Solid State Important Questions With Answers

NEET Chemistry 2023

1. A metal X crystallises in a face-centred cubic arrangement with the edge length 862 pm. What is the shortest separation of any two nuclei of the atom?
   a) 406 pm b) 707 pm c) 862 pm **d) 609.6 pm**

   Solution : -
   For fee arrangement, distance of nearest neighbour (d) is $\frac{a}{\sqrt{2}} = \frac{862}{1.414} = 609.6pm$

2. An electron trapped in an anion site in a crystal is called
   a) F-centre b) Frenkel defect c) Schottky defect d) interstitial defect

   Solution : -
   F-centres are electron trapped anion site which are responsible for colour.

3. The number of atoms contained in a facc unit cell of a monoatomic substance is
   a) 4 b) 6 **c) 8** d) 3

   Solution : -
   The no. of atoms is a unit cell may be calculated by the formula
   $Z = \frac{n_c}{8} + \frac{n_b}{1} + \frac{n_f}{2} + \frac{n_c}{4}$

4. In the solid state, MgO has the same structure as that of sodium chloride. The number of oxygens surounding each magnesium in MgO is
   a) 6 b) 1 c) 2 d) 4

   Solution : -
   Since MgO has a rock salt structure. In this structure, each cation is surrounded by six anions and vice versa

5. The edge length of fee cell is 508 pm. If radius of cation is 110 pm, the radius of anion is
   a) 110 pm b) 220 pm c) 285 pm **d) 144 pm**

   Solution : -
   For fcc,
   $2(r_+ + r_-)=a$
   $2(110+r_-)=580$
   $r_-=580/2-110=144$ pmx

6. An element crystallises into a structure which may be described by a cubic type of unit cell having one atom on each corner of the cube and two atoms on one of its diagonals. If the volume of this unit cell is 24×10^{-24} cm and density of element is 7.2 g cm^{-3} the number of atoms present in 200 g of element is:
   a) 3.5×10^{24} b) 5.7×10^{23} c) 6.3×10^{20} d) 1×10^{10}

   Solution : -
   No. of atoms in unit cell = 1 + 2 = 3
   Volume of unit cell = 24×10^{-24} cm^3
   Density = 7.2 g cm^{-3}

∵ Density= $\frac{n \times at.wt}{V \times N_A}$

$\therefore 7.2 = \frac{3 \times at.wt}{24 \times 10^{-24} \times 6.023 \times 10^{23}}$

∴ At.wt=34.69

∵ 34.69g has no.of atoms = 6.023 x 10^{23}

200g has no.of atoms $= \frac{6.023 \times 10^{23} \times 200}{34.69}$

$= 3.4722 \times 10^{24} atoms \approx 3.5 \times 10^{24} atoms$

7. A ferromagnetic substance becomes a permanent magnet when it is placed in a magnetic field because
   a) all the domains get oriented in the direction of magnetic field
   b) all the domains get oriented in the direction opposite to the direction of magnetic field
   c) domains get oriented randomly d) domains are not affected by magnetic field

8. With which one of the following elements silicon should be doped so as to give p-type of semiconductor?
   a) Selenium **b) Boron** c) Germanium d) Arsenic

   Solution : -

   If Si is doped with any of the element of group III (B, Al, Ga, In, Th) of the periodic table, p-type semiconductor will be obtained

9. In zinc blende structure
   a) each S^{2-}ion is surrounded by six Zn^{2+}ions b) it has fcc structure
   c) zinc ions occupy half of the tetrahedral sites d) each Zn^{2+} ion is surrounded by six sulphide ions

   Solution : -

   ZnS has a eep structure. S^{2-} ions are present at the corners of the cube and centre of each face. Zn^{2+} ions occupy half of the tetrahedral sites. Each Zn^{2+} ion is surrounded by four S^{2-} ions and each S^{2-} ion is surrounded by four Zn^{2+} ions.

