Consolidated Test-5
Solid State and Solutions
2021-22

10-10-2021

Name:

Mobile No:

Write your answer in the boxes provided.
Test Duration: **3hrs**

1. In a compound, atoms of element Y form ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. The formula of the compound will be:

(A) X_4Y_3 (B) X_2Y_3 (C) X_2Y (D) X_3Y_4

2. If AgI crystallises in zinc blende structure with I^- ions at lattice points, what fraction of tetrahedral voids is occupied by Ag^+ ions?

(A) 25% (B) 50% (C) 100% (D) 75%

3. Total volume of atoms present in a face centred cubic unit cell of a metal is (r is atomic radius)

(A) $\frac{16}{3}\pi r^3$ (B) $\frac{20}{3}\pi r^3$ (C) $\frac{24}{3}\pi r^3$ (D) $\frac{12}{3}\pi r^3$

4. The edge lengths of the unit cells in terms of the radius of spheres constituting fcc, bcc and simple cubic unit cell respectively are

(A) $2\sqrt{2}\,r, \frac{4r}{\sqrt{3}}, 2r$ (B) $\frac{4r}{\sqrt{3}}, 2\sqrt{2}\,r, 2r$

(C) $2r, 2\sqrt{2}\,r, \frac{4r}{\sqrt{3}}$ (D) $2r, \frac{4r}{\sqrt{3}}, 2\sqrt{2}\,r$

5. AB crystallises 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) 335 pm (B) 250 pm (C) 200 pm (D) 300 pm

6. CsBr crystal has bcc structure. It has an edge length of $4.3\,\text{Å}$. The shortest interionic distance between Cs^+ and Br^- ions is

(A) 1.86 Å (B) 2.86 Å (C) 3.72 Å (D) 4.72 Å

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

(A) $\frac{2}{\sqrt{3}}a$ (B) $\frac{4}{\sqrt{3}}a$ (C) $\frac{\sqrt{3}}{4}a$ (D) $\frac{\sqrt{3}}{2}a$

8. A given metal crystallises out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?

(A) 40 pm (B) 127 pm (C) 80 pm (D) 108 pm

9. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion (Ca^{2+}) and fluoride ion (F^-) are _____ respectively.

(A) 4 and 2 (B) 6 and 6
(C) 8 and 4 (D) 4 and 8

10. The Ca^{2+} and F^- are located in CaF_2 crystal respectively at body centred cubic lattice points and in

(A) tetrahedral voids (B) half tetrahedral voids
(C) octahedral (D) half of octahedral voids

11. The ionic radii of Rb^+ and I^- are 1.46 Å and 2.16 Å. The most probable type of structure exhibited by it is

(A) CsCl type (B) ZnS type
(C) NaCl type (D) CaF_2 type

12. Which is the incorrect statement?

(A) $FeO_{0.98}$ has non-stoichiometric metal excess defect.

(B) Density decreases in case of crystals with Schottky's defect.

(C) NaCl(s) is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.

(D) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.

13. An element occurring in the bcc structure has 12.08×10^{23} unit cells. The total number of atoms of the element in these cells will be

(A) 6.04×10^{23} (B) 12.08×10^{23}

(C) 24.16×10^{23} (D) 36.18×10^{23}

14. In a solid AB, 'A' atom occupy only the corners of the cubic unit cell and if 'B' occupies face centered positions and all the face-centred atoms along one of the axis are removed, then resultant stoichiometry of the solid is

(A) AB_2 (B) A_2B (C) A_4B_3 (D) A_3B_4

15. How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1.00 g? (atomic masses; Na= 23, Cl= 35.5)

(A) 1.28×10^{21} unit cells (B) 1.71×10^{21} unit cells

(C) 2.57×10^{21} unit cells (D) 5.14×10^{21} unit cells

16. Each rubidium halide crystallising in the NaCl-type lattice has a unit cell length 0.30 Å greater than that for corresponding potassium salt $\left(r_{(K^+)} = 1.33 \text{ Å}\right)$ of the same halogen. Hence, ionic radius of Rb^+ is

(A) 1.18 Å (B) 1.48 Å (C) 1.63 Å (D) 1.03 Å

17. The cubic unit cell of a metal (molar mass = 63.55 g mol^{-1}) has an edge length of 362 pm. Its density is 8.92 g cm^{-3}. The type of unit cell is

(A) primitive (B) face centred

(C) body centred (D) end centred

18. Sodium crystallises in bcc arrangement with the interfacial separation between the atoms at the edge 53 pm. The density of the solid is

