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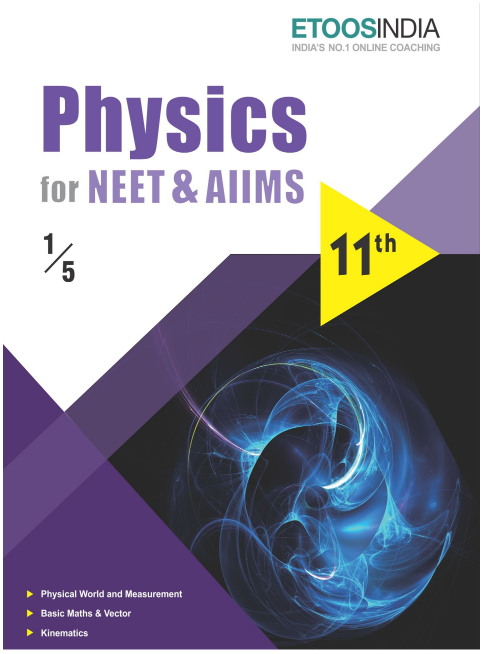
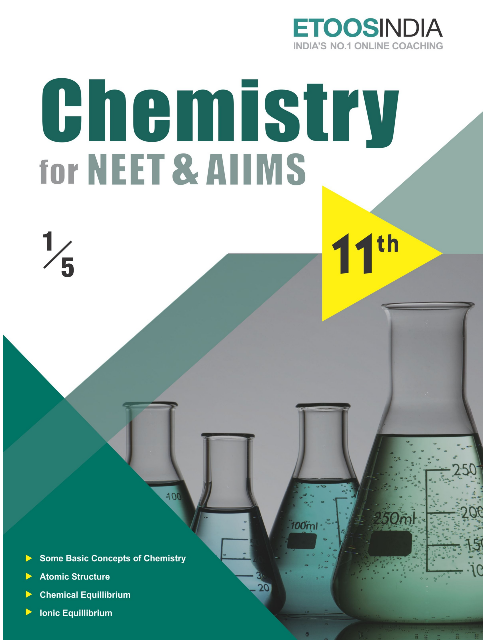
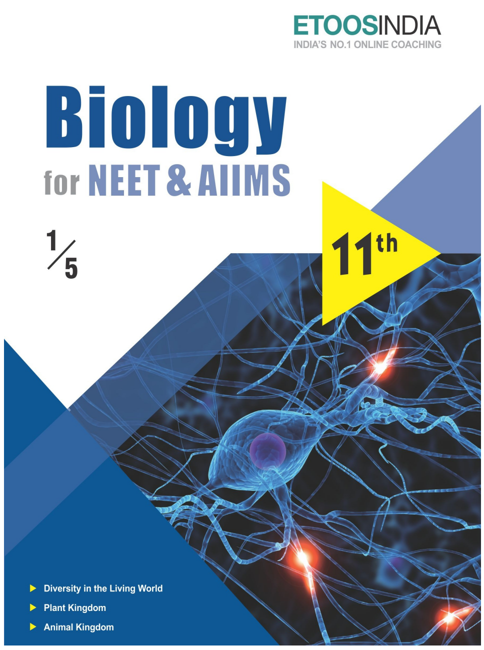
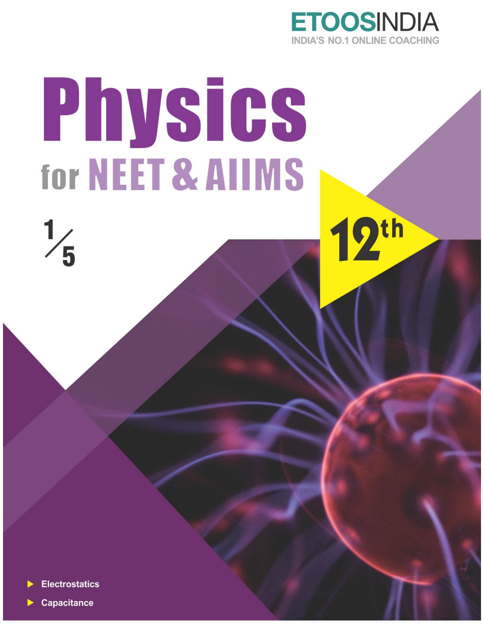
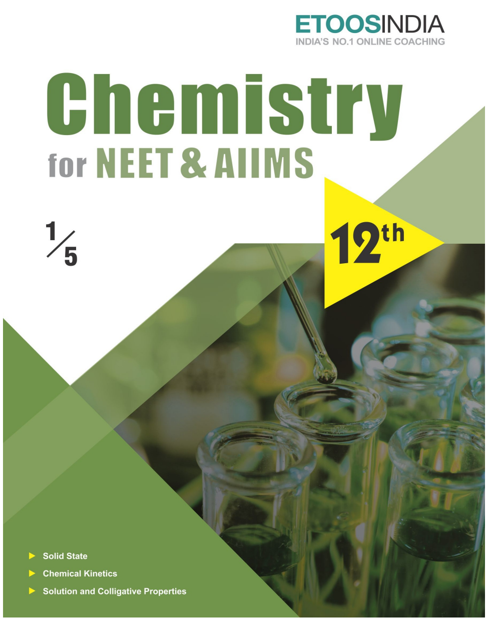
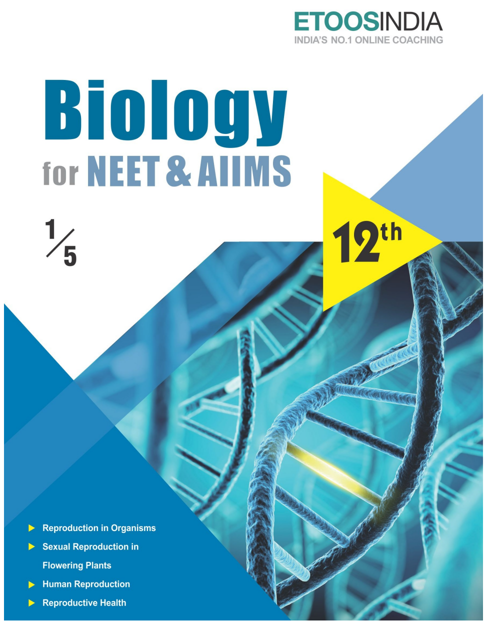












