



CHEMISTRY

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THE SOLID STATE

Example

1. The number of atoms per unit cell of bcc lattice is



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2. Schottky defects and frenkel defects are two stoichiometric defects shown by crystals.

Name a crystal showing both schottky defects and frenkel defects.



Answer:



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3. Which type of stoichiometric defect is shown by AgCl?



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4. What is the coordination number of cation and anion in Caesium chloride?

A. 8,8

B. 10,5

C. 8,6

D. 4,4

Answer:



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5. Schottky defect is observed when

A. Density of the crystal is increased

B. Density of the crystal is decreased

C. Unequal number of cations and anions
are missing from the lattice

D. Equal number of cations and anions are
missing from the lattice

Answer:



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6. In which of the substances the carbon atom is arranged in a regular tetrahedral structures?

A. Benzene

B. Diamond

C. Graphite

D. Charcoal

Answer:



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7. Which solid has weakest intermolecular force

A. Diamond

B. Phosporus

C. Ice

D. None of these

Answer:



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8. A crystalline solid has

A. Short range order

B. Disorder

C. Long range order

D. Definite order

Answer:



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9. Which point defect in its crystal units alter the density of a solid ?



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10. The magnetic dipoles are _____ to each of other in ferromagnetic substances.



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11. ' Interstitial defect decreases the density of a solid "State whether this statement is true or false ?



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12. Observe the relationship between the first two terms and fill in the blanks: Simple cubic : $r = a/2$: body centred cubic : _____.



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13. Choose the correctly matched pair

A. Diamagnetic material - Fe , CrO_2

B. Paramagnetic material- Cu^{2+} , Fe^{2+}

C. Ferromagnetic material- TiO_2 , $NaCl$

D.

Answer:



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14. Coordination number of central sphere is ____ In body-centred cubic structure.



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15. The empty space in body centred cubic lattice is



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16. Which of the following lattices has the highest packing efficiency ?

A. Simple cubic

B. Body - centred cubic

C. Hexagonal close packed lattice

D. Face-centred cubic

Answer:



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17. “A crystalline solid changes abruptly from solid to liquid”. State whether this is statement is true or false?



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18. Rock salt type crystal structure has coordination number for each type of ion.



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19. “Substances like MnO shows paramagnetism”. State whether this statement is true or false?



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20. The unit cell dimensions of a particular crystal system is given below $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$ Identify the crystal system.



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21. Hcp and ccp are two different ways of three dimensional close packing: Will hcp and ccp structure for a given element have same density?



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22. Hcp and ccp are two different ways of three dimensional close packing: What is the available space occupied in hcp and ccp?



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23. The unit cell dimensions of a particular crystal system is given below $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$ Identify the crystal system.



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24. The unit cell dimensions of a particular crystal system is given below. $a = b = c, \alpha = \beta = \gamma \neq 90^\circ$. In a crystalline

solid, the atom A are arranged in CCP array and atom B occupy all the octahedral voids and half of the tetrahedral voids. What is the formula of the compound ?



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25. Identify the crystal systems which have the following crystallographic dimensions. Give one example for each.

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

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



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26. A certain metal M crystallises in FCC lattice. It forms a compound with element A and B. A occupies all the octahedral voids and B occupies half of the tetrahedral voids. Find out the empirical formula of the compound.



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27. A cubic solid is made up of elements P and Q. Atoms P are at the corners of the cube and

Q at the body centre . Identify the formula of the compound.



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28. A cubic solid is made up of elements P and Q. Atoms P are at the corners of the cube and Q at the bodycentre: If an additional P atom is added to the body centre, what would be the formula of the compound?



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29. Calcium crystallizes in a FCC unitcell with edge length 0.556nm. Calculate the density of the metal If it contains 0.2% Frenkel defects.



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30. Calcium crystallises in fcc lattice with edge length 0.5 nm. What is the density if it contains 0.1% Shottky defect?



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31. A substance 'A' crystallizes in fcc lattice.

Calculate the number of atoms present per unit cell of 'A'.



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32. In a crystalline solid, some point defects is observed when a vacancy is created by an ion missing from its normal position . What is the name of the defects?



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33. Semiconductors can be obtained by doping silicon with Al or with P. What is the basic difference between these doping?



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34. In terms of Intermolecular forces, explain why do some substances exist as solids?



