CHEMISTRY

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SOLID STATE

Evaluate Yourself

1. An element has a face centered cubic unit cell with a length of 352.4pm along and edge . The density of the element is $8.9 gcm^{-3}$. How

many atoms are present in 100 g of an elements ?

2. Determine the density of CsCl which crystallizes in a bcc types structure with an edge length 412.1 pm.

3. A face centered cubic solid of an element (atomic mass 60) has a cube edge of 4Å. Calculate its density .

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1. Garphite and diamond are:

    A. Covalent and molecular crystals

B. ionic and covalent crystals

C. both covalent crystals

D. both molecular crystals

Answer: C

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2. An ionic compound A_x, B_y crystallizes in fcc type crystals structure with B ions at the centre fo each face and A ion occupying centre fo the cube the correct of formula of $A_x B_y$ is :

A. AB

B. AB_3

C. A_3B

D. A_8B_6

Answer: B

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3. The ratio of close packed atoms to tetrahedral hole in cubic packing is :

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:4$

Answer: B

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4. Solid CO_2 is an example of :

A. Covalent solid

B. metallic solid

C. molecular solid

D. ionic solid

Answer: C

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5. Assertion : monoclinic sulphur is an example of monoclinic crystal sytem .

Reason for a monoclinic system , $a \neq b \neq c$ and $\alpha = \gamma = 90°, \beta \neq = 90°$

A. Both assertion and reson are true and reason is the correct explaintion of assertion .

B. Both assertion and reason are true but reason is not the correct explanation of assertion .

C. Assertion is ture but reason is false.

D. Both assertion and reaosn are false.

Answer: A

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6. In calcium fluoride ,having the flurite structure the coordination number of Ca^{2+} ion and F^- ion are :

A. 4 and 2

B. 6 and 6

C. 8 and 4

D. 4 and 8

Answer: C

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7. The number of unit cells in 8 gram of an element X(atomic mass 40) which crystallizes in bcc pattern is (N_A is the Avogadro number) :

A. 6.023×10^{23}

B. 6.023×10^{22}

C. 60.23×10^{23}

D. $\left(\dfrac{6.023 \times 10^{23}}{8 \times 10} \right)$

Answer: B

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8. The number of carbon atoms per units cell of diamond is :

A. 8

B. 6

C. 1
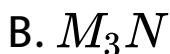
D. 4

Answer: A

9. In a solid atom M occupies ccp lattice and $\left(\dfrac{1}{3}\right)$ of tetrahedral voids are occupied by atom N. Find the formula of solid formed by M and N.

   A. MN_3

   B. M_3N

   C. MN_3

D. M_3N_2

Answer: D

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10. The composition of a sample of wurtizite is $Fe_{0.93}O_{1.00}$ What % of Iron present in the form of Fe^{3+} ?

A. 16.05 %

B. 15.05 %

C. 18.50 %

D. 17.05 %

Answer: B

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11. The ionic radii of A^+ and B^+ are 0.98×10^{-10} m the coordination number of each ion in AB is :

A. 8

B. 2

C. 6

D. 4

Answer: C

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12. CsCl has bcc arragement, its unit cell edge

length is 400 pm , its inter atomic distance is :

A. 400 pm

B. 800 pm

C. $\sqrt{3} \times 100$ pm

D. $\left(\dfrac{\sqrt{3}}{2}\right) \times 400$ pm

Answer: D

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13. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm , the radius of the will be :

A. $\left(\dfrac{100}{0.414}\right)$

B. $\left(\dfrac{0.732}{100}\right)$

C. 100×0.414

D. $\left(\dfrac{0.414}{100}\right)$

Answer: A

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14. The vacant space in bcc lattice unit cell is :

A. 0.48

B. 0.23

C. 0.32

D. 0.26

Answer: C

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15. The radius of an atoms is 300 pm , if it crystallizes is a face centered cubic lattice , the length of the edge of the unit cell is:

A. 488.5 pm

B. 848.5 pm

C. 884.5 pm

D. 484.5 pm

Answer: B

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16. The fraction of total volume occupied by the atoms is a simple cubic is :

A. $\left(\dfrac{\pi}{4\sqrt{2}} \right)$

B. $\left(\dfrac{\pi}{6} \right)$

C. $\left(\dfrac{\pi}{4} \right)$

D. $\left(\dfrac{\pi}{3\sqrt{2}} \right)$

Answer: B

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17. The yellow colour in NaCl crystal is due to :

A. excitation of electrons is F centers

B. reflection of light form Cl^- ion on the

   surface

C. refraction of light form Na^+ ion

D. all of the above

Answer: A

18. If a stands for the edge length of the cubic

system , se, bcc and fcc . Then the ratio of radii

of spheres in these systems will be respectively.

