CHEMISTRY

BOOKS - P BAHADUR CHEMISTRY (HINGLISH)

SOLID STATE

Exercise

1. The first $-$ order diffraction os $X-$ rays from a certain set of crystal planes occurs an angle of 11.8° from the planes. If the planes are $0.281nm$ apart, what is the wavelength of $X-$ rays?

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2. Under what conditions, the Bragg's equation wl fail to define a crystal ?

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3. Calculate the number (n) of atoms contained within (a) cubic cell, (b) a body $-$ centred cubic cell, (c) a face $-$ centred cubic cell.

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4. At room temperature, sodium crystallized in a body $-$ centred cubic lattrice with $a = 4.24\text{Å}$. Calculate theoretical density of sodium (at wt. of $Na = 23$).

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5. 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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6. 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 $8.92 g cm^{3}$.

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

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8. Thallium chloridde, $TlCl$ crystallized in either a simple cubic lattice or a face $-$ centred cubic lattice of Cl^{c-} ions with Tl^{+} ions in the holes. If the density of the solid is with Tl^{+} ions in the holes. If the density of the solide is $9.00gcm^{-3}$ and edge of the unit cell is $3.85 \times 10^{-8}cm$, what is the unit cell geometry ?

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

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

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11. Aluminium crystallizes in a cubic close-packed structre. Its metallic radius is $125p \pm$

a. What is the length of the side of the unit cell?

b. How many unit cell are there in $1.00 cm^3$ of aluminium?

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12. Gold (atoic radius = 0.144 nm) crystallizes in a facelcentred unit cell. What is the length of a side of the cell?

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13. 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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14. The radius of Cs^+ ion is $160 \pm$ while the radius of Cl^- ion is $181 \pm$. Suggest the co $-$ ordination of

cesium in $CsCl$.

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15. 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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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. A compound formed by elements A and B crystallizes in cubic structure, where A atoms are at the corners of a cube and B atoms are at the face $-$ centre. What is the formula of the compound ?

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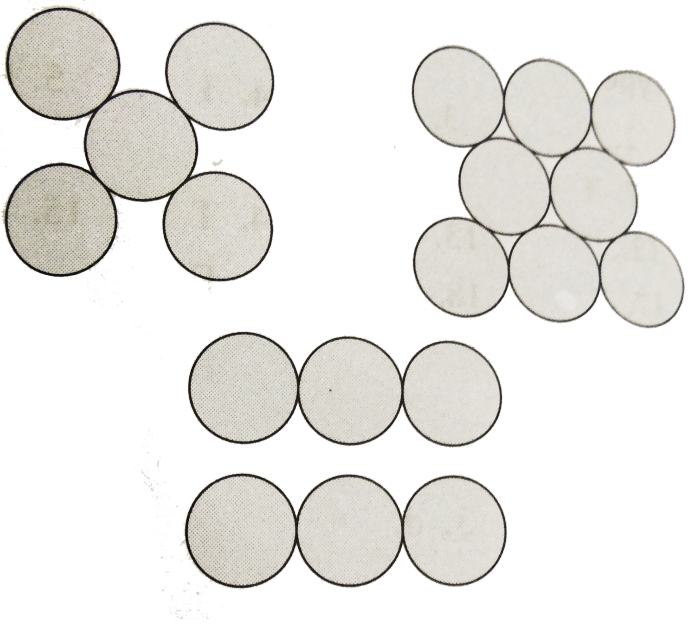
18. The figure below show the locations of atoms in three crystallographic planes in an fcc lattice. Draw the unit cells for these structure and identify these planes

in your diagrams.



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

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20. Chromium metal crystallizes with a body-centred cubic lattice. The length of the unit cell edge is found to be 287pm. Calculate the atomic radius. What woulds be the density of chromium in gcm^{-3}?

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21. 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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22. A unit of cell of sodium chloride has four formula units. The edge length of the unit cell is $0.564nm$. What is the density of sodium chloride?

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

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

(i) Find the density of lattice.

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

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25. 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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26. The edge length of unit cell of a metal having molecular weight $75gmol^{-1}$ is $5Å$ which crystallizes in cubic lattice. If the density is $2g\hat{}(-1)$, then find the radius of metal atom $\left(N_A = 6 \times 10^{23}\right)$. Give the answer in pm.

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27. Unit cell of Fe_2O_4(Ferrous ferrite) has $32O^{2-}$ ions in the unit cell. Then the unit cell of Fe_3O_4 has :

A. $16Fe^{2+}$ ions

B. $8Fe^{3+}$ ions

C. $16Fe^{3+}$ ions and $8Fe^{2+}$ ions

D. none of these

Answer:

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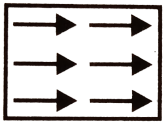
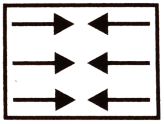
28. Paramagnetic substances are those, in which the individual atoms, ions or molecules posses a permanent

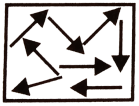
magnetic dipole moment. In the absence of an external magnetic field, the atomic dipoles of paramagentic substance are as below:

(a) 

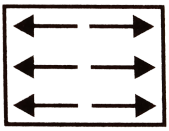
A. (A)

(b) 

B. (B)

(c) 

C. (C)

(d) 

D. (D)

Answer:

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29. In the above question, if an external magnetic field is applied, then the answer is :

A. (A)

B. (B)

C. (C)

D. (D)

Answer:

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30. Which of the following gases are of paramagnetic nature ?

A. Oxygen

B. N_2O_4

C. CO_2

D. H_2

Answer:

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31. Which of the following materials is not ferromagnetic ?

A. Iron

B. Cobalt

C. Nickel

D. Copper

Answer: d

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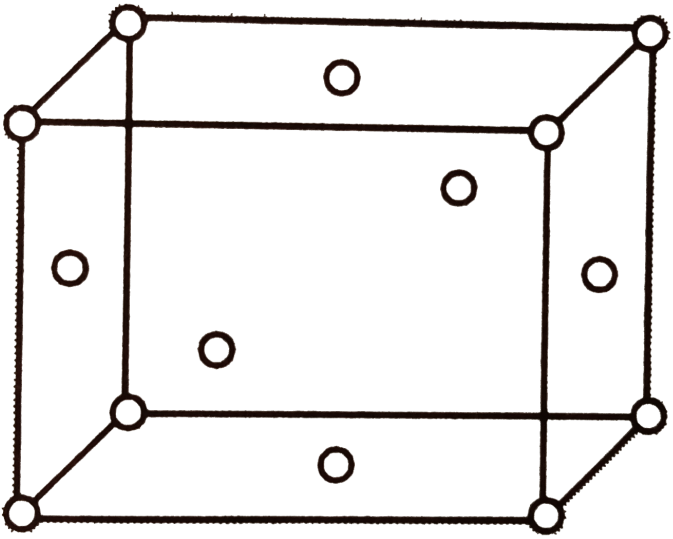
32. For the structure of solid given below, if the lattice points represent A^+ ions and the B^- ioins occupy the

tetrahedral voids, then coordination number of A is :



A. 2

B. 4

C. 6

D. 8

Answer: d

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33. In a crystal, some ions are missing from normal sites.

