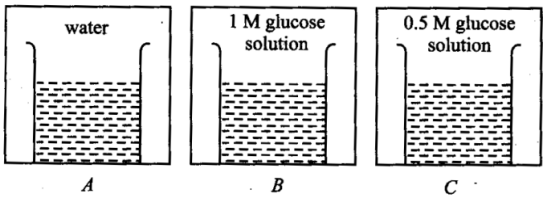
1. The unit of ebulioscopic constant is _____.
(a) K kg mol^{-1} or K (molality) $^{-1}$
(b) mol kg K^{-1} or K^{-1}(molality)
(c) Kg $mol^{-1}K^{-1}$ or $K^{-1}(molality)^{-1}$
(d) $K\,mol\,kg^{-1}$ or K (molality)

2. At a given temperature osmotic pressure of a concentrated solution of a substance _____.
(a) Is higher than that at a dilute solution.
(b) Is lower than that of a dilute solution
(c) Is same as that of a dilute solution
(d) Cannot be compared with osmotic pressure of dilute solution.

3. Solubility of a substance is its maximum amount that can be dissolve in a specified amount of solvent. It depends upon.
(i) Nature of solute
(ii) Nature of solven
(iii) Temperature
(iv) Pressure
(a) (i), (ii) and (iii) (b) (i), (iii) and (iv)
(c) (i) and (iv) (d) (i), (ii), (iii) and (iv)

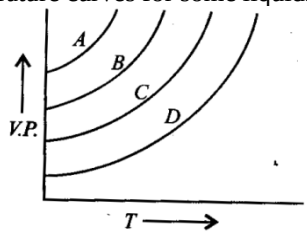
4. When a gas is bubbled through water at 298 K, a very dilute solution of gas is obtained. Henry's law constant for the gas is 100 kbar. If gas exerts a pressure of 1 bar, the number of moles of gas dissolved in 1 litre of water is
(a) 0.555 (b) 55.55×10^{-5}
(c) 55.55×10^{-3} (d) 5.55×10^{-5}

5. In three beakers labeled as (A), (B) and (C), 100 mL, of water, 100 mL of 1 M solution of glucose inwater are taken respectively and kept at same temperature.



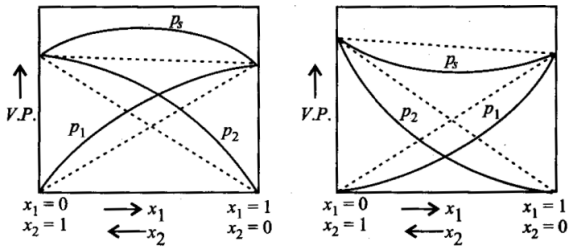
Which of the following statement is correct
(a) Vapour pressure in all the three beakers is same.
(b) Vapour pressure of beaker B is highest.
(c) Vapour pressure of beaker C is higher.
(d) Vapour pressure of beaker B is lower than that of C andvapour pressure of beaker C is lower than that of A.

6. The given graph shows the vapour pressure- temperature curves for some liquids.



Liquid A, B, C and D respectively are
(a) Diethyl ether, acetone, ethyl alcohol, water
(b) Acetone, ethyl alcohol, diethyl ether, water
(c) Water, ethyl alcohol, acetone, diethyl ether
(d) Ethyl alcohol, acetone, diethyl ether, water

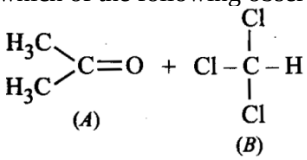
7. Study the figurer given below and mark the correct statement



(i) (ii)

(a) (i) Nitric acid + water (ii) Acetone + Ethyl alcohol
(b) (i) Water + Ethyl alcohol , (ii) Acetone+ Benzen
(c) (i) Acetone + Ethyl alcohol (ii) Acetone + chloroform
(d) (i) Benzene + Chloroform, (ii) Acetone+ Chloroform

8. When acetone and chloroform are mixed together, which of the following observation is correct



(a) A-A and B-B interactions are stronger than A-B interactions.
(b) A-A and B-B interaction are weaker than A-B interaction
(c) A-A , B-B and A-B interactions are equal
(d) The liquids from separated layer and are immiscible.

9. When acetone and chloroform are mixed together, hydrogen bonds are formed between them, which of the following statement is correct about the solution made by mixing acetone and chloroform
(a) On mixing acetone and chloroform will form an ideal solution
(b) On mixing acetone and chloroform positive deviation is shown since the vapour pressure increase
(c) On mixing acetone and chloroform negative deviation is shown since there is decreases in vapour pressure
(d) At a specific composition acetone and chloroform will form minimum boiling azeotrope.

