CHEMISTRY

BOOKS - PRADEEP CHEMISTRY (HINGLISH)

SOLUTIONS

PROBLEM

1. Calculate the molality and mole fraction of 2.5 g of ethanoic acid (CH_3COOH) in 75 g of benzene.

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2. Calculation the molarity and normality of a solution containing $9.8 \text{ g of } H_2SO_4$ in 250 cm^3 of the solution.

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3. Calculate the mole fraction of ethylene glycol $(C_2H_6O_2)$ in a solution containing 20% of $C_2H_6O_2$ by mass.

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4. Find the molaity and molatity of a 15% solution w/w of $H_2SO_4\left(\text{density of } H_2SO_4 = 1.02 gcm^{-3}\right)$.

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5. A solution has 25% of water,25% ethanol and 50% acetic acid by mass. Calculate the mol e fraction of each component.

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6. Calculate the molality of a sulphuric acid solution in which the mole fraction of water is 0.85.

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7. What volume of 95% sulphuric acid (density $= 1.85 \text{ g/cm}^3$) and what mass of water must be taken to prepare 100 cm^3 of 15% solution of sulphuric acid (density = 1.10 g/cm^3) ?

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8. Calculate the molarity of water if its density is $1000 kg / m^3$.

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9. The mole fraction fo benzene in a solution with toluene is 0.50 . Calculate the mass present of benzene in the solution.

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10. Calculate the normality of the solution obtained by mixing

100 cc of 0.2 N H_2SO_4 with 50 cc of 0.1 N HCl.

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11. Calculate the normality of the solution obtained by mixing

(ii) 100 cc of 0.1 N H_2SO_4 with 100 cc of 0.2 N NaOH.

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12. Calculate the normality of the solution obtained by mixing

(iii) 100 cc of 0.1 M H_2SO_4 with 100 cc of 0.1 M NaOH.

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13. What is the mole fraction of the solute in 2.5 m aqueous solutions ?

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14. A $6.90M$ solution of KOH contains 30% by weight of KOH. Calculate the density of the solution.

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15. Molarity of H_2SO_4 is 0.8 M and its density is $1.06gcm^{-3}$. What will be concentration of the solution in terms of molality and mole fraction ?

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16. One litre of a solution of N/2 HCl was heated in beaker and it was observed that when the volume of solution got reduce to 600 mL, 3.25 g of HCl was lost. Calculate the normality of the resulting solution.

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17. If N_2 gas is bubbled through water at $293K$, how many millimoles of N_2 gas would dissolve in$1L$ of water. Assume thatN_2 exerts a partial pressure of 0.987 bar. Given that Henry law constant for N_2 at $293K$ is 76.48 kbar.

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18. At what partial pressure, oxgyen will have a solubility of 0.05 g L^{-1} in water at 293 K ? Henry's constant (K_H) for O_2 in water at 293 K is 34.86 kbar. Assume the density of the solution to be same as that of the solvent .

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19. Air contains O_2 and N_2 in the ratio of $1:4$. Calculate the ratio of solubilities in terms of mole fraction of O_2 and N_2 dissolved in water at atmospheric pressure and room temperature at which Henry's constant for O_2 and N_2 are 3.30×10^7 torr and 6.60×10^7 torr respectively.

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20. The vapour pressure of chloroform $(CHCl)_3$ and dichlorocethene (CH_2Cl_2) at $298K$ is $200mmHg$ and $415mmHg$, respectively. Calculate

a. The vapour pressure of the solution prepared by mixing $25.5g$ of $CHCl_3$ and $40g$ of $CH_2\_Cl(2)$ at $298K$.

b. Mole fractions of each components in vapour phase .

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21. Two liquids X and Y one mixing form an ideal solution. At $30^\circ C$ the vapour pressure of the solution containing 3 moles of X and 1 mole Y is 550 mm Hg. But when 4 moles of X and 1 mole of Y are mixe, the vapour pressur of the solution thus formed is 560 mm Hg. What will be the vapour presure of pure and Pure Y at this temerature ?

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22. Ethylene dibromide $(C_2H_4Br_2)$ and 1, 2 - dibromo propane from a series of ideal solutions over the whole range of composition. At $85^\circ C$, the vapour pressure of these two liquids are 173 and 127 torr respectively. What would be the mole fraction of ethylene dibromide in a solution at $85^\circ C$ equilibrated with $1:1$ molar mixture in the vapour?

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23. At a given temperature, the vapour pressure in mm of Hg. of a solution of two volatile liquids A and B is given by the equation :

$\rho = 120 - 80X_B, X_B =$ mole fraction of B.

Vapour pressures of pure A and B at the same temperature are respectively

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24. At $90^{\circ} C$ th vapour pressure fo toluene is 400 mm and that of xylene is 150 mm. The mole of fraction of toluene in liquid mixture that will boil at $90(\circ)C$ when the pressure of mixture is 0.5 atm will be :

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25. The vapour pressure of water at $293K$ is $17.51mm$. The lowering of vapour pressure of sugar is $0.0614mm$. Calculate:

a. The relative lowering of vapour pressure

b.The vapour pressure of the solution

c. The mole fraction of water

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26. The vapour pressure of a 5% aqueous solution of a non-volatile organic substance at $373K$. Is $745mm$. Calculate the molecular mass of the solute.

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27. The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighting $0.5g$ when added to $39.0g$ of benzene (molar mass $78gmol^{-1}$). The vapour pressure of the solution then is 0.845 bar. What is the molar mass of the solid substance?

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28. At $298K$, the vapour pressure of water is $23.75mmHg$. Calculate the vapour pressure at the same temperature over 5% aqueous solution of urea. $\left[CO(NH_2)_2\right]$.

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29. A current of dry at was passed through a solution of 2.5 g of a non-volatile substance 'X' in 100 g of w ater and then through water along. The loss of weight of the former was 1.25 g and that of the latter was 0.05

g. Calculate (i) mole fraction of the solute in the solution (ii) molecular weight of the solute.

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30. Calculate the osmotic pressure of 0.01 M solution of cane-sugar at 300 K (R = 0.0821 litre atm/degree/mole).

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31. If this solution were placed in a tube of uniform cross-sectional area of $1cm^2$ with a semipermeable membrane at the lower end and this end is dipped in pure water, what will be hight of the vertical column developed ? Assume density of the solution as $1\,\mathrm{g\,m\,L}^{-1}$.

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32. Calculate the osmotic pressure at 273 K of a 5% solution of urea (Mol. Mass = 60). (R = 0.0821 litre atm/degree/mole).

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33. A solution containing 10 g/litre of surcose has an osmotic pressure of 0.66 atm at 273 K. Calculate the value of the constant R.

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34. Calculate the concentration of that solution of sugar which has osmotic pressure of 2.46 atmosphere at 300 K.

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35. $200cm^3$ of an aqueous solution of a protein contains $1.26g$of the protein. The osmotic pressure of such a solution at $300K$ is found to be

2.57×10^{-3} bar. Calculate the molar mass of the protein.

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36. A 4% solution of sucrose $C_{12}H_{22}O_{11}$ is isotonic with 3% solution of an unknown organic substance. Calculate the molecular mass of the unknown substance.

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37. Calculate the osmotic pressure of a solution obtained by mixing $100cm^3$ of 1.5% solution of urea (mol. Mass=60) and $100cm^3$ of 3.42% solution by cane sugar (mol. Mass = 342) at $20^{\circ}C$. (R=0.082 litre atm/deg/mole)

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38. 10 g of a substance were dissolved in water and the solution was made up to $250 cm^3$. The osmotic pressure of the solution was found to be $8 \times 10^5 Nm^{-2}$ (pascals) at 288 K. Find the molar mass of the solute.

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39. At $300K$, $36g$ of glucose present per litre in its solution has an osmotic pressure of 4.98^-. If the osmotic pressure of the solution is 1.52^- at the same temperature, what would be its concentration?

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40. At $300K$, two solutions of glucose in water of concentration $0.01M$ and $0.001M$ are separated by semipermeable membrane. Pressure needs to be applied on which solution, to prevent osmosis? Calculate the megitude of this applied pressure?

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41. Calculate the molal elevation constant of water, it being given that 0.1 molal aqueous solution of a substance boiled at $100.052^{\circ} C$.

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42. The boiling a point of benzene is 353.23K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is 2.53 K kg mol^{-1}.

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43. $18g$ of glucose $(C_6H_{12}O_6)$ is dissolved in $1kg$ of water in a saucepan. At what temperature will the water boil (at 1 atm) ? K_b for water is $0.52Kkgmol^{-1}$.

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44. Calculate the boiling point of solution containing $0.456g$ of camphor (molar mass =152) dissolved in $31.4g$ of acetone (boiling point $= 56.30^\circ C$), if the molar elevation constant per 100g of acetone is $17.2^\circ C$.

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45. A solution containing $0.5216g$ of naphthalene (mol.wt. $= 128.16$) in 50mL of CCl_4 shows boiling point elevation of 0.402° while a solution of $0.6216g$ of an unknown solute in the same weight of solvent gave a boiling point elevation of 0.647° . Find the molecular mass of the unknown solute.

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46. A solution containing $6g$ of a solute dissolved in $250cm^3$ of water gave an osmotic pressure of $4.5atm$ at $27^\circ C$. Calculate the boiling point of the solution.The molal elevation constant for water is $0.52^\circ C$ per 1000 g.

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47. Estimate the boiling point of a solution of 25.0g of urea $\mathrm{NH_2CONH_2}$ plus 25.0g of thiourea $\mathrm{NH_2CSNH_2}$ in 500g of choloform, $\mathrm{CHCl_3}$. The boiling point of pure choloform is $61.2^\circ\mathrm{C}$, $\mathrm{K_b}$ of choloform=3.63 $\mathrm{Km^{-1}}$

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48. An aqueous solution of glucose boils at $100.01^\circ C$.The molal elevation constant for water is $0.5kmol^{-1}kg$. The number of molecules of glucose in the solution containing $100g$ of water is

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49. A solution containing 34.2 g of cane-sugar $(C_{12}H_{22}O_{11})$ dissolved in $500cm^3$ of water froze at $-0.374^\circ C$. Calculate the freezing point depression constant of water.

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50. 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$. Find the molar mass of solute.

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51. $45g$ of ethylene glycol $C_2H_6O_2$ is mixed with $600g$ of water. Calculate (a) the freezing point depression and (b) the freezing point of solution. Given $K_f = 1.86 Kkgmol^{-1}$.

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52. A solution of urea in water has a boiling point of $100.128^\circ C$. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are $1.86^\circ C$ and $0.512^\circ C$ respectively.

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53. The average osmotic pressure of human blood is 7.7 atm at $40^\circ C$. (a) What would be the total concentration of the various solutes in the blood ? (b) Assuming the concentration to be essentially the same as the molality, find the freezing point of blood $\left(K_f \text{ for water } = 1.86^\circ C\right)$.

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54. A solution containing 2.56 g of sulphur dissolved in 100 g of naphthalene whose melting point is $80^\circ 1C$ gave a freezing point lowering of $0.680^\circ C$. Calculate the formula of sulphur (K_f for naphthalene = 6.8 K/m)

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55. How many grams of sucrose (molecular weight 342) should be dissolved in $100g$ water in order to produce a solution with $105^\circ C$

difference between the freezing point and the boiling point ? $(K_b = 0.51^{\circ} C m^{-1}, (K_f = 1.86^{\circ} C m^{-1})$

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56. The freezing point of a solution containing $50 cm^3$ of ethylene glycol in $50g$ of water is found to be $-34^{\circ} C$. Assuming ideal behaviour, Calculate the density of ethylene glycol (K_f for water = $1.86 K kg mol^{-1}$).

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57. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate freezing point of 10% glucose in water, if freezing point of pure is 273.15 K (Given molar mass of sucrose= 342 g mol^{-1}, Molar mass of glucose =180 g mol^{-1}).

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58. Calculate the amount of ice that will separated out when a solution containing 50 g of ethylene glycol in 200 g of water is colled to $-9.3^{\circ} C$. $\left(K_f \text{ for } H_2O = 1.86 \text{ K kg mol}^{-1}\right)$

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59. The freezing point depression of 0.1 molal solution of acetic acid in benzene is 0.256 K , K_f for benzene is 5.12 K Kg mol^{-1}. What conclusion can you draw about the molecular state of acetic acid in benzence ?

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60. $0.5g$ KCl was dissolved in $100g$ water, and the solution, originally at $20^{\circ} C$ froze at $-0.24^{\circ} C$. Calculate the percentage ionization of salt. K_f per $1000g$ of water =$1.86^{\circ} C$.

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61. Two grams of benzoic acid (C_6H_5COOH) dissolved in $25.0g$ of benzene shows a depression in freezing point equal to $1.62K$. Molal depression constant for benzene is $4.9Kkg^{-1}mol^{-1}$. What is the percentage association of acid if it forms dimer in solution?

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62. Calculate the boiling of one molar aqueous solution (density=1.04 g mL^{-1}) of potassium chloride $\left(K_b = 0.52 \text{ K kg mol}^{-1}\right)$

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63. There is KI and sucrose solution with 0.1 M concentration, if the osmotic pressure of KI and sucorse solution is 0.465 atm and 0.245 atm respectively. Then find the van't Hoff factor of KI and its degree of dissociation.

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64. $0.6mL$ of acetic acid (CH_3COOH) having density $1.06gmL^{-1}$ is dissolved in $1L$ of water. The depression in freezing point observed for this strength of acid was $0.0205^\circ C$.Calculate the Van't Hoff factor and dissociation constant of the acid. K_f for $H_2O = 1.86Kkg^{-1}\text{mol}^{-1}\big)$

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65. Assuming complete dissociation of the salts , calculate the molatity of sodium chloride solution whose elevation in boiling point is numerically equal to the depression in frezing point of 0.02 m aluminium sulphate solution in water $\big(K_b$ and k_f for water are 0.52 and 1.86 K kg mol^{-1} respectively).

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66. A decimolar solution of potassium ferrocyanide is 50% dissociated at $300K$. Calculate osmotic pressure of the solution. (Given $S = 8.341JK^{-1}mol^{-1}$)

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67. Arrange the following solutions in increasing order of their osmotic pressures .

(i)34.2 g/litre surcrose

(ii)60 g/litre of urea

(iii)90 g/litre of glucose

(iv)58.5 g/litre of sodium chloride

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SAMPLE PROBLEM

1. Calculate the molal elevation constant of water, it being given that its latent heat of vaporisation is $2.257kJ/g$.

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2. Latent heat of fusion of ice is $1436.3 \text{ cal mol}^{-1}$. Calculate the molal depression constant of water.

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CURIOSITY QUESTION

1. Why do aquatic species feel more comfortable in the lakes in winter than in summer ?

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2. Why pure ethyl alcohol cannot be obtained from rectified spirit (95.4% alcohol) even by fractional distillation ?

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3. Why oceans do not freeze ? Give two reasons.

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4. While making ice-creams in metal or plastic cones, the ice-cream seller puts a mixture of ice and common salt around the cones and not ice alone. Why?

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PROBLEMS FOR PRACTICE

1. Calculate the molarity and mole fraction of the solute in aqueous solution containing $3.0g$ of urea per $250gm$ of water (Mol. Wt. of urea = 60)

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2. Calcualate the molarity and molality of 20% aqueous ehtanol (C_5H_5OH) solution by volume. (density of solution $= 0.96gmL^{-1}$)

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3. A $10mL$ sample of human urine was found to have $5mg$ of urea on analysis. Calculate the molarity of the given sample w.r.t. urea. (molecular mass of urea = 60)

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4. An aqueous fo diabasic acid (molecular mass = 118) containing $35.4g$ of acid per litre of the solution has density $1.0077gmL^{-1}$.

Express the concentration in as many ways as you can?

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5. The concentration of H_2SO_4 in a botal labelled "conc. Sulphuric acid" is 18 M. The solution has a density of 1.84 g cm^{-3}. What is the mole fraction and weight percentage of H_2SO_4 in this solution?

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6. A $100cm^3$ solution of sodium carbonate is prepared by dissolving 8.653 g of the salt in water. The density of solution is 1.0816 g per millilitre. What are the molarity and molality of the solution ? (Atomic mass of Na is 23, of C is 12 and of O is 16).

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7. $4.0g$ of $NaOH$ is contained in one decilitre of aqueous solution. Calculate the following in the solution (d of $NaOH$ solution $= 1.038gmL^{-1}$)

a. Mole fraction of $NaOH$

b. Molartiy of $NaOH$

c. Molality of $NaOH$

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8. A solution contains 90 g of H_2O, 6.4 g of methanol and 18.4 g of glycerol. What is the mole fraction of glycerol ? $(\text{Glycerol} \quad = CH_2OH - CHOH - CH_2OH)$

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9. Calculate the molarity and normality of a solution containing 5 g of NaOH in 450 mL Solution.

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10. A sugar syrup of weight $214.2g$ contains $34.2g$ of sugar $(C_{12}H_{22}O_{11})$. Calculate (i) molal concentration and (ii) mole fraction of sugar in the syrup

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11. Concentrated HNO_3 is 69% by mass of nitric acid. Calculate the volume of the solution which contains $23g$ of HNO_3. (Density of concentrated HNO_3 solution is $1.41gml^{-1}$)

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12. Calculate the molality of 1 litre solution of 93% $H_2SO_4(\text{weight}/\text{volume})$. The density of solution is 1.84 g mL^{-1}.

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13. How many grams of Na_2CO_3 should be dissolved in 250 g of water to prepare 0.1 m solution?

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14. What is the mole fraction of ethanol and water respectively in a sample of rectified spirit which contains 95 % of ehtanol by weight ?

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15. Calculate the volume of $80\ \%\ H_2SO_4$ (density = 1.80 g/cc) required to prepare on litre of $20\ \%\ H_2SO_4$ (density = 1.25 g/cc).

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16. The solubility of $Ba(OH)_2 8H_2O$ in water at 298 K is 5.6 g per 100 g of water. What is the molality of the hydroxide ions in a saturatd solution of barium hydroxide at 298 K ? (Atomic mass of Ba =137, O=16)

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17. The density of a $3 M Na_2S_2O_3$ (sodium thiosulphate) solution is 1.25 g cm^{-3}. Calculate (i) the percentage by weight of sodium thiosulphate

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18. The density of a $3 M Na_2S_2O_3$ (sodium thiosulphate) solution is 1.25 g cm^{-3}. Calculate (ii) the mole fraction of sodium thiosulphate

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19. The density of a $3 M Na_2S_2O_3$ (sodium thiosulphate) solution is 1.25 g cm^{-3}. Calculate (iii) the molality of Na^+ and $S_2O_3^{2-}$ ions.

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20. Calculate the number of moles of methanol in 5 litres of its 2 m solution if the density of solution is 0.981 kgL^{-1} (Molar mass of methanol=32.0g mol^{-1}.

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21. $18g$ of glucose (molar mass $180g\text{mol}^{-1}$) is present in $500CM^3$ of its aqueous solution. What is the molarity of the solution? What additional data is required if the molality of the solution is also required to be calculated?

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22. An aqueous solution of sodium chloride is marked $10\,\%\,(w/w)$ on the bottle. The density of the solution is $1.071gmL^{-1}$. What is the molity and molarity? Also, what is the mole fraction of each components in the solution?

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23. H_2SO_4 used in lead storage cell is 38% by mass and has a density of 1.30 g cm^{-3}. Calculate its molarity.

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24. If $20.0cm'^{3}$ of 1.0 M CaCl_2 and 60.0 cm^3 of 0.20 M CaCl_2 are mixed, what will be the molarity of the final solution?

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25. Determine the molarity of an antifreeze solution containing 250 g water mixed with 222 g ethylene glycol $(C_2H_6O_2)$. The density of the solution is 1.07 g/mL.

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26. What volume of 10 % (w/v) solution of Na_2CO_3 will be required to neturalise 100 mL of HCl solution containing 3.65 g of HCl ?

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27. The Henry's Law constant for oxygen dissolved in water is $4.34 \times 10^{-4} Catm^{-1}$ at $25^\circ C$. If partial pressure of exygen in are is 0.2 atm. Under ordinary atmospheric conditions, calculate the concentration (in moles/litre) of dissolved oxygen in water in equilibrium with air at $25^\circ C$.

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28. The mole fraction of He gas in a saturated solution at $20^\circ C$ is 1.25×10^{-6}. Calculate the pressure of He gas above the solution . (K_H of He at $20^\circ C = 144.98$ k bar)

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29. Calculate the solubility of H_2 in water at $25^\circ C$ if its partial pressure above the solution is 1 bar. Given that Henry's constant for H_2 in water at $25^\circ C$ is 71.18 kbar.