This is an example of :

A. $F-$ centres

B. interstitial defect

C. Frenkel defect

D. Schottky defect

Answer: d

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34. TiO_2 is well known example of :

A. triclinic system

B. tetragonal system

C. monoclinic system

D. none of these

Answer: B

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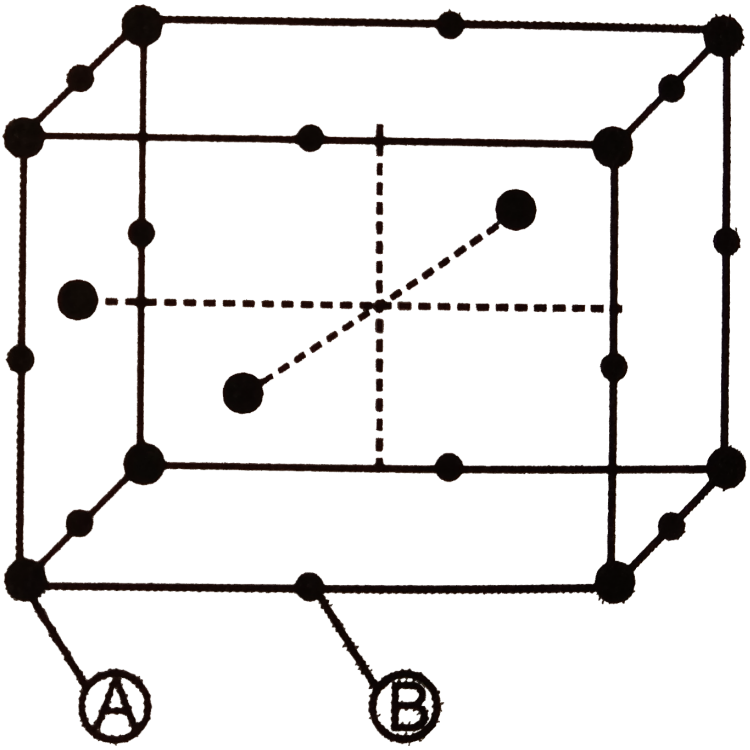
35. For a solid with the following structure, the coordination number of the point B is :



A. 3

B. 4

C. 5

D. 6

Answer: d

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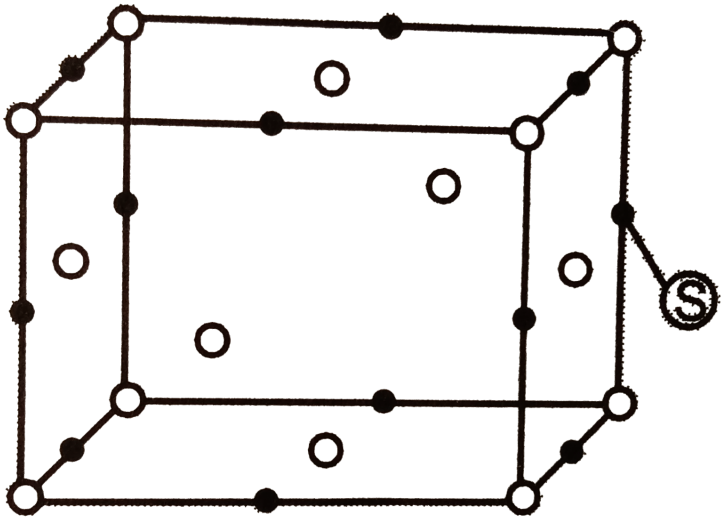
36. For the structure given below, the site marked as S is a :



A. tetrahedral void

B. cubic void

C. octahedral void

D. none of these

Answer: c

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37. The structue of sodium chloride crystal is :

A. body – centred cubic lattice

B. face – centred cubic lattice

C. octahedral

D. square planar

Answer: b

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38. Most crystals show good cleavage because their atoms, ions and molecules are :

A. weakly bonded together

B. strongly bonded together

C. spherically symmetrical

D. arranged in planes

Answer: d

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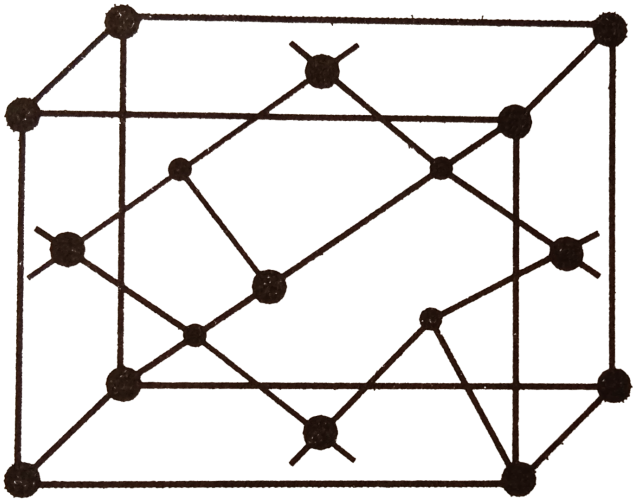
39. The following structure drawn is of:



A. fluorite

B. cesium chloride

C. wartzite

D. zinc blende

Answer: d

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40. The co – ordination number of a body – centred atom is :

A. 4

B. 6

C. 8

D. 12

Answer: c

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41. The ratio of closed packed atoms to tetrahedral holes in cubic close packing is :

A. $1:1$

B. $1:2$

C. $1:3$

D. $2:1$

Answer: b

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42. The vacant space in body $-$ centred cubic lattice $b.\ c.\ c.$ unit cell is about,

A. $32\ \%$

B. $10\ \%$

C. $23\ \%$

D. 46%`

Answer: a

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43. The melting point of $RbBr$ is $682^\circ C$, while that of NaF is $988^\circ C$. The principla reason that melting point

of NaF is much higher than that of $RbBr$ is that :

A. the two crystal are not isomorphous

B. the molar mass of NaF is smaller thean that of $RbBr$

C. the internuclear distance $r_c + r_a$ is greater for $RbBr$ than for NaF.

D. the bond in $RbBr$ has more covalent character than the bond in NaF.

Answer: c

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44. In solid NH_3 each NH_3 molecule has six other NH_3 molecules as nearest neighbouts. ΔH of sublimation of NH_3 at the melting point is $30.8 kJ mol^{-1}$ and the estimated ΔH of sublimation in the absence of $H-$ bonding is $14.4 kJ mol^{-1}$. What is the strength of a hydrogen bond in solid ammonia ?

