Solid State

Question1

What fraction of one edge centred octahedral void lies in one unit cell of fcc?

[NEET 2023]

Options:

A.

1/3

B.

1/4

C.

1/12

D.

1/2

Answer: B

Solution:

The total number of octahedral voids in FCC are four

Octahedral voids in FCC = Edge centres + Body centre

The contribution of edge centre $= \frac{1}{4}$

$\therefore$ Fraction of one edge centred octahedral void in one unit cell of $FCC = \frac{1}{4}$

Question2

A compound is formed by two elements A and B. The element B forms cubic close packed structure and atoms of A occupy 1/3 of tetrahedral voids. If the formula of the compound is A_xB_y, then the value of x + y is in option

[NEET 2023]

Options:

A.

4

B.

3

C.

2

D.

5

Answer: D

Solution:

Number of atoms of element B is N

So, the number of atoms of element A is $\frac{1}{3} \times 2N$

$\therefore$ The formula of the compound is $A_{\frac{2}{3}N}B_N = A_2B_3$

So, $x = 2$

$y = 3$

$\therefore x + y = 5$

Question3

How many number of tetrahedral voids are formed in 5mol of a compound having cubic close packed structure? (Choose the correct option)

[NEET 2023 mpr]

Options:

A.

1.550×10^{24}

B.

3.011×10^{25}

C.

3.011×10^{24}

D.

6.022×10^{24}

Answer: D

Solution:

Number of particles $= 5N_A$

Number of THV $= 2\times$ number of particles, for close packing

$= 2 \times 5N_A$

$= 10N_A$

$= 10 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{24}$

Question4

How are edge length 'a' of the unit cell and radius ' r ' of the sphere related to each other in ccp structure? (Choose correct option for your answer)

[NEET 2023 mpr]

Options:

A.

a = 2r

B.

a = r/2√2

C.

a = 4r/√3

D.

a = 2√2r

Answer: D

Solution:

For CCP (FCC)

$4r = \sqrt{2}a$

$a = \dfrac{4r}{\sqrt{2}}$

$a = 2\sqrt{2}r$

Question5

Copper crystallises in fcc unit cell with cell edge length of 3.608×10^{-8}cm. The density of copper is $8.92 gcm^{-3}$. Calculate the

atomic mass of copper.
[NEET-2022]

Options:

A. 63.1u

B. 31.55u

C. 60u

D. 65u

Answer: A

Solution:

$$d = \frac{ZM}{N_A(a)^3}$$

$$Z = 4(FCC), d = 8.92gcm^{-3}, N_A = 6.023 \times 10^{23}, a = 3.608 \times 10^{-8}cm$$

$$M = \frac{dN_A(a)^3}{Z}$$

$$= \frac{8.92 \times 6.023 \times 10^{23} \times (3.608 \times 10^{-8})^3}{4}$$

$$= \frac{8.92 \times 6.023 \times 10^{23} \times 46.97 \times 10^{-24}}{4} = \frac{2523.47 \times 10^{-1}}{4}$$

$$= 630.8 \times 10^{-1} = 63.08 \simeq 63.1u$$

Question6

Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A):
In a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells.
Reason (R):
In an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.
In the light of the above statements, choose the most appropriate answer from the options given below:
[NEET-2022]

Options:

A. Both (A) and (R) are correct and (R) is the correct explanation of (A)

B. Both (A) and (R) are correct but (R) is not the correct explanation of (A)

C. (A) is correct but (R) is not correct

D. (A) is not correct but (R) is correct

Answer: B

Solution:

- Assertion statement is classic explanation of Schottky defect in which cation and anion leaves their site, or impurity defect.

- Reason statement is true but not correct explanation as it is defining Frenkel defect in which ion does not leave crystal.

Question7

List - I (Defects)	List - II (shown by)
(a) Frenkel defect	(i) non-ionic solidsand density of thesolid decreases
(b) Schottky defect	(ii) non-ionic solidsand density of thesolid increases
(c) Vacancy defect	(iii) ionic solids anddensity of the soliddecreases
(d) Interstitial defect	(iv) ionic solids anddensity of the solidremains constant

Choose the correct answer from the options given below : [NEET Re-2022]

Options:

A. (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

B. (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

C. (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)

D. (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Answer: A

Solution:

Solution

Schottky and Frenkel defects are shown by ionic solids and in this density decreases and remains same respectively.