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30. What concentration of nitrogen should be present in a glass of water at room temperatrure ? Assume a temperature of $25^\circ C$, a total pressure of one atmosphere and mole fraction of nitrogen in air as 0.78 $(K_H$ for nitrogen=8.42x$10^{-7}\frac{M}{mmHg}$

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31. The mole fraction of ethyl alcohol in its solution with methyl alcohol is $0.80.$ The vapour pressure of ethyl alcohol in the solution is 40mm of Hg. What is its vapour pressure in solution if the solution is ideal ?

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32. Benzene (C_6H_6) and toluene (C_7H_8) from a nearly ideal solution at 313 K. The vapour pressure of pure benzene and toluene are 160 mm of Hg and 60 mm of Hg respectively. Calculate the partial pressure of benzene and toluene and the total pressure over the following solutions :

(i) containing equal weights of benzene and toluene.

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33. Benzene (C_6H_6) and toluene (C_7H_8) from a nearly ideal solution at 313 K. The vapour pressure of pure benzene and toluene are 160 mm of Hg and 60 mm of Hg respectively. Calculate the partial pressure of benzene and toluene and the total pressure over the following solutions :

(ii) containing 1 mole of benzene and 4 moles of toluene.

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34. Benzene (C_6H_6) and toluene (C_7H_8) from a nearly ideal solution at 313 K. The vapour pressure of pure benzene and toluene are 160 mm of

Hg and 60 mm of Hg respectively. Calculate the partial pressure of benzene and toluene and the total pressure over the following solutions :

(iii) containing equal molecules of benznen and toluene.

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35. The vapour pressure of a pure liquid A is $40 mmHg$ at $310K$. The vapour pressure of this liquid in a solution with liquid B is $32 mmHg$. The mole fraction of A in the solution, if it obeys Raoult's law, is:

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36. Methanol and ethanol froms nearly ideal solution at 300 K. A solution is made by mixing 32g methanol and 23 g ethanol. Calculate the partial pressure of its constituents and the total pressure of the solution. (at 300 K , $p^{\circ}_{(CH_3OH)} = 90$ mm Hg, $p^{\circ}_{(C_2H_5OH)} = 51$ mm Hg).

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37. The vapour pressures of benzene and toluene at $20^{\circ} C$ are 75mmHg and 22mmHg respectively. $23.4g$ of benzene and 64.4 g of toluene are mixed. If the two form an ideal solution, calculate the mole fraction of benzene in the vapour phase if the vapours are in equilibrium with the liquid mixture at the same temperature.

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38. The liquids X and Y from ideal solution having vapour pressures 200 and 100 mm Hg respectively. Calculate the mole fraction of component X in vapour phase in equilibrium with an equimolar solution of the two .

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39. The vapour pressure of ethly acetate and ethly propionate are72.8mm abd 27.7mm of Hg respectively. A solution is prepared by mixing 25 g ethly acetate and 50 g of ethly propionate. Assuming to be ideal, calculate its vapour pressure.

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40. Benzene and toluene form nearly ideal solution. At a certain temperature, the vapour pressure of the pure benzene is 150 mm Hg and of pure toluene is 50 mm Hg. For this temperature, calculate the vapour pressure of solution containing equal weights of two substances. Also calculate their composition in the vapour phase.

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41. 0.75 mol of ethylene bromide were mixed with 0.25 mol ofpropylene bromide at 358 K to form nearly ideal solution. Vapour pressures of pure ethylene bromide and propylene bromide at 358 K are $2.77 \times 10^4 \mathrm{N\,m}^{-2}$ and $1.73 \times 10^4 \mathrm{N\,m}^{-2}$ respectively. Calculate the vapour pressure of the solution.

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42. The vapour pressure of 2.1% solution of a non- electrolyte in water at $100^{\circ} C$ is 755 mm Hg. Calculate the molar mass of the solute .

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43. A solution containing 6 g of benzoic acid in 50 g ether $(C_2H_5OC_2H_5)$ has a vapour pressure of 410 mm of mercury at 293 K. Given that the vapour pressure of ether at the same temperature is 442 mm of mercury, calculate the molecular mass of benzoic acid. (Assume that the solution is dilute).

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44. The vapour pressure of water is 92 mm at 323 K. 18.1 g of urea are dissolved in 100 g of water. The vapour pressure is reduced by 5 mm. Calculate the molar mass of urea.

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45. Calculate the vapour pressure at 295 K of a 0.1 M solution of urea. The density of the solution may be taken as $1g/cm^3$. The vapour pressure of pure wa ter at 295 K is 20 mm.

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46. The vapour pressure of an aqueous solution of cane sugar (mol.wt. 342) is 756mm at $100^\circ C$. How many grams of sugar are present per 1000g of water ?

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47. At $25^\circ C$, the vapour pressure of pure water is 23.76 mm of Hg and that of an aqueous dilute solution of urea is 22.98 mm of Hg. Calculate the molality of this solution?

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48. Vapour pressure of an aqueous solution of glucose is 750 mm of Hg at 373 K. Calcualte the molality and mole fraction of solution?

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49. How mich urea $\left(\text{molar mass } = 60 g mol^{-1}\right)$ must be dissolved in 50 g of water so that the vapour pressure at room temperature is reduced by 25% ? Also calculate the molality of the solution obtained.

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50. The vapour pressure of CS_2 at $50^{\circ} C$ is 854torr and a solution of $2.0 g$ sulphur in $100 g$ of CS_2 has vapour pressure 848.9torr. If the formula of sulphur molecule is S_n, then calculate the value of n. (at mass of $S = 32$).

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51. Urea forms an ideal solution in water. Determine the vapour pressure of an aqueous solution containing 10% by mass of urea at $40^\circ C$ (Vapour pressure of water at $40^\circ C = 55.3 mmHg$)

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52. A 0.2 percent aqueous solution of a non-volatile solute exerts a vapour pressure of 1.004 bar at $100^\circ C$. What is the molar mass of the solute ? (Given : vapour pressure of pure water at $100^\circ C$ is 1.013 bar and molar mass of water is 18 g mol^{-1})

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53. 20 g of solute was added to 100 g of water at $25^\circ C$. The vapour pressure of water and that of solution were 23.76 mm Hg and 22.41 mm Hg respectively at the temperature. Calculate the relative molecular mass of the solute.

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54. 30 g of urea (M=60g mol^{-1}) is dissolved in 846g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23.8 mm Hg.

(b) Write two differences between ideal solutions and non-ideal solutions,

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55. An aqueous of glucose $C_6H_{12}O_6$ has an osmotic pressure of 2.72 atmospheres at 298 K. How many moles of glucose were dissolved per litre of the solution ? (R = 0.082 lit. atm. $\text{mol}^{-1}\text{deg}^{-1}$)

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56. A solution of sucrose (molecular mass 342/mol) is prepared by dissolving 68.4 g of it per litre of solution. What is the osmotic pressure at 300 K ? (R = 0.082 lit. atm $\text{deg}^{-1}\text{mol}^{-1}$).

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57. Calculate the osmotic pressure of a solution containing 17.1 g of cane - sugar (molecular mass 342) in 500 g of water at 300 K (R = 0.082 lit. atm $deg^{-1}mol^{-1}$). Density of the solution of urea. Find the molecular weight of urea.

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58. A 5 percent solution (by mass) of cane-sugar (M.W. 342) is isotonic with 0.877% solution of substance X. Find the molecular weight of X.

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59. At 298 K, $100cm^3$ of a solution containing 3.002 g of an unidentified solute exhibits an osmotic pressure of 2.55 atmospheres. What is the molar mass of solute? (R = 0.0821 L atm. $\text{mol}^{-1}K^{-1}$)

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60. One litre aqueous solution of sucrose (molar mass = 342 g mol^{-1}) weighing 1015 g is found to record an osmotic pressure of 4.82 atm at 292 K. What is the molality of the sucrose solution?

(R = 0.0821 atm $\text{mol}^{-1}\text{K}^{-1}$).

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61. The osmotic pressure of blood is 8.21 atm at $37^{\circ} C$. How much glucose would be used for an injection that is at the same osmotic pressure as blood?

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62. A solution containing 10.2 g of glycrine per litre is found to be isotonic with 2% solution of glucose $\left(\text{molar mass} = 180 gmol^{-1}\right)$. Calculate the molar mass of glycrine.

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63. The osmotic pressure of 0.200 g of haemoglobin in 20.0 ml of solution is 2.88 torr at $25^{\circ} C$. Calculate the molecular weight of haemoglobin.

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64. At $300K$, $36g$ of glucose present per litre in its solution has an osmotic pressure of 4.98^{-}. If the osmotic pressure of the solution is 1.52^{-} at the same temperature, what would be its concentration?

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65. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL

of water has an osmotic pressure of 0.335 torr at $25^{\circ} C$.

Assuming that the gene fragment is a non-electrolyte, calculate its molar mass.

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66. 100 mg of a protein was disoved in just enough water to make 10 mL of the solution. If the solution has an osmotic pressure of 13.3 mm Hg at $25^\circ C$, what is the mass of prtein $\left(R = 0.0821 Latmmol^{-1}K^{-1}\right)$

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67. Calculate the molal elevation constant for chloroform from the fact its boiling point is $61.2^\circ C$ and 0.1 molal solution of an organic substance in chloroform boiled at $61.579^\circ C$.

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68. When 1.80 g of non-volatile compound is dissolved in 25.0 g of acetone, the solution boils at $56.86^\circ C$ while pure acetone boils at $56.38^\circ C$ under the same atmospheric pressure. Calculate the molar mass of compound. The molal elevation constant for acetone is 1.72°.

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69. A solution containing 36 g of solute dissolved in one litre of water gave an osmotic pressure of 6.75 atmosphere at $27^{\circ}C$. The molal elevation constant of water is $0.52^{\circ}C$. Calculate the boiling point of the solution.

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70. At $100^{\circ}C$ the vapour pressure of a solution of $6.5g$ of an solute in $100g$ water is $732mm$.If $K_b = 0.52$, the boiling point of this solution will be :

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71. Calculate the molar mass of a substance 1.3 g of which when dissolved in 169 g of water gave a solution boiling at $100.025^{\circ}C$ at a pressure of one atmosphere (K_b for water = $0.52\ \mathrm{K\ m}^{-1}$)

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72. $3.24g$ of sulphur dissolved in $400g$ benzene, boiling point of the solution was higher than that of benzene by $0.081K$. K_b for benzene is $2.53Kkgmol^{-1}$. If molecular formula of sulphur is S_n. Then find the value of n. (at.wt.of $S = 32$).

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73. 0.90g of a non-electolyte was dissolved in 87.9 g of benzene. This reised the boiling point of benzene by $0.25^{\circ}C$. If the molecular mass of the non-electrolyte is 103.0 g mol^{-1} , calculate the molal elecation constant for benzene.

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74. A solution of an organic compound is prepared by dissolving 68.4 g in 1000 g of water.

Calculate the molecular mass of the compound and osmotic pressure of the solution

at 293 K when elevation of b.pt is 0.104 and K_b for water is 0.52 K mol^{-1}.

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75. A solution prepared by dissolving $1.25g$ of oil of winter green (methyl sallicylate) in $99.0g$ of benzene has a boiling point of $80.31^\circ C$. Determine the molar mass of this compound. ($B.P.$ of pure benzene $= 80.10^\circ C$ and K_b for benzene $= 2.53^\circ Ckg\text{mol}.1$)

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76. A solution of glycerol $(C-(3)H_8O_3$, molar mass = 92 g mol^{-1} iin water was prepared by dissolving some glycero 500 g of water. This solution has a boiling point of $100.42^\circ C$. What mass of glycerol was dissolved to make this solution ? K_b for water=$0.512kkgmol^{-1}$.

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77. Normal freezing point of a solvent is $150^{\circ} C$. A 0.5 molal solution of urea in the above solvent causes a freezing point depression of two degrees. Calculate the molal depression constant

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78. Calculate the temperature at which a solution containing 54g of glucose, $(C_6H_{12}O_6)$, in 250g of water will freeze. (K_f for water = 1.86 K mol^{-1} kg)

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79. Water is used in car radiators. In winter season, ethylene glycol is added to water so that water may not freeze. Assuming ethylene glycol to be non-volatile, calculate the minimum amount of ethylene glycol to be non-volatile, calculate the minimum amount of ethylene glycol that must be added to 6.0 kg of water of prevent it from freezing at $-0.30^{\circ}C$. The molar depression constant of water is $1.86K/m$.

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80. Visha took two aqueous solutions, one containing 7.5 g of urea (Molar mass = 60 g/mol) and the other containing 42.75 g of substance Z in 100 g of water, respectively. It was observed that both the solutions froze at the same temperature. Calculate the molar mass of Z.

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81. Pure solvent A has freezing point $16.5^{\circ}C$. On dissolving 0.4 g of B in 200 g of A, the solution freezing at $16.4^{\circ}C$ and on dissolving 2.24 g of C in 100 g of A, the solution has freezing point of $16.0^{\circ}C$. If the molar mass of Bis 74 g mol^{-1}, what is the molar mass of C?

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82. An aqueous solution freezes at $-0.2^{\circ}C$. What is the molality of the soluiton ? Determines also (i) elevation in the boiling point (ii) lowering of vapour pressure at 298 K, given that $K_f = 1.86^{\circ}\text{kg mol}^{-1}, K_b = 0.512^{\circ} \text{ kg mol}^{-1}$ and vapour pressure of water at 298 K is 23.756 mm.

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83. A solution contains $68.4gms$ of cane sugar $(C_{12}H_{22}O_{11})$ in $1000gms$ of water. Calculate the following for this solution (a) Vapour pressure: (b) Osmotic pressure at $20^{\circ}C$, (c) Freezing point, (d) Boiling point. [density of the solution $= 1.024gmcm^{-3}$, vapour pressure of water $= 17.54mm$, latent heat of fusion $= 80\text{cal}cm^{-1}$]`

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84. An aqueous solution contains 10% by weight by urea $(60.00)$and 5% by weight of glucose (180.00). What will be its freezing point ? K_f

for water is 1.86.

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85. The addition of $0.643g$ of a compound to $50mL$ of benzene (density 0.879 g mL^{-1}) lowers the freezing point from 5.51 to $5.03^{\circ}C$. If K_f for benzene is 5.12, calculate the molecular weight of the compound.

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86. The temperature at a hill station is $-10^{\circ}C$. Will it be suitable to add ethylene glycol (mol mass = 62)to water in the radiator so that the solution is 30% by mass ? (K_f for water $= 1.86\text{K m}^{-1}$)

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87. The molal freezing point depression constant of benzene(C_6H_6) is $4.90Kkgmol^{-1}$. Selenium exists as a polymer of the type Se_x. When

$3.26g$ of selenium is dissolved in $226g$ of benzene, the observed freezing point is $0.112^{\circ}C$ lower than pure benzene. Deduce the molecular formula of selenium. (Atomic mass of $Se = 78.8gmol^{-1}$)

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88. A solution of an organic compound is prepared by dissolving 34.2 g in 500 g of water.

Calculate the molar mass of the compound and freezing point of the solution.

Given that K_b for water $= 0.52 \text{ K mol}^{-1}$ B.pt of solution $= 100.104^{\circ}C$. K_f for water $= 1.87\text{K mol}^{-1}$.

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89. A 0.1539 molal aqueus solution of cane sugar $(\text{mol mass} = 342gmol^{-1})$ has a freezing point of 271 K while freezing point ofpure water is 273.15 K. What will be the freezing point of an aqueus solution containing 5 g of glucose $\left(\text{mol. Mass} = 180 gmol^{-1}\right)$

per 100 g of water?

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90. What mass of ethylene glycol (molar mass = 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from $0^{\circ} C$ to $-10.0^{\circ} C$ (k_f for water = $1.86 \text{ K kg mol}^{-1}$).

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91. (a) Define the following terms :

(i) Mole fraction

(ii) Ideal solution

(b) 15.0g of an unknown molecular material is dissolved in 450g of water . The resulting solution freezes at $-0.34^{\circ} C$. What is the molar mass of the material ?

$\left(K_f \text{ for water} = 1.86 \text{ K kg } mol^{-1}\right)$

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92. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K ($K_f = 5.12 \text{ K kg mol}^{-1}$)

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93. A solution of glucose (Molar mass $= 180 \text{ g mol}^{-1}$) in water has a boiling of $100.20^{\circ} C$. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are $1.86 \text{ K kg mol}^{-1}$ and 0.512 K kg mol^{-1} respectively.

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94. 0.1 mol of sugar was dissolved in 1 kg of water. The freezing point of the solution was found to be 272.814 K. What conclusion would you draw about the molecular state of sugar? K_f for water is $1.86 \text{ K kg mol}^{-1}$.

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95. The freezing point depression of 0.1 molal NaCl solution is 0.372 K. What conclusion can you draw about the molecular state of NaCl in water. K_f of water = 1.86 k/m.

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96. Which of the following solution will have the highest freezing point and which will have the lowest freezing point and why ? (i) 0.1 M NaCl solution (ii) 0.1 M glucose solution (iii) 0.1 M $BaCl_2$ solution

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97. Calcualate the amount of $NaCl$ which must be added to $100g$ water so that the freezing point, depressed by $2K$. For water K_f = $1.86Kkgmol^{-1}$.

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98. Decinormal solution of NaCl developed an osmotic pressure of 4.6 atmosphere at 300 K. Calcualte its degree of dissociatoin (R = 0.082 $\mathrm{L\,atm\,K^{-1}mol^{-1}}$)

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99. Calculate the van't Hoff factor of $CdSO_4$ (molecular mass 208.4) if the dissolution of 5.21 g of $CdSO_4$ in half litre water gives a depression in freezing point of $0.168^{\circ}C$ (K_f of water is $1.86\ \mathrm{K\,kg\,mol^{-1}}$)

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100. Datermine the osmotic pressure of a solution prepared by dissolving $2.5 \times 10^{-2}g$ of K_2SO_4 in 2L of water at $25^{\circ}C$, assuming that it is completely dissociated.

(R = 0.0821 atm K^{-1} mol^(-1),Molar mass of K_2SO_4=174 g mol^(-1)`).

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101. 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated for dissociated).

$\left(\text{Given : Molar mass of benzoic acid} = 122 \text{ g mol}^{-1}, K_f \text{ for benzene} = 4.9 \text{ I}\right.$

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102. A $0.01m$ aqueous solution of $K_3[Fe(CN)_6]$ freezes ar $-0.062^\circ C$. What is the apparent percentage of dissociation? $[K_f$ for water $= 1.86]$

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103. Phenol associates in benzene to a certain extent to form a dimer. A solution containing 20×10^{-1} kg phenol in 1 kg of benzene has its freezing pint depressed by 0.69 K. Calculate the fraction of phenol that has dimerised. $\mathrm{K_f}$ for benzene $= 5.12 \text{ kg mol}^{-1}\text{k}.$

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104. Out of the following three solutions, which has the highest freezing point and why ?

(a) 0.1 M urea (b) $0.1 M BaCl_2$ (c) $0.1 M Na_2SO_4$

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105. Which of the following solutions have highest boiling point and why ? (a) 1M glucose (b) 1 M KCl (c) 1 M aluminium nitriate

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106. A aqueous solution containing 1.248 g of barium chloride (molar mass $= 208.34 \text{ g mol}^{-1}$) in 100 g of water boids at $100.0832^{\circ} C$. Calculate the degree of dissociation of $BaCl_2 \left(K_b \text{ for water } = 0.52 \text{ K kg mol}^{-1}\right)$.

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107. A decimolar solution of potassium ferrocyanide is 50% dissociated at 300K. Calculate the osmotic pressure of the solution. $\left(R = 8.314 \text{ J K}^{-1}\text{mol}^{-1}\right)$.

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108. On a certain hill station, pure water is found to boil at $95^{\circ}C$. How many grams of NaCl must be added to 2 kg of water so that it boils at $100^{\circ}C$?

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109. Depression in freezing point of 0.1 molal solution of HF is $-0.201^{\circ}C$. Calculate percentage degree of dissociation of HF. $\left(K_f = 1.86 Kkgmol^{-1}\right)$.

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110. Calculate the freezing point depression expected for 0.0711 m aqueous solution of Na_2SO_4 . If this solution actually freezes at $-0.320^\circ C$, what would be the value of Van't Hoff factor ?

(K_f for water is $1.86^\circ Cmol^{-1}$) .

