Date : **TEST ID: XIICH0201**
Marks : **CHEMISTRY**

SOLUTIONS

Single Correct Answer Type

1. A super saturated solution is a metastable state of solution in which solute concentration.
   a) Is equal to the solubility of that substance in water
   b) Exceeds than it s solubility
   c) Less than its solubility
   d) Continuously change
2. Colligative properties of a solution depends upon
   a) Nature of both solvent and solute
   b) Nature of solute only
   c) Number of solvent particles
   d) The number of solute particles
3. The partition coefficient of solute X in between immiscible liquids A and B is 10 in favour of A. The partition coefficient of X in favour of B is :
   a) 0.1 b) 10 c) 0.01 d) 100
4. Which one is a colligative property?
   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 $(\pi)$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
5. At$25°C$, the highest osmotic pressure is exhibited by 0.1 M solution of
   a) Urea b) Glucose c) KCl d) $CaCl_2$
6. The vapour pressure of two liquids $X$and $Y$are 80 and 60 Torr respectively. The total vapour pressure of the ideal solution obtained by mixing 3 moles of $X$and 2 moles of Ywould be
   a) 68 Torr b) 140 Torr c) 48 Torr d) 72 Torr
7. Dilute 1 L one molar H_2SO_4 solution by 5 L water, the normality of that solution is
   a) 0.33 N b) 33.0 N c) 0.11 N d) 11.0 N
8. Solution A contains 7 g/L of $MgCl_2$ and solution B contains 7 g/L of NaCl. At room temperature, the osmotic pressure of
   a) Solution A is greater than B
   b) Both have same osmotic pressure
   c) Solution B is greater than A
   d) Cannot be determine
9. Which one of the following aqueous solutions will exhibit highest boiling point?
   a) 0.01 M Na_2SO_4 b) 0.01 M KNO_3 c) 0.015 M urea d) 0.015 M glucose
10. The modal elevation constant of water is 0.52°C. The boiling point of 1.0 modal aqueous KCl solution (assuming complete dissociation of KCl), therefore, should be
    a) 98.96°C b) 100.52°C c) 101.04°C d) 107.01°C
11. The increase in boiling point of a solution containing 0.6 g urea in 200 g water is $0.50°C$.Find the molal elevation constant.
    a) 10 K kg mol^{-1} b) 10 K g mol^{-1} c) 10 K kg mol d) 1.0 K kg mol^{-1}
12. Which is correct representation of phase rule?

a) $F = P + C + 2$
b) $F + P = C + 2$
c) $F + C = P + 2$
d) None of these

13. 40% by weight solution will contain how much mass of the solute in 1L solution, density of the solution is 1.2 g/mL?
a) 480 g b) 48 g c) 38 g d) 380 g

14. 20 g of binary electrolyte (mol. wt. =100) are dissolved in 500 g of water. The depression in freezing point of the solution is 0.74°C $(k_f = 1.86\ Km^{-1})$ the degree of ionisation of the electrolyte is
a) 0% b) 100% c) 75% d) 50%

15. What is the molality of pure water?
a) 1 b) 18 c) 55.5 d) None of these

16. Iodine was added to a system of water and CS_2. The concentrations of iodine in water and CS_2 were found to be c_1 and c_2 respectively. The ratio c_1/c_2 will not change only if :
a) More iodine is added
b) More water is added
c) More CS_2 is added
d) The temperature is changed

17. Which of the following associated with isotonic solutions is not correct?
a) They will have the same osmotic pressure
b) They will have the same vapour pressure
c) They have same weight concentrations
d) Osmosis does not take place when the two solutions are separated by a semipermeable membrane

18. The freezing point (in °C)of a solution containing 0.1 g of $K_3[Fe(CN)_6]$ (mol.wt.329) in 100 g of water is : $(K_f = 1.86\ K\ \text{kg mol}^{-1})$
a) -2.3×10^{-2} b) -5.7×10^{-2} c) -5.7×10^{-3} d) -1.2×10^{-2}

