Solutions Important Questions With Answers

NEET Chemistry 2023

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1. During dissolution when solute is added to the solvent, some solute particles separate out from the solution as a result of crystallisation. At the stage of equilibrium, the concentration of solute in the solution at given temperature and pressure

   a) increases b) decreases **c) remains constant** d) keeps changing.

   Solution : -

   At dynamic equilibrium, number of solute particles going into the solution will be equal to solute particles separating out. Hence, the concentration of solute in the solution remains constant.

2. The vapour pressures of ethanol and methanol are 44.5 mm Hg and 88.7 mm Hg respectively. An ideal solution is formed at the same temperature by mixing 60 g of ethanol with 40 g of methanol. The total vapour pressure of the solution and the mole fraction of methanol in the vapour are respectively.

   a) 43.46 mm and 0.51 **b) 66.15 mm and 0.657** c) 66.15 mm and 0.791 d) 70.59 mm and 0.657

   Solution : -

   We know, $P_{total}=P_1+P_2$

   Also $P_1=P_1^o \times x_1$ and $P_2=P_2^o \times x_2$

   x_1(mole fraction of CH_3OH) = $\frac{\frac{40}{32}}{\frac{40}{32}+\frac{60}{46}}$=0.49

   [Mol. wt. of CH_3OH = 32, Mol. wt. of C_2H_5OH = 46]

   x_2(mole fraction of C_2H_5OH) = $\frac{\frac{60}{46}}{\frac{40}{32}+\frac{60}{46}}$=0.51

   P_1= Partial vapour pressure of CH_3OH = 88.7 x 0.49 = 43.46 mm Hg

   P_2 = Partial vapour pressure of C_2H_5OH = 44.5 x 0.51 = 22.69 mm Hg

   P_{Total} = P_1 +P2 = (43.46 + 22.69) = 66.15 mm Hg

   Mole fraction of CH_3OH in vapour = $\frac{43.46}{66.15}$=0.657

3. On the basis of information given below mark the correct option.

   Information: On adding acetone to methanol some of the hydrogen bonds between methanol molecules break.

   a)

   At specific composition methanol-acetone mixture will form minimum boiling azeotrope and will show positive deviation from Raoult's law.

   b)

   At specific composition methanol-acetone mixture forms maximum boiling azeotrope and will show positive deviation from Raoult's law.

c)

At specific composition methanol-acetone mixture will form minimum boiling azeotrope and will show negative deviation from Raoults law.

d)

At specific composition methanol-acetone mixture will form maximum boiling azeotrope and will show negative deviation from Raoult's law.

4. An aqueous solution of 2% non-volatile solute exerts a pressure of 1.004 bar at the normal boiling point of the solvent. What is the molecular mass of the solute?

a) 23.4 g mol^{-1} **b) 41.35 g mol^{-1}** c) 10 g mol^{-1} d) 20.8 g mol^{-1}

Solution : -

Vapour pressure of pure water at boiling point =1 atm = 1.013 bar

Vapour pressure of solution (Ps) = 1.004 bar

Let mass of solution = 100 g

Mass of solute = 2 g

Mass of solvent = 100 - 2 = 98 g

$\frac{P^o-P_s}{P^o}=\frac{n_2}{n_1+n_2}=\frac{n_2}{n_1}=\frac{W_2/M_2}{W_1/M_1}$ ($\therefore n_2 << 1$)

$\frac{1.013-1.004}{1.013}=\frac{2}{M_2}\times\frac{18}{98}$ or $M_2=\frac{2\times 18}{98}\times\frac{1.013}{0.009}$ = 41.35 g mol^{-1}

5. Which one of the following is incorrect for ideal solution?

a) $\Delta H_{mix}=0$ b) $\Delta Umix = 0$ c) $\Delta P = P_{obs} - P_{calculate\ by\ Raoult's\ law} = 0$ **d) $\Delta G_{mix}=0$**

