CHEMISTRY

BOOKS - PRADEEP CHEMISTRY (HINGLISH)

Solid State

Problem

1. Calculate the number of atoms per unit cell present in simple, fcc and bcc unit cells.

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2. A compound formed by elements A and B has a cubic structure in which A atoms are at the corner of the cube and B atoms are at the face centres. Derive the fomula of the compound.

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3. A cubic solid is made up iof 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 ? What are the coordination number of X and Y ?

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4. An ionic compand made up of atoms A and B has a face- centred cubic arrangement in which atoms A are at the cornere and atoms B are at the face- centres. If one of the atoms is missing from the corrner, what is the simplest formula of the compound ?

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5. Calculate the number of unit cells in 8.1 g of aluminium if it crystalliz3es in aface cented cubic (f.c.c) structure. (Atomic mass of Al= 27 $gmol^{-1}$)

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Sample Problem

1. 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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2. Atoms of elements B from hcp 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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3. In a crystalline solid anions B are arranged in cubic close packing. Cation A are equally distributed between octahedral and tetrahedral voids. If all the octahedral voids are occupied, the formula for the solid is

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4. 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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5. What is the percent by mass of titanium in rutile, a mineral that contain Titanium and oxygen, if structure can be described as a closet packed array of oxide ions, with titanium in one half of the octahedral holes. What is the oxidation number of titanium ?

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6. Calculate the approximate number of unit cells present in 1 g of ideal NaCl crystals.

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7. Two ions $A^{\oplus}$ and B^{Θ} have radii 88 and 200 pm, respectively. In the close-packed crystal of compound AB, predict coodination number of $A^{\oplus}$.

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8. 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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9. 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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10. $CsCl$ has bcc arrangement and its unit cell edge length is 400 pm. Calculate the interionic distance in $CsCl$.

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11. Sodium metal crystallises in body centred cubic lattic with the cell edge, 4.29 Å . What is the radius of radius of sodium atom ? What is the length of the body dioganl of the unit cell ?

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12. In face - centred cubic (fcc) crystal lattice, edge length is 400 pm. Find the diameter of the greatest sphere which can be fitted into the interstital void without distortion of the lattice.

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13. Silver froms ccp lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver (atomic mass $= 107.9u$).

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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. 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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16. Gold has a close-packed structure which can be viewed as-spheres occupying 0.74 of the total volume. If the density of gold is 19.3 g/cc, calculate the apparent radius of a gold ion in the solid

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17. $CsCl$ has cubic structure. Its density is $3.99 gcm^{-3}$. What is the distance between $Cs^{\oplus}$ and Cl^{Θ} ions?

(Atomic mass of $Cs = 133$)

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18. The density of aluminium is $2700 kgm^{-3}$, Aluminium crytallises in face - centred cubic lattic. Calculate the radius of aluminium atom in meters (Atomic mass of Al = 27)

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19. The edge length of unit cell of a metal having molecular weight 75 g/mol is 5Å which crystallises in cubic lattice. If the density is 2 g/c.c., then the radius of the metal atom in pm is

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20. 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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21. The density of KCl is $1.9893 gcm^{-3}$ and the length of a side unit cell is $6.29082 Å$ as determined by $X-$ ray diffraction. Calculation the value of Avogadro's number.

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22. 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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23. An element crystallizes into a structure which may be describes by a cubic type of unit cell having one atom on each corner of the cube and two atoms on one of its diagonals. If the volume of this unit cell is $24 \times 10^{-24} cm^3$ and density of element is $7.2 gcm^{-3}$. Calculate the number of atoms present in $200 g$ of element.

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24. Density of Li is $0.53 \mathrm{g\ cm}^{-3}$. The edge length of Li is 3.5Å. Find the number of Li atoms in a unit cell $\left(N_0 = 06.023 \times 10^{23}, M = 6.94\right)$.

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25. The density of KBr is $2.75 g cm^{-3}$, The length of edge of the unit cell is 654 pm. Predict, the type of cubic lattice to which unit cell of KBr belongs $\left(N_0 = 6.023 \times 10^{23} \ \ \mathrm{mol}^{-1}\right.$, At mass : K = 29 , Br = 80)

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26. The density of copper metal is $8.95 \ \ \mathrm{g} \ \ cm^{-3}$. 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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27. If NaCl is doped with 10^{-3} mol percent of $SrCI_2$, what is the concentration of cation vacancy?

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

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Curiosity Question

1. Why is glass of window panes of very old buiildings found to be thicker at the bottom than as the top and why is it milky ?

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2. What ar optical fibers ? What are their advatages over ordinary glass like that of window panes ?

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Problem For Pactice

1. A compound formed by elements X and Y crysstallixzes in the cubic struture where Y atoms are at the corners of the cube and X atoms are at the alterante faces. What is the formula of the compound. ?

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2. Calculate the number of atoms in a cubic based unit cell having one atome on each corner and two atoms on each body diagonal.

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3. A compound made up of elements A and B crystallizes in the cubic structures. Atoms A are present on the corners as well as face centres whereas atoms B are present on the edge centres centres as well as body centre. What is the formula of the compound? Draw the structure of its unit cell.

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4. 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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5. 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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6. Calculate the approximate number of unit cells present in 1 g of gold. Given that gold cyrstallises in a face centred cubic lathce (Given atomic mass of gold = 197 u).

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7. 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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8. A solid AB has NaCl structure. If the radius of cation A^+ is 170 pm, calculate the maximum possible radius of the anion.

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

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10. In corundum, oxide ions are arranged in hexagonal close packing and aluminium ionsa occpy tow-third of the octaheral voids. What is the formula of corrundum ? .

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11. 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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12. A solid is made up of two elements P and Q , Atoms Q are in ccp arrangement while atoms P occupy all the tetrahdral sites. What is the formual of the compound ?

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13. In chromium (III) chloride $CeCl_3$ chloride ions have cubic close packed arrangement and Cr (III) ions present in the octahedral voids. What fraction of the octahedral void is occupied ? What fraction of the total number of voids is occupied?

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14. what is the formula of a compound in which element P forms ccp lattice and atoms of Q occupy 2/3rd of tetrahedral voids ?

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15. If the radius of Mg^{2+} ions, Cs^{+} ions, S^{2-} ions and Cl^{-} are 0.65 Å , 1. 69 Å , 1.84 Å and 1.81 Å respectively , calculate the coordination number of the cation in the crystals of MgS, MgO and CsCl.

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16. Predict the structure of MgO crystal and the co-ordination number of the cation in which the radii of the cation and anion are 65 pm and 140 pm respectively.

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17. Predict the close packed struture of an ionic compound A^+B^- in which the radius of the cation = 148 pm and radius of anion = 195 pm. What is the corrdination number of the cation ?

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18. If the close packed cations in an AB type solid with NaCl structure have a radius of 75 pm, what would be the maximum and mimimum sizes of the anions filling the voids ?

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19. A solid $A^{\oplus}B^{\ominus}$ has $NaCl$-type close-packed structure. If the anion has a radius of 250 pm, what should be the ideal radius for the cation? Can a cation $C^{\oplus}$ having radius of 180 pm be slipped into the tetrahedral site of the crystal $A^{\oplus}B^{\ominus}$? Give reason for your answer.

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20. If the radius of an atom of an elements is 75 pm and the lattice type is body-centred cubic, what is the edge length of the unit cell?

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21. The radius of an atom of an element is 500 pm. If it crystallizes as a face-centred cubic lattice, what is the length of the side of the unit cell?

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22. A solid AB has $CsCl$-type structure. The edge length of the unit cell is 404 pm. Calculate the distance of closest approach between $A^{\oplus}$ and B^{Θ} ions.

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23. what is the radius of sodium atom if it crystaliizes in bcc structure with the cell edge of 400 pm?

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24. Gold crystallizes in a face centered cubic lattice. If the length of the edge of the unit cell is 407 pm, calculate the density of gold as well as its atomic radius assuming it to be spherical. Atomic mass of gold = 197 amu.

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25. The effective radius of an iron atom is 1.42Å. It has a rock-salt structure. Calculate its density (Fe = 56)

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26. The edge length of NaCl unit cell is 564 pm. What is the density of NaCl in g/cm^3?

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27. The compound CuCl has ZnS structure and the edge length of the unit cell is 500 pm. Calculate its density (Atomic mass of Cu = 63, Cl = 35.5)

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28. KF and NaCl struture. If the distance between K^+ and F^- is 269 pm, find the denisty of KF ($N_A = 6.02 \times 10^{23} \text{mol}^{-1}$ a atomic mass of copper = 63.5

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29. 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

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30. Calculate the density of silver which crystallises in face-centred cubic from. The distance between nearest metal atoms is 287 pm (Molar mass of Ag = $107.87 gmol^{-1}$, $\left(N_0 = 6.022 \times 10^{23} mol^{-1}\right)$.

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31. 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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32. The density of a face centred cubic element (atomic mass = 60.2 amu) is 6.25 gm cm^{-3}, calculate the edge length of the unit cell.

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33. 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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34. 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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35. Lead (II) sulphide crystal has NaCl structure. What is the distance betweeen Pd^{2+} and S^{2-} in PhS if its density is $12.7 gcm^{-3}$? (At .mass of Pb = 207)

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36. KBr has fcc struture. The density of KBr is 2.75 g cm^{-3} . Find the distance between K^{+} and Br^{-} , (At mass of Br = 80.0)

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37. Calculate the value of Avogadro's number from the following data : Density of KF = $2.48 \ \mathrm{g\,cm^{-3}}$. Distance between K^{+} and F^{-} KF = 269 pm. (Atomic masses : K = 39 and F = 19 amu)

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38. Calculate the Avogadro's number from the following data of AB when AB has NaCl type stucture.

Density of AB = 2.48 $\mathrm{g\,cm^{-3}}$, $M = 58$

Distnace between $A^+a \neq dB^-$ AB = 269 pm.

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39. 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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40. 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 $3.18 \mathrm{g\,cm^{-3}}$. Use this information to calculate Avogadro's number (Molar mass of $CaF_2 = 78.0 \mathrm{g\,mol^{-1}}$)

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41. As element cystallises in BCC structure. The edge length of its unit cell is 288 pm. It the density of the crystals is $7.2 gcm^{-3}$, what is the atomic mass of the element ?

(b) How many atoms of the element are presnet in 100g ?

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42. 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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43. An element (density 6.8 g cm^{-3} and the length of the side of the unit cell is 316 pm. The unit cell in the most important crystalline form of tungsten is the body centred unit cell. How many atoms of the element does 50 g of the element contain ?

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44. Tungsten has a density of 19.35 g cm^{-3} and the length of the side of the unit cell is 316 pm. The unit cell is a body centred unit cell. How many atoms does 50 grams of the element contain?

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45. An element crytallizes in the cubic lattice and the edge of the unit cell is 430 pm. Calculation the number of atoms in a unit cell. [Atomic mass of Na = 23.0 amu. Density of sodium = 0.9623 g cm^{-3}, $N_A = 6.023 \times 10^{23} mol^{-1}$

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

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47. Using the data given below, find the type of cubic lattice to which the crystal belongs.