A. $6.5 kJ mol^{-1}$

B. $16.5 kJ mol^{-1}$

C. $5.5 kJ mol^{-1}$

D. $4.5 kJ mol^{-1}$

Answer: C

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45. Extremely pure samples of Ge and Si are non $-$ conductors, but their conductivity increases suddenly on introducting ..... in their crystal lattice

A. arsenic

B. boron

C. both (a) and (b)

D. none of these

Answer: c

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46. The crystals are bonded by plane faces (f) straight edges (e) and interfacial angle (c). The relationship between these is :

A. $f + c = e + 2$

B. $f + e = c + 2$

C. $c + e = f + 2$

D. none of these

Answer: a

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

A. Cu_4Ag_4Au

B. Cu_4Ag_2Au

C. $CuAgAu$

D. Cu_4Ag_3Au

Answer: d

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48. The ratio of cations to anion in a octahedral close packing is :

A. 0.414

B. 0.225

C. 0.02

D. none of these

Answer: a

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49. If a is the length of unit cell, then which one is correct relationship ?

A. For simple cubic lattice, Radius of metal atom $= \frac{a}{2}$

B. For $b.\ c.\ c.$ lattice, Radius of metal atom $= \frac{\sqrt{3}a}{4}$

C. For $f.\ c.\ c.$ lattice, Radius of metal atom $= \frac{a}{2\sqrt{2}}$

D. All of these

Answer: d

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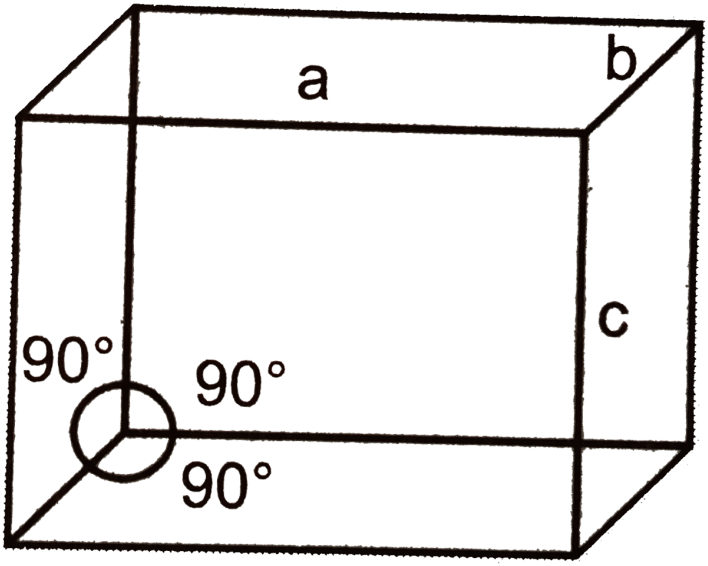
50. The unit cell with the structure below refers to ..... crystal system.



A. cubic

B. orthorhombic

C. tetragonal

D. trigonal

Answer: b

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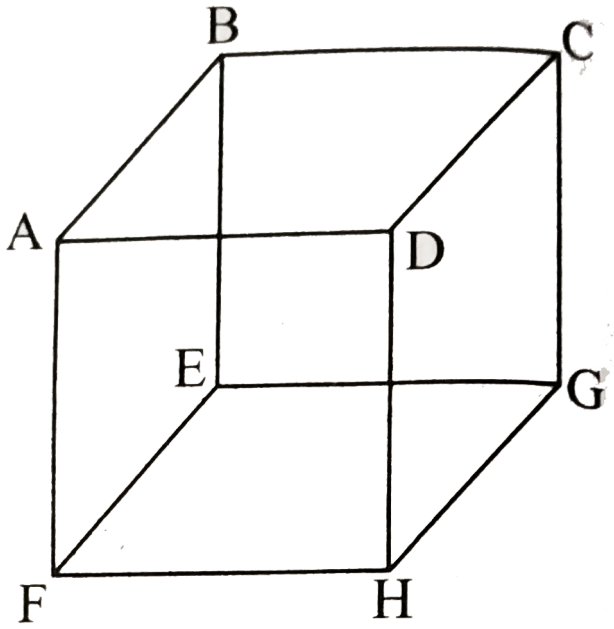
51. In the cubic lattice given below, the three distances between the atoms $A - B$, $A - C$, and $A - G$ are, respectively,



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

B. $a, \sqrt{3}a, \sqrt{2}a$

C. $a, \sqrt{2}a, \sqrt{3}a$

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

Answer: c

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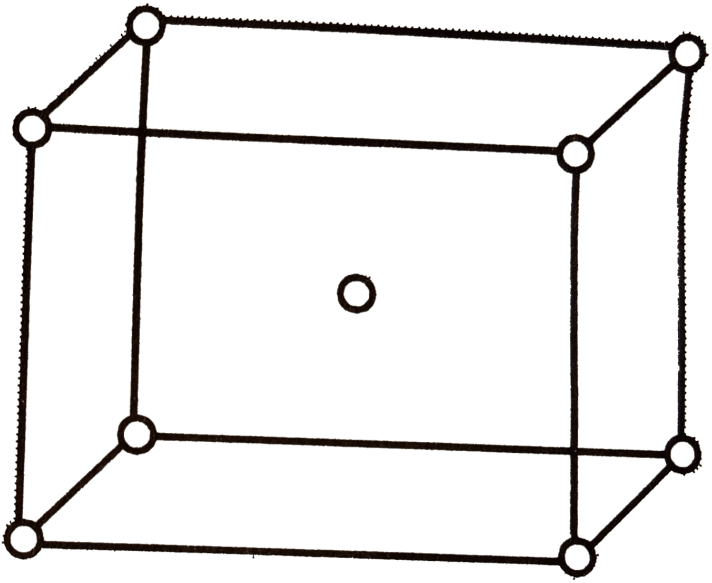
52. A solide A^+B^- has the B^- ions arranged as below. If the A^+ ions occupy half of the tetrahedral sites in

the structure. The formula of solid is :



A. AB

B. AB_2

C. A_2B

D. A_3B_4

Answer: a

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53. The radius of the Na^{2+} is $95pm$ and that of Cl^{-} ion is $181pm$. Predict the co $-$ ordination number of Na^{+} :

A. 4

B. 6

C. 8

D. unpredictable

Answer: B

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54. A metal crystallises in $b.c.c.$ lattice. The per cent fraction of edge length not covered by atom is :

A. $11.4\ \%$

B. $12.4\ \%$

C. $13.4\ \%$

D. $14.4\ \%$

Answer: c

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55. Silicon doped with arsenic is an example of :

A. $p-$ type conductor

B. $n-$ type conductor

C. $n-p-$ type conductor

D. none of these

Answer: b

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56. Which of the following statements is not correct?