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111. Calculate the boiling point of a solution containing $0.61g$ of benzoic acid in $50g$ of carbon disulphide assuming 84% dimerization of the acid. The boiling point and K_b of CS_2 are $46.2^\circ C$ and $2.3kgmol^{-1}$.

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112. What mass of $NaCI\left(\text{molar mass} = 58.5gmol^{-1}\right)$ be dissolved in $65g$ of water to tower the freezing point by $7.5^\circ C$? The freezing point depression constant, K_f, for water is $1.86Kkgmol^{-1}$. Assume van't Hoff factor for $NaCI$ is 1.87.

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113. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250 g of water . $(K_b = 0.512$ K kg mol^{-1} and molar mass of NaCl = 58.44 g mol^{-1})

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114. Calculate the freezing point of solution when 1.9 g of $MgCl_2$ (M = 95 g mol^{-1}) was dissolved in 50 g of water, assuming $MgCl_2$ undergoes complete ionization ($K_f \text{ for water} = 1.86 \text{ K kg mol}^{-1}$)

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ADVANCED PROBLEMS (FOR COMPETITIONS)

1. Two solution of H_2SO_4 of molarities x and y are mixed in the ratio of $V_1 mL : V_2 mL$ to form a solution of molarity M_1. If they are mixed in the ratio of $V_2 mL : V_1 mL$, they form a solution of molarity M_2. Given $V_1 / V_2 = \frac{x}{y} > 1 \text{ and } \frac{M_1}{M_2} = \frac{5}{4}$, then $x : y$ is

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2. You are given one litre each of 0.5 M HCl and 0.2 M HCl. Calculate the ratio in which they should be mixed so as to give maximum volume of 0.4 M HCl. What will be this volume ?

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3. A beaker containing $20g$ sugar in $100g$ water and another containing $10g$ sugar in $100g$ water are placed under a bell-jar and allowed to stand until equilibrium is reached. How much water will be transferred from one beaker to other?

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4. Vapour pressure of a saturated solution of a sparingly soluble salt A_2B_3 is 31.8 mm of Hg at $40^{\circ}C$. If vapour pressure of pure water is 31.9 mm of Hg at $40^{\circ}C$, calculate the solubility product of A_2B_3 at $40^{\circ}C$.

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5. The molar volume of liquid bezene (density $= 0.877 gmL^{-1}$) increase by a factor of 2750 as it vaporises at $20^{\circ}C$ and that of liquid toluene (density $0.867 gmL^{-1}$) increases by a factor of 7720 at $20^{\circ}C$. A solution of benzene and tuluene at $20^{\circ}C$ has a vapour pressure of 46.0 torr. Find the mole fraction of benzene in the vapour above the solution.

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6. At $10^{\circ}C$, the osmotic pressure of urea solution is $500 mm$.The solution is diluted and the temperature is raised to $25^{\circ}C$.when the osmotic pressure is found to be $105.3mm$. Determine the extent of dilution.

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7. Insulin $(C_2H_{10}O_5)_n$ is dissolved in a suitable solvent and the osmotic pressure (π) of solutions of various concentrations $(g/cm^3)C$ is measured at $20^\circ C$. The slope of a plot of π against C is found to be 4.65×10^{-3}. The molecular weight of insulin is:

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8. What is the ratio by weight of NaF and NaI which when dissolved in water produces the same obtained on evaporation of the salt solution is 0.48 g per 100 mL of solution evaporataed. Assume complete dissociation of the salts.

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9. If boiling point of an aqueous solution is $100.1^{\circ}C$. What is its freezing point? Given latent heat of fusion and vaporization of water are $80 cal g^{-1}$ and $540 cal g^{-1}$ respectively.

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10. 1000gm of sucrose solution in water is cooled to $-0.5^{\circ}C$. How much of ice would be separated out at this temperature, if the solution started to freeze at $-0.38^{\circ}C$. Express your answer in gram.

$\left(K_f H_2O = 1.86 K \text{mol}^{-1} kg\right)$

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11. A solution containing 0.1 mole of naphthalene and 0.9 mole of benzene is cooled out until some benzene freeze out. The solution is then decanted off from the solid and warmed upto 353 K where its vapour pressure was found to be 670 torr. The freezing point and boiling point of benzene are 278.5 K and 353 K respectively and its and its enthalpy of fusion is $10.67 \text{ kJ mol}^{-1}$. Calculate the temperature to which the solution was cooled originally and the amount of benzene that must have frozen out. Assume ideal behaviour.

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12. 1 g of a monobasic acid when dissolved in 100 g of water lowers the freezing point by $0.168^{\circ} C.0.2g$ of the same acid when dissolved and titrated required 15.1 mL of N/10 alkali solution. Calculate the degree of dissociation of the acid.

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13. A solution of monobasic acid with molarity 3×10^{-2}M has a freezing point depression of $0.06^{\circ} C$. Calculate pK_a of the acid (Molal depression constant of water is $1.86^{\circ} C/m$)

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14. A certain mass of a substance when dissolved in $100 g C_6H_6$ lowers the freezing point by $1.28^{\circ}C$. The same mass of solute dissolved in $100 g$ of water lowers of the freezing point by $1.40^{\circ}C$. If the substance has normal molecular weight in benzene and is completely dissocited in water, into how many ions does it dissocite in water ? K_f for H_2O and C_6H_6 are 1.86 and $5.12 K mol^{-1} kg$ respectively.

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15. An organic liquid A (immiscible with water) when boiled together with water, the boiling point is $90^{\circ}C$ at which the partial vapour pressure of water is 526 mm Hg. The atmospheric pressure is 736 mm Hg. The weight ratio of the liquid and water collected is 2.5 : 1. Calculate the molecular weight of the liquid.

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TEST YOUR GRIP (MULTIPLE CHOICE QUESTIONS)

1. Brass is

A. Solid solution

B. Liquid solution

C. Gas solution

D. All of these

Answer: D

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2. 200 ml of water is added of 500 ml of 0.2 M solution. What is the molarity of this diluted solution?

A. 0.5010 M

B. 0.2897 M

C. 0.7093 M

D. 0.1428 M

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3. In which mode of expression, the concentration of a solution remains independent of temperature?

A. Molarity

B. Normality

C. Formallity

D. Molality.

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4. Increasing the temperature of an aqueous solution wil case

A. decrease in molality

B. decrease in molarity

C. decrease in mole fraction

D. decrease in $\%$ w/w.

Answer: B

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5. Molarity of liquid HCl with density equal to 1.17g/cc is

A. 36.5

B. 18.25

C. 32.05

D. 42.10

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6. 5mL of $NHCI$, $20mL$ of $N/2H_2SO_4$ and 30 mL of $N/3HNO_3$ are mixed together and volume made to one litre. The normality of the resulting solution is

A. N/5

B. N/10

C. N/20

D. N/40

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7. Which one of the following gases has the lowest value of Henry law constant ?

A. N_2

B. He

C. H_2

D. CO_2

Answer: D

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8. An aqueous solution of methanol in water has vapour pressure

A. equal to that of water

B. equal to that of methanol

C. more than that of water

D. less than that of water

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9. 12.0 g urea is dissolved in 1 litre of water and 68.4 g sucrose is dissolved in 1 litre of water. The relative lowering of vapour pressure of urea solution is

A. greater than sucrose solution

B. less than sucrose solution

C. double that of sucorse solution

D. equal to that of sucrose solution.

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10. Formation of a solution from two componets can be considered as :

(i) pure solvent $\rightarrow$ separated solvent molecules, $\triangle H_1$

(ii) Pure solute $\rightarrow$ separated molecules, $\triangle H_2$

(iii) separated solvent and solute molecules $\rightarrow$ solution, $\triangle H_3$

solution so formed will be ideal if :

A. $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 + \Delta H_3$

B. $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 - \Delta H_3$

C. $\Delta H_{\text{soln}} = \Delta H_1 - \Delta H_2 - \Delta H_3$

D. $\Delta H_{\text{soln}} = \Delta H_3 - \Delta H_1 - \Delta H_2$

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11. The system that forms maximum boiling azeotrope is

A. carbon disulphide-acetone

B. benzene-toluene

C. acetone-chloroform

D. n-hexane - n-heptane

Answer: C

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12. The molal freezing point constant for water is $1.86^{\circ} C / m$. Therefore, the freezing point of 0.1 M NaCl solution in water is expected to be:

A. $-1.86^{\circ} C$

B. $-0.186^{\circ} C$

C. $-0.372^{\circ} C$

D. $+0.372^{\circ} C$

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13. What is the osomotic pressure of a $0.0020 \text{ mol dm}^{-3}$ sucrose $(C_{12}H_{22}O_{11})$ solution at $20^{\circ} C$?

(Molar gas constant, R $= 8.314 \text{ JK}^{-1}\text{mol}^{-1}$)

A. 4870 Pa

B. 4.87 Pa

C. 0.00487 Pa

D. 0.33 Pa

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14. Camphor is often used in molecular mass determination because

A. it is readily available

B. it has a very high cryoscopic constant

C. it is volatile

D. it is solvent for organic substances

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15. A5% solution of cane sugar (molar mass =342)is isotonic with 1% of a solution of an known solute.The molar mass of unknown solute in g/mol is

A. 136.2

B. 171.2

C. 68.4

D. 34.2

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16. The osmotic pressure of 0.1 M aqueous solution of NaCl is .... Osmotic pressure of 0.1 M aqueous solution of glucose

A. equal to

B. less than

C. half of

D. nearly double

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17. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at $-6^{\circ} C$ will be $\left(K_f\right.$ for water $= 1.86 K kg mol^{-1}$, and molar mass of ethylene glycol $= 62 g mol^{-1}\left.\right)$

A. 204.30g

B. 400.00 g

C. 304.60 g

D. 804.32 g

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18. If an aqueous solution of glucose allowed to freeze then crystal of which will be separated out first

A. glucose

B. water

C. both of these

D. none of these

Answer: B

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19. 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 0.01mole of sodium sulphate is dissoved in 1 kg of water,is $(K_f = 1.86 K kg mol^{-1})$

A. 0.0744 K

B. 0.0186 K

C. 0.0372 K

D. 0.0558 K

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20. Which of the following 0.1 m aqueous solution is likely to have the highest boiling points ?

A. Na_2SO_4

B. KCl

C. Glucose

D. Urea

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21. Four solutions of K_2SO_4 with the following concentration 0.1 m, 0.01 m, 0.001 m and 0.0001 m are available. The maximum value of Van't Hoff factor (i) will be of:

A. 0.0001 m solution

B. 0.001 m solution

C. 0.01 m solution

D. 0.1 m solution

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22. The Van't Hoff factor for a dillute aqueous solution of glucose is

A. 0.1

B. 1

C. 0.01

D. none of these

Answer: B

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23. The depression in freezing point for $1m$ urea,$1m$ glucose and $1mNaCl$ are in the ratio

A. $1:2:3$

B. $3:2:2$

C. $1:1:2$

D. none of these

Answer: C

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24. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively.

A. Greater than one and greater than one

B. Less than one and greater than one

C. Less than one and less than one

D. Greater than one and less than one

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25. The solubility of a substance in ether is $2.0 \times 10^{-3} M$.

The distribution coefficient of the substance in ether - water mixture is 4.

The solubility of the substance in ether is

A. $3.0 \times 10^{-4} M$

B. $5.0 \times 10^{-4} M$

C. $6.0 \times 10^{-4} M$

D. $8.0 \times 10^{-4} M$

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TEST YOUR GRIP (FILL IN THE BLANKS)

1. Hydrated salts are solution of ....in......................

Watch Video Solution

2. Molaliry of a solution is ....of the solute in ....of the ....

Watch Video Solution

3. An ionic compound dissolves in water if .... Energy is greater than...............energy.

Watch Video Solution

4. Solubility of gases in liquids decreases with rise in temperature because dissolution is an:

Watch Video Solution

5. The temperature above which $Na_2SO_4.10H_2O$ shows a change in behaviour in the solubility is called....... .

Watch Video Solution

6. At the same temperature, nitrogen gas is ....soluble in water than oxygen.

Watch Video Solution

7. According to Henry's law, the plot of ....versus....................is linear with slope equal to ....

Watch Video Solution

8. Assertion. Greater the value of Henry's constant of a gas in a particular solvent, greater is the solubility of the gas at the same pressure and temperature.

Reason. Solubility of a gas is directly propportional to its Henry's constant at the same pressure and temperature.

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9. In deep sea diving, the disease called bends or decompression sickness is caused due to dissolution of ....in the blood.

Watch Video Solution

10. For breathing. Deep-sea divers use a mixture of dioxygen and

Watch Video Solution

11. At altitude, concentration of oxygen in the blood is low. People feel weak and unable to think properly. This disease is called................ .

Watch Video Solution

12. The variation of vapour pressure with temperature is quantitatively studied by ....equation.

Watch Video Solution

13. For a non-ideal solution, $\Delta_{mix}V$ and $\Delta_{mix}H$ are zero.

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14. What are constant boiling mixture called?

Watch Video Solution

15. Assertion (A): Non-ideal solutions form azeotropic mixture.

Reason (R): The boiling point of an azeotropic mixture is only higher than boiling points of both components.

Watch Video Solution

16. The exact formula which can be applied to dilute as well as concentrated solutions is $\frac{p^{\circ} - p_s}{x} = \frac{n_2}{n_1}$ where x is ....

Watch Video Solution

17. The lowering of vapour pressure of a solvent by the addition of a non-volatile solute to . It , is directly proportional to ______.

Watch Video Solution

18. In osmosis , the net movement of solvent molecules is

Watch Video Solution

19. Osmotic pressure is the minimum pressure that has to be applied on the ....to prevent that entry of...........from ....to.................. .

Watch Video Solution

20. What will happen if pressure greater than the osmotic pressure is applied on the solution separated by a semi-permeable membrane from the solvent?

Watch Video Solution

21. Desalination of sea water is based on the phenomenon.............

Watch Video Solution

22. The semipermeable membrane generally used in the reverse osmosis is made up of ....

Watch Video Solution

23. Solutions having the same osmotic pressure are called:

Watch Video Solution

24. The rupturing of a plant or animal cell due to flow of water into it is called ....

Watch Video Solution

25. Shrinking of a plant cell in a hypertonic solution is called ....

Watch Video Solution

26. Red blood cells (RBC) are isotonic with .... $\% NaCl$ solution.

Watch Video Solution

27. A solution which has lower osmotic pressure compared to that of other solution is called ....

Watch Video Solution

28. People taking lot of salt experience puffiness or swelling of the body due to

Watch Video Solution

29. The best colligative property used for the determination of molecular mases of polymers is :

Watch Video Solution

30. The vapour pressure of water at $100^{\circ} C$ is ....bar .

Watch Video Solution

31. The molal elevation constant of water is .... while that of benzene is ....

Watch Video Solution

32. The molal depression constant of water is ....while that of benzene is ....

Watch Video Solution

33. Rast method is based upon the use of ....as solvent whose molal depression constant is ....

Watch Video Solution

Watch Video Solution

34. van't Hoff factor is the ratio of ....molecular mass to .... molecular mass.

Watch Video Solution

35. If van't Hoff factor is less than unity, this shows that the solute undergoes ....in the solution.

Watch Video Solution

36. In terms of osmotic pressure (π) and volume of the solution (V) containing n moles of the solute, van't Hoff factor (i) at temperature T = ...

Watch Video Solution

CONCEPTUAL QUESTIONS

1. When and why is molality preferred over molarity in handling solution in Chemistry?

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2. What is the effect of temperature on molarity of a solution?

Watch Video Solution

3. Which aqueous solution has higher concentration : 1 molar or 1 molal solution of the same solute ?

Watch Video Solution

4. V_1 cc of solution having molarity M_1 is diluted to have molarity M_2. Derive expression (in terms of $M_1, M_2 \text{ and } V_1$) for the volume of water required to be added.

Watch Video Solution

5. How is the molality of a solution different from its molarity?

Watch Video Solution

6. Why the solubility of Glauber,s salt $(Na_2SO_4 10H_2O)$ first increases up to $32.4^{\circ}C$ and then decreases ?

Watch Video Solution

7. Which of the following is not a substitutional solid?

Watch Video Solution

8. How is the solubility of gases in water related with their Henry's constants at the same presssure and temperature?

Watch Video Solution

9. Value of Henry's constant K_H...

Watch Video Solution

10. At a same temperature , hydrgone is more soluble in water than helium . Which of them will have a higher value of K_H and why ?

Watch Video Solution

11. Helium - oxygen mixture is used by deep sea divers in preference to nitrogen-oxygen mixture, because

Watch Video Solution

12. Why is the vapour pressure of liquid constant at a constant temperature ?

Watch Video Solution

13. Why vapour pressure of a liquid decreases when a non – volatile solute is added to it ?

Watch Video Solution

14. The bottle of liquid ammonia is generally cooled before opening the seal. Assign reson.

Watch Video Solution

15. $10ml$ of liquid A was mixed with $10ml$ of liquid B. The volume of the resulting solution was found to be `19.9ml what do you conclude?

Watch Video Solution

16. Two liquids A and$B$ on mixing produce a warm solution. Which type of deviation from Raoult's law does it show?

Watch Video Solution

17. Why does a solution of ethanol and cyclohexane show positive deviation from Raoult's law?

Watch Video Solution

18. 2 g each of the solutes A and B (mol mass of A gt B)

are dissolved separately in 20 g each of the same solvent C. Which will show gr eater lowering of vapour pressure and why ?

Watch Video Solution

19. Outer hard shells of two eggs are removed. One of the eggs is placed in pure water and the other is placed in saturated solution of sodium chloride. What will be observed and why?

Watch Video Solution

20. A peeled egg swells when dipped in water while shrinks in saturated brine solution. Why?

Watch Video Solution

21. What do you expect to happen when red blood corpuscles $(RBCs)$ are placed in $(a)0.5\% NaCl$ solution and $(b)1\% NaCl$ solution ?

Watch Video Solution

22. Given in the adjacent Fig. is the sketch of a plant for carrying out a process : $P_{\text{applied}} > \pi$

(i) Name the process occurring in the above plant.

View Text Solution

23. Given in the adjacent Fig. is the sketch of a plant for carrying out a process : $P_{\text{applied}} > \pi$

(ii) To which container does the net flow of solvent take place?

View Text Solution

24. Given in the adjacent Fig. is the sketch of a plant for carrying out a process : $P_{\text{applied}} > \pi$

(iii) Name one SPM which can be used in this plant.

View Text Solution

25. Given in the adjacent Fig. is the sketch of a plant for carrying out a process : $P_{\text{applied}} > \pi$

(iv) Give one practical use of the plant.

View Text Solution

26. When dehydrated fruits and vegetables are placed in water, they slowly swell and return to original form. Why? Would a temperature increase accelerate the process? Explain.

Watch Video Solution

27. Why does the use of pressure cooker reduce cooking time ?

Watch Video Solution

28. What will happen to the boiling point of a solutin if the weight of the solute dissolved is doubled but the weight of solvent taken is halved ?

Watch Video Solution

29. Why is camphor preferred as a solvent for measuring the molecular mass of naphthalene by Rast method?

Watch Video Solution

30. Why is camphor preferred in the determination of ΔT_f ?

Watch Video Solution

31. Why boiling point of water is increased on addition of sodium chloride into it ?

Watch Video Solution

32. Two liquids A and B boil $145^\circ C$and $190^\circ C$respectivly. Which of them has a higher vapour pressre at $80^\circ C$?

Watch Video Solution

33. Sodium chloride solution freezes at lower temperature then water but boils at higher temperature than water. Explain.

Watch Video Solution

34. Match the following if the molecular weights of X,Y and Z are the same.

Solvent	Boiling point	K_b
X	100°C	0.68
Y	27°C	0.53
Z	253°C	0.98

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35. What freezes out first when a solution of common salt is cooled?

Watch Video Solution

36. What is de-icing agent because it lowers the freezing point of water to such an extent that it does not freeze to from ice. Hence, it is used to clear snow from roads.

Watch Video Solution

37. Out of 1 M glucose and 2 M glucosee, which one has a higher boiling point why ?

Whay happens when the external pressure applied becomes more than the osmotic presure os solution ?

Watch Video Solution

38. 0.01 M solution of KCl and $CaCl_2$ are separately prepared in water. The freezing point of KCl is found to be $-2^\circ C$. What is the freezing point of $CaCl_2$ aq. Solution if it is completely ionized?

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39. Why is depression of freezing point of 0.1 M sodium chloride solution nearly twice that of 0.1 M glucose solution?