Vacancy and Interstitial defects are shown by non-ionic solid and in this density decreases and increases respectively.

Hence (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Question8

What fraction of Fe exists as Fe(III) in $Fe_{0.96O}$? (Consider $Fe_{0.96}O$ to be made up of Fe(II) and Fe(III) only)
[NEET Re-2022]

Options:

A. $\frac{1}{20}$

B. $\frac{1}{12}$

C. 0.08

D. $\frac{1}{16}$

Answer: B

Solution:

$Fe_{0.96}O = Fe_{96}O_{100}$

Let us consider Fe in $Fe^{-2} = x$

Fe in $Fe^{-3} = (96 - x)$

Total + ve charge = total − ve charge

$(96 - x) \times 3 + 2x = 200$

$288 - 3x + 2x = 200$

$x = 88$

$Fe^{-3} = 96 - 88 = 8$

Fraction of $Fe^{-3} = \frac{8}{96} = \frac{1}{12}$

Question9

The correct option for the number of body centred unit cells in all 14 types of Bravais lattice unit cells is :
[NEET 2021]

Options:

A. 7

B. 5

C. 2

D. 3

Answer: D

Solution:

● In 14 types of Bravais lattices, body centred unit cell is present in cubic, tetragonal and orthorhombic crystal systems.
● Hence, body centred possible variation is present in three crystal systems.

Question10

An element has a body centered cubic (bcc) structure with a cell edge of 288pm. The atomic radius is:
(2020)

Options:

A. $\frac{\sqrt{2}}{4} \times 288pm$

B. $\frac{4}{\sqrt{3}} \times 288pm$

C. $\frac{4}{\sqrt{2}} \times 288pm$

D. $\frac{\sqrt{3}}{4} \times 288pm$

Answer: D

Solution:

For bcc, $\sqrt{3}a = 4r \Rightarrow r = \frac{\sqrt{3}a}{4}$

Given, $a = 288pm$

$r = \frac{\sqrt{3}}{4} \times 288pm$

Question11

A compound is formed by cation C and anion A. The anions form hexagonal close packed (hcp) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is
(NEET 2019)

Options:

A. C_4A_3

B. C_2A_3

C. C_3A_2

D. C_3A_4

Answer: D

Solution:

In hexagonal close packed (HCP) lattice the number of atoms $= 6$
And the number of atoms is always equal to no. of octahedral voids and the tetrahedral voids are double of octahedral voids.
So here we are talking about octahedral voids therefore.
No. of octahedral voids $= 6$
And it is given in question that captions occupy 75% of octahedral voids.
$\therefore 6 \times \frac{75}{100} = \frac{9}{2}$ by solving this we get therefore, $\frac{9}{2}$ octahedral voids are occupied We can't write its formula because it is in fractions so firstly convert into whole no. by writing the ratio of cations and anions.
Cations: anions $\frac{9}{2} : 6$
$9 : 12$
$3 : 4$
C_3A_4

Question12

Formula of nickel oxide with metal deficiency defect in its crystal is $Ni_{0.98}O$. The crystal contains Ni^{2+} and Ni^{3+} ions. The fraction of nickel existing as Ni^{2+} ions in the crystal is (Odisha NEET 2019)

Options:

A. 0.96

B. 0.04

C. 0.50

D. 0.3

Answer: A

Solution:

Let the fraction of metal which exists as Ni^{2+} ion be x.
Then the fraction of metal as $Ni^{3+} = 0.98 - x$
$\therefore 2x + 3(0.98 - x) = 2$
$\Rightarrow 2x + 2.94 - 3x = 2$
$\Rightarrow x = 0.94$

Question13

Iron exhibits bcc structure at room temperature. Above 900°C, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is
(NEET 2018)

Options:

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

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

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

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

Answer: C

Solution:

For bcc lattice : $Z = 2, a = \frac{4r}{\sqrt{3}}$
For fcc lattice : $Z = 4, a = 2\sqrt{2}r$

$$\therefore \frac{d_{R.T.}}{d_{900°C}} = \frac{\left(\frac{ZM}{N_A a^3}\right)_{bcc}}{\left(\frac{ZM}{N_A a^3}\right)_{fcc}}$$

Given, molar mass and atom radii are constant. $= \frac{2}{4}\left(\frac{2\sqrt{2}r}{\frac{4r}{\sqrt{3}}}\right)^3 = \frac{3\sqrt{3}}{4\sqrt{2}}$