A. The co $-$ ordination number of each type of ion in

$CsCl$ crystal is 8

B. A metal that crystallises in $b.\ c.\ c.$ structure has a co $-$ ordination no. of 12

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

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

Answer: b

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57. In a $f.\ c.\ c.$ arrangement of A and B atoms, where A atoms are at the corners of the unit cell and B atoms

at the face — centres, one of the A atom is missing from one corner in each unit cell. The formula of compound is :

A. $A_{24}B_7$

B. A_7B_{24}

C. A_7B_{28}

D. $A_{28}B_7$

Answer: b

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58. How many tetrahedral holes are occupied in diamond ?

A. $25\ \%$

B. $50\ \%$

C. $75\ \%$

D. $100\ \%$

Answer: b

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59. A solid XY has $NaCl$ structure. If radius of X^+ is $100pm$. What is the radius of Y^- ion ?

A. $120pm$

B. $136.6to241.6pm$

C. $136.6pm$

D. $241.6pm$

Answer: b

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60. The density of KBr is $2.75gcm^{-3}$ length of the unit cell is $654pm$. $K = 39, Br = 80$, then what is true about the predicted nature of the solide ?

A. Solid has face $-$ centred cubic system with co $-$ ordination number $= 6$

B. Solid has simple cubic system with co $-$ ordinatiion number $= 4$

C. Solid has face $-$ centred cubic system with co $-$ ordination number $= 1$

D. none of these

Answer: a

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

A. A_7B_3

B. AB_3

C. A_7B_{24}

D. $A_{7/8}B_3$

Answer: c

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62. The number of atoms per unit cell in a simple cube, face – centred cube and body – centred cube are respectively :

A. $1, 4, 2$

B. $1, 2, 4$

C. $8, 14, 9$

D. $8, 4, 2$

Answer: A

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63. Antifluorite structure is for :

A. TiO_2

B. Na_2O

C. both (a) and (b)

D. none of these

Answer: b

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64. Two ionic solid AB and CB crystallise in the same lattice. If r_{A^+}/r_{B^-} and r_{C^+}/r_{B^-} are 0.50 and 0.70 respectively, then the ratio of edge length of AB and CB is :

A. 0.88

B. 0.78

C. 0.68

D. 0.58

Answer: a

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65. A matchbox exhibits :

A. cubic geometry

B. monoclinic geometry

C. orthohombic geometry

D. tetragonal geometry

Answer: C

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66. Which arrangement of electrons leads to ferromagnetism ?

A. ↑ ↑ ↑ ↑ ↑

B. ↓ ↑ ↓ ↑

C. ↑ ↑ ↑ ↓ ↓

D. none of these

Answer: a

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67. Ferrimagnetic is converted into ferromagnetic at :

A. $300K$

B. $400K$

C. $600K$

D. $850K$

Answer: d

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68. An alloy of copper and gold crystallizes in cubic lattic, in which the $Au-$ atoms occupy the lattice points at the corners of cube and $Cu-$ atoms occupy the centre of each face. The formula of this alloy is :

A. $AuCu$

B. $AuCu_2$

C. $AuCu_3$

D. Au_3Cu

Answer: c

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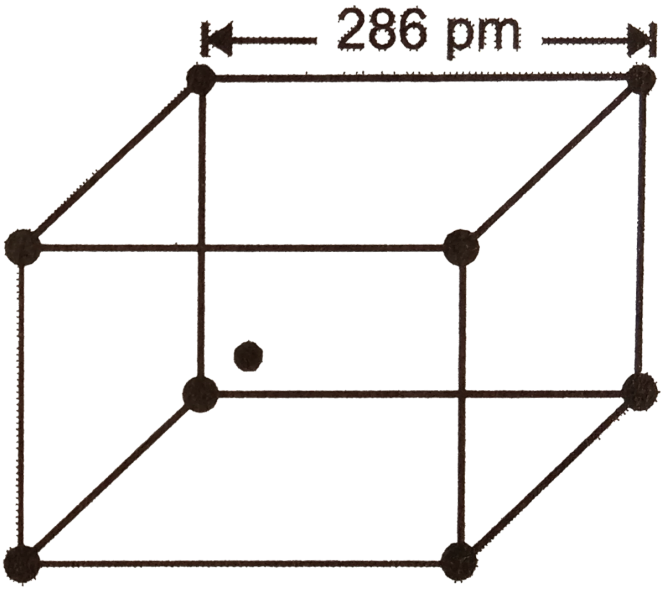
69. The crystal structure adopted by iron is shown below. The distance between the nearest iron atoms is :



A. $286pm$

B. $124pm$

C. $143pm$

D. $247.6pm$

Answer: d

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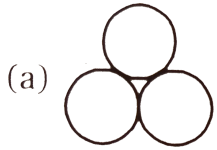
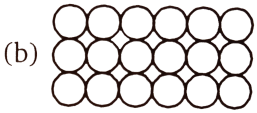
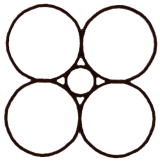
70. Which of the following figures represents the cross section of an OV?

A. 

B. 

C. 

D. (d) 

Answer: d

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71. The Ca^{2+} and F^{-} ions located in CaF_2 crystal respectively at $f.\ c.\ c.$ lattice points and in :

A. octahedral voids

B. tetrahedral voids

C. half of octahedral voids

D. half of tetrahedral voids

Answer: b

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72. If r is the radius of the octahedral voids and R is the radius of the atom in close packing,then :

A. $\frac{R}{r} = 9.1$

B. $\frac{R}{r} = 3.22$

C. $\frac{R}{r} = 2.41$

D. $\frac{R}{r} = 4.67$

Answer: d

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73. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avagadro number being $6.02 \times 10^{23} mol^{-1}$ the density of CsBr is

A. $8.5 g / cm^3$

B. $4.25 g / cm^3$

C. $42.5 g / cm^3$

D. $0.425 g / cm^3$

Answer: a

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74. The appearance of colour in solide state of alkali metal halides is generally due to :

A. Frenkel defect

B. Interstitial positions

C. $F-$ centres

D. Schottky defect

Answer: c

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75. The mole fraction of Schottky defect and Frenkel defects, in $NaCl$ crystal at $1000K$ are respectively. If

energy required to produce these defects are $2eV$ and $3eV$ respectively.

$\left(1eV = 1.6 \times 10^{-19}J \text{ and } k = 1.38 \times 10^{-23}JK^{-1}\right)$

A. 3.62×10^{-7} and 6.32×10^{-9})

B. 9.17×10^{-6} and 3.924×10^{-8}

C. 2.86×10^{-5} and 5.38×10^{-8}

D. 5.40×10^{-8} and 8.31×10^{-9}

Answer: b

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76. If a stands for the edge length of the cubic system : simple cubic, body — centred cubic anf face — centred cubic, then the ratio of radii of the spheres in these systems will be respectively :

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

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

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

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

Answer: c

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77. Which of the following relation is correct for first order Bragg's diffraction?