A. $\left(\dfrac{1}{2}a, \ \dfrac{\sqrt{2}}{3}a, \ \dfrac{\sqrt{2}}{2}a \right)$

B. $\left(\sqrt{1}a : \sqrt{3}a, \ \sqrt{2}a \right)$

C. $\left(\dfrac{1}{2}a, \ \dfrac{\sqrt{3}}{4}a, \ \dfrac{1}{2\sqrt{2}}a \right)$

D. $\left(\dfrac{1}{2}a, \ \sqrt{3}a, \ \dfrac{1}{\sqrt{2}}a \right)$

Answer: C

19. If a is the length of the side of the cube , the distance between the body centered atom and one corner atom in the cube will be :

A. $\left(\dfrac{2}{\sqrt{3}} \right) a$

B. $\left(\dfrac{4}{\sqrt{3}} \right) a$

C. $\left(\dfrac{\sqrt{3}}{4} \right) a$

D. $\left(\dfrac{\sqrt{3}}{2} \right) a$

Answer: D

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20. Potassium has bcc structure with nearest neighbor distance 4.52Å its atomic weight is 39 its density will be :

A. $915 kgm^{-3}$

B. $2142 kgm^{-3}$

C. $452 kgm^{-3}$

D. $390 kgm^{-3}$

Answer: A

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21. Schottky defect in a crystal is observed when :

A. unequal number of anions and anions are missing from the lattice .

B. equal number of anions and anions are missing form the lattice .

C. an ions leaves its noramal site and occupies an interstital site

D. no ions is missing from its lattice .

Answer: B

22. The cation leaves its normal position in the crystal and moves to some interstitial position, the defect in the crystal is know as :

   A. Schottky defect

   B. F-center

   C. Frenkel defect

   D. non-stoichiometric defect

Answer: C

23. Assertion : due to Frenkel defect, density of

the crystalline solid decrease .

Reason in Frenkel defect cation and anion

leaves the crystal.

A. Both assertion and reason are true and

reason is the correct explanation of

assertion.

B. Both assertion and reason are true but

reason in not the correct explanation of

assertion.

C. Assertion is true but reason is false .

D. Both assertion and reason are false .

Answer: D

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24. The crystal with a metal deficiency defect is

.

A. NaCl

B. FeO

C. ZnO

D. KCl

Answer: B

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1. Define unit cell.

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2. Give any three characteristics of ionic crystals.

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3. Differentiate crystalline solid and amorphous solids .

4. Classify the following solids .

(a) P_4 (b) Brass (c) diamond , (d) NaCl

(e) Iodine .

5. Explain briefly seven types of unit cell.

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6. Distingusih between hexagonal close packing and cubic packing .

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7. Distingusih tetrahedral and octahedral voids.

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8. What are point defect ?

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9. Explin Schottky defect.