19. The Henry's law constant for the solubility of N_2 gas in water at 298 K is $1.0 \times 105\ atm$. The mole fraction of N_2 In air is 0.8 The number of moles of N_2 from air dissolved in 10 moles of water of 298 K and 5 atm pressure is
a) 4×10^{-4} b) 4.0×10^{-5} c) 5.0×10^{-4} d) 4.0×10^{-6}

20. Van't Hoff factor more than unity indicates that the solute in solution has
a) Dissociated b) Associated c) Both (a) and (b) d) Cannot say anything

21. The condition for the validity of Henry's law are :
a) The pressure should not be too high
b) The temperature should not be too low
c) The gas should neither dissociate not enter into chemical combination with solvent
d) All of the above

22. In an osmotic pressure measurement experiment, a 5% solution of compound 'X'is found to be isotonic with a 2 % acetic acid solution . The gram molecular mass of 'X' is
a) 24 b) 60 c) 150 d) 300

23. Which is a colligative property ?
a) Osmotic pressure b) Free energy c) Heat of vaporisation d) Change in pressure

24. K_f for water is 1.86 K-kg-mol^{-1}. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol $(C_2H_6O_2)$ must you add to get the freezing point of the solution lowered to -2.8°C?
a) 93 g b) 39 g c) 27 g d) 72 g

25. Vapour pressure of a solvent containing non-volatile solute is :
a) More than the vapour pressure of a solvent
b) Less than the vapour pressure of solvent
c) Equal to the vapour pressure of solvent

d) None of the above

26. Among the following mixtures, dipole-dipole as the major interaction is present in :
    a) Benzene and ethanol
    b) KCl and water
    c) Acetonitrile and acetone
    d) Benzene and CCl_4
27. The vapour pressure of water depends upon :
    a) Surface area of container
    b) Volume of container
    c) Temperature
    d) All of these
28. Which of the following solution highest boiling point?
    a) 0.1 M urea b) 0.1 M sucrose c) 0.1 M $NaNO_3$ d) 0.1 M $Al(NO_3)_3$
29. At certain temperature a 5.12% solution of cane sugar is isotonic with a 0.9% solution of an unknown solute. The molar mass of solute is
    a) 60 b) 46.17 c) 120 d) 90
30. A mixture of ethane and ethene occupies 41 L at 1 atm and 500 K. the mixture reacts completely with $\frac{10}{3}$ mole of O_2 to produce CO_2 and H_2O. The mole fraction of ethane and ethene in the mixture are ($R = 0.082L$ atm K^{-1} mol^{-1}) respectively
    a) 0.50, 0.50 b) 0.75, 0.25 c) 0.67, 0.33 d) 0.25, 0.75

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ANSWER KEY

1)	b	2)	d	3)	a	4)	d
5)	d	6)	d	7)	a	8)	c
9)	a	10)	c	11)	a	12)	b
13)	a	14)	a	15)	c	16)	a
17)	c	18)	a	19)	a	20)	a
21)	d	22)	c	23)	a	24)	a
25)	b	26)	c	27)	c	28)	d
29)	a	30)	c				

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SOLUTIONS

HINTS AND SOLUTIONS

1 **(b)**
It is the characteristic of super saturated solution, the meta stable state leading to saturated solution after few time.

2 **(d)**
The properties of solution which depend only on the number of solute particles but not on the nature of the solute taken are called colligative properties.

3 **(a)**
$K = \frac{c_A}{c_B} = 10$
$\therefore\ K' = \frac{c_B}{c_A} = \frac{1}{10} = 0.1$

4 **(d)**
1. $P_A = X_A p_A^{\circ}$ true

2. $\pi = iMRT = MRT$ true (if van't Hoff factor $i = 1$)

3. i=[1+(y-1)x]

y= number of ions,
x = degree of ionization,
i=3 for $BaCl_2 x$=1(strong electrolyte)
i=(1+x) for $CH_3COOH\ x \ll 1(weak)$
i=1for sucrose (non-electrolyte)
i(for$BaCl_2$) >KCl>CH_3COOH > sucrose
Thus ,(c) is also true.

4. $\Delta T_f = k_f m$

k_f is dependent on solvent
Thus, freezing points [=T(solution)-ΔT_f) are different.
Thus, (d) is false.

