CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (ENGLISH)

SOLUTIONS

Illustration

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

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2. Calculate the molarity of a solution containing 5 g of NaOH in 450 mL solution.

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3. Calculate molality of 2.5 g of ethanoic acid (CH_3COOH) in 75g of benzene.

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4. In N_2 gas is bubble through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that henry's law constant for N_2 at 293 K is 76.48 k bar.

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5. Henry law constant for oxygen dissolved in water is $4.34 \times 10^4 atm$ at $25^\circ C$. If the partial pressure of oxygen in air is

0.4 atm.Calculate the concentration (in moles per litre) of the dissolved oxygen in equilbrium with air at $25^\circ C$.

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6. The henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm . The mole fraction of N_2 in air is 0.8 . The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is

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7. At same temperature, oxygen is more soluble in water than hydrogen. Which of them will have a higher value of K_H and why?

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8. For a solution of acetone in chloroform, Henry's law constant is 150 torr at a temperature of 300 K. (a) Calculate the vapour pressure of acetone when the mole fraction is 0.12. (b) Assuming that Henry's law is applicable over sufficient range of composition to make the calculation valid, calculate the composition at which Henry's law pressure of chloroform is equal to Henry's law pressure of acetone at 300 K. (Henry's law constant for chloroform is 175 torr.)

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9. Henry's law constant for oxygen and nitrogen dissolved in water at 298 K are 2.0×10^9 Pa and 5.0×10^9 Pa , respectively . A sample of water at a temperature just above 273 K was equilibrated with air (20% oxygen and 80% nitrogen) at 1 atm. The dissolved gas was separated from a sample of this water and the dried. Determine the composition of this gas.

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10. Henry Law

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11. A pressure cooker reduces cooking time for food because:

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

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13. Two liquids A and B are mixed and the resulting solution is found to be cooler. What do you conclude about the deviation from ideal behaviour?

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14. The dissolution of ammonium chloride in water is an endothermic process. What is the effect of temperature on its solubility?

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15. Mixing of acetone with chloroform takes place with reduction in volume? What type of deviation from Raoult's law is shown in this case?

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16. CCl4 and water are immiscible whereas ethanol and water are miscible in all proportions. Correlate this behaviour with molecular structure of these compounds.

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17. Vapour pressure of pure $A\left(p_A^{\circ}\right) = 100$ mm Hg

Vapour pressure of pure $B\left(p_B^{\circ}\right) = 150$ mm Hg

2 mol of liquid A and 3 mol of liquid B are mixed to form an ideal solution. The vapour pressure of solution will be:

A. $a.\ )185mm$

B. $b.\ )130mm$

C. $c.\ )148mm$

D. $d.\ )145mm$

Answer: b

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18. The vapour pressure of pure benzene at $88^{\circ} C$ is $957 mm$ and that of toluene at the same temperature is $379.5 mm$. The composition of benzene-toluene misture boiling at $88^{\circ} C$ will be

A. $\chi_{\text{benzene}} = 0.66, \chi_{\text{toluene}} = 0.34$

B. $\chi_{\text{benzene}} = 0.34, \chi_{\text{toluene}} = 0.66$

C. $\chi_{\text{benzene}} = \chi_{\text{toluene}} = 0.5$

D. $\chi_{\text{benzene}} = 0.75, \chi_{\text{toluene}} = 0.25$

Answer: a

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19. The vapour pressure of a certain pure liquid A at 298 K is 40 mbar. When a solution of B is prepared in A at the same temperature, the vapour pressure is found to be 32 mbar. The mole fraction of A in the solution is

A. $a.\ )0.5$

B. $b.\ )0.3$

C. $c.\ )0.4$

D. $d.\ )0.8$

Answer: d

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20. $100mL$ of liquid A and $25mL$ of liquid B are mixed to form a solution of volume $125mL$. Then the solution is

A. a.) Ideal

B. b.) Non-ideal with positive deviation

C. c.) Non-ideal with negative deviation

D. d.) Cannot be predicted

Answer: a

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21. An aqueous solution containing 28% by weight of a liquid A (molecular mass $= 140$) has a vapour pressure of 0.200 bar at $37^\circ C$. Calculate the vapour pressure of pure liquid (vapour pressure of water at $37^\circ C = 0.100$ bar).

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22. The vapour pressure of ethanol and methanol are $44.0mm$ and $88.0mmHg$, respectively. An ideal solution is formed at the same temperature by mixing $60g$ of ethanol with $40g$ of methanol. Calculate the total vapour pressure of the solution and the mole fraction of methanol in the vapour.

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23. Two liquids A and B form ideal solutions. At 300 K, the vapour pressure of a solution containing 1 mole of A and 3 moles of B is 550 mm Hg . At the same temperature , if one more mole of B is added to this solution, the vapour pressure of the solution increases by 10 mm Hg. The vapour pressures of A and B in their pure states are respectively

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24. The mole fraction of component A in vapour phase is χ_1 and mole fraction of component A in liquid mixture is $\chi_2(P_A^\circ$ =vapour pressure of pure A,P_B° =vapour pressure of pure B).Then total vapour pressure of the liquid mixture is

A. $p_A^\circ \dfrac{\chi_2}{\chi_1}$

B. $p_A^\circ \dfrac{\chi_1}{\chi_2}$

C. $p_B^\circ \dfrac{\chi_1}{\chi_2}$

D. $p_B \dfrac{^\circ\chi_2}{\chi_1}$

Answer: a

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25. Heptane and octane form an ideal solution. At $373K$, the vapour pressure of the two liquids are 105.0 kPa and 46.0 kPa, respectively.

What will be the vapour pressure, of the mixture of $25g$ of heptane and $35g$ of octane ?