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10. Write short note on metal excess and metal deficiency defect with an example .
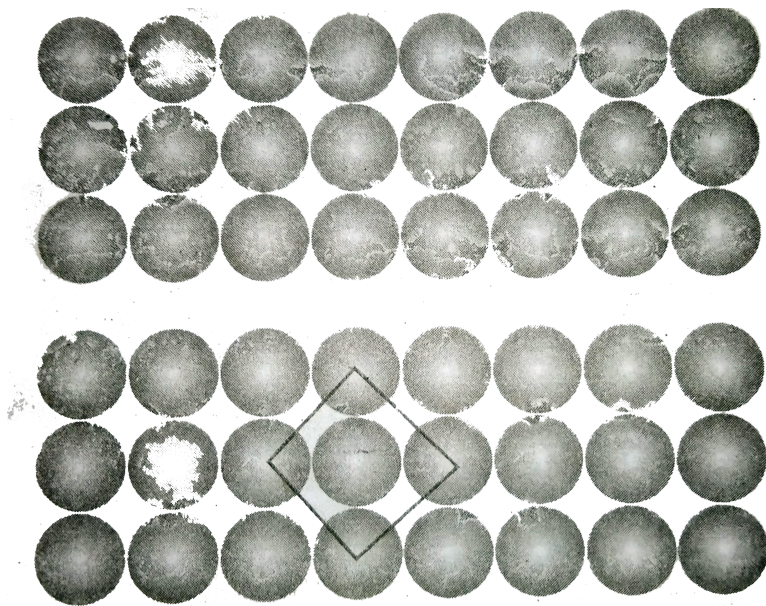
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11. Calculate the number of atoms in a fcc units cell.

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12. Explaub AAAA and ABABA and ABCABC type of three dimensionl packing with the help of neat diagram.

AAAA type

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13. Why ionic crystals are hard and brittle ?

14. Calculate the percentage efficiency of packing in case of body centered cubic crystal.

15. What is the two dimensional coordination number of a molecule in square close packed

layer ?

16. Experiment shows that Nickel oxide has the formula $Ni_{0.96}O_{1.00}$. What fraction of Nickel exists as Ni^{2+} and Ni^{3+} ions ?

17. What is meant by the term " coordination number " ? What is the coordination number

of atoms in a bcc structure ?

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18. An element has bcc structure with a cell edge of 288 pm the density of the elements is $7.2 gcm^{-3}$. How many atoms are present in 208g of the element.

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19. Aluminium crystallizes in a cubic close packed structure . Its metallic radius is 125 pm. Calculate the edge length of unit cell.

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20. If NaCl is dopped with 10^{-2} mol percentage of strontium chloride , what is the concentration of cation vacancy ?

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21. KF crystallizes in fcc structure like sodium chloride . Calculate the distance between K^+ and F^- in KF , (given : density of KF is $2.48 gcm^{-3}$)`.

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22. An atom crystallizes in fcc crystal lattice and has a density of $10 gcm^{-3}$ with unit cell edge leght of 100 pm . Calculate the number of atoms present in 1 g of crystal.

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23. Atoms X and Y from bcc crystallines structures. Atom X is presetn at the corners of the cube and Y is at the centre of the cube . What is the formula of the compound ?

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24. Sodium metal crystallizes in bcc strcture with the edge length of the unit cell

4.3×10^{-8} cm. Calculate the radius of sodium atom.

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25. Write a note on Frenkel defect .

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Other Important Question Answer Choose The Correct Answer

1. Which one of the following is a covalent crystal ?

A. Rock salt

B. Ice

C. Quartz

D. Dry ice

Answer: C

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2. Total volfume of atoms present in a face centered cubic unit cell of a metal is : (r = atomic radius).

A. $\dfrac{12}{3}\pi r^3$

B. $\dfrac{16}{3}\pi r^3$

C. $\dfrac{20}{3}\pi r^3$

D. $\dfrac{24}{3}\pi r^3$

Answer: B

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3. The fraction of the total volume occupied by the atoms present in a simple cube is :

A. $\dfrac{\pi}{4}$

B. $\dfrac{\pi}{6}$

C. $\dfrac{\pi}{3\sqrt{2}}$

D. $\dfrac{\pi}{4\sqrt{2}}$

Answer: B

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4. Three element A,B and C crystallise into a cubic solid lattice . Atoms A occupies the corners B atoms , the cubic centres, and atoms C, the edges . The formula of the compound is :
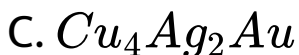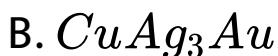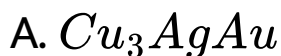
A. ABC

B. ABC_2

C. ABC_3

D. ABC_4

Answer: C

5. An alloy of copper , silver and gold is found to have copper forming the simple cubic close packed lattice . If silver atoms occupy the corners a dn gold atoms are present at the body centres , the formula of the alloy will be :

A. Cu_3AgAu

B. $CuAg_3Au$

C. Cu_4Ag_2Au

D. $CuAgAu.$

Answer: B

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6. A Solid compound XY has NaCl structure . If the radius of the cation is 100 pm, the radus of the anion (Y^-) will be :

A. 275.1 pm

B. 322.5 pm

C. 241.5pm

D. 165.7 pm

Answer: C

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7. The number of atoms is 100g of the fcc crystal with density $= 10g/cm^3$, and the cell edge edge equal to 200pm is equal to :

A. 5×10^{24}

B. 5×10^{24}

C. 6×10^{24}

D. 2×10^{25}

Answer: A

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8. Which of the following statement is not ture about amorphous solids ?

