation to fit perfectly in the lattice of anions, called radius ratio rule. This also defines the coordination number of an ion, which is the number of nearest neighbours of opposite charges. This depeds upon the ratio of radii of two types of ions, r_{+}/r_{-}. This ratio for coordination numbers 3,4,6,and 8 is

respectively 0.155 - 0.225, 0.225 - 0.414, 0.414 - 0.732 and 0.732 - 1 respectively.

The number of atoms per unit cell in simple (s), body centred(b) , face centred (f) and end centred (e) unit cell decreases as

A. f > b > e > s

B. f > b = e > s

C. b > f > s = e

D. f > b > e = s

Answer: B

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2. In the crystalline solids the smallest repeating part in the lattice is known as unit cell. The unit cells are described as simple (points at all corners), body centred (points at all the corners and it the centre), face centred (points at all the corners and centre of all faces), and end centred (points at all hte corners and centres of two opposite and faces) unit cells. In two common tyupes of packing ccp and hcp, 26% of space is left unoccupied in the form of interstitial sites. For the stable ionic crystalline structures, there is difinite radius ratio limit for a cation to fit perfectly in the lattice of anions, called radius ratio rule. This also defines the coordination number of an ion, which is the number of nearest neighbours of opposite charges. This depeds upon the ratio of radii of two types of ions, r_+/r_-. This ratio for coordination numbers 3,4,6,and 8 is

respectively 0.155 - 0.225, 0.225 - 0.414, 0.414 - 0.732 and 0.732 - 1 respectively.

Gold crystallizes in a face centred unit cell. Its edge length is 0.410 nm. The radius of gold atom is

A. 0.205 nm

B. 0.290 nm

C. 0.145 nm

D. 0.578 nm

Answer: C

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3. In the crystalline solids the smallest repeating part in the lattice is known as unit cell. The unit cells are described as simple (points at all corners), body centred (points at all the corners and it the centre), face centred (points at all the corners and centre of all faces), and end centred (points at all hte corners and centres of two opposite and faces) unit cells. In two common tyupes of packing ccp and hcp, 26% of space is left unoccupied in the form of interstitial sites. For the stable ionic crystalline structures, there is difinite radius ratio limit for a cation to fit perfectly in the lattice of anions, called radius ratio rule. This also defines the coordination number of an ion, which is the number of nearest neighbours of opposite charges. This depeds upon the ratio of radii of two types of ions, r_+ / r_-. This ratio for coordination numbers 3,4,6,and 8 is

respectively 0.155 - 0.225, 0.225 - 0.414, 0.414 - 0.732 and 0.732 - 1 respectively.

In a cubic lattice of XYZ, X atoms are present at all corners except one corner which is occupied by Y atoms. Z atoms are present at face centres . The formula of the compound is

A. X_8YZ_{24}

B. XYZ_3

C. $X_7Y_{24}Z$

D. X_7YZ_{24}

Answer: D

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4. In the crystalline solids the smallest repeating part in the lattice is known as unit cell. The unit cells are described as simple (points at all corners), body centred (points at all the corners and it the centre), face centred (points at all the corners and centre of all faces), and end centred (points at all hte corners and centres of two opposite and faces) unit cells. In two common tyupes of packing ccp and hcp, 26% of space is left unoccupied in the form of interstitial sites. For the stable ionic crystalline structures, there is difinite radius ratio limit for a cation to fit perfectly in the lattice of anions, called radius ratio rule. This also defines the coordination number of an ion, which is the number of nearest neighbours of opposite charges. This depeds upon the ratio of radii of two types of ions, r_+ / r_-. This ratio for coordination numbers 3,4,6,and 8 is

respectively 0.155 - 0.225, 0.225 - 0.414, 0.414 - 0.732 and 0.732 - 1 respectively.

The ionic radii of K^+, Rb^+ and Br^- are 137, 148 and 195 pm. The coordination number of cation in RbBr and KBr structures are respectively

A. 8,6

B. 6,4

C. 6,8

D. 4,6

Answer: A

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5. In the crystalline solids the smallest repeating part in the lattice is known as unit cell. The unit cells are described as simple (points at all corners), body centred (points at all the corners and it the centre), face centred (points at all the corners and centre of all faces), and end centred (points at all hte corners and centres of two opposite and faces) unit cells. In two common tyupes of packing ccp and hcp, 26% of space is left unoccupied in the form of interstitial sites. For the stable ionic crystalline structures, there is difinite radius ratio limit for a cation to fit perfectly in the lattice of anions, called radius ratio rule. This also defines the coordination number of an ion, which is the number of nearest neighbours of opposite charges. This depeds upon the ratio of radii of two types of ions, r_+ / r_-. This ratio for coordination numbers 3,4,6,and 8 is

respectively 0.155 - 0.225, 0.225 - 0.414, 0.414 - 0.732 and 0.732 - 1 respectively.