Solution : -

For ideal solution, we have

$\Delta H_{mix}=0$, $\Delta V_{mix}=0$

Now $\Delta U_{mix} = \Delta Hmix - P\Delta Vmix$

$\therefore \Delta Umix=0$

Also, for an ideal solution,

$P_A = X_A P_A^o$, $P_B = X_B P_B^o$

$\Delta p = P_{observe} - P_{calculated} = 0$

$\Delta G_{mix} = \Delta H_{mix} - T\Delta S_{mix}$

For an ideal solution, $\Delta S_{mix} \neq 0$

$\therefore \Delta G_{mix} \neq 0$

6. A 5% solution of cane sugar (mol. wt. = 342) is isotonic with 1 % solution of a substance X. The moiecular weight of x is:

a) 34.2 b) 171.2 c) 68.4 **d) 136.8**

Solution : -

Isotonic solutions are the solutions having same osmotic pressure.

Osmotic pressure of 5% cane sugar solution

$(\pi_1) = \mathrm{C} \times \mathrm{R} \times \mathrm{T}$

$= \frac{50\ \mathrm{g/L}}{342} \times 0.0821 \times T$

Osmotic pressure of 1% solution of substance

$X\,(\pi_2) = \frac{10\ \mathrm{g/L}}{M} \times 0.0821 \times T$

Both are isotonic

So, $\pi_1 = \pi_2$

or $\frac{50}{342} \times 0.0821 \times T = \frac{10}{M} \times 0.0821 \times T$

M (molecular weight of x) $= \frac{342}{5} = 68.4$

7. What will be the degree of dissociation of 0.1 M $Mg(NO_3)_2$ solution if van't Hoff factor is 2.7 4?

a) 75%   **b) 87%**   c) 100%   d) 92%

Solution : -

$Mg(NO_3)_2 \rightarrow Mg^{2+} + 2NO_3^-$

$\alpha = \frac{i-1}{n-1} = \frac{2.74-1}{3-1} = \frac{1.74}{2}$=0.87

Degree of dissociation = 0.87 x 100 = 87%

8. H_2S is a toxic gas used in qualitative analysis. If solubility of H_2S in water at STP is 0.195 m, what is the value of K_H?

   a) 0.0263 bar   b) 69.16 bar   c) 192 bar   **d) 282 bar**

   Solution : -

   No. of moles of H_2S = 0.195

   No. of moles of H_2O = $\frac{1000}{18}$=55.55 mol

   Mole fraction of H_2S= $\frac{0.195}{0.195+55.55}$=0.0035

   Pressure at STP = 0.987 bar

   According to Henry's law,p = K_Hx or K_H=$\frac{P_{H_2S}}{x_{H_2S}} = \frac{0.987}{0.0035}$=282 bar

9. Arrange the following aqueous solutions in the order of their increasing boiling points

   (i) 10^{-4} M NaCl

   (ii) 10^{-4} M Urea

   (iii) 10^{-3} M $MgCl_2$

   (iv) 10^{-2} M NaCl

   a) (i) < (ii) < (iv) < (iii)   b) (ii) < (i) = (iii) < (iv)   **c) (ii) < (i) < (iii) < (iv)**   d) (iv) < (iii) < (i) = (ii)

   Solution : -

   For 10^{-4} M NaCl i = 2

   10^{-4} M Urea i = 1

   10^{-3} M $MgCl_2$ i = 3

   10^{-2} M NaCl i = 2

   More the value of i, C, more will be the elevation in boiling point hence increasing order of boiling point is 10^{-4}M Urea < 10^{-4}M NaCl < 10^{-3}M $MgCl_2$ < 10^{-2}M NaCl.

10. Which of the following aqueous solutions should have the highest boiling point?

    a) 1.0 M NaOH   **b) 1.0 M Na_2SO_4**   c) 1.0 M NH_4NO_3 d) 1.0 M KNO_3

    Solution : -

    $\triangle T_b = iK_b m$

    $T_b - T_b^o = iK_b m$

    Thus, boiling point of solution (T_b) depends on value of van't Hoff factor (i).

    For 1.0 M Na_2SO_4 solution, i = 3 hence, it has highest boiling point.

11. Ihe relative lowering in vapour pressure is proportional to the ratio of number of

    a) solute molecules to solvent molecules   b) solvent molecules to solute molecules

    c) solute molecules to the total number of molecules in solution

    d) solvent molecules to the total number of molecules in solution.

