PREVIOUS YEARS' QUESTIONS

EXERCISE-II

- 1. A metal crystallises into two cubic phases, FCC and BCC whose unit cell lengths are 3.5 and 3.0 Å respectively. Calculate the ratio of densities of FCC and BCC.

 [JEE-1999]
- 2. An element crystallises in FCC lattice having edge length 400 pm. Calculate the maximum diameter which can be placed in interstital sites without disturbing the structure. [JEE 2005]
- 3. The edge length of unit cell of a metal having atomic weight 75 g/mol is 5 Å which crystallizes in cubic lattice. If the density is 2 g/cc then find the radius of metal atom. ($N_A = 6 \times 10^{23}$). Give the answer in pm. [JEE 2006]

Paragraph for Question No.4 to 6

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'.

4. The number of atoms in this HCP unit cells is

[JEE 2008]

- (1) 4
- (2)6
- (3) 12
- (4) 17
- 5. The volume of this HCP unit cell is [JEE 2008]
 - (1) $24\sqrt{2} r^3$
- (2) $16\sqrt{2} \, r^3$
- (3) $12\sqrt{2} r^3$
- (4) $\frac{64}{3\sqrt{3}}$ r³
- **6.** The empty space in this HCP unit cell is **[JEE 2008]**
 - (1) 74%
- (2) 47.6 %
- (3) 32%

- (4) 26%
- **7.** Copper crystallises in fcc with a unit cell edge length of 361pm. What is the radius of copper atom?

[AIEEE-2011]

- (1) 181pm
- (2) 128pm
- (3) 157pm
- (4) 108pm

8. Ammonium chloride crystallizes in a body centred cubic lattice with edge length of unit cell of 390 pm. If the size of chloride ion is 180 pm, the size of ammonium ion would be:

[JEE-Main (online)-12]

- (1) 158 pm
- (2) 174 pm
- (3) 142 pm
- (4) 126 pm
- 9. A solid has 'bcc' structure. If the distance of nearest approach between two atoms is 1.73 Å, the edge length of the cell is: [JEE-Main (online)-12]
 - (1) 314.20 pm
- (2) 216 pm
- (3) 200 pm
- (4) 1.41 pm
- **10.** Among the following the incorrect statement is :-

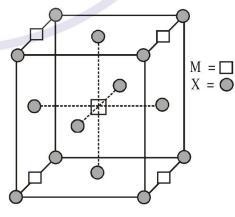
[JEE-Main (online)-12]

- (1) Density of crystals remains unaffected due to Frenkel defect
- (2) In BCC unit cell the void space is 32%
- (3) Electrical conductivity of semiconductors and metals increases with increase in temperature
- (4) Density of crystals decreases due to Schottky defect
- 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 :-

[JEE-Main (offline)-12]

- (1) 152 pm
- (2) 75 pm
- (3) 300 pm
- (4) 240 pm
- **12.** A compound $M_p X_q$ has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is :

[JEE-2012]



(1) MX

(2) MX_{2}

 $(3) M_{2}X$

(4) M X

13. In a face centred cubic lattice, atoms of A form the corner points and atoms of B form the face centred points. If two atoms of A are missing from the corner points, the formula of the ionic compound is

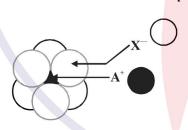
[JEE-Main (online)-13]

- (1) AB₂
- (2) AB₃
- $(3) AB_{4}$
- $(4) A_{2}B_{5}$
- 14. Which one of the following statements about packing in solids is **incorrect**?

[JEE-Main (online)-13]

- (1) Void space in ccp mode of packing is 26%
- (2) Coordination number in hcp mode of packing is 12
- (3) Void space in hcp mode of packing is 32%
- (4) Coordination number in bcc mode of packing is 8
- **15**. An element having an atomic radius of 0.14 nm crystallizes in an fcc unit cell. What is the length of a side of the cell? [JEE-Main (online)-13]
 - (1) 0.96 nm
- (2) 0.4 nm
- (3) 0.24 nm
- (4) 0.56 nm
- Experimentally it was found that a metal oxide has **16**. 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 M³⁺ would be :-[JEE-Main (offline)-13]
 - (1) 7.01%
- (2) 4.08%
- (3) 6.05%
- (4) 5.08
- The arrangement of X⁻ ions around A⁺ ion in solid **17**. AX is given in the figure (not drawn to scale). If the radius of X^- is 250 pm, the radius of A^+ is -