10. Given below are few mixtures formed by mixing two components, which of the following binary mixtures will have same composition is liquid and vapour phase.
(i) Ethanol +Chloroform
(ii) Nitric acid+ water
(iii) Benzene + Toluene
(iv) Ethyl chloride + Ethyl bromide
(a) (i) and (iii) (b) (i) and (ii)
(c) (i), (ii) and (iii) (d) (iii) and (iv)

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

Column I	Column II
(A) K_b	(i) $\frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$
(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) $\frac{\Delta T_b \times dRT}{1000 \times k_b}$

(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)

12. 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 freezing point of pure water is $273.15\,K$?

(a) $273.07\,K$ (b) $269.07\,K$

(c) $273.15\,K$ (d) $260.09\,K$

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

Column I		**Column II**	
(A)	Ethyl alcohol + water	(i)	$\frac{P^o - P_s}{P^o} = \frac{n}{n+N}$
(B)	Benzene + Toluene	(ii)	Effect of pressure on gas solution
(C)	Henry's law	(iii)	Ideal solution
(D)	Raoult's law	(iv)	Azeotropic mixture

(a) (A) $\rightarrow$ (i), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (iv)

(b) (A) $\rightarrow$ (i), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)

(c) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (i)

(d) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (iv)

14. Relative lowering of vapour pressure osmotic pressure of a solution and elevation in boiling points (p)properties osmosis is the passage of (q)through a semipermeable membrane from a solution of (r)towards a solution of (s). Osmotic pressure is equivalent to mechanical pressure which must be applied on (t)to prevent osmosis.

In the above paragraph p, q, r, s and t respectively are

(a) Colligative, solution, higher concentration, lower concentration, solution

(b) Colligative, solvent, higher concentration, lower concentration, solution

(c) Colligative solvent, lower concentration, higher concentration, solution.

(d) Colligative, solvent, lower concentration, higher concentration, solution.

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

Column I		**Column II**	
(A)	k_b	(i)	$mol\,kg^{-1}$
(B)	M	(ii)	$mol\,L^{1}$
(C)	M	(iii)	$g\,L^{-1}$
(D)	Strength	(iv)	$K\,kg\,mol^{-1}$

(a) (A) $\rightarrow$ (i), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)

(b) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iii)

(c) (A) $\rightarrow$ (ii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (i)

(d) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (iv)

16. 2 g of sugar is added to one litre of water to give sugar solution. What is the effect of addition of sugar on the boiling point and freezing point of water?

(a) Both boiling point and freezing point increase

(b) Both boiling point and freezing point decrease

(c) Boiling point increase and freezing point decreases

(d) Boiling point decrease and freezing point increase

17. Which of the following representation of I (Van't Hoff factor) is not correct?

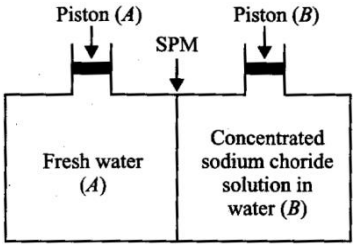
(a) $i = \frac{\text{Observed colligative property}}{\text{Expected coligative property}}$

(b) $i = \frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$

(c) $i = \frac{\text{Number of molecules actually present}}{\text{Number of molecules expected to be present}}$

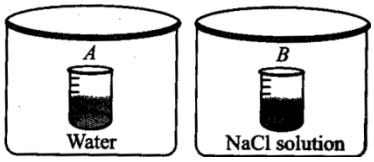
(d) $i = \dfrac{\text{Total number of particles taken before association / dissociation}}{\text{Number of particles after association / dissociation}}$

18. Consider the figure and mark the correct option.



(a) Water will move from side (A) to side (B) if a pressure lower than osmotic pressure is applied on piston (B).
(b) Water will from side (B) to side (a) if a pressure greater than osmotic pressure is applied on piston (B)
(c) Water will move from side (B) to side (A) if a pressure equal to osmotic pressure is applied on piston (B)
(d) Water will move from side (A) to side (B) if pressure equal to osmotic pressure is applied on piston (A).