Watch Video Solution

40. Explain why equimolar aqueous solution chloride and sodium sulphate are not isotonic?

Watch Video Solution

41. Why melting point of a substance is used as a criterion for testing the purity of the substance.

Watch Video Solution

NCERT (QUESTIONS AND EXERCISES WITH ANSWERS)

1. Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if $22g$ of benzene is dissoved in $122g$ of carbon tetrachloride.

Watch Video Solution

2. Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.

Watch Video Solution

Watch Video Solution

3. Calculate the molarity of each of the following solution :

(a) $30 \text{ g of Co } (NO_3)_2.6H_2O$in 4.3 L of solution

(Atomic mass of cobalt = 58.7)

Watch Video Solution

4. Calculate the molarity of each of the following solution :

$30 \text{ mL of } 0.5 \text{ M } H_2SO_4$ diluted to 500 mL.

(Atomic mass of cobalt = 58.7)

Watch Video Solution

5. Calculate the mass of urea (NH_2CONH_2) required in making $2.5kg$of

0.25molal aqueous solution.

Watch Video Solution

6. Calculate the (a) molality, (b) molartiy, and (c) mole fraction of KI if the density of 20% (mass / mass) aqueous KI is $1.202 g mL^{-1}$.

Watch Video Solution

7. H_2S, a toxic gas with rotten egg like smell, is used for the qualitative analysis.If the solubility of H_2S in water at STP is $0.195 m$, calculate Henry's law constant.

Watch Video Solution

8. Henry's law constant for CO_2 in water is $1.67 \times 10^8 Pa$ at $298 K$. Calculate the quantity of CO_2 in $500 mL$ of soda water when packed under $2.5 atm CO_2$ pressure at $298 K$.

Watch Video Solution

9. The vapour pressure of pure liquids A and B is 450 and $700 mmHg$, respectively, at $350K$. Find out the composition of the liquid mixture if the total vapour pressure is $600 mmHg$. Also find the composition of the vapour phase.

Watch Video Solution

10. Vapour pressure of pure water at $298K$ is $23.8 mmHg$. $50g$ of urea (NH_2CONH_2) is dissolved in $850g$ of water. Calculate the vapour pressure of water for this solution and its relative lowering.

Watch Video Solution

11. Boiling point of water at 750 mm Hg is $99.63^{\circ} C$. How much sucrose is to be added to 500 g of water such that it boils at $100^{\circ} C$? Molal elevation constant for water is $0.52 \text{ K kg mol}^{-1}$.

Watch Video Solution

12. Calculate the mass of ascorbic acid (Vitamin $C, C_6H_8O_6$) to be dissolved in $75g$ of acetic acid to lower its melting poit by $1.5^\circ C$. $K_f = 3.9 Kkgmol^{-1}$

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13. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving $1.0g$ of polymer of molar mass $185,000$ in $450mL$ of water at $37^\circ C$.

Watch Video Solution

NCERT EXERCISES

1. Define the term solution. How many types of solutions are formed ? Write briefly about eaCHM type with an example.

Watch Video Solution

2. Suppose a solid solution is formed between two substances, one whose particles are very large and the other whose particles are very small. What kind of solide solution is this likely to be ?

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3. Define the following terms :

$a.$ Mole fraction $b.$ Molality

$c.$ Molarity `d. Mass percentage.

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4. Concentrated nitric acid used in the laboratory is 68% nitric acid by mass aqueous solution. What should be the molarity of such a sample of the acid if the density of the solution is 1.504 g mL^{-1}?

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5. A solution of glucose in water is labelled as $10\text{percent}w/w$, what would be the molality and mole fraction of each component in the solution? If the density of the solution is $1.2gmL^{-1}$, then what shall be the molarity of the solution?

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6. How many of 0.1 N HCl are required to react completely with 1 g mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of two ?

Watch Video Solution

7. A solution is obtained by mixing 300 g of 25% and 400 g of 40% solution by mass. Calculate the mass percentage of the resultng solution.?

Watch Video Solution

8. An antifreeze solution is prepared from $222.6g$ of ethylene glycol $[C_2H_4(OH)_2]$ and $200g$ of water. Calculate the molality of the solution. If the density of the solution is $1.072gmL^{-1}$ then what shall be the molarity of the solution?

Watch Video Solution

9. A sample of drinking water was found to be severely contaminated with chloroform, $CHCl_3$, supposed to be carcinogen. The level of contamination was 15 ppm (by mass).

(i) Express this in per cent by mass.

(ii) Determine the molality of chloroform in the water sample.

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10. What role does the molecular interaction play in a solution of alcohol and water ?

Watch Video Solution

11. Why do gases always tend to be less soluble in liquids as the temperature is raised?

Watch Video Solution

12. State Henry's law and mention some of its imporant applications.

Watch Video Solution

13. The partial pressure of ethane over a saturated solution containing $6.56 \times 10^{-2} g$ of ethane is 1 bar. If the solution contains $5.00 \times 10^{-2} g$ of ethane, then what shall be the partial pressure of the gas?

Watch Video Solution

14. What is meant by positive and negative deviations from Raoult's law and how is the sign of $\Delta_{mix} H$ related to positive and negative deviations from Raoult's law ?

Watch Video Solution

15. An aqueous solution of 2 per cent $(wt. \ / wt)$ non-volatile solute exerts a pressure of 1.004 bar at the boiling point of the solvent. What is the molecular mass of the solute?

Watch Video Solution

16. Heptane and octane form ideal solution. At 373 K, the vapour pressures of the two liquid components are 105.2 kPa and 46.8 kPa respectively. What will be the vapour pressure of a mixture of 26.0 g of heptane and 35 g of octane ?

Watch Video Solution

17. The vapour pressure of water is $12.3kPa$ at $300K$. Calculate vapour pressure of 1 molal solution of a solute in it.

Watch Video Solution

18. Calculate the mass of a non-volatile solute (molecular mass 40) which should be dissolved in $114g$ octane to reduce its vapour pressure to 80% .

Watch Video Solution

19. A solution containing 30g of a non-volatile non-electrolyte solute exactly in 90g water has a vapour pressure of $2.8kPa$ at 298K. Further, 18g of water is then added to solution, the new vapour pressure becomes $2.9kPa$ at 298K. The solutions obey Raoult's law and are not dilute, molar mass of solute is

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20. A 5% solution (by mass) of cane sugar in water has freezing point of 271 K. Calculate the freezing point of a 5% glucose (by mass) in water. The freezing point of pure water is 273.15 K.

Watch Video Solution

21. Two elements A and B form compounds having formula AB_2 and AB_4. When dissolved in 20 g of benzene (C_6H_6), 1g of AB_2 lowers the freezing point by $2.3K$ whereas 1.0 g of AB_4 lowers it by $1.3K$. The molar depression constant for benzene is $5.1Kkgmol^{-1}$. Calculate atomic masses of A and B.

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22. At $300K$, $36g$ of glucose present per litre in its solution has an osmotic pressure of 4.98^{-}. If the osmotic pressure of the solution is 1.52^{-} at the same temperature, what would be its concentration?

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Watch Video Solution

23. Suggest the most important type of intermolecular interaction in the following pairs :

(i) n-hexane and n-octane

Watch Video Solution

24. Suggest the most important type of intermolecular interaction in the following pairs :

(ii) I_2 and CCl_4

Watch Video Solution

25. Suggest the most important type of intermolecular interaction in the following pairs :

(iii) $NaClO_4$ and water

Watch Video Solution

26. Suggest the most important type of intermolecular interaction in the following pairs :

(iv) methanol and acetone

Watch Video Solution

27. Suggest the most important type of intermolecular interaction in the following pairs :

(v) Acetonitrile (CH_3CN) and acetone (C_3H_6O).

Watch Video Solution

28. Based on solute $-$ solvent interactions, arrange the following in order of increasing solubility in $n-$octane and explain the result. Cyclohexane, KCl, CHM_3OH, CHM_3CN.

Watch Video Solution

29. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(i) Phenol

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30. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(ii) toluene

Watch Video Solution

31. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(iii) formic acid

Watch Video Solution

32. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(iv) ethylene glycol

Watch Video Solution

33. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(v) chloroform

Watch Video Solution

34. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water

(iv) pentanol

Watch Video Solution

35. If the density of some lake water is $1.25 gmL^{-1}$ and contains $92g$ of $Na^{\oplus}$ ions per kg of water, calculate the molality of $Na^{\oplus}$ ions in the lake.

Watch Video Solution

36. If the solubility product of CuS is 6×10^{-16}, calculate the maximum molarity of CuS in aqueous solution.

Watch Video Solution

37. Calculate the mass percentage of aspirin $(C_9H_8O_4)$ in acetonitrile (CHM_3CN) when $6.5g$ of $C_9H_8O_4$ is dissolved in $450g$ of CHM_3CN.

Watch Video Solution

38. Nalorphene $(C_{19}H_{21}NO_3)$, similar to morphine, is used to combat withdrawl symptoms in narcotic users. Does of nalorphene generally given is 1.5 mg. Calculate the mass of $1.5 \times 10^{-3} m$ aqueous solution required for the above does.

Watch Video Solution

39. Calculate the amount of benzoic acid (C_6H_5COOH) required for preparing $250 mL$ of $0.15 M$ solution in methanol.

Watch Video Solution

40. The depression in freezing point of water observed for the same amount of acetic acid, trichloroacetic acid, and trifluoroacetic acid increases in the order given above. Explain briefly.

Watch Video Solution

41. Calculate the depression in the freezing point of water when 10 g of $CH_3CH_2CHClCOOH$ is added to 250 g of water.

$K_a = 1.5 \times 10^{-3}, K_f = 1.86 \text{ K kg mol}^{-1}$

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42. 19.5 g of CH_2FCOOH is dissolved in 500 g of water. The depression in the freezing point observed is $1.0^\circ C$. Calculate the van't Hoff factor and dissociation constant of fluoroacetic acid. K_f for water is $1.86 \text{ K kg mol}^{-1}$.

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43. Vapour pressure of water at 293 K is 17.535 mm Hg. Calculate the vapour pressure of water at 293 K when 25 g of glucose is dissoved in 450 g of water.

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44. Henry's law constant for the molality of methane in benzene at 298 K is $4.27 \times 10^5 mm$ Hg. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg.

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45. $100g$ of liquid $A($ molar mass $140gmol^{-1})$ was dissolved in $1000g$ of liquid $B($ molar mass $180gmol^{-1})$. The vapour pressure of pure liquid B was found to be 500 torr. Calculate the vapour pressure of pure liquid A and its vapour pressure in the solution if the total vapour pressure of the solution is $475T$ or r

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46. Vapour pressure of pure acetone and chloroform at 328 K are 741.8 mm Hg and 632.8 mm Hg respectively. Assuming that they form ideal solution over the entire range of composition, plot $p_{\text{total}}, p_{\text{chloroform}}$ and p_{acetone} as a function of x_{acetone}. The experimental data observed for different composition of mixture is :

$100 \times x_{\text{acetone}}$	0	11.8	23.4	36.0	50.8	58.2	64.5	7
$p_{\text{acetone}} / \text{mm Hg}$	0	54.9	110.11	202.4	322.7	405. .9	454.1	5
$p_{\text{chloroform}} / \text{mm Hg}$	632.8	548.1	469.4	359.7	257.7	193.6	161.2	1

Plot this data also on the same graph paper. Indicate whether it has positive devition or negative deviation from the ideal solution.

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47. Benzene and toluene form ideal solution over the entire range of composition. The vapour pressures of pure benzene and toluene at 300 K are 50.71 mm Hg and 32.06 mm Hg respectively. Calculate the mole fraction of benzene in the vapour phase if 80 g of benzene is mixed with 100 g of toluene.

Watch Video Solution

48. The air is a mixture of a number of gases. The major components are oxygen and nitrogen with approximate proportion of $20\,\%$ is to $79\,\%$ by volume at 298 K. The water is in equilibrium with air at a pressure of 10 atm. At 298 K, if the Henry's law constants for oxygen and nitrogen are 3.30×10^7 mm and 6.51×10^7 mm respectively, calculate the composition of these gases in water.

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49. Determine the amount of $CaCl_2(i = 2.47)$ dissolved in 2.5 litre of water such that its osmotic pressure is 0.75 atm at$27^\circ C$.

Watch Video Solution

50. Determine the osmotic pressure of a solution prepared by dissolving $25 \text{ mg of } K_2SO_4$ in 2 litre of water at $25^\circ C$, assuming that it is completely dissociated.

Watch Video Solution

NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (MULTIPLE CHOICE QUESTIONS - I)

1. Which of the following units is useful in relating concentration of solution with its vapour pressure?

A. mole fraction

B. parts per million

C. mass percentage

D. molality

Answer: A

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2. On dissolving sugar in water at room temperature solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid?

A. sugar crystals in cold water

B. sugar crystals in hot water

C. Powdered sugar in cold water

D. Powerded sugar in hot water

Answer: D

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3. At equilibrium the rate of dissolution of a solid solute in a volatile liquid solvent is

A. less than the rate of crystallisation

B. greater than the rate of crsystallisation

C. equal to the rate of crystallisation

D. zero

Answer: C

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4. A beaker contains a solution of substance'A' precipitation of substance 'A' takes place when small amount of 'A' is added to the solution. The solution is.........

A. saturated

B. supersturated

C. unsaturated

D. concentrated

Answer: B

Watch Video Solution

5. Maximum amount of a solid slute that can be dissolved in a specified amount of a given liquid solvent does not depend upon ....

A. Temperaure

B. Nature of solute

C. Pressure

D. Nature of solvent

Answer: C

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6. Low concentration of oxygen in the blood ndtissues of people living at high altitude is due to.......

A. low temperature

B. low atmospheric pressure

C. high atmospheric pressure

D. both now temperature and high atmospheric pressure.

Answer: B

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7. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show positive deviation from Raoult's law?

A. Benzene and acetone

B. Chloroform and acetone

C. Nitric acid and water

D. Phenol and aniline

Answer: A

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8. Colligative properties depend on ___

A. the nature of the solute particles dissolved in solution

B. the number of solute particles in solution

C. the physical properties of the solute particles dissolved in solution

D. the nature of solvent particles

Answer: B

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9. Which of the following aqueous solution should have the highest boiling point ?

A. 1.0 M NaOH

B. $10 \text{ M Na}_2 SO_4$

C. $1.0 \text{ M NH}_4 NO_3$

D. 1.0 M KNO_3

Answer: B

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10. The unit of ebullioscopic constant is ....

A. $Kkgmol^{-1}$ or $K(molality)^{-1}$

B. $molkgK^{-1}$ or $K^{-1}(molality)$

C. $kgmol^{-1}K^{-1}$ or $K^{-1}(molality)^{-1}$

D. $Kgmol^{-1}K^{-1}$ or $K^{-1}(molality)^{-1}$

Answer: A

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11. In coparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M $MgCl_2$ solution is......

A. the same

B. about twice

C. about three times

D. about six times

Answer: C

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

Answer: D

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13. 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. can not be compared with osmotic pressure of dilute solution.

Answer: A

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14. Which of the following statements is false ?

A. Two different sollutions 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 $\pi = CRT$ (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.

Answer: A

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15. The values of van't Hoff factors for KCl, NaCl and K_2SO_4 , respectively , are ___

A. 2, 2 and 2

B. 2, 2 and 3

C. 1, 1 and 2

D. 1, 1 and 1

Answer: B

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16. Which of the following statements is false ?

A. Units of atmospheric pressure and osmotic pressure are the same

B. In reverse osmosis, solvent molecules move through a semipermeable membrane from a region of lower concentration of solute to a region of higher concentration

C. The value of molal depression constant depends on nature of solvent

D. Relative lowering of vapour pressure, is a dimensionless quantity.

Answer: B

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17. Value of Henry's constant K_H...

A. increases with increase in temperature

B. decreases with increases in temperature

C. remains consant

D. first increases, then decreases

Answer: A

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18. The value of Henry's constant K_H is ....

A. greater for gases with higher solubility

B. greater for gases with lower solubillity

C. constant for all gases

D. not related to the solubility of gases

Answer: B

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19.

https://d10lpgp6xz60nq.cloudfront.net/physics_images/ALN_PHY_R03_E08_015

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 move 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)

Answer: B

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20. We have three aqueous solutions of NaCl labelled as A, B and C with concentration $0.1M, 0.01 \text{and} 0.001$ M , respectively . The value of van't Hoff factor for these solutions will be in the order :

A. $i_A < i_B < i_C$

B. $i_A > i_B > i_C$

C. $i_A = i_B = i_C$

D. $i_A < i_B > i_C$

Answer: A

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21. On the basic of information given below mark the Correct option .Information:

(P)In bromoethane and choroethane mixture intermolar interactions of A.A and B.B tupesare nearly same as A .B type intersections.

(Q) In ethanol and acetone mixture A.A or B.B type inetermolecular interaction are stronger than A.B type interactions.

(R) In chloroform and acetone mixture A.A or B.B type intermolecular interactions are weaker than A. B type interactions.

A. Solution (B) and (C) will follow Raoult's law

B. Solution (A) will follow Raoult's law

C. Solution (B) will show negative deviation from Raoult's law

D. Solution (C) will show positive deviation from Raoult's law

Answer: B

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22. Two beakers of capacity 500 mL were taken. One of these beakers, labelled as "A", was filled with 400 mL water whereas the breaker labelled "B" was filled with 400 mL 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 the 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)

Answer: A

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23. If two liquids A and B from minimum boiling azeotrope at some specific composition then

A. $A - B$ interactions are stronger than those between $A - A$ or $B - B$

B. vapour pressure of solution increases because more number of molecules of liquids A and B can escape from the solution

C. vapour pressure of solution decreases because less number of molecules of only one of the liquids escape from the solution

D. $A - B$ interactions are weaker than those between $A - A$ or $B - B$

Answer: D

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24. 4 L of 0.02 M aqueous solution of NaCl was diluted by adding 1 L of water. The molality of the resultant solution is........

A. 0.004

B. 0.008

C. 0.012

D. 0.016

Answer: D

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25. 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 breaks.

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

Answer: A

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26. K_H value for $Ar(g), CO_2(g), HCHO(g)$ and $CH_4(g)$ are $40.39, 1.67, 1.83 \times 10^{-5}$ and 0.413 respectively.

Arrange these gases in the order of their increasing solubility.

A. $HCHO < CH_4 < CO_2 < Ar$

B. $HCHO < CO_2 < CH_4 < Ar$

C. $Ar < CO_2 < CH_4 < HCHO$

D. $Ar < CH_4 < CO_2 < CHHO$

Answer: C

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NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (MULTIPLE CHOICE QUESTIONS - II)

1. Which of the following factor (s) affect the solubility of a gaseous solute in the fixed volume of liquid solvent?

(i) nature of solute

(ii) temperature

(iii) pressure

A. All of these

B. (i) only

C. (ii) and (iii) only

D. (iii) only

Answer: A

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2. Intermolecular forces between two benzene molecules are nearly of same strength as those between two toluene molecules. For a mixture of benzene and toluene, which of the following are not true?

A. $\Delta_{\text{mix}}H = \text{zero}$

B. $\Delta_{\text{mix}}V = zero$

C. These will form minimum boiling azeotrope

D. These will not form ideal solution

Answer: c,d

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3. Relative lowering of vapour pressure is a colligative property because

A. It depends on the concentration of a non-electrolyte solute in solution and does not depend on the nature of the solute molecules

B. It depends on number of particles of electrolyte solute in solution and does not depend on the nature of the solute particles

C. It depends on the concentration of a non-electrolyte solute in solution as on the nature of the solute molecules

D. It depends on the concentration of an electrolyte or non-electrolyte solute in solution as well as on the nature of solute molecules

Answer: a,b

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4. van't Hoff factor (i) is given by the expression

A. $i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$

B. $i = \frac{\text{Abnormal molar mass}}{\text{Normal molar mass}}$

C. $i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$

D. $i = \frac{\text{Calculated colligative property}}{\text{Observed colligative property}}$

Answer: a,c

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5. Isotonic solutions must have the same..........

A. solute

B. density

C. elevation in boiling point

D. depression in freezing point

Answer: c,d

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6. Which of the following binary mixture will have same composition in liquid and vapour phase?

A. Benzene - Toluene

B. Water - Nitric acid

C. Water - Ethanol

D. n-Hexane - n - Heptane

Answer: b,c

Watch Video Solution

7. In isotonic solutions ....

A. solute and solvent both are same

B. osmotic pressure is same

C. solute and solvent may or may not be same

D. solute is always same, solvent may be different

Answer: b,c

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8. For a binary ideal liquid solution, the variation total vapour pressure versus composition of solution is given by which of the curves?