10. Graphite cannot be classified as _____ .
    a) conducting solid b) network solid c) covalent solid **d) ionic solid**

11. An element crystallises in a structure having a fcc unit cell of an edge 200 pm. If 200 g of this element contains 24 x 10^{23} atoms then its density is:
    a) 41.66 g cm^{-3} b) 313.9 g cm^{-3} c) 8.117 g cm^{-3} d) 400 g cm^{-3}

    Solution : -

    Molar mass of the element

    $\frac{200}{24 \times 10^{23}} \times 6.023 \times 10^{23} = 50.19$ g mol^{-1}

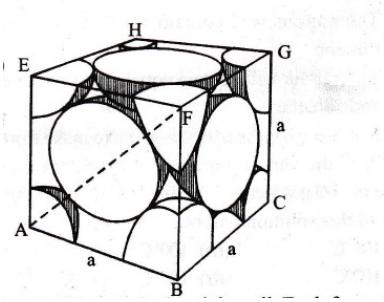
    For fcc, $Z = 4, V = a^3 = (200 \times 10^{-10})^3$

    $d = \frac{Z \times M}{N_A \times V} = \frac{4 \times 50.19}{6.023 \times 10^{23} \times (200 \times 10^{-10})^3}$

    = 41.66 g cm^{-1}

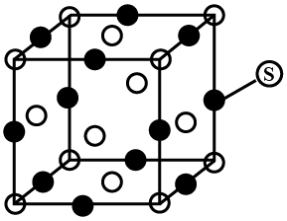
12. In face-centred cubic lattice, a unit cell is shared equally by how many unit cell?
    a) 2 b) 4 **c) 6** d) 8

    Solution : -



Above cubic is an isolated fcc cell. Each face of the cell is common to two adjacent cells. Thus, each face-centre atom contributes only half of its volume and mass to one cell. Arranging six cells each sharing the remaining half of the face centered atoms, constitutes/cc cubic lattice e.g.. Cu and Al.

13. For the structure given below the site marked as S is a



a) tetrahedral void b) cubic void **c) octahedral void** d) none of these.

Solution : -

Octahedral voids occupy the position of edge centre and body centre.

14. Assertion: Frenkel defect is also called dislocation defect.
Reason: Frenkel defect is shown by ionic substances in which cation and anion are of almost similar sizes.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but 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

Solution : -

Frenkel defect is called dislocation defect because smaller ion (generally the cation) is dislocated from its normal site to an interstitial site. It is shown by ionic substances in which there is large difference in the size of ions e.g. ZnS, AgCl.

15. Assertion: A tetrahedral void is surrounded by four spheres and an octahedral void is surrounded by six spheres.
Reason: The number of tetrahedral voids is double the number of close packed spheres and number of octahedral voids is equal to number of close packed spheres
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but 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

Solution : -

Tetrahedral voids are called so because a tetrahedron is formed when the centres of the four spheres are joined, while octahedral voids form octahedron when centres of surrounding six spheres are joined.

16. Assertion : Metals are good conductors of electricity.
Reason: Metals conduct electricity in solid as well as in molten state.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but 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

Solution : -

Metals have partially filled valence bands or overlapping valence and conduction band, hence electrons can flow easily under an applied electric field

17. What type of stoichiometric defect is shown by ZnS?

a) Schottky defect **b) Frenkel defect** c) Both Frenkel and Schottky defects d) Non-stoichiometric defect

18. Which of the following crystals does not exhibit Frenkel defect?
    a) AgBr b) AgCl **c) KBr** d) ZnS
19. NaCl type crystal (with coordination no. 6: 6) can be converted into CsCl type crystal (with coordination no. 8: 8) by applying
    a) high temperature **b) high pressure** c) high temperature and high pressure
    d) low temperature and low pressure.

    Solution : -

    Increase of pressure increases coordination number. Hence, by applying high pressure, NaCl type crystal can be changed into CsCl type crystal.
20. Which of the following statements is not correct about hexagonal close packing?
    a) In hcp, atoms occupy 74% the available space
    b) It is AB AB type packing in which third layer is aligned with the first layer.
    c) Be, Mg, Mo etc. are found to have hcp structure **d) The coordination number is 6.**
21. Which of the following statements about the interstitial compounds is incorrect?
    a) They are chemically reactive b) They are much harder then pure metal
    c) They have higher melting points than the pure metal. d) They retain metallic conductivity.