Question14

Which is the incorrect statement?
(NEET 2017)

Options:

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

B. $NaCl_{(s)}$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.

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

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

Answer: D

Solution:

Frenkel defect is favoured in those ionic compounds in which there is large difference in the size of cations and anions.
Non-stoichiometric defects due to metal deficiency is shown by Fe_xO where $x = 0.93$ to 0.96

Question15

In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are (NEET-II 2016)

Options:

A. 4 and 2

B. 6 and 6

C. 8 and 4

D. 4 and 8

Answer: C

Solution:

Solution:
In fluorite structure, Ca^{2+} ions are in the face-centred cubic arrangement. Each Ca^{2+} is connected to $4F^-$ ions below it and to another set of $4F^-$ ions above it $i.e.$ Ca^{2+} has a coordination number of 8 and each F^- ion has a coordination number 4 .

Question16

Lithium has a bcc structure. Its density is $530 kgm^{-3}$ and its atomic mass is $6.94 gmol^{-1}$. Calculate the edge length of a unit cell of lithium metal. ($N_A = 6.02 \times{}^{23}\ mol^{-1}$) (NEET-I 2016)

Options:

A. 527 pm

B. 264 pm

C. 154 pm

D. 352 pm

Answer: D

Solution:

Solution:

For bcc, $Z = 2$, $\rho = 530\,\mathrm{kg\,m^{-3}}$, at. mass of Li $= 6.94\mathrm{gmol^{-1}}$, $N_A = 6.02 \times 10^{23}\mathrm{mol^{-1}}$

$$\rho = 530\,\mathrm{kg\,m^{-3}} = \frac{530 \times 1000\mathrm{g}}{1 \times (100)^3\mathrm{cm}^3} = 0.53\ \mathrm{g\ cm^{-3}}$$

$$a^3 = \frac{Z \times \mathrm{At.\,mass}}{N_A \times \rho} = \frac{2 \times 6.94}{6.02 \times 10^{23} \times 0.53} = 43.5 \times 10^{-24}\mathrm{cm}^3$$

$\Rightarrow a = 352 \times 10^{-10}\mathrm{cm} = 352\mathrm{pm}$

Question17

The ionic radii of A^+ and B^- ions are 0.98×10^{-10}m and 1.81×10^{-10}m. The coordination number of each ion in AB is (NEET-I 2016)

Options:

A. 8

B. 2

C. 6

D. 4

Answer: C

Solution:

Solution:

Radius ratio, $\frac{r^+}{r^-} = \frac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.541$

It lies in the range of 0.414 to 0.732 hence, coordination number of each ion will be 6 as the compound will have NaCl type structure i.e., octahedral arrangement.

Question18

The vacant space in bcc lattice unit cell is (2015, 2008)

Options:

A. 48%

B. 23%

C. 32%

D. 26%

Answer: C

Solution:

Solution:
Packing efficiency of bcc lattice = 68%
Hence, empty space = 32%

Question19

The correct statement regarding defects in crystalline solids is (2015)

Options:

A. Frenkel defects decrease the density of xirystalline solids

B. Frenkel defect is a dislocation defect

C. Frenkel defect is found in halides of alkaline metals

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

Answer: B

Solution:

Solution:
Frenkel defect is a dislocation defect as smaller ion.- (usually cations) are dislocated from normal sites to interstitial sites. Frenkel defect is shown by compounds having large difference in the size of cations and anions hence, alkali metal halides do not show Frenkel defect.
Also, Schottky defect decreases the density of crystal while Frenkel defect has no effect on the density of crystal.

Question20

A given metal crystallises out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom? ((2015 Cancelled))

Options:

A. 80 pm

B. 108 pm

C. 40 pm

D. 127 pm

Answer: D

Solution:

Solution:
Z=4,i.e., structure is fcc
Hence, $r = \frac{a}{2\sqrt{2}} = \frac{361}{2\sqrt{2}} = 127.65pm \approx 127pm$

Question21

If a is the length of the side of a cube, the distance between the body centered atom and one comer atom in the cube will be (2014)

Options:

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

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

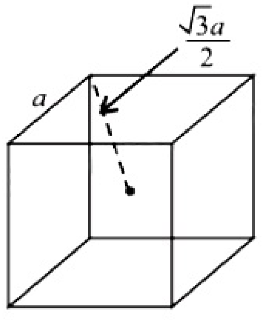
C. $\frac{\sqrt{3}}{4}a$

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

Answer: D

Solution:

