CHEMISTRY

RESONANCE ENGLISH

SOLID STATE

Solved Examples

1. Identfity molecular solide, covalent solid, ionic solid:

$P_4(s), S_8(s), SiC(s), Al_2O_3(s), He(s), Al_2Cl_6(s)$

.

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2. The lattice parameters of a given crystal are $a = 5.62\text{Å}, b = 7.41\text{Å}$ and $c = 9.48\text{Å}$. The three cordinate axes are mutually perpendicular to each other. The crystal is:

A. tetragonal

B. orthorhombic

C. monoclinic

D. trigonal

Answer: B

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3. Tetragonal crystal system has the following unit cell dimensions.

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

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

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

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

Answer: B

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4. In a face centred cubic arrangement of A and B atoms. A are present at the corners of the unit cell and B are present at the face centres. If on atom of A is missing from its position at the corner, what is the formula of the compound ?

A. A_7B_3

B. AB_3

C. A_7B_{24}

D. A_2B_3

Answer: C

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5. A compound has cubical unit cell in which X atom are present at 6 corner, Y atom are at remaining corner & only at those face centres which are not opposite to each other & Z atoms

are present at remaining face centre & body centre then find.

(i) Formula of compound (ii) Density if edge length $= 2\text{Å}$

Given: Atomic mass of X = 40 amu, Y = 60 amu, Z = 80 amu

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6. How many 'nearest' and 'next nearest' neighbours respectively does potassium have in s.c. lattice :

A. 8,8

B. 8,6

C. 6,8

D. 8,2

Answer: B

7. If a metal has a bcc crystal structure, the coordination number is 8 because:

A. each atom touches four atoms in the layer above it, four in the layer below it and none in its own layer

B. each other touches four atoms in the layer above it. four in the layer below it and one in its own layer

C. two atoms touch four atoms in the layer above them, four in the layer below them, and none in their own layer.

D. each atom touches eight atoms in the layer above it, eight in the layer below it and none in its own layer

Answer: A

8. Potassium crystallizes in body centered cubic lattice with a unit cell length $a = 5.2\text{Å}$

(A) what is the distance betweenn nearest neighbourss?

(B) What is the distance between next nearest neighbour ?

(C) How many nearest neighbours does each K atom have ?

(D) How many next nearest neighbours does each K has ?

(E) What is calculated density of crystalline K

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9. A metal crystallises into two cubic phases , face centred cubic (fcc) and body centred cubic (bcc) , whose unit cell lengths are 3.5 Å and 3.0 Å

, respectively. The ratio of densities of fcc and bcc is

A. 3.12

B. 2.04

C. 1.26

D. 0.72

Answer: C

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10. In a ccp structure, the:

A. first and third layers are repeated

B. first and fourth layers are repeated

C. second and fourth layers are repeated

D. first, third and sixth layers are repeated

Answer: B

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11. Lithium borohydride crystallizes in an orthormobic system with 4 molecules 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, then the density of crystals is:

A. $0.6708 gcm^{-2}$

B. $1.6708 gcm^{-3}$

C. $2.6708 gcm^{-3}$

D. None of these

Answer: A

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12. An fcc lattice has a lattice parameter $a = 400$ pm. Calculater the molar volume of the lattice including all the empty space.

A. 10.8 mL

B. 96 mL

C. 8.6 mL

D. 9.6 mL

Answer: D

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13. In a face centred cubic arrangement of metallic atoms, what is the relative ratio of the sizes of tetrahedral and octahedral voids ?

A. 0.543

B. 0.732

C. 0.414

D. 0.637

Answer: A

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14. The numbers of tetrahedral and octahedral holes in a ccp array of 100 atoms are respectively

A. 200 and 100

B. 100 and 200

C. 200 and 200

D. 100 and 100

Answer: A

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15. Copper has a face $-$ centred cubic structure with a unit $-$ cell edge length of 3.61Å. What is the size of the largest atom which could fit into the intersectices of the copper lattice without distorting if ?

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16. A mineral having the formula AB_2 crystallizes in c.c.p. lattice, with A atoms occupying the lattice points. The coordination number of A is 8 and that of B is 4. What percentage of the tetrahedral sites is occupied by B atoms?

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17. $CsBr$ has bcc stucture with edge length 4.3 A .The shortest interionic distance in between Cs and Br is

A. 3.72

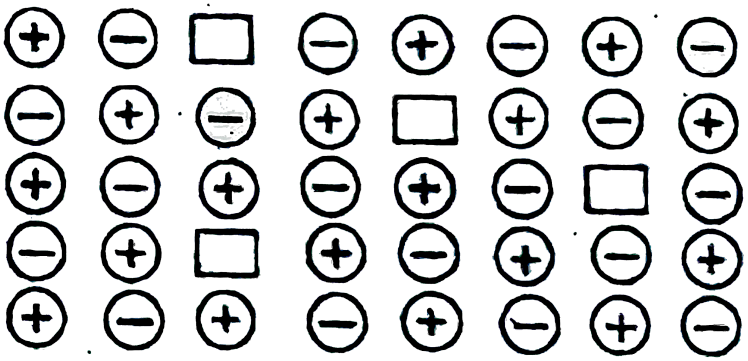
B. 1.86

C. 7.44

D. 4.3

Answer: A

18. Which of the following is incorrect



A. The defect is known as Schottky defect

B. Density of compound in the defect decreases

C. NaCl(s) is example which generally shows this defect

D. Stoichiometry of compound will change slightly

Answer: D

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19. Ferrous oxide (FeO) is experimentally found to have the formul $Fe_{0.93}O$. Find the %age of Fe ions in $+3$ state

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

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21. 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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Miscellaneous Solved Problems

1. Calculate the number of fornula units in each of the following types of unit cells:

(a) MgO in a rock salt type unit cell

(b) ZnS in zinc blende structure

(c) platinum in a face-centred cubic unit cell

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2. A mineral having the formula AB_2 crystallizes in c.c.p. lattice, with A atoms occupying the lattice points. The coordination number of A is 8 and that of B is 4. What percentage of the tetrahedral sites is occupied by B atoms?

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3. (a) What is the C.N. of Cr atom in bcc structure ?

(b) Cobalt metal crystallises in a hexagonal closest packed structure. What is the C.N. of

cobalt atom?

(c) Describe the crystal structure of Pt, which crystallises with four equivalent atoms in a cubic unit cell

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4. Titanium metal has a density of $4.54 \mathrm{g\ cm}^{-3}$ and an edge length of 412.6 pm. In what cubic unit cell does titanium crystallise ?

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5. 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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6. A solid AB has a rock salt structure . If radius of cation A^+ is 120 pm, what is the minimum value of radius of B^- anion ?

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7. Co-ordination number (CN) of barium ion $\left(Ba^{2+}\right)$ in BaF_2 is 8. What is the CN of F^- ion ?

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8. The radius of calcium ion is 94 pm and of oxide ion is 146pm. Predict the crystal structure of calcium oxide.

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9. Sodium metal crystallizes in a body centered cubic lattice with the cell edge $a = 4.29\text{Å}$. The radius of sodium atom is:

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10. CsCl has bcc structure with Cs^+ at the centre and Cl^- ion at each corner. If $r_{cs+} is 1.69\text{Å}$ and $r_{Cl-} is 0.81\text{Å}$, what is the edge length of the cube?

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11. Platinum (atomic radius $= 1.38\text{Å}$) crystallises in a cubic closed packed structure. Calculate the edge length of the face-centred cubic unit cell and the density of the platinum (Pt = 195)

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12. Calculate the edge length of the unit cell of sodium chloride given density of NaCl is $2.17 \times 10^3 kgm^{-3}$ and molecular weight $58.5 \times 10^{-3} kgmol^{-1}$.

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13. 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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14. In a cubic close packed structure (ccp) of mixed oxides, it is found that lattice has O^{2-} ions and one half of the octahedral voids are occupied by trivalent cations $\left(A^{3+}\right)$ and one-

eighth of the tetrahedral voids are occupied by divalent cations $\left(B^{2+}\right)$. Derive the formula of the mixed oxide.

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15. An element crystallises as face-centred cubic lattice with density as $5.20g/cm^3$ and edge length of the side of unit cell as 300pm. Calculate mass of the element which contains 3.01×10^{24} atoms

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16. Calcium crystallises in a face $-$ centred cubic unit cell with $a = 0.556nm$. Calculate the density if it contained $0.1\,\%$ Vacancy defects.

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Exercise 1

1. Classify each of the following solids as ionic, metallic, molecular, network (covalent) or amorphous :

(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.

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2. What are the crystallographic parameter of hexagonal, monoclinic and triclinic unit cell respectively

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3. The intermetallic compound $LiAg$ crystallizes in cubic lattice in which both lithium and silver have coordination number of 8. The crystal class is

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4. The body centered cubic cell of chronium has an edge lenth of 0.288nm. Calculte the density of chromium $\left(g/cm^3\right)$: $(\text{Atomic mass}: Cr = 52.0)$

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5. In which type of 3D arrangement have 1^{st} and IV layer's of sphere are identical

6. Metallic magensium has a hexagoanl close-packed structure and a density of $1.74g/cm^3$. Assume magnesium atoms to be sphere of radius r. 74.1 % of the space is occupied by atoms. Calculate the volume of each atom and the atomic radius r.(Mg = 24.31)

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7. Aluminium metal (atomic weight = 27 g) crystallises in the cubic system with edge length 4.0Å. The density of metal is 27.16 amu/Å^3. Determine the unit cell type and calculate the radius of the Aluminium metal.

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8. Tom' cat arranges the glass balls, in a particular 3D array, that two (I and II)

continuous layer are not identical, but all (I and III) alternative layer are identical, this type of arrangement is known as:

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9. A student wants to arrange 4 identical spheres (of radiusR) on a two dimensional floor as close as possible. Finally he could arrange them. Identify the type and dimensions of the figure obtained by joining their centers. Could he occupy the whole available space, if not, then what type of voids were generated. Calculate

their number and radius of small ball that can be fitted in them.

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10. Illustrate an octahedral void in the close packing of spheres. Why is it so called ?

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11. The number of tetrahedral and octahedral voids in a hexagonal close packed unit cell are:

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12. What is the number and closest distance between two octahedral voids and two tetrahdral voids in fcc unit cell ?

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13. Suggest the probable structures of the unit cells of the following each compound with the

help of given data

		Cationic radius	Anionic radius
(a)	$RbBe$	1.04Å	1.95Å
(b)	$MeTe$	0.65Å	2.21Å
(c)	MgO	0.65Å	1.40Å
(d)	BaO	1.35Å	1.40Å

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14. Why does ZnS not crystallize in the NaCl structure ?