5 **(d)**
Osmotic pressure is a colligative property *i.e.*, depends only upon the number of particles or ions in solution. More the number of ions in solution, more will be the osmotic pressure of solution
(i) 0.1 M urea and 0.1 M glucose will have same number of molecules in solution as they do not ionise.
(ii) KCl $\rightarrow K^+ + Cl^-$(2 ions)
5. $CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$ (3 ions)

$\therefore CaCl_2$ produces maximum number of ions.
$\therefore$ It will have highest osmotic pressure.

6 **(d)**
Mole of X, $n_x = \frac{3}{3+2} = \frac{3}{5}$

Moles of $Y, n_y = \frac{2}{3+2} = \frac{2}{5}$

$$P_T = P_x n_x + P_y n_y$$
$$= 80 \times \frac{3}{5} + 60 \times \frac{2}{5}$$
$$= 48 + 24 = 72\ Torr$$

8 **(c)**

Osmotic pressure is a colligative property . More the number of particles (or ions) in solution, more will be osmotic pressure.

Nacl solution

Given , mass of NaCl =7 g V=1L

∴ Concentration

$$= \frac{\text{mass}}{\text{mol.mass}} = \frac{7}{58.5} = 0.119\ M$$

NaCl dissociates as follows

$$NaCl \rightarrow Na^+Cl^-\ (2 \text{ ions})$$

∴ Concentration of ions in solution

$$= 2 \times 0.119\ M$$
$$= 0.0238\ M$$

MgCl solution

Given, mass of $MgCl_2$=7g, V=1L

∴ Concentration== $\frac{mass}{mol.mass} = \frac{7}{95} = 0.0747$

$MgCl_2$ dissociates as follows

$$MgCl_2 \rightarrow Mg^2 + 2Cl^-\ (3 \text{ ions})$$

∴ Concentration of ions in solution =3×0.074 M

=0.222 M

∵ Number of particles in solution *B*(NaCl)are more than in solution *A*. ∴ Osmotic pressure of solution *B*(NaCl) will be more than solution *A*.

9 **(a)**

Elevation in boiling point is a colligative property which depends upon the number of solute particles. Greater the number of solute particle in a solution higher the extent of elevation in boiling point. Na_2SO_4, gives maximum ions hence, it exhibits highest boiling point

10 **(c)**

$\Delta T_b = im\ k_b = 0.52 \times 1 \times 2 = 1.04$

$\therefore T_b = T + \Delta T_b = 100 + 1.04 = 101.04°C$

11 **(a)**

Molality, $m = \frac{\text{no.of moles of solute}}{\text{weight of solution in kg}}$

$$= \frac{1000 \times w_1}{m_1 W_1}$$
$$= \frac{1000 \times 0.6}{60 \times 200}$$
$$= 0.05$$

$[\therefore Molecular\ weight\ of\ NH_2CONH_2 = 60]$

Given, $\Delta T_b = 0.05$

$$\Delta T_b = K_b \times m$$

or $0.05 = K_b \times 0.05$

$\therefore K_b = 10\ K\ mol^{-1}$

12 **(b)**

This relation is equation for Gibbs phase rule for heterogeneous systems.

13 **(a)**

Molarity $= \frac{\text{of solution} \times 10(\text{in litre})}{\text{M}}$

where, M = molecular weight of the solute

Molarity $= \frac{40 \times 1.2 \times 10}{M \times 1000}$ ...(i)

Molarity $= \frac{\text{weight of the solute /M}}{\text{volume of solution (in litre)}}$ ...(ii)

From Eqs. (i)and(ii)

$\frac{\text{weight of solute}}{M \times 1000} = \frac{40 \times 1.2 \times 10}{M \times 1000}$

Weight of solute $= 480$ g

14 **(a)**

$\Delta T = \frac{1000 \times k_f \times w}{m \times 500}$

$0.74 = \frac{1000 \times 1.86 \times 20}{m \times 500}$

$m = 100$

Actual molecular mass $= 100$

$\therefore$ The degree of ionisation of the electrolyte is 0% .