Solution:
The distance between the body centered atom and one comer atom is $\frac{\sqrt{3}a}{2}$ i.e half of the body diagonal



Question22

The number of carbon atoms per unit cell of diamond unit cell is (2013 NEET)

Options:

A. 6

B. 1

C. 4

D. 8

Answer: D

Solution:

Solution:
Diamond is like ZnS (Zinc blende).Carbon forming cep (fcc) and also occupying half of tetrahedral voids.
Total no. of carbon atoms per unit cell =

$$\underset{\text{(corners)}}{8 \times \frac{1}{8}} + \underset{\text{(Face centered)}}{6 \times \frac{1}{2}} + \underset{\text{(Terahedral void)}}{4} = 8$$

Question23

A metal has a fcc lattice. The edge length of the unit cell is 404 pm. The density of the metal is $2.72 gcm^{-3}$.The molar mass of the metal is :(N_A Avogadro's constant $= 6.02 \times 10^{23} mol^{-1}$)
(2013 NEET)

Options:

A. $27 gmol^{-1}$

B. $20 gmol^{-1}$

C. $40 gmol^{-1}$

D. $30 gmol^{-1}$

Answer: A

Solution:

$$d = \frac{Z\,M}{N_A a^3} \quad \text{(Z = 4 for fcc)}$$

$$M = \frac{d \times N_A \times a^3}{Z} = \frac{2.72 \times 6.023 \times 10^{23} \times (404 \times 10^{-10})^3}{4}$$

$$M = 26.99 \approx 27 gmol^{-1}$$

Question24

Structure of a mixed oxide is cubic close packed (c.c.p). The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovalent metal B. The formula of the oxide is (2012 Mains)

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Options:

A. ABO_2

B. A_2BO_2

C. $A_2B_3O_4$

D. AB_2O_2

Answer: D

Solution:

Number of atoms in c.c.p = $4 = O^{2-}$
Number of tetrahedral voids $= 2 \times N = 2 \times 4$
Number of A^{2+} ions $= 8 \times \frac{1}{4} = 2$
Number of octahedral voids = Number of B^{+} ions = N = 4
Ratio ,$O^{2-} : A^{2+} :, B^{+} = 4 : 2 : 4 = 2 : 1 : 2$
Formula of oxide $= AB_2O_2$

Question25

**The number of octahedral void(s) per atom present in a cubic close-packed structure is
(2012)**

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Options:

A. 1

B. 3

C. 2

D. 4

Answer: A

Solution:

Solution:
Number of octahedral voids is same as number of atoms.

Question26

A metal crystallises with a face-centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is (2012)

Options:

A. 288 pm

B. 408 pm

C. 144 pm

D. 204 pm

Answer: A

Solution:

For a face centred cubic (fcc) structure,

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

$a = 408pm, r = \frac{408}{2\sqrt{2}} = 144pm$

Diameter $= 2r = 2 \times 144 = 288pm$

Question27

A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y) will be (2011 Mains)

Options:

A. 275.1 pm

B. 322.5 pm

C. 241.5 pm

D. 165.7 pm

Answer: C

Solution:

For NaCl, $\frac{r_+}{r_-} = 0.414$

Given radius of cation = 100 pm

$\frac{100}{r_-} = 0.414 \Rightarrow \frac{100}{0.414} = r_- \Rightarrow r_- = 241.5\text{pm}$

Question28

AB crystallizes in a body centred cubic lattice with edge length ‘a’ equal to 387 pm. The distance between two oppositely charged ions in the lattice is (2010)

Options:

A. 335 pm

B. 250 pm

C. 200 pm

D. 300 pm

Answer: A

Solution:

For a bcc lattice, $2(r_+ + r_-) = \sqrt{3}a$

Where r_+ = radius of cation

r_- = radius of anion

a = edge length

$\therefore (r_+ + r_-) = \frac{\sqrt{3} \times 387}{2} = 335.142\text{pm} \approx 335\text{pm}$

Question29

Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm? (2009)

Options:

A. 157

B. 181

C. 108

D. 128

Answer: D

Solution:

Solution:

Since Cu crystallises in a face-centred cubic lattice,atomic radius, $r = \frac{a}{2\sqrt{2}}$ (a = edge lenth = 361 pm)

$\therefore r = \frac{361}{2\sqrt{2}}$ = 127.6 ≈ 128pm

Question30

Lithium metal crystallises in a body-centred cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of lithium will be
(2009)

