



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## **SOLID STATE — DPP 1 TO 5**

Student Workbook + Teacher Answer Key

**Arihantam Academy** • Faith Strength Education

This set contains board-oriented objective, short-answer and long-answer practice for Bihar Board Class 12 Chemistry.

**Coverage:** Crystal lattice and types of solids; packing efficiency and voids; density numericals; defects; electrical/magnetic properties; full chapter test.



## ARIHANTAM ACADEMY

Faith Strength Education

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 1

Solid State | Crystal lattice, unit cell and types of solids

|                                                       |                  |
|-------------------------------------------------------|------------------|
| Student Name: _____                                   | Roll No.: _____  |
| DPP No.: 1 Chapter: Solid State                       | Date: _____      |
| Topic: Crystal lattice, unit cell and types of solids | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Which defect decreases density of an ionic crystal?  
(A) Frenkel defect (B) Schottky defect (C) Interstitial defect (D) Impurity defect
- The most unsymmetrical crystal system is:  
(A) Cubic (B) Hexagonal (C) Triclinic (D) Tetragonal
- In a simple cubic cell, effective number of atoms is:  
(A) 1 (B) 2 (C) 4 (D) 6
- Coordination number of BCC is:  
(A) 4 (B) 6 (C) 8 (D) 12
- Which is an amorphous solid?  
(A) Quartz (B) Diamond (C) Glass (D) NaCl
- A crystalline solid has:  
(A) No definite melting point (B) Long-range order (C) Irregular arrangement (D) Same properties in all directions
- Arrangement of points representing particle positions is:  
(A) Crystal lattice (B) Unit formula (C) Void (D) Defect
- Which solid conducts in molten but not solid state?  
(A) Ionic solid (B) Molecular solid (C) Covalent solid (D) Metallic solid
- Smallest repeating 3-D part of lattice is:  
(A) Unit cell (B) Atom (C) Void (D) Molecule
- Which is network covalent solid?  
(A) Iodine (B) Ice (C) Silicon carbide (D) Sodium chloride
- Corner atom contribution is:  
(A) 1 (B)  $\frac{1}{2}$  (C)  $\frac{1}{4}$  (D)  $\frac{1}{8}$
- Face-centred atom contribution is:  
(A)  $\frac{1}{8}$  (B)  $\frac{1}{4}$  (C)  $\frac{1}{2}$  (D) 1
- Metal crystal is held by:  
(A) Hydrogen bond (B) Ionic bond (C) Metallic bond (D) Dipole force
- Amorphous solids show:  
(A) Sharp melting (B) Anisotropy (C) Isotropy (D) Definite heat of fusion
- Atoms in FCC unit cell are:  
(A) 1 (B) 2 (C) 4 (D) 6

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Define crystal lattice.
- What is a unit cell?
- Give two differences between crystalline and amorphous solids.
- Why do ionic solids conduct electricity in molten state?
- State contribution of corner, face and body-centre atoms.

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Classify solids on the basis of interparticle forces. Give examples and properties.
- Differentiate crystalline and amorphous solids. Define anisotropy.

**Teacher record:** MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 1

Solid State | Crystal lattice, unit cell and types of solids

**MCQ answers:** 1-B, 2-C, 3-A, 4-C, 5-C, 6-B, 7-A, 8-A, 9-A, 10-C, 11-D, 12-C, 13-C, 14-C, 15-C

### Short-answer marking points

- 16. Regular 3-D arrangement of points representing constituent-particle positions.
- 17. Smallest repeating portion which reproduces a complete crystal.
- 18. Crystalline: long-range order and sharp melting; amorphous: short-range order and melting over a range.
- 19. Ions become mobile on melting and carry electric current.
- 20. Corner =  $1/8$ ; face =  $1/2$ ; body centre = 1.

### Long-answer marking points

- 21. Classify ionic, molecular, covalent/network and metallic solids; include bonding, one example and two properties each.
- 22. Mention long-range order, melting point, heat of fusion and directional properties; anisotropy means properties vary with direction.

**Remedial rule:** Score below 15/26: correct all errors in a separate notebook and take a 10-MCQ re-test in the next class.



## ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 2

Solid State | Unit-cell calculations, packing efficiency and voids

|                                                             |                  |
|-------------------------------------------------------------|------------------|
| Student Name: _____                                         | Roll No.: _____  |
| DPP No.: 2 Chapter: Solid State                             | Date: _____      |
| Topic: Unit-cell calculations, packing efficiency and voids | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Atoms in BCC unit cell are:  
(A) 1 (B) 2 (C) 4 (D) 6
- Atoms in FCC unit cell are:  
(A) 1 (B) 2 (C) 4 (D) 6
- Coordination number of FCC is:  
(A) 4 (B) 6 (C) 8 (D) 12
- Packing efficiency of FCC is:  
(A) 52% (B) 68% (C) 74% (D) 76%
- Packing efficiency of BCC is:  
(A) 52% (B) 68% (C) 74% (D) 80%
- Packing efficiency of SC is:  
(A) 52% (B) 68% (C) 74% (D) 90%
- FCC relation between  $a$  and  $r$  is:  
(A)  $a=2r$  (B)  $a=4r/\sqrt{3}$  (C)  $a=2\sqrt{2}r$  (D)  $a=\sqrt{2}r$
- BCC relation between  $a$  and  $r$  is:  
(A)  $a=4r/\sqrt{3}$  (B)  $a=2\sqrt{2}r$  (C)  $a=2r$  (D)  $a=4r$
- Tetrahedral voids in CCP of  $N$  spheres are:  
(A)  $N$  (B)  $2N$  (C)  $N/2$  (D)  $4N$
- Octahedral voids in CCP of  $N$  spheres are:  
(A)  $N$  (B)  $2N$  (C)  $N/2$  (D)  $4N$
- CCP layers follow:  
(A) ABAB (B) ABCABC (C) AAAA (D) ABCD
- Corner plus body-centre structure is:  
(A) SC (B) BCC (C) FCC (D) HCP
- Atoms in FCC occupy:  
(A) Corners only (B) Body centre (C) Corners and faces (D) Edges only
- In BCC atoms touch along:  
(A) Edge (B) Face diagonal (C) Body diagonal (D) None
- In FCC atoms touch along:  
(A) Edge (B) Face diagonal (C) Body diagonal (D) None

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Calculate atoms per BCC unit cell.
- Calculate atoms per FCC unit cell.
- Define tetrahedral and octahedral voids.
- Derive packing efficiency of simple cubic cell.
- Write  $a$ - $r$  relations for BCC and FCC.

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Derive packing efficiency of BCC.
- Explain close packing and number of voids in CCP.

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 2

Solid State | Unit-cell calculations, packing efficiency and voids

**MCQ answers:** 1-B, 2-C, 3-D, 4-C, 5-B, 6-A, 7-C, 8-A, 9-B, 10-A, 11-B, 12-B, 13-C, 14-C, 15-B

### Short-answer marking points

16. BCC:  $8 \times \frac{1}{8} + 1 = 2$  atoms.

17. FCC:  $8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$  atoms.

18. Tetrahedral void is surrounded by 4 spheres; octahedral void by 6 spheres.

19. SC:  $a=2r$ ; efficiency =  $\frac{(4/3\pi r^3)/(2r)^3 \times 100}{\pi/6 \times 100} \approx 52.4\%$ .

20. BCC:  $a=4r/\sqrt{3}$ ; FCC:  $a=2\sqrt{2}r$ .

### Long-answer marking points

21. For BCC,  $Z=2$  and  $a=4r/\sqrt{3}$ ; efficiency =  $\frac{\pi\sqrt{3}}{8} \times 100 \approx 68\%$ .

22. HCP has ABAB layers; CCP has ABCABC layers. For  $N$  spheres: tetrahedral voids =  $2N$  and octahedral voids =  $N$ .

**Remedial rule:** Score below 15/26: correct all errors in a separate notebook and take a 10-MCQ re-test in the next class.



## ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 3

Solid State | Density, number of atoms and numerical practice

|                                                        |                  |
|--------------------------------------------------------|------------------|
| Student Name: _____                                    | Roll No.: _____  |
| DPP No.: 3 Chapter: Solid State                        | Date: _____      |
| Topic: Density, number of atoms and numerical practice | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Density of cubic unit cell is:  
(A)  $\rho = \frac{ZM}{a^3 N_A}$  (B)  $\rho = \frac{Ma^3}{Z N_A}$  (C)  $\rho = \frac{Z N_A}{Ma^3}$  (D)  $\rho = \frac{a^3 M}{Z N_A}$
- Avogadro constant is:  
(A)  $6.022 \times 10^{23}$  (B)  $9.65 \times 10^4$  (C)  $3 \times 10^8$  (D)  $1.6 \times 10^{-19}$
- $Z=4$  generally indicates:  
(A) SC (B) BCC (C) FCC (D) HCP
- If edge is doubled, volume becomes:  
(A) 2 times (B) 4 times (C) 6 times (D) 8 times
- Density unit in calculation is:  
(A)  $\text{g cm}^{-3}$  (B)  $\text{g mol}^{-1}$  (C)  $\text{cm}^3 \text{mol}^{-1}$  (D)  $\text{mol cm}^{-3}$
- $Z$  for SC is:  
(A) 1 (B) 2 (C) 3 (D) 4
- $Z$  for BCC is:  
(A) 1 (B) 2 (C) 4 (D) 6
- $Z$  for FCC is:  
(A) 1 (B) 2 (C) 4 (D) 8
- Unit-cell volume is:  
(A)  $a$  (B)  $a^2$  (C)  $a^3$  (D)  $3a$
- $M$  in density formula denotes:  
(A) Molar mass (B) Atomic number (C) Mass number (D) Charge
- Density formula applies to:  
(A) Cubic unit cells (B) Only liquids (C) Only amorphous solids (D) Only gas
- Face-centred atom contributes:  
(A)  $1/8$  (B)  $1/4$  (C)  $1/2$  (D) 1
- Body-centred atom contributes:  
(A)  $1/8$  (B)  $1/4$  (C)  $1/2$  (D) 1
- If  $Z$  increases at constant  $M, a$ , density:  
(A) Decreases (B) Increases (C) Zero (D) Unchanged
- Number of atoms per cell is represented by:  
(A)  $Z$  (B)  $M$  (C)  $\rho$  (D)  $N_A$

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Write density formula and define symbols.
- Why must  $a$  be in cm for density in  $\text{g cm}^{-3}$ ?
- Convert 300 pm into cm.
- Find  $Z$  for 8 corner and 6 face atoms.
- If edge becomes three times, what happens to volume?

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- FCC metal:  $a=400$  pm,  $M=64$  g mol $^{-1}$ . Calculate density.
- Crystal:  $\rho=8.0$  g cm $^{-3}$ ,  $M=64$  g mol $^{-1}$ ,  $a=400$  pm. Calculate  $Z$  and likely structure.

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 3

Solid State | Density, number of atoms and numerical practice

**MCQ answers:** 1-A, 2-A, 3-C, 4-D, 5-A, 6-A, 7-B, 8-C, 9-C, 10-A, 11-A, 12-C, 13-D, 14-B, 15-A

### Short-answer marking points

16.  $\rho = ZM/(a^3 N_A)$ , where  $Z$ =atoms per cell,  $M$ =molar mass,  $a$ =edge and  $N_A$ =Avogadro constant.

17. Cell volume must be in  $\text{cm}^3$  to get density in  $\text{g cm}^{-3}$ .

18.  $300 \text{ pm} = 3.00 \times 10^{-8} \text{ cm}$ .

19.  $Z = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$ .

20. Volume becomes 27 times.

### Long-answer marking points

21.  $a = 4.00 \times 10^{-8} \text{ cm}$ ;  $\rho = (4 \times 64)/(6.022 \times 10^{23} \times (4 \times 10^{-8})^3) \approx 6.64 \text{ g cm}^{-3}$ .

22.  $Z = \rho a^3 N_A / M \approx 4.82$ ; nearest valid cubic value is 4, hence FCC (rounding discussed).

**Remedial rule:** Score below 15/26: correct all errors in a separate notebook and take a 10-MCQ re-test in the next class.



## ARIHANTAM ACADEMY

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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 4

Solid State | Defects, electrical and magnetic properties

|                                                    |                  |
|----------------------------------------------------|------------------|
| Student Name: _____                                | Roll No.: _____  |
| DPP No.: 4 Chapter: Solid State                    | Date: _____      |
| Topic: Defects, electrical and magnetic properties | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Frenkel defect occurs when ion:  
(A) Leaves crystal (B) Occupies interstitial site (C) Replaces another ion (D) Forms molecule
- Schottky defect generally occurs in:  
(A) AgCl (B) ZnS (C) SiO<sub>2</sub> (D) Glass
- Frenkel defect generally occurs in:  
(A) NaCl (B) AgCl (C) KCl (D) CsCl
- Defect that does not change density:  
(A) Schottky (B) Frenkel (C) Metal excess (D) Impurity
- Anion vacancy defect produces:  
(A) Cation vacancies (B) F-centres (C) Only interstitial ions (D) No colour
- F-centre crystal appears:  
(A) Colourless (B) Coloured (C) Liquid (D) Amorphous
- NaCl doped with SrCl<sub>2</sub> has:  
(A) Anion vacancies (B) Cation vacancies (C) No defect (D) Frenkel only
- Paramagnetic material contains:  
(A) Paired electrons (B) Unpaired electrons (C) No electrons (D) Only ions
- Diamagnetic materials are:  
(A) Attracted (B) Repelled (C) Ferromagnetic (D) Always coloured
- Ferromagnetism is shown by:  
(A) NaCl (B) Fe (C) Water (D) SiO<sub>2</sub>
- Antiferromagnetism has:  
(A) Parallel spins (B) Equal antiparallel spins (C) No spins (D) Random ions
- Ferrimagnetism has:  
(A) All paired (B) Unequal antiparallel spins (C) No spins (D) Only diamagnetism
- Semiconductor conductivity is:  
(A) Greater than metals (B) Between conductors and insulators (C) Zero (D) Temperature-independent
- Si doped with P is:  
(A) p-type (B) n-type (C) ionic (D) insulator
- Si doped with B is:  
(A) n-type (B) p-type (C) metal (D) superconductor

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Define Schottky and Frenkel defects.
- Why does Schottky defect lower density?
- What are F-centres?
- Differentiate paramagnetic and diamagnetic materials.
- Define n-type and p-type semiconductors.

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Explain stoichiometric and non-stoichiometric defects with examples.
- Describe dia-, para-, ferro-, antiferro- and ferrimagnetism.

**Teacher record:** MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | **Total** \_\_\_\_/30



ARIHANTAM ACADEMY

*Faith Strength Education*

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 4

Solid State | Defects, electrical and magnetic properties

**MCQ answers:** 1-B, 2-A, 3-B, 4-B, 5-B, 6-B, 7-B, 8-B, 9-B, 10-B, 11-B, 12-B, 13-B, 14-B, 15-B

### Short-answer marking points

- 16. Schottky: equal cation/anion vacancies; Frenkel: smaller ion shifts to interstitial site.
- 17. Mass falls while volume stays nearly unchanged.
- 18. Electrons trapped in anion vacancies; they impart colour.
- 19. Paramagnetic: unpaired electrons and attraction; diamagnetic: paired electrons and repulsion.
- 20. n-type uses pentavalent dopant/electrons; p-type uses trivalent dopant/holes.

### Long-answer marking points

- 21. Explain Schottky/Frenkel as stoichiometric; metal excess/deficiency as non-stoichiometric, with F-centres and examples.
- 22. State electron/spin arrangement and field response for each magnetic type; Fe is ferromagnetic.

**Remedial rule:** Score below 15/26: correct all errors in a separate notebook and take a 10-MCQ re-test in the next class.



## ARIHANTAM ACADEMY

Faith Strength Education

CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

### DAILY PRACTICE PROBLEM — DPP 5

Solid State | Full chapter important-question test

|                                             |                  |
|---------------------------------------------|------------------|
| Student Name: _____                         | Roll No.: _____  |
| DPP No.: 5 Chapter: Solid State             | Date: _____      |
| Topic: Full chapter important-question test | Score: ____ / 30 |

**Instructions:** Answer all objective questions. Attempt any 3 short-answer questions and any 1 long-answer question.

#### Section A — Objective Questions (15 × 1 = 15)

- Defect lowering density is:  
(A) Frenkel (B) Schottky (C) Interstitial (D) Impurity
- Atoms in FCC are:  
(A) 1 (B) 2 (C) 4 (D) 6
- BCC packing efficiency is:  
(A) 52% (B) 68% (C) 74% (D) 90%
- BCC relation is:  
(A)  $a=2r$  (B)  $a=2\sqrt{2}r$  (C)  $a=4r/\sqrt{3}$  (D)  $a=\sqrt{2}r$
- Tetrahedral voids in CCP are:  
(A)  $N/2$  (B)  $N$  (C)  $2N$  (D)  $4N$
- Frenkel defect does not affect:  
(A) Colour (B) Density (C) Ion position (D) Lattice
- F-centres are:  
(A) Cation vacancies (B) Electrons in anion vacancies (C) Anion interstitials (D) Impurity atoms
- p-type Si uses:  
(A) P (B) As (C) B (D) Sb
- FCC coordination number is:  
(A) 4 (B) 6 (C) 8 (D) 12
- Substance with unpaired electrons is:  
(A) Diamagnetic (B) Paramagnetic (C) Nonmagnetic (D) Always ferromagnetic
- $Z=2$  structure is:  
(A) SC (B) BCC (C) FCC (D) HCP
- Density equation is:  
(A)  $\rho = ZM/a^3N_A$  (B)  $\rho = Ma^3/ZNA$  (C)  $\rho = ZNA/Ma^3$  (D)  $\rho = a^3M/ZNA$
- Amorphous solid is:  
(A) NaCl (B) Quartz (C) Glass (D) Diamond
- Most unsymmetrical crystal is:  
(A) Cubic (B) Tetragonal (C) Triclinic (D) Hexagonal
- Corner contribution is:  
(A) 1 (B)  $1/2$  (C)  $1/4$  (D)  $1/8$

#### Section B — Short Answer (Attempt any 3) (3 × 2 = 6)

- Differentiate crystalline and amorphous solids.
- Calculate number of atoms in FCC.
- Give relation between  $r$  and  $a$  in FCC.
- Why do ionic solids not conduct in solid state?
- Explain F-centres and colour.

#### Section C — Long Answer (Attempt any 1) (1 × 5 = 5)

- Derive density relation  $\rho = ZM/a^3N_A$ .
- BCC metal:  $a=300$  pm,  $M=54$  g mol<sup>-1</sup>. Calculate density.

Teacher record: MCQ \_\_\_\_/15 | Short \_\_\_\_/6 | Long \_\_\_\_/5 | Presentation/Homework \_\_\_\_/4 | Total \_\_\_\_/30



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CLASS 12 CHEMISTRY — BIHAR BOARD (BSEB)

## TEACHER ANSWER KEY — DPP 5

Solid State | Full chapter important-question test

**MCQ answers:** 1-B, 2-C, 3-B, 4-C, 5-C, 6-B, 7-B, 8-C, 9-D, 10-B, 11-B, 12-A, 13-C, 14-C, 15-D

### Short-answer marking points

16. Long-range order/sharp melting versus short-range order/melting range.

17.  $Z = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$ .

18.  $\sqrt{2}a = 4r$ , hence  $a = 2\sqrt{2}r$ .

19. Ions are fixed in a solid; they conduct only when mobile in melt/solution.

20. Electrons in anion vacancies absorb visible light and produce colour.

### Long-answer marking points

21. Mass/cell =  $ZM/NA$ ; volume =  $a^3$ ; therefore  $\rho = ZM/(a^3NA)$ .

22.  $a = 3.00 \times 10^{-8}$  cm;  $\rho = (2 \times 54)/(6.022 \times 10^{23} \times (3 \times 10^{-8})^3) \approx 6.64 \text{ g cm}^{-3}$ .

**Remedial rule:** Score below 15/26: correct all errors in a separate notebook and take a 10-MCQ re-test in the next class.