    Solution : -

    In interstitial compounds compact atoms like H, B and centre into the non-viable sites between the packed atoms of crystalline metal. They keep metallic conductivity and are chemically inert.
22. What is the coordination number in a square close packed structure in two dimensions?
    a) 2 b) 3 **c) 4** d) 6
23. The major binding force in diamond, silicon and quartz is
    a) electrostatic force b) electrical attraction **c) covalent bond force** d) van der Waals force
24. Ionic solids conduct electricity in molten state but not in solid state because
    a) in molten state free ions are furnished which are not free to move in solid state
    b) in solid state ionic solids are hard, brittle and become soft in molten state
    c) all solids conduct electricity in molten state
    d) in solid state ions are converted to atoms which are insulators.

    Solution : -

    Ionic solids conduct electricity in molten state since in molten state ionic solids dissociate to give free ions which in solid state are not free to move and are held together by strong electrostatic forces of attraction.
25. Which of the following will have metal deficiency defect?
    a) NaCl **b) FeO** c) KCl d) ZnO

    Solution : -

    FeO is mostly found with a composition of $Fe_{0.95}O$.(Ranges from $Fe_{0.93}O$.- $Fe_{0.96}O$) In crystals of FeO, some Fe^{2+} cations are missing and the loss of positive charge is made up by the presence of the required number of Fe^{3+} ions.
26. Which of the following statements is not true?
    a) Paramagnetic substances are weakly attracted by magnetic field.
    b) Ferromagnetic substances cannot be magnetised permanently.
    c) The domains in antiferromagnetic substances are oppositely oriented with respect to each other.
    d) Pairing of electrons cancels their magnetic moment in the diamagnetic substances.
27. Assertion: Iron, cobalt, nickel and CrO_2 are called ferromagnetic substances.
    Reason : Ferromagnetic substances are weakly attracted by magnetic field

a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but 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

Solution : -

Ferromagnetic substances are strongly attracted by magnetic field and they can be permanently magnetised.

28. A compound MpXq has cubic close packing (eep) arrangement of X. Its unit cell structure shown below. The empirical formula of the compound is:
a) MX **b) MX_2** c) M_2X d) M_5X_{14}

Solution : -

8 X atoms present at the corners. Atoms contribute to 1 unit cell = 1/8 x 8 = 1 6 X atoms present at the face centres Atoms contribute to 1 unit cell = 6 x 1/2 = 3 Total X atoms = 3 + 1 = 4 4 M atoms present at edge centres Atoms present in 1 unit cell = 4 x 1/4 = 1 1 M atom present at body centre and it contribute completely to 1 unit cell. Thus, total M atoms in one unit cell = 1 + 1 = 2 Ratio is M: X :: 2: 4 :: 1: 2 Thus, empirical formula is MX2.

29. Iron exhibits bee structure at room temperature. Above 900°C, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C(assuming molar mass and atomic radii of iron remains constant with temperature) is :
a) $\frac{3\sqrt{3}}{4\sqrt{2}}$ b) $\frac{4\sqrt{3}}{3\sqrt{2}}$ c) $\frac{\sqrt{3}}{\sqrt{2}}$ d) $\frac{1}{2}$

Solution : -

BCC FCC

4r=$\sqrt{3a}$ 4r=$\sqrt{3a}$

a=$\frac{4r}{\sqrt{3}}$ a=$\frac{4r}{\sqrt{2}}$

$$\frac{d_{BCC}}{d_{FCC}} = \frac{\frac{Z_{BCC}\times M}{N_A a^3}}{\frac{Z_{FCC}\times M}{N_A a^3}} = \frac{\frac{2\times M}{N_A\left(\frac{4r}{\sqrt{3}}\right)^3}}{\frac{4\times M}{N_A\times\left(\frac{4r}{\sqrt{2}}\right)^3}} = \frac{3}{4}\sqrt{\frac{3}{2}}$$

So, the correct answer is (a).

