Self Practice Paper (SPP)

1. Solutions having the same osmotic pressure are called
(1) isotonic solutions (2) molar solutions (3) hypotonic solutions (4) ideal solutions

2. A colligative property of a solution depends on the
(1) arrangement of atoms in solute molecule. (2) total number of molecules of solute and solvent
(3) number of molecules of solute in solution. (4) mass of the solute molecules.

3. When 0.6 gm of urea dissolved in 100g of water, the water will boil at (K_b for water = 0.52 kJ. mol^{-1} and normal boiling point of water = 100°C) :
(1) 373.052 K (2) 273.52 K (3) 372.48 K (4) 273.052 K

4. The osmotic pressure of a solution is given by the equation :
(1) $p = \frac{CR}{T}$ (2) $\frac{\pi}{C} = RT$ (3) $p = \frac{CT}{R}$ (4) $p = \sqrt{C} \cdot \frac{R}{T}$

5. The relative lowering of vapour pressure is equal to the mole fraction of the solute. This is the statement of:
(1) Raoult's law (2) Boyle's law
(3) Osmotic pressure law (4) Graham's law

6. Azeotropes are :
(1) liquid mixtures which distil unchanged in composition
(2) liquids which can mix with each other in all proportions
(3) solids which form solid solutions of definite compositions
(4) gases which can be separated.

7. Swimming for a long time in salt water makes the skin of one's finger tips wrinkled. Which one of the following properties is responsible for this observation ?
(1) osmosis (2) dialysis (3) electrodialysis (4) coagulation.

8. A 2% solution of glucose has the same elevation in the boiling point as that of a 5% solution of a non-volatile solute. The molar mass of the solute is :
(1) 180 (2) 450 (3) 72 (4) 18

9. A 1.0 molal solution with the lowest freezing point is that of :
(1) $FeCl_3$ (2) HCl (3) KCl (4) $MgCl_2$.

10. From among the following, the aqueous solution which has the highest freezing point depression is :
(1) 0.1 M $Sr(NO_3)_2$ (2) 0.1 M KCl (3) 0.1 M HNO_3 (4) 0.1 M glucose.

11. In chemical industries, the preferred method of purification of liquids is :
(1) differential extraction (2) fractional distillation
(3) chromatography (4) leaching.

12. The solubility of a gas in a liquid is driectly proportional to the partial pressure of the gas over the solution. This statement is known as:
(1) Raoult's law (2) Henry's law
(3) Boyle's law (4) Charles' and Gay Lussac's Law

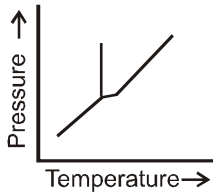
13. Which of the following is not a colligative property ?
(1) solubility. (2) vapor pressure lowering.
(3) boiling point elevation. (4) osmotic pressure.

14. Which of the following has the lowest freezing point and the highest boiling point?
(1) 1.5 m magnesium phosphate (2) 1.0 m sodium chloride
(3) 1.5 m aluminum nitrate (4) 1.5 m calcium chloride

15. A solution of urea was found to be isotonic with a solution of salt XY of molecular weight 74.6. If 0.15 moles of urea are dissolved in a certain volume V mL of the isotonic solution, the amount of salt in the solution will be :
(1) 22.4g (2) 5.6 g (3) 11.2 g (4) 7.46 g

16. The desalination of sea water involves the phenomenon of :
(1) Sedimentation (2) Distillation (3) Precipitation (4) Reverse osmosis

17. According to this phase diagram, which phases can exist at pressures lower than the triple point pressure ?



(1) gas only (2) solid and gas only
(3) liquid only (4) solid and liquid only

18. For a dilute solution, Raoult's law states that :
(1) the lowering of vapour pressure is equal to the mole fraction of the solute.
(2) the relative lowering of vapour pressure is equal to the mole fraction of the solute
(3) the vapour pressure of solution is equal to the mole fraction of solution.
(4) the relative lowering of vapour pressure is proportional to the amount of solute in the solution.