ETOOS Comprehensive Study Material
For NEET & AIIMS

CHAPTER 01

SOLID STATE

It seems probable to me that God, in the beginning, formed matter in solid, massy, hard, impenetrable, moveable particles.

"ISAAC NEWTON"

INTRODUCTION

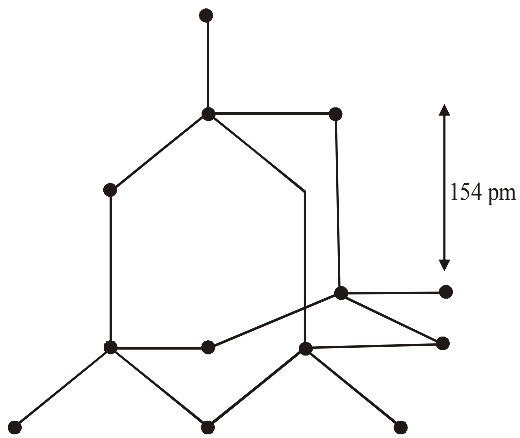
Matter can exist in three physical states namely ; solid, liquid and gas. Matter consists of tiny particles (atoms, ions or molecules). If the particles are very far off from one another, they behave like gases; nearer, they behave like liquids, and nearest, like solids. The three states of matter are thus known as the three states of aggregation from Latin word meaning **"Flacking together"**.