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Options:

A. 151.8 pm

B. 75.5 pm

C. 300.5 pm

D. 240.8 pm

Answer: A

Solution:

Solution:

Since Li crystallises in body-centred cubic crystal,

atomic radius $r = \frac{a\sqrt{3}}{4}$ (a=edge length)

$\therefore r = \frac{\sqrt{3}}{4} \times 351$ = 151.8 pm (given a = 351 pm)

Question31

If a stands for the edge length of the cubic systems: simple cubic, body centred cubic and face centred cubic, then the ratio of radii of the spheres in these systems will respectively

(2008)

Options:

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

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

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

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

Answer: C

Solution:

Solution:

For Simple cubic : $r_+ + r_- = \frac{a}{2}$

For Body centred : $r_+ + r_- = \frac{a\sqrt{3}}{4}$

Where a = edge length

$r_+ + r_-$ = interatomic distance,

For Face centered : $r_+ + r_- = \frac{a}{2\sqrt{2}}$

∴ Ratio of radii of the three will be

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

Question32

With which one of the following elements silicon should be doped so as to give p-type of semiconductor? (2008)

Options:

A. Selenium

B. Boron

C. Germanium

D. Arsenic

Answer: B

Solution:

If silicon is doped with any of the element of group III (B, Al, Ga, In, Tl) of the periodic table,p-type of semiconductor will be obtained.

Question33

Which of the following statements is not correct? (2008)

Options:

A. The number of carbon atoms in a unit cell of diamond is 4.

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

C. The fraction of the total volume occupied by the atoms in a primitive cell is 0.48.

D. Molecular solids are generally volatile.

Answer: C

Solution:

Solution:

Packing fraction for a cubic unit cell is given by $f = \frac{Z \times \frac{4}{3}\pi r^3}{a^3}$

where a = edge length, r = radius of cation and anion.

Efficiency of packing in simple cubic or primitive cell $= \frac{\pi}{6}$ = 0.52 i,e. 52% of unit cell is occupied by atoms and 48% is empty.

Question34

Percentage of free space in a body centred cubic unit cell is (2008)

Options:

A. 34 %

B. 28 %

C. 30 %

D. 32 %

Answer: D

Solution:

The ratio of volumes occupied by atoms in unit cell to the total volume of the unit cell is called as packing fraction or density of packing. For body centred cubic structure, packing fraction = 0.68 i.e., 68% of the unit cell is occupied by atoms and 32% is empty.

Question35

The fraction of total volume occupied by the atoms present in a simple cube is
(2007)

Options:

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

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

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

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

Answer: D

Solution:

Solution:

The maximum properties of the available volume which may be filled by hard sphere in simple cubic arrangement is $\frac{\pi}{6}$ or 0.52

Question36

If NaCl is doped with 10^{-4} mol % of $SrCl_2$ the concentration of cation vacancies will be ($N_A = 6.02 \times 10^{23} mol^{-1}$)
(2007)

Options:

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

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

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

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

Answer: B

Solution:

As each Sr^{2+} ion introduces one cation vacancy, therefore,concentration of cation vacancies = mole % of $SrCl_2$ added.
∴ Concentration of cation vacancies $= 10^{-4}$ mole%

$= \frac{10^{-4}}{100} \times 6.023 \times 10^{23} = 6.023 \times 10^{23} \times 10^{-6}$

$= 6.023 \times 10^{17}$

Question37

The appearance of color in solid alkali metal halides is generally due to (2006)

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Options:

A. interstitial positions

B. F-centres

C. Schottky defect

D. Frenkel defect

Answer: B

Solution:

F-centres are the sites where anions are missing and instead electrons are present. They are responsible for colours.

Question38

CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being $6.02 \times 10^{23} mol^{-1}$,the density of CsBr is
(2006)

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Options:

A. $4.25 g/cm^3$

B. $42.5 g/cm^3$

C. $0.425 g/cm^3$

D. $8.5 g/cm^3$

Answer: D

Solution:

Solution:

Denisty $= \frac{Z \times M}{a^3 \times N_A}$

Given Z = two formula unit of CsBr in 1 cubic unit = 2 and edge length, $a = 436.6 pm = 436.6 \times 10^{-10} cm$

Molecular weight of CsBr = 133 + 80 = 213g / mol

Upon substituting the values in the above density equation:

Density $= \frac{2 \times 213}{(436.6 \times 10^{-10})^3 \times 6.022 \times 10^{23}} = 8.5 g / cm^3$

Question39

The appearance of colour in solid alkali metal halides is generally due to
(2006)

Options:

A. interstitial positions

B. F -centres

C. Schottky defect

D. Frenkel defect.

Answer: B

Solution:

Solution:

F -centres are the sites where anions are missing and instead electrons are present. They are responsible for colours.

