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## CHEMISTRY

## NCERT - NCERT CHEMISTRY(TELUGU)

## THE SOLID STATE

Example

1. A compound is formed by two elements $X$ and $Y$.

Atoms of the element $Y$ (as anions) make ccp and those of the element $X$ (as cations) occupy of the octahderal voids. What is the formula of the compound?
2. Atoms of element B form hcp lattice and those of the element A occupy $2 / 3^{\text {rd }}$ of tetrahedral voids. What is the formula of the compound formed by the element A and $B$ ?

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3. An element has a body-centred cubic (bcc) structure with a cell edge of 288 pm . The density of the element is $7.2 \mathrm{~g} / \mathrm{cm}^{3}$. How many atoms are present in 208 g of the element?
4. X-ray diffraction studies show that copper crystallises in an fcc unit cell with cell edge of $3.608 \times 10^{-8} \mathrm{~cm}$. In a separate experiment, copper is determined to have a density of $8.92 \mathrm{~g} / \mathrm{cm}^{3}$, calculate the atomic mass of copper.

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5. Silver forms ccp lattice and X-ray studies of its crystals
show that the edge length of its unit cell is 408.6 pm .
Calculate the density of silver
(Atomic mass $=107.9 \mathrm{u}$ ).

## Intext Questions

1. Why are solids rigid ?

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2. Why do solids have a definite volume ?

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3. Classify the following as amorphous or crystalline solids : polyurethane , naphthalene , benzoic acid teflon , potassium nitrate , cellophane , polyvinyl chloride , fibre glass , copper .

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4. Why is glass considered a supercooled liquid ?

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5. Refractive index of a solid is observed to have the same value along all directions . Comment on the nature of this solids. Would it show cleavage property?

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6. Classify the following solids in different categories based on the nature of intermolecular forces operating in them :

Potassium sulphate, tin, benzene, urea, ammonia , water, zinc sulphide, graphite, rubidium, argon , silicon carbide .

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7. Solid ' $A$ ' is a very hard electrical insulator in solid as well as in molten state and melts at extremely high temperature. What type of solid is it ?
8. Ionic solids conduct electricity in molten state but not in solid state. Explain .

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9. What type of solids are electrical conductors , malleable and ductile ?

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10. Give the significance of a lattice point .
11. Name the parameters that characterise a unit cell .

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12. Distinguish between hexagonal and monoclinic unit cells .

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13. Explain how much portion of an atom located at

Corner ?

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14. What is the two dimensional coordination number of a molecule in square close packed layer ?

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15. A compound forms hexagonal close-packed structure
. What is the total number of voids in 0.5 mol of it ? How many of these are tetrahedral voids ?

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16. A compound is formed by two elements $M$ and $N$.

The element N forms ccp and atoms of M occupy $\frac{1}{3}$ rd of tetrahedral voids . What is the formula of the
compound?
i) Find the number of tetrahedral voids as number of tetrahedral voids $=2 \times$ number of atoms present in the lattice.
ii) Calculate the number of atoms (or ratio) of elements

M and N as a chemical formula represents the number of atoms of different elements presents in a compound.
iii) Derive the formula .

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17. Which of the following lattices has the highest packing efficiency ?
i) Simple cubic
ii) Body- centred cubic

Hexagonal close-packed lattice

## Packing efficiency in

i) Simple cubic lattice $=52.4 \%$
ii) body-centred cubic lattice $=68 \%$
iii) Hexagonal close-packed lattice $=74 \%$

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18. An element with molar mass $2.7 \times 10^{-2} \mathrm{kgmol}^{-1}$
forms a cubic unit cell with edge length 405 pm . If its density is $2.7 \times 10^{3} \mathrm{kgm}^{-3}$ what is the nature of the cubic unit cell ?

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19. What type of defect can arise when a solid is heated ? Physical property is affected by it and in what why?

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20. What type of stoichiometric defect is shown by

## ZnS

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21. Explain how vacancies are introduced in an ionic solid when a cation of higher valence is aded as an impurity in it ?
22. Ionic solids, which have anionic vacancies due to metal excess defect , develop colour . Explain with the help of a suitable example .

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23. A group 14 elements is to be converted into $n$ - type semiconductor by doping in with a suitable impurity. To which group shouyld theis impurity belong ?

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24. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic ?