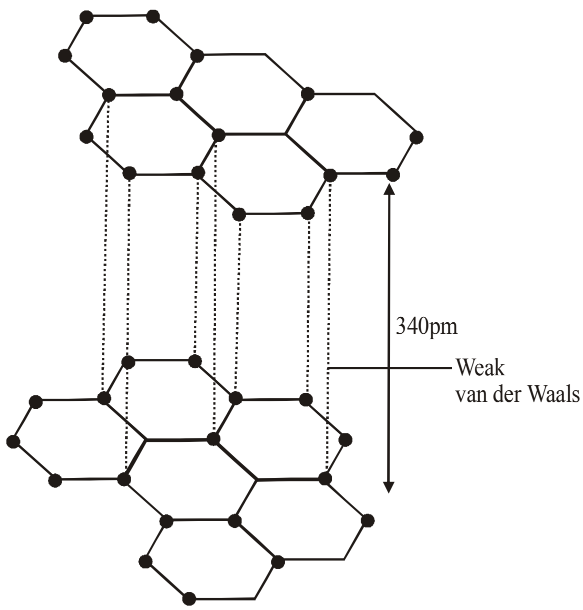
This chapter includes knowledge about

1. Most organised state of matter which includes study of various types of solids based upon arrangement of constituent particles in the bulk and different types of forces responsbile to bind the particles together.
2. Arrangement of unit cells in lattice and packing of lattice points in different arrangements.
3. Calculation of density of unit cell and unit cell dimension.
4. Calculation of packing efficiency of solids.
5. Types of voids, their locations and number of voids in different types of arrangements.
6. Imperfections or common defects in solids state.
7. Electrical and magnetic properties of solids.

3. **Covalent Solids (networks Solids) :** In these atoms are bonded together by covalent bond formation throughout the crystal. It means there is a continuous network of covalent bonds forming a giant three dimensional structure or giant molecule. Covalent bonds are strong and directional in nature. These solids are very hard, brittle and very high melting point. Due to absence of any free electrons or ions they are insulators. Their enthalpies of fusion are very high.

Example : Diamond, Graphite, Boron Nitride (BN), Silicon Carbide (SiC), SiO_2 (quartz) etc. are common examples of these solids.





Structure of (a) Diamond & (b) Graphite

(a) Diamond : It has a three dimensional network of large number of sp^3 hybridised carbon atoms each bonded tetrahedrally to four more carbon atoms by single covalent bonds. It makes diamond extremely hard crystal with very high mp = 3843 K. Diamond does not conduct electricity at all.

(b) Graphite : Each carbon atom is sp2 hydridised and covalently bonded to three other carbon atoms of same layer by single bonds, forming a layer of hexagonal rings. At each carbon atom the fourth valence electron is available free, which moves among different layers and provides good electrical and thermal conducting nature to graphite. Different layers connect by van der wals forces. As the forces are quite weak, the layers can slide over each other and make graphite a soft, lubricating solid.

4. **Molecular Solids :** Their molecules are held together by dispersion forces, London forces, dipole-dipole forces or hydrogen bonds. On the basis of type of interactive forces these solids are studied under the following sub-headings.

(a) Non-Polar Molecular Solids : Either atoms (e.g., He, Ne, Ar) or molecules (e.g., H_2, I_2 and Cl_2) are bonded together by weak dispersion forces or London forces. These are non-conductor soft solids with low m.p. and low enthalpies of vaporisation. They are volatile in nature hence, at room temperature and pressure they are available in liquid or gaseous state.

e.g., Iodine, Solid H_2 and CO_2 (dry ice). naphthalene, Camphor etc.

(b) Polar Molecular Solids : Polar covalent molecules are held together by strong dipole-dipole forces. These are soft non-conducting solids with low Melting point and Boiling Points, which are still higher than non-polar molecular solids. They have high enthalpy of vaporisation.

Example : Solid HCl, NH_3 and SO_2 etc.

(c) Hydrogen Bonded Molecular Solids : Polar covalent molecules containing "H' atom as positive pole and N, O or F atom as negative pole are held together by intermolecular H-bonding. Under room temperature and pressure conditions they are generally volatile liquids or soft solids and non conductors of electricity.

Example : Ice

ETOOS KEY POINTS

(A) Super Cooled Liquid : like liquids amorphous solids have a tendency to flow, hence they are also called as pseudo solids or super cooled liquids. If we notice glass window pane of old buildings, we find them slightly thicker at the bottom than at the top. hence, glass is also called as super cooled liquid. Super cooled liquids can flow slowly under their own weight and lose shape and can be easily distorted.

(B) Isomorphous and Polymorphous Solids : Two or more solid substances existing in same crystalline form or structure are isomorphous to each other.

e.g., (i) $MfSO_4 . 7H_2O$, $FeSO_4 . 7H_2O$ and $ZnSO_4 . 7H_2O$ are isomorphs

(ii) Na_2S and Ag_2S also show isomorphism

Existence of a substance in two or more crystalline forms having similar chemical composition but different arrangement of constituent particles is polymorphism.

e.g., ZnS in the form of zinc blende and wurtzite.

In case of elements polymorphism is also called allotropy and all crystalline allotropes are polymorphs to each other.

Ex. Identify molecular solid, covalent solid, ionic solid : $P_4(s)$, $S_8(s)$, SiC(s), $Al_2O_3(s)$, He (s), $Al_2Cl_6(s)$.