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15. Try to answer the following:

(i) In Zinc Blende structure there is one Zn^{+2} ion per S^{2-} ion. But the radius ratio lies in the range of Tetrahedral void and there are two tetrahedral voids available per S^{2-}. Can you given the idea about the arrangement of the lattice.

(ii) What is the striking difference between the Fluorite and the Anit-fluorite structures

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16. KBr crystallizes in NaCl type of unit cell. K^+ radius $= 1.33\text{Å}$, Br^- radius $= 1.95\text{Å}$

(a) How many K^+ ions and how many Br^- ions are in each unit cell ?

(b) Assuming the additivity of ionic radii, what is a ?

(c) Calculate the density of a perfect KBr crystal

(d) What minimum value of r_+ / r_- is needed to prevent anion-anion contact in this structure

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

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18. How would you explain that (i) non-stoichimetric NaCl is yellow, (ii) non-stoichiometric ZnO is yellow ?

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19. Account for the Silicon is an insulator but silicon doped with phosphorus acts as a semiconductor.

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20. How does the conductivity of a semiconductor change if its temperature is raised ?

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Part Ii Only One Option Correct Type

1. Which of the following is/are pseudo solids?

(P) KCl

(Q) Barium chloride dihydrate

(C) Coke left after distillation of coal tar:

A. I, III

B. II, III

C. III,IV

D. only III

Answer: C

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2. The smallest repeating pattern which when repeated in three dimensions results in the crystal of the substance is called

A. space lattice

B. crystal lattice

C. unit cell

D. coordination number

Answer: C

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3. Which of the following primitive cells show the given parameters ?

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

A. triclinic

B. tetragonal

C. cubic

D. orthorhombic

Answer: D

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4. Which of the following are the correct axial distance and axial angles for rhombohedral system?

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

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

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

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

Answer: A

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5. Choose the correct statements

A. equivalent points in unit cells of a periodic lattice lie on a Bravais lattice

B. equivalent points in unit cells of a periodic lattice do not lie on a Bravais lattice

C. There are four Bravais lattices in two dimension

D. There are five Bravais lattices in three dimensions

Answer: A

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6. The crystal system of unit cell dimensions a=0.387, b=0.387 and c=0.504 nm and $\alpha = \beta = 90^\circ$ and $\gamma = 120^\circ$ is

A. Cubic

B. Hexagonal

C. Orthorhombic

D. Rhombohedral

Answer: B

7. Body centred cubic lattice has a coordination number of

A. 8

B. 12

C. 6

D. 4

Answer: A

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8. Iron crystallises in a body centred cubic structure. Calculate the radius of iron atom if edge length of unit cell is 286 pm.

A. r = 124 pm

B. r = 128 pm

C. $r = 124\text{Å}$

D. $r = 128\text{Å}$

Answer: A

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9. A metal crystallize in a body centered cubic lattice (bcc) with the edge of the unit cell 5.2Å. The distance between the two nearest neighour is

A. 10.4Å

B. 4.5Å

C. 5.2Å

D. 9.0Å

Answer: B

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10. At room temperature, Polonium cryatsillises in Cubic primitive cell. If edge length is 3.0Å, calculate the theoretical density of Po. (Atomic wt of Po = 207g)

A. 25/3 amu/$Å^3$

B. 23/3 amu/$Å^3$

C. 21/3 amu/$Å^3$

D. 27/3 amu/$Å^3$

Answer: B

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11. Lithium crystallizes in a body centred cubic lattice , how many next nearest neighbours close each Li has ?

A. 6

B. 8

C. 12

D. 4

Answer: A

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12. Consider a Body Centred Cube (BCC) arrangement, let d_e, d_{fd}, d_{bd} be the distances between successive atoms located along the

edge, the face-diagonal, the body diagonal respectively in a unit cell. Their order is given as:

A. $d_e < d_{fd} < d_{bd}$

B. $d_{fd} > d_{bd} > d_e$

C. $d_{fd} > d_e > d_{bd}$

D. $d_{bd} > d_e > d_{fd}$

Answer: C

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13. How many number of atoms are completely inside the HCP unit cell ?

A. Exactly 6

B. > 6

C. < 6

D. 12

Answer: C

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14. The shortest distance between I^{st} and V^{th} layer of HCP arrangement is:

A. $8\sqrt{\frac{2}{3}}r$

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

C. $16\frac{\sqrt{12}}{3}r$

D. $8\sqrt{\frac{3}{2}}r$

Answer: A

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15. Volume of HCP unit cell is:

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

B. $8\sqrt{2}r^3$

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

D. $24\sqrt{3}r^3$

Answer: A

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16. Fraction of empty space in ABAB type arrangement in 3D

A. 0.74

B. 0.26

C. 0.68

D. 0.32

Answer: B

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17. What is the height of an HCP unit cell ?

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

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

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

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

Answer: C

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18. What is the number of atoms in a unit cell of a face-centred cubic crystal ?

A. 4

B. 6

C. 2

D. 1

Answer: A

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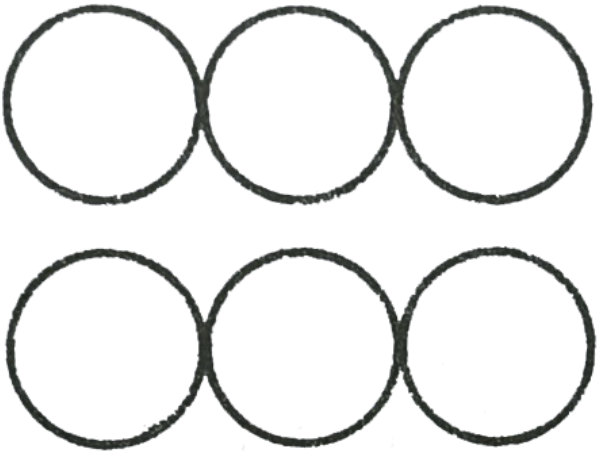
19. Which of theshaded plane in fcc lattice contains arrangement of atoms



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20. Copper crystallises in a structure of face centerd cubic unit cell. The atomic radius of

copper is 1.28Å. What is axial length on an edge of copper ?

A. 2.16Å

B. 3.62Å

C. 3.94Å

D. 4.15Å

Answer: B

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21. The maximum percentage of available volume that can be filled in a face centered cubic system by an atom is:

A. 0.74

B. 0.86

C. 0.34

D. 0.26

Answer: A

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22. What are the number of atoms per unit cell and the number of nearest neighbours in a face centered cubic structure?

A. 6

B. 8

C. 12

D. 14

Answer: C

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23. Which one of the following schemes of ordering closed packed sheets of equal sized spheres do not generate closet packed lattice?

A. ABCABC

B. ABACABAC

C. ABBAABBA

D. ABCBCABCBC

Answer: C

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24. If the anion (A) form hexagonal closet packing and cation (C) occupy only 2/3 octahedral voids in it, then the general formula of the comound is:

A. CA

B. CA_2

C. C_2A_3

D. C_3A_2

Answer: C

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25. You are given 4 identical balls. What is the maximum number of square voids and triangular voids (in separate arrangements) that can be created ?

A. 1,2

B. 2,1

C. 3,1

D. 1,3

Answer: A

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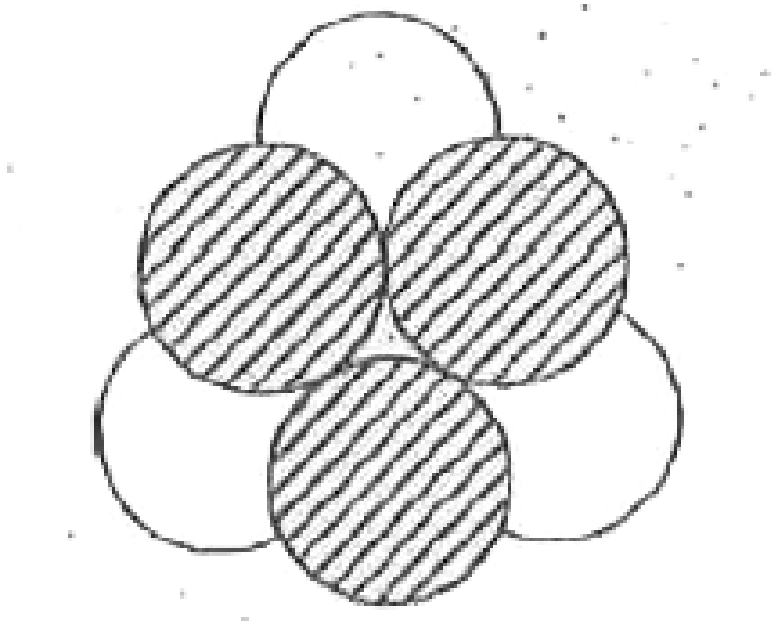
26. The empty space between the shaded balls and hollow balls as shown in the diagram is called



A. hexagonal void

B. octahedral void

C. tetrahedral void

D. double triangular void

Answer: B

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27. If the close-packed cations in an AB-type solid gave a radius of 75 pm. What would be the maximum and minimum sizes of the anions filling the voids?