A. $\sin\theta = \frac{\lambda}{2a}\left(h^2 + k^2 + l^2\right)^{1/2}$

B. $\sin\theta = \frac{\lambda}{2a}\left(h^2 + k^2 + l^2\right)^{2}$

C. $\sin\theta = \frac{2a}{\lambda}\left(h^2 + k^2 + l^2\right)^{1/2}$

D. $\sin\theta = \frac{2a}{\lambda}\left(h^2 + k^2 + l^2\right)^{2}$

Answer: a

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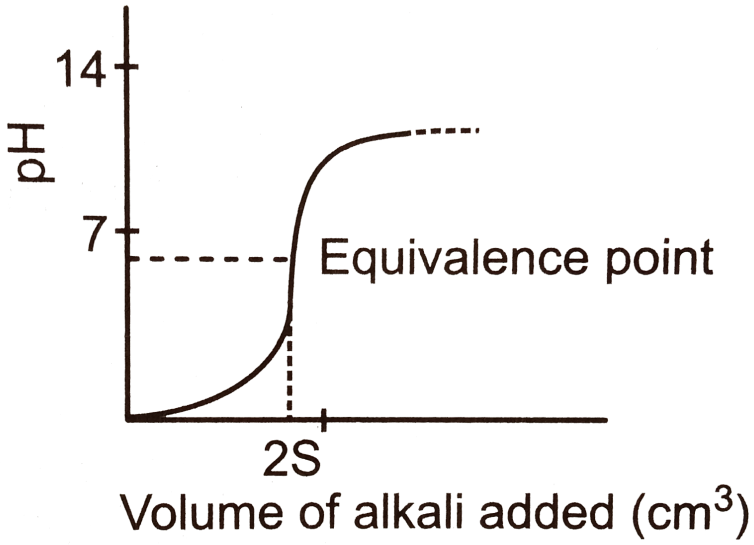

78.

The graph represents the titration curve for :

A. strong acid and strong base

B. strong acid and weak base

C. weak acid and stong base

D. weak acid and weak base

Answer: b

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79. Which of the following statements are correct ?

A. The co $-$ ordination number of each type of ions in $CsCl$ crystal is 8.

B. A metal that crystallizes in $b.c.c.$ structure has co $-$ ordination number of 12.

C. The length of a unit cell in $NaCl$ is $552pm$ $(r_{Na^+} = 95pm, r_{Cl^-} = 181pm)$

D. A unit cell of an ionic crystals shares some of its ions with other unit cells.

Answer: a,c,d

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

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

B. Frenkel defect is a dislocation defect.

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

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

Answer: b,c

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81. Which of the following are not the characteristics of crystalline solids ?

A. They are exhibit polymorphism

B. The are isotropic

C. They do not have thermodynamic defects

D. After melting, they become crystalline

Answer: b,c

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82. Which of the following statements are correct ?

A. The cations occupy more space than atoms in crystal packing

B. In Schottky defect, equal number of cation and anion vacancies are present

C. Ionic solids show change in density due to Frenkel defect.

D. An increase in pressure on $NaCl$ crystal, the $6:6$ co $-$ ordination changes to $8:8$ co $-$ ordination

Answer: a,b,d

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83. Which of the following statements are false ?

A. The radius of a metal atom is taken as half the nearest metal $-$ metal distance in a metallic crystal

B. One tetrahedral void per atom is present in $h.c.p.$ structure

C. In the fluorite structure (CaF_2), the Ca^{2+} ions are located at the lattice points and the fluoride ions fill all the tetrahedral holes in the $c.c.p.$ crystal

D. In the antifluorite structure (Li_2O, Rb_2S) the cations are located at the lattice points and anions fill the tetrahedral holdes in the $c.c.p.$ structure.

Answer: b,d

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84. If the radius of Na^+ ion is $95pm$ and that of Cl^- ion is $181pm$, then :

A. co $-$ ordination no. of Na^+ is 6

B. co $-$ ordination no. of Na^+ is 8

C. length of the unit cell is $552pm$

D. length of the unit cell is $380pm$

Answer: a,c

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85. Which of the following having their radius ratio between 0.414 to $0.73, i.e.,$ for $NaCl$ structure have

their radius ration not in theis range but possess $NaCl$ type structure ?

A. KCl

B. BaO

C. $RbCl$

D. $LiBr$

Answer: a,b,c,d

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86. Which of the following statement (s) is (are) correct ?

A. When the radius ration is in the range $0.414 - 0.732$, a $b.c.c.$ arrangement with co $-$ ordination no. 8

B. When the ration ratio is in the rage $0.225 - 0.414$, a tetrahedral arrangement with co $-$ ordination no . 4

C. When the radius ratio is in the range $0.155 - 0.225$, an octahedral arrangement with co $-$ ordination no . 6

D. In B_2O_3, smaller cations occupy triangular voids and a planar trigonal arrangement with co $-$ ordination no. 3

Answer: b,d

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87. In the crystal structure of $CsCl$:

A. Cl^- ions are present at the corners of a cube

B. Cs^+ ions are present in the cubic voids

C. Cl^- ions are present in the cubic voids

D. the close packed structure is formed by Cs^+ ions

Answer: a,b

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88. If radius of anion is $0.20nm$, the maximum radius of cations which can be filled in respective voids are correctly matched in :

A. $r^+ = 0.045nm$ triangular void

B. $r^+ = 0.0828nm$ for tetrahedral void

C. $r^+ = 0.1464nm$ for octahedral voids

D. none of these

Answer: a,b,c

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89. Which of the following statement(s) is (are) correct for $CaF + (2)$?

A. Ca^{2+} ions are present only at the corners of a cube

B. $c.\ c.\ p.$ type structure

C. F^{-} ions are present in all the octahedral voids

D. The structure has $8:4$ co $-$ ordination

Answer: b,d

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90. Which of the following statement are correct for the ionic solids in which positive and negative ions are held by strong electrostatic attractive forces ?