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35. Given reason :Why is Frenkel defect found in AgCl?



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36. Given reason: What is the difference, between Phosphorus doped and Gallium doped semiconductors?



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37. Account for the following : The electrical conductivity of a metal decrease with rise in temperature while that of semi-conductor increases.



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38. NaCl does not exhibit frenkel defect. Do you agree? Justify.



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39. Assumes that a fresh piece of KCl crystal is heated in an atmosphere of potassium vapour. Is there any colour change? Substantiate your answer.



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40. Consider a FCC crystal lattice with anions 'Q'. If half of the octahedral sites of the lattice are occupied by the cations 'P'. Write the formula of the crystal.



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41. A metallic element crystallizes into a lattice containing a sequence of layers ABCABC.

Name the type of close packing in this element.



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42. A metallic element crystallizes into a lattice containing a sequence of layers ABCABC.

What is the co-ordination number of the above close packing ?



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43. A metallic element crystallizes into a lattice containing a sequence of layers ABCABC.

What percentage by volume of this lattice is empty space?



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44. Some solids are given below. Water, Brass, Quartz, Calcium fluoride. Make a table containing solids, type of solids, physical nature and electrical conductivity.



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45. Explain tetrahedral void in close packing.



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46. A compound forms 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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47. Explain the following terms with suitable examples: i. Schottky defect ii. Frenkel defect iii. Interstitials and iv. F-centres.



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48. Explain the following terms with suitable examples: i. Schottky defect ii. Frenkel defect iii. Interstitials and iv. F-centres.



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49. Explain the following terms with suitable examples: i. Schottky defect ii. Frenkel defect iii. Interstitials and iv. F-centres.



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50. A compound is formed by two elements M and N. The element N forms CCP and atoms of M, occupy $1/3$ of tetrahedral voids. What is the formula of the compound?



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51. Classify the following solids on the basis of bonding considerations : CO_2 , MgO , Al, H_2 , Si, Gd, Pb, AgCl.



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52. How does amorphous silica differ from quartz?



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53. Classify the following on the basis of magnetic properties and name of class.

Al , TiO_2 , CO , MnO_2 ,

Benzene,

O_2 , $NaCl$, NH_3 , Fe^{3+} , Ni



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54. What are the properties of anti ferromagnetism?



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55. The vacant space In close packed structures are called voids? Illustrate an octahedral void in the close packing of spheres .



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56. The vacant space in close packed structures are called voids? What is the number of tetrahedral voids and octahedral voids in a crystal having n particles ?



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57. Diamond is covalent solid in which carbon atoms are covalently bonded to form a three dimensional network structure: Graphite and Diamond are covalent solids. Do you agree with this statement?



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58. Diamond is covalent solid in which carbon atoms are covalently bonded to form a three dimensional network structure: Give two difference in properties of covalent and molecular solids.



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59. Based on the dimensions of unit cells, crystal can be classified into seven.

Name the crystalline system that resembles a match box.



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60. Based on the dimensions of unit cells, crystals can be classified into seven: Draw the structure of different cubic , unit cells and

calculate the number of atoms/particles in different cubic unit cells.



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61. In Beryllium crystal the layers of atoms are being arranged in a pattern of ABABAB-type
Name the close packed arrangement.



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62. In Beryllium-crystal the layers of atoms are being stacked in a pattern of ABABAB- type of arrangement. Calculate the number of tetrahedral and octahedral voids present in 0.5 mol of Be crystal



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63. A solid has a ccp arrangement of O^{2-} ions. All of the tetrahedral voids are occupied by Na^{+} ions. Find molecular formula.





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64. Calculate the atomic mass of an element which crystallises into a cubic structure with one atom on each corner of the cube. The volume of the unit cell is $24 \times 10^{-24} \text{ cm}^3$ and density is 7.2 g cm^{-3} .



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65. Temperature has no role In deciding the coordination number of a compound. What Is

your opinion about this statement? Justify.



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66. A scientist was performing X-ray diffraction studies on a crystal having rock salt structure. The molecular mass of the crystal is 239 g mol^{-1} . The density of the crystal was found to be 12.7 g cm^{-3} . The scientist is supposed to study only those crystals having edge length below 0.75 mm. Show whether the

crystal selected by the scientist was appropriate or not.