    Solution : -

    $$\frac{P^o - P_s}{P^o} = \frac{n_2}{n_1 + n_2}$$

12. An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because________________

    a) it gains water due to osmosis   b) it loses water due to reverse osmosis

    c) it gains water due to reverse osmosis   **d) it loses water due to osmosis**

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Solution : -
When unripe mango is dipped in saturated salt solution then it loses water due to osmosis.

13. The vapour pressure, at a given temperature, of an ideal solution containing 0.2 mole of a non-volatile solute and 0.8 mole of solvent is 60 mm of Hg. The vapour pressure of the pure solvent at the same temperature is:
a) 150 mm of Hg   b) 120 mm of Hg   **c) 75 mm of Hg**   d) 60 mm of Hg

Solution : -
We know that, according to Raoult,s law
$\frac{p^{\circ}-p}{p^{\circ}}=\chi_B$
$\frac{p^{\circ}-60}{p^{\circ}}=\frac{n_B}{n_A+n_B}=\frac{0.2}{0.2+0.8}$
$=\frac{0.2}{1.0}=\frac{2}{10}=\frac{1}{5}$
$p^{\circ}-60=\frac{p^{\circ}}{5}$
$\Rightarrow p^{\circ}-\frac{p^{\circ}}{5}=60$
$\frac{5P^{\circ}-P^{\circ}}{5}=60$
$4p^{\circ}=60\times 5$
$p^{\circ}=\frac{60\times 5}{4}=\frac{300}{4}=75 \text{ mm of Hg}$

14. What will be the mole fraction of ethanol in a sample of spirit containing 85% ethanol by mass?
a) 0.69   b) 0.82   c) 0.85   d) 0.60

Solution : -
$x_{C_2H_5OH}=\frac{n_{C_2H_5OH}}{n_{C_2H_5OH}+n_{H_2O}}$
Mass of C_2H_5OH = 85 g
Molar mass of C_2H_5OH = 46 g/mol
$n_{C_2H_5OH}=\frac{85}{46}$=1.85 mol
Mass of water = 100 - 85 = 15 g
$n_{H_2O}=\frac{15}{18}$=0.833 mol
$x_{C_2H_5OH}=\frac{1.85}{1.85+0.833}=\frac{1.85}{2.683}$=0.69

15. Formation of a solution from two components can be considered as
(i) Puresolvent -> Separated solute molecules, ΔH_1
(ii) Puresolvent -> Separated solute molecules, ΔH_2
(iii) Separated solvent and solute molecules -l solution ΔH_3, solution so formed will be ideal if
a) $\Delta H_{sol}=\Delta H_3-\Delta H_1-\Delta H_2$ **b)** $\Delta H_{sol}=\Delta H_1+\Delta H_2-\Delta H_3$ c) $\Delta H_{sol}=\Delta H_3+\Delta H_2-\Delta H_1$
d) $\Delta H_{sol}=\Delta H_1-\Delta H_2-\Delta H_3$

Solution : -
We know that an ideal solution,
$\Delta H_{mixing}=0, \Delta H=\Delta H_1+\Delta H_2+\Delta H_3$ (According to Hess's law) i.e., for ideal solutions there is no change in magnitude of the attractive forces in the two components present.

16. Which of the following solutions shows positive deviation from Raoult's law?
a) Acetone + Aniline   **b) Acetone + Ethanol**   c) Water + Nitric acid   d) Chloroform + Benzene

Solution : -
Acetone + ethanol is an example of solutions showing positive deviation from Raoult's law. Since acetone-ethanol attractions are weaker than acetone-acetone and ethanol-ethanol attractions.

17. **Assertion:** Osmosis does not take place in two isotonic solutions separated by semipermeable membrane.
Reason: Isotonic solutions have same osmotic pressure.
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.