A. $r^-_{\text{minimum}} = 101.45, r^-_{\text{maximum}} = 303.3 \pm$

B. $r^-_{\text{minimum}} = 105.45, r^-_{\text{maximum}} = 300.3 \pm$

C. $r^-_{\text{minimum}} = 102.45, r^-_{\text{maximum}} = 333.3 \pm$

D. $r^-_{\text{minimum}} = 98.4, r^-_{\text{maximum}} = 333.3 \pm$

Answer: C

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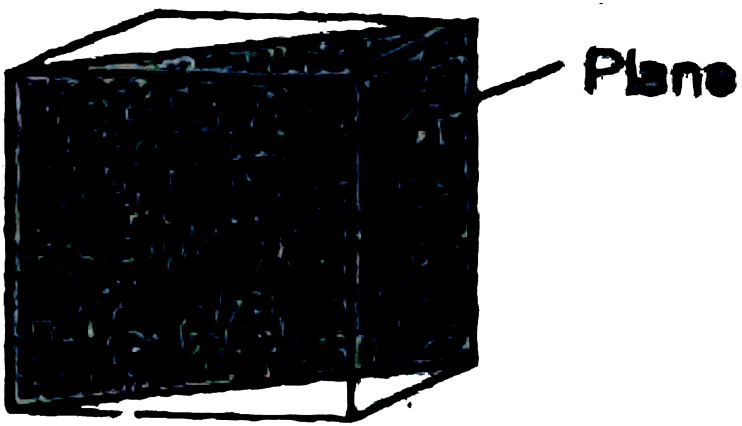
28. In a hypothetical solid C atoms form C C P lattice with A atoms occupying all the Tetrahedral Voids and B atoms occupying all the

octahedral voids A and B atoms are of the appropriate size such that there is no distortions in the CCP lattice. Now if a plane is cut (as shown) then the section would like



A. $O.V = 3, T.V. = 4$

B. $O.V. = 2, T.V. = 4$

C. O.V. = 1, T.V. = 2

D. O.V. = 0, T.V. = 4

Answer: A

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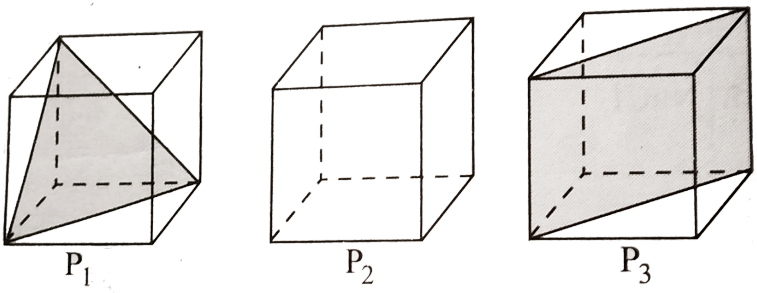
29. Following three planes (P_1, P_2, P_3) in an fcc unit cell are shown in the figure below. Consider the following statements and choose the correct option/options that follow:



(a)P_1 contains no three-dimensional voids.

(b)P_2 contains only octahedral voids.

(c)P_3 contains both octahedral and tetrahedral voids

(d)All of these

A. All are true

B. Only (i) & (ii) are true

C. (i) & (iii) are true

D. only (iii) is true

Answer: A

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30. In an FCC unit cell a cube is formed by joining the centers of all the tetrahedral voids to generate a new cube. Then the new cube would contain voids as

A. 1 full tetrahdral void, 1 full octahedral void

B. 1 full tetrahdral void only

C. 8 full tetrahedral voids and 1 full octahedral void

D. 1 full Octahedral void by

Answer: A

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31. The radius of Ag^+ is 126 pm while that of I^- ion is 216 pm. The co-ordination number of Ag in AgI is :

A. 2

B. 4

C. 6

D. 8

Answer: C

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32. The tetrahedral voids formed by ccp arrangement of Cl^- ions in rock salt structure are:

A. Occupied by Na^+ ions

B. Occupied by Cl^- ions

C. Occupied by either Na^+ or Cl^- ions

D. Vacant

Answer: D

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33. Antifluorite structure is derived from fluorite structure by:

A. heating fluorite structure crystal lattice

B. subjecting fluorite structure to high pressure

C. Inter chaning the positions of positive and negative ions in the lattice

D. none of these

Answer: C

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34. In ZnS (sphalerite) structure, the coordination number of Zn^{2+} and S^{2-} are respectively

A. 2

B. 4

C. 6

D. 8

Answer: B

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35. Strontium chloride has a flurite structure, which of the statement is true for the structure of strontium chloride ?

A. the strontium ions are in a body-centered cubic arrangement

B. the strontium ions are in a face-centered cubic arrangement

C. each chloride ion is at the centre of a cube of 8 strontium ions

D. each strontium ion is at the center of a tetrahedron of 4 chloride ions

Answer: B

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36. The spinel structure AB_2O_4 consists of an fcc array of O^{2-} ions in which the:

A. A cation occupies one-eighth of the tetrahedral holes and B cation occupied

one-half of octahedral holes

B. A cation occupies one-fourth of the tetrahedral holes and the B cations the octahedral holes

C. A cation occupies one-eighth of the octahdral hole and the B cation the tetrahdral holes

D. A cation occupies one-fourth of the octahdral holes and the B cations the tetrahedral holes

Answer: A

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37. In a crystal of diamond :

How many carbon atoms surround each carbon atom

A. fcc arrangement along with occupancy of 50% tetrahedral holes

B. fcc arrangement along with occupancy of 25% tetrahdral holes

C. fcc arrangement along with occupancy of 25% octahedral hole

D. bcc arrangement

Answer: A

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38. Cesium chloried on heating to $760K$ changes in

A. CsCl (g)

B. NaCl structure

C. antifluorite structure

D. ZnS structure

Answer: B

39. If a cation leaves a site in solid lattice, and is located at an interstitial position. The lattice defect is

A. Interstitial defect

B. Valency defect

C. Frenkel defect

D. Schottky defect

Answer: C

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40. Which of the following statements are correct in context of point defects in a crystal?

A. AgCl has anion Frenkel defect and CaF_2 has Schottky defects

B. AgCl has cation Frenkel defects and CaF_2 has anion Frenkel defects

C. AgCl as well as CaF_2 have anion Frenkel defects

D. AgCl as well as CaF_2 has Schottky defects

Answer: B

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41. F - center as :

A. the electrons trapped in anionic vacancies

B. the electrons trapeed in cation vacancies

C. non-equivalent sites of stoichiometric compound

D. all of the above

Answer: A

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

A. positive

B. neutral

C. negative

D. depends on concentration of p impurity

Answer: A

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Exercise 2 Part I

1. Which of the following are not correctly matched with the bonds found between the constituents particle?

A. Solid CO_2: Vanderwaal's

B. Graphite: Covalent and Vanderwaal

C. Grey Cast Iron : Inoic

D. Metal alloys: Ions -delocalised electrons

Answer: C

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2. Which of the following is not correct for ionic solids ?

A. They possess high melting point and boiling point

B. All are electrolyte

C. Exhibit the property of isomorphism

D. Exhibit directional properties of the bond

Answer: D

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3. An element with atomic mass 100 has a bcc structure and edge length 400 pm. The density of element is

A. $2.144 g / cm^3$

B. $5.2 g / cm^3$

C. $7.289 g / cm^3$

D. $10.376 g / cm^3$

Answer: B

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4. What is the nearest distance between two different layers in ABAB arrangement ($a = 2 \times$ radius of the particle)

A. $\sqrt{\frac{8}{3}}a$

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

C. $\frac{1}{\sqrt{6}}a$

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

Answer: D

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

(a) What is the formula of the compound ?

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

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

A. $X_7Y_{24}Z_2$

B. $X_7Y_{24}Z$

C. $X_{24}Y_7Z$

D. $XY_{24}Z$

Answer: B

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6. You are given 6 identical balls . The maximum number of square voids and triangular voids (in separate arrangements) that can be created respectively are

A. 2,4

B. 4,2

C. 4,3

D. 3,4

Answer: A

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7. In a simple cubic lattice of anions, the side length of the unit cell is 2.88Å. The diameter of the void in the body centre is

A. 1.934Å

B. 0.461Å

C. 2.108Å

D. 4.988Å

Answer: C

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8. In a multi layered close-packed structure

A. there ae twice as many tetrahedral holes as many close-packed atoms

B. there are as many tetrahedral holes as many closed packed atoms

C. there are twice as many octahedral holes as many close-packed atoms

D. there are as many tetrahedral holes as many octahedral holes

Answer: A

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9. In a compound,oxide ions are arranged in cubic close packing arrangement. Cations A occupy one-sixth of the tetrahdral voids and cations B occupy one-third of the octahedral voids. The formula of the compound is

A. A_2BO_3

B. AB_2O_3

C. $A_2B_2O_2$

D. ABO_3

Answer: D

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10. Platinum crystallize in a face-centred cubic crystal with a unite cell length a. the distance between nearest neighbours is:

A. a

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

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

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

Answer: C

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11. Platinum crystallises in a face centered cube crystal with a unit cell length of 3.9231 Å.The density and atomic radius of platinum are respectively . [Atomic mass of Pt=195]

A. $45.25g.\ cm^{-3}, 2.516Å$

B. $21.86g.\ cm^{-3}, 1.387Å$

C. $29.46g.\ cm^{-3}, 1.48Å$

D. None of these

Answer: B

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12. Gold has a face centered cubic lattice with an edge length of the unit cube of 407pm. The diameter of th gold atom is:

A. 2.035Å

B. 8.140Å

C. 2.878Å

D. 1.357Å`

Answer: C

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13. Which of the following statements is correct in the rock-salt structure of ionic compound?

A. Co-ordination number of cation is four whereas that of anion is six

B. Co-ordination number of cation is six whereas that of anion is four

C. Co-ordinatin number of each cation and anion is four

D. Co-ordination number of each cation and anion is six

Answer: D

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14. The compound AB crystallizes in a cubic lattice in which both A and B atoms have coordination number of 8. To what crystal class does that unit cell belong?

A. CsCl structure

B. NaCl structure

C. ZnS structure

D. Al_2O_3 strucuture

Answer: A

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15. BaO has a rock-salt type structure. When subjected to high pressure, the ratio of the coordination number of Ba^{+2} ion to O^{-2} changes to

A. $4:8$

B. $8:4$

C. $8:8$

D. $4:4$

Answer: C

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16. A crystal of NaCl, which has sodium ions and chloride ions missing from the lattice point, is said to exhibit:

A. Surface defect

B. Lattice defect

C. Frenkel defect

D. Schottky defect

Answer: D

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17. In a Schottky defect

A. cations are missing from the lattice sites and occupy the interstitial sites

B. equal number of cations and anions are missing

C. anion are missing and electrons are present in their place

D. equal number of extra cations and electrons are present in the interstitial sites

Answer: B

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18. NaCl shows Schottku defects and AgCl Frenkel defects. The electrical conductivity is due to the:

A. motion of ions and not the motion of electrons

B. motion of electrons and not the motion of ions

C. lower co-ordination number of NaCl

D. higher co-ordination number of AgCl

Answer: A

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19. Zinc oxide, white in colour at room temperature, acquires yellow colour on heating due to:

A. Zn being a transition element

B. paramagnetic nature of the compound

C. trapping of electrons at the site vacated by Oxide ions

D. Both A and B

Answer: C

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Exercise 2 Part Ii Single Correct Double Value Integer Type

1. How many of the following are Covalent network solids ?

S_8, Bronze, SiO_2, Diamond, $ZnSO_4$, Si, AlN, SiC, CO_2

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2. How many number of atom effectively present in a cubic unit formed by arrangement of eight B.C.C unit cell

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3. How many spherical balls of radii 2 cm can be placed completely inside a cubical box of edge = 8 cm?