19. A mixture of two liquids which boils without change in composition is called
(1) Stable mix ture (2) Binary liquid mixture
(3) Azeotropic mixture (4) Zerotropic mixture

20. The aqueous solution having osmotic pressure nearest to that of an equimolar solution of $K_4[Fe(CN)_6]$ is
(1) K_2SO_4 (2) Na_3PO_4 (3) $Al_2(SO_4)_3$ (4) $C_6H_{12}O_6$

21. The elevation in boling point of a solution containing 13.44 g of $CuCl_2$ in 1 kg of water is :
(K_b = 0.52 K kg mol^{-1})
(1) 0.05 (2) 0.10 (3) 0.16 (4) 0.21

22. The freezing point of a solution containing 8.1 g of HBr in 100 g of water, assuming the acid to be 90% ionized is [H = 1, Br = 80, K_f for water = 1.86 K kg mol^{-1}]
(1) 0.85ºC (2) –3.53ºC (3) 0ºC (4) –0.35ºC

23. Which of the following observation indicates colligative properties ?
I. A 0.5 M NaBr solution has a higher vapour pressure than 0.5 M $BaCl_2$.
II. A 0.5 M NaOH solution freezes at a lower temperature than pure water.
III. Pure water freezes at a higher temperature than pure ethanol.
(1) Only I (2) Only II (3) Only III (4) I and II

24. Osmotic pressure of a 2 % w/v solution of glucose is same as 5% w/v solution of a nonvolatile non-electrolyte solute. The molar mass of the solute is :
(1) 180 (2) 450 (3) 72 (4) 45

25. The colligative property used in the determination of molar mass of a polymer is :

(1) lowering of the vapour pressure (2) elevation in the boiling point
(3) depression in the freezing point (4) osmotic pressure.

26. Mole fraction of $C_3H_5(OH)_3$ in a solution of 36 g of water and 46 g of glycerine is :
(1) 0.46 (2) 0.36 (3) 0.20 (4) 0.40

27. Colligative properties have many practical uses, some of them may be :
I : Melting of snow by salt
II : Desalination of sea water
III : Determination of molar mass
IV : Determination of melting point and boiling point of solvent
Actual practical uses are :
(1) I, II (2) III, IV (3) I, II, III (4) II, III, IV

28. Select correct statement(s) :
(1) When solid $CaCl_2$ is added to liquid water, the boiling temperature rises
(2) When solid $CaCl_2$ is added to ice at 0°C, the freezing temperature falls
(3) Both (1) and (2)
(4) None of the above

29. If $pK_a = -\log K_a = 4$, and $K_a = Cx^2$ then Van't Hoff factor for weak monobasic acid when C = 0.01 M is :
(1) 1.01 (2) 1.02 (3) 1.10 (4) 1.20

30. Consider following terms (m = molality) :

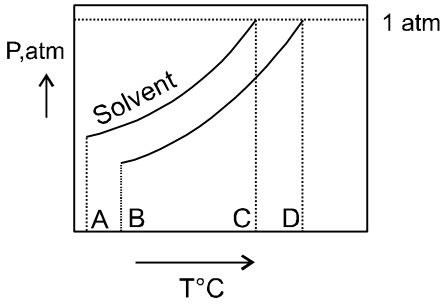
I : mK_b ; II : mK_bi III : $\frac{\Delta T_b}{i}$ IV : K_b

Terms which can be expressed in degree (temperature) are
(1) III, IV (2) I, II (3) I, II, IIII (4) I, III

31. Elevation in b.p. of an aqueous urea solution is 0.52°. (K_b = 0.52° mol^{-1} kg) Hence, mole-fraction of urea in this solution is :
(1) 0.982 (2) 0.567 (3) 0.943 (4) 0.018

32. Two solutions of a substance (non electrolyte) are mixed in the following manner. 480 ml of 1.5 M first solution + 520 mL of 1.2 M second solution. What is the molarity of the final mixture ?
(1) 1.20 M (2) 1.50 M (3) 1.344 M (4) 2.70 M

33. What is the normal boiling point of the solution represented by the phase diagram ?



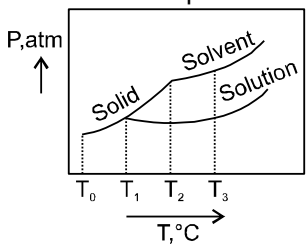
(1) A (2) B (3) C (4) D

34. An aqueous solution of a solute AB has b.p. of 101.08°C (AB is 100% ionised at boiling point of the solution) and freezes at – 1.80°C. Hence, AB (K_b / K_f = 0.3)
(1) is 100% ionised at the f.p. of the solution
(2) behaves as non-electrolyte at the f.p. of the solution
(3) forms dimer
(4) none of the above

35. Density of 1M solution of a non-electrolyte $C_6H_{12}O_6$ is 1.18 g/mL. If K_f (H_2O) is 1.86° mol^{-1} kg, solution freezes at :
(1) – 1.58°C (2) – 1.86°C (3) – 3.16°C (4) 1.86°C

36. Which one of the following aqueous solutions will exhibit highest boiling point ?
(1) 0.01 M Na_2SO_4 (2) 0.01 M KNO_3 (3) 0.015 M urea (4) 0.015 M glucose