[JEE-2013]



- (1) 104 pm
- (2) 125 pm
- (3) 183 pm
- (4) 57 pm
- 18. The total number of octahedral void(s) per atom present in a cubic close packed structure is :-

[JEE-Main (online)-14]

- (1) 1
- (2) 2
- (3) 3
- (4) 4
- **19**. In a monoclinic unit cell, the relation of sides and angles are respectively [JEE-Main (online)-14]
 - (1) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^{\circ}$
 - (2) $a \neq b \neq c$ and $\beta = \gamma = 90^{\circ} \neq \alpha$
 - (3) $a = b \neq c$ and $\alpha = \beta = \gamma = 90^{\circ}$
 - (4) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^{\circ}$

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

[JEE-Main (online)-14]

- (1) Frenkel defect
- (2) F-centres
- (3) Schottky defect
- (4) Interstitial position
- 21. In a face centred cubic lattice atoms A are at the corner points and atoms B at the face centred points. If atom B is missing from one of the face centred points, the formula of the ionic compound

[AIEEE-2011, JEE-Main (online)-14] is:

(1) AB₂

- $(2) A_2 B_3$
- $(3) A_5 B_2$
- $(4) A_2 B_5$
- CsCl crystallises in body centred cubic lattice. if 'a' 22. is its edge length then which of the following expression is correct: [JEE-Main (offline)-14]

(1)
$$r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$$
 (2) $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

(2)
$$r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$$

(3)
$$r_{Cs^+} + r_{Cl^-} = 3a$$

(3)
$$r_{Cs^+} + r_{Cl^-} = 3a$$
 (4) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

23. Sodium metal crystallizes in a body centred cubic lattice with a unit cell edge of 4.29Å. The radius of sodium atom is approximately:

[JEE-Main (offline)-15]

- (1) 5.72Å
- (2) 0.93Å
- (3) 1.86Å
- (4) 3.022Å
- 24. 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 -

[JEE-2015]

- (1) $\frac{1}{2}, \frac{1}{8}$
- (2) $1, \frac{1}{4}$
- (3) $\frac{1}{2}, \frac{1}{2}$
- $(4) \frac{1}{4}, \frac{1}{8}$
- **25**. Which of the following compounds is metallic and ferromagnetic? [JEE-Main (offline)-16]
 - (1) MnO₂
- $(2) \text{ TiO}_2$
- (3) CrO₂
- (4) VO₂

26. The **CORRECT** statement(s) for cubic close packed (ccp) three dimensional structure is (are)

[JEE-2016]

- (1) The number of the nearest neighbours of an atom present in the topmost layer is 12
- (2) The efficiency of atom packing is 74%
- (3) The number of octahedral and tetrahedral voids per atom are 1 and 2, respectively
- (4) The unit cell edge length is $2\sqrt{2}$ times the radius of the atom
- 27. 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 :-[JEE-Main (offline)-17]
 - (1) 2a
- (2) $2\sqrt{2}$ a (3) $\sqrt{2}$ a
- Which type of effect 'defect' has the presence of cations 28. in the interstitial sites -[JEE-Main (offline)-18]
 - (1) Vacancy defect
 - (2) Frenkel defect
 - (3) Metal deficiency defect
 - (4) Schottky defect

- **29**. All of the following share the same crystal structure except :-[JEE-Main (online)-18]
 - (1) RbCl (2) CsCl
 - (3) LiCl (4) NaCl
- 30. Which of the following arrangements shows the schematic alignment of magnetic moments of antiferromagnetic substance?

[JEE-Main (online)-18]

- $(1) \bigoplus \bigoplus \bigoplus \bigoplus \bigoplus$
- (2) (1) (1) (1) (1) (1)
- $(3) \bigoplus \bigoplus \bigoplus \bigoplus \bigoplus$
- (4) (1) (1) (1) (1) (1)

| PREVIOUS YEARS QUESTIONS | | | | ANSWER KEY | | | Exercise-II | | | |
|--------------------------|-------|----------|-----------|------------|----|-------|-------------|----|----|----|
| Que. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ans. | 1.259 | 117.1 PM | 216.59 PM | 2 | 1 | 4 | 2 | 1 | 3 | 3 |
| Que. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Ans. | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 |
| Que. | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Ans. | 4 | 1 | 3 | 1 | 1 | 2,3,4 | 4 | 2 | 2 | 4 |