	Fe	V	Pd
a in pm	286	301	388
ρ in gm cm^{-3}	7.86	5.96	12.16

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48. Thallium chloride (TICI) crystallizes in a cubic lattice whose edge length is found to be 385 pm. If the density of the solid is found to be 7.0 g cm^{-3}, predict the type of lattice to which the crystals of TICI

belong .

(Atomic mass of TI = 204, Cl = 35.5)

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49. Iron (II) oxide has a cubic structure and each unit cell has side 5 Å . If the density of the oxide is 4 g cm^{-3} Calculate the number of Fe^{2+} and O^{2+} ions presnent in each unit cell (Molar mass of FeO = 72 $\mathrm{g\,mol^{-1}}$

$N_A = 6.02 \times 10^{23} \mathrm{mol^{-1}}$)

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50. 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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51. 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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52. A crystal of lead (II) sulphide has NaCl strcuture . In this crystal the shorest distance between a Pb^{2+} ion and S^{2-} ion is 297 pm . What is the volume the of unit cell in lead sulphide ?

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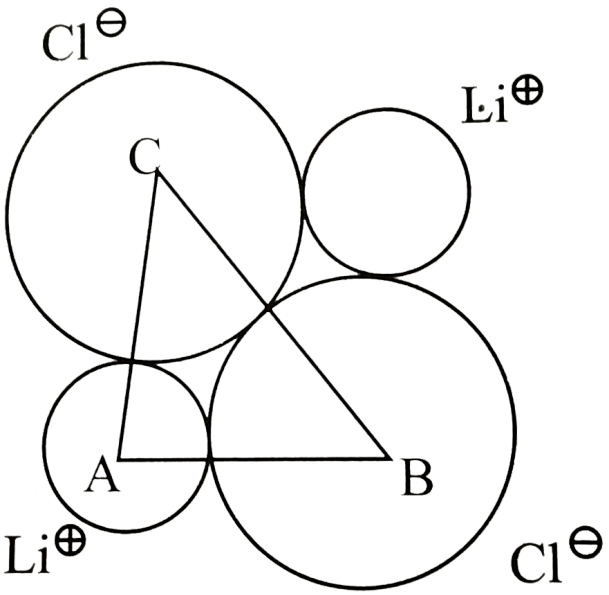
53. The unit cube length for $LiCl$ ($NaCl$ structure) is 5.14Å. Assuming anion-anion contact, calculate the ionic radius for chloride ion.



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54. A compound AB crystallises in bcc lattice with the unit cell edge length of 380 pm. Calculate (i) the distance between oppositely charged ions in the lattice ,(ii) radius of B^- if the radius of A^+ is 190 pm

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55. 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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56. 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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57. Aluminium metal forms a cubic face centred closed packed crystal structure. Its atomic radius is 125×10^{-12}m.

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

(b) How many unit cells are there in $1.0m^3$ of aluminium?

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58. A uni-univalment ionic crystal AX is composed of the following radii (ar bitrary units) .

A^+	X^-
1.0	2.0

Assuming that ions are hard spheres, predict giving reasons whether the crystal will have sodium chloride or cesium chloride structure. Calculate the volume of the unit cell.

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Test Your Grip Mcq

1. The property of crystalline solid is not

A. anisotropic

B. isotropic

C. hard

D. dense

Answer: C

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2. Wax is an example of -

A. ionic crystal

B. covalent

C. molecular crystal

D. amorphous solid

Answer: C

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3. Which of the following is a molecular crystal?

A. Rock salt

B. Quartz

C. Dry ice

D. Diamond

Answer: B

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4. In a tetragonal crystal

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

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

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

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

Answer: B

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5. An example of a face centred cubic lattice is

A. Zine

B. Sodium

C. copper

D. Caesium choride

Answer: D

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6. Percentage of free space in cubic close packed structure and in body centered packed structure are responsive:

A. 32% and 48%

B. 48% and 26%

C. 30% and 26%

D. 26% and 32%

Answer: C

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7. In a compound ,atoms of element Y from ccp lattice and those of element X occupy 2/3rd tetrahedral voids.The formula of the compound will be:

A. X_2Y

B. X_3Y_4

C. X_4Y_3

D. X_2Y_3

Answer: D

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8. The number of octahedral sites per sphere in fcc structure is

A. 8

B. 4

C. 2

D. 1

Answer: B

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9. which is not the correct statement for ionic solids in which positive and negtive lons are held by strong electrostatic attractive forces ?

A. the radius ratio r_+ / r_- increases as coordination number increases

B. As the differnce in size of ions increases, coordination number increases.

C. when coordiantion number is eight r_+/r_- ratio lies between 0.225 to 0.414.

D. In ionic solid of the type AX (ZnS, Wurtzite), The coordination number of Zn^+ and S^{2-} respectively are 4 and 4.

Answer: A

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10. The crystal lattice of NaCl is

A. face-centred cubic lattice

B. Body-centred cubic lattice

C. Simple cubic lattice

D. Hexagonal close packing

Answer: C

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11. What is the co-ordination number of sodium in Na_2O ?

A. 6

B. 4

C. 8

D. 2

Answer: B

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12. In NaCl crystal the Cl^- ions are in f.c.c. arrangement. Calculate the number of Cl^- ions in unit cell.

A. 6

B. 4

C. 8

D. 2

Answer: B

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13. Which of the following fcc structure contain cations in alternate tetrahedral voids?

A. NaCl

B. ZnS

C. Na_2O

D. CaF_2

Answer: B

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14. Which of the following defects is present in KCl crystals ?

A. Frenkel

B. Schottky

C. Linear

D. Impurity

Answer: B

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

A. F centres

B. p-type

C. Frenkel defect

D. schottky defect

Answer: C

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16. Which of the following is ferromagnetic ?

A. Calcium metal

B. Iron metal

C. sodium metal

D. Zinc metal

Answer: B

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17. The edge length of a face centred cubic cell of an ionic substance is 508 pm .If the radius of the cation is 110 pm the radius of the anion is

A. 618 pm

B. 144 pm

C. 288 pm

D. 398 pm

Answer: A::B

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Test Your Grip Fill In The Blanks

1. The constituent particles of a solid posses ..... Motion .

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2. If electrical conductivity is found to be same in all directions through a solid, the substance is ____ solid and this property is called _____\

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3. In a photovoltaic cell, the material the converts sunlight into electricity is _____

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4. The forces operating between non-polar molecules like He, H_2, CH_2 etc.When present as crystalline solids are called _____ (a type of van der waals forces

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5. For two- dimensional hexagonal lattice, the unit cell is _____

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6. The most unsymmetrical crystal system is _____

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7. The fourteen types of space lattices are collectively called .....

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8. The coordination number of a tetrahedral void is .....,while that of an octahedral void is .....

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9. AB AB ..... Type of packing is called ..... whereas ABCABC.....typeof packing is called .....

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10. The coordination number of each sphere in hexagonal close packing is ..... While that of body -centred cubic packing is.....

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11. The empty space in the hexogonal close packing is.....% while that in the body-centred cubic packing is .....%

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

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13. An octahedral void is _____times larger than a tetrahedral void.

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14. In the uint cell of a cubic close-packed struture, total number of voids is ..... Whereas in the unit cell of a hexagonal close-packed stucture, total number is voids is .....

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15. Ferrites are the compunds with the general formula.....

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16. Most of the ferrites have ..... structure.

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17. Spinel is the mineral with the formula.....

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18. In an ionic compound A^+B^- radius of A^+ is 88 pm while that of $B(-)$ is 200 pm. The coordination number of A^+ will be .....

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19. In a face-centred cubic crystal, the neighbour distance is ..... times the edge of the crystal.

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20. In a body-centred cubic crystal of an element , the ratio of the readius of the radius of the atom toi the edge of the unit cell is .....

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21. The mass of a unit cell of an element is the product of the atomic mass of the element and ..... divided further by.....

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22. The coordination number of Cl^+ ion in NaCl struture is..... whereas that in CsCl structure is .....

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23. In fluorite (CaF_2), Ca^{2+} ions form the ..... Struture whereas F^- ions are present in the ..... voids.

Watch Video Solution

24. In NaCl, Cl^- ions are present in the ..... Structure whereae Cl^- ions ar present in the ..... Voids.

Watch Video Solution

25. In ZnS , S^{2-} ions form ..... Structure while Zn^{2+} ions are present in ..... Voids.

Watch Video Solution

26. ZnS exists in two forms called ..... And .....

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27. Zinc blede has ..... Arrangement ofS^{2-} ions whereas wurtzite has ..... Arrangement of S^{2-} ions.

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28. Wurtzite has ..... formula units per unit celll wherease zinc blende has ..... Formula units per unit celll.

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29. Due to Frenkel defect, the density of the crystal, ... Wherease due to schottky defect, it .....

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

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31. The process of adding impurities to a crystalline substance so as to change its properties like conductivity etc. is called.....

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

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33. If aluminium is added as impurity to silicon, the type of semiconductor formed is called.....

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34. Frenkel defect is shown by crystals having..... coordination number and ..... Difference in the size of the cations and the anions.

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35. Semiconductors posses conducitivity in the range ..... To.....

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36. The band formed atomic orbitals of lower energy is called..... While that formed from atomic orbitals of higher energy is called.....

Watch Video Solution

37. If there is a large energy gap between the filled valance band and empty conduction band, the subtance acts as.....

Watch Video Solution

38. The electrical conductivity of semiconductors ..... With increase of temperature.

Watch Video Solution

39. Pure substances which show conducitivity similar to that of silicon and germanium are called ..... conductors.

Watch Video Solution

40. As regards magnetic behaviour , TiO_2 is .....

Watch Video Solution

41. Substances which show permanent magnetism even in the absence of magnetic field are called....

Watch Video Solution

42. Antiferromagnetic subtance have..... Magnetic moment.

Watch Video Solution

43. Magnetite is .....as regards magnetic behaviour .

Watch Video Solution

44. the electricity produced in a polar crystals when mechanical stress is applied on then is called....

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45. In terms of dielectric properties, barium titanate is.....

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46. The characteristic temperature of a ferromagnetic substance above which is shows no ferromagnetism is known as.....

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Conceptual Question

1. In terms of intermolecular forces, explain why do some substances exist as solids ?

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2. Why is glass considered a supercooled liquid?

Watch Video Solution

3. Why ureas has a sharp melting point but glass does not ?

Watch Video Solution

4. How do the structures of quartz and quartz glass differ from each other ?

Watch Video Solution

Watch Video Solution

5. In CaF_2 " Crystal , Ca^{2+} ions are present in FCC arrangement. Calculate the number of F^- ions in the unit cell.

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6. Do all the metals possess a close-packed struture ? Name the different structures exhibited and give their packing fractions.

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7. AgI crystallises in cubic close packed ZnS structure. Guess how it might have happened ?

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

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9. Write the coordination numbers of cations and anions in the following ionic compounds :

(a) Zinc blende (b) Fluortie

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10. In each of the compounds : NaCl, ZnS and CaF_2 ,

Write (i) ions occupying the voids (ii) types of voids occupied (iii) fraction of voids occupied.