A. On heating they may becomes crystalline at certain tempertaure .

B. They may become crystalline or keeping for long time .

C. Amorphous solids can be moulded by heating .

D. They are anisotropic in nature .

Answer: D

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9. The sharp melting point of crystalline solids is due to :

A. a regular arrangement of constituent particles observed over a short distance in the crystal lattice .

B. a regular arragement of constituent particles observed over a long distance in the crystal lattice

C. same arragment of constituent particles in different directions

D. different arrangement of constituent particles in different directions .

Answer: B

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10. Iodine molecules ar held in the crystal lattice by :

A. London farces

B. dipole - dipole interaction

C. covlent bonds

D. columbic forces

Answer: A

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11. Which of the following is a network solid ?

A. SO_2 (solid)

B. I_2

C. diamond

D. H_2O (ice)

Answer: C

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12. Which of the folloiwng solids is not an electrical conductor ?

(i) Mg (s) (ii) TiO (s)

(iii) $I_2(S)$ (iv) H_2O (ice)

A. (i) only

B. (ii) only

C. (iii)and (iv)

D. (ii), (iii) and (iv)

Answer: C

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13. The lattice sites in a pure crystal cannot be occupied by :

A. molecule

B. ion

C. electron

D. atom

Answer: C

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14. Cations are present in interstitial sites in :

A. Frankel defect

B. Schottky defect

C. Valency defect

D. Metal deficiency defect

Answer: A

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15. Schottky defect in obtained in crystal when

:

A. Some cation move form their lattice

sites to interstitial sites .

B. equal number of cations and anions are

   missing from the lattice .

C. Some lattice sites are occupied by

   electrons.

D. Some impurity is present in the lattice .

Answer: B

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16. The total number of tetrahedral void in the face centered unit cell is :

A. 6

B. 8

C. 10

D. 12

Answer: B

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17. Which of the folloiwng statements is not ture about hexagonal close packing ?

A. The coordination number is 12 .

B. It has 74% packing efficiency .

C. Tetrahedral voids of the second layer are coverd by shperes of the third layer .

D. In this arragement sppheres of the fourth layer are exactly aligned with those of the first .

Answer: D

18. What is the coordination number in square close packed structure in two dimension ?

A. 2

B. 3

C. 4

D. 6

Answer: C

19. The correct order to packing efficiency in different type of unit cell is :

    A. fcc $<$ bcc $<$ simple cubic

    B. fcc $>$ bcc $>$ simple cubic

    C. fcc $<$ bcc $>$ simple cubic

    D. bcc $<$ fcc $>$ simple cubic

Answer: B

20. In cubic close packing , the unit cell has :

A. 45 tetrahedral voids each of which is shared by adjacent unit cells.

B. 4 tetrahedral voids within the unit cell cell.

C. 8 tetrahedral viods each of which is shared by four adjacent unit cells.

D. 8 tetrahedral voids within the unit cells.

Answer: D

21. KCl crystallise in the same type of lattice as does NaCl. Given that r_{Na+}/R_{Cl-} is 0.55 and r_{K+}/r_{Cl-} is 0.74, Calculate the ratio of the side of the unit cell of KCl and NaCl.

A. 1.123

B. 0.891

C. 1.414

D. 0.414

Answer: A

22. Ice crystallise in a hexagonal lattice having a volume of the unit cell is $132 \times 10^{-24} cm^3$. It density of ice at the given temperature is $0.92 g cm^{-3}$, then number of H_2O molecules per unit cell is :

A. 1

B. 2

C. 3

D. 4

Answer: D

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23. The edge length of face centered cubic unit

it cell is 508 pm . If the radius of the cation is

110 gm , the radius of the anion will be :

A. 144 pm

B. 288 pm

C. 618 pm

D. 398 pm

Answer: A

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24. Which of the following statements is not correct ?