A.

B.

C.

D.

Answer: a,d

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9. Colligative properties are observed when........

A. a non-volatile solid is dissolved in a volatile liquid

B. a non-volatile liquid is dissolved in another volatile liquid

C. a gas is dissolved in non-volatile liquid

D. a volatile liquid is dissolved in another volatile liquid

Answer: a,b

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NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (SHORT ANSWER QUESTIONS)

1. Components of a binarey mixture of two liquids A and B were being separted by distillation. After some time separation of components stopped and composition of vapour phase vecame same as that of liquid phase. Both the components stated coming in the distillate. Explain why this happened ?

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2. Explain in why on addition of 1 mole of NaCl to 1L of water, the boiling point of water increases, while addition of 1 mole of methyl alcohol to 1 L of water decreases its boiling point .

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3. Explain the solubility rule "like dissolves like" in terms of intermolecular forces that exist in solutions,

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4. Concentration terms such as mass percentage, ppm, mole fraciton and molality are independent of temperature, however molarity is a function of temperature. Explain.

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5. What is the significance of Hanry's law constant K_H ?

Watch Video Solution

6. why are the aquatic species more comofortable in cold water in comparision to warm water?

Watch Video Solution

7. (a) Explain the following phenomena with the help of Henry's law.

(i) Painful condition known as bends.

(ii) Feeling of weakness and discomfort in breating at high altitude.

(b) Why soda water bottle kept at room temperature fizzes on opening?

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8. Why is the vapous pressure of an aqueous solution of gulucose lower than that of water ?

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9. How does sprinking of salt help in clearing the snow covered roads in hilly areas? Explain the phenomenon involved in the process.

Watch Video Solution

10. What is "semi permeable membrane"?

Watch Video Solution

11. Give an example of a material used for makin gsemipermeable membrance for carrying out reverse osmosis.

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NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (MATCHING TYPE QUESTIONS)

1. Match the items given in Column I and Column II.

Column I	Column II
(i) Saturated solution	(a) Solution having same osmotic pressure at a g
(ii) Binary solution	(b) A solution whose osmotic pressure is less tha
(iii) Isotonic solution	(c) Solution with two components.
(iv) Hypotonic solution	(d) A solution which contains maximum amoun
(v) Solid solution	(e) A solution whose osmotic pressure is more th
(vi) Hypertonic solution	(f) A solution is solid phase.

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2. Match the tererms given is Column I with the type of solutions given in Column II.

	ColumnI		ColumnII
A.	Soda water	1.	A solution of gas in solid.
B.	Sugar solution	2.	A slution of gas in gas.
C.	German silver	3.	A solution of solid in liquid.
D.	Air	4.	A solution of solid in solid.
E.	Hydrogen gas in palladium.	5.	A solution of gas in liquid.
		6.	A solution of liquid in solid.

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3. Match the laws given in Column I with expressions given in Column II.

Column I	Column II
(i) Raoult's law	(a) $\Delta T_f = K_f m$
(ii) Henry'law	(b) $\pi = CRT$
(iii) Elevation of boiling point	(c) $p = x_1 p_1^\circ + x_2 p_2^\circ$
(iv) Depression is freezing point	(d) $\Delta T_b = K_b m$
(v) Osmotic pressure	(e) $p = K_H x$

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4. Match the terms given in Column I with expressions given in Column II.

Column I	Column II
(i) Mass percentage	(a) $\frac{\text{Number of moles of the solute component}}{\text{Volume of solution in litres}}$
(ii) Volume percentage	(b) $\frac{\text{Number of moles of a component}}{\text{Total number of moles of all the components}}$
(iii) Mole fraction	(c) $\frac{\text{Volume of the solute component in solution}}{\text{Total volume of solution}} \times 100$
(iv) Molality	(d) $\frac{\text{Mass of the solute component in solution}}{\text{Total mass of the solution}} \times 100$
(v) Molarity	(e) $\frac{\text{Number of moles of the solute coponents}}{\text{Mass of solvent in kilograms}}$

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NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (ASSERTION AND REASON TYPE QUESTIONS)

1. Assertion (A) Molarity of a solution in liquid state changes with temperature.

Reason (R) The volume of a solution charges with change in temperature.

A. Assertion and reason both are correct statement and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion and reason both are incorrect statements.

Answer: a

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2. Assertion (A) When methyl alcohol is added to water, boiling point of water increases.

Reason (R) When a volatile solute is added to a volatile solvent evevation in boiling point is observed.

A. Assertion and reason both are correct statement and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion and reason both are incorrect statements.

Answer: d

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3. Assertion (A) When NaCl is added to water a depression in freezing point is observed.

Reason (R) The lowering of vapour pressure of a solution causes depression in the freezing point.

A. Assertion and reason both are correct statement and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion and reason both are incorrect statements.

Answer: a

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4. Assertion (A) When solution is separted from the pure solved semipermeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.

Reason (R) Diffusion solvent occurs from a region of concentration solution to a region of low concentration soluton.

A. Assertion and reason both are correct statement and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion and reason both are incorrect statements.

Answer: c

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NCERT (EXEMPLAR PROBLEMS WITH ANSWERS, HINTS AND SOLUTIONS) (LONG ANSWER QUESTIONS)

1. Diffine the following mofes of expressing the concentration of a solution? Which of which of these modes are independent of temperature and why ?

(a) w/w(mass percentage)
(b) V/V(volume percentage)
(c) w/V(mass by volume percentage)
(d) ppm(part per million)
(e) X(mole fraction)
(f) M(molarity)
(g) m(molality)

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2. Using Raoult's law explain how the total vapour pressure over the solution is related to mole fraction of components in the following solutions.

(i) $CHCl_3(l)$ and $CH_2Cl_2(l)$

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3. Using Raoult's law explain how the total vapour pressure over the solution is related to mole fraction of components in the following solutions.

(ii) $NaCl(s)$ and $H_2O(l)$

Watch Video Solution

4. Explain the terms ideal and non-idealsolution in the light of forces of interactions operating between molecules in liquid solutions.

Watch Video Solution

5. Why is it not possible to obtain pure ethanol by fractional distillation ? What general name is given to binary mixture which show deviation from Raoult's law and whose omponents cannot be separted by fractional distillation. How many types of such mixture are there?

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6. When kept in water, raisin swells in size. Name and explain the phenomenon involved with the help of a diagram. Give thre applications of the phenomenon.

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7. Discuss biological and industrial applications of osmosis.

Watch Video Solution

8. How can you remove the hard calcium carbonate layer of the egg without damaging its semipermeable numbrane? Can this egg be inserted into a bottel with a narrow neck without distorting its shape? Explain the process involved.

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9. Why is the mass determined by measuring a colligative property in case of some solutes abnormal? Discuss it with the help of van't Hoff factor.

Watch Video Solution

ADDITIONAL QUESTIONS (VERY SHORT ANSWER QUESTIONS)

1. How is it that alcohol and water are miscible inall proportions ?

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2. Give an example of a solution containing a liquid solute in a solid solvent.

Watch Video Solution

3. Give one example each of solid in gas and liquid in gas solutions.

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4. Define molality.

Watch Video Solution

5. What do you mean by saying that the molality of a solution is 0.1?

Watch Video Solution

6. What is the relation between normallity and molarity of a give solution of sulphuric acid ?

Watch Video Solution

7. What is the sum of mole fractions of all the components in a three component system?

Watch Video Solution

8. Why does not molality of the solution cange with temperature ?

Watch Video Solution

9. Calculate the molality of H_2SO_4 if the density of 10% (w/w) aqueous solution of H_2SO_4 is 1.84 g cm^{-3} $(\text{Molar mass of } H_2SO_4 = 98 \text{ g mol}^{-1}$).`

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10. What is the effect of temperature on the solubility of sodium sulphate decahydrate?

Watch Video Solution

11. Define transition temperature in solubility of a solid in a liquid.

Watch Video Solution

12. Give one example of an interstitial solid.

Watch Video Solution

13. State the formula relating pressure of a gas with its mole fraction in a liquid solution in contact with it.

Watch Video Solution

14. Why is the vapous pressure of an aqueous solution of gulucose lower than that of water ?

Watch Video Solution

15. What type of liquids form ideal solutions?

Watch Video Solution

16. What is the boiling point of an azeotrope of non-ideal solution showing positive deviations as compared to the boiling points of its components ?

Watch Video Solution

17. Under what condition do non-ideal solutions show negative deviations?

Watch Video Solution

18. Define an ideal solution.

Watch Video Solution

19. Define azeotropic mixture.

Watch Video Solution

20. Colligative property.

Watch Video Solution

21. What is the difference between lowering of vapour pressure and relative lowering of vapour pressure?

Watch Video Solution

22. Write the expression for relative lowering of vapour pressure

Watch Video Solution

23. What are isotonic solutions ? Give one example .

Watch Video Solution

24. What is van't Hoff equation for dilute solution?

Watch Video Solution

25. Why does water from the soil rise to the top of a tall tree?

Watch Video Solution

26. What happens when blood cells are placed in pure water?

Watch Video Solution

27. Define reverse osmosis. Give one use of it.

Watch Video Solution

28. Define osmotic pressure.

Watch Video Solution

29. What happens when the external pressure applied becomes more than the osmotic pressure of solution?

Watch Video Solution

30. Define molal elevation constant or ebullioscopic constant?

Watch Video Solution

31. Define molal depression constant or cryoscopic constant.

Watch Video Solution

32. Give one most important application of the phenomenon of depression in freezing point in everyday life.

Watch Video Solution

33. Between 2 M glucose solution and 1 M glucose, which one has a lower freezing point?

Watch Video Solution

34. What is an antifreeze?

Watch Video Solution

35. How muCHM molecular mass of $NaCl$ is obtained experimentally using colligative properties ?

Watch Video Solution

36. How is the colligative property of solution changed when a solute in a solution undergoes (i) association (ii) dissociation?

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37. Calculate the value of van't Hoff factor for a dilute solution of K_2SO_4 in water.

Watch Video Solution

38. Arrange the following solutions in increasing order of their van't Hoff factor :

$0.1MCaCl_2, 0.1MKCl, 0.1MAl_2(SO_4)_3, 0.1MC_{12}H_{22}O_{11}$

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39. Give an example of a compound in which hydrogen bonding results in the formation of a dimer.

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40. When is the value of van't Hoff factor more than one?

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41. What is the van't Hoff factor for a compound which undergoes tetramerisation in an organic solvent?

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ADDITIONAL QUESTIONS (SHORT ANSWER QUESTIONS)

1. To what type of solution an alloy belongs ? Give one example of a solution of liquid in solid.

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2. Explain the terms 'Mass fraction' and 'Mole fraction'?

Watch Video Solution

3. Which out of molality, molarity and mole fraction of a solution will remain unchanged on raising the temperature and why?

Watch Video Solution

4. Differentiate between molality and molarity of a solution. What is the effect of change in temperature of a solution on its molality and molarity?

Watch Video Solution

5. Discuss the effect of temperature on the solubility of solids in liquids.

Watch Video Solution

6. What are substitutional and interstitial solids? Give two examples of each.

Watch Video Solution

7. State Henry's law correlating the pressure of a gas and its solutbility in a solvent and mention two applications for the law. What helps in existence of aquatic life?

Watch Video Solution

8. State Henry's law and mention some important applications ?

Watch Video Solution

9. How can you justify the observation that the vapour pressure of solution of a non-volatile solute in a given solvent is less than that of the pure solvent? Also state the law concerning this observation.

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10. State Raoult's law. Derive its mathematical expression for a solution of a non-volatile solute in a volatile solvent.

Watch Video Solution

11. Derive the relationship between relative lowering of vapour pressure and mole fraction of the volatile liquid.

Watch Video Solution

12. Vapour pressure of a solution is different from that of pure solvent

(i) Name the law which helps us to determine partial vapour pressure of a volatile component in solution.

(ii) State the above law.

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13. Define vapour pressure of a liquid. What happens to the vapour pressure when (a) a volatile solute dissolves in the liquid and (b) the dissolved solute is non-volatile.

Watch Video Solution

14. Show that the relative lowering of vapour pressure for a soltuion is equal to the mole fraction of the solute when solvent alone is volatile.

Watch Video Solution

15. What do you understand by Relative lowering of vapour pressure ? How is it used to determine molecular mass of the solute?

Watch Video Solution

16. Draw a suitable diagram to express the relationship for ideal solutions of A and B between vapour pressure and mole fractions of components at constant temperature

Watch Video Solution

17. Non - ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.

Watch Video Solution

18. Write five differences in solutions having positive deviations and solutions having negative deviation.

Watch Video Solution

19. Write three difference between ideal and non-ideal solutions.

Watch Video Solution

20. What are the characteristics of an ideal solution? Why do solutions behave ideally only at low concentration?

Watch Video Solution

21. Define an ideal solution and write one of its characteristics.

Watch Video Solution

22. State Raoult's law. ? Using the law, how would you distinguish between ideal and non-ideal solutions?

Watch Video Solution

23. Non - ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.

Watch Video Solution

24. What are ideal and non-solutions? Give reason for the formation of such solutions. Give one example in each case.

Watch Video Solution

25. What type of deviation (positive or negative) from ideal behaviour will be shown by the solution of cyclohexane and ethanol? Give suitable reason.

Watch Video Solution

26. What are non-ideal solutions? What are their different types? Explain giving examples.

Watch Video Solution

27. CCl_4 and water are immiscible whereas ethanol and water are miscible in all proportions. Correlate this behaviour with molecular structure of these compounds.

Watch Video Solution

28. State Raoult's law. Write the conditions necessary for a solution to show ideal behaviour.

Watch Video Solution

29. What are azeotropic mixture? What are their different types? Explain with examples.

Watch Video Solution

30. State Raoult's law for a solution containing volatile liquids. Explain with suitable example the concept of maximum boiling azeotropes.

Watch Video Solution

31. What are differences between minimum boiling azeotropes and maximum boiling azeotropes?

Watch Video Solution

32. Why constant boiling mixture behave like a single component when subjected to distillation?

Watch Video Solution

33. What is meant by positive from Raoul's Law ? Give an example an example. What is the sing of ΔH_{mix} for positive deviation ?

Watch Video Solution

34. Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law? Give an example.

Watch Video Solution

35. What is a colligative property? Write down the different types of colligative properties. Show that relative lowering of vapour pressure is a colligative property.

Watch Video Solution

36. What is Raoult's law? How can molar mass of a non-volatile solute be determined with its help?

Watch Video Solution

37. What is osmotic pressure ? Why it is a colligative property ?

Watch Video Solution

38. Give four points of difference between osmosis and diffusion.

Watch Video Solution

39. What is the importance of semipermeable membrane in osmosis? Explain.

Watch Video Solution

40. Derive van't Hoff equation for dilute solutions.

Watch Video Solution

41. (i) What is osmotic pressure?

Watch Video Solution

42. (ii) State van't Hoff - Boyle's law

Watch Video Solution

43. (iii) What is an ideal solution?

Watch Video Solution

44. Define the term ' osmotic pressure' . Descibe how the molecular mass of a substance can be determined on the basis of pressrure measurement.

Watch Video Solution

45. Define the terms, 'osmosis' and 'osmotic pressure'. What is the advantage of using osmotic pressure as compared to other colligative for the determination of molar masses of solutes in solutions?

Watch Video Solution

46. What are colligative properties? Write the colligative property used to find the molecular mass of macromolecules.

Watch Video Solution

47. Why the boiling point of a liquid gets raised on dissolution of non-volatile solute into it?

Watch Video Solution

48. Explain qualitatively was elevation of boiling point of solution using Raoult's law.

Watch Video Solution

49. Illustrate elevation in boiling point with the help of vapour pressure-temperature curve of a solution. Show that elevation in boiling pointis a colligative property.

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50. Show graphically how the vapour pressure of a solvent and a solution of a non-volatile solute change with temperature? Show on this graph the boiling points of the solvent and the solution. Which is higher and why?

Watch Video Solution

51. Explain why the freezing point of a solvent is lowered on dissolving a non-volatile solute into it.

Watch Video Solution

52. Explain how the measurement of depression in freezing point can be used for the determination of molecular masses of non-volatile solutes.

Watch Video Solution

53. With the helps of a suitable diagram, whow that the lowering of vapour pressure of a solution than the pure solvent causes a lowering of freezing point for the solution compared to that of the pure solvent.

Watch Video Solution

54. An aqueous solution containing urea was found to have boiling point more than the normal boiling point of water (373.13 K). When the same solution was cooled, it was found that its freezing point is less than the normal freezing point of water (273.13 K) . Explain these observations.

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55. Why do electrolytes show abnormal molecular masses? Name the factors responsible for abnormallity.

Watch Video Solution

56. What is Abnormal Molecular Mass? Discuss its being in Molecular Association/Dissociation.

Watch Video Solution

57. Define van't Hoff factor . How is it related to the degree of dissociation ?

Watch Video Solution

58. What is van't Hoff factor ? What possible values can it have the solute molecules undergo

(i) Association and (ii) Dissociation, in solution

Watch Video Solution

59. Defind osmotic pressure. Arrange the following solutions in the incresing order of their osmotic pressure :

(a) 34.2 g/lit sucrose (b) 60 g/lit urea (c) 90 g/lit glucose (d) 58.5 g/lit sodium chloride.

Give reason in support of your answer.

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60. Define the following terms:

(i) Abnormal molar mass (ii) Van't Hoff factor (i)

Watch Video Solution

ADDITIONAL QUESTIONS (LONG ANSWER QUESTIONS)

1. (a) Differentiate between molality and molarity of a solution. How does a change in temperature influence their values?

Watch Video Solution

2. Calculate the freezing point of an aquteous containing 10.50 g of $MgBr_2$ in 200 g of water (molar mass of $MgBr_2 = 184 mol^{-1}, K_f f$ or $water = 1.86 K kg mol^{-1}$)

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3. Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.

Watch Video Solution

4. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250 g of water . ($K_b = 0.512$ K kg mol^{-1} and molar mass of NaCl = 58.44 g mol^{-1})

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5. (a) State the following : (i) Henry's law about partial pressure of a gas in a mixutre,

(ii) Raoult's law in its general from in reference to solutions.

Watch Video Solution

6. (b) What would be the molar mass of a compound if 6.21 g of it dissolved in 24.0 g of chloroform form a solution that has a boiling point of $68.04^{\circ} C$. The boiling point of pure chloroform is $61.7^{\circ} C$ and the boiling point elevation constant K_b for chloroform is $3.63^{\circ} C / m$.

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7. What is de-icing agent? How does it work?

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8. $19.5g$ of CH_2FCOOH is dissolved in $500g$ of water . The depression in the freezing point of water observed is $1.0^{\circ} C$. Calculate the Van't Hoff factor and dissociation constant of fluoroacetic acid.

Watch Video Solution

9. (i) Why elevation in boiling point in a colligative property?

Watch Video Solution

10. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving $1.0g$ of polymer of molar mass $185, 000$ in $450mL$ of water at $37^{\circ} C$.

Watch Video Solution

11. (a) Define Azeotropes and explain briefly minimum boiling azeotrope by taking suitable example.

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12. The vapour pressures of pure liquids A B are 450 mm and 700 mm of Hg respectively at 350 K. Calculate the compositon of the liquid mixture if total vapour pressure is 600 mm of Hg. Also find the composition in the Vapour phase.

Watch Video Solution

13. Explain the following :

(i) Henry's law about dissolution of a gas in a liquid. (ii) Boiling point elevation constant for a solvent.

Watch Video Solution

14. A solution of glycerol $(C-(3)H_8O_3$, molar mass = 92 g mol^{-1} iin water was prepared by dissolving some glycero 500 g of water. This solution has a boiling point of $100.42^\circ C$. What mass of glycerol was dissolved to make this solution ? K_b for water=$0.512kkgmol^{-1}$.

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15. Define the solubility of a solid in liquid. Briefly describe the various factors on which the solubility of a solid in a liquid depends.

Watch Video Solution

16. Define osmotic pressure and describe Berkeley and Hartley's method for the determination of osmotic pressure.

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17. State and explain Raoult's law for (a) volatile solute (b) non-volatile solute

Watch Video Solution

18. What do you understant by colligative properties of a solution? Explain briefly osmosis and osmotic pressure.

Watch Video Solution

19. When 2.56 g of sulphur is dissolved in 100 g of CS_2, the freezing point of the solution gets lowerd by 0.383 K. Calculate the formula of sulphur (S_x). [Given K_f for CS_2=$3.83\ Kkgmol^{-1}]$, [Atomic mass of sulphur=32g mol^{-1}]

Watch Video Solution

20. Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing

1.2% sodium chloride

0.4% sodium chloride

1.2% sodium chloride

0.4% sodium chloride.

