SAMPLE CONTENT

Absolute

NEET-UG & JEE (Main) CHEMISTRY Vol - 2.1

For all Medical and Engineering Entrance Examinations held across India.

2647 MCQs with Hints

As per latest syllabus issued by NMC & NTA

Helium

Helium (He) gas is used for filling balloons as it is lighter than air and non-combustible.

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M.Tech - IIT Bombay

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M.Sc. (Organic Chemistry)

Now with more study techniques

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Absolute

NEET (UG) & JEE (Main)

Chemistry Vol. 2.1

Now with more study techniques

Updated as per latest syllabus for:
NEET (UG) 2024 issued by **NMC on 6th October, 2023**
JEE (Main) 2024 issued by **NTA on 1st November, 2023**

Salient Features

- Comprehensive theory for every topic.
- Subtopic-wise segregation of MCQs for efficient practice
- Exhaustive coverage of questions including questions from previous years' NEET (UG), JEE (Main) and other competitive examinations till year 2023:
  - **2647** MCQs
  - Numerical Value Type (NVT) questions
  - Solutions to the questions are provided for better understanding
- Multiple study techniques to enhance understanding and problem solving
- Topic Test with answer keys provided in each chapter for self-assessment
- Includes Question Papers and Answer Keys (Solutions through Q.R. code) of:
  - NEET (UG) 2022
  - NEET (UG) 2023
  - NEET (UG) 2023 (Manipur)
  - JEE (Main) 2022 25th July (Shift - I)
  - JEE (Main) 2023 24th Jan (Shift - II)
- Q.R. codes provide:
  - Video links for boosting conceptual retention
  - Solutions to Topic Tests and previous exam papers of year 2022 and 2023
- Separate list of questions excluded from the NEET (UG) and JEE (Main) 2024 syllabus

Sample content

Scan the adjacent Q.R. Code in Quill - *The Padhai App to access solutions/hints to Topic Test.*

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PREFACE

Target's **'Absolute Chemistry Vol - 2.1'** is a complete guidebook, extremely handy for preparation of various competitive exams like NEET (UG), JEE (Main). This edition provides an unmatched comprehensive amalgamation of theory with MCQs. The chapters are aligned with the syllabus for NEET (UG) and JEE (Main) examinations and runs parallel to NCERT curriculum. The book provides the students with scientifically accurate context, several study techniques and skills required to excel in these examinations.

The sections of **Theory, Quick Review**, **Formulae, MCQs** and **Topic Test** form the backbone of every chapter and ensure adequate revision.

These MCQs are framed considering the importance given to every topic as per the NEET-UG & JEE (Main) exam. They are a healthy mix of theoretical, numerical, reactions and graphical based questions.

The level of difficulty of these questions is at par with that of various competitive examinations held across India. Questions from various examinations such as NEET (UG), JEE (Main), MHT CET, KCET, WB JEE, AP EAMCET, TS EAMCET, AP EAPCET, GUJ CET are exclusively covered.

Previous Years' Question Papers:

Question Papers and Answer Keys of **NEET (UG) 2022**, **2023** and **2023 (Manipur)** as well as **JEE (Main) 2022** 25th July (Shift - I) and **JEE (Main) 2023** 24th Jan (Shift - II) have been provided to offer students glimpse of the complexity of questions asked in entrance examination. Solutions are also provided through a separate Q.R. code.

The papers have been split topic-wise to let the students know which of the topics were more relevant in the latest examination.

All the questions included in a chapter have been specially created and compiled to enable students solve complex problems which require strenuous effort with promptness.

Considering the latest modifications in the syllabus of NEET (UG) and JEE (Main) examinations, a list of questions based on the concepts excluded from the syllabus is provided. The purpose of providing these questions is to display various question types and their level of difficulty that have been asked in previous examinations.

All the features of this book pave the path of a student to excel in examination. The features are designed keeping the following elements in mind: Time management, easy memorization or revision and non-conventional yet simple methods for MCQ solving.

We hope the book benefits the learner as we have envisioned.

A book affects eternity; one can never tell where its influence stops.

Publisher

Edition: Seventh

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

Disclaimer

This reference book is based on the NEET-UG and JEE (Main) syllabus prescribed by National Testing Agency (NTA). We the publishers are making this reference book which constitutes as fair use of textual contents which are transformed by adding and elaborating, with a view to simplify the same to enable the students to understand, memorize and reproduce the same in examinations.

This work is purely inspired upon the course work as prescribed by the National Council of Educational Research and Training (NCERT). Every care has been taken in the publication of this reference book by the Authors while creating the contents. The Authors and the Publishers shall not be responsible for any loss or damages caused to any person on account of errors or omissions which might have crept in or disagreement of any third party on the point of view expressed in the reference book.

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Sample Content

KEY FEATURES

Strategy

'**Strategy**' illustrates a general step-by-step approach towards solving a problem.

Smart tip

'**Smart tips**' comprise important theoretical or formula based short tricks considering their usage in solving MCQ.

Caution

'**Caution**' apprises students about mistakes which are made while solving an MCQs.

Smart Code

'**Smart Code**' showcases simple and smart mnemonic created for selected concepts.

QR code

'**QR code**' provides:

i. Access to a video/PDF in order to boost understanding of a concept or activity.

ii. Solutions to Topic Test of each chapter, NEET (UG) 2022, 2023 and 2023 (Manipur) as well as JEE (Main) 2022 and 2023 question papers.

Solved Examples

'**Solved Examples**' are provided consistently throughout the book to help you hone your problem-solving skills.

Clock Symbol

'**Clock Symbol**' instructs students that given MCQ can be solved apace by applying either smart tips, smart codes or thinking hatke.

Connection

'**Connection**' enables students to interlink concepts covered in different chapters.

Thinking Hatke

'**Thinking Hatke**' reveals quick witted approach to crack the specific question.

Remember This

'**Remember This**' includes key points, important reactivity orders, exceptions, point of difference, misconceptions, etc.

Gyan Guru

'**Gyan Guru**' illustrates real life applications or examples related to the concept discussed.

Knowledge Badhao!

'**Knowledge Badhao**' includes additional information relevant to concept.

Sample Content

Frequently Asked Questions

- **Why Absolute Series?**

Gradually, every year the nature of competitive entrance exams is inching towards conceptual understanding of topics. Moreover, it is time to bid adieu to the stereotypical approach of solving a problem using a single conventional method.

To be able to successfully crack the NEET/JEE (Main) examinations, it is imperative to develop skills such as data interpretation, appropriate time management, knowing various methods to solve a problem, etc. With Absolute Series, we are sure, you'd develop all the aforementioned skills and take a more holistic approach towards problem solving. The way you'd tackle advanced level MCQs with the help of Hints, Solved examples, Smart tips, Smart codes and Thinking Hatke would give you the necessary practice that would be a game changer in your preparation for the competitive entrance examinations.

- **What is the intention behind the launch of Absolute Series?**

The sole objective behind the introduction of Absolute Series is to cater to needs of students across a varied background and effectively assist them to successfully crack the NEET/JEE (Main) examinations. With a healthy mix of MCQs, we intend to develop a student's MCQ solving skills within a stipulated time period.