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c) If assertion is true but reason is false. d) If both assertion and reason are false

18. Which of the following relations is not correctly matched with the formula?

a) In case of association, $\propto=\frac{i-1}{\frac{1}{n}-1}$ **b) In case of association, $\propto=\frac{i-1}{n+1}$**

c) Relative lowering of vapour pressure= $\frac{P_A^o-P_A}{P_A^o}=i\frac{n_B}{n_A+n_B}$

d) Elevation in boiling point, $\triangle T_b=k_b\times\frac{W_B\times1000}{M_B\times W_A}$

Solution : -

In case of dissociation: $A_n\longrightarrow nA$

$$initial\ number\ of\ moles\quad 1\quad 0$$

$$After\ dissociation\quad 1-\alpha\ n\alpha$$

No. of particles = 1 - α + nα

i=$\frac{1-\alpha+n\alpha}{1}$ or i = 1-α +nα.

i - 1= nα - α= (n -1)α $\therefore\alpha=\frac{i-1}{n-1}$

19. **Assertion:** Decrease in the vapour pressure of water by adding 1 mol of sucrose to one kg of water is higher to that produced by adding 1 mol of urea to the same quantity of water at the same temperature.

Reason: Molecular mass of sugar is less than that of urea.

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 : -

Decrease in the vapour pressure of solvent depends on the quantity of non-volatile solute irrespective of its nature. Hence, decrease will besame in both the cases.

20. **Assertion:** Lowering of vapour pressure is not dependent on the number of species present in the solution.

Reason: Lowering of vapour pressure and relative lowering of vapour pressure are colligative properties.

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 : -

Lowering of vapour pressure is directly proportional to the number of species present in the solution. Only relative lowering of vapour pressure is a colligative property.

21. An aqueous solution is 1.00 molal in 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 KI **d) Addition of water**

Solution : -

Addition of solute decreases the vapour pressure as some sites of the surface are occupied by solute particles resulting in decreased surface area. However, addition of solvent, i.e., dilution increases the surface area of the liquid surface, thus results in increased vapour pressure. Hence, addition of water to the aqueous solution of (1 molal) KI results in increased vapour pressure.

22. A solution has 1: 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20°C are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction of pentane in the vapour phase would be :

a) 0.549 b) 0.200 c) 0.786 **d) 0.478**

Solution : -

Total vapour pressure of mixture = Vapour pressure of pentane in mixture + Vapour pressure of hexane in mixture

As the ratio of pentane to hexane = 1: 4

∴ Mole fraction of pentane = 1/5

Mole fraction of hexane = 4/5

Total vapour pressure =(Mole fraction of pentane x Vapour pressure of pentane) + (mole fraction of hexane x vapour pressure of hexane)

$\left(\frac{1}{5} \times 440 + \frac{4}{5} \times 120\right)$

= 184 mm of Hg

∴ Vapour pressure of pentane in mixture

= (Vapour Pressure of mixture x Mole fraction of pentane in vapour phase)

88 = 184 x mole fraction of pentane in vapour phase

∴ Mole fraction of pentane in vapour phase

= $\frac{88}{184}$ = 0.478

23. The van't Hoff factor of 0.005 M aqueous solution of KCl is 1.95. The degree of ionisation of KCl is

a) 0.95 b) 0.97 c) 0.94 d) 0.96

Solution : -

$KCl \rightleftharpoons Mg^{2+} + 2Cl^{-}$ (n=2)

$\alpha = \frac{i-1}{n-1} = \frac{1.95-1}{2-1}$=0.95

24. **Assertion:** 1M solution of KCl has greater osmotic pressure than 1 M solution of glucose at the same temperature.

Reason: In solution KCl dissociates to produce more number of particles.

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

25. Which of the following statements is false?

a)

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

b)

The osmotic pressure of a solution is given by the equation 1t = CRT (where C is the molarity of the solution).

c)

Decreasing order of osmotic pressure for 0.01 M aqueous solutions of barium chloride, potassium chloride, acetic acid and sucrose is $BaCl_2$> KCl > CH_3COOH > sucrose.

d)

According to Raoult's law, the vapour pressure exerted by a volatile component of a solution is directly proportional to its mole fraction in the solution.

Solution : -

The value of K_f depends upon the nature of the solvent. Thus, two different solutions of sucrose of same molality prepared in different solvents will have the different depression in freezing point.