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11. The mineral haematite, Fe_2O_3 consists of a cubic close packed array of oxide ions with Fe^{3+} ions occupying intersitial positions. Predict whether the iron ions are in the octahdral or tetrahedral holes. Radius of Fe^{3+} = 0.65Å .

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12. 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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13. 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 ration of densities of fcc and bcc.

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14. Why FeO in non-stochiometric with the formula $Fe_{0.95}O$?

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15. Why the defects of the crystalline solids are called thermodynamic defects?

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16. Why stoichiometric defects are also called intrinsic defects?

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

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18. Zinc oxide is white but it turns yellow on heating . Explain.

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

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

Watch Video Solution

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

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22. 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 ?

Watch Video Solution

23. 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 stoichiometric 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

24. Examine the given defective crystal

$$\begin{array}{ccccc} X^+ & Y^- & X^+ & Y^- & X^+ \\ Y^- & Z^{2+} & Y^- & X^+ & Y^- \\ X^+ & Y^- & O & Y^- & X^+ \\ Y^- & X^+ & Y^- & X^+ & Y^- \end{array}$$

(i) Write the term used for this of defect .

(ii) What is the result when XY crystal is doped with divalent $\left(Z^{2+}\right)$ impurtiy ?

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

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26. What is the difference between anti-ferromagnetic and ferrimagnetic substances ? What is the cause of the difference ?

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27. 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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28. What type of magnetism is shown by a substance if magnetic moments of domains are arranged in same direction?

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29. 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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30. NaCl and CsCl have similar formular . Then why they have differnet strutures ?

Watch Video Solution

31. Out of SiO_2 (s) , NaCl (s) and Br_2 (l) which is the best electrical conductor ?

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32. Calculate the co $-$ ordination number of an atom in :

(i) A primitive cubic unit cell,

(ii) A body $-$ centred cubic unit cell.

(iii) A face $-$ centred cubic unit cell.

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33. Why is coordination number of 12 not found in lonic crystals ?

Watch Video Solution

34. Give reason:

(i) In stochiometric defects, NaCl exhibits schottky defect and not Frenkel defect.

(ii) Silicon on doping with phosphorus forms n-type semiconductor .

(iii) Ferrimagnetic substances show better magnetisation than antiferromagnetic substences.

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Ncert Questions And Exercises With Answers

1. Why are solids 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 very hard electrical insulator in solid as well as in molten state and melts at an extremely 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."

Watch Video Solution

11. Name the parameters that characterized a unit cell.

Watch Video Solution

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) $AgBr$

Watch Video Solution

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

Watch Video Solution

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?

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

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Ncert Exercise

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

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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?

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5. 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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6. (a) 'Stability of a crystal is reflected in the magnitude of its melting point'. Comment.

(b) The melting points of some compounds are given below : Water = 273 K, Ethyl alcohol = 155.7 K, Diethyl ether = 156.8 K, Methane = 90.5 K. What can you say about the intermolecular forces between these molecules ?

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

(i) Hexagonal close packing and cubic close packing

(ii) Crystal lattice and unit cell (iii) Tetrahedral void and octadedral void.

Watch Video Solution

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

(i) Hexagonal close packing and cubic packing ltbr

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9. Explain

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

b. Ionic solids are hard and brittle.

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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 $10.5 g cm^{-3}$. Calculate the atomic mass of silver.

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12. A cubic solid is made up of two elements P and Q . Atoms of P are present at the corners of the cube and atoms of Q are present at body centre. What is the formula of the compound and what are coordination numbers of P and Q ?

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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 $93u$.

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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

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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?

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17. What is a 'semiconductor' ? Describe the two main types of semiconductors and contrast their condcution mechanisms.

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?

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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 = 0.144nm) crystallises in a face centred unit cell. What is the length of the 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.

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

(ii) How many unit cells are there in $1.00\mathrm{cm}^3$ of aluminium ?

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

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26. 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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Ncert Exemplar Mcq

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

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

A. Define and characteristic heat of fusion.

B. Isotropic nature.

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

D. A true solid.

Answer: B

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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: D

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

A. 

B. 

C. 

D. 

Answer: A

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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 direactions

C. Cannot be measured

D. Always zero

Answer: D

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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 moulded by heating .

D. They are anisotropic in nature.

Answer: B

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

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

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

C. same arrangement of consitituent particles in different direction.

D. different arrangement of constituent particles in different directions.

Answer: A

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

A. London forces

B. dipole-dipole interractions

C. covalent bonds

D. coulombic forces

Answer: C

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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. © and (D)

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

Answer: A

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

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

B. Brittle nature.

C. Very strong, forces of interactions.

D. Anisotropic nature.

Answer: B

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12. Graphite is a good conductor of electricity 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: D

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: C

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

A. molecule

B. ion

C. electron

D. atom

Answer: D

Watch Video Solution

16. Graphite cannot be classified as :

A. conducting solid

B. network solid

C. covalent solid

D. ionic solid

Answer: A

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

A. frenkel defect

B. Schottky defect

C. Vacancy defect

D. Metal deficiency defect

Answer: B

Watch Video Solution

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

A. some cations move from their lattice sites to interstitial 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

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

A. positive

B. neutral

C. negative

D. depends on concentration of p impurity

Answer: D

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20. To get n-type semicoductor from silicon, it should be doped with a substance with group no.....

A. 12

B. 15

C. 13

D. 15

Answer: B

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

A. 6

B. 8

C. 10

D. 12

Answer: A

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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. © and (D)

C. (A) and ©

D. (B) and (D)

Answer: B

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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

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

A. 74

B. 68

C. 32

D. 26

Answer: D

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25. which of the following statemets 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^- ion from fcc lattice and Na^+ ions occupy all octahedral voids of the unit cell.

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

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

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

Answer: C

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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: D

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28. which kind of defects are introduced by doping ?

A. Disolocation defect

B. Schottky defect

C. Frenkel defect

D. Electronic defects

Answer: B

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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 substances are weakly attacted by magnetic field.

B. Ferromagnetic substances cannot be magnetised permanently

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

D. domains are not affected by magnetic field.

Answer: D

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

A. bigger ions form theclose 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 fecation of octahedral or tetradheral voids occupied depneds upon the radii of the ions occupying the voids.

Answer: A

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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 domins get oriented in the direction opposite to the direcation of magnetic field.

C. domains get oriented randomly.

D. domains are not affected by magnetic field.

Answer: B

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

A. fcc lt bcc lt simple cubic

B. fcc gt bcc gt simple cubic

C. fcc lt bcc gt simple cubic

D. bcc lt fcc gt simple cubic

Answer: A

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

A. frenkel defect

B. Schottky defect

C. Non-stoichiometric defect

D. simple intersitiial defect

Answer: D

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35. In the cubic close close 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 adjecent unit cells.

D. 8 tetrahdral voids within the unit cells.

Answer: A

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

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

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. $k_{\text{metals}} < < k_{\text{insulator}} < k_{\text{semiocductors}}$

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

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

Answer: C::D

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Ncert Exemplar Mcq Ii

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

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

B. All the triangular voids arenot covered by the spheres of the second layer.

C. Tetrahedral voids are formed when the traingular voids in the seconds layer lie above the triangular shapes of these boids do not overlap.

D. Octadrdral obids are fomed when the traingular voids in the second later exactly overlap with similar 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 resoect to each other without the applications of amgnetic fields.

D. cancel out each other's magnetic moment.

Answer: C::D

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3. Which of the folowings statements are not true ?

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

B. Intersitital defect 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: A::B::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 conducition band cannot be determined.

D. Valance band amy remain partially filled.

Answer: A::B

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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 posiitively charged plate through electron holes.

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

C. Both electrons and holes appear to move towards the positively charged plate.

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

Answer: B::C

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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 increases the conductiviy of n-type semiconductor.

Answer: A::D

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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

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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: A::C

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

A. pseudo solids

B. true solids

C. super cooled liquids

D. super cooled solids

Answer: A::C

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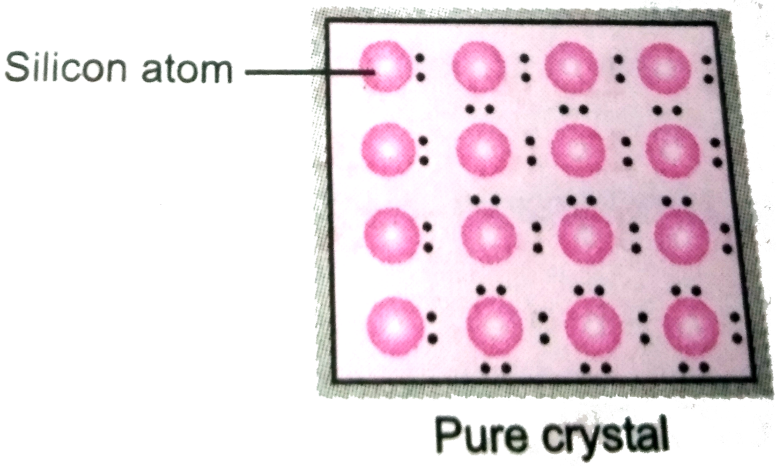
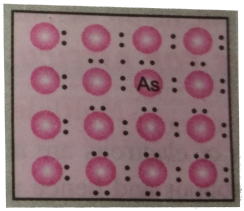
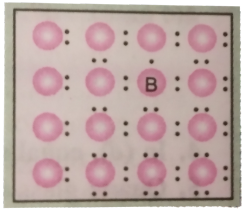
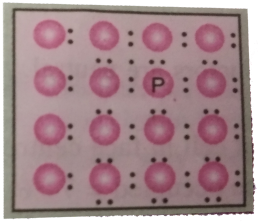
10. A perfect crystal of silicon (show in the fig below) is doped with some elecments as given in the options. Which of these options show n-type

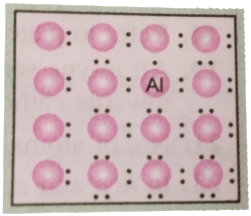
semiconductors ?



A. 

B. 

C. 

D. 

Answer: A::D

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11. Which of the following statements are correct ?

A. Frrimagnetic substances lost ferrimagnetism on heating and become paramagnetic.

B. Ferrimagnetic substances do not lose ferrimagnetism 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 direaction of magnetic field and remain as such even after removing magnetic field.

Answer: A::C

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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 liquied . \

Answer: A::B::C

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

A. SiC (Silicon carbide)

B. AIN

C. Diamond

D. I_2

Answer: A::D

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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::B

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

A. stoichiometric defect

B. dislocation defect

C. impurity defect

D. non- stoichiometric effect

Answer: B::D

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16. Which of the following defects decrease the density ?

A. Intersitital defect

B. Vancancy defect

C. Frenkel defect

D. schottky defect

Answer: C::D

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Short Answer 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 ?

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

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

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6. why does white Zn0(s) becomes yellow upon heating ?

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

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8. 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 ?

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

A. As a result of slow heating and cooling over a long period, an amorphous solid acquires some crystalline character e.g., window glass of old buildings.

B.

C.

D.

Answer: $(i) \rightarrow ©, (ii) \rightarrow (a), (iii) \rightarrow d, (iv) \rightarrow b$

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10. (A) write two difference between crystalline solids and amorphous solids ?

(b) Draw a diagram for anisotropic behaviour of crystalline solids.