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4. Coordination number in ABAB ... type arrangement is

Watch Video Solution

5. Coordination number in ABAB ... type arrangement is

Watch Video Solution

6. How many number octahedral voids are effectively inside an HCP unit cell

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7. In a compound oxide ions are arranged in cubic close packing arrangement. Cations A occupy one-sixth of the tetrahedral voids and cations B occupy one-third of the octahdral voids. The formual of the compound is A_x, B_y, O_z then find the value of $x + y + z$

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8. What is the coordination number of

(i) sodium in sodium oxide (Na_2O)?

(ii) oxide ion in sodium oxide (Na_2O)?

(iii) calcium in calcium fluoride (CaF_2)?

(iv) zinc in zinc blende (ZnS)?

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9. In a crystalline solid, having formula AB_2O_4 oxide ions are arranged in cubic close packed lattice while cations A are present in tetrahedral

voids and cations B are present in octahedral voids.

(a) What percentage of the tetrahedral voids is occupied by A?

(b) What percentage of the octahedral voids is occupied by B ?

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Exercise 2 Part Iii

1. Which of the following statements is/are false

A. it is the isotropic nature of amorphous solids that all the bonds are of equal strength

B. Entropy of a crystalline solid is higher than that of an amorphous solid

C. Amorphous solids have definite volume but not definite shape

D. Amorphous solids can become crystalline on slow heating (annealing)

Answer: A::B::C

Watch Video Solution

2. Amorphous solids can also be callled ..... .

A. pseudo solids

B. true soids

C. super cooled liquids

D. super cooled solids

Answer: A::C

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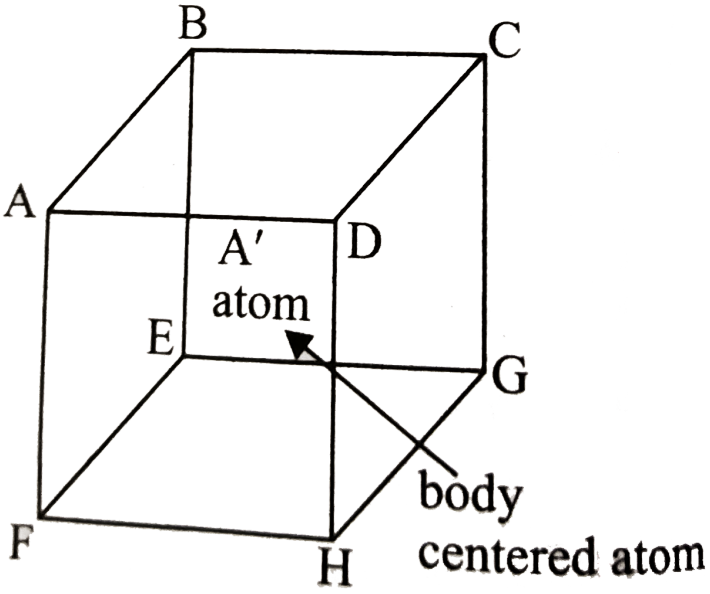
3. In body-centred cubic lattice given below, the three disntances AB, AC, and A' are



A. $AB = a$

B. $AC = \sqrt{2}a$

C. $AA' = \dfrac{\sqrt{3}a}{2}$

D. $AA' = \sqrt{3}a$

Answer: A::B::C

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4. A metal crystallises in bcc. Find % fraction of edge length not covered and also % fraction of edge length covered by atom is

A. $10.4\,\%$

B. $13.4\,\%$

C. $86.6\,\%$

D. $11.4\,\%$

Answer: B::C

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5. Select the correct statement(s) about three-dimensional hcp system.

A. Number of atoms in HCP unit cell is six

B. The volume of HCP unit cell is $24\sqrt{2}r^3$

C. The empty space in HCP unit cell is 26%

D. The base area of HCP unit cell is $6\sqrt{3}r^2$

Answer: A::B::C::D

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6. Which of the following is/are ture about HCP and CCP lattice?

A. Number of tetrahedral voids are twice of octahedral holes

B. 12 tetrahedral and 6 octahedral voids are present in one HCP unit cell

C. C.N. of HCP unit cell is 12

D. If atom of tetrahedral voids displace into octahedral voids then it is Schootky defect

Answer: A::B::C

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7. In which of the following arrangments octahedral voids are formed ?

A. hcp

B. bcc

C. simple cubic

D. fcc

Answer: A::D

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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 thimes the number of octahedral voids

Answer: B::C

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9. 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 crystallises in bcc structure has a coordination number of 12

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

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

Answer: A::C::D

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10. Which of the following is/are correct ?

A. Schottky defect lowers the density

B. Frenkel defect increases the dielectric constant of the crystals

C. Stoichiometric defects make the crystals electrical conductors

D. In the Schoottky defect, equal number of extra cations and electrons are present in the interstitials sites

Answer: A::B::C

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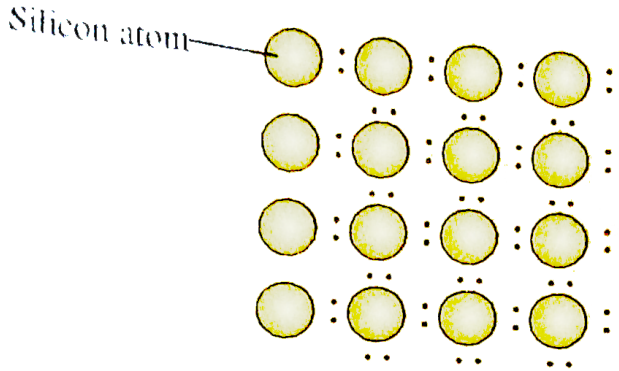
11. A perfect crystal of silicon (Fig.) is doped with some elements as given in the otpions. Which of these options show n-type semi-conductors ?



Pure crystal of Si

A. 

B. 

C. 

D. 

Answer: A::C

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12. 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 conductivity of n-type semiconductor

Answer: B::C

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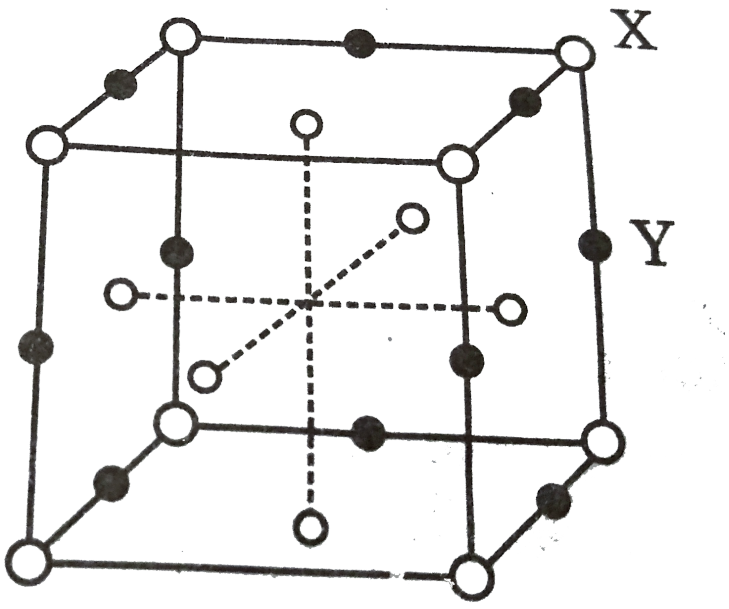
Exercise 2 Part Iv Comprehension

1. Consider the figure given for solid XY. Answer the following questions :



The number of XY units per unit cell is:

A. 4

B. 3

C. 3

D. 8

Answer: A

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2. What is Co-ordination number

A. 3

B. 4

C. 6

D. 8

Answer: C

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3. When an atom or an ion is missing from its normal lattice site, a lattice vacancy (Schottky defect) is created. In stoichimetric ionic crystals, a vacancy of one ion has to be accompanied by

the vacancy of the oppositely charged ion in order to maintain electrical neutrality.

In a Frenkel defect an ion leaves its position in the lattice and occupies an interstitial void. This is the Frenkel defect commonly found along with the Schottky defects and interstitials. In pure alkali halides, Frenkel defects are not found since the ions cannot get into the interstitial sites. Frenkel defects are found in silver halides because of the small size of the Ag^+ ion. Unlike Schottky defects, Frenkel defects do not change the denstiy of the solids. In certain ionic solids (e.q. AgBr) both Schottky

and Frenkel defects occur.

The defects discussed above do not disturb the stoichiometry of the crystalline material. There is large variety of non-stoichiomertic inorganic solids which contain an excess or deficiency of one of the elements. Such solids showing deviations from the ideal stoichiometric composition from an inmportant group of solids. For example in the vanadium oxide, VO_x, x can be anywhere between 0.6 and 1.3. There are solids which are difficult to prepare in the stoichiometric composition. Thus, the ideal composition in compounds such as FeO is

difficult to obtain (normally we get a composition of $Fe_{0.95}O$ but it may range from $Fe_{0.93}O$ to $Fe_{0.96}O$). Non-stoichiometric behaviour is most commonly found for transition metal compounds though is also known for some lanthanoids and actinoids.

Zinc oxide loses oxygen reversibly at high temperature and turns yellow in colour. The excess metal is accommodated interstitially, giving rise to electrons trapped in the neighbourhood. The enhanced electrical conductivity of the non-stoichiometric ZnO arises from these electrons.ltrbgt Anion

vacancies in alkali halides are produced by heating the alkali halide crystals in an atmosphere of the alkali metal vapur. When the metal atoms deposit on the surface they diffuse into the crystal and after ionisation the alkali metal ion occupies cationic vacancy whereas electron occupies anionic vacancy. Electrons trapped in anion vacancies are referred to as F-centers (from Farbe the German word for colour) that given rise to interesting colour in alkali halides. Thus, the excess of potassium in KCl makes the crytal appear violet and the excess of lithium in LiCl makes it pink.

When LiCl is heated into the vapour of lithium, the crystal acquires pink colour. This is due to

A. Schottkty defects

B. Frenkel defect

C. Metal excess defect leading to F-centers

D. Electronic defect

Answer: C

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Stongly heated ZnO crystal can conduct electricity. This is due to

A. Movement of extra Zn^{2+} ions present in the interstitial sites

B. Movement of electrons in the anion vacancies

C. Movement of both Zn^{2+} ions and electrons

D. None of these

Answer: B

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5. AgCl is crystallized from molten AgCl containing a little $CdCl_2$. The solid obtained will have

A. cationic vacancies equal to number of Cd^{2+} ions incorporated

B. cationic vacancies equal to double the number of Cd^{2+} ions

C. anionic vacancies

D. neither cationic nor anionic vacancles

Answer: A

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6. When an atom or an ion is missing from its normal lattice site, a lattice vacancy (Schottky detect) is created In stoichiometric ionic crystals, a vacancy of one ion has to be accompanied by the vacancy of the oppositely charged ion in order to maintain electrical neutrality.