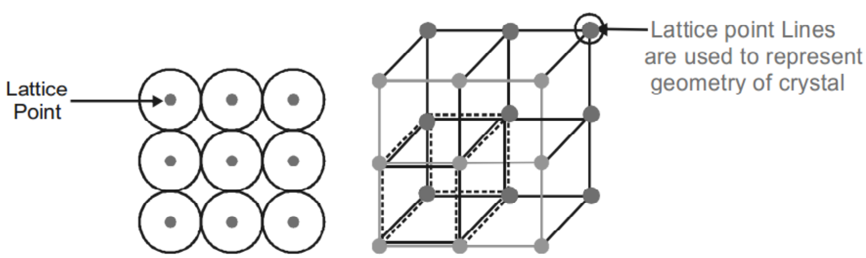
Sol. Molecular solid $\rightarrow$ $P_4(s)$, S_8 (s), He (s), $Al_2Cl_6(s)$

Covalent solid $\rightarrow$ SiC

Ionic solid $\rightarrow$ $Al_2O_3(s)$.

Space Lattice/Crystalline Lattice/3–D Lattice

Space lattice is a regular arrangement of lattice points (atoms or ions or molecules showing how the particles are arranged at different sites in 3D -view.)



1. The three dimensional distribution of component particles in a crystal can be found by X-ray diffraction of different faces of the crystal.
2. On the basis of the classification of symmetry , the crystals have been divided into seven systems. These seven systems with the characteristics of their axes (Interfacial angles and intercepts) where some examples of each are given in the following table.

The crystal systems differ in length of unit cell edges (a, b and c) and the angles between the unit cell edges.

In cubic and trigonal (rhombohedral) systems, the three unit edges are of equal lengths but for the rest five systems it is not so. The interfacial angles are all 90º in the cubic, tetragonal and orthorhombic systems but it is not so for the rest four systems.

Etoos Tips & Formulas

1. Various type of Criptals

Some Important Characteristics of Various types of Crystals

S.No.	Characteristics	Ionic Crystals	Covalent Crystals	Molecular Crystals	Metallic Crystals
1	Units that occupy lattice points	Cations and anions	Atoms	Molecules	Positive ions in a "sea or pond" of electrons.
2	Binding forces	Electrostatic attraction between ions	Shared electrons	vander Waals or Dipole -dipole	Electrostatic attraction between positively charged ions and negatively charged electrons.
3	Hardness	Hard	Very hard Graphite is soft	Soft	Hard or soft
4	Brittleness	Brittle	Intermediate	Low	Low
5	Melting point	High	Very high	Low	Varying from moderate to high
6	Electrical	Semi conductor due to crystal imperfections, conductor is fused state	Non-conductor Graphiteis good	Bad conductor	Good conductors
7	Solubility in	Soluble	Insoluble	Soluble as well as insoluble	Good conductors

The Seven Crystal Systems

S.No.	Name of System	Axes	Angles	Bravais Lattices
1	Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90°$	Primitive, Face-centred, Body centred = 3
2	Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90°$	Primitive, Body centred = 2
3	Rhombohedral or Trigonal	$a = b = c$	$\alpha = \beta = \gamma \neq 90°$	Primitive = 1
4	Orthorhombic or Rhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90°$	Primitive, Face-centred, Body centred End centred = 4
5	Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = 90°$; $\beta \neq 90°$	Primitive, End - centred = 2
6	Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90°$	Primitive = 1
7	Hexagonal	$a = b \neq c$	$\alpha = \beta = 90°$ $\beta \neq 120°$	Primitive = 1 Total = 14

SOLVED EXAMPLE

Ex. 1 Titanium metal has a density of 4.54 g/cm^3 and an edge length of 412.6 pm. In what cubic unit cell does titanium crystallise? (Ti = 48)

Sol. Density $d = \frac{zM}{a^3 N_0}$

$d = 4.54\ g/cm^3$, $M = 48 g\ mol^{-1}$, $Z = ?$

$N_0 = 6.023 \times 10^{23}\ mol^{-1}$

If value of z is known, structure can be decided

$$z = \frac{dN_0a^3}{M}$$

$$= \frac{4.54 \times 6.023 \times 10^{23} \times (412.6 \times 10^{-10})^3}{48} = 4$$

Thus, titanium has **face-centred cubic** structure.