A. The radius ratio r^+/r^- increases as co $-$ ordination number increases

B. As the difference in size of ions increases co $-$ ordination number increases

C. When $co-$ ordination number is 8 , the r^+/r^- ratio lies between 0.225 to 0.414

D. In ionic solid of the type $AX(ZnS,$ Wurtzite $)$ the co $-$ ordination number of Zn^+ and S^+ are 4 and 4 respectively

Answer: a,b,d

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91. Na and Mg crystallise in $b.c.c.$ and $f.c.c.$ type crystals respectively, then the number of atoms of Na and Mg present in the unit cell of their repsectively crystal is :

A. 4 and 2

B. 9 and 14

C. 14 and 9

D. 2 and 4

Answer: D

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

A. 1.28×10^{21} unit cells

B. 1.71×10^{21} unit cells

C. 2.57×10^{21} unit cells

D. 5.14×10^{21}unit cells

Answer: C

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93. What type of crystal defect is indicated in the diagram given below

$Na^{\oplus}$	$Cl^{\ominus}$	$Na^{\oplus}$	$Cl^{\ominus}$	$Na^{\oplus}$	$Cl^{\ominus}$
$Cl^{\ominus}$	$\square$	$Cl^{\ominus}$	$Na^{\oplus}$	$\square$	$Cl^{\ominus}$
$Na^{\oplus}$	$Cl^{\ominus}$	$\square$	$Cl^{\ominus}$	$Na^{\oplus}$	$Cl^{\ominus}$
$Cl^{\ominus}$	$Na^{\oplus}$	$Cl^{\ominus}$	$Na^{\oplus}$	$\square$	$Na^{\oplus}$

A. Frenkel and Schottky defects

B. Schottky defect

C. Interstitial defect

D. Frenkel defect

Answer: B

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94. An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions on the centers of the faces of the cube .The empirical formula for this compound would be

A. AB

B. A_2B

C. A_3B

D. AB_3

Answer: d

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

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

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

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

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

Answer: D

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96. In a compound atoms of element Y form ccp lattice and those of element X occupy $2/3^{rd}$ of tetrahedral

voids .The formula of the compound will be

A. X_4Y_3

B. X_2Y_3

C. X_2Y

D. X_3Y_4

Answer: a

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97. Copper crystallises in fcc with a cell length of 361 pm .What is the radius of copper atoms?

A. $108pm$

B. $127pm$

C. $157pm$

D. $181pm$

Answer: B

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98. The edge length of a face-centred cubic unit cell is $508 \pm$. If the radius of the cation is $110 \pm$ the radius of the anion is

A. $288pm$

B. $398pm$

C. $618pm$

D. $144pm$

Answer: D

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99. Percentage of free space in cubic close packed struchure and in body centred structure are respectively.

A. $30\ \%$ and $26\ \%$

B. $26\ \%$ and 32%`

C. $32\ \%$ and $48\ \%$

D. $48\ \%$ and $26\ \%$

Answer: B

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

A. A_2B

B. AB_2

C. A_2B_2

D. A_2B_5

Answer: d

101. Lithium forms body centred cube structure .The length of the side of its unirt cell is 351 pm Atomic radius of the lithium will be

A. $300pm$

B. $240pm$

C. $152pm$

D. $75pm$

Answer: C

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

A. 12

B. 4

C. 8

D. 6

Answer: A

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103. 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: A

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104. A substance A_xB_y crystallizes in a face-centred cubic lattice in which atoms A occupy the centres of each face of the cube. Identify the correct composition of the substance A_xB_y.

A. AB_3

B. A_4B_3

C. A_3B

D. can not be specified

Answer: A

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105. In which of the following crystals, alternate tetrahedral voids are occupied?

A. $NaCl$

B. ZnS

C. CaF_2O

D. Na_2O

Answer: B

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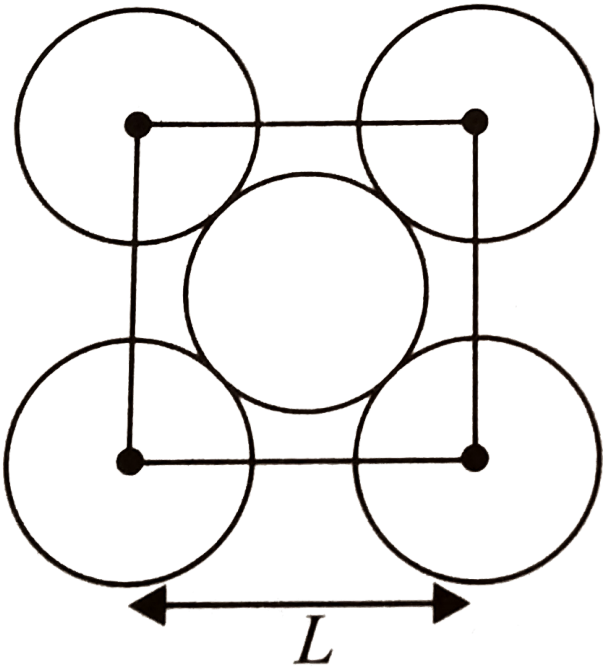
106. The packing efficiency of a two-dimensional square unit cell shown below is



A. $32.97\,\%$

B. $68.02\,\%$

C. $74.05\,\%$

D. $78.54\,\%$

Answer: D

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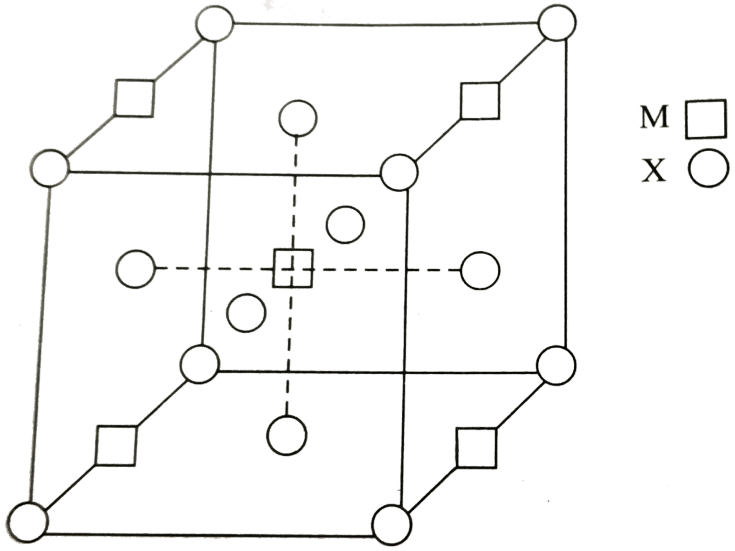
107. A compound M_pX_q has cubic close packing (p) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



a. MX **b.** MX_2 **c.** M_2X

A. MX

B. MX_2

C. M_2X

D. M_5X_{14}

Answer: b

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108. A molecule $A_2B(Mw = 166.4)$ occupies triclinic lattice with $a = 5Å$, $b = 8Å$, and $c = 4Å$,. If the density of AB_2 is $5.2gcm^{-3}$, the number of molecules present in one unit cell is

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109. Chromium metal crystallizes with a body-centred cubic lattice. The length of the unit cell edge is found to be 287pm. Calculate the atomic radius. What woulds be the density of chromium in gcm^{-3}?

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110. Calculate the number of atoms in a cubic-shared unit cell having one atom on each corner and two atoms one each diagonal.

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111. If the radius of Cs^+ si $169pm$ and that of Cl^- is $181pm$, then find the co $-$ ordination number of Cs^+

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112. A compound AB_x is formed such that A atoms are at corners and B atoms at face centre. Find the value of x.