26. The volume strength of 1.5 N H_2O_2 solution is:

a) 4.8 b) 5.2 **c) 8.4** d) 8.8

Solution : -

Normality = 1.5 N

Equivalent weight of H_2O_2 = 17

So, strength of the solutions, S = E x N

= 17 x 1.5 = 25.5

$2H_2O_2 \longrightarrow 2H_2O + O_2$

= 2 x 34 = 68 g

68 g of H_2O_2 produce O_2 at NTP = 22.4L

25.5 g of H_2O_2 will produce

$= \frac{22.4}{58} \times 25.5$

$= 8.4 \text{ L of } O_2$

27. 75.2 g of phenol is dissolved in a solvent of K_f= 14. If the depression in freezing point is 7 K then find the % of phenol that dimerises.

    a) 75% b) 80% c) 70% d) 100%

    Solution : -

    $2C_6H_5OH \rightleftharpoons (C_6H_5OH)_2$

    $initially \quad C \quad 0$

    $at\ equil \ C(1-\alpha) \ C\alpha/2$

    Total number of moles = C - Cα + (Cα/2)

    $=C - \frac{C\alpha}{2} = \frac{2C - C\alpha}{2} = \frac{C(2-\alpha)}{2}$

    C=$\frac{Weight}{Molecular\ weight}$=$\frac{75.2}{94}$=0.8

    $\triangle T_f = K_f \times m$

    $\Rightarrow 7 = 14 \times 0.8\left(\frac{2-\alpha}{2}\right)$ or, 1=0.8(2-α)

    α=0.75=75%

28. When 1.04 g of $BaCl_2$ is present in 10^5 g of solution the concentration of solution is

    a) 0.104 ppm **b) 10.4 ppm** c) 0.0104 ppm d) 104 ppm

29. Match the column I with column II and mark the appropriate choice

Column I		Column II	
(A)	K_b	(i)	$\frac{K_b \times W_2 \times 1000}{\triangle T_b \times W_1}$
(B)	M_2	(ii)	$\frac{W_2 \times 1000}{M_2 \times W_1}$
(C)	π	(iii)	$\frac{RT_b^2}{1000 \times L_V}$
(D)	m	(iv)	$\frac{\triangle T_b \times dRT}{1000 \times k_b}$

    a) (A) ⟶(i), (B) ⟶ (iii), (C) ⟶ (ii), (D) ⟶ (iv) b) (A) ⟶ (iv), (B) ⟶ (ii), (C) ⟶ (i), (D) ⟶ (iii)

    c) (A)⟶ (ii), (B)⟶ (iv), (C)⟶ (iii), (D)⟶ (i) **d) (A) ⟶ (iii), (B) ⟶ (i), (C) ⟶ (iv), (D) ⟶ (ii)**

30. The mole fraction of the solute in one molal aqueous solution is:

    a) 0.009 **b) 0.018** c) 0.027 d) 0.036

    Solution : -

    We know that one molal solution means one mole solute present in 1 kg (1000g) solvent

    mole of solute = 1

    Mole of solvent (H_2O)

    $= \frac{1000}{18g} = \frac{1000}{18}$

    Mole fraction of solute

    $= \frac{1}{\left(1+\frac{1000}{18}\right)}$

    $= \frac{18}{1018} = 0.01768 = 0.18$

31. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case?

    a) X is undergoing dissociation in water b) Molecular mass of X is greater than the molecular mass of Y

    c) Molecular mass of X is less than the molecular mass of Y

    d) Y is undergoing dissociation in water while X undergoes no change.

    Solution : -

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We have Molality of solution X = Molality of solution Y = 0.2 mol kg^{-1}
We know that, $\Delta T_b \propto m$ or $\Delta T_b = k_b m$
where m = molality of solution k_b = ebullioscopic constant
By elevation in boiling point $\Delta T_b = ik_b m$ or $\Delta T_b \propto i$
where, i= van't Hoff factor
As ΔT_b of solution X is greater than ΔT_b of solution Y (observed colligative property is greater than normal colligative property)
∴ i of solution X > i of solution Y
Thus, solution X undergoes dissociation.