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11. What are crystalline and amorphous solids? Explain with examples.

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12. On the basis of nature of bonding , how can the solids be classified into different types ?

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13. Classify basis the following solids on bonding consdierations :

CO_2, MgO, Al, H_2, Si, Gd, Pd, AgCl

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

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15. Define Body - centred cubic cell and Face-centrd cubic cells.

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16. 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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17. Calculate the number of atoms in a face centred cubic unit cell.

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18. What is the number of atoms in a body-centred cubic unit cell of a monoatomic substance ? Give one example .

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19. What is the difference between cubic close packing and hexagonal close packing ? Give three examples of elements of each type. What is the coordination number in each case ?

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20. What are tetrahedral and octahdral voids ? How are their radii related to the radii of the spheres in the close packed arrangement ?

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

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22. Name the ions which form the close - packed structure (along with the type of packing) and the ions which fill the viods (along with the types of voids) in the compounds. (i) NaCl (ii) ZnS (iii) CaF^2

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23. Draw the structure of NaCl and represent the coordinatin numbers of Na^+ and Cl^- ion in the diagram.

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24. What is the difference in the structures of zinc blende and wurtzite ?

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25. Define radius-ratio. What is the coordination number if the radius ratio of the compound is 0.52 ?

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26. Define radius ratio. What is the value of radius ratio for octahedral geometry ?

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27. For a face- centred cubic crystal of an element, prove that raidus (r) of the atoms is related to the atoms is related to the edge (a) as $r = a/2\sqrt{2}$

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28. For a body -centred cubic, crystal of an element, derive that relationship between radius (r) of the atoms and edge (a).

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29. Explain how can you determine the atomic mass of an density of the cubic crystal of an element whose edge is 'a' on and atomic mass is M.

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

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31. Write the difference between Frenkel and Schottky defects.

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32. Explain the nature of crystal defect produced when sodium Chloride is doped with magnesium chloride.

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33. what are intersitials ? Explain with suitable examples .

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34. Briefly explain what you understand by ' F-centre' .

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35. Define the term doping. Pure silicon is an insulator. Silicon doped with phosphorus is a semiconductor. Silicon doped with gallium is also a semi-conductor. What is difference between the two types of semi-conductors ?

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

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

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38. Explain the term 'Doping'.

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39. State the difference between schottky and Frenkel defects ? Which of these two changes the density of the solid and why ?

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40. Explain Frenkel defect in ionic crystals. What type of compounds exhibit this defect ?

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41. How would you account for the following ?

(i) Frenkel defects are not found in alkali metal halides .

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

(iii) Impurity doped silicon is a semiconductor.

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

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43. what is doping ? What are n-type and p-type semiconductors ?

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44. Solids can be classified into three types on the basis of their electrical conductivities.

(i) Name three types of solids classified on the basis of electrical conductivities.

(ii) How will you explain such classification based on band theory ?

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45. Explain ferromagnetism with suitable examples.

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46. Difference between Diagmagnetism, Paramagnetism , Ferromagnetism

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47. Explain superconductivity.

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48. Explain each of the following with a suitable example.

(i) paramagnetism (ii) Piezoelectric effect (iii) Frenkel defect in crystals.

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49. Define the following terms in relation to crystalline solids :

(i) Unit cell (ii) Coordination number.

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50. (a) What type of semiconductor is obtained when silicon is doped with boron ?

(b) What type of magnetism is shown in the following alignment of magnetic moments?

(c) What type of point defect is produced when AgCl is doped with $CdCl_2$?

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51. (a) Based on the nature of intermolecular forces, classify the following solids:

Silicon carbide, Argon

(b) ZnO turns yellow on heating. Why?

(c) What is meant by groups 12-16 compounds? Give an example.

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52. (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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53. (a) Based on the nature of intermolecular forces, classify the following solids:

Sodium sulphat, Hydrogen

(b) What happens when $CdCl_2$ is doped with $AgCl$?

(c) why do ferrimagnetic substances show better magnetism than antiferromagnetic substances?

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Matching Type Questions

1. match the defects given in Column I with the statements in given column II.

Column I	Column II
(i) Simple vacancy defect	(a) shown by non- ionic solids and increase
(ii) Simple intersitial defect	(b) show by ionic solids and decreases dens
(iii) Frenkel defect	(c) shown byy non-ionic solids and density
(iv) Schottky defect	(d) Shown by ionic solids and density of

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

Column I	Column II
(i) Primitive cubic unit cell	(a) Each of the three perpen
(ii) Body centred cubic unit cell	(b) Number of atoms pe uni
(iii) Face centred cubic unit cell	(c)Each of the three perpendi
(iv) End centred orthorhombic unit cell	(d) In addition to the contrib
	(e) In addition to the contri

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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
(i) Impurity defect	(a) NaCl with anionic sites called F-centres
(ii) Metal excess defect	(b) FeO with Fe^{3+}
(iii) Metal deficiency defect	(c) NaCl with Sr^{2+} and some cationic sites

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4. Match the items given in Column I with the items given in Column II.

Column I	Column II
(i) Mg in solid state	(a) p -type semiconductor
(ii) $MgCl_2$ in molten state	(b) n-type semiconductor
(iii) Silicon with phosphorus	(c) electrolytic conductors
(iv) Geranium with boron	(d) 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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	Column I (Crystal system)	(Column II (Axial ratio)
	(A) Tetragonal	(p) $a \neq b \neq c, \alpha = \beta = \gamma = 90^\circ$
6.	(B) Rhombic	(q) $a = b \neq c, \alpha = \beta = \gamma = 90^\circ$
	(C)Monoclinic	(r) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90^\circ$
	(D) Triclinic	(s) $a \neq b \neq c, \alpha = \gamma = 90^\circ \neq \beta$

A. A-s , B-r , C-p, D-q

B. A-q , B-r , C-q , D-p

C. A-r, B-p, C-q, D-s

D. A-p , B-q , C-r , D-s

Answer: b

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	Column I (Crystal)	Column II (Crystal system)
	(A) $CuSO_4.5H_2O$	(p) Hexagonal
7.	(B) $Na_2SO_4.10H_2O$	(q) Cubic
	(C) Dimaond	(r) Monoclinic
	(D) Graphite	(s) Triclinic

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8.

Column I (Type of crystal)	Column II (Location of cations/anions
(A) NaCl	(p) Cations -fcc, Anions- all tetrahedral voi
(B) ZnS	(q) Anions -fcc, Cations-all tetrahedral voids
(C) CaF_2	(r) Anions-fcc, Cations-all octahedral voids
(D) Na_2O	(s) Anions-fcc,Cations - aternate tetrahedral

A. A-r, B-s , C-p , D-q

B. A-q , B-p, C-s, D-r

C. A-s, B-p, C-r, D-q

D. A-r, B-s,C-q, D-p

Answer: c

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9.

Column I (Defect)	Column II (Effe
(A) Schottky defect	(p) Crystal becon
(B) Doping silicon with aluminium	(q) n-type semico
(C) Doping silicon with arsenic	(r) p-type semico
(D) Heating NaCl crystal in presence of sodium vapour	(s)Density of the

A. A-s, B-q, C-r, D-p

B. A-q,B-p, C-r, D-s

C. A-q,B-s,C-q,D-p

D. A-s, B-r, C-q, D-p

Answer: b

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10.

Column I (Defect)	Column II (Efect)
(A) Ferrites	(p) Ferromagnetic
(B) CrO_2	(q) Paramagnetic
(C) Nitric oxide (NO)	(r) Ferrimagnetic
(D) Manganese dioxide(MnO_2)	(s) Antiferromagnetic

A. A-r, B-q, C-p, D-s

B. A-r, B-s,C-q, D-p

C. A-r, B-s, C-q, D-p

D. A-s,B-p, C-r, D-q

Answer: d

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11. 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. A-p,B-r,C-q,D-t,E-s

B. A-t,B-q,C-r,D-p,E-s

C. A-r,B-t, C-q,D-p,E-s

D. A-s,B-t,C-q,D-r,E-p

Answer: (A-r ; B-p,r,s; C-r, D-q)

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Assertion And Reason Type Question

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.

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

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

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

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

Answer: b

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

Reason (R): Graphite is soft in nature, on the other hand diamond is very hard and brittle.

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

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

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

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

Answer: c

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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.

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

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

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

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

Answer: b

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

Reason : The cordination number is 12 in fcc structure.

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

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

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

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

Answer: c

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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 .

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

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

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

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

Answer:

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Long Answer Questions

1. with the help of a labelled diagram show that there are four octahedral voids per unit cell in cubic close packed structure .

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2. Show that in a cubic close packed structure, eight tetrahedral voids are present per unit cell.

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3. How does the doping increase the conductivity of semiconductor ?

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4. A sample of ferrous oxide has actual formula $Fe_{0.93}O_{1..00}$. In this sample what fraction of metal ions are Fe^{2+} ions? What type of non-stoichiometric defect is present in this sample ?

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5. What are amorphous solids ? Give their important properties and uses.

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6. What is space lattice and unic cell ? What do you understand by simple, face centred and body centred unit cells?

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7. Briefly explain how the packing of the constituent particles in a crystal takes place.

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8. Derive the following relationships for cubic crystals of an element :

(i) For FCC, $r = a/2\sqrt{2}$

(ii) For BCC, $r = \sqrt{3}a/4$

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9. Derive an expression for density of a cubic crystal from the edge of the cubic crystal of an element in terms of SI units.

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Additional Questions

1. Crystalline solids are anisotropic in nature. What does this statement mean ?

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2. How can a substance be made amorphous?

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3. What is photovoltaic cell ?

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4. What type of crystalline solid is graphite ?

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5. Classify the following into ionic, molecular,cvalent and metallic crystals.

Bronze, Dry ice, Nitre and Diamond

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6. Classify the following substances into ionic, covalent, molecular or metallic.

MgO, SO_2, I_2, $H_2O(\text{ice})$, SiO_2 (quartz), brass.

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7. Which type of solid is SiC ?

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

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

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10. Write any two differences between amorphous solids and crystalline solids.

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11. In NaCl crystal the Cl^- ions are in f.c.c. arrangement. Calculate the number of Cl^- ions in unit cell.

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12. 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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13. A metallic crystal cystallizes into a lattice containing a sequence of layers $ABABAB\ldots$. Any packing of spheres leaves out voids in the lattice. What percentage by volume of this lattice is empty spece?

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14. Given packing efficiency and coordination number of the following crystal structres .

(a) body centred cubic (b) cubic close packing

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15. What is the corrdination number of an octahedral voids ?

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16. Ina crystal of zinc sulphide, zinc occupies tetrahedral voids. What is the coodination number of zinc ?

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

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18. Arrange the following accroding to their packing fraction:

simple cubic, face-centred cubic , body -centred cubic.

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19. Write the coordination number of each ion in the following crystals .

(i) NaCl (ii) CsCl (iii) ZnS (iv) CaF_2 (v) Na_2O

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20. A solid substance AB has a rock salt geometry. What is the coordination number of A and B ? Ho amy atoms oif A and B are presnet in the unit cell ?

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21. How can you convert NaCl structure into CsCl structure and vice versa ?