19. Two beakers of capacity 500 mL were taken. One of these beaker, labeled as "A", was filled with 400 mL water of 2 M solution of NaCl. At the same temperature both the beakers were placed in closed containers of same material and same capacity as shown in figure



At a given temperature, which of the following statement is correct about the vapour pressure of pure water and that of NaCl solution.
(a) Vapour pressure in container (A) is more than that in container (B).
(b) Vapour pressure in container (A) is less than that in container (B)
(c) Vapour pressure is equal in both the containers.
(d) Vapour pressure in container (B) is twice the vapour pressure in container (A)

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

21. pH of 0.1(M) BOH (weak base) is found to be 12. The solution at temperature T K will display an osmotic pressure equal to
(a) 0.01 RT (b) $0.01(RT)^2$ (c) 0.11 RT (d) 1.1 RT

22. If liquid A and B form ideal solution, then
(a) $\Delta G_{mix} = 0$ (b) $\Delta H_{mixing} = 0$
(c) $\Delta G_{mix} = 0$, $\Delta S_{mix} = 0$ (d) $\Delta S_{mix} = 0$

23. A compound MX_2 has observed and normal molar masses 65.6 and 164 respectively. Calculate the apparent degree of ionization of MX_2 -
(a) 75 % (b) 85 % (c) 65 % (d) 25 %

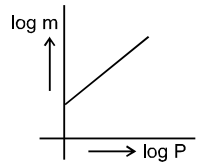
24. Two liquids A and B have $P_A^0 : P_B^0 = 1 : 3$ at a certain temperature. If the mole fraction ratio of $x_A : x_B = 1 : 3$, the mole fraction of A in vapour in equilibrium with the solution at a given temperature is -
(a) 0.1 (b) 0.2 (c) 0.5 (d) 1.0

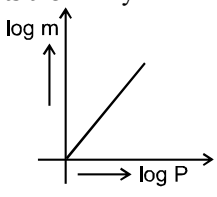
25. Equimolar solutions in the same solvent have :
(a) Same boiling point but different freezing point
(b) Same freezing point but different boiling point
(c) Same boiling and same freezing points
(d) Different boiling and freezing points

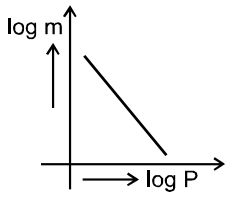
26. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is
(a) 3.28 mol Kg^{-1} (b) 2.28 mol Kg^{-1}
(c) 0.44 mol Kg^{-1} (d) 1.14 mol Kg^{-1}

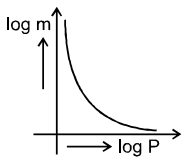
27. K_f for water is 1.86 K kg mol^{-1}. If your automobile radiator holds 1.0 kg of water, how may grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to -2.8^0C ?
(a) 72 g (b) 93 g (c) 39 g (d) 27 g

28. The dissolving process is exothermic when :
(a) The energy released in solvation exceeds the energy used in breaking up solute-solute and solvent-solvent interactions.
(b) The energy used in solvation exceeds the energy released in breaking up solute-solute and solvent-solvent interactions.
(c) The energy released in solvation is about the same as the energy used in breaking up solute-solute and solvent-solvent interactions.
(d) The energy used in solvation is about the same as the energy used in breaking up solute-solute and solvent-solvent interactions.

29. Which of the following curves represents the Henry's law ?
(a) 

(b) 

(c) 

(d) 

30. In the following aqueous solutions
(A) 1 m sucrose
(B) 1 m potassium ferricyanide and
(C) 1 m potassium sulphate maximum value of vapour pressure of solution is that of :
(a) A (b) B (c) C (d) Equal

1. (a) Unit of ebulioscopic constant (K_b) is K kg mol^{-1} or K (molality)$^{-1}$

$(\because \text{molality} = \text{mol kg}^{-1})$

2. (a) $\pi = CRT$

Greater the concentration of solution more will be its osmotic pressure. Thus, osmotic pressure of a concentrated solution of a substance is higher than that at a dilute solution.

3. (d) Solubility depends on all these factors.

4. (b) $p = k_H \times x$

$$x = \frac{p}{K_H} = \frac{1}{100 \times 10^3} = 1 \times 10^{-5}$$

$$\text{Mole fraction} = \frac{\text{Moles of gas}}{\text{Total moles}}$$

$$\text{Moles of } H_2O = \frac{1000}{18} = 55.55 \quad (\because 1L = 1000g)$$

$$\text{Mole fraction} = \frac{x}{x + 55.55} (55.55 >>> x)$$

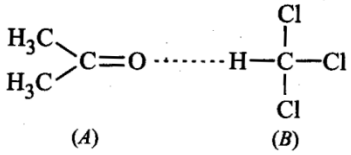
$$\therefore 10^{-5} = \frac{x}{55.55} \text{ or } x = 55.55 >>> x$$

5. (d) Vapour pressure of a solution containing non volatile solute is less than that of the pure solvent. The decrease in vapour pressure depends upon the quantity of non volatile solute present in it. Hence, vapour pressure of A > C > B

6. (a) The vapour pressure increase with increase in intermolecular forces. When the forces are weak, the liquid has high volatility and maximum vapour pressure diethyl ether has higher vapoour pressure while water has lowest vapour pressure.

