The Solid State + Solutions + Surface Chemistry

1. In a binary compound, atoms of element A form a hcp structure and those of elements M occupy $2/3$ 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

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. Metallic solid

   B. Ionic solid

   C. Molecular solid

   D. Covalent solid

3. 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 true but Statement II is false

   B. Both Statement I and Statement II are true

   C. Statement I is false but Statement II is true

   D. Both Statement I and Statement II are false

The Solid State + Solutions + Surface Chemistry

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

   A. ZnS

   B. $CsCl$

   C. $AgBr$

   D. KBr

5. An element crystallises in a face-centred cubic (fcc) unit cell with edge length a. The distance between the centres of two nearest octahedral voids in the crystal lattice is:

   A. a

   B. $\sqrt{2}a$

   C. $\frac{a}{\sqrt{2}}$

   D. $\frac{a}{2}$

6. 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:
   $\text{Avogadro constant } (N_A) = 6 \times 10^{23}\ mol^{-1})$

   A. $40\ N_A$

   B. $4\ N_A$

   C. $2\ N_A$

   D. $8\ N_A$

The Solid State + Solutions + Surface Chemistry

7. Which one of the following 0.06 M aqueous solution has lowest freezing point?

   A. KI

   B. $Al_2(SO_4)_3$

   C. $C_6H_{12}O_6$

   D. K_2SO_4

8. Which one of the following $0.10\ M$ aqueous solutions will exhibit the largest freezing point depression ?

   A. glycine

   B. $KHSO_4$

   C. hydrazine

   D. glucose

9. A set of solutions is prepared using $180\ g$ of water as a solvent and $10\ g$ of different non-volatile solutes $A,\ B\ and\ C$. The relative lowering of vapour pressure in the presence of these solutes are in the order [Given, molar mass of $A = 100\ g\ mo1^{-1}; B = 200\ g\ mol^{-1};\ C = 10,000\ g\ mol^{-1}$]

   A. $A > C > B$

   B. $C > B > A$

   C. $A > B > C$

   D. $B > C > A$

The Solid State + Solutions + Surface Chemistry

10. The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following processes can explain this?

    A. Osmosis

    B. Reverse osmosis

    C. Diffusion

    D. Dialysis

11. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non volatile solute are together sealed in a container. Over time:

    A. The volume of the solution and the solvent does not change

    B. The volume of the solution increases and the volume of the solvent decreases

    C. The volume of the solution does not change and the volume of the solvent decreases

    D. The volume of the solution decreases and the volume of the solvant increases.

12. At 35^oC, the vapour pressure of $CS_2\ is\ 512\ mm\ Hg$ and that of acetone is $344\ mm\ Hg$. A solution of CS_2 in acetone has a total vapour pressure of $600\ mm\ Hg$. The false statement amongst the following is

    A. Raoult's law is not obeyed by this system

    B. A mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL

    C. Heat must be absorbed in order to produce the solution at $35^\circ C$

    D. CS_2 and acetone are less attracted to each other than to themselves

The Solid State + Solutions + Surface Chemistry

13. Which one of the following statements is FALSE for hydrophilic sols ?

    A. Their viscosity is of the order of that of H_2O

    B. They do not require electrolytes for stability

    C. These sols are reversible in nature

    D. The sols cannot be easily coagulated

14. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is:

    A. Sometimes positive and sometimes negative

    B. Negative

    C. Neutral

    D. Positive

15. The INCORRECT statements below regarding colloidal solution is

    A. The flocculating power of Al^{3+} is more than that of Na^{+}

    B. A colloidal solution shows Brownian motion of colloidal particles.

    C. An ordinary filter paper can stop the flow of colloidal particles.

    D. A colloidal solution shows colligative properties.

16. A colloidal system consisting of a gas dispersed in a solid is called a/an:

    A. aerosol

    B. foam

    C. solid sol

    D. gel

The Solid State + Solutions + Surface Chemistry

17. Given below are two statements : one is labelled as
Assertion A and the other is labelled as Reason R.
Assertion A : $SO_2(g)$ is adsorbed to a larger extent than $H_2(g)$ on activated charcoal.
Reason R : $SO_2(g)$ has a higher critical temperature than $H_2(g)$.
In the light of the above statements, choose the most appropriate answer from the options given below.