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67. A crystalline solid has a cubic structure In which Tungsten (W) atoms are located at the cubic comers of the unit cell, oxygen atoms at the cube edges and sodium atom at the cube centre. What is the molecular formula of the compound?



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68. A metal has a density of 2.6gcm^{-3} and its atomic mass is 27. Its cell has an edge length of 405 pm. What type of crystal lattice is for the metal?



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69. Calculate the efficiency of packing in case of a metal crystal for : Simple cubic.



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70. Calculate the efficiency of packing in case of a metal crystal for: Face centred cubic.



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71. Aluminium crystallises in a cubic, close packed structure. Its metallic radius is 125 pm :
What is the length of the side of the unit cell?



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72. 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 cm^3 of aluminium?



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73. Based on the nature of Inter-molecular forces classify the solids into different categories. Potassium sulphate, Tin, Brass,

Naphthalene, Ammonia, Water, Zinc sulphide, Graphite, Argon, Silicon carbide, Phosphorus.



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74. Account for the following : The electrical conductivity of a metal decrease with rise in temperature while that of semi-conductor increases.



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75. ZnO appears yellow on heating.



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76. Account for the following: Schottky defect lowers the density of ionic crystals while Frenkel defect does not.



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



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



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79. Based on the nature of order present in the arrangement of the constituent particles, solid are classified into two crystalline and amorphous.

List out any four points of difference between crystalline and amorphous solids.



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80. Though glass and quartz are both made up of SiO_4 they differ structurally. Mention the main structural difference between them.



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81. Distinguish between crystal lattice (space lattice) and unit cell.



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



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83. Non-stoichiometric cuprous oxide, ' Cu_2O ' can be prepared in laboratory. In this oxide, Copper to oxygen ratio is slightly less than '2:1'. Can you account for the fact-that this substance is a p-type semiconductor?



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84. Aluminium crystallises in a cubic, close packed structure. Its metallic radius is 125 pm : What is the length of the side of the unit cell?



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85. 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 cm^3 of aluminium?



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86. Stability of a crystal is reflected in the magnitude of its melting points'. Comment. Collect melting points of solid, water, ethyl alcohol, diethyl ether and methane from a data book. What can you say about the intermolecular forces between these molecules?



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87. Ferric oxide crystallises in a hexagonal close packed array of oxide ions with two out of every three octahedral holes occupied by ferric ion: Derive the formula of the ferric oxide.



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88. Which of the following lattices has the highest packing efficiency ?

A. Simple cubic

B. Body - centred cubic

C. Face-centred cubic

D.

Answer:



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89. Classify each of the following as being either a p-type or n-type semiconductor: Ge doped with B.



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90. Classify each of the following as being either a p-type or n-type semiconductor: Si doped with As



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91. Frenkel defect and Shottky defects are two stoichiometric defects found in crystalline solids.

Write any two differences between Frenkel defect and Schottky defect.



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92. An element crystallizes in F.C.C manner.

What is the length of a side of the unit cell if the atomic radius of the element is 0.144 nm?



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93. What are point defects? Explain the non stoichiometric point defects in ionic crystals.



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94. What is the co-ordination number of particles present in FCC crystal structure?



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95. Based on the nature of inter molecular forces, classify the solid: SiO_2



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96. Based on the nature of inter molecular forces, classify the solid:Ice



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97. ZnO appears yellow on heating.



98. Identify the non-stoichiometric defect

i) Schottky defect

ii) Frenkel defect

iii) Interstitial defect

iv) Metal deficiency defect

A. Schottky defect

B. Frenkal defect

C. Interstitial defect

D. Metal deficiency defect

Answer:



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99. What type of substance could make better permanent magnets - ferromagnetic or ferrimagnetic? Justify your answer.



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100. In terms of Band theory write the differences between conductor and insulator.



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101. Which of the following is a molecular solid?

A. Diamond

B. Graphite

C. Ice

D. Quartz

Answer:



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102. Unit cell can be classified into primitive and centred unit cells. Differentiate between primitive and centred unit cells.



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103. Presence of excess sodium makes NaCl crystal coloured. Explain on the basis of crystal defects.



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104. Unit cell can be divided into two categories primitive and centred unit cells.

Differentiate between unit cell and crystal lattice.



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105. Unit cell can be divided into two categories primitive and centred unit cells.