30. The edge length of sodium chloride unit cell is 564 pm. If the size of Cl^- ion is 181 pm. The size ofNa^+ ion will be
a) 101 pm b) 181 pm c) 410 pm d) 202 pm

Solution : -

$2(r_+ + r_-) = a$

$2(r_{Na^+} + rCl^-) = 564$ pm

$r_{Na^+} = \frac{564}{2} - 181 = 101pm$

31. The distance between Na^+ and Cl^- ions in NaCl with a density 3.165 g cm^{-3} is
a) 497 pm **b) 248.5 pm** c) 234 pm d) 538.5 pm

Solution : -

$d = \frac{Z\times M}{a^3\times N_A}$

$a^3 = \frac{Z\times M}{d\times N_A} = \frac{4\times 58.5}{3.165\times 6.023\times 10^{23}}$

$a^3 = 122.77\times 10^{-24} cm^3$

a=4.97x10^{-8} cm or 497pm

D·istance between Na^+ and Cl^-=$\frac{a}{2} = \frac{497}{2}$=248.5 pm

32. Which type of crystals contains more than one Bravais lattice?
a) Hexagonal b) Triclinic c) Rhombohedral **d) Monoclinic**

Solution : -

Monoclinic crystals have two Bravais lattices- Primitive and end centred

33. Which of the following solids is the structure of CsCl crystal?

a) Body centred cubic b) Simple cubic c) Face centred cubic d) Edge centred cubic

Solution : -

CsCl has structure with Cl^- ions at the corners and Cs^+ at the centre of the cube

34. Which of the following point defects are shown by $AgBr_{(s)}$ crystals?

(I) Schottky defect

(II) Frenkel defect

(III) Metal excess defect

(IV) Metal deficiency defect

a) (I) and (II) b) (III) and (IV) c) (I) and (III) d) (II) and (IV)

Solution : -

Schottky and Frenkel defects are shown by $AgBr_{(s)}$ crystals.

35. In a Schottky defect,

a) an ion moves to interstitial position between the lattice points b) electrons are trapped in a lattice site

c) some lattice sites are vacant **d) some extra cations are present in interstitial spaces**

36. The conductivity of intrinsic semiconductors can be increased by adding a suitable impurity. This process is called (P). This can be done with an impurity which is (Q) rich or deficient as compared to the semiconductor. Such impurities introduce(R) defects in them. Electron rich impurities result in (S) type semiconductors while electron deficit impurities result in (T) type semiconductors

a)

P	Q	R	S	T
doping	proton	point	p	n

b)

P	Q	R	S	T
doping	electron	non-stoichiometric	p	n

c)

P	Q	R	S	T
energy gap	charged	impurity	n	p

d)

P	**Q**	**R**	**S**	**T**
doping	**electron**	**electronic**	**n**	**p**

37. Schottky defect in crystals is observed when

a) an ion leaved its normal site and occupies an interstitial site

b) unequal number of cations and anions are missing from the lattice c) density of the crystal is increased

d) equal number of cations and anions are missing from the lattice

Solution : -

If in an ionic crystal of the type A^+, B^-, equal number of cations and anions are missing from their lattice sites so that the electrical neutrality is maintained. The defect is called the Schottky defect.

38. Which of the following statements is true about semiconductors?

a) Impurity of lower group creates n-type semiconductors.

b) Impurity of higher group creates p-type semiconductors

c) Extrinsic semiconductors are formed by doping impurity

d) Intrinsic semiconductors become conductors when temperature is raised

Solution : -

Intrinsic semiconductors are insulators at room temperature and become semiconductors when temperature is raised.

39. Which of the following metal oxides is antiferromagnetic in nature?

a) MnO_2 b) TiO_2 c) NO_2 d) CrO_2

40. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} l m and 1.81×10^{-10} m. The coordination number of each ion in AB is :

a) 8 b) 2 **c) 6** d) 4

Solution : -

From radius radio, $\frac{r_+}{r_-} = \frac{0.98\times10^{-10}}{1.81\times10^{-10}}$ =0.541

It lies in the range of 0.414 to 0.732 hence coordination number of each ion will be 6 as the compound will have NaCl type structure i.e., octahedral arrangement.