- **What do I gain out of Absolute Series?**

After using Absolute Series, students would be able to:

a. assimilate the given data and apply relevant concepts with utmost ease.

b. tackle MCQs of different pattern such as match the columns, diagram based questions, multiple concepts and assertion-reason efficiently.

c. garner the much needed confidence to appear for competitive exams.

d. easy and time saving methods to tackle tricky questions will help ensure that time consuming questions do not occupy more time than you can allot per question.

- **How to derive the best advantage of the book?**

To get the maximum benefit of the book, we recommend :

a. Go through the detailed theory and Examples solved alongwith at the beginning of a chapter for concept clarity. Commit Smart Tips into memory and pay attention to Caution, Remember This.

b. Read through the Quick review section to summarize the key points in chapter.

c. Know all the Formulae compiled at the end of theory by heart.

d. Using subtopic wise segregation as a leverage, complete MCQs in each subtopic at your own pace. Questions from exams such as JEE (Main), NEET-UG are tagged and placed along the flow of subtopic. Mark these questions specially to gauge the trends of questions in various exams.

e. Be extra receptive to Thinking Hatke, Alternate Method and application of Smart Tips. Assimilate them into your thinking.

Best of luck to all the aspirants!

Sample Content

CONTENTS

Note: ☒ *Complete chapter excluded from the NEET (UG) and JEE (Main) 2024 syllabus (in index)*

◑ *Part of the chapter excluded from the NEET (UG) and JEE (Main) 2024 syllabus (in index)*

Sample Content

Questions based on the concepts excluded from NEET (UG) and JEE (Main) 2024 Syllabus

Chapter Name	Subtopic Name		Questions excluded from 2024 Syllabus	Page No.
1. Solid State	Entire Chapter Deleted			1
5. Surface Chemistry	Entire Chapter Deleted			275 to 329
6. General Principles and Processes of Isolation of Elements	Entire Chapter Deleted			330 to 377
7. p-Block Elements	7.4	Dinitrogen (Preparation, properties and uses)	All Questions	Theory - 387 and 389 MCQs - 466 and 467
	7.5	Compounds of nitrogen (Ammonia, nitric acid, oxoacids and oxides of nitrogen)		Theory- 390 to 400 MCQs - 467 to 469
	7.6	Phosphorus		Theory - 400 and 401 MCQs - 469 and 470
	7.7	Compounds of phosphorus (Phosphine, phosphorus halides, oxoacids and oxides of phosphorus)		Theory - 401 to 407 MCQs - 470 to 472
	7.11	Dioxygen (preparation, properties and uses)		Theory - 416 to 418 MCQs - 474
	7.12	Compounds of oxygen (Ozone and classification of oxides)		Theory - 418 to 423 MCQ - 474 to 476
	7.13	Sulphur- Occurrence and allotropic forms		Theory - 423 to 425 MCQs - 476
	7.14	Compounds of sulphur (Sulphur dioxide and sulphuric acid)		Theory - 425 to 432 MCQs - 476 and 477
	7.15	Oxoacids of sulphur		Theory - 432 to 434 MCQs - 477
	7.20	Chlorine (Preparation, properties and uses)		Theory - 442 to 447 MCQs - 480
	7.21	Compounds of chlorine (Hydrogen chloride or hydrochloric acid)		Theory - 447 to 449 MCQs - 480 and 481
	7.22	Oxoacids of halogens		Theory - 450 MCQs - 481

Sample Content

	7.23 Interhalogen compounds	All Questions	Theory - 451 MCQs - 481 and 482
	7.26 Compounds of xenon (Xenon fluorides and xenon oxides)		Theory - 456 to 459 MCQs - 483
	7.27 Uses of noble gases		Theory - 459 and 460 MCQs - 483 and 484
	Miscellaneous	1, 2, 3, 4, 7, 9, 10, 11, 13, 14, 15, 16, 17, 18, 20, 23, 24 to 28, 30, 32, 33, 34	484 to 486
	Numerical Value Type Questions (NVT)	1 to 6	486
	Topic Test	2 to 9, 12 to 14, 16, 17, 19, 20, 22, 23, 24, 25	507 and 508
NEET (UG) 2022	Section A	1, 2, 7, 8	634 and 635
	Section B	12, 15	635 and 636
NEET (UG) 2023	Section A	1, 6, 7	637
	Section B	10, 11, 12, 13	638
NEET (UG) 2023 (Manipur)	Section A	6, 7	639
	Section B	10, 11, 13, 14	640
JEE (Main) 2022 25th July (Shift – I)	MCQs	2, 3, 4	641
JEE (Main) 2023 24th January (Shift – II)	MCQ	2	643
	Numerical Value Type Questions (NVT)	4, 5	644

Note: i. *The above table contains the list of chapters/subtopics/question numbers that are excluded from the latest syllabus of NEET (UG) and JEE (Main) 2024.*

ii. *These questions are covered to give an idea about the variety and difficulty levels of questions asked in the examination over the years.*

Sample Content

Solving previous year papers is the best way to work on your strength, weaknesses, and time management.
Scan the adjacent QR Code to know more about our ***“36 Years NEET Chemistry PSP (Previous Solved Papers)”*** book for the NEET UG Entrance examination.

Get an overall idea of the type of questions that are asked in the NEET UG Examination. Scan the adjacent QR Code to know more about our ***“Previous 11 Years NEET solved papers with Solutions”*** book for the NEET UG Entrance examination.

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Increase your score in JEE mains by Practicing more Integer type (NVT) questions. Scan the adjacent QR Code to know more about our ***"JEE Main Numerical Value Type Questions (NVT)"*** Book.

Sample Content

1 Solid State

* marked section is only for JEE (Main) **marked section is for NEET-UG

1.0 Introduction

➢ **States of matter:**

i. Matter can exist in three physical states – solid, liquid and gas. One state of matter can be changed to another state by changing the conditions of temperature and pressure. The equilibrium between solid, liquid and gas is

$$\text{Solid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Liquid} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{Gas}$$

ii. All the above transformations can also be brought by either changing the pressure alone or changing both temperature and pressure.

iii. The most stable state of a substance under a given set of conditions of temperature and pressure depends upon the net effect of two opposing factors: **Intermolecular forces**, which tend to keep the molecules (or atoms or ions) closer, and the **thermal energy**, which tends to keep them apart by making them move faster.

iv. At sufficiently low temperature, the thermal energy is low and intermolecular forces bring the particles of a substance so close that they cling to one another, occupying fixed positions and the substance exists in **solid state**.

➢ **General characteristics of solid state:**

*A **solid** is defined as that form of matter which possesses rigidity and hence possesses a definite shape and a definite volume.*

i. Solids cannot be compressed like gases. This is due to small intermolecular distance of separation between neighbouring molecules. Also, solids cannot be poured like liquids because the positions of constituent particles, atoms or molecules cannot be changed. Thus, solids have fixed mass, volume, shape and density.

ii. The density of solid state is greater than the density of liquid state or gaseous state. Ice (solid water) is an exception, which has density lower than that of liquid water. The density of mercury (liquid state) is very high (13.6 g mL^{-1}).

iii. Solids are rigid and hard due to strong intermolecular forces of attraction. These forces are stronger than those present in liquid state and gaseous state. Exceptions: sodium, potassium and phosphorus are soft.

iv. Pure solids have characteristic melting points. Solids with strong intermolecular forces of attraction have high melting points. Solids with weak intermolecular forces of attraction have low melting points.
E.g. Diamond has very high melting point (few thousand kelvin) and helium has very low melting point (almost absolute zero).

v. In solid state, constituent particles have fixed positions and can only oscillate about their mean positions.

vi. In comparison with liquids and gases, solids diffuse very slowly.

Sample Content

Page no. **2** to **13** are purposely left blank.

To see complete chapter buy **Target Notes** or **Target E-Notes**

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GG - Gyan Guru

An interesting example of close packing!!

We know that hexagonal close packing is very effective to pack the largest number of objects in a minimum space.
If we take a bunch of pencils (shown in the picture on the right), or straws or toothpicks, and hold them tightly together, what we get is: hexagonal close packing!

Students can scan the adjacent QR code in *Quill - The Padhai App* to get conceptual clarity on hexagonal close packed structures with the aid of a relevant video.

- **Number of voids per atom in hcp and ccp structures:**
  The number of tetrahedral and octahedral voids depend upon the number of close packed spheres.
  If the number of close packed spheres is N, then:
  The number of **tetrahedral** voids generated = **2N** and
  The number of **octahedral** voids generated = **N**
  The number of octahedral voids is half that of tetrahedral voids.

EXAMPLE – 1.1

A metal forms hcp structure. What is the number of (i) octahedral voids and (ii) the total number of voids formed in 0.4 mol of it?

Solution:

Number of atoms in 0.4 mol = $0.4 \times N_A = 0.4 \times 6.022 \times 10^{23} = 2.4098 \times 10^{23}$

i. Number of octahedral voids = Number of atoms = $\mathbf{2.4098 \times 10^{23}}$

ii. Total number of voids = Number of octahedral voids + Number of tetrahedral voids
Now, Number of tetrahedral voids = 2 × Number of atoms = $2 \times 2.4098 \times 10^{23} = 4.818 \times 10^{23}$

$\therefore$ Total number of voids = $2.409 \times 10^{23} + 4.818 \times 10^{23} = \mathbf{7.227 \times 10^{23}}$

Ans: Number of octahedral voids is $\mathbf{2.4098 \times 10^{23}}$ and the total number of voids is $\mathbf{7.227 \times 10^{23}}$.

- **Locating tetrahedral and octahedral voids:**
  Locating voids in a crystal: In the cubic close packing (ccp) or face-centred cubic (fcc) unit cell, there are 4 atoms or ions per unit cell. Therefore, there are 4 octahedral voids and 8 tetrahedral voids. These are located at different positions as explained below:

i. **Locating tetrahedral voids:** Consider a unit cell of ccp or fcc lattice. The unit cell is divided into eight small cubes. Each small cube has atoms at alternate corners as shown in figure (a). In all, each small cube has 4 atoms. When joined to each other, they make a regular tetrahedron. Thus, there is one tetrahedral void in each small cube and eight tetrahedral voids in total. Since, ccp structure has 4 atoms per unit cell, thus, the number of tetrahedral voids is twice the number of atoms per unit cell.

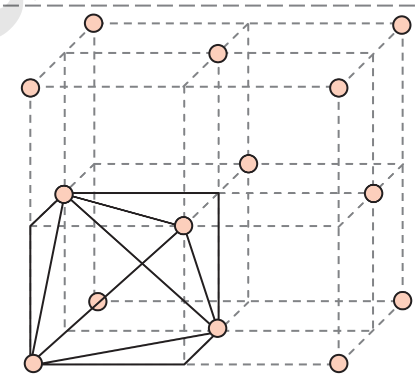


Fig. (a)

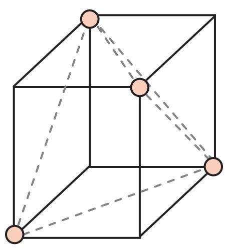


Fig. (b)

(a) Eight tetrahedral voids per unit cell of ccp structure
(b) One tetrahedral void showing the geometry

Sample Content

ii. **Locating octahedral voids:** Consider a unit cell of ccp or fcc lattice as shown in figure (a). The body-centre of the cube, is not occupied but it is surrounded by six atoms on face-centres. If these face-centres are joined, an octahedron is generated. Thus, this unit cell has one octahedral void at the body-centre of the cube.

Besides the body-centre, there is one octahedral void at the centre of each of the 12 edges as shown in figure (b). It is surrounded by six atoms, four belonging to the same unit cell (2 on the corners and 2 on face-centre) and two belonging to two adjacent unit cells. Since each edge of the cube is shared between four adjacent unit cells, only 1/4th of each void belongs to a particular unit cell.

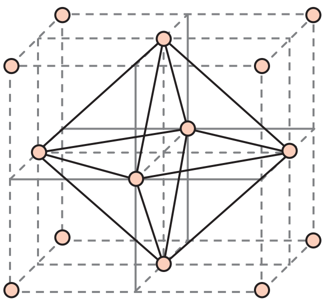


Fig. (a)

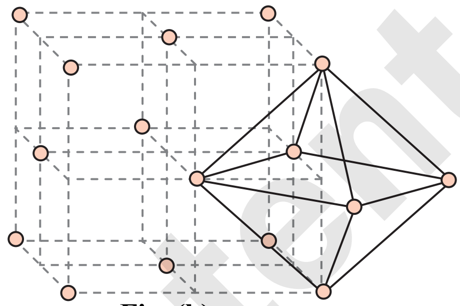


Fig. (b)

Location of octahedral voids per unit cell of ccp or fcc lattice
(a) at the body centre of the cube
(b) at the centre of each edge (only one such void is shown)

Thus in cubic close packed structure:

Octahedral void at the body-centre of the cube = 1

12 octahedral voids located at each edge and shared between four unit cells = $12 \times \frac{1}{4} = 3$

∴ Total number of octahedral voids = 3 + 1 = 4

In ccp structure, each unit cell has 4 atoms. Thus, the number of octahedral voids is equal to 4.

➢ **Formula of a compound and number of voids filled:**

The structure of an ionic solid depends on the relative sizes of the ions and its stoichiometry. In simple ionic solids, the anions are present in the close packed arrangement and the cations commonly occupy the voids or holes. Generally, bigger cations occupy octahedral holes while smaller cations occupy tetrahedral holes.

All octahedral or tetrahedral voids are not occupied. In a given compound, the fraction of octahedral or tetrahedral voids that are occupied, depends upon the chemical formula of the compound.

EXAMPLE – 1.2

In an ionic crystalline solid atoms of element D form hcp lattice. The atoms of element C occupy one third of tetrahedral voids. What is the formula of the compound?

Solution:

The atoms of element D form hcp structure.
The number of tetrahedral voids generated is twice the number of D atoms.
Thus, number of tetrahedral voids = 2D
The atoms of element C occupy (1/3) of these tetrahedral voids.
Hence, number of C atoms = 2D × 1/3 = 2/3D
Ratio of C and D atoms = 2/3D : 1D = 2/3 : 1 = 2 : 3
∴ Formula of compound = $\mathbf{C_2D_3}$

Ans: The formula of the given compound is $\mathbf{C_2D_3}$.

Sample Content

Knowledge Badhao!

i. Radius ratio rule for ionic solids:

The ratio of radius of cation to that of anion (i.e., r^+/r^-) is called the radius ratio.

$$\text{Radius ratio} = \frac{\text{Cation radius}}{\text{Anion radius}} = \frac{r^+}{r^-}$$

The following table gives the limiting values of radius ratio, the coordination number of the cation and the structural arrangement of anions around cations.

Radius ratio $\left(\frac{r^+}{r^-}\right)$	Coordination number of cation	Structural arrangement of anions around cations	Examples
0.155 to 0.225	3	Planar triangular	B_2O_3
0.225 to 0.414	4	Tetrahedral	ZnS
0.414 to 0.732	6	Octahedral	NaCl
0.732 to 1.0	8	Cubic	CsCl

ii. Structures of some ionic solids:

	Ionic solid	Arrangement of ions	Coordination number
a.	NaCl (Sodium chloride)	Cl^- ⇒ fcc arrangement Na^+ ⇒ occupy all octahedral sites	Cl^- = 6 Na^+ = 6
b.	CsCl (Caesium chloride)	Cl^- ⇒ simple cubic arrangement Cs^+ ⇒ occupy cubic sites	Cl^- = 8 Cs^+ = 8
c.	ZnS (Zinc blende)	S^{2-} ⇒ fcc arrangement Zn^{2+} ⇒ occupy half of the tetrahedral sites	S^{2-} = 4 Zn^{2+} = 4
d.	CaF_2 (Calcium fluoride)	Ca^{2} ⇒ fcc arrangement F^- ⇒ occupy all tetrahedral sites	Ca^{2+} = 8 F^- = 4

1.8 PACKING EFFICIENCY

➢ **Packing efficiency:**

*The **packing efficiency** is the percentage of total space occupied by the particles.*

i. Packing efficiency is given by following formula:

$$\textbf{Packing efficiency} = \frac{\textbf{Total volume occupied by spheres in unit cell}}{\textbf{Volume of the unit cell}} \times 100$$

ii. The magnitude of packing efficiency gives a measure of how tightly particles are packed together.

➢ **Packing efficiency in a simple cubic unit cell:**

Step 1: Radius of sphere:

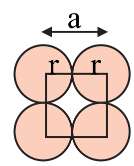
In simple cubic unit cell, particles (spheres) are at the corners and touch each other along the edge.

A face of simple cubic unit cell is shown in the figure.

From the figure, we can find that

$$a = 2r \text{ or } r = \frac{a}{2} \qquad \ldots(1)$$

where, ‘r’ is the radius of atom and ‘a’ is the length of unit cell edge.



Face of simple cubic unit cell

Step 2: Volume of sphere:

Volume of a sphere = $\frac{4}{3}\pi r^3$. Substitution for r from equation (1) gives:

$$\text{Volume of one particle} = \frac{4}{3}\pi \times \left(\frac{a}{2}\right)^3 = \frac{\pi a^3}{6} \qquad \ldots(2)$$

Step 3: Total volume of particles:

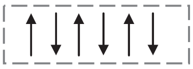
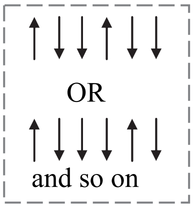
Because simple cubic unit cell contains only one particle, volume occupied by particle in unit cell = $\frac{\pi a^3}{6}$

Sample Content

Page no. **17** to **28** are purposely left blank.

To see complete chapter buy **Target Notes** or **Target E-Notes**

Sample Content

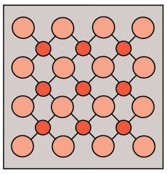
Antiferromagnetic materials	• The domains align in such a way that resultant magnetic moment is zero. • The number of domains that are aligned in parallel direction is equal to the number of domains that are aligned in anti-parallel direction.  • Change to paramagnetic solid when heated.	MnO	Used in instruments of magnetic susceptibility measurement.
Ferrimagnetic materials	• The domains align in such a way that there is a small net magnetic moment. • The number of domains that are aligned in parallel direction is not equal to the number of domains that are aligned in anti-parallel direction.  • Weakly attracted by a magnetic field. • Change to paramagnetic solid when heated.	Fe_3O_4 (magnetite), Ferrites like $MgFe_2O_4$, $ZnFe_2O_4$, etc.	—

Quick Review

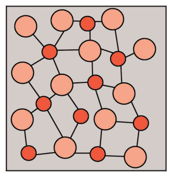
➢ **Types of solids:**

Solids

- **Crystalline solids**
  - **E.g.** NaCl, Fe
  - Regular arrangement of constituent particles
  - Shows anisotrophy



- **Amorphous solids**
  - **E.g.** Glass, Rubber
  - Random arrangement of constituent particles
  - Shows isotrophy



➢ **Types of crystalline solids:**

Crystalline Solids

- **Molecular solids**
  Constituent particles are molecules of the same compound.
- **Ionic solids**
  Constituent particles are cations and anions.
  E.g. NaCl, ZnS, CuCl
- **Metallic solids**
  Formed by atoms of the same metallic elements.
  E.g. Copper, gold
- **Covalent solids**
  Formed by chemical (covalent) bonds between the neighbouring constituent atoms of non-metallic solids.
  E.g. diamond, graphite and fullerene

Molecular solids:

- **Polar molecular solids**
  Constituent particles are held together by dipole-dipole forces.
  E.g. HCl, SO_2 at low temperature and high pressure
- **Non-polar molecular solids**
  Constituent particles are held together by dispersion forces.
  E.g. CO_2, H_2, Cl_2, CH_4 at very low temperatures
- **Hydrogen bonded molecular solids**
  Molecules are held together by hydrogen bonds.
  E.g. Solid ice

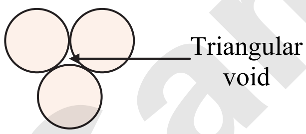
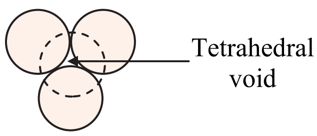
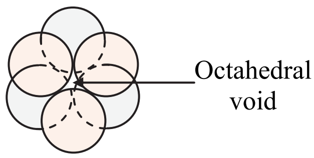
Sample Content

- **Packing in solids:**

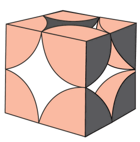
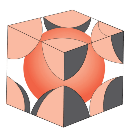
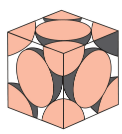
Close packing of spheres

- **Linear packing** in one dimension
  In this arrangement, the spheres are placed in a horizontal row touching each other.
  Coordination number = 2
- **Planar packing** in two dimensions
  - **AAAA type**, square close packed structure
    In this arrangement, several linear one dimensional identical rows are placed one over the other in such a way that they have horizontal and vertical alignment.
    Coordination number = 4
  - **ABAB type**, hexagonal close packed structure
    In this arrangement, several linear one dimensional identical rows are placed one over the other in such a way that alternate rows (i.e., first and third row) have horizontal and vertical alignment.
    Coordination number = 6
- **Close packing** in three dimensions
  - **AAAA type**, simple cubic structure
    In this arrangement, several layers of two dimensional square close packed structures are placed one above the other in such a way that they have horizontal and vertical alignment. **E.g.** Polonium
    Coordination number = 6
  - **ABAB type**, hexagonal close packed (hcp) structure
    In this arrangement, several layers of two dimensional hexagonal close packed structures are placed one above the other in such a way that alternate layers (i.e., first and third row) have horizontal and vertical alignment.
    Here, spheres of third layer are placed into the tetrahedral voids.
    E.g. Metals such as magnesium, zinc,
    Coordination number = 12
  - **ABCABC type**, cubic close packed (ccp) or face-centred cubic (fcc) structure
    In this arrangement, several layers of two dimensional hexagonal close packed structures are placed one above the other in such a way that first and fourth layer have horizontal and vertical alignment.
    Here, spheres of third layer are placed into the octahedral voids.
    E.g. Metals such as copper, silver, etc.
    Coordination number = 12

- **Types of voids:**

Triangular voids	Tetrahedral voids	Octahedral voids
A triangular void is surrounded by three spheres.	A tetrahedral void is surrounded by four spheres.	An octahedral void is surrounded by six spheres.
		

- **Types of cubic unit cell:**

Type of unit cell	Simple cubic	Body-centred cubic	Face-centred cubic
Diagram			
No. of particles per unit cell	**1**	**2**	**4**
Coordination number of atoms	6 : four in the same layer, one directly above and one directly below	8 : four in the layer below and one in the layer above	12 : six in its own layer, three above and three below
Packing efficiency	**52.4 %**	**68 %**	**74 %**

Sample Content

- **Types of point defects:**

Point defects
- Stoichiometric defects
- Non-stoichiometric defects
- Impurity defects

Stoichiometric defects
- **In non-ionic solids**
  - **Vacancy defect**
  - **Interstitial defect**
- **In ionic solids**
  - **Schottky defect**
  - **Frenkel defect**

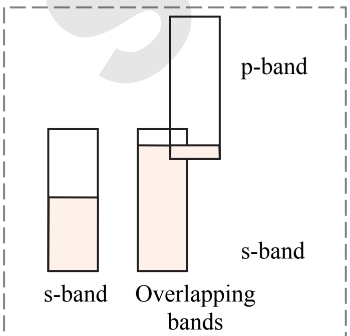
Non-stoichiometric defects
- **Metal excess defects**
  Defects which arise due to the excess of positive ions.
  - **Conditions causing defects**
    - **Anionic vacancies**
      Eg. Excess Na in NaCl
    - **Presence of extra cations at interstitial sites**
      Eg. $Zn_{1+x}O$
- **Metal deficiency defects**
  Defects which arise due to the deficiency of positive ions.
  - **Conditions causing defects**
    - **Cationic vacancies**
      Eg. $Fe_{0.95}O$
    - **Presence of extra anions at interstitial sites**

- **Classification of solids based on electrical properties:**

Solids

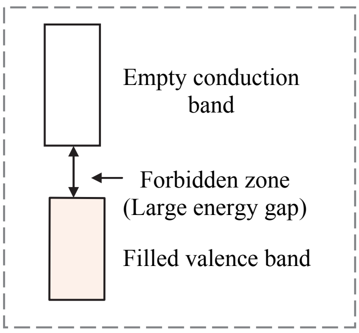
Metallic conductors

E.g. Cu, Al
- Conductivity: **10^4 to 10^7** Ohm^{-1} m^{-1}
- Band gap = No



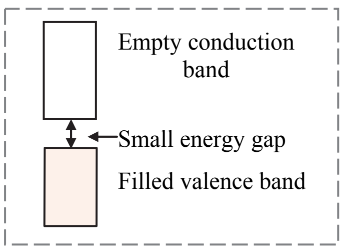
Insulators

E.g. Diamond
- Conductivity: **10^{-20} to 10^{-10}** $Ohm^{-1}m^{-1}$
- Band gap = Large



Semiconductors

E.g. Si, Ge
- Conductivity: **10^{-6} to 10^4** Ohm^{-1} m^{-1}
- Band gap = small



Sample Content

➢ **Types of extrinsic semiconductors:**

n-type semiconductors	p-type semiconductors
It is an extrinsic semiconductor, which is obtained by adding group 15 element to an intrinsic semiconductor which belongs to group 14.	It is an extrinsic semiconductor, which is obtained by adding group 13 element to an intrinsic semiconductor which belongs to group 14.
E.g. Silicon doped with phosphorus	**E.g.** Silicon doped with boron

➢ **Classification of solids based on response to magnetic field:**

Substance	Characteristics	Examples
Diamagnetic materials	• Repelled weakly in magnetic field. • All electrons are paired.	Benzene, NaCl, H_2O, etc.
Paramagnetic materials	• Weakly attracted in magnetic field. • Unpaired electrons are present. • Permanent magnetisation is not possible.	Oxygen, Cu^{2+}, Fe^{3+}, Cr^{3+}, etc.
Ferromagnetic materials	• Strongly attracted in magnetic field. • Unpaired electrons are present. • Permanent magnetisation is possible.	Fe, Co, Ni, Gd, CrO_2, etc.
Antiferromagnetic materials	• The number of domains that are aligned in parallel direction is equal to the number of domains that are aligned in anti-parallel direction.	MnO
Ferrimagnetic materials	• The number of domains that are aligned in parallel direction is not equal to the number of domains that are aligned in anti-parallel direction. • Weakly attracted by a magnetic field.	Fe_3O_4 (magnetite), Ferrites like $MgFe_2O_4$, $ZnFe_2O_4$, etc.

Formulae

1. Packing efficiency

$$= \frac{\text{Volume occupied by spheres in unit cell}}{\text{Volume of unit cell}} \times 100$$

2. Relationship between radius of atom (r) and edge length (a):

Simple cubic unit cell	Body-centred cubic unit cell	Face-centred cubic unit cell
$r = \frac{a}{2}$	$r = \frac{\sqrt{3}}{4}a$	$r = \frac{a}{2\sqrt{2}}$

3. Volume of one particle in unit cell:

Simple cubic unit cell	bcc unit cell	fcc unit cell
$\frac{\pi a^3}{6}$	$\frac{\sqrt{3}\pi a^3}{16}$	$\frac{\pi a^3}{12\sqrt{2}}$

4. Total volume occupied by particles in unit cell:

Simple cubic unit cell	bcc unit cell	fcc unit cell
$\frac{\pi a^3}{6}$	$\frac{\sqrt{3}\pi a^3}{8}$	$\frac{\pi a^3}{3\sqrt{2}}$

5. Distance between the nearest neighbours (D) in a unit cell:

Simple cubic unit cell	bcc unit cell	fcc unit cell
D = a	$D = \frac{\sqrt{3}a}{2}$	$D = \frac{a}{\sqrt{2}}$

6. Density of unit cell

$$= \frac{\text{Mass of unit cell}}{\text{Volume of unit cell}} = \frac{Z \times M}{a^3 \times N_A} \text{ g cm}^{-3}$$

where, a is the edge length of unit cell in cm
Z is the number of atoms per unit cell
M is the molar mass (g/mol)
N_A is Avogadro number (6.022×10^{23} mol^{-1})
For fcc, Z = 4, for bcc, Z = 2 and for simple cubic, Z = 1

7. Number of atoms in *x* g of metal $= \frac{xZ}{d \times a^3}$

8. Number of unit cells in *x* g of metal $= \frac{x}{d \times a^3}$

9. Number of unit cells in volume (V) of metal

$$= \frac{V}{a^3}$$

10. Some unit conversions:

1 pm = 1×10^{-12} m = 1×10^{-10} cm
1 Å = 1×10^{-8} cm = 100 pm

Sample Content

Multiple Choice Questions

1.0 Introduction

1. Which of the following conditions favours the existence of a substance in the solid state? [NCERT Exemplar]
   (A) High temperature
   (B) Low temperature
   (C) High thermal energy
   (D) Weak cohesive forces

1.1 Classification of Solids

1. Which of the following is NOT a property of solids?
   (A) Solids are always crystalline in nature.
   (B) Solids have high density and low compressibility.
   (C) The diffusion of solids is very slow.
   (D) Solids have definite volume.

2. The sharp melting point of crystalline solids is due to _______. [NCERT Exemplar]
   (A) a regular arrangement of constituent particles observed over a short distance in the crystal lattice
   (B) a regular arrangement of constituent particles observed over a long distance in the crystal lattice
   (C) same arrangement of constituent particles in different directions
   (D) different arrangement of constituent particles in different directions

3. Which of the following is NOT a characteristic of a crystalline solid? [NCERT Exemplar]
   (A) Definite and characteristic heat of fusion
   (B) Isotropic nature
   (C) A regular periodically repeated pattern of arrangement of constituent particles in the entire crystal
   (D) A true solid

4. Which of the following properties of a crystalline solid changes with change in direction of measurement?
   (A) Refractive index
   (B) Electrical conductance
   (C) Dielectric constant
   (D) All of these

5. _______ is a crystalline solid.
   (A) Glass (B) Tar
   (C) Plastic (D) Sugar

6. Amorphous solids are _______.
   (A) super cooled solids
   (B) super cooled gases
   (C) super cooled liquids
   (D) none of these

7. Amorphous solids _______.
   (A) possess sharp melting points
   (B) undergo clean cleavage when cut with knife
   (C) do not undergo clean cleavage when cut with knife
   (D) possess orderly arrangement over long distances

8. Which of the following is TRUE about the value of refractive index of quartz glass? [NCERT Exemplar]
   (A) Same in all directions
   (B) Different in different directions
   (C) Cannot be measured
   (D) Always zero

9. Which of the following is an amorphous solid? [NCERT Exemplar]
   (A) Graphite (C)
   (B) Quartz glass (SiO_2)
   (C) Chrome alum
   (D) Silicon carbide (SiC)

10. Glass is a _______.
    (A) microcrystalline solid
    (B) pseudo solid
    (C) gel
    (D) true solid

11. Which of the following statements is TRUE?
    (A) Both crystalline and amorphous solids are isotropic.
    (B) Both crystalline and amorphous solids are anisotropic.
    (C) Crystalline solids are isotropic and amorphous solids are anisotropic.
    (D) Crystalline solids are anisotropic and amorphous solids are isotropic.

12. Which of the following statements is NOT true about amorphous solids? [NCERT Exemplar]
    (A) On heating they may become crystalline at certain temperature.
    (B) They may become crystalline on keeping for long time.
    (C) Amorphous solids can be moulded by heating.
    (D) They are anisotropic in nature.

1.2 Classification of Crystalline Solids

1. Which among the following solids is a non-polar solid? [MHT CET 2016]
   (A) Hydrogen chloride
   (B) Sulphur dioxide
   (C) Water
   (D) Carbon dioxide

Sample Content

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Sample Content

8. Identify the CORRECT statement.
   (A) Germanium doped with traces of arsenic forms p-type semiconductors.
   (B) In antiferromagnetic materials, the resultant magnetic moment is zero.
   (C) Boron nitride is a molecular solid.
   (D) The atomic ratio of the constituent atoms of the substance is different for isomorphous substances.

9. Which is the INCORRECT statement?
   [NEET (UG) 2017]
   (A) Density decreases in case of crystals with Schottky's 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) $Fe_{0.98}O$ has stoichiometric metal deficiency defect.

Numerical Value Type Questions

1. How many total spheres of constituent particles are present in fcc type of unit cell?
   [Ans: 4]

2. If a metal crystallizes in face-centred cubic lattice with metallic radius of 25 pm, the number of unit cells in 1.00 cm^3 of lattice is 2.8×10^x. Value of x is ________.
   [Ans: 24]

3. 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_xB_y. The value of 'y' is _______.
   [Ans: 5]

4. If the edge length of a unit cell is 5 Å, the smallest distance in Å between the two neighbouring metal atoms in a face-centred cubic lattice is _______.
   [Ans: 3.54]

5. The coordination number of an atom in a body-centered cubic structure is _______.
   [Assume that the lattice is made up of atoms.]
   [Ans: 8]

6. A metal sample has 5×10^4 fcc unit cells. The total number of tetrahedral voids present are 4×10^x. The value of x is:
   [Ans: 5]

7. The edge of unit cell of Xe crystal having fcc structure is 620 pm. The radius of Xe atom is _______ pm.
   [Ans: 219.17]

Answers to MCQs

1.0 :	1.	(B)																		
1.1 :	1.	(A)	2.	(B)	3.	(B)	4.	(D)	5.	(D)	6.	(C)	7.	(C)	8.	(A)	9.	(B)	10.	(B)
	11.	(D)	12.	(D)																
1.2 :	1.	(D)	2.	(A)	3.	(D)	4.	(D)	5.	(B)	6.	(B)	7.	(D)	8.	(A)	9.	(C)	10.	(B)
	11.	(B)	12.	(A)	13.	(C)	14.	(C)	15.	(A)	16.	(B)	17.	(A)	18.	(C)	19.	(D)	20.	(D)
	21.	(B)	22.	(A)	23.	(C)	24.	(A)	25.	(B)										
1.3 :	1.	(A)	2.	(A)	3.	(B)														
1.4 :	1.	(B)	2.	(A)	3.	(B)														
1.5 :	1.	(B)	2.	(B)	3.	(A)	4.	(C)	5.	(D)	6.	(B)	7.	(C)	8.	(C)	9.	(B)	10.	(A)
	11.	(A)	12.	(C)	13.	(B)														
1.6 :	1.	(C)	2.	(B)	3.	(A)	4.	(A)	5.	(D)	6.	(C)	7.	(C)	8.	(C)	9.	(D)	10.	(A)
1.7 :	1.	(A)	2.	(B)	3.	(B)	4.	(A)	5.	(C)	6.	(C)	7.	(B)	8.	(C)	9.	(B)	10.	(B)
	11.	(B)	12.	(C)	13.	(D)	14.	(C)	15.	(D)	16.	(B)	17.	(D)	18.	(B)	19.	(C)	20.	(B)
	21.	(B)	22.	(D)	23.	(C)	24.	(D)	25.	(C)	26.	(A)	27.	(B)	28.	(C)	29.	(A)	30.	(B)
	31.	(B)	32.	(C)	33.	(A)	34.	(B)	35.	(B)	36.	(D)	37.	(D)	38.	(C)	39.	(D)	40.	(D)
1.8 :	1.	(A)	2.	(B)	3.	(A)	4.	(C)	5.	(D)	6.	(C)	7.	(B)	8.	(A)	9.	(C)	10.	(A)
	11.	(A)	12.	(B)	13.	(A)	14.	(D)	15.	(B)	16.	(C)	17.	(A)	18.	(A)	19.	(C)	20.	(A)
	21.	(C)	22.	(C)	23.	(C)	24.	(B)	25.	(A)	26.	(B)	27.	(B)	28.	(C)	29.	(B)	30.	(D)
	31.	(B)																		

Sample Content

1.9:	1. (B)	2. (A)	3. (B)	4. (D)	5. (A)	6. (C)	7. (D)	8. (A)	9. (A)	10. (C)
	11. (D)	12. (A)	13. (D)							
1.10:	1. (A)									
1.11:	1. (B)	2. (D)	3. (A)	4. (A)	5. (D)	6. (C)	7. (A)	8. (A)	9. (C)	10. (C)
	11. (B)	12. (C)	13. (A)	14. (A)	15. (C)	16. (C)	17. (D)	18. (D)	19. (A)	20. (B)
	21. (B)	22. (C)	23. (A)	24. (B)	25. (D)	26. (B)	27. (B)			
1.12:	1. (A)	2. (D)	3. (A)	4. (B)	5. (A)					
1.13:	1. (B)	2. (A)	3. (A)	4. (C)	5. (A)	6. (D)	7. (D)	8. (B)	9. (C)	10. (B)
	11. (A)	12. (D)	13. (B)	14. (D)	15. (A)	16. (C)	17. (B)	18. (C)	19. (D)	
1.14:	1. (D)	2. (A)	3. (D)	4. (A)	5. (D)	6. (A)	7. (B)	8. (B)	9. (D)	10. (D)
	11. (D)	12. (C)	13. (B)	14. (B)	15. (C)					
Misc.:	1. (B)	2. (A)	3. (D)	4. (C)	5. (C)	6. (A)	7. (D)	8. (B)	9. (C)	

Hints to MCQs

1.0 Introduction

1. Lowering the temperature of a substance reduces the thermal energy of its particles. This allows the intermolecular forces to hold the particles close to each other and occupy fixed positions with respect to each other. The particles may still be able to oscillate about their mean positions; however, the substance will now exist in the solid state.

1.1 Classification of Solids

1. Some solids are crystalline whereas others are amorphous in nature.
3. Crystalline solids are anisotropic.
5. Sugar is a crystalline solid while glass, rubber and plastic are amorphous solids.
6. Amorphous solids neither have ordered arrangement (i.e. no definite shape) nor have sharp melting point, but when heated, they become pliable until they assume the properties usually related to liquids. It is therefore, that they are regarded as super cooled liquids.
8. Quartz glass is an amorphous solid and hence isotropic in nature. Thus, value of physical properties such as refractive index will be same in all directions.
12. Amorphous solids are isotropic, as these substances show same properties in all directions.

1.2 Classification of Crystalline Solids

2. Solid I_2 is a non-polar molecular solid in which constituent particles are non-polar molecules held by weak dispersion forces or London forces.
6. LiF is an example of ionic crystal solid, in which constituent particles are positive (Li^+) and negative (F^-) ions.
11. Non-polar molecular solids contain only dispersion or London forces. Hence, they have very low melting points.
20. Graphite is a covalent or network solid and is a good conductor of electricity. Hence, (D) is the right option.
23. In fullerene, all carbon atoms are sp^2 hybridized.
25. Nonpolar molecular solids have low melting points and are insulators in solid as well as liquid state. Among the given options, methane is a nonpolar molecular solid. So, X is methane.

1.4 Bragg's Law and its Applications

1. $n = 1, \lambda = 1.54$ Å, $d = 2.01$ Å

   According to the Bragg's equation,

   $n\lambda = 2d \sin\theta$

   $\sin\theta = \dfrac{n\lambda}{2d} = \dfrac{1\times1.54}{2\times2.01}$

   $\sin\theta = 0.383$

2. $n = 1, \lambda = 1.54$ Å, $\theta = 11.29°$

   According to the Bragg's equation,

   $n\lambda = 2d \sin\theta$

   $d = \dfrac{n\lambda}{2\sin\theta} = \dfrac{1\times1.54}{2\times\sin 11.29°} = \dfrac{1.54}{2\times0.1958} = 3.93$ Å

3. $n = 1, d = 2$ Å, $\theta = 9°$

   According to the Bragg's equation,

   $n\lambda = 2d \sin\theta$

   $\lambda = \dfrac{2d\sin\theta}{n} = \dfrac{2\times2\times\sin 9°}{1} = 4 \times 0.1564$

   $= 0.6256$ Å

Sample Content

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Sample Content

Miscellaneous

1. Oxidation state of Li = +1, Co = +3
50% lithium (Li) is extracted from the lattice. Hence, the decrease in total oxidation number is 0.5.
To maintain electrical neutrality, the oxidation state of Co must increase by 0.5. Hence, the average % increase is
$\frac{0.5}{3} \times 100 = 16.67\%$

2. For an orthorhombic cell, $\alpha = \beta = \gamma = 90°$
$\therefore$ Volume of unit cell = a × b × c
$= (5.42 \times 10^{-8}\text{ cm}) \times (4.41 \times 10^{-8}\text{ cm}) \times (6.83 \times 10^{-8}\text{ cm})$
$= 1.63 \times 10^{-22}\text{ cm}^3$
$\therefore$ Density, $d = \frac{ZM}{(a \times b \times c)N_A}\text{ g cm}^{-3}$
$= \frac{4 \times 22}{1.63 \times 10^{-22} \times 6.022 \times 10^{23}}$
$= 0.895\text{ g cm}^{-3}$

3. Extrinsic semiconductors are obtained on doping pure intrinsic semiconductor with electron rich or electron deficient impurities. This introduces electronic defects in the original lattice structure.

5. A pure i.e., defect-free crystal can only have molecules, ions or atoms occupying its lattice sites. Hence, (C) is the right option.

8. (A) Germanium doped with traces of arsenic forms n-type semiconductors.
(C) Boron nitride is a covalent solid.
(D) The atomic ratio of the constituent atoms of the substance is same for isomorphous substances.

Numerical Value Type Questions

2. For fcc unit cell, $r = \frac{a}{2\sqrt{2}}$
$\therefore$ Edge length (a) = $2\sqrt{2} \times r = 2\sqrt{2} \times 25\text{ pm}$
Number of unit cells in volume (V) of metal = $\frac{V}{a^3}$
$\therefore$ Number of unit cells in 1.00 cm^3 of metal
$= \frac{1.00}{\left(2\sqrt{2} \times 25 \times 10^{-10}\right)^3} = \frac{1.00 \times 10^{30}}{\left(\sqrt{2} \times 50\right)^3}$
$= \frac{100 \times 100 \times 100 \times 10^{24}}{\left(\sqrt{2}\right)^3 \times 50 \times 50 \times 50} = \frac{2 \times 2 \times 2 \times 10^{24}}{\sqrt{2} \times \sqrt{2} \times \sqrt{2}} = 2.8 \times 10^{24}$
Therefore, value of *x* is 24.

3.

Atom/ion	Location	Contribution to a unit cell
A	Corners of cube	⅛ × 8 = 1
B	Centres of 5 faces (since one atom is missing)	½ × 5 = 5/2
Ratio	A : B = 1 : 5/2 = 2 : 5	
Formula	A_2B_5	

Therefore, value of y is 5.

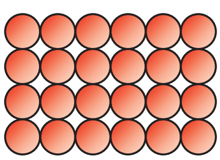
6. In fcc unit cell, the number of tetrahedral voids is equal to twice the number of atoms per unit cell.
The number of atoms in fcc unit cell = 4
$\therefore$ No. of tetrahedral voids per unit cell = 8
$\therefore$ 5×10^4 unit cells have $8 \times 5 \times 10^4 = 4 \times 10^5$ tetrahedral voids
Therefore, value of *x* is 5.

7. The type of unit cell is fcc.
Using ***Smart Tip - 1 (iii)***,
r = 0.3535 a
Where r = radius of the sphere
a = edge length of the unit cell = 620 pm
r = 0.3535 × 620 = 219.17 pm

Topic Test

1. A metal atom having radius 135 pm crystallises in bcc structure. The ratio of edge length to the body diagonal of the unit cell is _______.
(A) 1 : 0.577 (B) 1 : 1.732
(C) 1 : 1.414 (D) 1 : 2.309

2. The planar packing arrangement shown in the following figure is _______.



(A) AAAA type, simple cubic structure
(B) ABAB type, hexagonal close packing
(C) AAAA type, square close packing
(D) ABCABC type, cubic close packed structure

3. Which of the following is INCORRECT for substances that exist in solid state?
(A) They are incompressible.
(B) The intermolecular forces between the particles are weak.
(C) The intermolecular distances between the particles are short.
(D) They have definite mass.

Sample Content

4. The crystal system of compound with unit cell dimensions $a = b = c$, $\alpha = \beta = \gamma \neq 90°$ is _______.
   (A) orthorhombic (B) rhombohedral
   (C) triclinic (D) tetragonal

5. The ability of crystalline solids to change values of physical properties when measured in different directions is called _______.
   (A) isotropy (B) anisotropy
   (C) isomerism (D) polymorphism

6. The number of octahedral voids in a unit cell of a cubic close packed structure is _______.
   (A) 1 (B) 2 (C) 4 (D) 8

7. Germanium is _______.
   (A) a metallic conductor
   (B) a semiconductor
   (C) an insulator
   (D) electrolytic conductor

8. ________ arises when the magnetic moments, of the domains are aligned in parallel and anti-parallel directions in equal numbers.
   (A) Paramagnetism
   (B) Ferromagnetism
   (C) Antiferromagnetism
   (D) Ferrimagnetism

9. The coordination number of spheres in the two dimensional hexagonal closed packed structure is _____.
   (A) 2 (B) 4
   (C) 6 (D) 8

10. Crystallization of molten NaCl containing a little amount of $SrCl_2$ results in _______.
   (A) impurity defect (B) Frenkel defect
   (C) Schottky defect (D) interstitial defect

11. A solid has 'bcc' structure. If the distance of nearest approach between two atoms is 1.73 Å, the edge length of the unit cell is _______ pm.
   (A) 314 (B) 200
   (C) 141 (D) 173

12. Select the CORRECT statement.
   (A) An octahedral void is surrounded by eight spheres.
   (B) The coordination number of each sphere forming a simple cubic structure is 6.
   (C) In a unit cell of orthorhombic lattice, all sides are of unequal length.
   (D) The possible variations of unit cells for a tetragonal crystal system are primitive and face-centred.

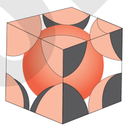
13. Schottky defect in a crystal is observed when, _______.
   (A) unequal number of cations and anions are missing from the lattice
   (B) no ion is missing from its lattice site
   (C) an ion leaves its normal site and occupies an interstitial site
   (D) equal number of cations and anions are missing from the lattice

14. Ferrimagnetic materials are _______.
   (A) weakly repelled by magnetic field
   (B) weakly attracted by magnetic field
   (C) strongly attracted by magnetic field
   (D) strongly repelled by magnetic field

15. An atom is situated at the corner of a simple cubic unit cell. Its contribution towards the unit cell is _______.
   (A) 1/2 (B) 1/4
   (C) 1/6 (D) 1/8

16. If a bcc unit cell of an element has edge length of 400 pm, then the volume of one particle is _______ cm^3.
   (A) 2.2×10^{-23} (B) 4.3×10^{-23}
   (C) 3.3×10^{-23} (D) 4.7×10^{-23}

17. Identify the type and packing efficiency of the following cubic unit cell.



   (A) body-centred, 68%
   (B) face-centred, 74%
   (C) body-centred, 32%
   (D) face-centred, 26%

18. An example of covalent solid is _______.
   (A) boron nitride (B) gold
   (C) zinc sulphide (D) dry ice

19. Which amongst the following is diamagnetic?
   (A) Co (B) Fe^{3+}
   (C) NaCl (D) MnO

20. Cristobalite is a polymorphic form of _______.
   (A) calcium carbonate (B) carbon
   (C) calcium oxide (D) silicon dioxide

Answers

1.	(B)	2.	(C)	3.	(B)	4.	(B)
5.	(B)	6.	(C)	7.	(B)	8.	(C)
9.	(C)	10.	(A)	11.	(B)	12.	(C)
13.	(D)	14.	(B)	15.	(D)	16.	(A)
17.	(A)	18.	(A)	19.	(C)	20.	(D)

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