

CHEMISTRY

BOOKS - IIT-JEE PREVIOUS YEAR (CHEMISTRY)

SOLID STATE

Jee Main And Advanced

1. 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. $2a$

B. $2\sqrt{2}a$

C. $\sqrt{2}a$

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

Answer: D

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2. Sodium metal crystallises in body centred cubic lattice with cell edge 4.29\AA . What is the radius of sodium atom ?

A. 1.86\AA

B. 3.22\AA

C. 5.72\AA

D. 0.93\AA

Answer: A

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3. $CsCl$ crystallizes in body centred cubic lattice. If ' a ' is its edge length then which of the following expressions is correct ?

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

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

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

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

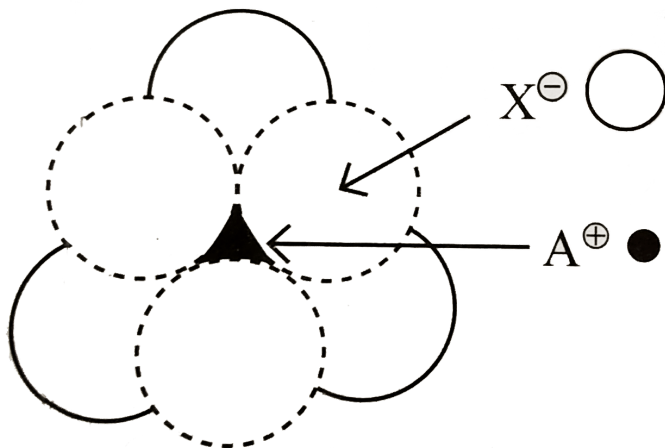
Answer: C



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4. The arrangement of X^\ominus ions around A^\oplus ion in solid AX is given in the figure (not drawn to scale). If the radius of X^\ominus is $250 \pm$, the radius of

A^{\oplus} is



A. 104 pm

B. 125 pm

C. 183 pm

D. 57 pm

Answer: A

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

A. 7.01 %

B. 4.08 %

C. 6.05 %

D. 5.08 %

Answer: B



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

A. Iodine

B. Silicon

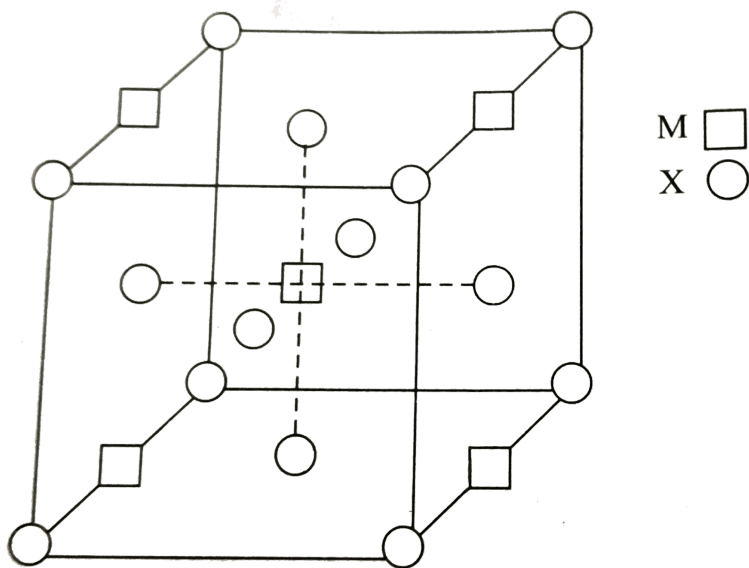
C. Sulphur

D. Phosphorus

Answer: B

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



a. MX

b. MX_2

c. M_2X

A. MX

B. MX_2

C. M_2X

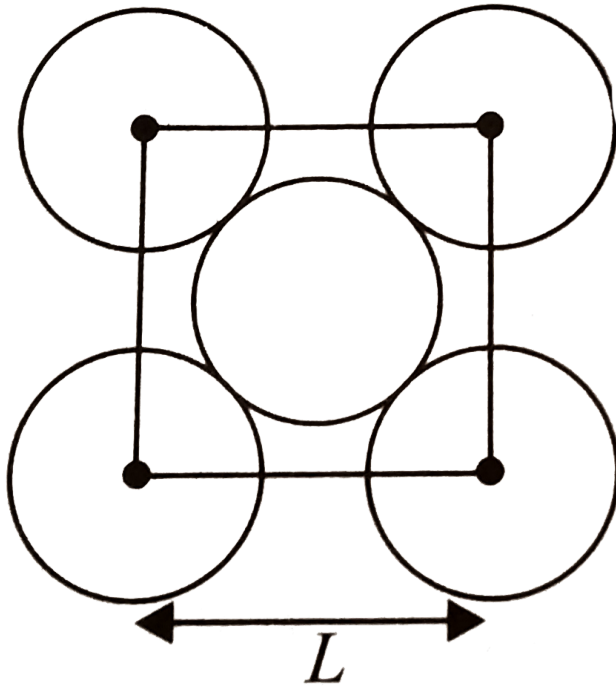
D. M_5X_{14}

Answer: B



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



- A. 39.27 %
- B. 68.02 %
- C. 74.05 %
- D. 78.54 %

Answer: D



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9. 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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10. In a solid AB having the $NaCl$ structure, A atom occupies the corners of the cubic unit cell. If all the face-centred atoms along one of the axes are removed, then the resultant stoichiometry of the solid is