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German word for colour) that gives rise to interesting colour in alkali halides.Thus, the excess of potassium in KCl makes the crystal appear violet and the excess of lithium in LiCl makes it pink.

Which of the following is most appropriate crystal of show Frenkel defect.

A. CsCl

B. NaCl

C. AgBr

D. $CaCl_2$

Answer: C

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7. Compare the acidic strength of o- and p- nitro phenols.

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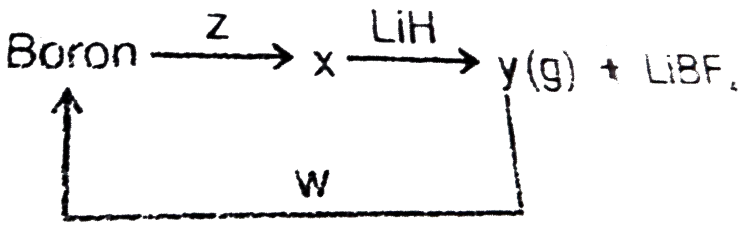
8. 

True statement is:

A. (I) (i) P

B. (II) (i) Q

C. (III) (iv) S

D. (IV) (iii)R

Answer: B

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Exercise 3 Part I

1. Draw the unit cell of the fcc lattice

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2. In a solid 'AB' having the $NaCl$ structure, 'A' atoms occupy the corners of the cubic unit cell. If all the face centered atoms along one of the axes are removed, then the resultant stoichiometry of the solid is :

A. AB_2

B. A_2B

C. A_4B_3

D. A_3B_4

Answer: D

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3. 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. composition cannot be specified

Answer: A

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

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5. A binary salt AB (formula weight = 6.023 Y amu, where Y is an arbitray number) has rock salt structure with $1:1$ ratio of A to B. The shortes A - B distance in the unit cell is $Y^{1/3}nm$.

(a) Calculate the density of the salt in kgm^{-3}

(ii) Given that the measured denstiy of the salt is $20kgm^{-3}$, specify the type of point defect present in the crystal

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

A. NaCl

B. ZnS

C. CaF_2

D. Na_2O

Answer: B

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7. An element crystallizes in fcc lattice having edge length $400 \pm$ Calculate the maximum diameter of an atom which can be place in interstitial site without distorting the structure.

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8. For a unit cell edge length $= 5\text{Å}$, the element is of atomic mass 75, has denstiy of 2gm/cc. Calculate atomic radius of the element

Watch Video Solution

9. In hexagonal system of crystals, a frequently encountered arrangement of atoms is described as hexagonal prism Here the top and bottom of the unit cell are regular hexagones and three atoms are sandwiched in between them. A space filling model of this structure, called hexagonal close packed (hcp) is consituted by a sphere on a flat surface surrounded int he same plane by six identical spheres as closely as possible Three spheres are then placed on the first layer so that they touch each other and represent the second layer. Each

one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is covered with a third layer that is identical to the bottom layer in relative position Assume radius of every sphere to be 'r'

The number of atoms in hcp unit cell is:

A. 4

B. 6

C. 12

D. 17

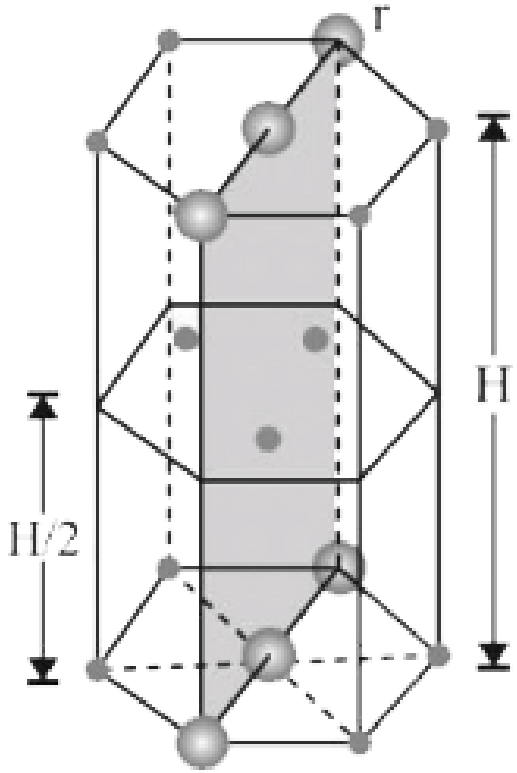
Answer: B

Watch Video Solution

10. In hexagonal 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 hexagons and three atoms are sandwiched in between them. A space-filling model of this structure, called hexagonal close-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. Each one of these three spheres touches three spheres of the bottom layer. Finally, the second layer is covered with a third layer that is identical to the bottom layer in relative position. Assume radius of every sphere to be ‘r’.

The volume 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

Watch Video Solution

11. In a hexaonal system system of cycstals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are refular hexagons, and three atoms are sandwiched in between

them. A space-cilling model of this structure, called hexagonal close-paked is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spherres are then placed overt the first layer so that they toych each other and represent the second layer so that they toych each other and present the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally, the second layer is convered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r.

The empty space in this hcp unit cell is

(a)$74\ \%$

(b)$48.6\ \%$

(c)$32\ \%$

(d)$26\ \%$

A. 0.74

B. $47.6\ \%$

C. 0.32

D. 0.26

Answer: D

Watch Video Solution

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

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

B. Frenkel defect is a dislocation defect

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

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

Answer: B::C

13. If the unit cell of 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 magnesium 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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14. The CORRECT statements (s) for cubic close packed (ccp) three dimensional structure is (are)

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

B. The efficiency of atom packing is 74%

C. The number of octahedral and tetrahedral voids per atoms are 1 and 2, respectively

D. The unit cell edge length is $2\sqrt{2}$ times the radius of the atom

Answer: B::C::D

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15. 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 8 g cm^{-3}, then the number of atoms present in 256 g of the crystal is $N \times 10^{24}$. The value of N is _____.

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16. Consider an ionic solid MX with NaCl structure. Construct a new structure (Z) whose unit cell is constructed from the unit cell of MX following the sequential instructions given below. Neglect the charge balance. 1.Remove all the anions (X) except the central one 2.Replace all the face centered cations (M) by anions (X) 3.Remove all the corner cations (M) 4.Replace the central anion (X) with cation (M)

The value of $\left(\frac{\text{number of anion s}}{\text{number of cation s}}\right)$ in z is _____.

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Exercise 3 Part Ii

1. Na and Mg crystallize in bcc- and fcc-type crystals, respectively, then the number of atoms of Na and Mg present in the unit cell of their respective crystal is

A. 4 and 2

B. 9 and 14

C. 14 and 9

D. 2 and 4

Answer: D

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2. How many unit cells are present in a cubic shaped ideal crystal of NaCl of mass 1.0 g ?

A. 2.57×10^{21}

B. 5.14×10^{21}

C. 1.28×10^{21}

D. 1.71×10^{21}

Answer: A

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3. What type of crystal defect is shown in the figure given below ?

$$\begin{array}{ccccc} Na^+ & Cl^- & Na^+ & Cl^- & Na^+ \\ Cl^- & \square & Cl^- & Na^+ & Cl^- \\ Na^+ & Cl^- & Na^+ & \square & Na^+ \\ Cl^- & Na^+ & \square & Na^+ & Cl^- \\ Na^+ & Cl^- & Na^+ & Cl^- & \square \end{array}$$

A. Frenkel defect

B. Schottky defect

C. intestitial defect

D. Frenkel and Schottky defects

Answer: B

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4. A ionic compound has a unit cell consisting of a ions at the corners of a cube, B ions on the centres of the faces of the cube but one axis of its faces are missing. The empirical formula for this compound would be -

A. AB

B. A_2B

C. AB_3

D. A_3B

Answer: C

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5. Total volume of atoms present in a fcc unit cell of a metal with radius r 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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6. In a compound, atoms of the element Y form ccp lattice and those of the element X occupy

$2/3rd$ of tetrahedral voids. The formula of the compound will be :

A. X_2Y_3

B. X_2Y

C. X_3Y_4

D. X_4Y_3

Answer: D

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7. Copper crystallises in fcc with a unit cell length of 361 pm. The radius of copper atom is :

A. 127 pm

B. 157 pm

C. 181 pm

D. 108 pm

Answer: A

Watch Video Solution

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

A. 288 pm

B. 398 pm

C. 618 pm

D. 144 pm

Answer: D

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

A. 30% and 26%

B. 26 % and 32%

C. 32% and 48%

D. 48 % and 26%

Answer: B

Watch Video Solution

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

A. A_2B

B. AB_2

C. A_2B_3

D. A_2B_5

Answer: D

Watch Video Solution

11. Copper crystallises in fcc with a unit cell length of 361 pm. The radius of copper atom is :

A. 108 pm

B. 128 pm

C. 157 pm

D. 181 pm

Answer: B

Watch Video Solution

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

A. 75 pm

B. 300 pm

C. 240 pm

D. 152 pm

Answer: D

Watch Video Solution

13. Experimentally it was found that a metal oxide has formula $M_{0.098}O$. Metal M, present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be nearly

[Report your answer by rounding it upto nearset whole number]

A. 0.0701

B. 0.0408

C. 0.0605

D. 0.0508

Answer: B

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14. CsCl crystallises in body centred cubic lattice. If 'a' is its edge length then which of the following expression is correct ?

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

B. $r_{CS^+} + r_{Cl^-} = \frac{3a}{2}$

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

D. $r_{CS^+} + r_{Cl^-} = \sqrt{3}a$

Answer: C

Watch Video Solution

15. Sodium metal crystallizes in a body centered cubic lattice with the cell edge $a = 4.29\text{Å}$. The radius of sodium atom is:

A. 1.86Å

B. 3.22Å

C. 5.72Å

D. 0.93Å

Answer: A

Watch Video Solution

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

A. CrO_2

B. VO_2

C. MnO_2

D. TiO_2

Answer: A

Watch Video Solution

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. $2\sqrt{2}a$

B. $\sqrt{2}a$

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

D. 2^a

Answer: C

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18. Which type of `defect' has the presence of cations in the interstitial sites?