A. The fraction of the total volume occupied by the atoms in a primitive cell is 0.48.

B. Molecular solids are generally volatile.

C. The number of carboon atoms in a unit cell of diamod is 4 .

D. The number of bravis lattice in which a crystal can be categorised to it .

Answer: C

25. Assertion (A) : Hexagonal close packing is more closely packed than cubic close packing .

Reason (R) : Hexagonal close packing has a coordination number 12 wherease the cubic close packing has a cooordination number 8 .

A. If both assertion and reason are ture and reason is the correct explanation of assertion .

B. If both assertion and reason are ture and reason, is not the correct explaintion of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false .

Answer: D

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26. Assertion (A) : Frankel defect are shown by silver halides .

Reason (R) : Ag^+ ion is smaller in size .

A. If both assertion and reason are true and reason is the correct explanation of assertion .

B. If both assertion and reason are true , and reason is not the correct explanation of assertion .

C. If assertion is true but reason is false .

D. If both assertion and reason are false .

Answer: A

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1. Why are solids rigid ?

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2. Classify the following as amorphous or crystalline solids .

Polyurethane, naphthalene , benzoic acid teflon, potassium nitrate , cellophone , polyvinyl chloride fibre glass , copper .

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3. Explain why glass is considered as an amorphous solids.

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4. Classify the following solids in different categories based on the nature of inter molecular forces operating in than :

potassium sulphate , tin , benzene, urea , ammonia water, zinc sulphate , rubidium , argon, silicon carbide .

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5. Ionic solids conduct electricity in the molten state but not in slids state. Explain.

6. Briefly outline the properties of covalent solids .

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7. What are covalent solids ? Give example .

 ▶ View Text Solution

8. What are molecular solids ? Give example .

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9. Explain various types of molecular solids with example .

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10. Explain the types of attraction that exist (i) non polar molecular solids , (ii) polar

molecular solids , (ii) hydrogen bonded moleculare solids .

11. What are the characteristics of metallic solids ? What type of attraction forces that exist among the constituent particels ?

12. Given example for metallic solids .

13. Define the following : (i) Lattice point (ii) Crystal lattice , (ii) Unit cell.

14. What are the characteristices of a unit cell ?

15. Briefly explain how constituent particles are arranged in (i) simple cubic, (ii) body centered cubic and (iii) face centered cubic unit cells.

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16. Distingusih between primitive and non primitive unit cells.

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17. Define co -ordination number ? What is the coordination number of each constituent particle present at (i) simple cubic , (ii) body centered cubic and (iii) face centered cubic unit cell ?

18. Explain how will you calculate the number of particle in a unit cell.

19. Calculate the number of particle present in (i) simple cubic (ii) body centered and (iii) face centered unit cells.

20. A compound formed by elements A and B has a cubic structure in which A atoms are at the corners and B atoms are at face centers. Derive the formula fo the compound.

21. A cubic solid is made up of two elements X and Y. Atoms 'Y' are present at the corners of the cube and atoms X at the body centers. What is the formula of the compound ? What are the coordination numbers of X and F ?

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22. A compound formed by elements X and Y crystallise in the cubic strcuture where Y

atoms are at the corners of the cube and X atoms are at alternate faces. What is the formula of the compound ?

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23. Give the expression to find out the inter planar distance (d) between two successive plane of atoms.

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24. X-rays of wave length 1.54Å strike a crystal and are observed to be deflected at an angle $22.5°$. Assuming that n = 1 , calculate the spacing between the planes of atom that are responsible for this reflection .

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25. Derive an expression to find the density of a crystal form lattice parameters.

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26. The edge length of a unit cell is 408 pm . Its density is $10.6 gcm^{-3}$. Predict whether the metal is body cenetred , or simple cubic .

Molar mass of the metal $= 107.9 gmol^{-1}$ and $N_A = 6.023 \times 10^{23}$.