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22. MgO has a structure of NaCl and TiCl has the structure of CsCl. What are the coordination number of ions in each (MgO and TiCl)

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23. Name a compound having body centred cubic unit cell crystal lattice.

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24. 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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25. Define coordination number of a metal ion an ionic crystal.

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26. what is the corrdination number of

(i) Sodium in sodium oxide (Na_2O) ? (ii) oxide ion in sodim oxide (Na_2O) ?

(iii) Calcium in calcium fluoride (CaF_2) ? (iv) Zinc in zinc blende (ZnS) ?

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27. what is the effect of pressure on NaCl type crystals ?

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28. What type of structures are exhibited by (a) $BaCl_2(b)Na_2O$

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29. In the compound AX, the radius of A^+ ion is 95 pm and that of X^- ion is 181 pm. Predict the crystal structure of AX and write the coordination number of each of the ions.

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30. Silver crystallises with face - centred cubic unit cells .each side of the unit cell has a length of 409 pm . What is the radius of an atom of silver ?

(Assume that each face atom is touching the four corner atoms.)

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31. Write expression for molar mass, M (in kg mol^{-1}) of a body-centred cubic crystal of an ionic compound if it has an edge length of 'a' metre and a density of 'd' kg m^{-3}

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32. What are stoichiometric defects or intrinsic defects in ionic crystals ?

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33. What are intersitials in a crystal ?

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34. Schottky defect.

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35. Explain the term ' Dislocations' in relation to crystals ?

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36. Give the name of one solid which shows both Schottky and Frenkel defects?

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37. What are non-stoichiometric compounds ?

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38. When does Frenkel defect arise ? Give reason .

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39. What other elements may be added to silicon to make electrons available for conduction of an electric current?

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40. Why does Frenkel defect not change the density of AgCl crystals ?

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

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

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43. What is meant by point defect in crystals ?

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44. What type of crystal defect is produced when sodium chloride is doped with $MgCl_2$?

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45. What is potassium chloride sometimes violet instead of pure white ?

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46. What is the difference between 13-15 and 12-16 compounds ?

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47. What is F-centre ?

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

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49. Name the type of defect that occurs in the crystals of zinc sulphide.

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50. which point defect in crystals of a solid does not change the density of the soild ?

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51. Which point defect in crystals of a solid decreases the density of the solid?

Watch Video Solution

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

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53. Intrinsic and extrinsic semiconductors

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

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55. How do paramagnetic substances differ from ferromagnetic ?

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56. What happens when a ferromgnetic or anti - ferromagnetic or a ferrimagnetic solid is heated ?

Watch Video Solution

57. Ferromagnetic subtances make permanent magnets. Give reason.

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58. What happens when ferrimagnetic Fe_3O_4 is heated to 850 K and why ?

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59. What type of substances exhibit antiferromagnetism ?

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60. How is electrical conductivity caused in (a) semiconductors, (b) metals, and (c) inoic compounds?

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61. How do the electrical conductivity and resistivity of metallic conductors, semi-conductors, and super conductors vary with temperature ?

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62. How may the conductivity of an intrinsic semiconductor be increased ?

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63. What is energy gap in band theory ? Compare its size in conductors, semiconductors and insulators.

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

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65. What I a semiondutor ? Mention the two main types of semiconductor.

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66. Define superconductivity of a substance .

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Hots Questions

1. If the atoms of an element have the radius r, then in a primitive cubic unit cell, calculate

(a) the length of the face diagonal. (b) the lenth of the body diagonal.

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2. Out of NaCl and CsCl, which on is more stable and why ?

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3. In a crystal, Frenkel defect is not shown by alkali metal halides buy sliver halides show. Why ?

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4. What is the arrangement of atoms in the lattice structure of diamond and give contribution of each C atom ?

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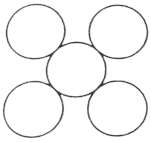
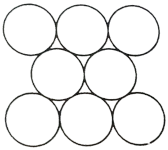
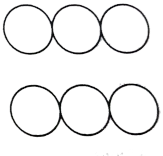
5. The figures given show the location of atoms in three crystallographic planes in a fcc lattice. Draw the unit cell for the corresponding structure and identify these planes in your diagram.

(*i*)  (*ii*)  (*iii*) 

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6. If r_{Na^+} and r_{Cl^-} represent the radii of Na^+ and Cl^- ions respectively and n is the number of NaCl units per unit cell, derive an expression for molar volume of the crystal in terms of r_{Na^+}, t_{Cl^-} and n.

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Hots Problems

1. 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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2. If the crystallises in zinc blende structure with I^- ions at lattice points. What fraction of tetrahedral voids is occupied by Ag^+ ions ?

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3. A compound consisting of the monvalent ions, A^+, B^- crystallizes in the body -centred cubic lattice. (i) What is the formula of the compound ? (ii) If one of A^+ ions from the corner is replaced by a monovalent ion C^+. What would be the simplest formula of the resulting compound ?

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4. Calcium metal crystallizes in a face -centred cubic lattice with edge of 0.556 nm. Calculate the density of the metal if it contains (i) 0.5 % Frenkel defects (ii) 0.2 % Schottky defects .

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5. There is a collection of crystalline substances in a hexagonal closed packing. If the density of matter is $2.6g/cm^3$, what would be the average density of matter in collection? What fraction of space is actually unoccupied ?

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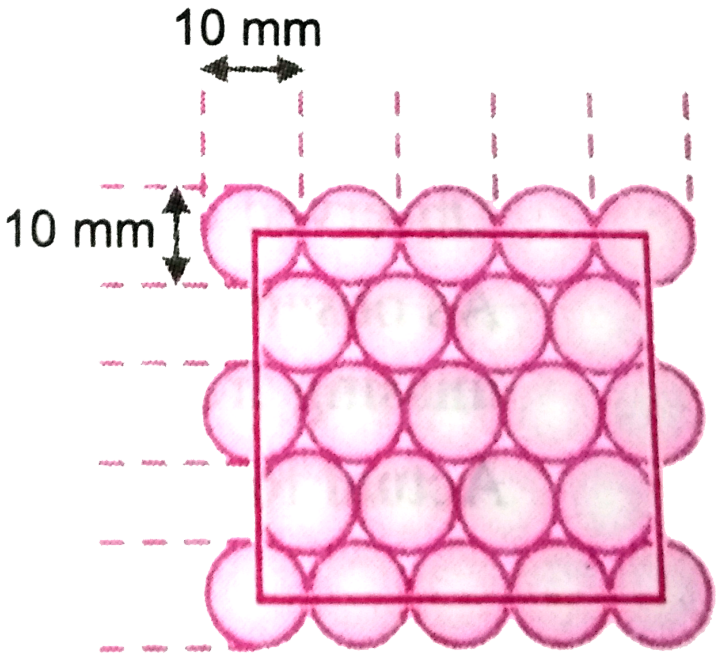
6. You are given marbles of dimeter 10 mm. they are to be placed such that their centres are lying in a spuare bound by four lines each of length 40 mm. what will be the arrangemnt of marbles in a plane so that maximum number of marbles can be placed inside the area ? Sketch the diagram and derive an expression for the number of marbles per unit area.



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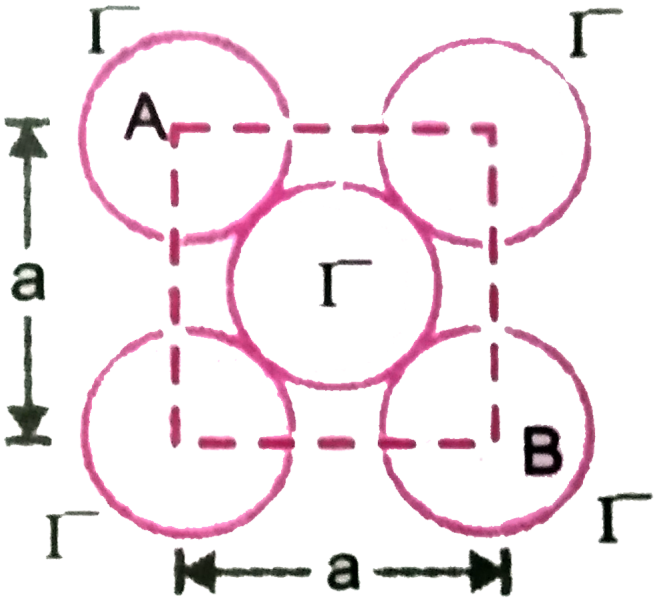
7. Lithium iodide crystal has a face - centred cubic unit cell. If the edge length of the unit cell is 620 pm, determine the ionic radius of I^- ion.



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8. When heated above $916^\circ C$, iron changes, its crystal structure from body centred cubic to cubic closed packed structure. Assuming that the

metallic radius of an atom does not change, calculate the ratio of the density of the bcc crystal to that of ccp crystal.

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9. X-ray diffraction studies show that edge length of a unit cell of NaCl is 0.56 nm. Density of NaCl was found to be $2.16 g/cc$. What type of defect is found in the solid? Calculate the percentage of Na^+ and Cl^- ions that are missing.

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Value Based Questions

1. Maneesh , a student of class XII, watched a programme on TV where it was being show how use of polythene bags blocked the sewer system and how sometimes the polythene bags thrown as garbage into the streets were swallowed by the animals resulting into their death. Maneesh was

highly upset and he discussed the problem with the class teacher to creater an awakening among his class-mates.

After reading the above paragraph, answer the following question s :

(a) What values do you attache to Maneesh's observation on TV and iscussion with his class teacher ?

(b) What is the basic reason to the harmful effects of use of polythene bags ? What alternative do you suggest ?

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2. Aneesh, a student of Class XII, went to a hospital along with his mother. There he saw a woman patient whose neck was highly swollen. He asked his mother what had happened to this woman. She told him that this woman had a problem of thyroid disorder which was due to deficiency of iodine.

After reading the above paragraph, answer the following questions :

(a) What values do you attach to the information conveyed by Aneesh's mother to him ?

(b) What is the simplest way to follow to save ourselves from this disease ?

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Multiple Choice Questions

1. Which of the following exists as covalent crystals in the solid state?

A. Phosphorus

B. Iodine

C. Silicon

D. Sulphur

Answer: C

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2. Which of the following statements about amorphous solid is incorrect ?