A. AB_2

B. A_2B

C. A_4B_3

D. A_3B_4

Answer: D



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

A. 12

B. 4

C. 8

D. 6

Answer: A



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

- A. The number of the nearest neighbours of an atom present in the topmost layer is 12
- B. The packing efficiency of atom is 74 %
- C. The number of octahedral and tetrahedral voids per atom are 1 and 2, respectively
- D. The unit cell edge length is $2\sqrt{2}$ times the radius of the atom

Answer: B::C::D



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13. If the unit cell of a mineral has cubic close packed (ccp) array of oxygen atoms with m fraction of octahedral holes occupied by aluminium ions

and n fraction of tetrahedral holes occupied by 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 statement regarding defects in crystalline solids.

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-centre
- D. Schottky defect have no effect on the physical properties of solids

Answer: B::C

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15. Which of the following statement(s) is/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 an ionic crystal shares some of its ions with other unit cells
- D. The length of the unit cell in $NaCl$ is 552 pm.
($r_{Na^+} = 95\text{pm}$, $r_{Cl^-} = 181\text{pm}$)

Answer: A::C::D



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

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



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17. In a hexagonal system 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 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 so that they touch 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 covered with a third layer identical to the bottom layer in relative position. Assume the radius of every sphere to be r .

The number of atom in this hcp unit cell is

- A. 4
- B. 6
- C. 12
- D. 17

Answer: B



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The empty space in this hcp unit cell is

- A. 74 %
- B. 47.6 %
- C. 32 %
- D. 26 %

Answer: D



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19. Match the crystal system/unit cells mentioned in Column I with their characteristic features mentioned in Column II.

A.

Column I

Column II

Simple cubic and face centred cubic *p*. have these cell parameters $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$

B.

Column I

Column II

Cubic and rhombohedral *q*. are two crystal systems

C.

Column I

Column II

Cubic and tetragonal *r*. have only two crystallographic angles of 90°

D.

Column I

Column II

Hexagonal and monoclinic *s*. belong to same crystal system

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



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20. A crystalline solid of a pure substance has a face-centred cubic structure with a cell edge of 400 pm. If the density of the substance in

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

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

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22. Silver (atomic weight 108gmol^{-1}) has a density of 10.5gcm^{-3} . The number of silver atoms on a surfaces of area 10^{-12}m^2 can be expressed in scientific notation as $Y \times 10^{-x}$, The value of x is

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23. The edge length of unit cell of a metal having molecular weight 75gmol^{-1} is 5\AA which crystallizes in cubic lattice. If the density is

$2g^{-1}$, then find the radius of metal atom ($N_A = 6 \times 10^{23}$). Give the answer in pm.

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

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25. The crystal AB (rock salt structure) has molecular weight $6.023Yu$, where Y is an arbitrary number in u . If the minimum distance between cation and anion is $\frac{Y^1}{3} nm$ and the observed density is $20 kgm^{-3}$. Find

a. The density in kgm^{-3} . and

b. The type of defect

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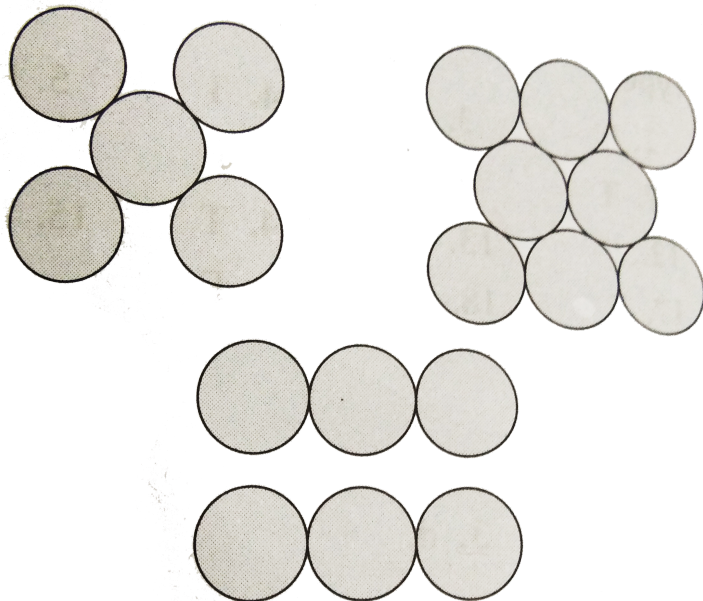
26. You are given marbles of diameter 10mm . They are to be placed such that their centres are laying in a square bound by four lines each of length 40mm . What will be the arrangements of marbles in a plane so that maximum number of marbles can be placed inside the area? Sketch the diagram and derive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



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

these planes in your diagrams.



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28. A metal crystallizes into two cubic phases, face-centred cubic and body-centred cubic, which have unit cell lengths 3.5 and $3.0A$, respectively. Calculate the ration of densities of fcc and bcc.



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

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30. A metallic crystal crystallizes into a lattice containing a sequence of layers $ABABAB\dots$. Any packing of spheres leaves out voids in the lattice. What percentage by volume of this lattice is empty space?

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

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1. Which of the following fcc structure contains cations in alternate tetrahedral voids ?



Answer: B



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Passage

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

Answer: A



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