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26. Two liquids A and B form an ideal solution such that $p_A^\circ = 700mm$ and $p_B^\circ = 300mm$. A small amount of solution is vapourized and the vapour condensed (at equilibrium). The condensate has equilibrium vapour pressure of $500mm$ (at same temperature). Find the composition of the original solution.

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

a. $50mol\ \%$, b.$52mol\ \%$,c.$34mol\ \%$,d.$48mol\ \%$

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28. At $298K$, the vapour pressure of pure liquid n-butane is 1823 torr and vapour pressure of pure n-pentane is 521 torr and form nearly an ideal solution.

a. Find the total vapour pressure at $298K$ of a liquid solution containing $10\ \%$ n-butane and $90\ \%$ n-pentane by weight,

b. Find the mole fraction of n-butane in solution exerting a total vapour pressure of 760 torr.

c. What is composition of vapours of two components (mole fraction in vapour state)?

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29. The vapour pressure of pure water at $25 \circ C$ is 23.00 torr. What is the vapour pressure of $100g$of water to which $100g$ of $C_6H_{12}O_6$ (glucose) has been added ?

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30. $4.375g$ of a substance when dissolved in $36.0g$ of water, lowered its vapour pressure by $0.5mm$ at a given temperature. The vapour pressure of water at this temperature is $25.0mm$. Calculate the molecular weight of solute.

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31. Assuming ideal behaviour, calculate the pressure of $1.0molal$ solution of a non-volatile molecular solute in water at $50 \circ C$. The vapour presure of water at $50 \circ C$ is $0.222atm$.

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32. At a certain temperature, the vapour pressure of pure ether is $640mm$ and that of pure acetone is $280mm$. Calculate the mole fraction of each component in the vapour state if the mole fraction of ether in the solution is 0.50.

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33. The vapour pressure of methyl alcohol at $298K$ is 0.158 bar. The vapour pressure of this liquid in solution with liquid B is 0.095 bar. Calculate the mole fraction of methyl alcohol in the solution if the mixture obeys Raoult's law.

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34. The vapour pressure of acetone at $298K$ is $40mm$ of Hg. Its mole fraction in a solution with alcohol is 0.80. What is its vapour pressure in solution if the mixture obey Raoult's law?

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35. $100g$ of water contains $1.0g$ urea and $2.0g$ sucrose at $298K$. The vapour pressure of water at $298K$ is $0.3atm$. Calculate the vapour pressure of the solution. (Molecular weight of urea =60, Molecular weight of sucrose = 342)

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36. Benzene and toluene form nearly ideal solution. At $298K$, the vapour pressure of pure benzene is 150 torr and of pure toluence is

50 torr. Calculate the vapour pressure of the solution, containing equal weights of two substances at this temperature?

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37. At $20^{\circ} C$, the vapour pressure of pure liquid A is $22 mmHg$ and that of pure liquid B is $75 mmHg$. What is the composition of the solution of these two components that has vapour pressure of $48.5 mmHg$ at this temperature?

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38. An aqueous solution containing 28% by mass of liquid A $(mol. mass = 140)$ has a vapour pressure of $160 mm$ at $30^{\circ} C$. Find the vapour pressure of the pure liquid A. (The vapour pressure of the water at $30^{\circ} C$ is $150 mm$.)

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39. Two liquids A and B have vapour pressure of 0.600 bar and 0.2 bar, respectively. In an ideal solution of the two, calculate the mole fraction of A at which the two liquids have equal partial pressures.

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40. Two liquids $A$and B have vapour pressures in the ratio of $p_A \circ , p_B \circ$ = 1 : 2 at a certain temperature. Suppose we have an ideal solution of A and B in the mole fraction ratio $A : B = 1 : 2$. What would be the mole fraction of A in the vapour in equilibrium with the solution at a given temperature?

a.0.25 , b.0.2 , c.0.5 d.0.33

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41. A certain ideal solution of two liquids A and B has mole fraction of 0.3 and 0.5 for the vapour phase and liquid phase, respectively. What would be the mole fraction of B in the vapour phase, when the mole fraction of A in the liquid is 0.25?

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42. Solution of two volatile liquids x and y obey Raoult's law. At a certain temperature it is found that when the total pressure above a given solution is $400mm$ of Hg, the mole fraction of x in the vapour is 0.45 and in the liquid is 0.65. What are the vapour pressures of two pure liquids at the given temperature?

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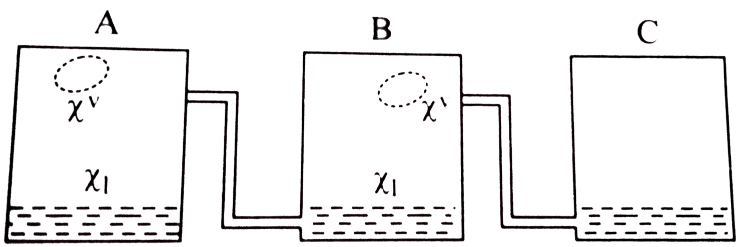
43. Liquids X and Y form an ideal solution. The vapour pressure of X and Y at $100^{\circ} C$ are 300 and $100 mm$ of Hg, respectively. Suppose that a solution composed of $1 mol$ of X and $1 mol$ of Y at $100^{\circ} C$ is collected and condensed. This condensate is then heated at $100 \circ C$ and vapour is again condensed to form a liquid A. What is the mole fraction of X in A ?



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44. A liquid mixture of benzene and toluene is composed of $1 mol$ of benzene and $1 mol$ of toluence.

If the pressure over the mixture at $300 K$ is reduced, at what pressure does the first vapour form?

Given:$p_T \circ = 32.05 mmHg, p_B \circ = 103 mmHg$

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45. Ethylene bromide $C_2H_4Br_2$, and 1,2 -dibromopropane,$C_3H_6Br_2$,form a series of ideal solutions over the whole range of composition. At $85^\circ C$, the vapour pressure of these two pure liquids are 173 and 127 torr, respectively.