37. What is the normal freezing point of the solution represented by the phase diagram ?



(1) T_1 (2) T_2 (3) T_3 (4) T_0

38. Total vapour pressure of mixture of 1 mol of volatile component A (p_A° = 100 mmHg) and 3 mol of volatile component B (p_B° = 60 mmHg) is 75 mm. For such case :
(1) there is positive devitation from Raoult's low
(2) boiling point has been lowered
(3) force of attraction between A and B is smaller than that between A and A or between B and B
(4) all the above statements are correct

39. A colligative property of a solution depends on the :
(1) arrangement of atoms in solute molecule (2) total number of molecules of solute and solvent
(3) number of molecules of solute in solution (4) mass of the solute molecules

40. Which has maximum freezing point ?
(1) 6g urea solution in 100 g H_2O (2) 6g acetic acid solution in 100g H_2O
(3) 6g sodium chloride in 100 g H_2O (4) All have equal freezing point

41. If M_{normal} is the normal molecular mass and α is the degree of ionization of $K_3[Fe(CN)_6]$, then the abnormal molecular mass of the complex in the solution will be :
(1) $M_{normal}\ (1 + 2\alpha)^{-1}$ (2) $M_{normal}\ (1 + 3\alpha)^{-1}$ (3) $M_{normal}\ (1 + \alpha)^{-1}$ (4) equal to M_{normal}

42. The vapour pressure of a pure liquid A is 40 mmHg at 310 K. The vapour pressure of this liquid in a solution with liquid B is 32 mmHg. Mole fraction of A in the solution, if it obeys Raoult's law is :
(1) 0.8 (2) 0.5 (3) 0.2 (4) 0.4

43. Mole fraction of the toluene in the vapour phase which is in equilibrium with a solution of benzene (p° = 120 Torr) and toluene (p° = 80 Torr) having 2.0 mol of each is
(1) 0.50 (2) 0.25 (3) 0.60 (4) 0.40

44. An azeotropic solution of two liquids has a boiling point lower than either of them when it :
(1) shows negative deviation from Raoult's law (2) shows positive deviation from Raoult's low
(3) shows ideal behaviour (4) is saturated

45. The total concentration of dissolved particles inside red blood cells is approximately 0.30 M and the membrane surrounding the cells is semipermeable. What would the osmotic pressure (in atmosphere) inside the cells become if the cells were removed from the blood plasma and placed in pure water at 298 K ?
(1) 7.34 atm (2) 1.78 atm (3) 2.34 atm (4) 0.74 atm

SPP Answers

1.	(1)	**2.**	(3)	**3.**	(1)	**4.**	(2)	**5.**	(1)	**6.**	(1)	**7.**	(1)
8.	(2)	**9.**	(1)	**10.**	(1)	**11.**	(2)	**12.**	(2)	**13.**	(1)	**14.**	(1)
15.	(2)	**16.**	(4)	**17.**	(2)	**18.**	(2)	**19.**	(3)	**20.**	(3)	**21.**	(3)
22.	(2)	**23.**	(4)	**24.**	(2)	**25.**	(4)	**26.**	(3)	**27.**	(3)	**28.**	(3)
29.	(3)	**30.**	(3)	**31.**	(4)	**32.**	(3)	**33.**	(4)	**34.**	(2)	**35.**	(2)
36.	(1)	**37.**	(1)	**38.**	(4)	**39.**	(3)	**40.**	(1)	**41.**	(2)	**42.**	(1)
43.	(4)	**44.**	(2)	**45.**	(1)								

SPP Solutions

20. It will produce 5 ions.

21. $\Delta T_b = iK_b\, m$

$= 3\times 0.52 \times \dfrac{13.44/134.5}{1} = 0.3\times 0.52 = 0.16$

22. $\Delta T_f = (1 - \alpha + 2\alpha)\ 1.86 \times \dfrac{\frac{8.1}{81}}{0.1}$

$= 1.9 \times 1.86 = 3.53$

T_f of water = – 3.53ºC

23. I $\longrightarrow$ Relative lowering of vapour pressure

II $\longrightarrow$ Depression in freezing point.

III $\longrightarrow$ Comparision of melting point of two different compounds.

$\therefore$ I & II are indicating colligative properties.

24. $\pi_{gaseous} = \pi_{He}$

$$\frac{2}{180}\times\frac{1000}{100} = \frac{5}{M}\times\frac{1000}{100}$$

$$M = \frac{180\times 5}{2} = 450\,g$$

26. Mole of H_2O = $\dfrac{36}{18}$ = 2

Mole of glycerine = $\dfrac{46}{92}$ = 0.5

total mole = 2 + 0.5 = 2.5

Mole fractions of glycerine = $\dfrac{n_1}{n_1+n_2} = \dfrac{0.5}{2.5}$

X_0 = 0.2 Ans.