41. The lattice site in a pure crystal cannot be occupied by

a) molecule b) ion **c) electron** d) atom

Solution : -

Lattice sites in a pure crsytal are occupied by the constituent units like atoms, molecules, ions but not occupied by electrons._____

42. AB crystallizes in a body-centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is:

a) 335pm b) 250pm c) 200pm d) 300pm

Solution : -

For a body centered cubic lattice.

$2(r_+ + r_-) = \sqrt{3a}$

$\therefore (r+ + r-) = \frac{\sqrt{3a}}{2} = \frac{\sqrt{3a}\times387}{2}$

=335.142 pm≈335 pm

43. Pure silicon and germanium behave as

a) conductors b) semiconductors **c) insulators** d) piezoelectric crystals.

Solution : -

Pure Si and Ge are insulators because of the absence of any hole or free electron. They show semiconductor behaviour only after doping

44. Cation and anion combine in a crystal to form following type of compound:

a) ionic b) metallic c) covalent d) dipole-dipole.

Solution : -

The electrostatic force of attraction which exists between oppositely charged ions is called as ionic bond.

45. A solid compound XY has NaCl structure. If the radius of the cations is 100 pm, the radius of the anion (Y)will be:

a) 275.1 pm b) 322.5 pm **c) 241.5 pm** d) 165.7 pm

Solution : -

Know that, Radius of NaCl like crystal

$\Rightarrow \frac{r^+}{r^-} = 0.414$

Hence the radius of anions r^-

$r^- = \frac{100}{0414} = 241.5\text{pm}\,(r^+ = 100)$

46. A metal crystallises into a lattice containing a sequence of layers as AB AB AB _____What percentage of voids are left in the lattice?

a) 72% b) 48% **c) 26%** d) 32%

Solution : -

AB AB packing is hexagonal close packing in which all atoms occupy 74% of the total space. Hence, 26% of the space is empty or voids

47. An element with atomic mass 100 has a bee structure and edge length 400 pm. The density of element is:

a) 10.37 g cm^{-3} b) 5.19 g cm^{-3} **c) 7.29 g cm^{-3}** d) 2.14 g cm^{-3}

Solution : -

$d = \frac{Z \times M}{a^3 \times N_A} = \frac{2 \times 100}{(400 \times 10^{-10}) \times 6.023 \times 10^{23}}$

$5.188 g \quad cm^{-3}$

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

a) $\frac{\pi}{4}$ **b)** $\frac{\pi}{6}$ c) $\frac{\pi}{3\sqrt{2}}$ d) $\frac{\pi}{4\sqrt{2}}$

49. In which of the following structures coordination number for cations and anions in the packed structure will be same?

a) Cl^- ions form fee lattice and Na^+ ions occupy all octahedral voids of the unit cell

b) Ca^{2+} ions form fcc lattice and F^- ions occupy all the eight tetrahedral voids of the unit cell

c) O2- ions formfee lattice and Na^+ ions occupy all the eight tetrahedral voids of the unit cell

d) S^{2-} ions form fee lattice and Zn^{2+} ions go into alternate tetrahedral voids of the unit cell.

Solution : -

In NaCl type unit cell, all cations and anions have a coordination number of 6.

50. A metal has a fcc lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72 g cm^{-3}. The molar mass of the metal is: (N_A Avogadro's contant = 6.02 x 10^{23} mol^{-1})

a) 27 g mol^{-1} b) 20 g mol^{-1} c) 40 g mol^{-1} d) 30 g mol^{-1}

Solution : -

$\rho = \frac{zM}{N_A a^3} \Rightarrow M = \frac{\rho \times N_A \times a^3}{z}$

$M = \frac{2.72 \times 6.023 \times 10^{23} \times (404 \times 10^{-10})^3}{4}$

$= 26.99 = 27$ g mol^{-1}