. If $10.0g$ of ethylene bromide is dissolved in $80.0g$ of 1,2-dibromopropane, calculate the partial pressure of each component and teh total pressure of the solution at $85^\circ C$.

b. Calculate the mole fraction of ethylene bromide in the vapour in equilibrium with the above solution.

c. What would be the mole fraction of ethylene bromide in a solution at $85^\circ C$ equilibrated with a $50:50$ mole mixture in the vapour?

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46. The vapour pressures of two pure liquids A and B that form an ideal solution are 300 and 800 torr, respectively, at tempertature T. Calculate

The composition of

the first drop of the condensate.

A mixture of the vapours of A and B for which the

mole fraction A is 0.25 is slowly compressed at

temperature T.

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47. Calculate the vapour pressure lowering of a $0.1m$ aqueous solution of non-electrolyte at $75 \circ C$.

$\Delta H = 9.720 Kcalmol^{-1}$, P_2 = 742.96 torr

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48. What is the composition of the vapour which is in equilibrium at $30 \circ C$ with a benzene-toluene solution with a mole fraction of benzene of (a) 0.400 and (b) 0.600?

$P_b \circ = 119$ torr ,$P_t \circ = 37.0$ torr

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49. Solution of two volatile liquids x and y obey Raoult's law. At a certain temperature it is found that when the total pressure above a given solution is $400mm$ of Hg, the mole fraction of x in the vapour is 0.45 and in the liquid is 0.65. What are the vapour pressures of two pure liquids at the given temperature?

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50. 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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51. Why is an increase in temperature observed on mixing chloroform with acetone?

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52. Althrough dissolution of NH_4CI in water is endothermic yet is dissolved. Why?

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53. Two liquids X and Y boil at $110^\circ C$ and $130^\circ C$, respectively. Which one of them has higher vapour pressure at $50^\circ C$?

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

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55. What do you understand by colligative properties?

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56. Name four important colligative properties of solutions of non-volatile solutes.

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57. Cutting onions taken from the fridge is more comfortable than cutting those lying a room temperture. Explain why.

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

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59. 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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60. What type of liquids form ideal solutions?

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

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62. What are constant boiling mixtures called ?

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63. What are maximum boiling azetropes? Give one example.

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64. What are minimum boiling azeotropes? Give one example.

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65. Give one example each of miscible liquid pairs showing positive and negative deviation from Raoult's law. Give one reason for each for such deviations.

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66. Can we separate the components of azeotropic mixture by distillation?

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67. What mass of non-volatile solute (urea) needs to be dissolved in $100g$ of water in order to decrease the vapour pressure of water by 30%. What will be the molality of solution?

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68. A solution containing $30g$ of a non-volatile solute in exactly $90g$ of water has a vapour pressure of $21.85mm$ of $25^{\circ}C$. Further $18g$ of water is then added to the solution, the new vapour pressure becomes $22.15mm$ of Hg at $25C$. Calculate the (a) molecular mass of the solute and (b) vapour pressure of water at $25^{\circ}C$.

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69. The vapour pressure of a dilute aqueous solution of glucose is $700mm$ of Hg at $373K$. Calculate the (a) molality and (b) mole fraction of the solute.

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70. $10g$ of glucose (molar mass 180) and $20g$ of sucrose (molar mass 342) are dissolved in $100g$ of water. What will be the vapour pressure of the resultant solution if the vapour pressure of water is $30mmHg$?

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71. Calculate the vapour pressure of an aqueous solution of 1.0 molal glucose solution at $100^{\circ}C$.

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72. The vapour pressure of pure benzene at 50° is $268 mm$ of Hg. How many moles of non-volatile solute per mole of benzene are required to prepare a solution of benzene having a vapour pressure of $16.0 mm$ of Hg at $50^{\circ} C$?

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73. Lowering of vapour pressure due to a solute in 1 molal aqueous solution at $100^{\circ} C$ is

a.$13.44 mmHg$,b. $14.14 mmHg$,c.$13.2 mmHg$,d. $35.2 mmHg$

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74. Calculate the vapour pressure lowering caused by the addition of $68.4 g$ of sucrose (molecular mass = 342) to $500 g$ of water if the vapour pressure of pure water at $25^{\circ} C$ is $20.0 mmHg$.

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75. Calculate the vapour pressure of an aqueous solution which contains $5 masspercent$ of $urea$. The vapour pressure of pure water is $23.5 mmHg$. The molar mass of $urea$ is 60.

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

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77. 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 $78 g mol^{-1}$). The vapour pressure of the solution then is 0.845 bar. What is the molar mass of the solid substance?

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78. At $25^\circ C$, the vapour pressure of pure water is $25.0 mmHg$. And that of an aqueous dilute solution of urea is $20 mmHg$. Calculate the molality of the solution.

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79. Equal amounts of a solute are dissolved in equal amounts of two solvents A and B. The lowering of vapour pressure of solution A has twice the lowering of vapour pressure for solution B. If Mw_A and Mw_B are the molecular weights of solvents A and B, respectively , then a.$Mw_A = Mw_B$, b. $Mw_A = Mw_B / 2$,