A. They melt over a range of temperature

B. They are anisotropic

C. There is no orderly arrangement of particles

D. They are rigid and incompressible

Answer: D

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3. How many unit cells are present in a cube - shaped ideal crystal of NaCl of mass 1.00 g ? [atomic masses : Na =23,Cl-=35.5]

A. 5.14×10^{21}

B. 1.28×10^{21}

C. 1.71×10^{21}

D. 2.57×10^{21}

Answer: C

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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. AB_2

B. A_2B_3

C. A_5B_5

D. A_2B

Answer:

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5. The vacant space in bcc lattice unit cell is

A. 0.23

B. 0.32

C. 0.26

D. 0.48

Answer:

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6. If spheres of radius 'r' are arranged in ccp fashion (ABC ABC...) the vertical distance between any two consecutive A layers is

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

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

C. 6 r

D. $r\sqrt{6}$

Answer:

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7. 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:

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8. 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:

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9. The packing efficiency of the two dimensional square unit cell show in the adjoining fig ,. Is

`(##PR_CHE_V01_XII_C01_E20_009_Q01.png" width="80%">

A. 0.3927

B. 0.6802

C. 0.7405

D. 0.7854

Answer: D

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10. 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:

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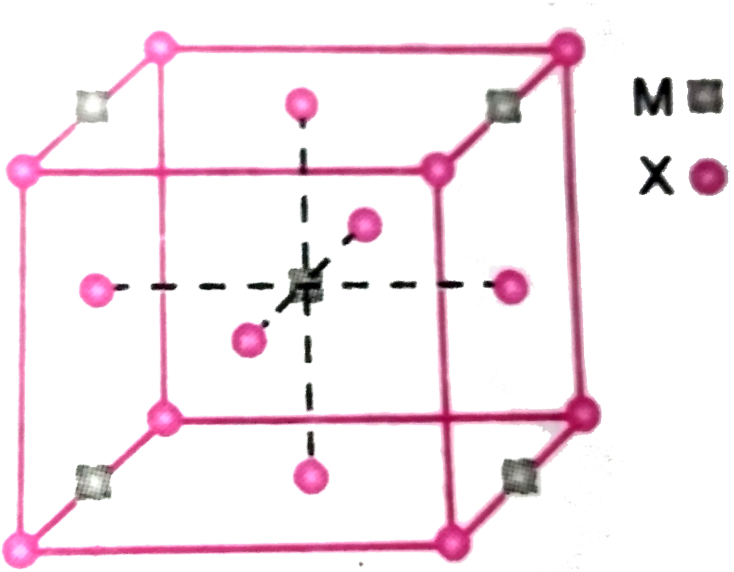
11. A compound M_pX_q has cubic close packing (ccp) arrangement of X. its unit cell structure is shown below. The empirical formula of the compound is



A. MX

B. MX_2

C. M_2X

D. M_5X_{14}

Answer: C

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12. 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. $+2$

B. $+3$

C. $+4$

D. $+1$

Answer: C

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13. 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. 12

Answer: C

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14. Structure of a mixed oxide is cubic closed - packed (ccp) .The cubic unit cell of mixed oxide is composed of oxide ions .One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovelent metal B .The formula of the oxide is

A. $A_2B_3O_4$

B. AB_2O_2

C. ABO_2

D. A_2BO_2

Answer: A

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15. 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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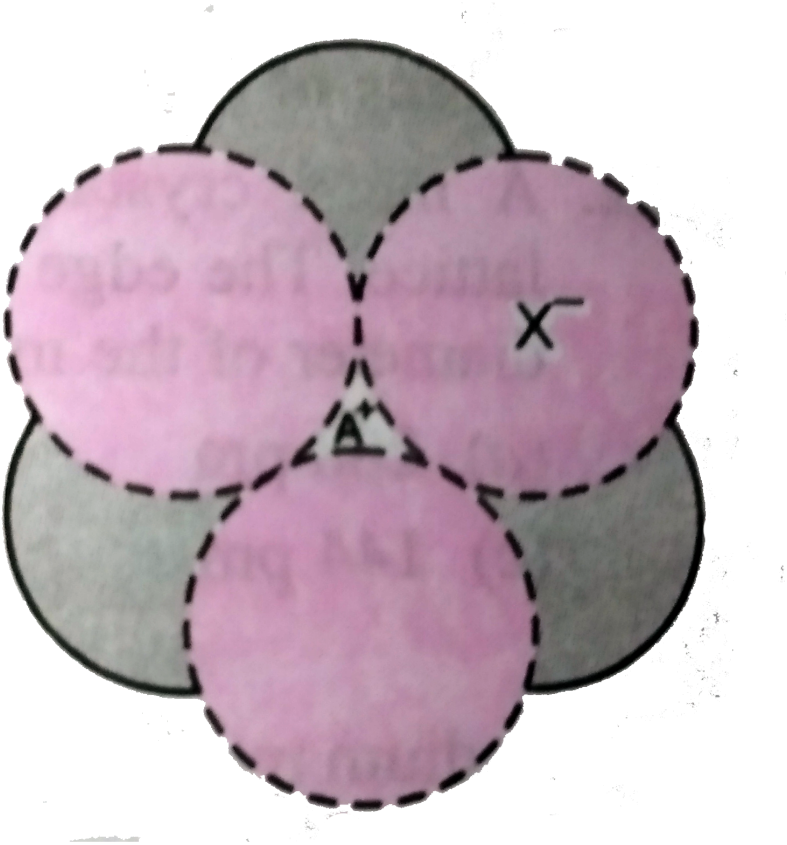
16. The arrangement of X^- ions around A^+ ion in solid AX is given in the fig. (not drawn to scale). If the radius of X^- is 250 pm, the radius of A^+ is



A. 104 pm

B. 125 pm

C. 183 pm

D. 57 pm

Answer: B

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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. $\sqrt{2}a$

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

C. 2a

D. $2\sqrt{2}a$

Answer: C

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

A. 4 and 2

B. 6 and 6

C. 8 and 4

D. 4 and 8

Answer: D

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19. In an ionic compound $A^{+}X^{-}$, the radii of A^{+} and X^{-} ions ar 1.0pm and 2.0om, respectively. The volume of the unit cell of the crystal AX will be:

A. 27pm^3

B. 64pm^3

C. 125pm^3

D. 216pm^3

Answer: C

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20. A solid compound XY has $NaCl$ structure. If the radius of the cation is 100 pm, the radius of the anion $\left(Y^-\right)$ will be

A. 275.1

B. 322.5 pm

C. 241. 5 pm

D. 165. 7 pm

Answer: B

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21. 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. 2

B. 6

C. 4

D. 8

Answer: A

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22. a metal crystallizes with a face-centered cubic lattice.The edge of the unit cell is 408 pm. The diameter of the metal atom is :

A. 288 pm

B. 408 pm

C. 144 pm

D. 204 pm

Answer: C

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

A. 5.72 Å

B. 0.93 Å

C. 1.86 Å

D. 3.22 Å

Answer: D

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24. 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: a

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25. The edge length of face centred cubic unit cell is 5.8 pm. if the radius of the caiton is 110 pm. The radius of the anion is

A. 144 pm

B. 288 pm

C. 618 pm

D. 398 pm

Answer: d

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26. $CsCl$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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27. 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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28. The edge length of a cube is 400 pm .its body diagonal would be

A. 500 pm

B. 600 pm

C. 566 pm

D. 693 pm

Answer: D

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

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

Answer: c

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30. 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. $40gmol^{-1}$

B. $30gmol^{-1}$

C. $27gmol^{-1}$

D. $20gmol^{-1}$

Answer:

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31. The number of atoms is 100 g of a fcc crystal with density = 10.0 g/cm^3 and cell edge equal to 200 pm is equal to

A. 5×10^{24}

B. 5×10^{25}

C. 6×10^{23}

D. 2×10^{25}

Answer: d

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32. Ice crystallises in a hexagonal lattice having a volume of the unit cell as $132 \times 10^{-24} cm^3$. If density of ice at the given temperature is 0.92 gcm^{-3}, the number of H_2O molecules per unit cell is

A. 1

B. 2

C. 3

D. 4

Answer: b

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33. if the edge length of a NaH unit cell is 488 pm, what is the length of Na-H bond if it crystallises in the fcc structure ?

A. 122 pm

B. 244 pm

C. 488 pm

D. 976 pm

Answer: d

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

A. 527 pm

B. 264 pm

C. 154 pm

D. 352 pm

Answer: a

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35. The incorrect statement regarding defects in crystalline solids is

A. Frenkel defect is a dislocation defect

B. Frenkel defect is found in halids of alkaline metals

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

D. Frenkel defects decrease the density of crystalline solids

Answer: d

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36. In NaCl is doped with 10^{-4} mol % of $ScCl_2$, the concentration of cation vacancies will be $\left(N_A = 6.02 \times 10^{23} mol^{-1}\right)$

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

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

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

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

Answer: b

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37. The crystal with metal deficiency defect is:

A. NaCl

B. FeO

C. KCl

D. ZnO

Answer: c

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

A. 0.0508

B. 0.0701

C. 0.0408

D. 0.0605

Answer: b

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39. Substance which is weakly repelled by a magnetic field is

A. O_2

B. H_2O

C. CrO_2

D. Fe_3O_4

Answer: a

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40. Which of the following metal oxides is anti-ferromagnetic in nature?

A. MnO_2

B. TiO_2

C. VO_2

D. CrO_2

Answer: a

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41. The energy gap $\left(E_g\right)$ between valence band and conduction band for diamond , silicon and germanium are in the order

A. $E_g(\text{ diamond}) < E_g\ (\text{Silicon}) < E_g\ (\text{ germanium})$

B. $E_g\ (\text{diamond}) < E_g(\text{silicon}) < E_g\ (\text{germanium})$

C. $E_g\ (\text{ diamond}) = E_g\ (\text{ silicon}) = E_g\ (\text{ germanium})$

D. $E_g\ (\text{ diamond}) < E_g\ (\text{ germanium}) < E_g\ (\text{ silicon})$

Answer:

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42. Which of the following compound is metallic and ferromagnetic ?

A. CrO_2

B. VO_2

C. MnO_2

D. TiO_2

Answer: b

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43. For which crystal anion-anion contact is valid ?

A. NaF

B. Nal

C. CsBr

D. KCl

Answer:

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44. Each rubidium halide crystallising in the NaCl-type lattice has a unit cell length 0.30Å greater than that for corresponding potassium salt $(r_{k+} = 1.33\text{Å})$ of the same halogen. Hence, ionic radius of Rb^+ is

A. 1.03 Å

B. 1.18 Å

C. 1.48 Å

D. 1.63 Å

Answer: c

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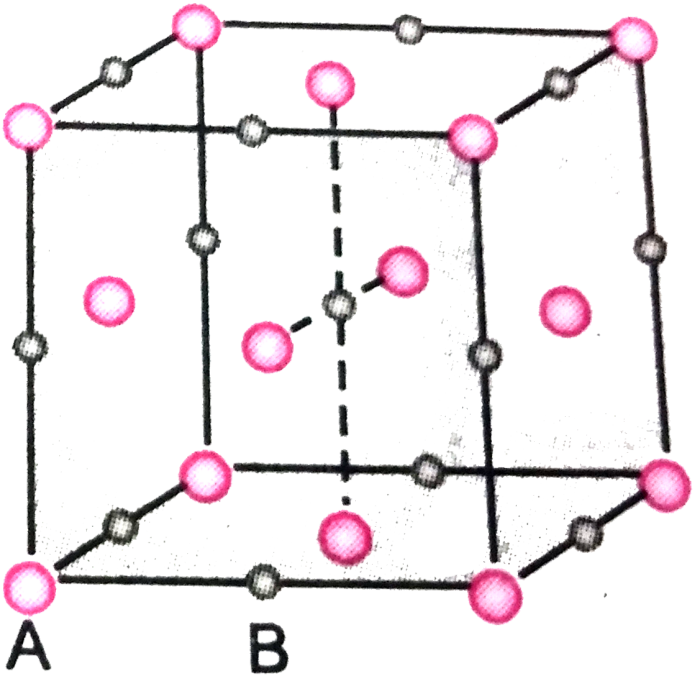
45. For a solid with the adjoining structure, the coordination number of the points A and B respectively are



A. 6,8

B. 8,8

C. 6,6

D. 4,6

Answer: b

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46. If the positions of Na^+ and Cl^- are interchanged in NaCl, having fcc arrangement of Cl^- ions then in the unit cell of NaCl

A. Na^+ ions will decrease by 1 while Cl^- ions will increase by 1.

B. Na^+ ions will increase by 1 while Cl^- ions will decrease by 1

C. Number of Na^+ and Cl^- ions will remain the same

D. The crystal structure of NaCl will change.

Answer:

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47. Which of the following statements is not correct ?