    A. A is correct but R is not correct

    B. Both $A\ and\ R$ are correct but R is not the correct explanation of A

    C. A is not correct but R is correct

    D. Both A and R are correct and R is the correct explanation of A

18. Which one of the following is correct for the adsorption of a gas at a given temperature on a solid surface ?

    A. $\Delta H < 0,\ \Delta S < 0$

    B. $\Delta H > 0, \Delta S < 0$

    C. $\Delta H > 0, \Delta S > 0$

    D. $\Delta H < 0, \Delta S > 0$

19. Tyndall effect is more effectively shown by :

    A. Lyophobic colloid

    B. Lyophilic colloid

    C. True solution

    D. Suspension

The Solid State + Solutions + Surface Chemistry

20. The sol given below with negatively charged colloidal particles is :

    A. KI added to $AgNO_3$ solution

    B. $AgNO_3$ added toKI solution

    C. $Al_2O_3.xH_2O$ in water

    D. $FeCl_3$ added to hot water

21. A certain element crystallises in a bcc lattice of unit cell edge length $27\ \mathring{A}$. If the same element under the same conditions crystallises in the fcc lattice. The edge length of the unit cell in $\mathring{A}$will be _____ (Round off to the nearest integer.)
    [Assume each lattice point has a single atom]
    [Assume $\sqrt{3} = 1.73, \sqrt{2} = 1.41$]

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

23. 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_____

24. 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 : $N_A = 6.022 \times 10^{23}\ mol^{-1}$]

25. When 12.2 g benzoic acid is dissolved in 100 g of water , the freezing point of solution was found to be $-0.93^0C\ \left(K_f\left(H_2O\right) = 1.86\ K\ \ kg\ \ mol^{-1}\right)$. The number (n) of benzoic acid molecules associated (assuming 100% association) is

The Solid State + Solutions + Surface Chemistry

26. At 363 K , the vapour pressure of A is $21\ kPa$ and that of b is $18\ kPa$. 1 mol of A and 2 moles of B are mixed . Assuming that this solution is ideal , the vapour pressure of the mixture in kPa rounded off to the Nearest Integer is

27. The elevation of boiling point of $0.10\ m$ aqueous $CrC1_3.xNH_3$ solution is two times that of $0.05\ m$ aqueous $CaCl_2$, solution. The value of x is _____ [Assume 100% ionisation of the complex and $CaCl_2$, coordination number of $Cr\ is\ 6$, and that all NH_3 molecules are present inside the coordination sphere]

28. The osmotic pressure of a solution of $NaCl\ is\ 0.10\ atm$ and that of a glucose solution is $0.20\ atm$. The osmotic pressure of a solution formed by mixing $1\ L$ of the sodium chloride solution with $2\ L$ of the glucose solution is $x \times 10^{-3}\ atm.\ x$ is _____. (nearest integer)

29. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled. the value of n in the Freundlich isotherm equation is $x \times 10^{-2}$. The value of x (Round off to the Nearest integer)

30. CH_4, is adsorbed on $1\ g$ charcoal at $0^{\circ}C$ which follows the Freundlich adsorption isotherm. $10.0\ mL\ of\ CH_4$, is adsorbed at $100\ mm\ of\ Hg$, whereas $15.0\ mL$ is adsorbed at $200\ mm\ of\ Hg$. The volume of CH_4, adsorbed at $300\ mm\ of\ Hg$ is $10^x\ mL$. The value of x is_____$\times 10^{-2}$. (Nearest integer) $[Use\ log_{10}2 = 0.3010,\ log_{10}3 = 0.4771]$