c.$Mw_A = 4Mw_B$, d. $Mw_A = 2Mw_B$

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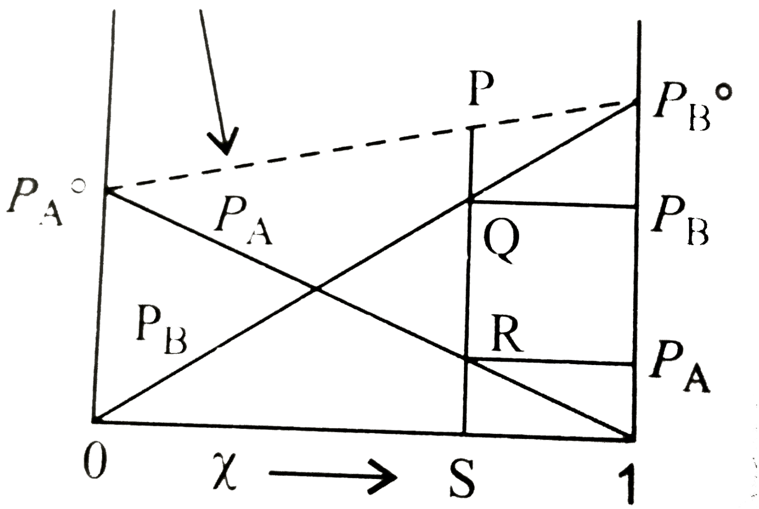
80. Consider the follwing vapour pressure composition graph. SP is equal to:

a. $PQ + RS$m , b. $PQ + QR$, c. $SR + SQ$, d. PQ + QR + RS



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81. 2g each of two solutes A and B are dissolved separately in 50g each of the same solvent.

Which will show greater elevation in boiling point?

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82. Distinguish between the boiling point of a liquid and the normal boiling point of a liquid.

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83. Explain why the melting point of a substance gives an indication of the purity of a substance.

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84. What happens to the vapour pressure of water if a table spoon of sugar is added to it?

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85. Define molal elevation constant or ebullioscopic constant.

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86. Two liquids A and B boil at $130^\circ C$ and $160^\circ C$, respectively. Which of the them has higher vapour pressure at $80^\circ C$.

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

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88. The boiling point of a solution made by dissolving $12.0g$ of glucose in $100g$ of water is $100.34^{\circ} C$. Calculate the molecular weight of glucose, K_b for water $= 0.52^{\circ} C / m$.

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89. A solution containing $0.2563g$ of naphthalene (molecular mass = 128) in $50g$ of carbon tetrachloride yields a boling point elevation of $0.201^{\circ} C$ while a solution of $0.6216g$ of an unknown solute in the same mass of the solvent gives a boiiling point elevation of $0.647^{\circ} C$. Find the molecular mass of unknown solute.

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90. The boiling point elevation contant for benzene is $2.57^{\circ} C / m$. The boiling point of benzene is $81.0^{\circ} C$. Determine the boiling point of a solution formed when $5g$ of $C_{14} H_{12}$ is dissolved I $15g$ fo benzene.

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91. $12.2g$ of benzoic acid is dissolved in (i) $1kg$ acetone $\left(K_b = 1.9Kkgmol^{-1}\right)$ and (ii) 1 kg benzene $\left(K_b = 2.6Kkgmol^{-1}\right.$. The elevation of boiling points are $0.19^{\circ} C$ and $0.13^{\circ} C$, respectively.

a. What are the molar masses of benzoic acid in the two solutions ?

, b. What are the structures of benzoic acid in the two solutions ?

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92. The ebullioscopic constant for benzene is $2.52 K Kg mol^{-1}$. A solution of an organic substance in benzene boils at $0.125^{\circ} C$ higher than benzene. Calculate the molality of solution?

A. 10

B. 1

C. 2

D. 0.05

Answer: D

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93. 18 g glucose, $C_6H_{12}O_6$ (Molar Mass = 180 g mol^{-1}) is dessolved in 1 kg of water in a sauce pan. At what temperature will this solution boil ?

K_b for water $= 0.52 K kg mol^{-1}$, boiling point of pure water =373.15 K)

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94. $0.90g$ of a non-electrolyte was dissolved in $90g$ of benzene. This raised the boiling point of benzene by $0.25^{\circ} C$. If the molecular mass of the non-electrolyte is $100.0 g mol^{-1}$, calculate the molar elevation constant for benzene.

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95. 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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96. Calculate the molar mass of a substance $1g$ of which when dissolved in $100g$ of water gave a solution boiling at $100.1^{\circ}C$ at a pressure of 1 atm $(K_b$ for water $= 0.52 Kkgmol^{-1})$

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97. On dissolving $3.24g$ of sulphur in $40g$ of benzene, the boiling point of the solution was higher than sulphur? (K_b for benzene = $2.53 Kkgmol^{-1}$, atomic mass of sulphur $= 32 gmol^{-1}$).

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98. A solution containg $12g$ of a non-electrolyte substance in $52g$ of water gave boiling point elevation of $0.40K$. Calculate the molar mass of the substance. $(K_b$ for water $=0.52 Kkgmol^{-1})$

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99. Molal elevation constant (K_b) values of following alcohols are in the order:

$CH_3CH_2CH_2CH_2OH > (CH_3)_2CH - CH_2OH > (CH_3)_3C - OH$

Explain in brief.

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100. Why is it advised to add ethylene glycol to water in car radiator while driving in a hill station?

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

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

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103. Sodium choride or calcium chloride is used to clear snow from the roads. Why?

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104. Define cryoscopic constant.

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105. What is an antifreeze?

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106. What are units of cryoscopic contant?

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

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108. What do you understand by the term that K_f for water is $1.86 K kg mol^{-1}$?

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109. Calculate the molal depression constant of a solvent which has

a. Freezing point $16.6^{\circ} C$ and latent heat of fusion $180.75 J g^{-1}$.

b. Freezing point $20.0^{\circ} C$ and latent heat of fusion $200.00 J g^{-1}$.

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110. If the boiling point of an aqueous solution containing a non-volatile solute is $100.1^{\circ} C$. What is its freezing point? Given latent heat of fusion and vapourization of water $80 cal g^{-1}$ and $540 cal g^{-1}$, respectively.