Ex. 2 MgO has a structure of NaCl and TiCl has the structure of CsCl. What are the coordination numbers of ions in each (MgO and TiCl).

Sol. C.N. of Na^+ in NaCl = 6

C.N. of Cl^- in NaCl = 6

hence C.N. of Mg^{2+} is also = **6**

and that of O^{--} or O^{2-} = **6 in MgO**

We know in CsCl

C.N. of Cs^+ = 8

C.N. of Cl^- = 8

Hence, **Ti+ and Cl^-, in TiCl, have also C.N. 8 each.**

Ex. 3 A solid AB has the NaCl structure, If radius of cation A^+ is 120 pm, calculate the maximum possible value of the radius of the anion B^-.

Sol. We know for the NaCl structure, for maximum of radius of B^-, the ratio r^+ / r^- should be minimum for octahedral void i.e. 0.414.

radius of cation/radius of anion = 0.414

$$\frac{r_{A^+}}{r_{B^-}} = 0.414$$

$$r_{B^-} = \frac{r_{A^+}}{0.414} = \frac{120}{0.414} = \mathbf{290\ pm.}$$

Ex. 4 Calculate the number of formula 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.

Sol. (A) 4 (the same as in NaCl)

(B) 4

(C) 4 (1 at the corner, 3 at the face-centres)

Ex. 5 A mineral having the formula AB_2 crystallises in the cubic close-packed lattice, with the A atoms occupying the lattice points. What is the coordination number of the A atoms and B atoms ? What percentage fraction of the tetrahedral sites is occupied by B atoms ?

Sol. C.N. of A atom = 8

C.N. of B atom = 4

tetrahedral sites occupied by atoms B = 100% (all tetrahedral voids are occupied).

Ex. 6 (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.

Sol. (A) 8, (B) 12, (C) fcc or cubic close packed.

Ex. 7 The C.N. of the barium ion Ba^{2+}, in BaF_2 is 8. What must be the C.N. of F^- ion ?

Sol. C.N. of barium ion tells us that it is surrounded by eight fluoride ions (charge $8 \times (-1) = -8$). In order to balance out the eight negative charges, we need four barium ion (charge $4 \times (+2) = +8$). Hence, the C.N. of F^- ions must be **4.**

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

Sol. The ratio $\frac{r_+}{r_-} = \frac{94}{146} = 0.644$

The prediction is an octahedral arrangement of the oxide ions around the calcium. Because the ions have equal but opposite charges, there must also be an octahedral arrangement of calcium ions around oxide ions. Thus CaO structure is similar to Rock Salt(NaCI) structure.

Exercise # 1

SINGLE OBJECTIVE — NEET LEVEL

1. The three states of matter are solid, liquid and gas. Which of the following statement is/are true about them
(A) Gases and liquids have viscosity as a common property
(B) The molecules in all the three states possess random translational motion
(C) Gases cannot be converted into solids without passing through the liquid phase
(D) Solids and liquids have vapour pressure as a common property

2. A pure crystalline substance, on being heated gradually, first forms a turbid looking liquid and then the turbidity completely disappears. This behaviour is the characteristic of substances forming
(A) Isomeric crystals
(B) Liquid crystals
(C) Isomorphous crystals
(D) Allotropic crystals

3. Which of the following is ferroelectric compound
(A) $BaTiO_3$ (B) $K_4[Fe(CN)_6]$
(C) Pb_2O_3 (D) $PbZrO_3$

4. Solid is an example of
(A) Molecular crystal (B) Ionic crystal
(C) Covalent crystal (D) Metallic crystal

5. Value of heat of fusion of is
(A) Very low
(B) Very high
(C) Not very low and not very high
(D) None of the above

6. Piezoelectric crystals are used in
(A) TV (B) Radio
(C) Record player (D) Freeze

7. Which of the following is true for diamond
(A) Diamond is a good conductor of electricity
(B) Diamond is soft
(C) Diamond is a bad conductor of heat
(D) Diamond is made up of and

8. NaCl is an example of
(A) Covalent solid (B) Ionic solid
(C) Molecular solid (D) Metallic solid

9. Amorphous substances show
(a) Short and long range order
(b) Short range order
(c) Long range order
(d) Have no sharp M.P.
(A) a and c are correct
(B) b and c are correct
(C) c and d are correct
(D) b and d are correct

10. The characteristic features of solids are
(A) Definite shape
(B) Definite size
(C) Definite shape and size
(D) Definite shape, size and rigidity