Question40

In a face-centred cubic lattice, a unit cell is shared equally by how many unit cells?
(2005)

Options:

A. 2

B. 4

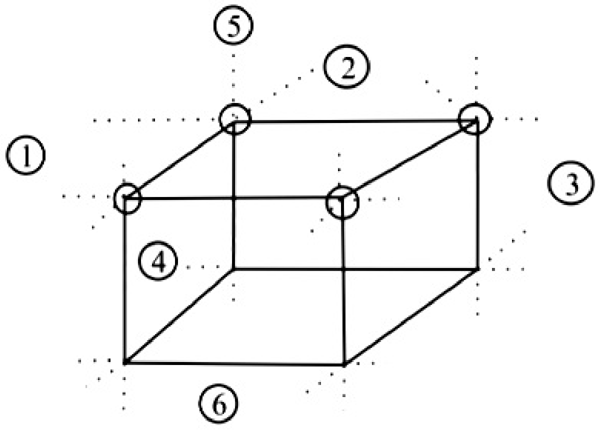
C. 6

D. 8

Answer: C

Solution:

Here given unit cell is shared equally by six faces in the fcc which is shared equally by six different unit cells.



Question41

A compound formed by elements X and Y crystallises in a cubic structure in which the X atoms are at the corners of a cube and the Y atoms are at the face-centres. The formula of the compound is (2004)

Options:

A. XY_3

B. X_3Y

C. XY

D. XY_2

Answer: A

Solution:

Solution:
In a unit cell, X atoms at the corners $= \frac{1}{8} \times 8 = 1$
Y atoms at the face centres $= \frac{1}{2} \times 6 = 3$
Ratio of X and Y $= 1 : 3$. Hence formula is XY_3.

Question42

The pyknometric density of sodium chloride crystal is $2.165 \times 10^3 \, kg \, m^{-3}$ while its X-ray density is $2.178 \times 10^3 \, kg \, m^{-3}$. The fraction of unoccupied sites in sodium chloride crystal is
(2003)

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Options:

A. 5.96

B. 5.96×10^{-2}

C. 5.96×10^{-1}

D. 5.96×10^{-3}

Answer: D

Solution:

Molar volume from pyknometric density $= \dfrac{M}{2.165 \times 10^3} m^3$

Molar volume from X -ray density $= \dfrac{M}{2.178 \times 10^3} m^3$

Fraction unoccupied $= \dfrac{\left(\dfrac{0.013M \times 10^{-3}}{2.165 \times 2.178}\right)}{\left(\dfrac{M \times 10^{-3}}{2.165}\right)} = 5.96 \times 10^{-3}$

Question43

When Zn converts from melted state to its solid state, it has hcp structure, then find the number of nearest atoms.
(2001)

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Options:

A. 6

B. 8

C. 12

D. 4

Answer: C

Solution:

hcp is a closed packed arrangement in which the unit cell is hexagonal and coordination number is 12 .

Question44

Cation and anion combines in a crystal to form following type of compound
(2000)

Options:

A. ionic

B. metallic

C. covalent

D. dipole-dipole.

Answer: A

Solution:

Solution:
The electrostatic force of attraction which exists between oppositely charged ions is called as ionic bond.

Question45

In cube of any crystal A -atom placed at every corners and B -atom placed at every centre of face. The formula of compound is
(2000)

Options:

A. AB

B. AB_3

C. A_2B_2

D. A_2B_3

Answer: B

Solution:

'A' atoms are at '8' corners of the cube.

Thus, no. of ' A ' atoms per unit cell $= 8 \times \frac{1}{8} = 1$

' B ' atoms are at the face centre of six faces. Thus, no. of B ' atoms per unit cell $= 6 \times \frac{1}{2} = 3$

The formula is AB_3.

Question46

In crystals of which one of the following ionic compounds would you expect maximum distance between centres of cations and anions? (1998)

Options:

A. CsI

B. CsF

C. LiF

D. LiI

Answer: A

Solution:

Solution:
As Cs^{+} ion has larger size than Li^{+} and I^{-} has larger size than F^{-}, so maximum distance between centres of cations and anions is in CsI.

