Date : **TEST ID: XIICH0202**
Marks : **CHEMISTRY**

SOLUTIONS

Single Correct Answer Type

31. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mole of sodium sulphate is dissolved in 1 kg of water, is ($k_f = 1.86$ Kkg mol^{-1})
    a) 0.0372 K b) 0.0558 K c) 0.0744 L d) 0.0186 K
32. 2.5 L of NaCl solution contain 5 moles of the solute.What is the molarity ?
    a) 5M b) 2M c) 2.5M d) 12.5M
33. If for a sucrose solution elevation in boiling point is 0.1°C then what will be boiling point of NaCl solution for the same molal concentration?
    a) 0.1 b) 0.2 c) 0.16 d) 0.26
34. In two solutions having different osmotic pressure, the solution of higher osmotic pressure is called :
    a) Isotonic solution
    b) Hypertonic solution
    c) Hypotonic solution
    d) None of these
35. Isotonic solution have the same
    a) Normality b) Density c) Molar concentration d) None of these
36. Vapour pressure of pure $A = 100$ torr, moles $= 2$; vapour pressure of pure B=80 torr, moles $= 3$. Total vapour pressure of the mixture is
    a) 440 torr b) 460 torr c) 180 torr d) 88 torr
37. Which of the following is incorrect?
    a) Relative lowering of vapour pressure is independent of the solute and the solvent.
    b) The relative lowering of vapour pressure is a colligative property.
    c) Vapour pressure of a solution is lower than the vapour pressure of the solvent.
    d) The relative lowering of vapour pressure is directly proportional to the original pressure.
38. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is
    a) 23.077% b) 230.77% c) 2.3077% d) 0.23077%
39. The atmospheric pressure is sum of the
    a) Pressure of the biomolecules
    b) Vapour pressure of atmospheric constituents
    c) Vapour pressure of chemicals and vapour pressure of volatiles
    d) Pressure created on to atmospheric molecules
40. Lowering in vapour pressure is the highest for:
    a) 0.2 m urea
    b) 0.1 m glucose
    c) 0.1 m $MgSO_4$
    d) 0.1 m $BaCl_2$
41. 6.02×10^{20}molecules of urea are present in 100 mL of its solution. The concentration of urea solution is
    a) 0.1 M b) 0.01 M c) 0.001 M d) 0.02 M
42. The osmotic pressure (At27°C) of an aqueous solution (200 mL) containing 6 g of a protein is 2×10^{-3}atm . If R=0.080 L atm mol^{-1} K^{-1}, the molecular weight of protein is
    a) 7.2×10^5 b) 3.6×10^5 c) 1.8×10^5 d) 1.0×10^5

43. 100 cc of 0.6 N H_2SO_4 and 200 cc of 0.3 N HCl were mixed together. The normality of the solution will be
a) 0.2 N b) 0.4 N c) 0.8 N d) 0.6 N

44. Mole fraction ($\mathcal{X}$) of any solution is equal to
a) $\frac{\text{no. of moles of solute}}{\text{volume of solution in litre}}$ b) $\frac{\text{no. of gram} - \text{equivalent of solute}}{\text{volume of solution in litre}}$
c) $\frac{\text{no. of moles of solute}}{\text{mass of solvent in kg}}$ d) $\frac{\text{no. of moles of any constituent}}{\text{total number of moles of all constituents}}$

45. Which is not a colligative property in the following?
a) pH ofa buffer solution b) Boiling point elevation
c) Freezing point depression d) Vapour pressure lowering

46. The normality of 10% (weight/volume) acetic acid is
a) 1 N b) 1.3 N c) 1.7 N d) 1.9 N

47. Two solutions have different osmotic pressure. The solution of lower osmotic pressure is called :
a) Isotonic solution
b) Hypertonic solution
c) Hypotonic solution
d) None of these

48. Osmatic pressure is 0.0821 atm at temperature of 300 K. Find concentration in mole per litre
a) 0.33 b) 0.22×10^{-2} c) 0.33×10^{-2} d) 0.44×10^{-2}

49. 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

50. The distribution law holds good for :
a) Heterogeneous systems b) Homogeneous systems c) Both (a) and (b) d) None of these

51. Two solutions of KNO_3 and CH_3COOH are prepared separately. Molarity of both is 0.1 M and osmatic pressures are p_1 and p_2 respectively. The correct relationship between the osmatic pressures is
a) $p_1 = p_2$ b) $p_1 > p_2$ c) $p_2 > p_1$ d) $\frac{p_1}{p_1 + p_2} + \frac{p_2}{p_1 + p_2}$