Justify your answer

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## Exercises

1. Define the term amorphous.
2. What makes a glass different from a solid such as quartz? Under what conditions could quartz be converted into glass?

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3. Classify each of the following solids as ionic, metallic, molecular, network (covalent) or amorphous.
(i) Tetra phosphorus decoxide $\left(P_{4} O_{10}\right)$ (vii) Graphite (ii) Ammonium phosphate $\left(\mathrm{NH}_{4}\right)_{3} \mathrm{PO}_{4}$ (viii) Brass
(iv) $S i C$
(ix) Rb
(iv) $I_{2}$
(x) $L i B r$
(vi) Plastic
(xi) Si
4. (i) What is meant by the term 'coordination number'?
(ii) What is the coordination number of atoms:
(a) in a cubic close-packed structure?
(b) in a body-centred cubic structure?

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5. How do you determine the atomic mass of an unknown metal if you know its density and dimension of its unit cell ? Explain .

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6. Stability of a crystal is reflected in the magnitude of its melting points'. Comment. Collect melting points of solid water, ethyl alcohol, diethyl ether and methane from a data book. What can you say about the intermolecular forces between these molecules?

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7. How will you distinguish between the following pairs of terms:
(i) Hexagonal close-packing and cubic close-packing?
(ii) Crystal lattice and unit cell?
(iii) Tetrahedral void and octahedral void?
8. How many lattice points are there in one unit cell of face centered cubic lattice

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## 9. Explain

(i) The basis of similarities and differences between metallic and ionic crystals.
(ii) Ionic solids are hard and brittle.

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10. Calculate the efficiency of packing in case of a metal of body centered cubic crystal .

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11. Silver crystallizes in FCC lattice . If edge of the cell is
$4.07 \times 10^{-8}$ and density is $10.5 \mathrm{~g} . \mathrm{cm}^{3}$. Calculate the atomic mass of silver .

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12. A cubic solid is made of two elements $P$ and $Q$.

Atoms of $Q$ are at the corners of the cube and $P$ at the
body - centre . What is the formula of the compound ? What are the coordination numbers of $P$ and $Q$ ?

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13. Niobium crystallizes in body - centered cubic structure. If density is $8.55 \mathrm{~g} \mathrm{~cm}^{-3}$, calculate atomic radius of niobium using its atomic mass 93 U .

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14. If the radius of the octahedral void is $r$ and radius of
the atoms in close packing is R , derive relation between $r$ and $R$.
15. Copper crystallizes into a FCC lattice with edge length $3.61 \times 10^{-8} \mathrm{~cm}$. Show that the calculated density is in agreement with its measured value of $8.92 \mathrm{~g} . \mathrm{cm}^{-3}$.

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16. Analysis shows that nickel oxide has the formula $N i^{0.98} 0,1.00$, what fractions of nickel exist as $N i^{2+}$ and $N i^{3+}$ ions ?
17. Describe the two main types of semiconductors and contrast their conduction mechanism .

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18. Non-stoichiometric cuprous oxide, $\mathrm{Cu}_{2} \mathrm{O}$ can be prepared in laboratory. In this oxide, copper to oxygen ratio is slightly less than 2:1. Can you account for the fact that this substance is a p-type semiconductor?
19. Ferric oxide crystallizes in a hexagonal close - packed array of oxide ions with two of every three octahedral holes occupied by ferric ions. Derive the formula of ferric oxide .

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20. Classify each of the following as either a p-type or a n -type semiconductor .
21. Ge doped with $\ln 2$. Si doped with B .

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21. Gold (atomic radius $=0.144 \mathrm{~nm}$ ) crystallizes in a face centered unit cell. What is the length of a side of the unit cell ?

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22. In terms of band theory, what is the difference between a conductor and an insulator?

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23. Explain the following terms with suitable examples:
(i) Schottky defect (ii) Frenkel defect (iii) Interstitials and
(iv) F-centres.

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24. Aluminium crystallizes in a cubic close packed structure. Its metallic radius is 125 pm .

What is the length of the side of the unit cell .

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25. In NaCl is doped with $1 \times 10^{-3} \mathrm{~mol}$ percent of $\mathrm{SrCl}_{2}$, what is the concentration of cation vacancies ?
26. Explain the following with suitable examples:
(i) Ferromagnetism
(ii) Paramagnetism
(iii) Ferrimagnetism
(iv) Antiferromagnetism
(v) 12-16 and 13-15 group compounds.

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