(A) 1.23 g/cc (B) 485 g/cc (C) 4.85 g/cc (D) 123 g/cc

19. A binary solid $\left(A^{+}B^{-}\right)$ has a zinc blende structure with B^{-} ions constituting the lattice and A^{+} ions occupying 25% tetrahedral holes. The formula of solid is

(A) A_2B (B) AB_2 (C) AB_4 (D) AB

20. Iron exhibits bcc 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) $\frac{1}{2}$

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

(A) Cl^{-} ions form fcc 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) O^{2-} ions form fcc lattice and Na^{+} ions occupy all the eight tetrahedral voids of the unit cell

(D) All of these

22. The correct order of the packing. efficiency in different types of unit cell is _____.

(A) fcc < bcc < simple cubic (B) fcc > bcc > simple cubic
(C) fcc < bcc > simple cubic (D) bcc < fcc > simple cubic

23. What is the coordination number in a square close-packed structure in two dimensions?

(A) 2 (B) 3 (C) 4 (D) 6

24. The vacant space in bcc lattice cell is

(A) 26% (B) 48% (C) 23% (D) 32%

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

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3\sqrt{2}}$ (C) $\frac{\pi}{4\sqrt{2}}$ (D) $\frac{\pi}{4}$

26. Persons are medically considered to have lead poisoning if they have a concentration of greater than $10\mu g$ of lead per decilitre of blood. Concentration in parts per billion is:

(A) 1000 (B) 100 (C) 10 (D) 1

27. The volume of water to be added to $100\ cm^3$ of $0.5\ (NH_4)_2SO_4$ to get decinormal concentration is

(A) $400\ cm^3$ (B) $450\ cm^3$ (C) $500\ cm^3$ (D) $100\ cm^3$

28. At a given temperature, total vapour pressure in torr of a mixture of a volatile components A and B is given by $p = 120 - 75\chi_B$ hence, vapour pressures of pure A and B respectively (in torr) are:

(A) 120, 75 (B) 120,195 (C) 120, 45 (D) 75,45

29. Mole fraction of the component A in vapour phase is χ_1 and mole fraction of component A in liquid mixture is χ_2 (p_A^o = vapour pressure of pure A; p_B^o = vapour pressure of pure B), then total vapour pressure of the liquid mixture is

(A) $\frac{p_A^o\chi_2}{\chi_1}$ (B) $\frac{p_A^o\chi_1}{\chi_2}$ (C) $\frac{p_B^o\chi_1}{\chi_2}$ (D) $\frac{p_B^o\chi_2}{\chi_1}$

30. A solution of sucrose (molar mass = $342\ g\ mol^{-1}$) has been prepared by dissolving 68.5 g of sucrose in 1000 g s of water. The freezing point of the solution obtained will be (K_f for water $= 1.86K\ kg\ mol^{-1}$)

(A) $-0.372°C$ (B) $-0.520°C$ (C) $+\ 0.372°C$ (D) $-0.570°C$

31. Of the following 1.10 m aqueous solutions which one will exhibit the largest freezing point depression?

(A) KCl (B) $C_6H_{12}O_6$ (C) $Al_2(SO_4)_3$ (D) K_2SO_4

32. A solution of urea (mol. mass 56 $g\,mol^{-1}$) boils at $100.18°C$ at the atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K $kg\,mol^{-1}$ respectively, the above solution will freeze at

(A) $-6.54°C$ (B) $6.54°C$ (C) $0.654°C$ (D) $-0.654°C$

33. Which one of the following statements is false?

(A) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction

(B) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$, where, M is the molarity of the solution

(C) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose

(D) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

34. A 5% solution of cane sugar (molar mass 342) is isotonic with 1% of a solution of an unknown solute. The molar mass of unknown solute in g/mol is

(A) 136.2 (B) 171.2 (C) 68.4 (D) 34.2

35. The van't Hoff factor, *i* for a compound which undergoes dissociation in one solvent and association in other solvent is respectively

(A) less than one and less than one

(B) greater than one and less than one

(C) greater than one and greater than one

(D) less than one and greater than one

36. At temperature $327°C$ and concentration C, osmotic pressure of a solution is *p*, the same solutions at concentration C/2 at $427°C$ shows osmotic pressure 2 atm, value of p will be

(A) $\frac{12}{7}$ (B) $\frac{24}{7}$ (C) $\frac{6}{5}$ (D) $\frac{5}{6}$

37. Water and chlorobenzene are immiscible liquids. Their mixture boils at $90°C$ under a reduced pressure of 7.82×10^4 Pa. The vapour pressure of pure water at $90°C$ is 7.03×10^4 Pa. On weight per cent basis, chlorobenzene in the distillate is equal to (molecular weight of chlorobenzene is $112.5\ g\ mol^{-1}$)