11. Which one of the following is a good conductor of electricity
(A) Diamond (B) Graphite
(C) Silicon (D) Amorphous carbon

12. A crystalline solid
(A) Changes abruptly from solid to liquid when heated
(B) Has no definite melting point
(C) Undergoes deformation of its geometry easily
(D) Has an irregular 3-dimensional arrangements
(E) Softens slowly

13. Diamond is an example of
(A) Solid with hydrogen bonding
(B) Electrovalent solid
(C) Covalent solid
(D) Glass

14. The solid is a bad conductor of electricity since
(A) In solid there are no ions
(B) Solid is covalent
(C) In solid there is no velocity of ions
(D) In solid there are no electrons

15. The existence of a substance in more than one solid modifications is known as or Any compound having more than two crystal structures is called
(A) Polymorphism (B) Isomorphism
(C) Allotropy (D) Enantiomorphism

16. The correct statement in the following is
(A) The ionic crystal of AgBr has Schottky defect
(B) The unit cell having crystal parameters, $a=b\neq c$, $\alpha=\beta=90°, \gamma=120°$ is hexagonal
(C) In ionic compounds having Frenkel defect the ratio $\frac{\gamma_+}{\gamma_-}$ is high
(D) The coordination number of Na^+ ion in NaCl is 4

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. 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

2. The crystal system for which $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^0$ is said to be :
(A) triclinic (B) tetragonal
(C) cubic (D) orthorhombic

3. 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 dimensions
(D) There are five Bravais lattices in three dimensions

4. Which of the following are the correct axial distance and axial angles for rhombohedral system?
(A) $a = b = c, \alpha = \beta = \gamma \neq 90^0$
(B) $a = b \neq c, \alpha = \beta = \gamma = 90^0$
(C) $a \neq b \neq c, \alpha = \beta = \gamma = 90^0$
(D) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90^0$

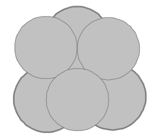
5. A metal crystallizes in a body centered cubic lattice (bcc) with the edge of the unit cell 5.2Å. The distance between the two nearest neighbour is
(A) 10.4 Å (B) 4.5 Å
(C) 5.2Å (D) 9.0Å

6. Body centred cubic lattice has co–ordination number of :
(A) 8 (B) 12
(C) 6 (D) 4

7. Consider a Body Centered Cubic(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 by:
(A) $d_e < d_{fd} < d_{bd}$ (B) $d_{fd} > d_{bd} > d_e$
(C) $d_{fd} > d_e > d_{bd}$ (D) $d_{bd} > d_e > d_{fd}$,

8. Lithium crystallizes in a body centered cubic lattice. How many next–nearest neighbors does each Li have?
(A) 6 (B) 8
(C) 12 (D) 4

9. 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



10. 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

11. Which one of the following schemes of ordering closed packed sheets of equal sized spheres does not generate close packed lattice.
(A) ABCABC (B) ABACABAC
(C) ABBAABBA (D) ABCBCABCBC

12. Copper crystallises in a structure of face centerd cubic unit cell. The atomic radius of copper is 1.28 Å. What is axial length on an edge of copper.
(A) 2.16 Å (B) 3.62 Å
(C) 3.94 Å (D) 4.15 Å

13. The maximum percentage of available volume that can be filled in a face centred cubic system by atoms is-
(A) 74% (B) 68%
(C) 34% (D) 26%

14. In a face centred cubic lattice the number of nearest neighbours for a given lattice point are :
(A) 6 (B) 8
(C) 12 (D) 14

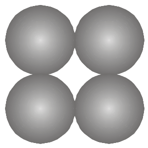
15. In a ccp structure, the (according to cubic 3D arrangement) :
(A) first and third layers are repeated
(B) first and fourth layers are repeated
(C) second and fourth layers are repeated
(D) first, third and sixth layers are repeated.