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113. Ice crystallizes in hexagonal lattice. At the low temperature at which structure was determined, the

lattice contents were were $a = 4.53Å$ and $c = 7.41Å$.

$c = 741Å$. Calcuate the no. of H_2O molecules present in a unit cell. (Density of ice $= 9.22g/cm$)

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114. The density of Cr atoms is $7.02g/cm$. If the unit cell has edge length $289pm$. Calculate the number of chromium atoms per unit cell. (at masss of $Cr = 52$).

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115. In $CsCl$ with cubic structure, Cl^- ions are located at each corner and Cs^+ ions at the centre of the unit

cell. If r_{Cs^+} and r_{Cl^-} and 1.69Å and 1.81Å respectively.

Find the value of edge length of cube.

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116. Find the coordination of $Na^{\oplus}$ in Na_2O.

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117. The density of KBr is 2.73g//cm . $The \leq n > hoftheunitcellis$654p m` . Find the number of atoms per unit cell in the cubic structure.

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118. At room temperature, sodium crystallized in a body $-$ centred cubic lattrice with $a = 4.24\text{Å}$. Calculate theoretical density of sodium (at wt. of $Na = 23$).

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119. 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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120. $1mole$ of an ideal monoatomic gas is mixed with $1mole$ of an ideal diatomic gas. The molar specific heat

of the mixture at constant volume is :

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121. Temperature of $1mol$ of a gas is increased by 1° at constant pressure. The work done is

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122. For a gaseous reaction $A + 3B \Leftrightarrow 2C, \Delta H^\circ = -90.0kJ, \Delta S^\circ = -200.0jk^{-1}$ AT $400k$. The ΔG° for the reaction $\frac{1}{2}A + \frac{3}{2}B \to C$ at $400K$ is :

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123. Find the number of Na^+ ions and Cl^- ions associated with each in a unit cell and $NaCl$.

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124. Find the number of hexagonal faces that are present in a truncated octahedral.

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125. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the

interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23} g$.

The density of solid is :

A. $2.16 g / cm^3$

B. $0.54 g / cm^3$

C. $1.08 g / cm^3$

D. $1.562 g / cm^3$

Answer: a

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126. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23}g$.

The ionic radius of B ion assuming anion $-$ anion contact is :

A. 1.815Å

B. 1.994Å

C. 1.682Å

D. 1.712Å

Answer: b

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127. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23}g$.

The ionic radius for A^+ ion is :

A. 0.755Å

B. 0.625Å

C. $0.826Å$

D. $0.914Å$

Answer: c

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128. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23}g$.

The co $-$ ordination number of solid is :

A. 8

B. 6

C. 4

D. 2

Answer: b

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129. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of

solid has mass $9.712 \times 10^{-23} g$.

Which statement is wrong about solid is :

A. Cation fills the void

B. The solid has octahedral voids filled by A^{+} ions

C. Anion fills the void

D. Each anion has six octahedral holes

Answer: c

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130. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units.

Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23} g$.

The structural arrangement of AB is :

A. cubic

B. octahedral

C. tetrahedral

D. triangular

Answer: b

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131. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23}g$.

The solid AB is supposed to have structure like :

A. $NaCl$

B. $CsCl$

C. ZnS

D. BaS

Answer: a

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132. A solid made up of ions of A and B possess edge length of unit cell of $0.5664nm$ has four formula units. Among the two ions, the smaller one occupy the interstitial void and the larger ions occupy the space lattice with ccp type of arrangement. One molecule of solid has mass $9.712 \times 10^{-23}g$.

The solide AB is supposed to show :

A. Schottky defect

B. Frenkel defect

C. non $-$ stoichiometric defect

D. none of these

Answer: A

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133. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the

second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The number of atom in this hcp unit cell is

A. 4

B. 6

C. 12

D. 17

Answer: B

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134. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second

layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The voume of this hcp unit cell is

A. $24\sqrt{2}r^3$

B. $16\sqrt{2}r^3$

C. $12\sqrt{2}r^3$

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

Answer: a

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135. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the

bottom layer in relative position. Assume the radius of every sphere to be r.

The empty space in this hcp unit cell is

A. $74\ \%$

B. $47.6\ \%$

C. $32\ \%$

D. $26\ \%$

Answer: d

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136. The $CsCl$ has cubic structure of Cl^- ions in which Cs^+ in which Cs^+ ion is present in the body centre of the cube. It density is $3.99gcm^{-3}$.

Then length of the edge of unit cell is :

A. $312pm$

B. $412pm$

C. $436pm$

D. $536pm$

Answer: b

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137. $CsCl$ has cubic structure. Its density is $3.99gcm^{-3}$.

What is the distance between $Cs^{\oplus}$ and Cl^{Θ} ions?

(Atomic mass of $Cs = 133$)

A. $256.8pm$

B. $348.8pm$

C. $248.\ 8pm$

D. $356.8pm$

Answer: d

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138. The $CsCl$ has cubic structure of Cl^- ions in which Cs^+ in which Cs^+ ion is present in the body centre of the cube. It density is $3.99gcm^{-3}$.

The radius of Cs^+ ion if the radius of Cl^- ion is $180pm$ is :

A. $180.6pm$

B. `276.8p m

C. $176.8pm$

D. $280.6pm$

Answer: c

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139. Statement: Initially the term pseudo – solid was given for solids which were easily distorted by bending and compressing forces. They even tend to flow slowly under its own weight and lose shape.

Explanation : These, characteristics are shown by pseudo – solids as in pitch, glass and thus the name pseudo – solid was replaced by super – cooled liquids.

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140. Assertion :The close packing of atoms in cubic structure is in the order $f > b > sc$

Reason: Packing density $= \dfrac{\text{Volume of unit cell}}{a^3}$

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141. Assertion : In hexagonal close packing vaccant space are between three touching spheres whose centes lie at the coeners of an equilateral traingle

Reason :In hexagonal close packing voids are called voids are called square voids

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142. Assertion :Bragg's equation has no solution, if $n = 2 \text{ and } \lambda > d$

Reason : Bragg's equation is $n\lambda = 2d \sin\theta$

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143. Statement : $6:6co-$ ordination at normal tempeature and pressure changes to $8:8$ co $-$ ordination at high pressure.

Explanation : Pressure influences the structure of solids.

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144. Statement : $8:8$ co $-$ ordination of $CsCl$ at low temperature changes to $6:6$ co $-$ ordinationat $760K$.

Explanation : Temperature also infuences the strutures of solids.

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145. Statement : Solids containing $F-$ centres are paramagnetic.

Explanation : $F-$ centres solids possess holes occupied by unpaired electrons.

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146. Assertion : Solids having more F-centre possess intense colour

Reason: Excess of Na^+ in $NaCI$ solid having F-centers makes it appear pink

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147. Statement : The conductance through electrons is called $n-$ type conductance and if through positive holes it is called $p-$ type conducton.