27. An element crystallises in bcc structure the edge length of its unit cell is 288 pm . The

density of the crystal is $7.2 gcm^{-3}$. What is the atomic mass of the element ?

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28. A metallic element exists as body centered cubic lattice . Each edge of the unit cell is 2.88pm. The density of the metal is $7.2 gcm^{-3}$. How many atoms and unit cells are there in 100 g of the atom ?

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29. The density of a face centered cubic element is $6.25 gcm^{-3}$. Calculate the length of the unit cell . (Atomic mass of the element = 60.2 amu).

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30. KBr has NaCl type structure . What is the distance between K^+ and Br^- in KBr^- if the density is $2.75 gcm^{-3}$?

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31. Derive an expression to calculate the packing efficiency in a simple cubic arrangement.

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32. Show that the packing efficiency in face centered cubic unit cell is 74%.

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33. Given the relationship between the nearest neighbour distance (d) and the edge (a) of the unit cell of a cubic crystal.

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34. Give the relationship between atomic radius (r) , (which is d/2 for crystals of pure substance), and edge (a) of the unit cell of a cubic crystal.
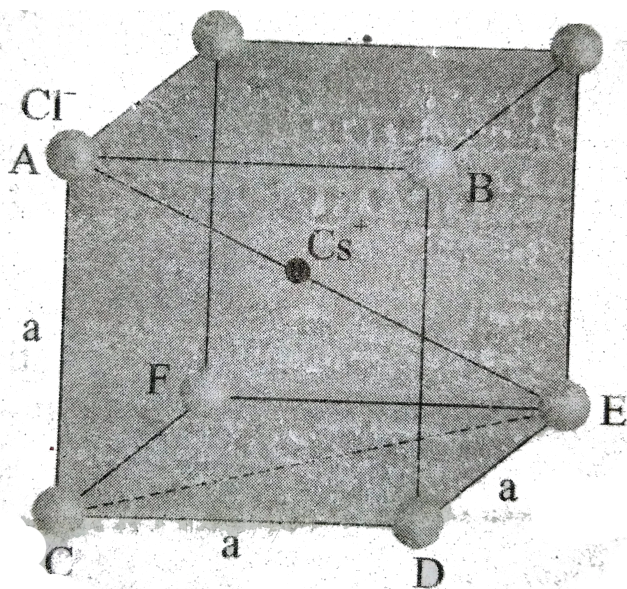
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35. Xenon crystallise in face centered cubic lattice and edge of the unit cell is 620 pm . What is the nearest neigbour distance and what is the radius of xenon atom.

36. CsCl has bcc arrangement and its unit cell edge length is 400 pm . Calculate the inter

ionic distance in CsCl.

37. If the radius of the atom is 75 pm and the lattice type is body centered cubic ,what is the edge of the unit cell ?

38. The radius of an atom of an elements is 500 pm. If it crystallises as fcc lattice , what is the length of the side of the unit cell ?

39. A solid AB has CsCl strcture . The edge length of the unit cell is 404 pm. Calculate the

distance of closet approach between A^+/B^- ions.

40. What is radius ratio ? Mention its importance.

41. What is the meaning of the term imperfection in solids ?

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42. What is the meaning of the term imperfection found in crystals ?

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43. What are interstitials in a crystal ?

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44. What is Schottky defect ?

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45. What is Frenkel defect ?

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46. Which crystal defect lower the density of the solid ?

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47. Which crystal defect in crystals does not alter the density of a relevant solid ?

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48. Which point defect increase the density of the solid ?

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49. Which point defect in the crystal increase the density of the solid ?

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50. Name one solid in which both Frenkel and Schottky defects occur.

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51. Why does Frenkel defect does not change the density of AgCl crystal ?

52. What are F. Centres ?

53. What are non stoichiometric defect ?

54. Why does table salt,NaCl appear yellow in colour ?

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55. Why is FeO (s) not formed in stoichiometric composition ?

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56. How would you account for the following ?

(i) Frenkel defects are not found in alkali metal halides.

(ii) Schottky defect lower the density of the solid .

(iii) Impurity doped silicon is a semi conductor.

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57. Briefly explain metal excess defect.

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58. Briefly explain metal deficiency defect .

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59. Briefly explain impurity defect.

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