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111. $1.4 g$ of acetone dissolved in $100 g$ of benzene gave a solution which freezes at $277.12 K$. Pure benzene freezes at $278.4 K . 2.8$ of solid (A) dissolved in $100g$ of benzene gave a solution which froze at $277.76K$. Calculate the molecular mass of (A).

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112. The freezing point of a solution containing $50cm^3$ 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 = $1.86Kkgmol^{-1}$).

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113. An aqueous solution of a non-volatile solute boils at $100.17^\circ C$. At what temperature will the solution freeze? (Given: $K_b = 0.512$ and $K_f = 1.86$)

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114. A solution of urea in water has boiling point of $100.15^{\circ} C$. Calculate the freezing point of the same solution if K_f and K_b for water are $1.87 K kg mol^{-1}$ and $0.52 K kg mol^{-1}$, respectively.

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115. By dissolving $13.6 g$ of a substance in $20 g$ of water, the freezing point decreased by $3.7^{\circ} C$. Calculate the molecular mass of the substance. (Molal depression constant for water $= 1.863 K kg mol^{-1}$)

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116. On dissolving $0.25 g$ of a non-volatile substance in $30 mL$ benzene $(density 0.8 g mL^{-1})$, its freezing point decreases by $0.25^{\circ} C$.

Calculate the molecular mass of non-volatile substance $\left(K_f = 5.1 K kg mol^{-1}\right)$.

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117. Ethylene glycol is used as an antifreeze agent. Calculate the amount of ethylene glycol to be added to 4 kg of water to prevent it from freezing at $-6^\circ C$. $\left(K_f \text{ for } HH_2O = 1.85 \text{ K mol}^{-1}\text{kg}\right)$

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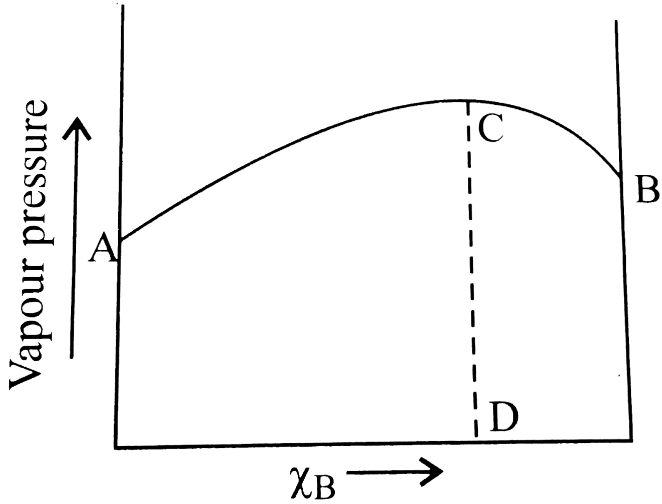
118. The diagram given below is a vapour-pressure-composition diagram for a binary solution of A and B.



In the solution,$A - B$ interactions are:

a. Similar to $A - A$ and $B - B$ interactions

b. Greater than $A - A$ and $B - B$ interactions

c. Smaller than $A - A$ and $B - B$ interactions

d. Unpredictable

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119. $1.355g$ of a substance dissolved in $55g$of CH_3COOH produced a depression in the freezing point of $0.618^\circ C$. Calculate the molecular weight of the substance $(K_f = 3.85)$

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120. What mass of sugar $C_{12}H_{22}O_{11}(M_0 = 342)$ must be dissolved in $4.0kg$ of H_2O to yield a solution that will freeze at $-3.72^\circ C$. (Take $K_f = 1.86^\circ Cm^{-1}$)

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121. Calculate the freezing point depression and boiling point elevation of a solution of $10.0g$ of urea $(M_B = 60)$ in $50.0g$ of water at $1atm.$ pressure.K_b and K_f for water $0.52^\circ Cm^{-1}$ and $1.86^\circ Cm^{-1}$ respectively.

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122. $1g$ of monobasic acid in $100g$ of water lowers the freezing point by 0.168°. If $0.2g$ of same acid requires $15.1 mLmol^{-1}$ of $N/10$ alkali for complete neutralization, calculate the degree of dissociation of acid. K'_f for H_2O is $1.86 Kmol^{-1}kg$.

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123. 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 ? $\left(K_b = 0.51^{\circ}Cm^{-1}, \left(K_f = 1.86^{\circ}Cm^{-1}\right)\right.$

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124. A liquid possessing which of the following characteristics will be most suitable for determining the molecular mass of a compound by cryoscopic measurements?

a.That having low freezing point and small enthalpy of fusion

b.That having high freezing point and small enthalpy of fusion

c.That having hifh freezing point and small enthalpy of vapourization

d.That having large surface tension

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125. 45 g fo ethylene glycol $(C_2H_6O_2)$ is mixed with 600 g of water. Calculate (a) the freezing point depression and (b). The freezing point of the solution.

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126. 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 K kg mol^{-1}. Find the molar mass of the solute.

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127. Addition of $0.40g$ of a compound to $45.5mL$ of benzene (density $0.879gmL^{-1}$) lowers the freezing point from $5.51^{\circ}C$ to $4.998^{\circ}C$.If K_f for benzene is $5.12Kkgmol^{-1}$,calculate the molar mass of the compound.

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128. 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 $Se = 78.8 g mol^{-1}$)

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

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130. In a cold climate water gets frozen causing damage to radiator of a car. Ethylene glycol is used as an anifreezing agent. Calculate the amount of ethylene glycol to be added to $4kg$ of water to prevent it from freezing at -6° . (K_f for water = $1.85 kg mol^{-1}$)

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131. Two aqueous solution containing, respectively, 7 g urea (molar mass = 60 g) and 42 g of substance X in $100g$ of water freeze at the same temperarture. Calculate the molecular weight of X.