A face centred lattice a metal M and a body centred cubic lattice of metal N contain same number of 2.25×10^{22} unit cells. If density of M is twice than that of N, the ratio between the number of atoms per unit cell is

A. $4:1$

B. $1:1$

C. $2:1$

D. $1:4$

Answer: C

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6. Density of a unit cell is same as the density of the substance. If the density of the substance is known, number of atoms or dimensions of the unit cell can be calculated . The density of the unit cell is related to its mass(M), no. of atoms per unit cell (Z), edge length (a in cm) and Avogadro number N_A as :

$$\rho = \frac{Z \times M}{a^3 \times N_A}$$

An element crystallizes in a structure having a fcc unit-cell an edge 100 pm. If 24 g of the element contains 24×10^{23} atoms, the density is

A. $2.40 gcm^{-3}$

B. $40 gcm^{-3}$

C. $4 gcm^{-3}$

D. $24 gcm^{-3}$

Answer: B

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7. Density of a unit cell is same as the density of the substance. If the density of the substance is known, number of atoms or dimensions of the unit cell can be calculated . The density of the unit cell is related to its mass(M), no. of atoms per unit cell (Z), edge length (a in cm) and Avogadro number N_A as :

$$\rho = \frac{Z \times M}{a^3 \times N_A}$$

The number of atoms present in 100 g of a bcc crystal (density = $12.5 gcm^{-3}$) having cell edge 200 pm is

A. 1×10^{25}

B. 1×10^{24}

C. 2×10^{24}

D. 2×10^{26}

Answer: C

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8. Density of a unit cell is same as the density of the substance. If the density of the substance is known, number of atoms or dimensions of the unit cell can be calculated . The density of the unit cell is related to its mass(M), no. of atoms per unit cell (Z), edge length (a in cm) and Avogadro number N_A as :

$$\rho = \frac{Z \times M}{a^3 \times N_A}$$

A metal X (at. mass = 60) has a body centred cubic crystal structure. The density of the metal is $4.2gcm^{-3}$. The volume of unit cell is

A. $8.2 \times 10^{-23}cm^3$

B. $4.75 \times 10^{-23}cm^3$

C. $3.86 \times 10^{23}cm^3$

D. $3.86 \times 10^{-23}cm^3$

Answer: B

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9. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The number of atom in this hcp unit cell is

A. 4

B. 6

C. 12

D. 17

Answer: B

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10. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The voume of this hcp unit cell is

A. $24\sqrt{2}r^3$

B. $16\sqrt{2}r^3$

C. $12\sqrt{2}r^3$

D. $\frac{64}{3\sqrt{3}}r^3$.

Answer: A

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11. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The empty space in this hcp unit cell is

A. 74%

B. 47.6%

C. 32%

D. 26%

Answer: D

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Competition File Objective Type Questions Matching Type Questions

1. Match the type of crystal system given in List I with its description given in List II.

List I	List II
P. Monoclinic	1. $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90^\circ$
Q. Tetragonal	2. $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
R. Triclinic	3. $a \neq b \neq c$, $\alpha = \gamma = 90^\circ$, $\beta \neq 90^\circ$
S. Rhombic	4. $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$

A. $\begin{matrix} P & Q & R & S \\ 3 & 4 & 2 & 1 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 4 & 3 & 1 & 2 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 3 & 4 & 1 & 2 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 2 & 3 & 4 & 1 \end{matrix}$

Answer: C

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2. Match the type of crystal given in List I with example in List II.

List I	List II
P. Ionic	1. AIN
Q. Network	2. Mg
R. Metallic	3. MgO
S. Molecular	4. Solid CO_2

A. $\begin{matrix} P & Q & R & S \\ 3 & 1 & 4 & 2 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 3 & 1 & 2 & 4 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 1 & 3 & 2 & 4 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 4 & 2 & 3 & 1 \end{matrix}$

Answer: B

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3. Match the distribution of particles A and B in List I with formula given in List II.