Watch Video Solution

HIGHER ORDER THINKING SKILLS (QUESTIONS PROBLEMS WITH ANSWERS/SOLUTIONS) (HOTS PROBLEMS)

1. Match the boiling point with K_b for x,y and z, if molecular weight of x,y and z are same.

	$b.\ pt.$	$\mathrm{K_b}$
x	100	0.68
y	27	0.53
z	253	0.98

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2. Derive the relationship between relative lowering of vapour pressure and mole fraction of the volatile liquid.

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3. Why dissolution of some solid compounds is exothermic while that of some others is endothermic?

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4. Benzene and toluene have equal mole fractions in their mutual solution. What do you expect about their mole fraction n the vapour phase at the same temperature? Explain.

(Given : $p^{\circ}_{\text{Benzene}} = 3 \times p^{\circ}_{\text{Toluene}}$)

Watch Video Solution

5. Why a person suffering from high blood pressure is advised to take minimum quantity of common salt?

Watch Video Solution

6. The boiling point of carbon tetrachloride is

$77^\circ C$ and its heat of vaporisation is 31 kJ mol^{-1}.

Calculate the vapour pressure of carbon

tetrachloride in atmospheres at $25^\circ C$.

Watch Video Solution

7. A 0.001 molal solution of a complex represented as $Pt(NH_3)_4Cl_4$ in water had freezing point depression of $0.0054^\circ C$. Given K_f for $H_2O = 1.86 Km^{-1}$. Assuming 100% ionization of the complex, write the ionization nature and formula or complex.

Watch Video Solution

8. To $500cm^3$ of water, $3.0 \times 10^{-3}kg$ acetic acid is added. If 23% of acetic acid is dissociated, what will be the depression in freezing point? K_f and density of water are $1.86Kkgmol^{-1}$ and $0.997gcm^{-3}$ respectively.

Watch Video Solution

9. Calculate the density of H_2SO_4 solution if its molalilty and molarity are 94.5 and 11.5 resoectuvely.

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10. 17.4% K_2SO_4 solution at $27^\circ C$ is isotonic with 4% $NaOH$ solution at the same temperature. If $NaOH$ is 100% ionized, what is the degree of ionization of K_2SO_4 in aqueous solution?

Watch Video Solution

11. The boiling point of benzene rises from

$80.1^\circ C$ to $13.76g$ of biphenyl $(C_6H_5 - C_6H_5)$

is dissolved into 100 g of benzene.

Calculate latent heat of vaporisation of benzene.

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12. Find out the osmotic pressure of 0.1 M monobasic acid if pH = 2.0 at

$25^\circ C$.

Watch Video Solution

13. A storage battery contains a solution of $H_2SO_4 38\%$ by weight. At this concentration, the Vant't Hoff factor is 2.50. At what temperature will the battery contents freeze? $(K_f = 1.86^\circ mol^{-1} kg)$

Watch Video Solution

14. Calculate the resulting molarity of the solution that is obtained by adding 5 g of NaOH to 250 ml of $\frac{M}{4}NaOH$ solutoin (density $= 1.05g/cm^3$). The density of the resulting solutoin is $1.08g/cm^3$.

Watch Video Solution

15. Calculate the molarity of a solution of $CaCl_2$ if on chemical analysis it is found that 200 ml of $CaCl_2$ solution contains 3.01×10^{22} chloride ions.

Watch Video Solution

16. A solution of A and B with 30 moles present of A is in equilibrium with its vapour which contain 60 mole percent of A. Assuming that the solution and the vapour behave ideally, calculate the ratio of the vapour pressures of pure A and pure B.

Watch Video Solution

17. Vapour pressures of benzene and toluene in a mixute at $50^\circ C$ are given in mm by $P = 179X_B + 92$ where X_B is the mole fraction of benzene. Calculate.

(a) Vapour pressures of pure benzene and toluene at $50^\circ C$.

Watch Video Solution

18. Vapour pressures of benzene and toluene in a mixute at $50^\circ C$ are given in mm by $P = 179X_B + 92$ where X_B is the mole fraction of benzene. Calculate.

(b) Vapour pressure of a liquid mixture obtained by mixing 224 g benzene and 184 g of toluene.

Watch Video Solution

19. Vapour pressures of benzene and toluene in a mixute at $50^\circ C$ are given in mm by $P = 179X_B + 92$ where X_B is the mole fraction of benzene. Calculate.

(c) If the vapours are removed and condensed into liquid and again brought to the temperature of $50^\circ C$, what would be the mole fraction of benzene in the vapour phase?

Watch Video Solution

20. 1000 g of 1 molal aqueous solution of sucrose is cooled and maintained at $-3.534^\circ C$. Find out how much ice will separate out at this temperature. (K_f for water $= 1.86 km^{-1}$)

Watch Video Solution

VALUE BASED QUESTIONS WITH ANSWERS

1. On a week end, Shubham went on a picnic with this his parents. There was a beautiful view of a lake but suddenly, Shubham saw some fish floating on the surface of water of the lake as they had died. Shubham asked his parents why these fish had died. They told him that fish also need oxygen for their survival as we do. Dissolved oxygen in the water gets depleted due to discharge of human sewage and organic wastes of the industries into the lake water.

After reading the above paragraph, answer the following questions:

(a) What lesson do you learn from the explanation given by Shubham's parents to him?

Watch Video Solution

2. On a week end, Shubham went on a picnic with this his parents. There was a beautiful view of a lake but suddenly, Shubham saw some fish floating on the surface of water of the lake as they had died. Shubham asked his parents why these fish had died. They told him that fish also need oxygen for their survival as we do. Dissolved oxygen in the water gets depleted due to discharge of human sewage and organic wastes of the industries into the lake water.

After reading the above paragraph, answer the following questions:

(b) Hoe dissolved oxygen gets depleted due to presence of the organic waste?

Watch Video Solution

3. Shawn went to a meat shop to but meat from the butcher. While buying the meat, he observed that the butcher was highely upset. When he asked him the reason, he told that he was suffering a heavy loss as his meat gets spoiled very soon. Shawan suggested him that he should apply common salt on the meat to save it from spoilage.

After reading the above passage, answer the following questions :

(a) What values are expressed by Shawn?

Watch Video Solution

4. Shawn went to a meat shop to but meat from the butcher. While buying the meat, he observed that the butcher was highely upset. When he asked him the reason, he told that he was suffering a heavy loss as his meat gets spoiled very soon. Shawan suggested him that he should apply common salt on the meat to save it from spoilage.

After reading the above passage, answer the following questions :

(b) Why did Shawn suggest him to apply salt on the meat? How does it work?

Watch Video Solution

5. There was a medical check-up of teeth of a particular class in a school. It was found that some students had cavities in their teeth. The teacher asked them two questions. First, how many chocolates or sweets do they eat? Second, which toothpaste do they use for brushing their teeth, i.e., does it contain fluoride or not?

After reading the above paragraph, answer the following questions :

(a) What values are expressed by the teacher?

Watch Video Solution

6. There was a medical check-up of teeth of a particular class in a school. It was found that some students had cavities in their teeth. The teacher asked them two questions. First, how many chocolates or sweets do they eat? Second, which toothpaste do they use for brushing their teeth, i.e., does it contain fluoride or not?

After reading the above paragraph, answer the following questions :

(b) What is the limiting value of the fluoride that should be present in the toothpaste? What happens if this limit is exceeded?

Watch Video Solution

7. There was a medical check-up of teeth of a particular class in a school. It was found that some students had cavities in their teeth. The teacher asked them two questions. First, how many chocolates or sweets do they eat? Second, which toothpaste do they use for brushing their teeth, i.e., does it contain fluoride or not?

After reading the above paragraph, answer the following questions :

(c) How does fluoride protect our teeth ?

Watch Video Solution

Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (I. Multiple Choice Question)

1. Which of the following is dependent on temperature?

A. Molality

B. Molarity

C. Mole fraction

D. Weight precentage

Answer: B

Watch Video Solution

2. A 5.2 molal aqueous of methyl alcohol, CH_3OH, is supplied. What is the molefraction of methyl alcohol in the solution ?

A. 0.19

B. 0.086

C. 0.05

D. 0.1

Answer: B

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3. What is the mole fraction of the solute in a 1.00 m aqueous solution ?

A. 0.0354

B. 0.0177

C. 0.177

D. 1.77

Answer: B

Watch Video Solution

4. The molarity of a solution obtained by mixing 750 mL of 0.5 M HCl with 250 mL of 2 M HCl will be

A. 0.975 M

B. 0.875 M

C. 1.00 M

D. 1.175 M

Answer: B

Watch Video Solution

5. Calculate the density $\left(\text{in gm L}^{-1}\right)$ of a 3.60 M sulphuric acid solution that is 29 % H_2SO_4 by mass $\left(\text{molar mass} = 98 \text{ g mol}^{-1}\right)$

A. 1.45

B. 1.64

C. 1.88

D. 1.22

Answer: D

Watch Video Solution

6. Concentrated aqueous solution of sulphuric acid is 98% by mass and has density of 1.80g mL^{-1}. What is the volume of acid required to make one liter $0.1 MH_2SO_4$ solution ?

A. 5.55 mL

B. 11.10 mL

C. 16.65 mL

D. 22.20 mL

Answer: A

Watch Video Solution

7. How many grams of concentrated nitric acid solution should be used to prepare $250 mL$ of $2.0 MHNO_3$? The concentrated acid is $70\% \ HNO_3$:

A. $45.0 \text{ g conc } HNO_3$

B. $90.0 \text{ g conc } HNO_3$

C. $70.0 \text{ g conc } HNO_3$

D. $54.0 \text{ g conc } HNO_3$

Answer: A

Watch Video Solution

8. 6.02×10^{23} molecules of urea are present in $100ml$ of its solution. The concentration of urea solution is -

A. 0.02 M

B. 0.01 M

C. 0.001 M

D. 0.1 M

Answer: B

Watch Video Solution

9. To neutralize completely 20 mL of 0.1M aqueous solution of phosphorus acid (H_3PO_3) the volume of $0.1M$ aqueous KOH solution required is

A. 10 mL

B. 20 mL

C. 40 mL

D. 60 mL

Answer: C

Watch Video Solution

10. The volumes of $4NHCI$ and $10NHCI$ required to make 1 litre of $6NHCI$ are

A. 0.75 litre of 4 N HCl and 0.25 litre of 10 N HCl

B. 0.25 litre of 4 N HCl and 0.75 litre of 10 N HCl

C. 0.67 litre of 4 N HCl and 0.33 litre of 10 N HCl

D. 0.80 litre of 4 N HCl and 0.20 litre of 10 N HCl

Answer: C

Watch Video Solution

11. A person is considered to be suffering from lead poisoning if its concentration in him is more than 15 micrograms of lead per decilitre of blood. Concentration in parts per billion parts is

A. 1

B. 0

C. 150

D. 1000

Answer: C

Watch Video Solution

12. The molarity of 900 g of water is

A. 50 M

B. 55.5 M

C. 5 M

D. cannot be calculated

Answer: B

Watch Video Solution

13. Which one of the following statements is not true?

A. Dissolution of all solid solutes in water is exothermic

B. Common salt is more soluble in water than canesugar at the same temperature

C. Solubility of sodium sulphate decahydrate crystals first increases upto a certain temperature and then decreases

D. Enthalpy of solution can be found using Clausius - Clapeyron equation

Answer: A

View Text Solution

14. Which of the following is not a substitutional solid?

A. Brass

B. Brozne

C. steel

D. Monel metal

Answer: C

Watch Video Solution

15. The mole fraction of a gas dissolved in a solvent is given by Henry's law. Constant for gas in water at 298 K is 5.55×10^7 Torr and the partial pressure of the gas is 200 Torr, then what is the amount of the gas dissolved in 1.0 kg of water?

A. $2.0 \times 10^{-4} mol$

B. $2.5 \times 10^{-5} mol$

C. $3.7 \times 10^{-6} mol$

D. $1.2 \times 10^{-8} mol$

Answer: A

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16. The solubility of a gas in water at 300 K under a pressure of 100 atmospheres is $4 \times 10^{-3} \text{kg L}^{-1}$. Therefore, the mass of the gas in kg dissolved in 250 mL of water under a pressure of 250 atmospheres at 300 K is

A. 2.5×10^{-3}

B. 2.0×10^{-3}

C. 1.25×10^{-3}

D. 5.0×10^{-3}

Answer: A

Watch Video Solution

17. The amount of solute (molar mass 60 g mol^{-1}) that must be added to 180 g of water so that the vapour pressure of water is lowered by 10% is

A. 30 g

B. 60 g

C. 120 g

D. 12 g

Answer: B

Watch Video Solution

18. At $80^\circ C$ the vapour pressure of pure liquid 'A' is 520 mm Hg and that of pure liquid 'B' is 1000 mm Hg. If a mixture solution of 'A' and 'B' boils at $80^\circ C$ and 1 atm pressure, the amount of 'A' in the mixture is (1 atm $= 760 mmHg)$

A. 48 mol percent

B. 50 mol percent

C. 52 mol percent

D. 34 mol percent

Answer: B

Watch Video Solution

19. Two liquids X and Y form an ideal solution. The mixture has a vapour pressure of 400 mm at 300 K when mixed in the molar ratio 1:1. when mixed in the molar ratio of 1:2 at the same temperatre the vapour pressure of the mixture is 350 mm. The vapour pressure of the two pure liquids X and Y respectively are

A. 250 mm, 550 mm

B. 350 mm, 450 mm

C. 350 mm, 700 mm

D. 550 mm, 250 mm

Answer: D

Watch Video Solution

20. Two liquids X and Y form an ideal solution. At 300K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mm Hg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mmHg) of X and Y in their pure states will be, respectively

A. 200 and 300

B. 300 and 400

C. 400 and 600

D. 500 and 600

Answer: C

Watch Video Solution

21. If two substances A and B have $p_A^\circ : p_B^\circ = 1:2$ and have mole fraction in solution as 1:2 then mole fraction of A in vapour phase is

A. 0.33

B. 0.25

C. 0.52

D. 0.2

Answer: D

Watch Video Solution

22. The relative lowering of vapour pressure of an aqueous solution containing a non-volatile solute, is 0.0125. The molality of the solution is

A. 0.7

B. 0.5

C. 0.6

D. 0.8

Answer: A

Watch Video Solution

23. P_A and P_B are the vapour pressure of pure liquid components ,Aand B respectively of an ideal binary solution,If x_A represents the mole fraction of component A, the total pressure of the solution will be

A. $\frac{p_A^\circ - x_1}{x_2}$

B. $\frac{p_A^\circ - x_2}{x_1}$

C. $\frac{p_B^\circ x_1}{x_2}$

D. $\frac{p_B^\circ x_2}{x_1}$

Answer: B

Watch Video Solution

24. X_A and X_B are the mole fraction of A and B respectively in liquid phase y_A and y_B are the mole fraction of A and B respective in vapour phase. Find out the slope of straight line if a graph is plotted $\frac{1}{y_A}$ along

Y-axis against $\frac{1}{x_A}$ along X-axis gives straight line $\left[p_A^\circ\right.$ and p_B° are vapour pressure of pure components A and B].

A. p_B° / p_A°

B. p_A° / p_B°

C. $p_B^\circ - p_A^\circ$

D. $p_A^\circ - p_B^\circ$

Answer: A

Watch Video Solution

25. One component of a solution follows Raoult's over the entire range $0 \leq x_1 \leq 1.$ The second component must follow Raoult's law in the range when x_2 is

A. close to zero

B. close to 1

C. $0 \leq x_2 \leq 0.5$

D. $0 \leq x_2 \leq 1$

Answer: D

Watch Video Solution

26. The vapour pressure of a solvent decreased by 10 mm of Hg when a non-volatile solute was added to the solvent. The mole fraction of solute in solution is 0.2, what would be the mole fraction of solvent if the decrease in vapour pressure is 20 mm of Hg?

A. 0.8

B. 0.6

C. 0.4

D. 0.4

Answer: B

Watch Video Solution

27. $18g$ glucose $(C_6H_{12}O_6)$ is added to $178.2g$ water. The vapour pressure of water (in torr) for this aqueous solution is:

A. 7.6

B. 76

C. 752.4

D. 759.0

Answer: C

Watch Video Solution

28. Which of the following statements about the composition of the vapour over an ideal $1:1$ mol mixture of benzene and toluene is correct? Assume that the temperature is constant at $25^\circ C$. (Given: vapour pressure Date at $25^\circ C$, benzene=12.8 kP, toluene=3.85 kPa)

A. The vapour will contain equal amounts of benzene and toluene

B. Not enough information is given to make a prediction

C. The vapour will contain a higher percentage of benzene

D. The vapour will contain a higher percentage of toluene

Answer: C

Watch Video Solution

29. 1 mole of liquid A and 2 moles of liquid B make a solution having a total vapour pressure of 38 torr. The vapour pressures of pure A and pure B are 45 torr and 36 torr respectively. The described solution

A. is an ideal solution

B. shows negative deviation

C. is a minimum boiling azeotrope

D. has volume greater than the sum of individual volumes

Answer: B

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

A. $\Delta H_{\text{mix}} = 0$

B. $\Delta U_{\text{mix}} = 0$

C. $\Delta P = P_{\text{obs}} - P_{\text{calculated by Raoult's law}} = 0$

D. $\Delta G_{\text{mix}} = 0$

Answer: D

Watch Video Solution

31. The vapor pressure of acetone at $20^\circ C$ is 185 torr. When $1.2g$ of a non-volatile solute was dissolved in $100g$ of acetone at $20^\circ C$, it vapour pressure was 183 torr. The molar mass $(gmol^{-1})$ of solute is:

A. 128

B. 488

C. 32

D. 64

Answer: D

Watch Video Solution

32. Dry air is passed through a solution containing 10 g of the solute in 90 g of water and then through pure water. The loss in weight of solution is 2.5 g and that of pure solvent is 0.05 g. Calculate the molecular weight of the solute.

A. 50

B. 180

C. 100

D. 25

Answer: C

Watch Video Solution

33. The mass of glucose that would be dissolved in 50g of water in order to produce the same lowering of vapour pressure as is produced by dissolving 1g of urea in the same quantity of water is :

A. 1 g

B. 3 g

C. 6 g

D. 8 g

Answer: B

Watch Video Solution

34. The vapour pressure of a solution of a non-volatile electrolyte B in a solvent A is 95% of the vapour pressure of the solvent at the same temperature. If the molecular weight of the solvent is 0.3 times, the molecular weight of solute, the weight ratio of the solvent and solute are:

A. 0.15

B. 0.2

C. 4.0

D. 5.7

Answer: D

Watch Video Solution

35. At a certain temperature, the value of the slope of the plot of osmotic pressure (π) against concentration $(\mathrm{C\ in\ mol\ L^{-1}})$ of a certain polymer solution is 291R. The temperature at which osmotic pressure is measured is (R is gas constant)

A. $271^{\circ} C$

B. $18^{\circ} C$

C. 564 K

D. 18 K

Answer: B

Watch Video Solution

36. The empirical formula of a non-electrolyte is CH_2O. A solution containing 3 g L^{-1} of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution. The molecular formula of the compound is :

A. CH_2O

B. $C_2H_4O_2$

C. $C_4H_8O_4$

D. $C_3H_6O_3$

Answer: B

Watch Video Solution

37. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass $= 60 g mol^{-1}$) in the same solvent. If the densities of both the solutions are assumed to be equal to $1.0 g cm^{-3}$, molar mass of the substance will be:

A. 210.0 g mol^{-1}

B. 90.0 g mol^{-1}

C. 115.0 g mol^{-1}

D. 105.0 g mol^{-1}

Answer: A

Watch Video Solution

38. Insulin $(C_2H_{10}O_5)_n$ is dissolved in a suitable solvent and the osmotic pressure (π) of solutions of various concentrations $(g/cm^3)C$ is measured at $20^\circ C$. The slope of a plot of π against C is found to be 4.65×10^{-3}. The molecular weight of insulin is:

A. 3.17×10^6

B. 4.17×10^6

C. 5.17×10^6

D. 6.17×10^6

Answer: C

Watch Video Solution

39. Osmotic pressure of insulin solution at 298 K is found to be $0.0072 atm$. Hence, height of water Column due to this pressure is

A. 7.4 mm

B. 7.4 cm

C. 74 cm

D. 760 mm

Answer: B

Watch Video Solution

40. A solution of protein (extracted from carbs) was prepared by dissolving $0.75g$ in $125cm^3$ of an aqueous solution. At $4^\circ C$ and osmotic pressure rise of $2.6mm$ of the solution was observed. Then molecular weight of protein is (assume density of solution is $1.00g/cm^3$):

A. $9. \times 10^5$

B. 5.4×10^5

C. 5.4×10^{10}

D. 9.4×10^{10}

Answer: B

Watch Video Solution

41. An aqueous solution of urea is found to boil at $100.52^{\circ}C$. Given K_b for water is 0.52 K kg mol^{-1}, the mole fraction of urea in the solution is

A. 1

B. 0.5

C. 0.018

D. 0.25

Answer: C

Watch Video Solution

42. For a dilute solution containing 2.5g of a non-volatile non-electrolyte solute in 100g of water, the elevation in boiling point at 1 atm pressure is

2° C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take K_b=0.76 K kg mol^{-1})

A. 724

B. 740

C. 736

D. 718

Answer: A

Watch Video Solution

43. A solution containing 1.8 g of a compound (empirical formula CH_2O) in 40 g of water is observed to freeze at -0.465° C. The molecules formula of the compound is (K_f of water =1.86kg Kmol^{-1}):

A. $C_2H_4O_2$

B. C_3H_6

C. $C_4H_8O_4$

D. $C_6H_{12}O_6$

Answer: D

Watch Video Solution

44. A solution containing 0.10 g of non-volatile solute X (molar mass : 100) in 200 g of benzene depresses the freezing point of benzene by $0.25^\circ C$ while 0.50 g of another non-volatile solute Y in 100 g of benzene also depresses the freezing point of benzene by $0.25^\circ C$. What is the molecular mass of Y ?