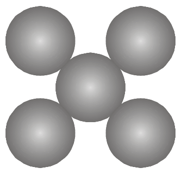
Exercise # 3

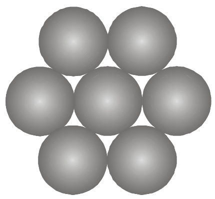
PART - 1

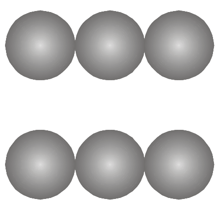
MATRIX MATCH COLUMN

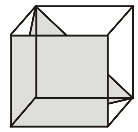
1. **Column I (Arrangement of the atoms/ions)** **Column II (Planes in fcc lattice)**

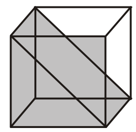
(A) 

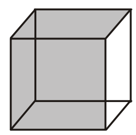
(B) 

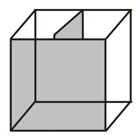
(C) 

(D) 

(p) 

(q) 

(r) 

(s) 

2. **Column I** **Column II**

(A) ZnS crystal
(B) CaF_2 crystal
(C) NaCl crystal
(D) Diamond crystal

(p) fcc
(q) hcp
(r) Distance between closest particles is $\frac{\sqrt{3}}{4}$ a.
(s) Only one type of voids are occupied

3. **Column-I** **Column-II**

(A) 68% occupy of space
(B) CsCl
(C) Hexagonal close packing in three dimensions
(D) Antifluorite structure
(E) Covalent crystal

(p) Simple cubic lattice
(q) Diamond
(r) Na_2O
(s) AB AB type of close packing
(t) Body centred cubic lattice.

4. **Column-I** **Column-II**

(A) Spinel structure
(B) Glass
(C) Quartz
(D) Metallic crystal
(E) Co-ordination number 6

(p) Framework silicate
(q) $ZnFe_2O_4$
(r) NaCl crystal
(s) Pseudo solid
(t) Melleable and ductile

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. A molecule contains atoms x and y so that x occurs at the corners of the cube while y at the face centres. The formula of the molecule can be
(A) xy_3 (B) x_3y
(C) xy_2 (D) x_2y [2000]

2. The edge length of face centred cubic unit cell is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is
(A) 288 pm (B) 398 pm
(C) 144 pm (D) 618 pm [2000]

3. A solid AB has NaCl type structure. The radius of A^+ is 100 pm. What is the radius of B^-?
(A) 190.47 (B) 540.13
(C) 525 (D) 78.12 [2000]

4. Crystalline solids have
(A) short range order (B) long range order
(C) anisotropic distribution (D) all of these [2001]

5. Schottky defect defines imperfection in the lattice structure of a
(A) solid (B) gas
(C) liquid (D) plasma [2002]

6. An AB_2 type structure is found in
(A) NaCl (B) CaF_2
(C) Al_2O_3 (D) N_2O [2002]

7. An element (atomic mass 100 g/mol) having bcc structure has unit cell edge 400 pm. The density of element is (No. of atoms in bcc (Z) = 2).
(A) 2.144 g/cm^3 (B) 7.289 g/cm^3
(C) 5.188 g/cm^3 (D) 10.379 g/cm^3 [2002]

8. The crystal system of a compound with unit cell dimensions a = 0.387, b = 0.387 and c = 0.504 nm and $\alpha = \beta = 90°$ and $\gamma = 120°$ is
(A) cubic (B) hexagonal
(C) orthorhombic (D) rhombohedral [2004]

9. If Z is the number of atoms in the unit cell that represents the closest packing sequence ...ABCABC...., the number of tetrahedral voids in the unit cell is equal to
(A) Z (B) 2Z
(C) Z/2 (C) Z/4 [2005]

10. Ca^{2+} and F^- are located in CaF_2 crystal, respectively at face centred cubic lattice points and in
(A) tetrahedral voids
(B) half of tetrahedral voids
(C) octahedral voids
(D) half of octahedral voids [2006,2015]

11. The energy gasps (E_g) between valence band and conduction band for diamond, silicon and germanium are in the order
(A) E_g(diamond) > E_g(silicon) > E_g(germanium)
(B) E_g(diamond) < E_g(silicon) < E_g(germanium)
(C) E_g(diamond) = E_g(silicon) = E_g(germanium)
(D) E_g(diamond) > E_g(germanium) > E_g(silicon) [2006]

12. The coordination number in hcp is
(A) 6 (B) 12
(C) 18 (D) 24 [2007]

13. The flame colours of metal ions are due to
(A) Frenkel defect
(B) Schottky defect
(C) metal deficiency defect
(D) metal excess defect [2008]

14. A unit cell of sodium chloride has four formula units. the edge length of the unit cell is 0.564 nm. What is the density of sodium chloride ?
(A) 1.2 g/cm^3 (B) 2.165 g/cm^3
(C) 3.64 g/cm^3 (D) 4.56 g/cm^3 [2008]