52. The freezing point of aqueous solution that contains 5% by mass urea, 1.0% by mass KCl and 10% by mass of glucose is : ($K_f H_2O = 1.86$ K molality^{-1})
a) 290.2 K b) 285.5 K c) 269.93 K d) 250 K

53. Which of the following solutions has the highest normality?
a) 6 g of NaOH/100 mL b) 0.5 M H_2SO_4 c) N phosphoric acid d) 8 g of KOH/L

54. 100 mL of 0.3 HCl is mixed with 200 mL of 0.6 N H_2SO_4. The final normality of the resulting solution will be
a) 0.3 N b) 0.2 N c) 0.5 N d) 0.1 N

55. A solute when distributed between two immiscible phases remains associated in phase II and dissociated in phase I. If α is the degree of dissociation and n is the number of molecules associated then :
a) $K = \frac{c_I}{c_{II}}$ b) $K = \frac{c_I}{\sqrt[n]{c_{II}(1-\alpha)}}$ c) $K = \frac{c_I}{c_{II}\,(1-\alpha)}$ d) $K = \frac{c_I(1-\alpha)}{\sqrt[n]{c_{II}}}$

56. Which solution would exhibit abnormal osmotic pressure?
a) Aqueous solution of urea
b) Aqueous solution of common salt
c) Aqueous solution of glucose
d) Aqueous solution of sucrose

57. If α is the degree of dissociation of Na_2SO_4 the van't Hoff factor (i) used for calculating the molecular mass is
a) $1 - 2\,\alpha$ b) $1 + 2\,\alpha$ c) $1 - \alpha$ d) $1 + \alpha$

58. The temperature at which vapour pressure of a solvent in its liquid and solid phase becomes same is called :
    a) b. p. b) f. p. c) Krafft point d) None of these
59. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in a solution with liquid B is 32 mm Hg. What is the mole fraction of A in the solution if it obeys the Raoult's law?
    a) 0.5 b) 0.6 c) 0.7 d) 0.8
60. Which of the following shows maximum depression in freezing point?
    a) K_2SO_4 b) NaCl c) Urea d) glucose

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ANSWER KEY

31)	b	32)	b	33)	b	34)	b
35)	c	36)	d	37)	d	38)	a
39)	b	40)	d	41)	b	42)	b
43)	b	44)	d	45)	a	46)	c
47)	c	48)	c	49)	c	50)	a
51)	b	52)	c	53)	a	54)	c
55)	d	56)	b	57)	b	58)	b
59)	d	60)	a				

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HINTS AND SOLUTIONS

31 **(b)**

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$

van't Hoff factor for $Na_2SO_4 = 3$

$\Delta T_f = i \times k_f \times m$

$= 3 \times 1.86 \times 0.01$

$\left[\because \quad m = \frac{0.01}{1} = 0.01\right]$

$= 0.0558$ K

32 **(b)**

$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$

$\Longrightarrow \text{molarity} = \frac{5}{205} = 2\text{M}$

33 **(b)**

Elevation in boiling point is a colligative property as it depends upon the number of particles

$\Delta T_b \propto n$

For sucrose $n = 1\ \Delta T_b = 0.1°\text{C}$

For NaCl, $n = 2, \Delta T_b = 0.2°\text{C}$

34 **(b)**

In a pair of two solution, the one having higher osmotic pressure is called hypertonic and the other having lower osmotic pressure is called hypotonic.

36 **(d)**

$P_{total} = P_A^\circ X_A + P_B^\circ X_B$

where , P= vapour pressure

X= mole fraction

Total moles of A and $B = 5$

Mole fraction of compound $A = \frac{2}{5}$

Mole fraction of compound $B = \frac{3}{5}$

then, $P_{total} = 100 \times \frac{2}{5} + 80 \times \frac{3}{5}$

$= 88$ torr

37 **(d)**

According to Raoult's law the relative lowering of vapour pressure of a dilute solution is equal to the mole fraction of the solute present in the solution, *i.e.*,

$$\frac{p - p_s}{p} = \frac{n}{n + N}$$

38 **(a)**

If $H_2O = x$ mol $= 18x$ g

Then urea $= x$ mol $= 60x$ g

Total mass of the solution

$= 18x + 60x = 78x$g

Mass % of urea $= \frac{18x}{78x} \times 100$

$= 23.077\%$

40 **(d)**

$\frac{P_0-P_S}{P_0}$ = molality × $(1-\alpha+x\alpha+y\alpha)$

The value of $P_0 - P_s$ is maximum for $BaCl_2$.