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132. The freezing point of 0.02 mole fraction acetic acid in benzene is $277.4K$. Acetic acid exists partly as dimer. Calculate the equilibrium constant for dimerization. The freezing point of benzene is $278.4K$ and the heat the fusion of benzene is $10.042kJmol^{-1}$. Assume molarity and molality same.

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133. The freezing point of $0.08 molal NaHSO_4$ is $-0.345^\circ C$. Calculate the percentage of $HSO_4 + O$ ions that transfers a proton to water. Assume 100% ionization of $NaHSO_4$ and K_t for $H_2O = 1.86 K molality^{-1}$.

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134. Given that the latent heat of fusion of naphthalene is $19.0 KJ mol^{-1}$ and its melting point is $80.2^\circ C$.Estimate the solubility of naphthalene in benzene at $76.2^\circ C$.

Watch Video Solution

135. If a solution containing $6g$ of triphenyl methane, $(C_6H_5)_3CH(\text{molecular weight} = 244)$,in $1000g$ of benzene is cooled to $0.22^\circ C$.below the freezing point of benzene, how much

solvent will crystallize out and what will be the molality of residual solution? $(K_f = 5.1 K m^{-1})$

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136. A very small amount of a non-volatile solute (that does not dissociate) is dissolved in $56.8 cm^3$ of benzene (density $0.889 g cm^3$). At room temperature, vapour pressure of this solution is $98.88 mmHg$ while that of benzene is $100 mmHg$. Find the molality of this solution. If the freezing temperature of this solution is 0.73 degree lower than that of benzene, what is the value of molal the freezing point depression constant of benzene?

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137. Calculate the amount of ice that will separate out on cooling containing $50 g$of ethylene glycol in $200 g$ of water to $-9.3^\circ C (K_f$

for water $=1.86 K mol^{-1} kg$)

Watch Video Solution

138. 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 $= 1.86 km^{-1}$)

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139. A $10 m$ solution of urea is cooled to $-13.02^{\circ} C$. What amount of urea will separate out if the mass of solution taken is $100 g$? $\left[K_f(\text{water}) = 1.86 K kg mol^{-1}\right]$

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140. The melting point of phenol is $40^{\circ} C$. A solution containting $0.172 g$acetanilide $\left(C_{8} H_{9} O H\right)$ in $12.54 g$.phenol freezes at $39.25^{\circ} C$. Calculate the freezing point constant and the latent heat of fusion of phenol.

Watch Video Solution

141. How much ethly alcohol must be added to 1.0 L of water so that solution will not freeze at -4° ? $\left(K_{f}=1.86^{\circ} C / m\right)$

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142. Osmotic Pressure

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143. Write short notes on Reverse osmosis.

Watch Video Solution

144. Briefly explain the underlying principle of the purification of water by reverse osmosis.

Watch Video Solution

145. State how does osmotic pressure vary with temperature?

Watch Video Solution

146. What are isotonic solutions ?

Watch Video Solution

147. 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?

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148. 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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149. Why is great care taken in intravenous injections to have comparable concentration of solutions to be injected to that of blood plasma?

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150. Which colligative property is preferred for the molar mass determination of macromolecules (i.e.,proteins and polmers)?

Watch Video Solution

151. Addition of Hgl_2 to the aqueous solution of KI shows an increase in the osmotic pressure, why?

Watch Video Solution

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

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153. What is osmotic pressure and how is it related with the molecular mass of a non-volatile substance? What advantage the osmotic pressure method has over the elevation of boiling point method for determining molecular masses?

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

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155. Blood freezes at $272.44K$ and a solution of $3.0g$ of urea in $250g$ of water freezes at $272.63K$. Calculate the osmotic pressure of blood at $300K$. (Assume density of blood at $300K$ to be $1gcc^{-1}$)

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156. xg of non-electrolytic compound (molar mass =200) is dissolved in $1.0L$ of $0.05MNaCl$ solution. The osmotic pressure of this solution is found to be $4.92atm$ at $27^{\circ}C$. Calculate the value of x. Assume complete dissociation of $NaCl$ and ideal behaviour of this solution.

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157. The osmotic pressure of a solution is $1.3atm$. The density of solution is $1.3gcm^{-3}$. Calculate the osmotic pressure rise. ($1atm = 76cmHg, d_{Hg} = 13.6gcm^{-3}$)

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158. Two solutions of glucose have osmotic pressure 1.5 and $2.5atm$,respectively. $1L$ of first solution is mixed with $2L$of second solution.

The osmotic pressure of the resultant solution will be

a.$2.62 atm$, b.$6.12 atm$,c.$3.26 atm$, d.$2.16 atm$

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159. $18g$ glucose and $6g$ urea are dissolved in $1L$ aqueous solution at $27^\circ C$. The osmotic pressure of the solution will be

a.$8.826 atm$, b.$4.926 atm$,c.$2.92 atm$, d.$4.42 atm$

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160. The osmotic pressure of decimolar solution of urea at $27^\circ C$ is

a.2.49 bar, b.5 bar, c.3.4 bar, d.1.25 bar

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161. The osomotic pressure of a solution at $0^{\circ} C$ is $4atm$. What will be its osmotic pressure at $546K$ under similar conditions?

a.$4atm$, b.$9atm$,c.$8atm$, d.$6atm$

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162. 3% solution of glucose is isotonic with 1% solution of non-volatile non-electrolyte solute. The molecular mass of the solute would be

a.180, b.160,c.120, d.60

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163. $300cm^{3}$ of an aqueous solution contains $1.26g$ a polymer. The osmotic pressure of such solution at $300K$ is found to be 1.26×10^{-3} bar. Calculate the molar mass of the polymer.

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164. The solution containing $10g$ of an organic compound per litre showed an osmotic pressure of $1.18atm$ at $0^\circ C$. Calculate the molecular mass of the compound "(R=0.0821 litre atm per degree per mol)"

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165. Calculate the osmotic pressure of 5% solution of cane sugar (sucrose) at $300K$.