List I	List II
P. A in ccp and B equally distributed in octahedral and tetrahedral	1. A_2B_3
Q. B in hcp and A occupy 2/3 rd of octahedral voids	2. A_3B
R. A at the corners and face centres and B at edge centres and body centres	3. AB
S. B in ccp and A occupy all the octahedral and tetrahedral sites	4. AB_2

A. $\begin{matrix} P & Q & R & S \\ 4 & 1 & 3 & 2 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 4 & 1 & 2 & 3 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 3 & 2 & 1 & 4 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 4 & 2 & 3 & 1 \end{matrix}$

Answer: A

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4. Match the entries of column I with appropriate entries of column II.

Compound	Magnetic property
$(A) NaCl$	(p) Ferrimagnetic
$(B) MnO$	(q) Paramagnetic
$(C) CrCl_3$	(r) Ferromagnetic
$(D) CrO_2$	(s) Diamagnetic
$(E) MgFe_2O_4$	(t) Antiferromagnetic

A. $\begin{matrix} P & Q & R & S \\ 4 & 1 & 3 & 2 \end{matrix}$

B. $\begin{matrix} A & B & C & D & E \\ t & q & r & p & s \end{matrix}$

C. $\begin{matrix} A & B & C & D & E \\ r & t & q & p & s \end{matrix}$

D. $\begin{matrix} A & B & C & D & E \\ s & t & q & r & p \end{matrix}$

Answer: D

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Competition File Objective Type Questions Matrix Match Type Questions

1. Match the crystal system/unit, cells mentioned in Column-I with their characteristic features mentioned in Column-II.

Column-I		Column-II	
(a)	simple cubic and face-centered cubic	(p)	have these cell parameters $a = b = c$ and $\alpha = \beta = \gamma$
(b)	cubic and rhombohedral	(q)	are two crystal systems
(c)	cubic and tetragonal	(r)	have only two crystallographic angles of 90°
(d)	hexagonal and monoclinic	(s)	belong to same crystal system

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2. Match the imperfections in solids mentioned in column I with the characteristic features mentioned in column II .

Column I	Column II
(A) Schottky defects	(p) excess cations occupy interstitial sites
(B) Frenkel defects	(q) conduct electricity due to free electrons
(C) Metal excess defects	(r) act as p-type semi-conductors
(D) Metal deficient defects	(s) are non-stoichiometric defects

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3. Match the type of arrangment in column I with the characteristic feature mentioned in column II.

Column I	Column II
(A) Cubic close packing	(p) occupy 74% of the space
(B) Hexagonal close packing	(q) occupy 68% of the space
(C) Body centred cubic	(r) have 1 atom per unit cell
(D) Simple cubic	(s) have more number of atoms per unit cell than simple cubic arrangement

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Competition File Objective Type Questions Integer Type Or Numerical Value Type Questions

1. Silver (atomic weight $108 g mol^{-1}$) has a density of $10.5 g cm^{-3}$. The number of silver atoms on a surfaces of area $10^{-12} m^2$ can be expressed in scientific notation as $Y \times 10^{-x}$, The value of x is ....

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2. Number of Na^{+} and Cl^{-} ions associated with each a unit cell of $NaCl$ is:

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3. A metal 'X' crytallizes in a unit cell in which the radius of atom (r) is related to edge of unit cell (a) as r = 0.3535 a. The total number of atoms present per unit cell is

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4. The radius ratio of an ionic solid r_{+} / r_{-} is 0.524. The coordination number of this type of structure is

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5. Atoms of elements B from hep lattice and those of element A occupy two-thirds of tetrahedral voids. What is the formula of the compound formed by elements A and B?

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6. In hexagonal close packing, the difference, in the number of respecitvely, and octahedral voids per unit cell is

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7. The coordination number in hcp is

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8. A compound is formed by two elements X and Y. The element Y form ccp and atoms of X occupy 1/3 of tetrahedral voids. If the formula of the compund is X_aY_b, then value of $a + b$ is

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9. A cubic unit cell has one atom on each corner and one atom on each body diagonal. The number of atoms in the unit cell is

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10. The number of hexagonal faces that are present in a truncated octahedron is

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11. A crystalline solid of a pure substance has a face-centred cubic structure with a cell edge of 400 pm. If the density of the substance in the crystal is $8gcm^{-3}$, then the number of atoms present in 256g of the crystal is $N \times 10^{24}$. The value of N is

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12. Consider an ionic solid MX with NaCl structure. Construct a new structure (Z) whose unit cell is constructed from the unit cell of MX following the sequential instructions given below. Neglect the charge balance. 1.Remove all the anions (X) except the central one 2.Replace all the face centered cations (M) by anions (X) 3.Remove all the corner cations (M) 4.Replace the central anion (X) with cation (M)

The value of $\left(\frac{\text{number of anion s}}{\text{number of cation s}}\right)$ in z is _______.