A. 50

B. 100

C. 150

D. 1000

Answer: D

Watch Video Solution

45. A solution of urea boils at $100.18^{\circ} C$ at the atmospheric pressure. If K_f and K_b for water are 1.86 and $0.512 K kg mol^{-1}$ respectively, the above solution will freeze at,

A. $-6.54^{\circ} C$

B. $-0.654^{\circ} C$

C. $6.54^{\circ} C$

D. $0.654^{\circ} C$

Answer: B

Watch Video Solution

46. At $100^{\circ} C$ the vapour pressure of a solution of $6.5 g$ of an solute in $100 g$ water is $732 mm$.If $K_b = 0.52$, the boiling point of this solution will be :

A. $102^\circ C$

B. $103^\circ C$

C. $101^\circ C$

D. $100^\circ C$

Answer: C

Watch Video Solution

47. In 100g of naphthalene, $2.423g$ of S was dissolved. Melting point of naphthalene $= 80.1^\circ C \Delta T_f = 0.661^\circ C. L_f = 35.7cal/g$ of naphthalene, molecular formula of sulphur is

A. S_2

B. S_4

C. S_6

D. S_8

Answer: D

Watch Video Solution

48. 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 $-2.8^\circ C$?

A. 27 g

B. 72 g

C. 93 g

D. 39 g

Answer: C

Watch Video Solution

49. When mercuric iodide is added to the aqueous solution of potassium iodide, then:

A. freezing point is raised

B. freezing point is lowered

C. freezing point does not change

D. boiling point does not change

Answer: A

Watch Video Solution

50. The amount of ice that will separate out on cooling a solution containing 50 g ethylene glycol in 200 g water to $-9.3^{\circ}C$ is : ($K'_f = 1.86K\text{molality}^{-1}$)

A. 18.71 g

B. 28.71 g

C. 38.71 g

D. 48.71 g

Answer: C

Watch Video Solution

51. An element X of atomic mass 25.0 exists as $X)_4$ in benzene to the extent of 100%. When $10.30g$ of saturated solution of X in benzene is added to 20.0 g of benzene, the depression in freezing point of the resulting solution is 0.51 K. If K_f for benzene is $5.1 \text{ K kg mol}^{-1}$, the solubility of X in 100 g of benzene will be

A. 3.0 g

B. 2.7 g

C. 0.30 g

D. 0.27 g

Answer: A

Watch Video Solution

52. If molarity of the dilute solutions is doubled ,the value of molal depression constant (K_f) will be:

A. doubled

B. halved

C. tripled

D. unchanged

Answer: D

Watch Video Solution

53. Pure water freezes at 273 K and 1 bar. The addition of 34.5 g of ethanol to 500 g of water changes the freezing point of the solution. Use the freezing point depression constant of water as 2 K $kgmol^{-1}$. The figures shown below represent plots of vapour pressure (V.P.) versus temperature

(T). [molecular weight of ethanol is$46 g mol^{-1}$ Among the following, the option representing change in the freezing point is

A.

B.

C.

D.

Answer: A

Watch Video Solution

54. Which of the following aqueous solution has the highest boiling point

A. $0.1 \text{ M } KNO_3$

B. $0.1 \text{ M } \ Na_3PO_4$

C. $0.1 M BaCl_2$

D. $.1 M K_2SO_4$

Answer: B

Watch Video Solution

55. Which of the following electrolytes has the same value of van't Hoff factor (i)is that of $Al_2(SO_4)_3$(if all are 100% ionised?

A. K_2SO_4

B. $K_3[Fe(CN)_6]$

C. $Al(NO_3)_3$

D. $K_4[Fe(CN)_6]$

Answer: D

Watch Video Solution

56. The degree of association (α) is given by the expression

A. $\alpha = \frac{n(i-1)}{1-n}$

B. $\alpha = \frac{i(n-1)}{1+n}$

C. $\alpha = \frac{i(n+1)}{1-n}$

D. $\alpha = \frac{i(n+1)}{n-1}$

Answer: A

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57. The molar mass of the solute sodium hydrdoxide obtained from the measurement of the osmotic pressure of its aqueous solution at $27^{\circ} C$ is $25 g mol^{-1}$. Therefore its ionization percentage in this solution is

A. 75

B. 60

C. 80

D. 70

Answer: B

Watch Video Solution

58. $1g$ of monobasic acid in $100g$ of water lowers the freezing point by 0.168°. If $0.2g$ of same acid requires $15.1mLmol^{-1}$ of $N/10$ alkali for complete neutralization, calculate the degree of dissociation of acid. K'_f for H_2O is $1.86Kmol^{-1}kg$.

A. 9.8%

B. 19.6%

C. 4.9%

D. 1.68%

Answer: B

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59. 0.6 mL of acetic acid is dissolved in 1 litre of water. The value of van't Hoff factor is 1.04. What will be the degree of dissociation of the acetic acid?

A. 0.01

B. 0.02

C. 0.03

D. 0.04

Answer: D

Watch Video Solution

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

A. Molecular mass of X is less than molecular mass of Y

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

C. X is undergoing dissociation in water

D. Molecular mass of X is greater than the molecular mass of Y

Answer: C

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61. The freezing point (in $.^{\circ} C$) of a solution containing $0.1g$ of $K_3[Fe(CN)_6]$ (Mol.wt. 329) in 100 g of water $(K_f = 1.86 K kg mol^{-1})$ is

A. -2.3×10^{-2}

B. -5.7×10^{-2}

C. -5.7×10^{-3}

D. -1.2×10^{-2}

Answer: A

Watch Video Solution

62. The van't Hoff factor for $BaCl_2$ at 0.01 M concentration is 1.98. The percentage dissociation of $BaCl_2$ at this concentration is :

A. 49

B. 69

C. 89

D. 98

Answer: A

Watch Video Solution

63. The van't hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

A. 0

B. 1

C. 2

D. 3

Answer: D

Watch Video Solution

64. The freezing point depression constant for water is $-1.86^{\circ} Cm^{-1}$. if $5.00 g Na_2SO_4$is dissolved in $45.0 g H_2O$,the freezing point is changed by $-3.82^{\circ} C$,Calculate the van't Hoff factor for Na_2SO_4

A. 0.381

B. 2.05

C. 2.63

D. 3.11

Answer: C

Watch Video Solution

65. A 0.1 molal aqueous solution of a weak acid is 30% ionized. If K_f for water is $1.86^\circ C/m$, the freezing point of the solution will be.

A. $-0.18^\circ C$

B. $-0.54^\circ C$

C. $-0.36^\circ C$

D. $-0.24^\circ C$

Answer: D

Watch Video Solution

66. v1_newFlow

A. $i = (1 - x)$

B. $i = (1 + x)$

C. $i = (1 - x/2)$

D. $1 = (1 + x / 2)$

Answer: C

Watch Video Solution

67. The freezing point of benzene decreases by $0.45^{\circ} C$ when $0.2g$ of acetic acid is added to $20g$ of benzene. IF acetic acid associates to form a dimer in benzene, percentage association of acetic acid in benzene will be $\left(K_f \text{for benzene} = 5.12 Kkgmol^{-1}\right)$

A. $76.6\ \%$

B. $94.6\ \%$

C. $64.6\ \%$

D. $80.4\ \%$

Answer: B

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68. A $0.004M$ solution of Na_2SO_4 is isotonic with a $0.010M$ solution of glucose at same temperature. The apparent degree of dissociation of Na_2SO_4 is

A. $25\ \%$

B. $50\ \%$

C. $75\ \%$

D. $85\ \%$

Answer: C

Watch Video Solution

69. Van't Hoff factors are x,y,z in the case of association, ionisation and no charge respectively. Increasing order is

A. x lt y lt z

B. x gt z gt y

C. x lt z lt y

D. x gt y gt z

Answer: C

Watch Video Solution

70. For a weak monobasic acid, if $pK_a = 4.$ then at a concentration of 0.01 M of the acid solution, the van't Hoff factor is

A. 1.01

B. 1.02

C. 1.10

D. 1.20

Answer: C

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71. The pH of 1 M solution of a weak monobasic acid (HA) is 2. Then, the van't Hoff factor is

A. 1.01

B. 1.02

C. 1.10

D. 1.20

Answer: A

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72. At a certain Hill station, water boils at $96^{\circ} C$. The amount of NaCl that should be added to one litre of water so that it boils at $100^{\circ} C$ will be (K_b for $H_2O = 0.52K/m$)

A. 450 g

B. 225 g

C. 125 g

D. 250 g

Answer: B

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73. One molal solution of a complex of cobalt chloride with NH_3 in water showed an elevation in boiling point equal to 2.08°. Assuming that the complex is completely ionized in the solution, the complex is (K_b for water = $0.52 \text{ K kg mol}^{-1}$)

A. $[Co(NH_3)_6]Cl_3$

B. $[Co(NH_3)_5Cl]Cl_2$

C. $[Co(NH_3)_4Cl_2]Cl$

D. none of these

Answer: A

Watch Video Solution

74. The depression in freezing point of $0.01m$ aqueous $CH_3C\infty H$ solution is 0.02046°, $1m$ urea solution freezes at $-1.86^\circ C$. Assuming molality equal to molarity, pH of CH_3COOH solution is

A. 2

B. 3

C. 3.2

D. 4.2

Answer: B

Watch Video Solution

75. The average osmotic pressure of human blood is 7.8 bar at $37^\circ C$. What is the concentration of an aqueous $NaCl$ solution that could be used in the blood stream ?

A. $0.15 \text{ mol}/\text{L}$

B. $0.30 \text{ mol}/\text{L}$

C. 0.60 mol'L

D. $0.45 \text{ mol}/\text{L}$

Answer: A

Watch Video Solution

76. 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. can't determine.

Answer: C

Watch Video Solution

77. Two solution (A)containing $Fecl_3(aq)$and(B) semipermeable membrance as shown below.If $FeCl_3$on reaction with $K_4[Fe(CN)_6]$,produces blue colour of $Fe_4[Fe(CN)_6]$, the clue colour will be noticed in :

$$\left|\begin{array}{cc} (A) & (B) \\ FeCl_3 & K_4[Fe(CN)_6] \end{array}\right|$$

A. A

B. B

C. In both A and B

D. Neither in A nor in B

Answer: D

Watch Video Solution

78. Pure benzene freezes t $5.3^{\circ} C$. A solution of 0.223 g of phenylacetic acid $(C_6H_5CH_2COOH)$ in 4.4 g of benzene $\left(K_f = 5.12 K kg mol^{-1}\right)$ freezes at $4.47^{\circ} C$. From the observation one can conclude that :

A. phenylacetic acid exists as such in benzene

B. phenylacetic acid undergoes partial ionization in benzene

C. phenylacetic acid undergoes complete ionization in benzene

D. phenylacetic acid dimerizes in benzene

Answer: D

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79. Consider separate solution of $0.500 M C_2H_5OH(aq), 0.100 M Mg_3(PO_4)_2(aq), 0.250 M KBr(aq)$ and $0.125 M Na_3PO_4(aq)$ at $25^{\circ} C$. Which statement is true about these solutions, assuming all salts to be strong electrolytes?

A. $0.500 \text{ M } C_2H_5OH(aq)$ has the highest osmotic pressure

B. They all have the same osmotic pressure

C. $0.100 \text{ M } Mg_3(PO_4)_2$ has the highest osmotic pressure

D. $0.125 \text{ M } Na_3PO_4(aq)$ has the highest osmotic pressure

Answer: B

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80. Of the following$0.10m$ aqueous solutions,which one will exhibits the largest freezing point depression?

A. KCl

B. $C_6H_{12}O_6$

C. $Al_2(SO_4)_3$

D. K_2SO_4

Answer: C

Watch Video Solution

81. On gram of silver gets distributed between $10cm^3$ of molten zinc and 100 cm^3 of molten lead at $800^\circ C$. The percentage of silver still left in the lead layer is approximately

A. 2

B. 5

C. 3

D. 1

Answer: C

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82. The correct relationship between molarity (M) and molality (m) is (d = density of the solution, in $\mathrm{kg\,L^{-1}}$, M_2= molar mass of the solute in $\mathrm{kg\,mol^{-1}}$)

A. $M = \dfrac{md}{1 + nM_2}$

B. $M = \dfrac{m}{1 + mM_2 d}$

C. $M = \dfrac{1 + mM_2}{md}$

D. $M = \dfrac{1 + md}{mM_2}$

Answer: A

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (II. Multiple Choice Question)

1. If P° and P_S are the vapour pressure of the solvent and its solution respectively and x_1 and x_2 are the mole fraction of the solvent and solute respectively, then

A. $P_S = p^\circ N_2$

B. $P^\circ - P_S = p^\circ N_2$

C. $P_S = P^\circ N_1$

D. $(P^\circ - P_S) / P_S = N_1 / (N_1 + N_2)$.

Answer: B::C

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2. The vapour pressure of a dilute solution of a solute is not influenced by

A. nature of the solute if it is non-electrolyte

B. mole fraction of the solute

C. melting point of the solute

D. degree of dissociation of the solute.

Answer: A::C

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3. Which statement are true about osmotic pressure (π), volume (V) and temperature (T)?

Solution (A)	Solution (B)
$FeCl_3$	$K_4Fe(CN)_6$

A. $\pi \propto \frac{1}{V}$ if T is constant

B. $\pi \propto T$ if V is constant

C. $\pi \propto V$ if T is constant

D. πV is constant if T is constant.

Answer: A::B::D

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4. The colligative properties of a solution are

A. $\propto$ molality

B. $\propto$ (1)/(molecular mass of the solute)

C. proportional to each other

D. independent of the nature of the solute, i.e., electrolyte or non-electrolyte.

Answer: A::B::C

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5. In the depression of freezing point experiment, it is found that the:

A. The vapour pressure of the solution is equal to that of pure solvent

B. The vapour pressure of the solution is more than that of pure solvent

C. Only solute molecules solidify at the freezing point

D. Only solvent molecules solidify at the freezing point.

Answer: D

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6. Mixture (s) showing positive deviation from Raoult's law at $35^{\circ}C$ is (are)

A. carbon tetrachloride + methanol

B. carbon disulphide + acetone

C. benzene + toluene

D. phenol + aniline

Answer: A::B

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7. For a solution formed by mixing liquid L and M, the vapour pressure of L plotted against the mole fraction of M in solution is shown in the following figure. Here x_L and x_M represent mole fractions of L and M respectively, in the solution. The correct statement(s) applicable to this system is (are)

A. The point Z represents vapour pressure of pure M and Raoult's law is obeyed from $x_L = 0$ to $x_L = 1$

B. Attractive intermolecular interactions between $L - L$ in pure liquid L and $M - M$in pure liquid M are stronger than those between $L - M$ when mixed in solution

C. The point Z represents vapour presssure of pure liquid M and Raoul's law is obeyed when $x_L \to 0$

D. The point Z represents vapour pressure of pure liquid L and Raoul's law is obeyed when $x_L \to 1$

Answer: B::D

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (III. Multiple Choice Question)

1. An ideal solution of two liquids is a solution in which each component obeys Raoult's which states that the vapour pressure of any component in the solution depends on the mole fraction of that component in the solution and the vapour pressure of that component in the pure state. However, there are many solution which do not obey Raoult's law. In other words, they show deviations from ideal behaviour which may be positive or negative. However, in either case, corresponding to a particular composition, they form a constant boiling mixtures called azeotropes.

Which of the following mixture do you expect will not show positive deviation from Raoult's law ?

A. Benzene - Chloroform

B. Benzene - Acetone

C. Benzene - Ethanol

D. Benzene - Carbon tetrachloride

Answer: A

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2. An ideal solution of two liquids is a solution in which each component obeys Raoult's which states that the vapour pressure of any component in the solution depends on the mole fraction of that component in the solution and the vapour pressure of that component in the pure state. However, there are many solution which do not obey Raoult's law. In other words, they show deviations from ideal behaviour which may be positive or negative. However, in either case, corresponding to a particular composition, they form a constant boiling mixtures called azeotropes. Which of the following mixture do you expect will not show positive deviation from Raoult's law ?

A. shows no deviations from Raoult's law

B. shows a positive deviation from Raoult's law

C. shows a negative deviation from Raoult's law

D. is staurated

Answer: B

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3. An ideal solution of two liquids is a solution in which each component obeys Raoult's which states that the vapour pressure of any component in the solution depends on the mole fraction of that component in the solution and the vapour pressure of that component in the pure state. However, there are many solution which do not obey Raoult's law. In other words, they show deviations from ideal behaviour which may be positive or negative. However, in either case, corresponding to a particular composition, they form a constant boiling mixtures called azeotropes.

A solution has a $1:4$ mole ratio of pentane to hexane. The vapour presssures of the pure hydrocarbons at $20^{\circ}C$ are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction at pentane in the vapour phase would be

A. 0.2

B. 0.478

C. 0.549

D. 0.786

Answer: B

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4. Colligative properties of a solution depend upon the number of moles of a solute dissolved and do not depend upon the nature of the solute. However, they are applicable only to dilute solutions in which the solutes do not undergo any association or dissociation. For solutes undergoing such changes, van't Hoff introduced a factor, called van't Hoff factor (i). This has helped not only to explain the abnormal molecular masses of such solutes in the solution but has also helped to calculate the degree of association or dissociation.

The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is

A. $91.3\ \%$

B. $87\ \%$

C. $100\ \%$

D. 74%

Answer: B

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5. Which one of the following aqueous solutions will have the lowest freezing point ?