Watch Video Solution

166. A solution is prepared by dissolving $1.08g$ of human serum albumin, a protein obtained from blood plasma, in $50cm^3$ of aqueous solution. The solution has an osmotic pressure of $5.85 mmHg$ at $298K$.

a. What is the molar mass of albumin ?

b. What is the height of water column placed in solution ?

$d_{(H_2O)} = 1gcm^{-3}$

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167. A 5% solution of cane sugar is isotonic with 0.877% solution of urea. Calculate the molecular mass of urea if the molecular mass of cane sugar is 342.

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168. $200cm^3$ of an aqueous solution of a protein contains 1.26 g 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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169. At 300K ,36g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of the solution is 1.52 bars at the same temperature, what would be its concentration?

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170. The osmotic pressure of blood is $8.21 atm$ at $310K$. How much glucose should be used per L for an intravenous injection that is isotonic with blood?

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171. A solution was prepared by dissolving $6.0g$ an organic compound in $100g$ of water. Calculate the osmotic pressure of this solution at $298K$,when the boiling point of the Solution is $100.2^\circ C$. (K_b for water =$0.52Km^{-1}$), R=0.082 L atm $K^{-1}mol^{-1}$)

Watch Video Solution

172. A solution obtained by mixing 100 mL of 20% solution of urea (molar mass =60) and 100 mL of 1.6% solution of cane sugar (molar mass =342) at $300K$. (R=0.083 L bar $K^{-1}mol^{-1}$). Calculate

a.Osmotic pressure of urea solution

b.Osmotic pressure of cane sugar solution

c.Total osmotic pressure of solution

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173. The osmotic pressure of a solution containing $5g$ of substance (molar mass =100) in 308 m L of solution was found to be 4.0 atm at $300K$. Calculate the value of solution constant (R)

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174. The osmotic pressure of a solution was found to be $8atm$ when $8mol$ of a non-volatile solute was dissolved in V L of solution at $300K$.Calculate the volume of solution $\left(R = 0.0821L - \text{atm}K^{-1}\text{mol}^{-1}\right)$

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175. A solution of an organic compound is prepared by dissolving $30g$ in $100g$ water. Calculate the molecular mass of compound and the osmotic pressure of solution at $300K$, when the elevation in boiling point is 0.52 and K_b for water is $0.52Km^{-1}$.

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176. What will be the osmotic pressure of $0.1M$ monobasic acid its pH is 2 at $25^{\circ}C$?

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177. $100mL$ of $1.0g$ sample of a drug having compound $C_{21}H_{23}O_5N$ as drug is coated with sugar lactose (mol.wt.342) exerts the osmotic pressure of $0.70atm$ at $27^{\circ}C$. What is the drug percentage in sample?

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178. 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 $105.3 mm$. Determine the extent of dilution.

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179. An M/10 solution of potassium ferrocyanide is 46% dissociated at $300 K$. What will be its osmotic pressure?

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180. A 0.5% aqueous solution of KCl was found to freeze at $-0.24^{\circ} C$. Calculate the Van,t Hoff factor and degree of dissociation of the solute at this concentration. (K_f for water =$1.86 K kg mol^{-1}$

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181. 2g of benzoic acid (C_6H_5COOH) dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62K. Molal depression constant for benzene is 4.9 K kg mol^{-1}. What is the percentage association of acid if it forms dimer in solution?

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182. 0.6 mL of acetic acid (CH_3COOH). Having density $1.06 \text{ g } mL^{-1}$, is dissolved in 1 litre 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 the dissociation constant of acid.

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183. The freezing point depression of a 1.00×10^{-3} m solution of $K_x[Fe(CN)_6]$ is $7.10 \times 10^{-3} K$. Determine x given $K_l = 1.86 K kg \text{mol}^{-1}$ for H_2O.

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184. A solution of non-volite solute in water freezes at $-0.30^\circ C$.The vapour pressure of pure water at $298K$ is $23.51 mmHg$.and K_f for water is 1.86degree per molal. Calculate the vapour pressure of this solution at $298K$.

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185. A 1.17% solution of $NaCl$ is isotonic with 7.2% solution of glucose. Calculate the Van't Hoff factor of $NaCl$.

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186. 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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187. $0.002molar$ solutiion of $NaCl$ having degree of dissociation of 90% at $27^\circ C$ has osmotic pressure equal to

a.0.94 bar , b.9.4 bar , c.0.094 bar , d.9.4×10^{-4} bar

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188. $0.1M$ aqueous solution of $MgCl_2$ at $300K$ is $4.92atm$. What will be the percentage ionination of the salt?

a.49% , b. 59% ,c.79% d. 69%

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189. The Van't Hoff factor of Hg_2Cl_2 in its aqueous solution will be (Hg_2Cl_2 is 80% ionized in the solution)

a.1.6 , b.2.6 ,c.3.6 ,d.4.6

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190. A certain substance A tetramerizes in water to the extent of 80% . A solution of $2.5g$ of A in $100g$ of water lowers the freezing point by $0.3^{\circ}C$. The molar mass of A is

a.120 , b.61 ,c.60 ,d.62

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191. When cells of skeletal vacuoles of a frog were placed in a series of $NaCl$ solutions of different concentration solution at $25^{\circ}C$, it

was observed microscopically that they remained unchaged in 0.7% solution, shrank in a more concentrated and swelled in more dilute solution. Water freezes from the 0.7% salt solutions at $-406^{\circ}C$. What is the osmotic pressure of the cell cytoplasm at $25^{\circ}C$. $\left(K =_f \ = 1.86 kg \text{mol}^{-1} K\right)$