Explanation : Doping involves preparation of semi $-$ conductors by the presence of impurities in the intrisic semi $-$ conductor.

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148. Statement I: In any ionic solid $[MX]$ with Schottky defect, the number of positive and negative ions are same.

Statement II: An equal number of cation and anion vacancies is present.

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149. Statement : Due to Frenkel defect the density of the crystalline solid remains same.

Explanation : In Frenkel defect, no cations or anions leave the lattice.

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150. Statement : Schottky defect is generally shown by the compounds with high co – ordination no.

Explanation : Equal no. of cations and anions are missing from the lattice sites in Schottky defect.

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151. Calculate the number (n) of atoms contained within (a) cubic cell, (b) a body $-$ centred cubic cell, (c) a face $-$ centred cubic cell.

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152. A body $-$ centred cubic lattice is composed of anions Q and cations P, where ions Q occupy the corners and ions P occupy the centre.

(i) What is the formula of the compound ?

(ii) What is the co $-$ ordination number of P and Q ?

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153. A compound formed by elements A and B crystallizes in cubic structure, where A atoms are at the corners of a cube and B atoms are at the face $-$ centre. What is the formula of the compound ?

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154. 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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155. In a close packed structure of an ionic compound anions B form the close packed lattice and the cations A occupy octahedral voids.Predict the formula of the compound.

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

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157. A solid between A and B has the following arrangement of atoms :

(i) Atoms A are arranged in $c.c.p.$ array.

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

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158. In a closed packed structure of mixed oxides, the lattice is composed of mixed oxides ions. One-eighth of tetrahedral voids are occupied by divalent cation $\left(A^{2+}\right)$ while one-half of octahedral voids are occupied by trivalent cations $\left(B^{3+}\right)$. The fromula of mixed oxide is

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159. In a crystal of an ionic compound, the anions B form a close packed lattice and the cations A occupy one half of the tetrahedral voids. What is the formula of the compound ?

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160. In a crystal of an ionic compound, the anions B form a close packed lattice and the ions A occupy all the tetrahedral voiods. What is the formula of the compound ?

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161. A closed packed structure of uniform spheres has the cell edge $= 0.8mm$. Calculate the radius of molecule if it has :

(a) simple cubic lattice,

(b) $b.\ c.\ c.$ lattice,

(c) $f.\ c.\ c.$ lattice.

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162. An ionic solid $A^{\oplus}B^{\Theta}$ crystallizes as an bcc structure. The distance between cation and anion in the lattice is $338 \pm$. The edge length of cell is

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163. The edge length of a body $-$ centred cubic unit cell is $390pm$. If the radius of the cation is $150pm$, what is the radius of the anion ?

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164. The edge length of a face $-$ centred cubic unit cell is $508pm$. If the radius of the anion is $144pm$, what is the radius of the cation ?

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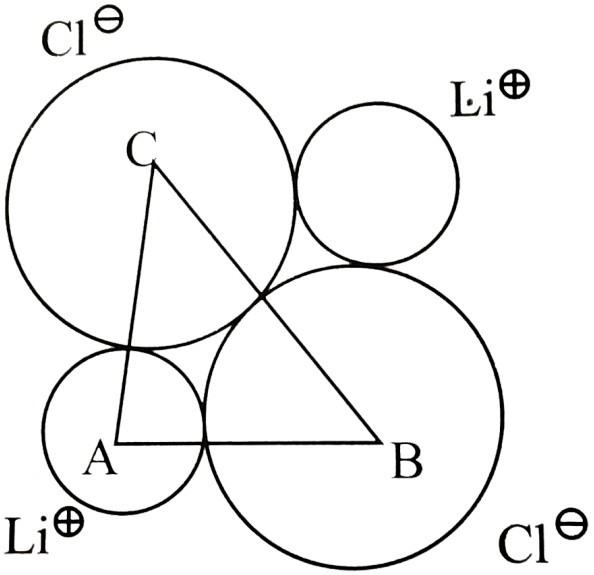
165. The unit cube length for $LiCl$ ($NaCl$ structure) is $5.14Å$. Assuming anion-anion contact, calculate the

ionic radius for chloride ion.



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

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167. Cesium bromide crystallizes in the cubic system. Its unit cell has a Cs^+ ion at the body centred and a Br ion at each corner. Its density is $4.44 gcm^{-3}$. Determine the length of the unit cell edge.

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168. Calculate the value of Avogadro number from the internuclear distance of adjacent ions in $NaCl, 0.282nm$ and the density of solid $NaCl$ is $2.17 \times 10^3 kg/m^3$. A unit cell contains $4NaCl$ formula units.

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169. Lithium borohydride crystallizes in an orthorhombic system with 4 molecule per unit cell. The unit cell dimensions are $a = 6.8\text{Å}, b = 4.4\text{Å}$ and $c = 7.2\text{Å}$. If the molar mass is 21.76, calculate density of crystal.

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170. An element crystallizes as body $-$ centred cubic lattic. Its density is $7.12 g cm^{-3}$ and the length of the side of the unit cell is 2.88Å. Calculate the number of atoms present is $288 g$ of the element.

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171. A compound $CuCl$ has face $-$ centred cubic structure. Its density is $3.4gcm^{-3}$. What is the length of unit cell ?

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172. The density of KCl is $1.9893g.\ cm^{-3}$ and the length of a side of unit cell is 6.29082Å. The value of Avogadro's number is:

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173. A face-centred cubic element (atomic mass 60) has a cell edge of 400 pm. What is its density?

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174. Potassium fluoride (KF) has $NaCl$ structure . Its density is $2.48gcm^{-3}$ and its molar mass is $58gmol^{-1}$. Compute the distance between K^{+} and $F^{-}ions \in$ KF`.

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175. At room temperature, sodium crystallized in a body $-$ centred cubic lattrice with $a = 4.24\text{Å}$. Calculate

theoretical density of sodium (at wt. of $Na = 23$).

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176. 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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177. 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 $7.2 g cm^{-3}$. Calculate the number of atoms present in $200 g$ of element.

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178. The density of solid argon is $1.65 g/mL$ 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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179. 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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180. If $NaCl$ is doped with 10^{-3} mol% of $SrCl_2$, what is the concentration of cation vacancies?

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181. 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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182. Calculate λ of X-rays which give a diffraction angle $2\theta = 16.8^{\circ}$ for crystal, if the interplanar distance in the crystal is $0.2nm$ and that only for the first-order diffraction is observed. Given $\sin 8.40^{\circ} = 0.146$.

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183. The angle of diffraction 2θ for a first $-$ order nature was found to be $27^{\circ}8'$ using $X-$ rays of wavelength 2.29Å. Calculate the distance between two diffracted planes.

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Exercise 9

1. 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 $193g/cc$, calculate the apparent radius of a gold ion in the solid.

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