Question47

The second order Bragg diffraction of X-rays with λ = 1.00Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystal is (1998)

Options:

A. 2.00Å

B. 1.00Å

C. 0.575Å

D. 1.15Å

Answer: D

Solution:

According to Bragg's equation,
$n\lambda = 2d \sin\theta$
As, $n = 2$, $\lambda = 1.00Å$, $\theta = 60°$, $d = ?$
$\Rightarrow d = \frac{1}{\sin 60°} = \frac{2}{\sqrt{3}} = 1.15Å$

Question48

The edge length of face-centred unit cubic cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is (1998)

Options:

A. 144 pm

B. 398 pm

C. 288 pm

D. 618 pm

Answer: A

Solution:

Solution:
In the face-centred cubic lattice, the edge length of the unit cell, $a = r + 2R + r$
where $r =$ Radius of cation
$R =$ Radius of anion
$\Rightarrow 508 = 2 \times 110 + 2R \Rightarrow R = 144$ pm

Question49

Schottky defect in crystals is observed when (1998)

Options:

A. density of the crystal is increased

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

C. an ion leaves its normal site and occupies an interstitial site

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

Answer: D

Solution:

In Schottky defect equal no. of cations and anions are missing from the lattice. So the crystal remains neutral. Such defect is more common in highly ionic compounds of similar cationic and anionic size, $i.e.$ NaCl.

Question50

The high density of water compared to ice is due to
(1997)

Options:

A. dipole-induced dipole interactions

B. induced dipole induced dipole interactions

C. hydrogen bonding interactions

D. dipole-dipole interactions.

Answer: C

Solution:

Solution:
Due to polar nature, water molecules are held together by intermolecular hydrogen bonds. The structure of ice is open with large number of vacant spaces. Thus the density of ice is less.

Question51

For two ionic solids CaO and KI, identify the wrong statement among the following.
(1997)

Options:

A. CaO has high melting point.

B. Lattice energy of CaO is much larger than that of KI.

C. KI has high melting point.

D. KI is soluble in benzene.

Answer: D

Solution:

KI is an ionic compound while benzene is not.

Question52

The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
(1997)

Options:

A. face-centred cube

B. simple cube

C. body-centred cube

D. none of these.

Answer: C

Solution:

Solution:
A body-centred cubic unit cell consists of 8 atoms at the corners and one atom at the centre.

Question53

The f cc crystal contains how many atoms in each unit cell?
(1996)

Options:

A. 6

B. 8

C. 4

D. 5

Answer: C

Solution:

The contribution of eight atoms of face-centred cubic unit cell $= 8 \times \frac{1}{8} = 1$ atom.

There is one atom at each of six faces, which is shared by 2 unit cells each.

The contribution of 6 face-centred atoms $= 6 \times \frac{1}{2} = 3$.

Therefore $n = 1 + 3 = 4$

Question54

If we mix a pentavalent impurity in a crystal lattice of germanium, what type of semiconductor formation will occur?
(1996)

Options:

A. n -type semiconductor

B. p -type semiconductor

C. Both (a) and (b)

D. None of these.

Answer: A

Solution:

Solution:
When an impurity atom with 5 valence electrons (as arsenic) is introduced in a germanium crystal, it replaces one of the germanium atoms. Four of the five valence electrons of the impurity atom form covalent bonds with each valence electron of four germanium atoms and fifth valence electron becomes free to move in the crystal structure. This free electron acts as a charge carrier. Such as an impure germanium crystal is called n -type semiconductor because in it charge carriers are negative (free electrons).

Question55

An element (atomic mass $= 100 g / mol$) having bcc structure has unit cell edge 400 pm. The density of element is
(1996)

Options:

A. $7.289 g / cm^3$

B. $2.144 g / cm^3$

C. $10.376 g / cm^3$

D. $5.188 g / cm^3$

Answer: D

Solution:

Cell edge $= 400$ pm; Number of atoms in bcc$(Z) = 2$ and atomic mass $= 100g / mol$.
since atomic mass is $100g / mol$,
therefore mass of each atom $(m) = \frac{100}{6.023 \times 10^{23}} = 16.6 \times 10^{-23}$ g
We know that volume of unit cell $= (400\,pm)^3 = (64 \times 10^6)\,pm^3 = 64 \times 10^{-24}\,cm^3$ and
mass of unit cell $= Z \times m = 2 \times (16.6 \times 10^{-23}) = 33.2 \times 10^{-23} g$
Therefore density $= \frac{\text{Mass of unit cell}}{\text{Volume of unit cell}} = \frac{33.2 \times 10^{-23}}{64 \times 10^{-24}} = 5.188 g / cm^3$

Question56

The number of atoms in 100g of a fcc crystal with density $d = 10g / cm^3$ and cell edge equal to 100 pm, is equal to
(1994)

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Options:

A. 2×10^{25}

B. 1×10^{25}

C. 4×10^{25}

D. 3×10^{25}

Answer: C

Solution:

Mass$(m) = 100g$; Density $(d) = 10g / cm^3$ and length $(l) = 100\,pm = 100 \times 10^{-12} m = 100 \times 10^{-12}\,cm$
We know that volume of the unit cell $= (l)^3 = (100 \times 10^{-10} cm)^3 = 10^{-24} cm^3$
and volume of 100g of element $= \frac{\text{Mass}}{\text{Density}} = \frac{100}{10} = 10 cm^3$
Therefore, number of unit cells $= \frac{10}{10^{-24}} = 1 \times 10^{25}$
since each fcc cube contains 4 atoms, therefore total number of atoms in 100g $= 4 \times (1 \times 10^{25}) = 4 \times 10^{25}$

Question57

Ionic solids, with Schottky defects, contain in their structure
(1994)

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Options:

A. cation vacancies only

B. cation vacancies and interstitial cations

C. equal number of cation and anion vacancies

D. anion vacancies and interstitial anions.

Answer: C

Solution:

When an atom is missing from its normal lattice site, a lattice vacancy is created. Such a defect, which involves equal number of cation and anion vacancies in the crystal lattice is called a Schottky defect.

Question58

The pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. The behaviour is a characteristic of substance forming
(1993)

Options:

A. allotropic crystals

B. liquid crystals

C. isomeric crystals

D. isomorphous crystals.

Answer: B

Solution:

Solution:
Liquid crystals on heating first become turbid and then on further heating turbidity completely disappears.

Question59

On doping Ge metal with a little of In or Ga, one gets
(1993)

Options:

A. p -type semiconductor

B. n -type semiconductor

C. insulator

D. rectifier.

Answer: A

Solution:

p-type of semiconductors are produced (a) due to metal deficiency defects (b) by adding impurity containing less electrons (i.e. atoms of group 13). Ge belongs to Group 14 and In or Ga to Group 13. Hence on doping p -type semiconductor is obtained. This doping of Ge with In increase the electrical conductivity of the Ge crystal.

Question60

In the fluorite structure, the coordination number of Ca^{2+} ion is (1993)

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Options:

A. 4

B. 6

C. 8

D. 3

Answer: C

Solution:

Solution:
In fluorite (CaF_2) structure, C.N. of $Ca^{2+} = 8$, C.N. of $F^- = 4$

Question61

The number of atoms contained in a fcc unit cell of a monatomic substance is (1993)

Options:

A. 1

B. 2

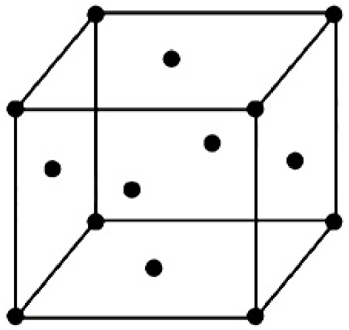
C. 4

D. 6

Answer: C

Solution:

f cc crystal contains $= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$ atoms in a unit cell



Question62

For orthorhombic system axial ratios are a ≠ b ≠ c and the axial angles are
(1991)

Options:

A. $\alpha = \beta = \gamma \neq 90°$

B. $\alpha = \beta = \gamma = 90°$

C. $\alpha = \gamma = 90°, \beta \neq 90°$

D. $\alpha \neq \beta \neq \gamma \neq 90°$

Answer: B

Solution:

For orthorhombic system $\alpha = \beta = \gamma = 90°$

Question63

Most crystals show good cleavage because their atoms, ions or molecules are
(1991)

Options:

A. weakly bonded together

B. strongly bonded together

C. spherically symmetrical

D. arranged in planes.

Answer: D

Solution:

Crystals show good cleavage because their constituent particles are arranged in planes.