Calculate the number of atoms per unit cell in the following: Body centred cubic unit cell (bcc)



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106. Calculate the number of atoms per unit cell in the following :

Face centred cubic unit cell (fcc)



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107. Every substance has some magnetic properties associated with it. How will you account for the following magnetic properties?

Paramagnetic property



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108. Every substance has some magnetic properties associated with it. How will you account for the following magnetic properties?

Ferromagnetic property



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

all the tetrahedral voids. What is the formula of the compound?



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110. A crystal has an ordered arrangement of constituent particles: Define the term unit cell.



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111. A crystal has an ordered arrangement of constituent particles: Calculate the number of

atoms in simple cubic and body centred unit cells.



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112. A crystal has an ordered arrangement of constituent particles: Copper crystal has a face centred cubic lattice structure. Its density is 8.93 g cm^{-3} . What is the length of the unit cell?
Atomic mass of copper is 63.5 g mol^{-1} .



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113. NaCl has fcc structure. Calculate the number of NaCl units in a unit cell of NaCl.



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114. Calculate the density of NaCl, if edge length of NaCl unit cell is 564 pm. [Molar mass of NaCl = 58.5 g mol^{-1}].



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115. Name three types of solids classified on the basis of electrical conductivities.



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116. How will you explain such classification on the basis of Band theory?



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117. Schottky and Frenkel defects are stoichiometric defects.

Write any two differences between Schottky defect and Frenkel defect.



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118. Crystal defects give rise to certain special properties in the solids. What is meant by Frenkel defect.



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119. Crystal defects give rise to certain special properties in the solids:. Explain the pink colour of LiCl when heated in the vapours of Li.



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120. Crystal defects give rise to certain special properties in the solids. Why does LiCl not exhibit frenkel defect?



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121. When pure NaCl crystal is heated in an atmosphere of sodium vapour it turns yellow.

Give reason? KCl shows violet colour when heated In presence of Li vapour- Why?



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122. Classify the following crystals into those showing Schottky defects and Frenkel defects:

NaCl, AgCl, CsCl, CdCl₂



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123. Classify the following crystals into those showing Schottky defects and Frenkel defects:

AgCl, NaCl, ZnS, KCl



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124. Schottky defects and Frenkel defects are two stoichiometric defects shown by crystals.

Classify the following crystals into those showing Schottky defects and Frenkel defects:

NaCl, AgCl, CsCl, $CdCl_2$



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125. Schottky defects and Frenkel defects are two stoichiometric defects shown by crystals.

Classify the following crystals into those showing Schottky defects and Frenkel defects:

NaCl, AgCl, CsCl, $CdCl_2$



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126. The number of atoms per unit cell of bcc lattice is



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127. What type of substance could make better permanent magnets - ferromagnetic or ferrimagnetic? Justify your answer.



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128. Schottky defects and frenkel defects are two stoichiometric defects shown by crystals.

Classify the following crystals into those showing schottky defects and frenkel defects

NaCl, AgCl, CsCl, CdCl₂

name a crystal showing both schottky defects and frenkel defects.



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129. Schottky defects and Frenkel defects are two stoichiometric defects shown by crystals. Classify the following crystals into those showing schottky defects and frenkel defects :AgCl,NaCl,CsCl,CdCl₂



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130. Schottky defects and Frenkel defects are two stoichiometric defects shown by crystals. Classify the following crystals into those

showing schottky defects and frenkel defects

:CScI,ZnS,Kcl,AgBr,AgI



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131. Schotttcky defects and Frenkel defects are two stoichiometric defects shown by crystals.

Which type of defect observed in $CdCl_2$



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132. Schottky defects and Frenkel defects are two stoichiometric defects shown by crystals.

Name a crystal showing both Schottky defect and Frenkel defect.



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133. One of your friends said that radius ratio of NaCl is 0.52 .Can you predict geometry of voids and cordination number of NaCl?



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134. One of your friends said that radius ratio of NaCl is 0.52 :What is meant by radius ratio?



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



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136. Unit cell can be divided into two categories primitive and centred unit cells.

Differentiate between unit cell and crystal lattice.



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137. Unit cell can be divided into two categories , primitive, and centred unit cells :

Why does LiCl not exhibit Frenkel defect?



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138. Name three types of solids classified on the basis of electrical conductivities.



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

How will you explain such classification based on Band theory ?



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