32. When a gas is bubbled through water at 298 K, a very dilute solution of gas is obtained. Henry's law constant for the gas is 100 k bar. If gas exerts a pressure of 1 bar, the number of moles of gas dissolved in 1 litre of water is:
a) 0.555 **b) 55.55 x 10^{-5}** c) 55.55 x 10^{-3} d) 5.55 x 10^{-5}

Solution : -
$P = K_H \times x$
$x = \frac{P}{K_H} = \frac{1}{100\times 10^3} = 1 \times 10^{-5}$
Mole fraction = $\frac{Mole\ of\ gas}{Total\ mole}$
Moles of H_2O = $\frac{1000}{18}$ = 55.55 (∴ 1 L=1000 g)
Mole fraction = $\frac{x}{x+55.55}$ (55.55 >>>x)
$\therefore 10^{-5} = \frac{x}{55.55}$ or x = 55.55 x 10^{-5}

33. Two liquids A and B form ideal solutions. At 300 K, the vapour pressure of a solution containing 1 mole of A and 3 moles of B is 550 mm Hg. At the same temperature, if one more mole of B is added to this solution, the vapour pressure of the solution increases by 10 mm Hg. The vapour pressures of A and B in their pure states are respectively
a) P_A^o = 600 mm Hg and P_B^o = 400 mm Hg b) P_A^o = 550 mm Hg and P_B^o= 560 mm Hg
c) P_A^o= 450 mm Hg and P_B^o = 650 mm Hg **d) P_A^o= 400 mm Hg and P_B^o = 600 mm Hg**

Solution : -
Vapour pressure of solution containing 1 mole of A + 3 moles of B = 550 mm Hg×
Vapour pressure of solution containing 1 mole of A + 4 moles of B = (550 + 10) = 560 mm Hg
$P_{Total} = P_A^o \times x_A + P_B^o \times x_B$
or $550 = P_A^o \times x_A + P_B^o \times x_B$
$= P_A^o \times \frac{1}{4} + P_B^o \times x_B$
$= P_A^o \times \frac{1}{4} + P_B^o \times \frac{3}{4}$ $[\therefore x_A = \frac{1}{1+3} = \frac{1}{4}, x_B = \frac{3}{1+3} = \frac{3}{4}]$ -------(i)
$550 = \frac{P_A^O}{4} + \frac{3}{4} \times P_B^o \times \frac{4}{5}$
$\left(\therefore x_A = \frac{1}{1+4} = \frac{1}{5}, x_B = \frac{4}{1+4} = \frac{4}{5}\right)$ -------(ii)
$2800 = P_A^o + 4\ P_B^o$ ... (ii)
Solving equations (i) and (ii), we get
P_B^o = 600 mm Hg
P_A^o = 400 mm Hg

34. A solution containing 10.2 g glycerine per litre is isotonic with a 2% solution of glucose. What is the molecular mass of glycerine?
a) 91.8 g b) 91.8 g c) 83.9 g d) 890.3 g

Solution : -

$\pi_{glycerine} = \pi_{glucose}$
$\frac{n_1}{V_1}RT = \frac{n_2}{V_2}RT$
$\frac{10.2}{M} \times \frac{1}{1} = \frac{2}{180} \times \frac{1000}{100}$
⇒ M=$\frac{10.2\times18}{2}$=91.8 g (Density of wa ter = 1 g/cm^3)

35. What is the mole fraction of the solute in a 1.00 m aqu solution?
a) 0.177 b) 1.770 c) 0.0354 **d) 0.0177**

Solution : -
We know that,
$\text{Molarity } = \frac{W}{M} \times \frac{1}{V(\text{ kg})}$
$= \frac{n}{V(\text{ kg})}(\text{ where } n_{\text{solute }} = \text{W/M})$
$1.00 \text{ m} = \frac{n}{V(\text{ kg})}$
1 mole in 1 kg of water
Moles of 1 kg H_2O
$= \frac{1000 \text{ g}}{18 \text{ g/mol}} = 55.55 \text{ mole}$
moles of solute = 1
$= \frac{n_{\text{solute}}}{n_{\text{solute }} + n_{\text{water}}} = \frac{1}{(1+55.55)}$
= 0.01768 = 0.0177

36. Which one of the following modes of expressing concentration is independent of temperature?
a) Molarity **b) Molality** c) Formality d) Normality

Solution : -
Molality is the best method of expressing concentration of solution because in molality, we take mass of solvent which is independent of temperature, so molality of solution is independent of temperature