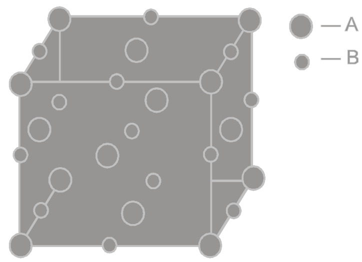
15. Schottky defect in crystals is observed when
(A) unequal number of cations and anions are missing from the lattice
(B) equal number of cations and anions are missing from the lattice
(C) an ion leaves its normal site and occupies an interstitial site
(D) density of the crystal is increased [2009]

16. In tetragonal crystal system, which of the following is not true ?
(A) All axial lengths and all axial angles are equal.
(B) All three axial lengths are equal
(C) All three axial angles are equal
(D) Two axial angles are equal but the third is different. [2010]

MOCK TEST

STRAIGHT OBJECTIVE TYPE

1. A crystal is made of particles A and B. A forms FCC packing and B occupies all the octahedral voids. If all the particles along the plane as shown in figure are removed. Then, the formula of the crystal would be :

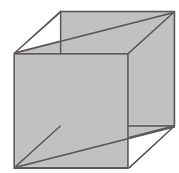


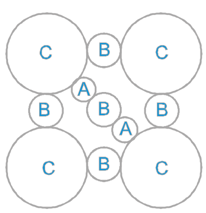
(A) AB   **(B)** A_5B_7 **(C)** A_7B_5 **(D)** None of these

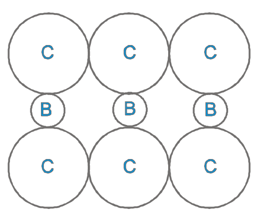
2. A crystal is made of particle X, Y & Z. X forms FCC packing, Y occupies all octahedral voids of X and Z occupies all tetrahedral voids of X, if all the particles along one body diagonal are removed then the formula of the crystal would be –

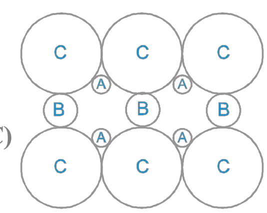
(A) XYZ_2 **(B)** X_2YZ_2 **(C)** $X_8Y_4Z_5$ **(D)** $X_5Y_4Z_8$

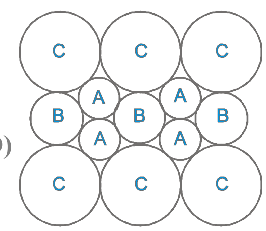
3. In a hypothetical solid C atoms are found to from cubical close packed lattice. A atoms occupy all tetrahedral voids & B atoms occupy all octahedral voids. A and B atoms are of appropriate size, so that there is no distortion in CCP lattice of C atoms. Now if a plane as shown in the following figure is cut. Then the cross section of this plane will look like.



(A)


(B)


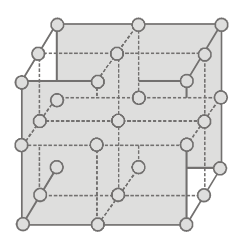
(C)


(D)


4. Diamond has face-centred cubic lattice. There are two atoms at (0, 0, 0) and $\left(\frac{1}{4},\frac{1}{4},\frac{1}{4}\right)$ coordinates. The ratio other carbon-carbon bond distance to the edge of the unit cell is

(A) $\sqrt{\frac{3}{16}}$ **(B)** $\sqrt{\frac{1}{4}}$ **(C)** $\frac{1}{4}$ **(D)** $\frac{1}{\sqrt{2}}$

5 The following diagram shows arrangement of lattice point with a = b = c and $\alpha = \beta = \gamma = 90°$. Choose the correct options.



(A) The arrangement is SCwith each lattice point surrounded by 6 nearest neighbours.
(B) the arrangement is SC with each
(C) The arrangement is FCC with each lattice point surrounded by 12 nearest neighbours.
(D) The arrangement in BCC with each lattice point surrounded by 8 nearest neighbours.

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics 5 Modules

Chemistry 5 Modules

Mathematics 5 Modules

PHYSICS

Module-1
1. Electrostatics
2. Capacitance

Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3
1. Electromagnetic Induction
2. Alternating Current

Module-4
1. Geometrical Optics
2. Wave Optics

Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues