

CHEMISTRY · JEE MAIN

Solid State

Chapter-wise previous year questions, with answer key

42

PYQS

2020–2024

PAPERS

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TOPICS

Crystal Systems and Unit Cells

Crystal Defects

Voids

Crystalline and Amorphous Solids

Close Packing

- 1 Attempt each question on paper first — they're grouped by topic, newest papers first.
- 2 Check yourself against the answer key at the end.
- 3 Got one wrong? Tap “Step-by-step solution” under it for the full working.

Stuck on a question?

Every question has a free step-by-step solution on PrepWiser — tap “Step-by-step solution” under it.

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Crystal Systems and Unit Cells · 19 PYQs

Q1 JEE Main 2023 · 15 Apr · Shift 1

Which of the following expressions is correct in case of a CsCl unit cell (edge length 'a')?

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

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

(C) $r_{\text{Cs}^+} + r_{\text{Cl}^-} = a$

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

[Step-by-step solution ► prepwiser.in/questions/0bXRONja7r](https://www.prepwiser.in/questions/0bXRONja7r)

Q2 JEE Main 2023 · 13 Apr · Shift 2

Sodium metal crystallizes in a body centred cubic lattice with unit cell edge length of $4\overset{\circ}{\text{A}}$. The radius of sodium atom is _____ $\times 10^{-1}\overset{\circ}{\text{A}}$ (Nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/btp7xZCNZM](https://www.prepwiser.in/questions/btp7xZCNZM)

Q3 JEE Main 2023 · 11 Apr · Shift 1

An atomic substance A of molar mass 12g mol^{-1} has a cubic crystal structure with edge length of 300pm. The no. of atoms present in one unit cell of A is _____. (Nearest integer)

Given the density of A is 3.0g mL^{-1} and $N_A = 6.02 \times 10^{23}\text{mol}^{-1}$

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/6-pME_tca2](https://www.prepwiser.in/questions/6-pME_tca2)

Q4 JEE Main 2023 · 6 Apr · Shift 2

Number of crystal systems from the following where body centred unit cell can be found, is _____. Cubic, tetragonal, orthorhombic, hexagonal, rhombohedral, monoclinic, triclinic

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/-R769bqN5b](https://www.prepwiser.in/questions/-R769bqN5b)

Q5 JEE Main 2023 · 1 Feb · Shift 2

A metal M crystallizes into two lattices :- face centred cubic (fcc) and body centred cubic (bcc) with unit cell edge length of 2.0 and $2.5\overset{\circ}{\text{A}}$ respectively. The ratio of densities of lattices fcc to bcc for the metal M is _____. (Nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/F9LN89dgOv](https://www.prepwiser.in/questions/F9LN89dgOv)

Q6 JEE Main 2023 · 30 Jan · Shift 2

Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of $5.0\overset{\circ}{\text{A}}$. If density of the FeO in the crystal is 4.0g cm^{-3} , then the number of FeO units present per unit cell is _____. (Nearest integer)

Given: Molar mass of Fe and O is 56 and 16g mol^{-1} respectively. $N_A = 6.0 \times 10^{23}\text{mol}^{-1}$

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/wyD8VWiNqY](https://www.prepwiser.in/questions/wyD8VWiNqY)

Q7 JEE Main 2023 · 25 Jan · Shift 1

A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}$ rd of the total faces. The empirical formula of the compound is :

- (A) $X_2Y_{1.5}$ (B) X_3Y_2
(C) $XY_{2.5}$ (D) $X_{2.5}Y$

[Step-by-step solution ► prepwiser.in/questions/Fhf1Za2749](https://www.prepwiser.in/questions/Fhf1Za2749)

Q8 JEE Main 2022 · 28 Jul · Shift 2

Metal M crystallizes into a fcc lattice with the edge length of 4.0×10^{-8} cm. The atomic mass of the metal is _____ g/mol. (Nearest integer)

(Use : $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$, density of metal, $M = 9.03 \text{ g cm}^{-3}$)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/ZuminP7DpE](https://www.prepwiser.in/questions/ZuminP7DpE)

Q9 JEE Main 2022 · 28 Jul · Shift 1

An element M crystallises in a body centred cubic unit cell with a cell edge of 300 pm. The density of the element is 6.0 g cm^{-3} . The number of atoms present in 180g of the element is _____ $\times 10^{23}$. (Nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/JYS8QQpv4T](https://www.prepwiser.in/questions/JYS8QQpv4T)

Q10 JEE Main 2022 · 30 Jun · Shift 1

An element X has a body centred cubic (bcc) structure with a cell edge of 200 pm. The density of the element is 5 g cm^{-3} . The number of atoms present in 300 g of the element X is _____.

Given : Avogadro constant, $N_A = 6.0 \times 10^{23} \text{ mol}^{-1}$.

- (A) $5 N_A$
(B) $6 N_A$
(C) $15 N_A$
(D) $25 N_A$

[Step-by-step solution ► prepwiser.in/questions/H5thN1PhIj](https://www.prepwiser.in/questions/H5thN1PhIj)

Q11 JEE Main 2022 · 25 Jun · Shift 1

The distance between Na^+ and Cl^- ions in solid NaCl of density 43.1 g cm^{-3} is _____ $\times 10^{-10} \text{ m}$. (Nearest Integer)

(Given : $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/k6-8ZtrVBf](https://www.prepwiser.in/questions/k6-8ZtrVBf)

Q12 JEE Main 2021 · 27 Jul · Shift 1

The parameters of the unit cell of a substance are $a = 2.5$, $b = 3.0$, $c = 4.0$, $\alpha = 90^\circ$, $\beta = 120^\circ$, $\gamma = 90^\circ$. The crystal system of the substance is :

- (A) Hexagonal (B) Orthorhombic
(C) Monoclinic (D) Triclinic

Step-by-step solution ► [prepwisser.in/questions/Q2bwIZG2bm](https://www.prepwisser.in/questions/Q2bwIZG2bm)

Q13 JEE Main 2021 · 22 Jul · Shift 2

A copper complex crystallising in a CCP lattice with a cell edge of 0.4518 nm has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be 7.62 g cm^{-3} . The molar mass of copper complex is _____ g mol^{-1} . (Nearest integer)

[Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/2j96YGwW9Y](https://www.prepwisser.in/questions/2j96YGwW9Y)

Q14 JEE Main 2021 · 20 Jul · Shift 2

Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is _____.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/dUSUG2CHZ3](https://www.prepwisser.in/questions/dUSUG2CHZ3)

Q15 JEE Main 2021 · 16 Mar · Shift 1

A certain element crystallises in a bcc lattice of unit cell edge length $27 \text{ \AA}$. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in Å will be _____. (Round off to the Nearest Integer).

[Assume each lattice point has a single atom]

[Assume $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$]

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/KBVBuYzNey](https://www.prepwisser.in/questions/KBVBuYzNey)

Q16 JEE Main 2021 · 25 Feb · Shift 2

The unit cell of copper corresponds to a face centered cube of edge length 3.596 Å with one copper atom at each lattice point. The calculated density of copper in kg/m^3 is _____. [Molar mass of Cu : 63.54 g; Avogadro Number = 6.022×10^{23}]

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/uFW-zETjOE](https://www.prepwisser.in/questions/uFW-zETjOE)

Q17 JEE Main 2021 · 24 Feb · Shift 1

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

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/TQe_tvZzmq](https://www.prepwisser.in/questions/TQe_tvZzmq)

Q18 JEE Main 2020 · 5 Sep · Shift 1

A diatomic molecule X_2 has a body-centred cubic (bcc) structure with a cell edge of 300 pm. The density of the molecule is 6.17 g cm^{-3} . The number of molecules present in 200 g of X_2 is :
(Avogadro constant (N_A) = $6 \times 10^{23} \text{ mol}^{-1}$)

- (A) $8 N_A$
- (B) $40 N_A$
- (C) $4 N_A$
- (D) $2 N_A$

[Step-by-step solution ► prepwisser.in/questions/p8mKOKcyS2](https://www.prepwisser.in/questions/p8mKOKcyS2)

Q19 JEE Main 2020 · 3 Sep · Shift 1

An element with molar mass $2.7 \times 10^{-2} \text{ kg mol}^{-1}$ forms a cubic unit cell with edge length 405 pm. If its density is $2.7 \times 10^3 \text{ kg m}^{-3}$, the radius of the element is approximately _____ $\times 10^{-12} \text{ m}$ (to the nearest integer).

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/B5EMjB5Vji](https://www.prepwisser.in/questions/B5EMjB5Vji)

Crystal Defects · 6 PYQs

Q20 JEE Main 2023 · 24 Jan · Shift 1

When $\text{Fe}_{0.93}\text{O}$ is heated in presence of oxygen, it converts to Fe_2O_3 . The number of correct statement/s from the following is _____

- A. The equivalent weight of $\text{Fe}_{0.93}\text{O}$ is $\frac{\text{Molecular weight}}{0.79}$
- B. The number of moles of Fe^{2+} and Fe^{3+} in 1 mole of $\text{Fe}_{0.93}\text{O}$ is 0.79 and 0.14 respectively
- C. $\text{Fe}_{0.93}\text{O}$ is metal deficient with lattice comprising of cubic closed packed arrangement of O^{2-} ions
- D. The % composition of Fe^{2+} and Fe^{3+} in $\text{Fe}_{0.93}\text{O}$ is 85% and 15% respectively

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/SUNkgEmyC_](https://www.prepwisser.in/questions/SUNkgEmyC_)

Q21 JEE Main 2022 · 28 Jun · Shift 1

The incorrect statement about the imperfections in solids is :

- (A) Schottky defect decreases the density of the substance.
- (B) Interstitial defect increases the density of the substance.
- (C) Frenkel defect does not alter the density of the substance.
- (D) Vacancy defect increases the density of the substance.

[Step-by-step solution ► prepwisser.in/questions/VxYn--WsYL](https://www.prepwisser.in/questions/VxYn--WsYL)

Q22 JEE Main 2022 · 27 Jun · Shift 1

Metal deficiency defect is shown by $\text{Fe}_{0.93}\text{O}$. In the crystal, some Fe^{2+} cations are missing and loss of positive charge is compensated by the presence of Fe^{3+} ions. The percentage of Fe^{2+} ions in the $\text{Fe}_{0.93}\text{O}$ crystals is _____. (Nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/qIbd7cOe7C](https://www.prepwiser.in/questions/qIbd7cOe7C)

Q23 JEE Main 2021 · 26 Aug · Shift 1

Given below are two statements.

Statement I : Frenkel defects are vacancy as well as interstitial defects.

Statement II : Frenkel defect leads to colour in ionic solids due to presence of F-centres.

Choose the most appropriate answer for the statements from the options given below :

- (A) Statement I is false but Statement II is true
- (B) Both Statement I and Statement II are true
- (C) Statement I is true but Statement II is false
- (D) Both Statement I and Statement II are false

[Step-by-step solution ► prepwiser.in/questions/7BnwqHJGO](https://www.prepwiser.in/questions/7BnwqHJGO)

Q24 JEE Main 2021 · 17 Mar · Shift 2

KBr is doped with 10^{-5} mole percent of SrBr_2 . The number of cationic vacancies in 1g of KBr crystal is _____ 10^{14} . (Round off to the Nearest Integer).

[Atomic Mass : K : 39.1 u, Br : 79.9 u $N_A = 6.023 \times 10^{23}$]

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/ClV8zyeb_4](https://www.prepwiser.in/questions/ClV8zyeb_4)

Q25 JEE Main 2020 · 8 Jan · Shift 2

Which of the following compounds is likely to show both Frenkel and Schottky defects in its crystalline form?

- | | |
|----------|----------|
| (A) CsCl | (B) AgBr |
| (C) ZnS | (D) KBr |

[Step-by-step solution ► prepwiser.in/questions/gqDPij4yDQ](https://www.prepwiser.in/questions/gqDPij4yDQ)

Q26 JEE Main 2023 · 6 Apr · Shift 1

A compound is formed by two elements X and Y. The element Y forms cubic close packed arrangement and those of element X occupy one third of the tetrahedral voids. What is the formula of the compound?

- (A) XY_3 (B) X_3Y_2
(C) X_3Y (D) X_2Y_3

[Step-by-step solution ► prepwisser.in/questions/jS46InxKKs](https://www.prepwisser.in/questions/jS46InxKKs)

Q27 JEE Main 2023 · 29 Jan · Shift 2

A metal M forms hexagonal close-packed structure. The total number of voids in 0.02 mol of it is _____ $\times 10^{21}$ (Nearest integer).

(Given $N_A = 6.02 \times 10^{23}$)

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/GGAIPuP1Kx](https://www.prepwisser.in/questions/GGAIPuP1Kx)

Q28 JEE Main 2022 · 26 Jun · Shift 2

In a solid AB, A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y . The value of x is _____. [nearest integer]

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/WOycdS3ujr](https://www.prepwisser.in/questions/WOycdS3ujr)

Q29 JEE Main 2022 · 24 Jun · Shift 1

Atoms of element X form hcp lattice and those of element Y occupy $\frac{2}{3}$ of its tetrahedral voids. The percentage of element X in the lattice is _____. (Nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/iIXjSx_7QC](https://www.prepwisser.in/questions/iIXjSx_7QC)

Q30 JEE Main 2021 · 31 Aug · Shift 2

The empirical formula for a compound with a cubic close packed arrangement of anions and with cations occupying all the octahedral sites in A_xB . The value of x is _____. (Integer answer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/WdPrkHue1c](https://www.prepwisser.in/questions/WdPrkHue1c)

Q31 JEE Main 2021 · 18 Mar · Shift 1

In a binary compound, atoms of element A form a hcp structure and those of element M occupy $\frac{2}{3}$ of the tetrahedral voids of the hcp structure. The formula of the binary compound is :

- (A) M_2A_3
(B) M_4A_3
(C) M_4A
(D) MA_3

[Step-by-step solution ► prepwisser.in/questions/Se898LaNVF](https://www.prepwisser.in/questions/Se898LaNVF)

Q32 JEE Main 2021 · 16 Mar · Shift 2

Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is _____ $\times 10^{21}$. (Round off to the Nearest Integer). [Given : $N_A = 6.023 \times 10^{23}$]

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/tEqIqfRVyw](https://www.prepwiser.in/questions/tEqIqfRVyw)

Q33 JEE Main 2021 · 26 Feb · Shift 2

The number of octahedral voids per lattice site in a lattice is _____. (Rounded off to the nearest integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/_egtfo5Yo1](https://www.prepwiser.in/questions/_egtfo5Yo1)

Q34 JEE Main 2020 · 6 Sep · Shift 2

A crystal is made up of metal ions ' M_1 ' and ' M_2 ' and oxide ions. Oxide ions form a ccp lattice structure. The cation ' M_1 ' occupies 50% of octahedral voids and the cation ' M_2 ' occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation numbers of ' M_1 ' and ' M_2 ' are, respectively :

(A) + 3, + 1

(B) + 4, + 2

(C) + 1, + 3

(D) + 2, + 4

[Step-by-step solution ► prepwiser.in/questions/8xvgt24rs2](https://www.prepwiser.in/questions/8xvgt24rs2)

Crystalline and Amorphous Solids · 6 PYQs

Q35 JEE Main 2024 · 6 Apr · Shift 1

Which of the following material is not a semiconductor.

(A) Copper oxide

(B) Graphite

(C) Silicon

(D) Germanium

[Step-by-step solution ► prepwiser.in/questions/4aXMo7tNXL](https://www.prepwiser.in/questions/4aXMo7tNXL)

Q36 JEE Main 2023 · 11 Apr · Shift 2

Which one of the following pairs is an example of polar molecular solids?

(A) HCl(s) , AlN(s)

(B) MgO(s) , $\text{SO}_2\text{(s)}$

(C) $\text{SO}_2\text{(s)}$, $\text{NH}_3\text{(s)}$

(D) $\text{SO}_2\text{(s)}$, $\text{CO}_2\text{(s)}$

[Step-by-step solution ► prepwiser.in/questions/ju08WqQznm](https://www.prepwiser.in/questions/ju08WqQznm)

Q37 JEE Main 2021 · 27 Jul · Shift 2

Select the correct statements

- (A) Crystalline solids have long range order.
- (B) Crystalline solids are isotropic
- (C) Amorphous solid are sometimes called pseudo solids.
- (D) Amorphous solids soften over a range of temperatures.
- (E) Amorphous solids have a definite heat of fusion.

Choose the most appropriate answer from the options given below.

- (A) (A), (B), (E) only
- (B) (B), (D) only
- (C) (C), (D) only
- (D) (A), (C), (D) only

[Step-by-step solution ► prepwisser.in/questions/WAaJghcjtV](https://www.prepwisser.in/questions/WAaJghcjtV)

Q38 JEE Main 2021 · 20 Jul · Shift 1

Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Sharp glass edge becomes smooth on heating it upto its melting point.

Reason R : The viscosity of glass decreases on melting.

Choose the most appropriate answer from the options given below.

- (A) A is true but R is false
- (B) Both A and R are true but R is NOT the correct explanation of A.
- (C) A is false but R is true.
- (D) Both A and R are true and R is the correct explanation of A.

[Step-by-step solution ► prepwisser.in/questions/gV3WXmw0KZ](https://www.prepwisser.in/questions/gV3WXmw0KZ)

Q39 JEE Main 2021 · 18 Mar · Shift 2

A hard substance melts at high temperature and is an insulator in both solid and in molten state. This solid is most likely to be a/an :

- (A) Covalent solid
- (B) Molecular solid
- (C) Ionic solid
- (D) Metallic solid

[Step-by-step solution ► prepwisser.in/questions/u25fyQWQLN](https://www.prepwisser.in/questions/u25fyQWQLN)

Q40 JEE Main 2020 · 9 Jan · Shift 1

'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is :

- (A) Mercury
- (B) Carbon tetrachloride
- (C) Zinc sulphide
- (D) Silicon carbide

[Step-by-step solution ► prepwisser.in/questions/Gvn_qLRYIR](https://www.prepwisser.in/questions/Gvn_qLRYIR)

Close Packing · 2 PYQs

Q41 JEE Main 2023 · 10 Apr · Shift 2

The correct relationships between unit cell edge length ' a ' and radius of sphere ' r ' for face-centred and body-centred cubic structures respectively are :

(A) $r = 2\sqrt{2}a$ and $\sqrt{3}r = 4a$

(B) $r = 2\sqrt{2}a$ and $4r = \sqrt{3}a$

(C) $2\sqrt{2}r = a$ and $\sqrt{3}r = 4a$

(D) $2\sqrt{2}r = a$ and $4r = \sqrt{3}a$

[Step-by-step solution ► prepwiser.in/questions/jB-RZUo5f4](https://www.prepwiser.in/questions/jB-RZUo5f4)

Q42 JEE Main 2022 · 29 Jul · Shift 1

Ionic radii of cation A^+ and anion B^- are 102 and 181 pm respectively. These ions are allowed to crystallize into an ionic solid. This crystal has cubic close packing for B^- . A^+ is present in all octahedral voids. The edge length of the unit cell of the crystal AB is _____ pm. (Nearest Integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/wjQU4iFJdz](https://www.prepwiser.in/questions/wjQU4iFJdz)

Answer key — Solid State

Numbers match the question numbers above. For full working, open the solution link under each question.

1	A	2	17	3	4	4	3	5	4	6	4	7	B	8	87
9	22	10	D	11	1	12	C	13	106	14	8	15	33	16	9077
17	8	18	C	19	143	20	4	21	D	22	85	23	C	24	5
25	B	26	D	27	36	28	3	29	43	30	1	31	B	32	15
33	1	34	D	35	B	36	C	37	D	38	B	39	A	40	B
41	D	42	566												

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