(A) 50 (B) 60 (C) 70 (D) 80

38. Relative decrease in vapour pressure of an aqueous solution containing 2 moles of $\left[Cu(NH_3)_2Cl\right]Cl$ in 3 moles of H_2O is 0.50. On reaction with $AgNO_3$ this solution will form

(A) 1 mol AgCl (B) 0.25 mol AgCl
(C) 2 mol AgCl (D) 0.40 mol AgCl

39. The boiling point of water is $100°C$. The vapour pressure of water at $25°C$ is 23 mm Hg and enthalpy of 18 vaporisation is $40.650\ kJ\ mol^{-1}$. What will be the temperature at which water will be boil, if atmospheric pressure become 23 mm Hg?

(A) 12.5 K (B) 51.6K (C) 298 K (D) 250 K

40. Ratio of $\Delta T_b / K_b$ of 6% A_2B and 9% A_2B (AB_2 and A_2B both are non-electrolytes) is 1 mol/kg in both cases. Hence, atomic masses of A and B are respectively.

(A) 60, 90 (B) 40, 40 (C) 40, 10 (D) 10, 40

41. A complex of iron and cyanide ions is 100% ionised at 1 m (molal). If its elevation in boiling point is 2.08K. $\left(K_b = 0.52\ K\ mol^{-1}\ kg\right)$ then the complex is

(A) $K_3\left[Fe(CN)_6\right]$ (B) $Fe(CN)_2$

(C) $K_4\left[Fe(CN)_6\right]$ (D) $Fe(CN)_4$

42. 25 mL of an aqueous solution of KCl was found to 20 mL of 1 M $AgNO_3$ solution when titrated using K_2CrO_4 as indicator. Depression in freezing point of KCl solution with 100 % ionisation will be
($K_f = 2.0°\ mol^{-1}\ kg$ and molarity = molality)

(A) $5.0°$ C (B) $3.2°$ C (C) $1.6°$ C (D) $0.8°$ C

43. Human blood gives rise to an osmotic pressure of approximately 7.65 atm at the body temperature $37°C$. Hence, molarity of an intravenous glucose solution to have the same osmotic pressure as blood should be

(A) 0.30 M (B) 0.20 M (C) 0.10 M (D) 0.50 M

44. The freezing point of an aqueous solution of urea is $-0.52°C$. If the molarity and molarity are same and K_f, for H_2O is equal to 1.86 K $molality^{-1}$, the osmotic pressure of solution would be

(A) 0.686 atm (B) 6.886 atm

(C) 68.86 atm (D) 688.6 atm

45. Consider the following cases

I. $2M\ CH_3COOH$ solution in benzene at $27°C$ where there is dimer formation to the efficient of 100%

II. 0.5 M KCl aq. solution at $27°C$ which ionises 100% which of the above is are true statements (s)?

Choose the correct option

(A) Both are isotonic (B) ll is hypertonic

(C) l is hypertonic (D) None of these

46. What will be the ratio of the messes o formation (HCHO) and glucose $\left(C_6H_{12}O_6\right)$ contained equal volumes of solutions having same osmotic pressure at the given temperature?

(A) 1:1 (B) 1:2 (C) 1:3 (D) 1:6

47. Calculate the mass of a non-volatile solute $\left(\text{molar mass } 40 \text{ g mol}^{-1}\right)$ which should be dissolved in 114 g octane to reduce its vapour pressure to 80%

(A) 20g (B) 10g (C)30g (D) 45g

48. The partial pressure of ethane over a solution containing 6.56×10^{-3}g of ethane is 1 bar. If the solution contains 5.00×10^{-2}g of ethane, then what should be the partial pressure of gas?

(A) 4.2 bar (B) 7.6 bar (C) 8.9 bar (D) 9.8 bar

49. An aqueous solution is 1.00 molal of KI. Which change will cause the vapour pressure of the solution to increase?

(A) Addition of NaCl (B) Addition of Na_2SO_4
(C) Addition of 1.00 molal Kl (D) Addition of water

50. K_H value for Ar, CO_2, HCHO and CH_4 are $40.39, 1.67, 1.83 \times 10^{-5}$ and 0.413 respectively. Arrange these gases in the order of their increasing solubility.

(A) $HCHO < CH_4 < CO_2 < Ar$ (B) $HCHO < CO_2 < CH_4 < Ar$
(C) $Ar < CO_2 < CH_4 < HCHO$ (D) $Ar < CH_4 < CO_2 < HCHO$