7. (c) Acetone + ethyl alcohol solution shows positive
Deviation while acetone + chloroform shows negative deviation.
Other examples:
Positive deviations – Acetone + ethyl alcohol,
Acetone + benzene, water + ethyl alcohol,
Negative deviation – Nitric acid + water,
Benzene + chloroform

8. (b) When acetone and chloroform are mixed together a hydrogen bond is formed between them which increase intermolecular interactions, hence A – B interactions are stronger than A – A and A – B interactions.



9. (c) When acetone and chloroform are mixed together, hydrogen bonds are formed between them which increase intermolecular interactions hence deceases the vapour pressure showing negative deviation.

10. (b) (iii) and (iv) will form ideal solutions hence do not form azeotropes. Azeotropes have same composition in liquid and vapour from when distilled.

11. (d) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (ii)

12. (b) $\Delta T_f = \frac{k_f \times W_B}{M_B \times W_A}$

For cane sugar solution

$$2.15K = \frac{k_f \times 5}{342 \times 0.095}$$

(95 g of water = $0.095 kg$)

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

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

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

Freezing point of glucose solution

$= 273.15 - 4.085$

$= 269.07 K$

13. (c) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (i)

14. (d) Colligative, solvent, lower, concentration, higher concentration, solution

15. (b) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iii)

16. (c) When a non volatile solute is added to water there is elevation in boiling point and depression in freezing point.

17. (d)

$$i = \frac{\text{Total no. of particles after association / dissociation}}{\text{No. of particles taken before associaiton / dissociation}}$$

18. (b) Reverse osmosis will occur.

19. (a) When a non volatile solute (NaCl) is dissolved in a liquid its vapour pressure decrease.

20. (a) At specific composition methanol – acetone mixture will form minimum boiling azeotrope and will show positive deviation from Raoult's law.

21. (c)

pH = 12, pOH = 14 – 12 = 2, $[OH^-] = 10^{-2}$

$= 0.1\ \alpha$

or $\alpha = 0.1$

$i = 1 + (n - 1)\alpha = 1 + (2 - 1) \times 0.1 = 1.1$

$\pi = iCRT = 1.1 \times 0.1\ RT = 0.11\ RT$

22. (b)

For ideal solution $\Delta H_{mix} = 0$ and $\Delta V_{mix} = 0$.

23. (a)

$$i = \frac{\text{Theo. Mw.}}{\text{exp. Mw}}$$

$$= \frac{164}{65.6} = 2.5$$

$$\alpha = \frac{1 - i}{n - 1}$$

$$= \frac{2.5 - 1}{3 - 1} = 0.75$$

$\alpha = 75\ \%$

24. (a)

$$y_A = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}$$

$$y_A = \frac{1}{1 + \frac{P_B^0 X_B}{P_A^0 X_A}}$$

$$y_A = \frac{1}{1+(3)(3)} = \frac{1}{10} = 0.1$$

25. (c)

According to Raoult's law equimolal solutions of all the substances in the same solvent will show equal elevation in boiling points as well as equal depression in freezing point.

26. (b)

$$\text{Molality, } m = \frac{M}{1000d - MM_2} \times 1000$$

where M = molarity, d = density, M_2 = molecular mass

$$m = \frac{2.05}{1000 \times 1.02 - 2.05 \times 60} = 2.28 \text{ mol kg}^{-1}$$

27. (b)

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

$$2.8 = 1 \times 1.86 \times \frac{x}{62 \times 1}$$

$$x = \frac{2.8 \times 62}{1.86} = 93 \text{ gm}$$

28. (a)

Solvent-solvent interaction and solute-solute interaction are endothermic while solvent-solute interaction is exothermic. The sum of the three interaction determines whether ΔH_{sol} is endothermic as exothermic.

29. (a)

Henary's law is $m = K \cdot P$; where m = mass of gas absorbed by given volume of the solvent.

P = pressure of gas ;

$\therefore \log m = \log K + \log P$

30. (a)

Less is the no. of moles of solute present in the solution, Less is the lowering in vapour pressure, here least no of moles are of sucrose.