41 **(b)**

Mole of urea = $\frac{6.02\times10^{20}}{6.02\times10^{23}} = 10^{-3}$mol

Conc. of solution (in molarity)= $\frac{10^{-3}}{100}\times 1000 = 0.01$ M

42 **(b)**

$\pi V = \frac{w}{m} RT$

M=$\frac{wRT}{\pi V}$

Here, w=6 g, $\pi = 2\times10^{-3}\ atm$, T=300 K,

R=0.080 L-atm $mol^{-1}\ K^{-1}$, V =200 mL =0.2 L

M= $\frac{6\times0.080\times300}{2\times10^{-3}\times0.2} = 3.6\times10^5$

43 **(b)**

Normality of the mixed solution

$= \frac{N_1V_1+N_2V_2}{V_1+V_2}$

$= \frac{0.6\times\frac{100}{1000}+0.3\times\frac{200}{1000}}{\frac{100+200}{1000}}$

$= \frac{0.6\times0.1+0.3\times0.2}{0.3}$

$= \frac{0.06+0.06}{0.3}$

$= \frac{0.12}{0.3} = 0.4$ N

45 **(a)**

Colligative properties certain properties of dilute solution containing non-volatile solute do not depend upon the nature of the solute dissolved but depend only upon the number of particles of the solute present, are called colligative properties. Some colligative properties are boiling point elevation, freezing point depression, lowering of vapour pressure,

46 **(c)**

$N = \frac{w\times1000}{\text{eq. wt.}\times V(\text{mL})}$

$= \frac{10\times1000}{60\times100} = 1.66$ N

47 **(c)**

In a pair of two solution, the one having higher osmotic pressure is called hypertonic and the other having lower osmotic pressure is called hypotonic.

49 **(c)**

Two solutions are isotonic if their osmotic pressure are equal.

$\pi_1 = \pi_2$

$M_1ST_1 = M_2ST_2$

($M_1$and M_2 are molarities)

At a given temperature,

$M_1 = M_2$

$\frac{1000w_1}{m_1V_1} = \frac{1000w_2}{m_2V_2}$ $(V_1 = V_2 = 100mL)$

Cane sugar unkown

$\therefore$ $\frac{w_1}{m_1} = \frac{w_2}{m_2}$

$\frac{5}{329} = \frac{1}{m_2}$

$m_2 = \frac{342}{5} = 68.4$ g mol^{-1}

50 **(a)**
The two solvents in which a solute is to be distributed shows $K = c_1/c_2$ only when two liquids are immiscible, *i. e.*, No. of phase ≥ 2 or heterogeneous systems.

51 **(b)**
KNO_3 dissociates completely while CH_3COOH dissociates to a small extent hence, $p_1 > p_2$

52 **(c)**
$$\Delta T = \Delta T \text{ for glucose } = \Delta T \text{ for KCl} + \Delta T \text{ for urea}$$
$$= \frac{1000 \times 1.86 \times 10}{100 \times 180} + \frac{1000 \times 1.86 \times 1 \times 2}{74.5 \times 100} + \frac{1000 \times 1.86 \times 5}{100 \times 60}$$
$$= 3.069$$
$$\therefore \text{ f. p.} = 273 - 3.069 = 269.93 \text{ K}$$

53 **(a)**
$$N = \frac{6 \times 1000}{40 \times 100} = 1.5 \text{ N}$$

54 **(c)**
$N_1V_1 + N_2V_2 = N_3V_3$
$0.3 \times 100 + 0.6 \times 200 = N_3 \times 300$
$0.3 + 1.2 = 3N_3$
$N_3 = 0.5$

55 **(d)**
This is the mathematically modified form of distribution law when solute undergoes association in either of the solvent.

56 **(b)**
Common salt dissociates to furnish ions.

57 **(b)**
$Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$
van't Hoff factor i=[1+(y-1) α]
where y is the number of ions from one mole solute, (in this case =3), α the degree of dissociation.
i=(1+2 α)

58 **(b)**
It is definition of freezing point.

59 **(d)**
According to Raoult's law,
$$P_A = P_A^\circ \varkappa_A$$
or
$$\varkappa_A = \frac{P_A}{P_A^\circ}$$
$$= \frac{32\text{mm Hg}}{40 \text{ mm Hg}} = 0.8$$

60 **(a)**
Depression in freezing point is a colligative property. It depends on number of particles. More the number of particles, more will be depression in freezing point.
1. $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

   It gives 3 particles.
2. $NaCl \rightarrow Na^+ + Cl^-$

   It gives 2 particles.
3. Urea→ No dissociation
4. Glucose → No dissociation.

$\therefore$ K_2SO_4 produces maximum number of particles

$\therefore$ K_2SO_4 has maximum depression in freezing point.