A. Frenkel defect

B. Metal deficiency defect

C. Schottky defect

D. Vacancy defect

Answer: A

Watch Video Solution

Exercise 3 Jee Main

1. In a face centered cubic lattice atoms A are at the corner points and atoms B at the face centered points. If atoms B is missing from one

of the face centered points, the formula of the ionic compound is

A. AB_2

B. A_5B_2

C. A_2B_3

D. A_2B_5

Answer: D

Watch Video Solution

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

A. Schottky defect

B. Frenkel defect

C. Interstitial positions

D. F-centres

Answer: D

Watch Video Solution

3. In a monoclinic unit cell the relation of sides and angles are respectively

A. $a = b \neq c$ and $\alpha = \beta = \gamma = 90^{\circ}$

B. $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^{\circ}$

C. $a \neq b \neq c$ and $\alpha = \gamma = 90^{\circ} \neq \beta$

D. $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^{\circ}$

Answer: C

Watch Video Solution

4. The number of octahedral void(s) per atom present in a cubic close-packed structure is

A. 2

B. 4

C. 1

D. 3

Answer: C

Watch Video Solution

5. Which of the following arrangements shows the schematic alignment of magnetic moments of anti - ferromagnetic substance?

A. 

B. 

C. 

D. 

Answer: D

Watch Video Solution

6. All of the following share the same crystal structure except

A. LiCl

B. NaCl

C. RbCl

D. CsCl

Answer: D

Watch Video Solution

7. The one that is extensively used as a piezoelectric material is:

A. tridymite

B. amorphous silica

C. quartz

D. mica

Answer: C

Watch Video Solution

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

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

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

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

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

Answer: C

Watch Video Solution

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

A. Monoclinic

B. Triclinic

C. Hexagonal

D. Tetragonal

Answer: B

Watch Video Solution

10. A compound of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms :

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

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

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

D. hcp lattive $-A$, $\frac{1}{3}$ Tetrahdral voids-B

Answer: B

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

A. $0.0432 kgmol^{-1}$

B. $0.0305 kgmol^{-1}$

C. $0.4320 kgmol^{-1}$

D. $0.0216 kgmol^{-1}$

Answer: B

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

A. 0.047 a

B. 0.027 a

C. 0.134 a

D. 0.067 a

Answer: D

 Watch Video Solution

Apsp

1. In a lattice of X and Y atoms, If X atoms are present at corners and Y atoms at the body centre & one X atom is removed from a corner

from each unit cell, then the formula of the compound will be:

A. X_7Y

B. X_8Y_7

C. X_7Y_8

D. X_7Y_7

Answer: C

Watch Video Solution

2. The vacant space in b.c.c unit cell is :

A. 0.32

B. 0.1

C. 0.23

D. 0.46

Answer: A

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3. When NaCl crystal is heated in sodium vapors, then it attains yellow colour. It is due to

A. electrons trapped in cation vacancies

B. F-centres, which is electron trapped in anion vacancy created by Cl^-

C. F-centres, which is cation trapped in cation vacancy created by Na^+

D. interstitial defect caused by external impurity

Answer: B

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4. 1 g of X has atoms arranged in cubic packing so as to give best packing efficiency. The possible arrangement is

A. simple cubic

B. face centred cubic

C. body certred cubic

D. hexagonal close packing

Answer: B

Watch Video Solution

5. In 3D close packed structures, for every 100 atoms, it contains

A. 50 octahedral voids

B. 100 tetrohedral voids

C. 200 octohedral voids

D. 100 octahedral voids

Answer: D

 Watch Video Solution

6. If x = radius of Na^+ & $y =$ radius of Cl^- & a is the unit cell edge length for NaCl crystal, then which of the given relation is correct ?

A. $x + y = a$

B. $2x + 2y = a$

C. $x + y = 2a$

D. $x + y = \sqrt{2}a$

Answer: B

Watch Video Solution

7. The co-ordination number of calcium fluoride (CaF_2) type structure is

A. $1:2$

B. $4:4$

C. $4:8$

D. $8:4$

Answer: C

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8. The lattice of CaF_2 is called fluorite structure. $SrCl_2$ has fluorite structure. Which of the following statements is true for $SrCl_2$?

A. Sr^{2+} are at the corner and face centres of the cubic arrangment

B. Sr^{2+} are arranged in bcc lattice

C. a^- are arranged in fcc lattice

D. Cl^- occupy octahedral holes in the lattice

Answer: A

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9. Which of the following unit cells is the most unsymmetrical ?

A. Cubic

B. Hexagonal

C. Triclinic

D. orthorhombic

Answer: C

Watch Video Solution

10. Schottky defect occurs mainly in electrovalent compound where

A. Positive ions and negative ions are of different size

B. Positive ions and negative ions are of same size

C. positive ions and small and negative ions are big

D. positive ions are big and negative ions are small

Answer: B

11. A ionic compound is expected to have tetrahedral structure if r_c / r_a:

A. 0.155 to 0.225

B. 0.732 to 0.414

C. 0.414 to 0.732

D. 0.225 to 0.414

Answer: D

12. Malleability and ductility of metals can be accounted due to

A. the capacity of layers of metal ions to slide over the other

B. the interaction of electrons with metal ions in the other

C. the presence of electrostatic forces

D. the crystalline structure of metal

Answer: A

Watch Video Solution

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

$r_{Na^+}/r_{Cl^-} = 0.75$, calculate the ratio of the side of the unit cell for KCl to that of NaCl.

A. 1.123

B. 0.891

C. 1.414

D. 0.414

Answer: A

Watch Video Solution

14. A solid compound is formed containing x , y and z atoms in a cubic lattice with x atoms at corners. Y atoms at body centre and z atoms at face centres. What is empirical formula of compound ?

A. XY_2Z_3

B. XYZ_3

C. $X_2Y_2Z_3$

D. X_8YZ_6

Answer: B

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15. An example of a face centred cubic lattice is

A. Zinc

B. Sodium

C. Copper

D. Caesium chloride

Answer: C

Watch Video Solution

16. Which of the following is NOT ferromagnetic ?

A. Cobalt

B. Iron

C. Maganese

D. Nickel

Answer: C

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17. In AgBr, there can occur

A. only schottky defect

B. only Frenkel defect

C. both (1) and (2)

D. None of these

Answer: C

Watch Video Solution

18. In face centred cubic unit cell, edge length is

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

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

C. $2r$

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

Answer: B

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19. In an antifluorite structure, cations occupy :

A. octahedral voids

B. centre of the cube

C. tetrahedral void

D. corners of the cubic

Answer: C

Watch Video Solution

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

A. 4

B. 6

C. 8

D. 10

Answer: C

21. A p-type material is electrically...

A. positive

B. negative

C. neutral

D. depends upon the concentration of p impurities

Answer: C

 Watch Video Solution

22. The interionic distance for cesium chloride crystal will be

A. a

B. a/2

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

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

Answer: C

Watch Video Solution

23. Superconductors are derived from the compounds of

A. p-block elements

B. lanthanides

C. actinides

D. transition elements

Answer: A

Watch Video Solution

24. A substance A_XB_Y crystallises in a face centred cubic (fcc) lattice in which atoms 'A' occupy each corner of the cube and atoms 'B' 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. composition cannot be specified

Answer: A

Watch Video Solution

25. The number of atoms in $100g$ of an fcc crystal with density $= 10.0gcm^{-3}$ 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: A

Watch Video Solution

26. In the sphalerite (ZnS) structure S^{2-} ions form a face-centred cubic lattice. Then Zn^{2+} ions are present on the body diagonals at

A. $\frac{1}{3}$ rd of the distance

B. $\frac{1}{4}th$ of the distance

C. $\frac{1}{6}th$ of the distance

D. $\frac{1}{8}th$ of the distance

Answer: B

Watch Video Solution

27. In a solid S^{2-} ions are packed in fcc lattice. Zn^{2+} occupy half of the tetrahedral voids in an alternating arrangement. Now if a plane is cut (as shown) then the cross -section would be

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

28. S_1: Cubic system have four possible type of unit cells

S_2 : H_2O is diamagnetic substance and it is weakly attracted in magnetic fields

S_3: Graphite is a covalent solid with vanderwaal's forces as well

A. FFT

B. FTF

C. TFF

D. FFF

Answer: A

Watch Video Solution

29. S_1: Distance between Na^+ & Cl^- in NaCl crystal is more than half of edge length.

S_2: The no. of triangular viods in the given arrangement in the enclosed region is 3

S_3: In ZnS structure, $2Zn^{2+}$ & $2S^{2-}$ ions are present in each unit cell

A. FFT

B. FTF

C. TFF

D. FFF

Answer: D

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Part Ii National Standard Examination In Chemistry

1. What is the number of atoms per unit cell of the body centred cube?

A. six

B. four

C. two

D. one

Answer: C

Watch Video Solution

2. Co-ordination number for sodium metal is

A. 11

B. 12

C. 8

D. 10

Answer: C

 Watch Video Solution

3. Sodium chloride crystallises in a face centred cubic lattice in which each

A. Sodium ion is tetrahedrally surrounded by 4 chloride ions and each chloride ion is tetrahedrally surrounded by 4 sodium ions

B. sodium ion is tetrahedrally by 4 chloride ions and each chloride ion is octahedrally surrounded by 6 sodium ions

C. sodium ion is octahedrally surrounded by 6 chloride ions and each chloride ion is surrouneded by 4 sodium ions

D. sodium ion is octahedrally surrouned by 6 chloride ions and each chloride ion is octahedrally surrounded by 6 sodium ions

Answer: D

 Watch Video Solution

4. An element crystallises in a faces centered cubic lattice. Hence, its unit cell contains

A. 14 atoms of the element and 8 of them belong to the unit cell

B. 14 atoms of the element and 4 of them belongs to the unit cell

C. 8 atoms of the unit cell and only 1 of them belongs to the cell

D. 8 atoms of the unit cell and only 2 of them belong to the cell

Answer: B

Watch Video Solution

5. Arsenic is used to dope germanium to obtain

A. intrinsic semiconductor

B. p-type semiconductors

C. n-type semiconductors

D. non-conducting germanium

Answer: C

6. Carborundum is

A. molecular solid

B. covalent solid

C. ionic solid

D. amorphours solid

Answer: B

7. Assertion (A) : Graphite is an example of tetragonal crystal system.

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

A. Monoclinic

B. Triclinic

C. Hexagonal

D. orthorhombic

Answer: A

 Watch Video Solution

8. The number of units cells in 17.0 grams of NaCl is approximately

A. 12×10^{20}

B. 3×10^{23}

C. 6×10^{23}

D. 1×10^{24}

Answer: B

Watch Video Solution

9. In the unit cell of the crystal formed by the ionic compound of X and Y, the corners are occupied by X and the centers of the faces by Y. The empirical forumal of the compound is