A. The fraction of the total volume unoccupied by the atoms in a primitive cell is 0.48.

B. Molecular solids are generally volatile

C. The number of carbon atoms in a unit cell of Diamond is 4.

D. The number of Bravais lattices in which a crystal can be categorized is 14.

Answer:

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48. 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:

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49. Which has no rotaition of symmetry ?

A. Hexogonal

B. orthorhombic

C. Cubic

D. Triclinic

Answer:

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50. Which is the incorrect statement ?

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

B. Density decreases in case of crystals with Schottky's defect

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

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

Answer:

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Ii Multiple Choice Questions

1. Which of the following statements are not true ?

A. An element with BCC structure has two atoms per unit cell.

B. An ionic compound A^+B^- with BCC structure has one AB formula unit per unit cell.

C. The shape of the octahedral void is octahedral.

D. The edge of the crystal A^+B^- is equal to the distance between A^+ and B^- ions.

Answer:

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

A. it has a coordination number of 6.

B. It has 26% empty space.

C. It is ABCABC....type of arrangement.

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

Answer:

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3. which of the following are true ?

A. In NaCl crystals , Na^+ ions are present in all the octahedral voids.

B. In ZnS (zinc blende) , Zn^{2+} ions are present in alternate tetrahedral voids.

C. In CaF_2, F^- ions occupy half the octahral voids .

D. In Na_2O, O^{2-} ions occupy half the octahedral voids.

Answer:

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4. Crystal systems in which no two axial lengths are equal are

A. Tetragonal

B. Orthorhombic

C. Monoclinic

D. Triclinic

Answer:

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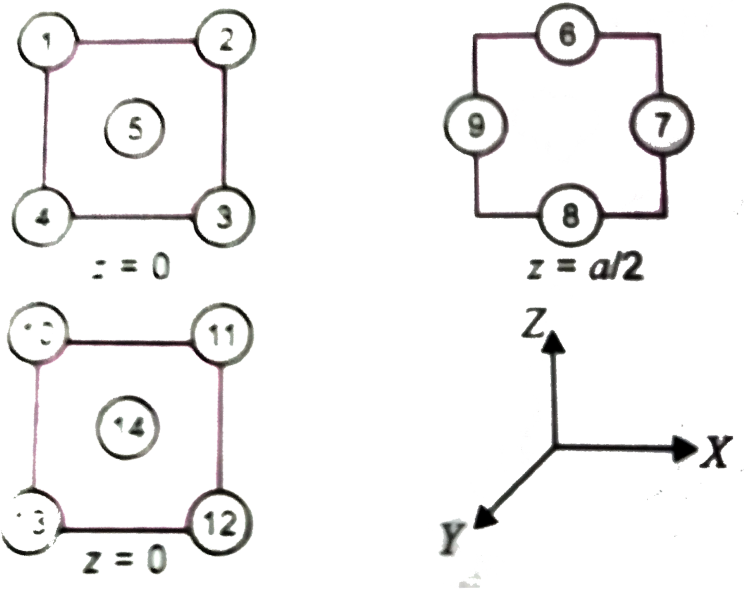
5. A metal has cubic close packed (ccp) arrangement the layer sequence of which is show below :



A face diagonal pases through the centre of atom 4 and the centre (s) of which other atom (s) ?

A. 1

B. 2,5

C. 8,12

D. 9,10

Answer:

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6. The density of KBr is $2.75g/cm^3$. The length of the unit cell is 654 pm. Atomic mass of K= 39, Br =80. Then what is true about the predicted nature of the solid ?

A. It has $4K^+$ and $4Br^-$ ions per unit cell

B. It is face -centred

C. It has rock- salt type structure

D. It can have schottky defects

Answer:

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7. 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 of 12.

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

D. The length of the edge of unit cell of NaCl is 552 pm $(r_{Na^+} = 95 \text{ pm}, r_{Cl^-} = 181\text{pm})$

Answer:

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

A. Frenkel dectes are usually favoured by a very small difference in the size of the cation and anion

B. Frenkel defect is 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:

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9. With respect to graphite and diamond, which of the following statement(s) given below is (are) correct ?

A. Graphite is harder than diamond

B. Graphite has higher electrical conducitivity than diamond .

C. Graphite has higher thermal conducitivity than diamond

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

Answer:

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10. The correct statement (s) for cubic close packed (ccp) three dimensional structure is (are)

A. The number of neighbours of an atom present in the topmost layer is 12.

B. The efficiency of the 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:

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Iii Multiple Choice Questions

1. By X-ray studies, the packing atoms, in a crystal of gold is found to be in layers such that starting from any layer, every fourth layer is found to be exactly idenctical. The density of gold is found to be $19.4 gcm^{-3}$ and its atomic mass is 197 a.m.u.

The coordination number of gold atom in the crystal is

A. 4

B. 6

C. 8

D. 12

Answer:

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2. By X-ray studies, the packing atoms, in a crystal of gold is found to be in layers such that starting from any layer, every fourth layer is found to be exactly idenctical. The density of gold is found to be $19.4 gcm^{-3}$ and its

atomic mass is 197 a.m.u.

The fraction occupied by gold atoms in the crystal is

A. 0.52

B. 0.68

C. 0.74

D. 1.0

Answer:

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3. By X-ray studies, the packing atoms, in a crystal of gold is found to be in layers such that starting from any layer, every fourth layer is found to be exactly idenctical. The density of gold is found to be $19.4gcm^{-3}$ and its atomic mass is 197 a.m.u.

The length of the edge of the unit cell will be

A. 407 pm

B. 189 pm

C. 814 pm

D. 204 pm

Answer:

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4. By X-ray studies, the packing atoms, in a crystal of gold is found to be in layers such that starting from any layer, every fourth layer is found to be exactly idenctical. The density of gold is found to be $19.4gcm^{-3}$ and its atomic mass is 197 a.m.u.

Assuming gold atom to be spherical , its radius will be

A. 203.5 "pm"^(2)`

B. 143.9 pm

C. 176. 2 pm

D. 287 . 8 pm

Answer: c

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5. No crystal is found to be prefect at room temperature. The defects present in the crystals can be stoichimetric or non-stoichiometric. Due to non-stoichiometric defects, the formula of the ionic compound is different from the ideal formula. For example, the ideal formula of ferrous oxide should be FeO but actually in one sample, it was found to be $Fe_{0.93}$ O. This is because the crystal may have some ferric ions in place of ferrous ions. These defects change the properties of the crystals. In some cases, defects are introduced to have crystals of desired properties as required in the field of electronics. Doping of elements of Group 14 with those of Group 13 or 15 is most common. In ionic compounds, usually impurities are introduced in which the cation has higher valency than the cation of the parent crystal, e.g, $SrCl_2$ into NaCl.

which one of the following doping will produces p-type semiconductor ?

A. Silicon doped with arsenic

B. Germanium doped with phosphorus

C. Germanium doped with aluminium

D. Silicon doped with phosphours

Answer: c

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6. No crystal is found to be prefect at room temperature. The defects present in the crystals can be stoichimetric or non-stoichiometric. Due to non-stoichimetric defects, the formula of the ionic compound is different from the ideal formula. For example , the ideal formula of ferrous oxide should be FeO but actually in one sample , it was found to be $Fe_{0.93}O$. This is because the crystal may have some ferric ions in place of ferrous ions. These defects change the propeties of the crystals. In some cases, defects are introduced to have crystals of desired properties as required in the field of electronics. Doping of elments of Group 14 with those of Group 13 or 15 is most common. In ionic compounds, usually impurities

are introduced in which the cation has higher valency than the cation of the parent crystal, e.g, $SrCl_2$ into NaCl.

which one of the following defects does not affect the density of the crystal ?

A. Schottky defect

B. Interstitial defect

C. Frenkel defect

D. Both in (b) and (c)

Answer: c

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7. In an ideal crystal, the entropy of the constituents at absolute zero temperature (0K) is zero. However, the crystals generally suffer from certain defects also called imperfections They may be both electronic and atomic in nature. The atomic imperfections may be stoichiometric (Schottky and Frenkel defects) or non-stoichiometric (metal excees and

metal deficiency defects). In addition to these, there are impurity defects which are caused by the addition of certain impurities of metals and this is known as dopping. The dopping leads to semi conductors which may be either n-type or p-type in nature.

In stoichiometric defects, the ratio of positive and negative ions as indicated by chemical formula of the compound:

A.

B.

C.

D.

Answer: REMAINS SAME

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8. In hexogonal systems of crystals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are regular hexongonas and three atoms are

sandwiched inbetween them. A space filling model of this structure called haxagonal closed packed (HCP) is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible . Three spheres are then placed over the first layer so that they touch each other and represent the second layer. Finally, the second layer is covered with a third layer that is identical to the bottom layer that is identical to the bottom layer in relative position. Assume radius of every sphere to be 'r'.

The empty space in this HCP unit cell is

A. 0.26

B. 6

C. 12

D. 17

Answer: a

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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 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. $\dfrac{64}{3\sqrt{3}}r^3$

Answer: d

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10. In hexogonal systems of crystals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are regular hexongonas and three atoms are sandwiched inbetween them. A space filling model of this structure called haxagonal closed packed (HCP) is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible . Three spheres are then placed over the first layer so that they touch each other and represent the second layer. Finally, the second layer is covered with a third layer that is identical to the bottom layer that is identical to the bottom layer in relative position. Assume radius of every sphere to be 'r'.

The empty space in this HCP unit cell is

A. 0.74

B. 0.476

C. 0.32

D. 0.26

Answer: c

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Matrix Match Type Question

	Column I (Type of crystal)	Column II (Example/Property)
	(A) Ionic solids	(p) Dry ice
1.	(B) Molecular solids	(q) Brass
	(C) Covalent solids	(r) Generally insulators
	(D) Metallic solids	(s) Generally have low melting points

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2.