A. 0.1 molal solution of urea

B. 0.1 molal solution of acetic acid

C. 0.1 molal solution of sodium chloride

D. 0.1 molal solution of calcium chloride

Answer: D

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6. A solution of sucross (molar mass = 342 $g\ mol^{-1}$) has been prepared by dissolving 68.4 g of sucrose in one kg of water. K_f for water is $1.86\ K\ kg\ mol^{-1}$ and vapour pressure of water at 298 K is 0.024 atm. The vapour pressure of the solution at 298 K will be

A. 0.230 atm

B. 0.233 atm

C. 0.236 atm

D. 0.0239 atm

Answer: D

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7. A solution of sucross (molar mass = 342 $g\ mol^{-1}$) has been prepared by dissolving 68.4 g of sucrose in one kg of water. K_f for water is $1.86\ K\ kg\ mol^{-1}$ and vapour pressure of water at 298 K is 0.024 atm. the osmotic pressure of the solution at 298 K will be

A. 4.29 atm

B. 4.49 atm

C. 4.69 atm

D. 4.89 atm

Answer: D

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8. A solution of sucross (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.4 g of sucrose in one kg of water. K_f for water is $1.86 \text{ K kg mol}^{-1}$ and vapour pressure of water at 298 K is 0.024 atm. The freezing point of the solution will be

A. $-0.684^{\circ} C$

B. $-0.342^{\circ} C$

C. $-0.372^{\circ} C$

D. $-0.186^{\circ} C$

Answer: C

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9. A solution of sucross (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.4 g of sucrose in one kg of water. K_f for water is $1.86\ \mathrm{K\,kg\,mol}^{-1}$ and vapour pressure of water at 298 K is 0.024 atm. The mass of sodium chloride that should be dissolved in the same amount of water to get the same freezing point will be

A. 136.8 g

B. 32.2 g

C. 5.85 g

D. 11.60 g

Answer: C

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10. A solution of sucross (molar mass = 342 $\mathrm{g\ mol}^{-1}$) has been prepared by dissolving 68.4 g of sucrose in one kg of water. K_f for water is $1.86\ \mathrm{K\ kg\ mol}^{-1}$ and vapour pressure of water at 298 K is 0.024 atm. If on dissolving the above amount of NaCl in 1 kg of water, the freezing point is found to be $-0.344^{\circ}C$, the percentage dissociation of NaCl in the solution is

A. $75\ \%$

B. $80\ \%$

C. $85\ \%$

D. $90\ \%$

Answer: C

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11. Properties such as boiling point, freezing point and vapour pressure of a pure solvent change when solute molecules are added to get homogeneous solution. These are called colligative properties. Application of colligative properties are very useful in day- to - day life. One of its examples is the use of ethylene glycol and water mixture as anti-freezing liquid in the radiator of automobiles.

A solution M is prepared by mixing ethanol and water. The mole fraction of ethanol in the mixture is 0.9.

Given : Freezing point depression constant of water $\left(K_f^{\text{water}}\right) = 1.86\ \mathrm{K\ kg\ mol}^{-1}$

Freezing point depression constant of ethanol $\left(e_f^{\text{ethanol}}\right) = 2.0\ \mathrm{K\ kg\ mol}^{-1}$

Boiling point elevation constant of water $\left(K_b^{\text{water}}\right) = 0.52\ \mathrm{K\ kg\ mol}^{-1}$

Boiling point elevation constant of ethanol $\left(K_b^{\text{ethanol}}\right) = 1.2\ \mathrm{K\ kg\ mol}^{-1}$

Standard freezing point of water = 273 K

Standard freezing point of ethanol = 155.7 K

Standard boiling point of water = 373 K

Standard boiling point of ethanol = 351.5 K

Vapour pressure of pure water = 32.8 mm Hg

Vapour pressusre of pure ethanol = 40 mm Hg

Molecular weight of water = $18\ \mathrm{g\ mol}^{-1}$

Molecular weight of ethanol = 46 g mol^{-1}

In answering the following questions, consider the solutions to be ideal dilute solutions and solutes to be non-volatile and non-dissociative.

The freezing point of solution M is

A. 268.7 K

B. 268.5 K

C. 234.2 K

D. 150.9 K

Answer: D

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12. Properties such as boiling point, freezing point and vapour pressure of a pure solvent change when solute molecules are added to get homogeneous solution. These are called colligative properties. Application of colligative properties are very useful in day- to - day life. One of its examples is the use of ethylene glycol and water mixture as anti-freezing liquid in the radiator of automobiles.

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Molecular weight of water = 18 g mol^{-1}

Molecular weight of ethanol = 46 g mol^{-1}

In answering the following questions, consider the solutions to be ideal dilute solutions and solutes to be non-volatile and non-dissociative.

The vapour pressure of the solution M is

A. 39.3 mm Hg

B. 36.0 mm Hg

C. 29.5 mm Hg

D. 28.8 mm Hg

Answer: A

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13. Properties such as boiling point, freezing point and vapour pressure of a pure solvent change when solute molecules are added to get homogeneous solution. These are called colligative properties. Application of colligative properties are very useful in day- to - day life. One of its examples is the use of ethylene glycol and water mixture as anti-freezing liquid in the radiator of automobiles.

A solution M is prepared by mixing ethanol and water. The mole fraction of ethanol in the mixture is 0.9.

Given : Freezing point depression constant of water $\left(K_f^{\text{water}}\right) = 1.86 \text{ K kg mol}^{-1}$

Freezing point depression constant of ethanol $\left(e_f^{\text{ethanol}}\right) = 2.0 \text{ K kg mol}^{-1}$

Boiling point elevation constant of water $\left(K_b^{\text{water}}\right) = 0.52 \text{ K kg mol}^{-1}$

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Vapour pressure of pure water = 32.8 mm Hg

Vapour pressusre of pure ethanol = 40 mm Hg

Molecular weight of water = 18 g mol^{-1}

Molecular weight of ethanol = 46 g mol^{-1}

In answering the following questions, consider the solutions to be ideal dilute solutions and solutes to be non-volatile and non-dissociative.

Water is added to the solution M such that the mole fraction of water in the solution becomes 0.9. The boiling of the solution is

A. 380.4 K

B. 376.2 K

C. 375.5 K

D. 354.7 K

Answer: B

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (IV. Matching Type Questions)

1. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options given.

Column I	Column II
For a 5% solution of $H_2SO_4\left(d = 1.01 \text{ g mL}^{-1}\right)$	
(A) Molarity of the solution	(p) 0.537
(B) Molality of the solution	(q) 0.0096
(C) Mole fraction of H_2SO_4	(r) 0.05
(D) Mass fraction of H_2SO_4	(s) 0.515

A. A-r, B-s, C-p, D-q

B. A-q, B-p, C-s, D-r

C. A-s, B-p, C-q, D-r

D. A-s, B-r, C-p, D-q

Answer: C

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2. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options given.

Column I (Solutions mixed)	Column II (Noram
(A) 100 cc of 0.2 NH_2SO_4 + 100 cc of 0.1 N HCl	(p) 0.25 N
(B) 100 cc of 0.2 M H_2SO_4 + 100 cc of 0.1 M HCl	(q) 0.067 N
(C) 100 cc of 0.1 M H_2SO_4 + 100 cc of 0.1 M NaOH	(r) 0.15 N
(D) 100 cc of 0.1 M HCl + 50 cc of 0.2 N NaOH	(s) 0.05

A. A-r, B-s, C-p, D-q

B. A-q, B-p, C-r, D-s

C. A-r, B-p, C-s, D-q

D. A-s, B-r, C-p, D-q

Answer: C

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3. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options given.

Column I (Substance)	Column II (Solubility)
(A) Li_2CO_3	(p) Increases continuously with increase of temper
(B) KCl	(q) Decreases continuously with increase of temper
(C) $Na_2SO_4.10H_2O$	(r) First increases and then decreases
(D) NH_4NO_3	(s) Increases but not continuously

A. A-s, B-r, C-p, D-q

B. A-r, B-s, C-q, D-p

C. A-p, B-q, C-r, D-s

D. A-q, B-p, C-r, D-s

Answer: D

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4. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options given.

Column I (van't Hoff factor)	Column II (Behaviour)
(A) $i > 1$	(p) There is association.
(B) $i < 1$	(q) There is dissociation.
(C) $i = 1$	(r) Impossible
(D) $i = 0$	(s) No association or dissociation

A. A-p, B-q, C-s, D-r

B. A-s, B-r, C-p, D-q

C. A-r, B-s, C-q, D-p

D. A-q, B-p, C-s, D-r

Answer: D

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (V. Matrix-Match Type Questions)

1.

Column I	Column II
(A) Carbon tetrachloride + Toluene	(p) Shows positive deviation fr
(B) Chloroform + Benzene	(q) Shows negative deviation fr
(C) Carbon tetrachloride + Chloroform	(r) Mixing is endothermic
(D) Benzene + Toluene	(s) Shows ideal behaviour

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2.

Column I (Solvent)	Column II (Value of K_f or K_b)
(A) 0.1 M Glucose sol.	(p) Lowest freezing point
(B) 0.1 M Sucroe sol.	(q) Highest freezing point
(C) 0.1 M $BaCl_2$ sol.	(r) Lowest osmotic pressure
0.1 M $Ca(NO_3)_2$ sol.	(s) Highest osmotic pressure

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (VI. Integer Type Questions)

1. Number of moles of Na_2CO_3 that should be dissolved in 4 litres of the solution to obtain 1 N Na_2CO_3 solution is

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2. The molality of a sulphuric acis solution in which the mole fraction of water is 0.86 is

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3. 100 mL of 1 M H_2SO_4 are mixed with 200 mL of 8 M HCl solution. The noramlity of the resulting solution is

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4. The elevation in boiling point expected for 0.3 m $Al_2(SO_4)_3$ solution will be how many times compared with the elevation in boiling point of 0.1 m Na_2SO_4 solution ?

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5. van't Hoff factor of an electrolyte A_2B_3 assuming that it ionizes 75% in the solution is

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6. 29.2% $(w/w)HCl$ stock, solution has a density of $1.25gmL^{-1}$. The molecular weight of HCl is $36.5gmol^{-1}$. The volume (mL) of stock solution required to prepare a $200mL$ solution of $0.4MHCl$ is :

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7. A compound H_2X with molar weigth of 80g is dissolved in a solvent having density of $0.4gmol^{-1}$. Assuming no change in volume upon dissolution, the molarity of a 3.2 molar solution is

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8. MX_2 dissociates into M^{2+} and X^{-} ions in an aqeous solution, with a degree dissociation (α) of 0.5. The ratio of the observed depression of freezing point of the aqueous solution to the value of the depression of freezing point in the absence of ionic dissociation is

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9. If the freezing point of a 0.01 molal aqueous solution of a cobalt (III) chloride-ammonia complex (which behaves as a strong electrolyte) is $-0.0558^{\circ}C$, the number of chloride (s) in the coordination sphere of the complex if $\left[K_f \text{ of water } = 1.86 K kg mol^{-1}\right]$

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10. The mole fraction of a solute in a solutions is 0.1. At $298K$ molarity of this solution is the same as its molality. Density of this solution at 298 K is $2.0 g cm^{-3}$. The ratio of the molecular weights of the solute and solvent, $\dfrac{MW_{\text{solute}}}{MW_{\text{solvent}}}$ is

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (VII. Assertion-Reason Type Questions)(Type I)

1. Statement-1 : 0.1 M HCl solution has higher ozmotic pressure than 0.1 M NaCl solution.

Statement-2 : Cl^{-} ions being common, the small size H^{+} ions have greater ionic mobility than large size Na^{+} ions.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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2. Statement-1 : If on mixing the two liquids, the solution becomes hot, it implies that it shows negative deviation from Raoult's law.

Statement-2. Solution which show negative deviation are accompained by decrease in volume.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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3. Assertion :- If a liquid solute more volatile than the solvent is added to the solvent, the vapour pressure of the solution may increase i.e., $p_s > p^\circ$.

Reason :- In the presence of a more volatile liquid solute, only the solute will form vapours and solvent will not.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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4. Statement-1. One molar aqueous solution has always higher concentration than one molal solution.

Statement-2. One molar solution contains less solvent than one molal solution.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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5. Statement-1. Vapour pressure of water is less than 1.013 bar at 373K.

Statement-2. Water boils at 373 K as the vapour pressure at this temperature becomes equal to atmosphere pressure.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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6. Statement-1. Any concentration of NaCl solution can be injected intravenously as NaCl, being a common table salt, is harmless chemical.

Statement-2. 0.9% (mass/volume) NaCl solution is isotonic with the fluid inside the blood cells.

A. Statement-1 is True, Statement-2 is True , Statement-2 is a correct explanation of Statement-1.

B. Statement-1 is True, Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

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Competition (FOCUS) JEE (Main and Advanced)/Medical Entrance SPECIAL (VII. Assertion-Reason Type Questions)(Type II)

1. Assertion. $1.575 \text{ g of } H_2C_2O_4.2H_2O$ in 250 mL solution makes it 0.1 N.

Reason. $H_2C_2O_4.2H_2O$ is a dihydrate organic acid.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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2. Assertion. One molar aqueous solution has always higher concentration than one molal.

Reason. The molality of a solution depends upon the density of the solution whereas molarity does not.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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3. Assertion (A): Na_2SO_4 is soluble in water while $BaSO_4$ is insoluble.

Reason (R): Latice enthalpy of $BaSO_4$ exceeds its hydration enthalpy.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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4. Assertion. Greater the value of Henry's constant of a gas in a particular solvent, greater is the solubility of the gas at the same pressure and temperature.

Reason. Solubility of a gas is directly propportional to its Henry's constant at the same pressure and temperature.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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5. Assertion :- If a liquid solute more volatile than the solvent is added to the solvent, the vapour pressure of the solution may increase i.e., $p_s > p^\circ$.

Reason :- In the presence of a more volatile liquid solute, only the solute will form vapours and solvent will not.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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6. Assertion : Azeotropic mixtures are formed only by non - ideal solutions and they may have boiling points either greater than both the components or less than both the compontents.

Reason : The c omposition of the vapour phase is same as that of the liquid phase of an azeotropic mixture.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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7. Assertion. If red blood cells were removed from the body and placed in pure water, pressure inside the cells increases.

Reason. Boiling point inside the pressure cooker.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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8. Assertion (A): Cooking time in pressure cooker is reduced.

Reason (R): The boiling point inside the pressure cooker is raised.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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9. Assertion : Addition of a nonvolatile solute to a volatile solvent increases the boiling point.

Reason : Addition of nonvolatile solute results in lowering of vapour pressure.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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10. Assertion. The depression in freezing point depend on the amount of the solute dissolved and not one the nature of the solute or solvent.

Reason. K_f for both has different values.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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11. Assertion (A): $0.1M$ solution of glucose has same increment in freezing point than has $0.1M$ solution of urea.

Reason (R): K_f for both has different value.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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12. Assertion (A): The increasing pressure on water decreases its freezing point.

Reason (R):The density of water is maximum at $273K$.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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13. Each question contains STATEMENT-I(Assertion) and STATEMENT-2(Reason).the statement carefully and mark the correct answer accoring to the instrution given below:

STATEMENT - 1 : The molecular mass of acetic acid determined by depression in freezing point method in benzene and water was found to be differrent.

STATEMENT - 2 : Water is polar and benzene is non-polar.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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14. Assertion. Higher the molal depression constant of the solvent used, higher the freezing point of the solution.

Reason. Depression in freezing point depends on the nature of the solvent.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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15. The best colligative property used for the determination of molecular mases of polymers is :

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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16. Assertion. Van't Hoff factor for benzoic acid in benzene is less than one.

Reason. Benzoic acid behaves as a weak electrolyte in benzene.

A. If both assertion and reason are true, and reason is the true explanation of the assertion.

B. If both assertion and reason are true, but reason is not the true explanation of the assertion.

C. If assertion is true, but reason is false.

D. If both assertion and reason are false.

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IMPORTANT QUESTIONS FOR BOARD EXAMINATION

1. Suppose a solid solution is formed between two substances, one whose particles are very large and the other whose particles are very small. What kind of solide solution is this likely to be ?

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2. Out of molarity and molality which one is preferred and why ?

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3. Concentrated nitric acid used for laboratory works is 68% nitric acid by mass in aqueous solution. What should be the molarity of such a sample of the acid if the density of solution is $1.504 gmL^{-1}$?

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4. Molarity of H_2SO_4 is 0.8 and its density is $1.06 g/cm^3$. What will be its concentration in terms of molality and mole fraction?

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5. Calculate the molality of a sulphuric acid solution in which the mole fraction of water is 0.85.

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6. Calcualate the molarity and molality of 20% aqueous ehtanol (C_5H_5OH) solution by volume. (density of solution $= 0.96gmL^{-1}$)

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7. How many of 0.1 N HCl are required to react completely with 1 g mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of two ?

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8. State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law. What helps in existence of aquatic life?

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9. H_2S, a toxic gas with rotten egg like smell, is used for the qualitative analysis.If the solubility of H_2S in water at STP is $0.195m$, calculate Henry's law constant.

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10. State Raoult's law. Derive its mathematical expression for a solution of a non-volatile solute in a volatile solvent. Using the law, how would you distinguish between ideal and non-ideal solutions?

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11. The air is a mixture of a number of gases. The major components are oxygen and nitrogen with approximate proportion of $20\% : 79\%$ by volume at $298K$. The water is in equilibrium with air at a pressure of $10atm$ At $298K$ if Henry's law constants for oxygen and nitrogen at $298K$ are $3.30 \times 10^7 mm$ and $6.51 \times 10^7 mm$, respectively, calculate the composition of these gases in water.

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12. Why vapour pressure of a liquid decreases when a non $-$ volatile solute is added to it ?

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13. Benzene and toluene form ideal solution over the entire range of composition. The vapour pressure of pure benzene and naphthalene at $300K$ are $50.71 mmHg$ and $32.06 mmHg$, respectively. Calculate the mole fraction of benzene in vapour phase if $80g$ of benzene is mixed with $100g$ of naphthalene.

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14. Sodium chloride solution freezes at lower temperature then water but boils at higher temperature than water. Explain.

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15. Calculate the mass of a non-volatile solute (molecular mass 40) which should be dissolved in $114g$ octane to reduce its vapour pressure to 80%.

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16. Two liquids A and B on mixing produce a warm solution. Which type of deviation from Raoult's law does it show?

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17. Why does a solution of ethanol and cyclohexane show positive deviation from Raoult's law?

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18. Calculate the osmotic pressure at 273 K of a 5% solution of urea (Mol. Mass = 60). (R = 0.0821 litre atm/degree/mole).

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19. A solution containing 30 g of a non-volatile solute exactly in 90 g water has a vapour pressure of 2.8 kPa at 298 K. Further 18 g of water is then added to the solution, the new vapour pressure becomes 2.9 kPa at 298 K. Calculate

(i) molar mass of the solute.

(ii) vapour pressure of water at 298 K.

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20. $200cm^3$ of an aqueous solution of a protein contains $1.26g$of the protein. The osmotic pressure of such a solution at $300K$ is found to be 2.57×10^{-3} bar. Calculate the molar mass of the protein.

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21. Calculate the osmotic pressure of a solution obtained by mixing $100cm^3$ of 1.5% solution of urea (mol. Mass=60) and $100cm^3$ of 3.42% solution by cane sugar (mol. Mass = 342) at $20^\circ C$. (R=0.082 litre atm/deg/mole)

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22. When dehydrated fruits and vegetables are placed in water, they slowly swell and return to original form. Why? Would a temperature increase accelerate the process? Explain.

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23. A solution containing $0.5216g$ of naphthalene (mol.wt. $= 128.16$) in 50mL of $\mathrm{C}Cl_4$ shows boiling point elevation of 0.402° while a solution of $0.6216g$ of an unknown solute in the same weight of solvent gave a boiling point elevation of 0.647° . Find the molecular mass of the unknown solute.

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24. A solution containing $6g$ of a solute dissolved in $250cm^3$ of water gave an osmotic pressure of $4.5atm$ at $27^{\circ}C$. Calculate the boiling point of the solution.The molal elevation constant for water is $0.52^{\circ}C$ per 1000 g.

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25. The boiling point of water at $750mmHg$ is $99.63^{\circ}C$. How much sucrose is to be added to $500g$ of water such that it boils at $100^{\circ}C$.

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26. Explain in why on addition of 1 mole of NaCl to 1L of water, the boiling point of water increases, while addition of 1 mole of methyl alcohol to 1 L of water decreases its boiling point .

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27. A solution of urea in water has a boiling point of $100.128^\circ C$. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are $1.86^\circ C$ and $0.512^\circ C$ respectively.

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28. Two elements A and B form compounds having formula AB_2 and AB_4 . When dissolved in 20 g of benzene (C_6H_6) , 1g of AB_2 lowers the freezing point by $2.3K$ whereas 1.0 g of AB_4 lowers it by $1.3K$. The molar depression constant for benzene is $5.1Kkgmol^{-1}$. Calculate atomic masses of A and B.

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29. Two grams of benzoic acid (C_6H_5COOH) dissolved in $25.0g$ of benzene shows a depression in freezing point equal to $1.62K$. Molal depression constant for benzene is $4.9Kkg^{-1}mol^{-1}$. What is the percentage association of acid if it forms dimer in solution?

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30. $17.4\%\ K_2SO_4$ solution at $27^\circ C$ is isotonic with $4\%\ NaOH$ solution at the same temperature. If $NaOH$ is 100% ionized, what is the degree of ionization of K_2SO_4 in aqueous solution?

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31. A 0.001 molal solution of $\left[Pt(NH_3)_4CI_4\right]$ in water had a freezing point depression of $0.0054^\circ C$. If K_f for water is 1.80, the correct formulation for the above molecule is

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