15 **(c)**

Molality is defined as the number of moles per 1000 g of solvent. Molality of water $= \frac{1000}{18} =$ 55.5m

16 **(a)**

For a given amount of solute in two solvents,

$K = \frac{\text{concentration of solute I}}{\text{concentrtion of solute II}}$

17 **(c)**

The solutions having the same osmatic pressure are called isotonic solution. They have same weight concentrations

18 **(a)**

$$K_3[Fe(CN)_6] \longrightarrow 3K^+ + Fe(CN)_6^{3-}$$

Before dissociation	1	0	0
After dissociation	0	3	1

Total no. of particles furnished by $K_3[Fe(CN)_6] = n = 4$

$\therefore$ van't Hoff's fator, $i = 4$

Now $\Delta T_f = \frac{1000 \times K_f \times w}{m \times W} \times i$

$= \frac{1000 \times 1.86 \times 0.1 \times 4}{329 \times 100}$

$= 2.3 \times 10^{-2}\,^{\circ}C$

$\therefore$ $T'_f = 0 - 2.3 \times 10^{-2}$

$= -2.3 \times 10^{-2}\,^{\circ}C$

19 **(a)**

$P_{N_2} = K_H \times$ mole $-$ fraction (N_2)

mole-fraction

$(N_2)\frac{1}{10^5} \times 0.8 \times 5 = 4 \times 10^{-5} mol^{-1}$

In 10 mole solubility is 4×10^{-4}.

20 **(a)**

van't Hoff factor greater than 1 means observed value is greater than calculated value which is so when the solute dissociates .

21 **(d)**

All are conditions for Henry's law.

22 **(c)**

2 % acetic acid solution

$= \frac{2\times1000}{60\times100}$M acetic acid
$=0.33$ M acetic acid

As the solution of compound "X" is isotonic to acetic acid solution, the molarity of solution of "X" will also be equal to 0.33 M. This is 5% solution. Hence

Mol.wt. of "X"$=\frac{5\times1000}{0.33\times100} = 150$

23 **(a)**

Osmotic pressure is a colligative property.

24 **(a)**

$$\Delta T = \frac{1000 \times K_f \times w}{m \times W}$$

$$\therefore \quad W = \frac{\Delta T \times m \times W}{1000 \times K_f}$$

$$= \frac{2.8 \times 62 \times 1000}{1000 \times 1.86} = 93.33 \text{ g}$$

25 **(b)**

Addition of non-volatile solute always lowers the vapour pressure.

26 **(c)**

Both the molecules are polar and possess dipole.

27 **(c)**

Vapour pressure is independent of surface area and volume of container.

28 **(d)**

Elevation in boiling point is a colligative property, which depends upon the nmber of particles in solution. $Al(NO_3)_3$ give maximum ions (4 ions) in solution, hence , its elevation in boiling point will be the highest. Hence, boiling point of 0.1 M $Al(NO_3)_3$ solution will be the highest.

29 **(a)**

"Solutions having same osmotic pressure are called isotonic solutions." The osmotic pressure is given as

$$\therefore \quad \pi = \frac{w_b RT}{VM_B}$$

π (cane sugar)$=\pi$ (unknown solute)

$$\frac{5.12}{342} = \frac{0.9}{M}$$

$$M = \frac{342\times0.9}{5.12}$$

$$=60$$

30 **(c)**

$pV = n$RT

$1\times 41 = n \times 0.0821 \times 500$

$n = 0.998$ mol

The no. of moles of ethane $= x$

so no. of moles of ethane $= (0.998 - x)$

Reaction of ethane and ethene with O_2:

(i) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

(ii) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

According to (i) reactions

2 mole ethane reacts with $=7$ mole O_2

x mole ethane react with $= \frac{7x}{2}$ mole O_2

According to (ii) reactions

1 mole ethene reacts with $= 3$ mole O_2

$(0.998 - x)$mole ethene reacts $=3\ (0.998-x)$mole of O_2

$\frac{7x}{2} + [3\ (0.998-x)] = \frac{10}{3}$mole of O_2

$3.5x + 2.994 - 3x = \frac{10}{3}$ mole of O_2

$0.5x = 3.333 - 2.994 = 0.3393$

$x = \frac{0.3393}{0.5} = 0.678$ mole of ethane

moles of ethene $= 0.998 - 0.678 = 0.32$