37. Which of the following statement about the compositions of the vapour over an ideal 1 : 1 molar mixture of benzene and toiuene is correct? Assume that the temperature is constant at 25^{o}C.
(Given: Vapour Pressure Data at 25^{o}C benzene= 12.8 kPa, toluene = 3.85 kPa)
a) The vapour will contain a hight percentage of benzene
b) The vapour will contain a higher percentage of toluene
c) The vapour will contain equal amounts of benezene and toluene
d) Not enough information is given to make a prediction

Solution : -
If Suppose, A is benzene and B is Toluene.
Then, 1 : 1 molar mixture of A and B
$\therefore \text{x}_\text{A} = \frac{1}{2} \text{ and } \text{x}_\text{B} = \frac{1}{2}$
Total pressure of solution
$(\text{P}) = \text{P}^0{}_\text{A}\text{x}_\text{A} + \text{P}^{0\text{x}}{}_{\text{B}}{}_{\text{B}}\ldots(1)$
Putting the value in (l)
$\text{P} = 12.8 \times 1/2 + 3.85 \times 1/2 = 8.325\text{kPa}$
$\text{YA} = \frac{P_A^0 x_A}{P} = \frac{12.8\times\frac{1}{2}}{8.325} = 0.768$
$\text{Then, } Y_A + Y_B = 1, \text{ Or } Y_B = 1 - Y_A$
$\text{Hence, } \text{Y}_\text{B} = 1 - 0.768 = 0.232$

38. A 5% solution (w/W) of cane sugar (molar mass = 342 g mol^{-1}) has freezing point 271 K. What will be the freezing point of 5% glucose (molar mass = 18 g mol^{-1}) in water if freezing point of pure water is 273.15 K?
a) 273.07 K **b) 269.07 K** c) 273.15 K d) 260.09 K

Solution : -

$\triangle T_f = \frac{K_f \times W_B}{M_b \times W_A}$

For cane sugar solution, 2.15 K = $\frac{K_f \times 5}{342 \times 0.095}$

($\therefore$95 g of water = 0.095 kg)

For glucose solution, $\triangle T_f = \frac{K_f \times 5}{180 \times 0.095}$

$\frac{\triangle T_f}{2.15} = \frac{K_f \times 5}{180 \times 0.095} \times \frac{342 \times 0.095}{k_f} \times 5$

$\triangle T_f = \frac{342}{180} \times 2.15$=4.085 K

Freezing point of glucose solution = 273.15 - 4.085 = 269.07 K

39. What will be the freezing point of a 0.5 m KCI solution? The molal freezing point constant of water is 1.86 °C m^{-1}.

a) -1.86°C b) - 0.372 °C c) - 3.2 °C d) O°C

Solution : -

$\triangle T_f = iK_f$ x m = 2 x 1.86 x 0.5 = 1.86°C

$T_f = T^o_f - \triangle T_f$=0 - 1.86 = -1.86°C

40. The freezing point depression constant (K_f) of benzene is 5.12 K kg mol^{-l}. The freezing point depression for the solution of molality 0.078 m containing a non-electrolyte solute in benzene is (rounded off up to two decimal places)

a) 0.60K b) 0.20K c) 0.80K **d) 0.40K**

Solution : -

$\Delta \mathrm{T_f} = \mathrm{K_f} \times \mathrm{m}$

$= 5.12 \times 0.078$

$\Delta \mathrm{T_f} = 0.40\ \mathrm{K}$

41. According to Raoult's law, Relative lowering of vapour pressure of a solution is equal to

a) moles of solute b) moles of solvent **c) mole fraction of solute** d) mole fraction of solvent

Solution : -

According to Raoult's law, the relative lowering of vapour pressure is equal to the mole fraction of solute

i.e. $\frac{p^\circ - p}{p^\circ} = \chi_B$

$x_B =$ moie fraction of solute

42. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ion, CO_3^{2-} are respectively (Molar mass of Na_2CO_3 = 106 g mol^{-1})

a) 0955M and 1.910M **b) 1.910M and 0.955M** c) 1.90M and 1.910M d) 0.477M and 0.477M