Comlumn I (type of packing)	Column II (Metal possessing it/Spac
(A) Hexagonal cubic packing (hcp)	(p) Iron
(B) Cubic close packing (ccp)	(q) 52%
(C) Body centred cubic (bcc)	(r) 68%
(D) Simple cubic	(s) 74%

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3. Match the crystal systems/unit cells mentioned in colunn I with their characteristic features mentioned in column II. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	Column II
(A) simple cubic and face-centred cubic	(p) have these cell parameters a
(B) Cubic and rhombohedral	(q) are two crystal systems
(C) Cubic and tetragonal	(r) have only two crytallograph
(D) Hexagonal and monoclinic	(s) belong to the same crystal s

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Integer Type Questions

1. 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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2. In hexagonal close packing, the difference, in the number of respecitvely, and octahedral voids per unit cell is

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3. NH_4^+ and Br^- ions have ionic of 143 pm and 196 pm respecitvely. The coordination number of NH_4^+ ion in NH_4Br is

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4. Iron (II) oxide has a cubic strcuture and each unit cell has side 5 Å. If the density of the oxide is 4 g cm^{-3}, the number of oxide ions present in

each unit cell is (Molar mass of FeO = $72 \mathrm{g\ mol}^{-1}$, $N_A = 6.02 \times 10^{23} \mathrm{mol}^{-1}$

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5. Al^{3+} ions replace Na^{+} ions at the edge centres of NaCl lattice. The number of vacancies in one mole NaCl is found to be x x 10^{23}. The value of x approximately is

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6. The oxide $Tl_nCa_2Ba_2Cu_3O_{10}$ is found to be superconductor at 125 K. the value of n is

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7. The coordination number of Al in the crystalline state of $AlCl_3$ is _____.

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8. The number of hexagonal faces that are present in a truncated octahedron is

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9. 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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Assertion Reason Type Question

1. Statement -1 : Covalent crystals have the highest melting point .

Statement 2: Covalent bonds are stronge than ionic bonds.

A. Statement 1 is True , Statementy -2 True , Statement -2 is a correct explanation for statement -1 .

B. Statement 1 is True , Statement -2 is True , Statement -2 in NOT a correct explanation of statement -1.

C. Statement -1 is True , Statement -2 is False.

D. Statement -1 is False , Statement -2 is True.

Answer: b

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2. Statement -1 : In NaCl crystal , all the octahdefral voids are occupied by Na^+ ions.

Statement-2 : The number of octahedral voids is equal to the number of Cl^- ions in the packing .

A. Statement 1 is True , Statementy -2 True , Statement -2 is a correct explanation for statement -1 .

B. Statement 1 is True , Statement -2 is True , Statement -2 in NOT a correct explanation of statement -1.

C. Statement -1 is True , Statement -2 is False.

D. Statement -1 is False , Statement -2 is True.

Answer: d

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3. Assertion : The octahedral viods have double the size of the tetrabedral voids in a crystal

Reason: The number of tetrahedral voids is double the number of octabehedral voids is a crystal

A. Statement 1 is True , Statementy -2 True , Statement -2 is a correct explanation for statement -1 .

B. Statement 1 is True , Statement -2 is True , Statement -2 in NOT a correct explanation of statement -1.

C. Statement -1 is True , Statement -2 is False.

D. Statement -1 is False , Statement -2 is True.

Answer: a

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4. 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 .

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5. Assertion (A): Triclinic system is the most unsymmetrical system.

Reason(R): No axial angle is equal to 90° in triclinic system.

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6. Assertion . Graphite is an example to hexogonal crystal system.

Reason . For a tetragonal system, $a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$

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7. Assertion : $CsCI$ has body - centred cunic arrangement

Reason: $CsCI$ has one and $8CI^-$ ion is its unit cell

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8. Assertion . Hexagonal close packing is equally closely packed than cubic close packing .

Reason. Hexagonal close packing has a corrdination number of 12 whereas cubic close packing has a coordination number of 8.

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9. Assertion (A) : Zinc blende and wurtzite both have f arrangement of S^{2-} ions.

Reason (R) : A unit cell of both has four formula units of ZnS.

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10. Assertion: In a crystal, the size of the cation is larger in a tetrahedral hole than in an octahedral hole.

Reason: Cations occupy more space than atoms in crystal packing

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11. Assertion. In a unit cell of NaCl, all Cl^- ions as will they touch each other.

Reason. Radius ratio r_+ / r_- in NaCl is 0.414.

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12. Assertion:If the length of the unit cell of $LICI$ having $NaCI$ structure is 5.14Å, the ionic radius of CI^- ion is $.82\text{Å}$

Rason : Anion- anion contact is retaned in$LiCI$ structure because anion constitute the lattice

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13. Assertion. The sum of the radii of Na^+ and Cl^- ions in NaCl cystal is 281 pm Hence, edge of the unit cell is 281 pm.

Reason. Edge of the unit cell is the distance between the centres of Na^+ and Cl^- ions touching each other.

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

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

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15. Assertion. No compound has both Schottky and Frenkel defects.

Reason. Both defects change the density of the soild .

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16. Assertion. When 1.0 mol of NaCl is doped with 10^{-3} mol $SrCl_2$, the number of cationic sites remaining vacant is 10^{-3}

Reason. Each $SrCl_2$ unit produces two cation vacancies.

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17. Assertion (A) : Antiferromagnetic substances on heating to high temperature become paramagnetic.

Reason (R) : On heating, the randomization of spins occurs.

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Important Questions

1. Why is glass considered a supercooled liquid?

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2. (a) 'Stability of a crystal is reflected in the magnitude of its melting point'. Comment.

(b) The melting points of some compounds are given below : Water = 273 K, Ethyl alcohol = 155.7 K, Diethyl ether = 156.8 K, Methane = 90.5 K. What can you say about the intermolecular forces between these molecules ?

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

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4. Three elements P, Q and R crystallise in a cubic solid lattice with P atoms at corners Q atoms at the body centre and R atoms at the centre of edges, then write the formula of the compound.

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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. Arrange the following accroding to their packing fraction:

simple cubic, face-centred cubic , body -centred cubic.

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7. Ferrimagnetic substance show better magnetism than antiferromagnetic Substances. Why ?

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8. In a crystalline solid anions B are arranged in cubic close packing. Cation A are equally distributed between octahedral and tetrahedral voids. If all the octahedral voids are occupied, the formula for the solid is

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9. 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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10. 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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11. An ionic compand made up of atoms A and B has a face- centred cubic arrangement in which atoms A are at the cornere and atoms B are at the face- centres. If one of the atoms is missing from the corrner, what is the simplest formula of the compound ?

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12. 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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13. 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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14. Gold has a close-packed structure which can be viewed as-spheres occupying 0.74 of the total volume. If the density of gold is 19.3 g/cc, calculate the apparent radius of a gold ion in the solid

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

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

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

(ii) How many unit cells are there in 1.00cm^3 of aluminium ?

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

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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. Zinc oxide is white but it turns yellow on heating. Explain.

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21. What type of stoichiometric defect is shown by:

(a) ZnS (b) $AgBr$

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22. 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?

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

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

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

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26. What do you understand by curie temperature ?

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27. Why is coordination number of 12 not found in lonic crystals ?

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Advanced Problems

1. A bcc lattic is made up of hollow spheres of X. spheres of soldid 'Y,' are present in hollow spheres of X. The radius of 'Y' is half of the radius of 'X' . Calculate the ratio of the total volume of spherees of 'X' unoccupied by Y in a unit cell and volume of the unit cell ?

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2. 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 ration of densities of fcc and bcc.

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3. The density of solid argon is $1.65g/mL$ at $-233^{\circ}C$. If the argon atom is assumed to be sphere of radius $1.54 \times 10^{-8}cm$, what percentage of solid argon is apparentaly empty space ? $(At.\ Wt.\ of Ar = 40)$

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4. In the cubic crystal of $CsCl\left(d = 3.97gcm^{-3}\right)$, the eight corners are occupied by Cl^{Θ} with a $Cs^{\oplus}$ at the centre and vice versa. Calculate the distance between the neighbouring $Cs^{\oplus}$ and Cl^{Θ} ions. What is the radius of the two ions? (Aw of $Cs = 132.91$ and $Cl = 35.45$)

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5. An ionic compound AB has a rock salt structure with A :B = 1:1. the formula mass of AB is 6.023 y amu and the closest A-B distance is $y^{1/3}$ nm.

(a) Calculate the density of the attice.

(b) If the observed density of the lattice is found to be $20 \ \ \mathrm{kg\,m^{-3}}$. then predict the type of defect.

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6. An element crystallises in $f.c.c.$ lattice having edge length $400pm$. Calculate the maximum diameter, which can be placed in interstitial sites without disturbing the structure.

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7. In diamond lattice, all attice point and alternate tetrahedral voids are occupied by carbon atoms.

if diamond crystallizes in fcc form with edge length 'a' find out .

(b) distance between the next nearest neighbours.

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8. A metallic crystal cystallizes into a lattice containing a sequence of layers $ABABAB\ldots$. Any packing of spheres leaves out voids in the lattice. What percentage by volume of this lattice is empty spece?

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9. Calculate the distance between (111) planes in a crystal of calcium. Repeat the calculation for (222) planes. Which palnes are closer ? (a = 0.556 nm)

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10. Determine the miller indices of the shaded plane. Coordinates of the corner of the plane

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11. The coordinate of the three corners of a shaded face on a cubic unit cell are $\left(\frac{1}{2}, \frac{1}{2}, 1\right), \left(0, 1, \frac{1}{2}\right)$ and $\left(1, 1, \frac{1}{2}\right)$ as shown in the figure. Determine the Miller indices of the plane.

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12. The density of sodium chloride at $25^{\circ} C \text{is} 2.163 \times 10^{3} \ \text{kg m}^{-3}$ When X -rays rom a palladium target having waveleth of 58.1 pm are used, the (200) reflection of sodium chloride occurs at an angle of 5.90° . How many Na^{+} and Cl^{-} ions are present in the unit cell ? (Molar mass of NaCl = 58.5 $\text{mol}^{-1} \sin 5.9^{\circ} = 0.1028$)

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13. What fraction (n/N) of the lattice sites are vacant at 298 K for a crystal in which the energy required to make a defect is 1 eV. $\left(1eV = 1.602 \times 10^{-19} J\right)$

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14. Metallic magnesium has a hexagonal close packed structure and a density of $1.74 g/cm^3$. Assuming magnesium atoms to be spherical, calculate the volume of each atom and atomic radius of Mg atom (Atomic mass of Mg =24)

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15. Calculate the packing fraction and density of diamond if a = 3.57Å . Diamond crystallizes in fcc lattice with some more carbon atoms in alternate tetrahedral voids.

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16. Calculate the packing effeciency of a fcc crystal in which all the tetrahedral and octahedral voids are occupied by the largest spheres without disturibing the lattice.

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17. Using X -rays of wavelength 154.1 pm and staring from the glancing angle, the reflection fro sliver crystal was found to occur at $\theta = 22.20^\circ$. Calculate the spacing between the planes of Ag atoms that gave rise to the above reflection. $(\sin 22.20^\circ = 0.3778)$

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18. A reflaction from (111) planes of a cubic crystal was observed ad at a glancing angle of 11.2° when X -rays of wavelength 154 pm were used. What is the length of the side of the unit cell ? $(\sin 11.2^\circ = 0.1944)$

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19. When an electron in an excited state of Mo atom falls L to K -shell, an X -ray is emitted. These X -rays are diffranted at angle of 7.75° by planes with a sepration of 2.64Å . What is the difference in energy between K-shelll and L -shell in Mo, assuming a first order diffraction ? `(sin 7.75^(@) = 0.1349)

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