27. I. Melting of snow by salt : Depression in freezing point

II. Desalination of sea water : Reverse osmosis

III. Osmosis is used to determine the molar mass.

28. When non volatile solute added to solvent. Due to elevation in boiling point, boiling point ↑ and due to dispression in freezing point, freezing temperature ↓

29. $HA \rightleftharpoons H^+ + A^-$

$i = [1 + (y - 1) x] = 1 + x$

$pK_a = 4 = -\log K_a$

$\therefore \quad K_a = 10^{-4} = Cx^2$

$1 \times 10^{-4} = 0.01 \times x^2 \Rightarrow \quad x = 0.1 \quad \therefore \quad i = 1 + x = 1.1$

30. As $\Delta T_b = i K_b m$

so $iK_b m$ can be expressed in degree (Unit of temperature)

and $K_b m$ can be expressed in degree (Unit of temperature)

and $\frac{\Delta T_b}{i}$ can be expressed in degree (Unit of temperature)

But unit of K_b is mol^{-1} kg K

31. As ΔT_b = molality × K_b

$0.52 = m \times 0.52$

molality = 1 mol kg^{-1}

$\therefore$ urea = 1 mol

moles of water = $\frac{1000}{18} = 55.55$

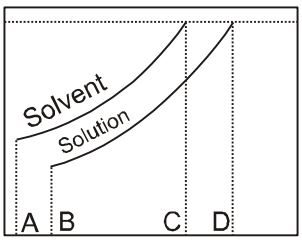
mole fraction of urea = $\frac{1}{56.55}$ = **0.018**

32. Total millimoles of solute = 480 × 1.5 + 520 × 1.2 = 720 + 624 = 1344.

Total volume = 480 + 520 = 1000.

Molarity of the final mixture = $\frac{1344}{1000}$ = 1.344 M.

33.



Normal boiling point of the solution is that temperature at which vapour pressure of solution equals to 1 atm.

34. Given $\Delta T_b = 1.08^0C$, $i = 2$ at boiling pt. of solution.

and $\Delta T_f = 1.80^0C$, and $\frac{k_b}{k_f} = 0.3$

so $\frac{\Delta T_b}{\Delta T_f} = \frac{i_b k_b m}{i_f k_f m}$

so $i_f = 1$

i.e., AB behaves as non–electrolyte at the f.p of the solution.

35. 1M $C_6H_{12}O_6$ (molar mass = 180 g mol^{-1})
1000 mL solution has = 180 g solute
1180 g solution has = 180 g solute
1000 g solvent has = 180 g solute
Thus, molality = 1 molal
$\therefore$ $\Delta T_f = K_f$ molality
$= 1.86 \times 1 = 1.86°$
$\therefore$ F.P. = – 1.86°C

36. Elevation in boiling point is a colligative property which depends upon the number of solute particles. Greater the number of solute particles in a solution, higher the extent of elevation in boiling point.

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

37. From given graph, we can say T_1 is that temp at which solid state and liquid (solution) are in equilibrium.

38. $P = P_A°X_A + P_B°X_B$

$$\frac{100}{4} + \frac{60 \times 3}{4}$$

= 70 mm < 75 mm (experimental)

Thus, there is positive deviation (1) is true, mixture is more volatile due to decrease in b.p. Thus, (2) is true also force of attraction is decreased thus (3) is true.

39. Colligative property of a solution depends on no. of particles of solute in solution.

40. Value of van't Hoff factor is least for urea solution, so there will be least depression in freezing point i.e., maximum freezing point.

41.

	$K_3[Fe(CN)_6]$	$\rightleftharpoons$	$3K^+$	+	$[Fe(CN)_6]^{3-}$	
At t = 0	1		0		0	
After ionization	$(1-\alpha)$		3α		α;	$i = 1 + 3\alpha$

Since, $i = \frac{M_{normal}}{M_{abnormal}}$

$\therefore$ $\frac{1+3\alpha}{1} = \frac{M_{normal}}{M_{abnormal}}$

42. $p_A = X_A p°_A$
$32 = X_A\, 40$
$\therefore$ $X_A = \frac{32}{40} = 0.8.$

43. $P_T = X_A p°_A + X_B p°_B$

$= \left(\frac{2}{4}\right) \times 80 + \left(\frac{2}{4}\right) \times 120 = 100$ Torr

Now mole fraction in vapour phase = $\frac{X_A P_A^0}{P_T} = \frac{40}{100} = 0.4.$

44. Boiling point get lowered when vapour pr. increases and it happens when there is a positive deviation from Raoult's law.

45. Osmotic pressure = CRT
$= 0.30 \times 0.082 \times 298 = 7.34$ atm