A. XY

B. X_2Y

C. XY_3

D. X_8Y_6

Answer: C

Watch Video Solution

10. How many nearest neighbours surround each ion in a face-centered cubic lattice of an ionic crystal ?

A. 4

B. 6

C. 8

D. 12

Answer: D

Watch Video Solution

11. Match box exhibits:

A. Cubic geometry

B. Monoclinic geometry

C. Teragonal geometry

D. Othorhombic geometry

Answer: D

Watch Video Solution

12. The simplest formula of a compound containing $50\,\%$ of element X $(\text{atomic mass} = 10)$ and $50\,\%$ OF the element Y $(\text{atomic mass} = 20)$ by weight is :

A. AB

B. A_2B

C. A_2B_2

D. A_2B_3

Answer: B

Watch Video Solution

13. For a face centered cubic lattaice, the unit cell content is

A. 1

B. 2

C. 3

D. 4

Answer: D

 Watch Video Solution

14. Body centred cubic lattice has a coordination number of

A. 8

B. 10

C. 6

D. 4

Answer: A

Watch Video Solution

15. Which of the following primitive cells show the given parameters ?

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

A. Monoclinic

B. Triclinic

C. Hexagonal

D. othorhombic

Answer: D

Watch Video Solution

16. What are the number of atoms per unit cell and the number of nearest neighbours in a body centered cubic structure?

A. 4, 12

B. 2, 6

C. 9, 6

D. 2,8

Answer: D

Watch Video Solution

17. Ionic salt AX grows in face centered cubic lattice with cell length 'a'. The ratio r_{A^+}/r_{X^-} for this salt will be

A. 0.155

B. 0.225

C. 0.414

D. 0.732

Answer: C

Watch Video Solution

18. The unit cell of a compound made up of the three elements X, Y and Z is given below.

 The formula of this compound is

A. X_2YZ_3

B. XY_3Z

C. XYZ_3

D. X_3YZ_2

Answer: C

Watch Video Solution

19. The metal M crystallizes in a body centered lattice with cell edge. 400 pm. The atomic radius of M is

A. 200 pm

B. 100 pm

C. 173 pm

D. 141 pm

Answer: C

 Watch Video Solution

20. Ice crystallizes in a hexagonal lattice. At ascertain low temperature, the lattice constants are a $= 4.53\text{Å}$ and $c = 7.41\text{Å}$. The number of H_2O molecules contained in a unit cell ($d \approx 0.92 gcm^{-3}$ at the given temperature) is

A. 4

B. 8

C. 12

D. 24

Answer: A

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21. One mole crystal of a metal halide of the type MX with molecular weight 119 g having face centered cubic structure with unit cell length 6.58Å was recrystallized. The density of the recrystallized crystal was found to be $2.44\ \text{gcm}^{-3}$. The type of defect introduced during the recrystalization may be

A. a ditional M^+ and X^- ions at interstitial sites

B. Schottky defect

C. F-centre

D. Frenkel defect

Answer: B

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22. An ionic solid Lal_2 shown electrical conduction due to presence of

A. La^{2+} and $2l^-$

B. $La^{3+}, 2l^{-}$ and e^{-}

C. La^{2+}, I_2 and $2e^{-}$

D. La^{3+}, I_2 and $3e^{-}$

Answer: B

 Watch Video Solution

23. In a cubic crystal structure, divalent metal-ion is located at the body -centered position, the smaller tetravalent metal ions are located at each corner and the O^{2-} ions are located half

way along each of the edges of the cube. The number of nearest neighbour for oxygen is

A. 4

B. 6

C. 2

D. 8

Answer: C

Watch Video Solution

24. HgO is prepared by two different methods: one shows yellow colour while the other shows red colour. The difference in colour is due to difference in

A. electronic d-d transitions

B. particle size

C. Frenkel defect

D. Schottkey defect

Answer: B

 Watch Video Solution

25. When NiO is doped with a small quantity of Li_2O

A. both cation and anion vacancies are generated

B. Schottky defects are generated

C. NiO becomes an n-type semiconductor

D. NiO becomes a p-type semiconductor

Answer: D

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26. A crystal of KCl containing a small amount of $CaCl_2$ will have

A. vacant Cl^- sites

B. vacant K^+ sites and a higher density as compared to pure KCl

C. vacant K^+ sites and a lower density as compared to pure KCl

D. K^+ ions in the interstitial sites

Answer: C

Watch Video Solution

27. A scientist attempts to replace a few carbon atoms in 1.0 g of diamond with boron atoms or nitrogen atoms in separate experiments. Which of the following is correct ?

A. The resulting material with B droping will be an n-type semiconductor

B. The resulting material with B droping will be an p-type semiconductor

C. B droping is NOT possible as B cannot from multiple bonds

D. the resulting material with N droping will be a p-type semiconductore

Answer: B

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Part Iii Hlp

1. Consider a cube of body-centerd cubic until cell of edge length a. Now atom at the body centre can be viewed to be lying on the corner of another cube 2 Find the volume common to cube 1 and cube 2.

A. $\frac{a^3}{27}$

B. $\frac{a^3}{64}$

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

D. $\frac{a^3}{8}$

Answer: D

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2. In an arrangement of type ABABA .... identical atoms of first layer (A) and third layer (A) are joined by a line passing through their centers . Identify the correct statement .

A. No void is found on the line

B. Only Tetrahedral voids are found on the line

C. Only octahedral voids are found on the line

D. Equal number of tetrahedral and octahedral voids are found on the line

Answer: B

 Watch Video Solution

3. Square packed sheets are arranged on the top fo the other such that a sphere in the next layer rests on the center of a square in the previous layer. Identify the type of arrangement and find the coordination number:

A. Simple Cubic, 6

B. Face centered cubic, 8

C. Face centered cubic 12

D. Body centered cubic, 8

Answer: C

 Watch Video Solution

4. Given an alloy of Cu, Ag and Au in which Cu atoms constitute the ccp arrangement . If the

hypothetical formula of the alloy is Cu_4Ag_3Au , the probable locations of Ag and Au atoms are

A. Ag - All tetrahedral voids, Au -all octahedral voids

B. Ag - $3/8^{th}$ tetrahedral voids, Au - $1/4^{th}$ octahedral voids

C. Ag-1/2 octahedral voids, Au -1/2 tetrahedral voids

D. Ag -all octahedral voids, Au -all tetrahedral voids

Answer: B

5. The distance between adjacent, oppositely charged ions is rubidium chloride is 3.285Å, in potassium chloride is 3.139Å in sodium bromide is2.981Å. And in potassium bromide is 3.293Å. The distance between adjacent oppositely charged ions in rubidium bromide is:

A. 3.147Å

B. 3.385Å

C. 3.393Å

D. 3.439Å

Answer: D

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6. Zinc sulphide exists in two different forms- zinc blende and wurtzite. Both occurs as $4:4$ coordination compounds. Choose the correct option from among the following:

A. zinc blende has a bcc structure and wurtzite an fcc structure

B. zinc blende has an fcc structure and wurtizite and hcp structure

C. zinc blende as well as wurtzite have a hcp structure

D. zinc blende as well wurtzite have a hcp structure

Answer: B

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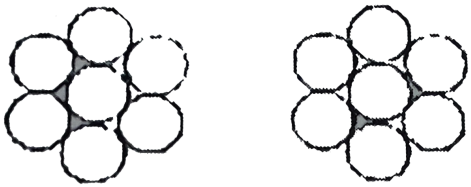
Part Iii Single And Double Value Integer Type

1. The 2D unit cell of an element is shown. The two layers are placed one over the other and touching each other. Find the effective number of atoms in the unit cell



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2. 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 apparently empty space? (At. wt. of Ar = 40).

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3. How many number of tetrahedral voids are completely inside the HCP unit cell

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4. How many number of atoms present in half of HCP unit cell

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5. Let $MgTiO_3$ exists in pervoskite structure. In this lattice, all the atoms of one of the face diagonals are removed. Calculate the denstiy of unit cell if the radius of Mg^{2+} is 0.7Å and the corner ions are touching each other. [Given atomic mass of Mg = 24, Ti = 48]

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6. A mineral having formula AB_2 crystallises in the cubic close packed lattice, with the A atoms occupying the lattice points. Hence coordination number of A and B atoms are

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Part Iii One Or More Than One Option Correct Type

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

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

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

C. Tetrahedral voids are formed when the triangular voids in the second layer lie

above the triangular voids in the first layer and the triangular shapes of these voids do not overlap

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

Answer: C::D

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2. The co-ordination number of FCC structure for metals is 12, since

A. each atom touches 4 others in same layer, 3 in alyer above and 3 in layer below

B. each atom touches 4 others in same layer, 4 in layer above and 4 in layer below

C. each atom touches 6 others in same layer, 3 in layer above and 3 in layer below

D. each atom touches 3 others in same layer, 6 in layer above and 6 in layer below

Answer: B::C

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3. Three lines are drawn from a single corner of an FCC unit cell to meet the other corner such that they are found to pass through exactly-1-Octahedral void only , no voids Octahedral void only .Identify the line in the same order -

A. Edge length

B. Body diagonal

C. Face diagonal

D. A line which passes through only two face centres of opposite faces

Answer: A::B::C::D

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Part Iv

1. In a square close packing pattern, one atom is in contact with how many atom in the 2D plane

base ?

A. 2

B. 4

C. 6

D. 8

Answer: B

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

face centres.

(a) What is the formula of the compound ?

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

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

A. X_7Y_{24}

B. $X_{24}Y_7$

C. XY_{24}

D. $X_{24}Y$

Answer: A

3. In a ccp structure of X atoms, Y atoms occupy all the octahedral holes. If 2X atom are removed from corners and replaced by Z, then the formula of the compound will be

A. $X_{15}Y_{16}Z$

B. X_7Y_8Z

C. $X_{7.5}Y_8Z$

D. $X_8Y_8Z_3$

Answer: A

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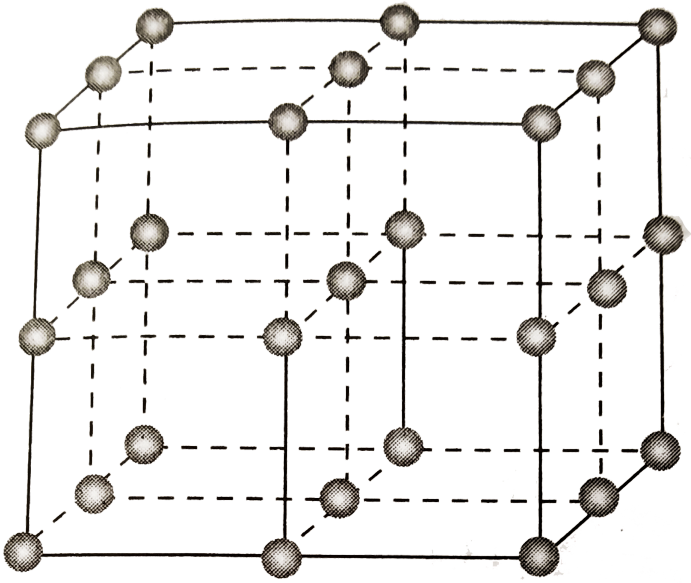
4. The following diagram shows the arrangement of lattice points with $a = b = c$

and $\alpha = \beta = \gamma = 90^\circ$. Choose the correct



options.