Solution : -

Molarity = $\frac{Number\ of\ moles\ of\ solute}{Volume\ of\ solution\ in\ liter}$

= $\frac{25.3 \times 1000}{106 \times 250}$ = 0.9547 ≈ 0.955 M

$NaCO_3 \rightleftharpoons 2Na^+ + CO_3^{2-}$

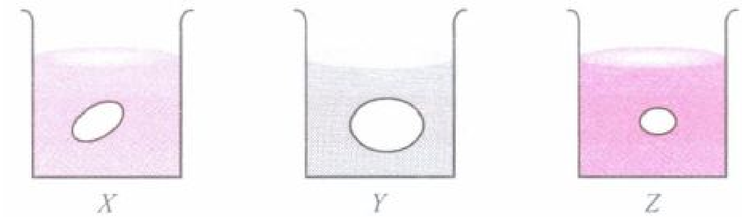
x 2x x

So, cone. of CO_3^{2-} = 0.955 mol/lit

conc. of $2Na^+$= 2 x 0.955

= 1.91 mol/lit

43. Grapes placed in three beakers X, Y and Z containing different type of solutions are shown in figures.



If beaker X contains water, Yand Z contain

a) Y - hypotonic solution, Z - hypertonic solution b) Y - hypertonic solution, Z - hypotonic solution

c) Y and Z- isotonic solutions d) Y and Z- hypotonic solutions

Solution : -

In hypotonic solution, the water is drawn in and the grape swells while in hypertonic solution the water is drawn out and the grape shrinks.

44. For which of the following solutes the van't Hoff factor is not greater than one?

a) $NaNO_3$ b) $BaCl_2$ c) $K_4[Fe(CN)_6]$ **d) NH_2CONH_2**

Solution : -

Urea is non-electrolyte, hence will not dissociate to give ions.

45. **Assertion:** Pressure does not have any effect on solubility of solids in liquids.

Reason: Solids and liquids are highly incompressible

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

46. Partial pressure of a solution component is directly proportional to its mole fraction. This is known as

a) Henry's law **b) Raoult's law** c) Distribution law d) Ostwald's dilution law

47. **Assertion:** The concentration of pollutants in water or atmosphere is often expressed in terms of ppm.

Reason: Concentration in parts per million can be expressed as mass to mass, volume to volume and mass to volume.

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 : -

When a solute is present in trace quantities it is convenient to express concentration in ppm.

48. A solution is obtained by mixing 200 g of 30% and 300 g of 20% solution by weight. What is the percentage of solute in the final solution?

a) 50% b) 28% c) 64% **d) 24%**

Solution : -

Solute in 200 g of 30% solution = 60 g

Solute in 300 g of 20% solution = 60 g

Total grams of solute = 120 g

Total grams of solution = 200 + 300 = 500 g

% of solute in the final solution = $\frac{120}{500} \times 100$=24%

49. Which of the following will have the highest f.pt. at one atmosphere?

a) 0.1 M NaCl solution **b) 0.1 M sugar solution** c) 0.1 M $BaCl_2$ solution d) 0.1 M $FeCl_3$ solution

Solution : -

For the same concentration of different solvents any colligative property $\propto$ i
For NaCl, i = 2
Sugar solution, i = 1
$BaCl_2$, i = 3; $FeCl_3$, i = 4
Thus, for sugar solution depression in freezing point is minimum i.e., highest freezing point.

50. The vapour pressure of benzene at a certain temperature is 640 mm Hg. A non-volatile and non-electrolyte solid, weighing 2.175 g is added to 39.08 g of benzene. If the vapour pressure of the solution is 600mm Hg, what is the molecular weight of solid substance?

a) 49.50 b) 59.60 **c) 69.40** d) 79.82

Solution : -

According to Raoult's law

$$\frac{p^0 - p}{p^0} = \frac{w_2 \times w_1}{M_2 \times w_1}$$

$$\frac{640 - 600}{640} = \frac{2.175 \times 78}{M_2 \times 39.08}$$

(M_1 for C_6H_6 = 78 g mol^{-1})

$M_2 = \frac{2.175 \times 78 \times 640}{40 \times 39.08} = 69.45 \approx 69.4$

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