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Unit Practice Test

1. The ratio of closed packed atoms to tetrahedral holes in cubic close packing is :

A. $1:1$

B. $1:3$

C. $1:2$

D. $2:1$

Answer: C

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2. In which pair most efficient packing is present?

A. hcp and bcc

B. hcp and simple cubic

C. hcp and fcc

D. fcc and bcc

Answer: C

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3. In a compound atoms of element Y form ccp lattice and those of element X occupy $2/3^{rd}$ of tetrahedral voids .The formula of the compound will be

A. 5

B. 2

C. 7

D. 4

Answer: C

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4. Assertion : In $AgCI$ crystal, frenkel defect can be observed

Reason:Ag^+ is a small sized cation

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5. Assertion : The packing efficiency is maximum for the fcc structure.

Reason : The cordination number is 12 in fcc structure.

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6. Name an element with which silicon should be doped to given n-type of semiconductor.

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7. why is Frenkel defects not found in pure alkali metal halides ?

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8. Analysis shows that a metal oxide has the empirical formula $M_{0.96}O_{1.00}$. Calculate the percentage of M^{2+} and

M^{3+} ions in the sample.

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9. What is the difference between anti-ferromgnetic and ferrimagnetic substances ? What is the cause of the difference ?

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10. An element has a bcc structure with a celledge of 288 pm. The density of the element is $7.2gcm^{-3}$. How many atins are present in $208g$ of the element?

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11. When an atom or an ion is missing from its nomal lattice site a lattice vacanecy (Schottky defect) is created. In stoichmeteric ionic crystals, a vacancy of one ion has to be accompanied by the vacancy of the oppositely charge ion in order to maintain electrical neutrality.

In a Frenken defect an ion leaves its position in the lattice and occupies an interstitial void. This id the Frenkel defect commonly found along with the Schottky defects and interstitial. In pure alkali halides. Frenked defects are not found since the ions cannot get into the interstitial sites. Frenkel defects are found in silver halides because of the small size of the Ag^+ ion. Unike Schottky defects, Frenkel defect do not change the density of the solids. in certain ionic solids (e.g., AgBr) both schottky and Frenkel defect occur.

The Defects idiscussed above do not disturb the stoichiometery of the crystalline material. there is large variety of non-stoichiometric inorganic solids which contains an excess or deficienty of one of the elements. Such solids showing deviations from the ideal stoichiometric composition from an important group of solids. For example in the vanadium oxide, VO_x, x can be anywehere between 0.6 and 1.3 there are solids such as difficult to prepare in the soichiometric omposition thus, the ideal composition in compounds such as FeO is difficult to obtain (normally we get a compositiion of $Fe(0.95)$O but it may range from $Fe_{0.93}$O to $Fe_{0.96}O$). Non-stoichiometric behavious is most commonly found for transition metal compounds through is also known for some lathanoids and actinoids.

Zinc oxide loses oxygen reversible at high temperature and turns yellow in colour. the excess metal is accomodated interstitial, giving rise to electrons trapped in the neighbourhood, the enchanced electrical conductivity of the non-stoichiometric ZnO arises from these electrons.

Anion vacancies in alkali halides are produced by heating the alkali halid crystals in an atmosphere of the alkali metal vapour. when the metal atoms deposit on the surface they diffuse into the cystal and after ionisation the alkali metal ion occupies cationic vacancy whereas electron occupies anionic vacancy. Electrons trapped i anion vacancies are referred to as F-centers (From Farbe the German word for colouf) that gives rise to interesting colour in alkali halides. Thus, the excess of potassium i KCl makes the crystal appear violet and the excess of lithium in LiCl makes it pink.

Strongly heated ZnO crystal can conduct electricity. This is due to :

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12. Explain the following terms with suitable examples:

(i) Ferrimagnetism

(ii) Intrinsic conduction of solids

(iii) Ferromagnetism.

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13. (a) If the radius of octahedral void is r and the radius of the atoms in the close packing is R, derive a relationship between r and R.

(b) What is a semiconductor? Describe the two main types of semiconductors and conductor and contrast conduction mechanism in them.

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