A. The arrangement is SC with each lattice point surrounded by 6 nearest neighbours

B. The arrangement is SC with each lattice point surrounded by 8 nearest neighbours

C. The arrangement is FCC with each lattice point surrounded by 12 nearest neighbour

D. The arrangement in BCC with each lattice point surrouned by 8 nearest neighbour

Answer: A

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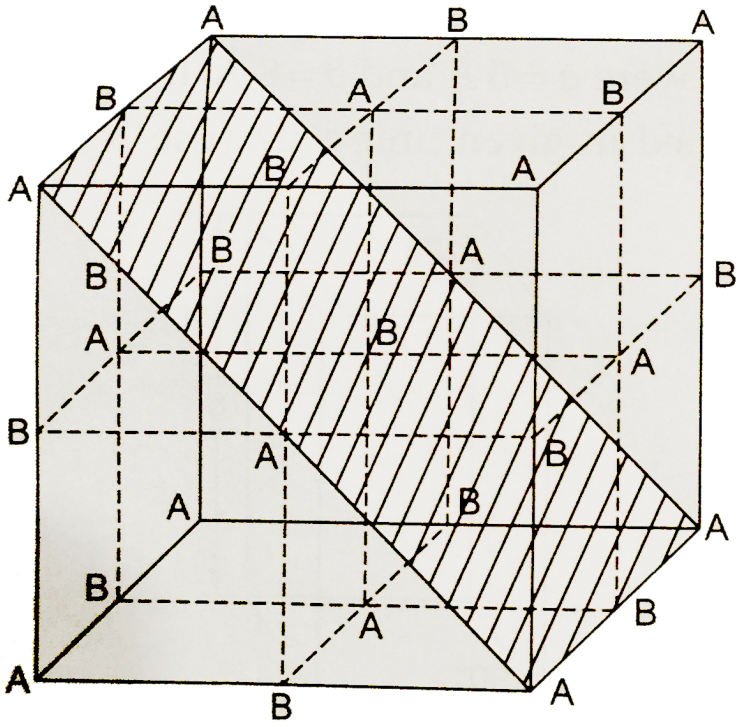
5. A crystal is made of particles A and B . From fcc packing and B occupies all the octahedral voids . If all the particle along the plane as shown in figure are removed , then, the formula of the crystal would be :



A. AB

B. A_5B_7

C. A_7B_5

D. `None of these

Answer: A

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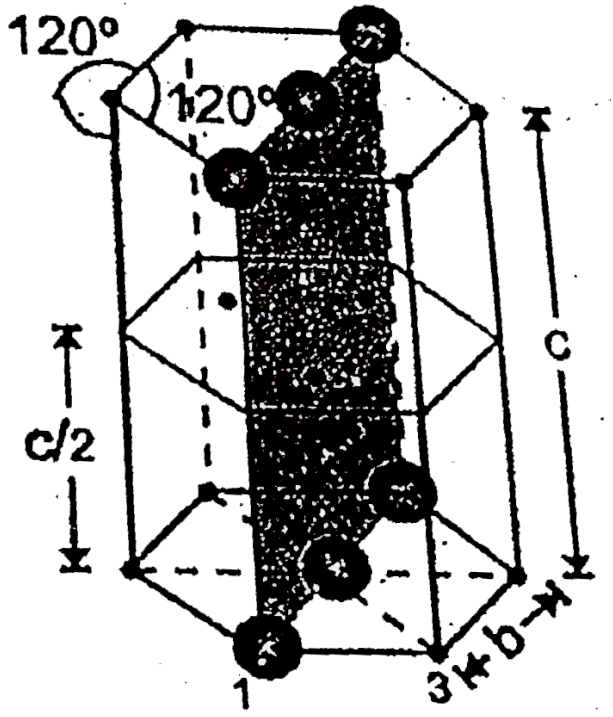
6. Calculate the perimeter of given in HCP unit cell $\left(\text{ Given that radius of atoms } = R\text{Å}\right)$.



A. 6.437R

B. 15.32R

C. 16R

D. 8R

Answer: A

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7. $MgAl_2O_4$, is found in the Spinal structure in which O^{2-} ions consititute CCP lattice, Mg^{2+} ions occupy 1/8th of the Tetrahedral voids and Al^{3+} ions occupy 1.2 of the Octahedral voids. Find the total +ve charge contained in one unit cell

A. $+7/4$ electronic charge

B. $+6$ electronic charge

C. $+2$ electronic charge

D. $+8$ electronic charge

Answer: D

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8. Lead metal has a density of $11.34 g / cm^3$ and crystallizes in a face-centered lattice. Choose the correct alternatives

A. the volume of one unit cell is

$1.214 \times 10^{-22} cm^3$

B. the volume of one unit cell is

$1.214 \times 10^{-19} cm^3$

C. the atomic radius of lead is 175 pm

D. the atomic radius of lead is 155.1 pm

Answer: A::C

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9. Given that interionic distance in Na^+, F^- crystal is 2.31Å and $r_{F^+} = 1.36\text{Å}$, which of the following predictions will be right

A. $r_{Na^+}/r_{F^-} \approx 0.7$

B. coordination number of Na^+ = coordinatin number of $F^- = 6$

C. Na^+, F^- will have rock salt type crystal structure

D. effective nuclear charge for Na^+ and F^- are equal

Answer: A::B::C

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10. Which of the following statement (s) for crystal having schottky defect is/are correct

A. Schottky defect arises due to absence of cation & anion from position which they are expected to occupy

B. The density of crystal having shottky defect is smaller than that of perfect

crystal

C. Schottky defect are more common in co-valent compound with higher co-ordination number

D. The crystal having shottky defect is electrically neutral as a whole

Answer: A::B::D

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11. For each of the following substances, identify the intermolecular force or forces that predominate. Using your knowledge of the relative strength of the vaious forces, rank the substance in order of their normal boiling points. Al_2O_3, F_2, H_2O, Br_2, ICl, $NaCl$

A. $F_2 < Br_2 < ICl$

B. $H_2O < NaCl < Al_2O_3$

C. $ICl < H_2O$

D. $H_2O < ICl$

Answer: A::B::C

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12. The ZnS zinc blende structure is cubic. The unit cell may be described as a face-centered sulfide ion sublattice with zinc ions in the centers of alternating minicubes made by partitioning the main cube into 8 equal parts

(a) How many nearest neighbors does each Zn^{2+} have ?

(b) How many nearest neighbors does each S^{2-} have?

(c) what angle is made by the line connecting any Zn^{2+} to any two of its nearest neighbors ?

(d) What minimum r_+/r_- ratio is needed to avoid anion -anion contact, if closest cation-anion pairs are assumed to touch ?

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13. A metal (M), shows ABAB arrangement of atoms in solid state, then what is the relatin

between radius of atom (r) and edge length (a) and height (c) of HCP unit cell

A. $a = 2R$

B. $c = \left(\sqrt{\frac{2}{3}}\right)4r$

C. $c = \left(\sqrt{\frac{3}{2}}\right)4r$

D. $a = \left(2\sqrt{2}\right)r$

Answer: A::B

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14. What is the total number of atoms per unit cell in a face-centred cubic (fcc) crystal structures ?

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15. Percentage of void space in AB solid having rock salt structure if $\frac{r_+}{r_-} = \frac{1}{2}$ having cation anion contact. Given $\pi = 3.15$

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16. In an ionic solid $r_{(+)} = 1.6A$ and $r_{(-)} = 1.864A$. Use the radius ratio to determine the edge length of the cubic unit cell in A.

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17. Ice crystallizes in a hexagonal lattice. At the low temperature at which the structure was determined, the lattice constants were $a = 4.53\text{Å}$ and $c = 7.41\text{Å}$ (as shown in fig). How mant H_2O molecules are contained in a

unit cell ? (Density of ice = 0.92 gm/cc)

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18. A spinal is an important class of oxides consisting of two types of metal ions with oxides ions arranged in CCP layer. The normal spinal has one-eighth of the tetrahedral holes occupied by one type of metal ion and one-half of the octahedral holes occupied by another type of metal ion. such a spinal is formed by Zn^{2+}, Al^{3+} and O^{2-} in the tetrahedral holes.

if formula of the compound is $Zn_xAl_yO_z$, then find the value of $(x+y+z)$?

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19. Stacking of square close packed layers give rise to:

A. hexagonal close packing

B. squre close packing

C. cubic close packing

D. body centered packing

Answer: B

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20. Two dimensional close packed structure can be generated by stacking the rows of close packed spheres. This can be done in two different ways.

(I) The second row may be placed in contact with the first one, such that the spheres of the second row are exactly above those of first row. The spheres of the two rows are aligned

vertically as well as horizontally.

If we call the first row as 'A' type of row, the second row being exactly same as the first one is also of 'A' type. Similarly, we may place more rows to obtain AAAA.... type arrangement

(II) In this type, the second row may be placed above the first one in a staggered manner such that its spheres. fit in depressions of first row. if the arrangement of spheres in the first row is called 'A' type the one in the second row is different and may be called 'B' type. When the third row is placed adjacent to the second in staggered manner, its spheres are aligned with

those of first layer. Hence this layer is also 'A' type. The spheres of similarly placed fourth row will be aligned with those of the second row ('B' type). Hence this arrangement is of ABAB.... type The type of voids generated in type (I) & (II) respectively are

A. tetrahedral, octahedral

B. octahedral, tetrahedral

C. triangular, square

D. square, triangular

Answer: C

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21. Match list-I with list-II and select the correct answer by using the codes given below

A. $\begin{matrix} P & Q & R & S \\ 3 & 4 & 1 & 2 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 3 & 2 & 1 & 4 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 2 & 1 & 4 & 3 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 1 & 3 & 4 & 2 \end{matrix}$

Answer: A

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