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192. A saturated solution of $Mg(OH)_2$ has a vapour pressure of $759.5mm$ at $373K$. Calculate the solubility and K_{sq} of $Mg(OH)_2$. " (Assume molarity equals molality)"

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193. The freezing point of an aqueous solution of KCN containing $0.1892 mol Kg^{-1}$, the freezing point of the solution was found to be $-0.530^{\circ}C$. If the complex formation takes place according to the following equation:

$Hg(CN)_2$, the freezing point of the solution was found to be $-0.530^\circ C$. If the complex formation takes place according to the following equation:

$Hg(CN)_2 + nKCN \Leftrightarrow K_n[Hg(CN)_{n+2}]$

what is the formula of the complex? $[K_f(H_2O)$ is $1.86 K kg mol^{-1}]$

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194. One mole of $(C_6H_5)_3C.OH$ dissolved in $1000g$ of 100% sulphuric acid lowers the freezing point of sulphuric acid twice as one mole of CH_3OH shows in $1000g$ of 100% sulphuric acid. Comment on it associated in sulphuric acid.

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195. A $0.025m$ solution of monobasic acids has a freezing point of $-0.060^{\circ}C$. What are K_a and pK_a of the acid? $\left(K_f = 1.86^{\circ}C\right)$

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196. A $0.2molal$ solution of KCl freezes at $-0.68^{\circ}C$. If K_f for H_2O is 1.86, the degree of dissociation of KCl is

a.85% , b.83% , c. 65% , d. 90%

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197. A mixture of $0.1mol$ of Na_2O and $0.1mol$ of BaO is dissolved in $1000g$ of H_2O. Calculate the vapour pressure of solution at $373K$

.

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198. $1575.2g$ of C_6H_5OH (phenol) is dissolved in $960g$ of a solvent of solvent of $K_f = 14Kkgmol^{-1}$. If the depression in freezing point is $7K$, then find the percentage of phenol that dimerizes.

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199. Follwing are equimolal aqueous solution:

a.$1murea$, b.$1mKCl$, c.$1mMgCl_2$, d.$1mNa_3PO_4$

Arrange them in increaseing

i. Boiling point , ii.Freezing point , iii. Osmotic pressure , iv.Vapour pressure

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200. To $250mL$ of water, xg of acetic acid is added. If 11.5% of acetic acid is dissociated, the depressin in freezing point comes out

0.416. What will be the value of x if $K_f(\text{water}) = 1.86 K kg mol^{-1}$

and density of water is $0.997 gmL$.

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201. A $250 mL$ water solution containing $8.19 g$ of sodium chloride at $300 K$ is separated from pure water by means of a semi-permeable membrane. The pressure that must be applied above this solution in order to just prevent osmosis is "($R = 0.0821 L atm mol^{-1} K^{-1}$)"

a.13.80 atm ,b.27.58 atm ,c.23.34 atm ,d.9.80 atm

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202. Calculate the osmotic pressure of a solution containing $0.02 mol$ of $NaCl$ and $0.03 mol$ of glucose in $500 mL$ at $27^\circ C$.

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203. When dissolved in benzene, a compound $C_{38}H_{30}$ partilly dissociates by the following equation:

$25.6g$ of $C_{38}H_{30}$ is dissolved in $400g$ of benzene, the freezing point is lowered by $0.680^{\circ}C$. What percentage of $C_{38}H_{30}$ molecules have dissociated? $(K_f = 4.9)$

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204. Find the Van't Hoff factor of

a.CH_3COOH in H_2O ,

b.CH_3COOH in benzene

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205. A $0.1M$ solution of potassium sulphate K_2SO_4 is dissolved to the extent of 80%. What would be its osmotic pressure at $27(\circ)C$

.

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206. Van't Hoff factors of aqueous solutions of X,Y and Z are 2.8, 1.8 and 3.5 respectively. Which of the following statement(s) is (are) correct?

a.$BP: X < Y < Z$

b.$FP: Z < X < Y$

c.Osmotic pressure,X=Y=Z

d.$VP: Y < X < Z$

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207. Acetic acid associates in benzene to form a dimer. $1.65g$ of acetic acid when dissolved in $100g$ of benzene raised the boiling point by $0.36^{\circ}C$. Calculate the Van't Hoff factor and degree of association of acetic acid.

(K_b for benzene=$2.57^{\circ}C$)

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208. The vapour pressure of benzene at $30^{\circ}C$ is $164.88mm$ of Hg. In $3mol$ of benzene, when $6g$ of acetic acid was dissolved, the vapour pressure of the solution became $162.04mm$ of Hg. Calculate

a. Van't Hoff factor

b.The degree of association of acetic acid in bezene at $30^{\circ}C$.

Watch Video Solution

209. The freezing point of a solution contaning $0.3g$ of acetic acid in $43g$ of benzene reduces by 0.3°. Calculate the Van's Hoff factor "(K_f for benzene =$5.12 K kg mol^{-1}$)"

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210. The freezing point of a 0.08 molal solution of $NaHSO^4$ is $-0.372^{\circ} C$. Calculate the dissociation constant for the reaction.

K_f for water =$1.86 K m^{-1}$

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211. Which of the following is (are) correct statements?

i. $0.1 M CaCl_2$ has higher boiling point than $0.1 M NaCl$.

ii. $0.05 M Al_2(SO_4)_3$ has higher freezing point than $0.1 M K_3[Fe(CN)_6]$.

iii.$0.1M$ glucose exerts higher osmotic pressure than $0.08MCH_3COOH$ (25% dissociated). iv. Vapour pressure of $0.05M$ urea solution is greater than that of $0.05MKCl$ solution.

a.i,ii ,b.ii,iv , c. i,ii,iii , d. i,ii,iv

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212. Under what condition Van't Hoff factor

(i) is

(a) equal to unity, (b) less than 1, and (c) greater than 1.

Explain your answer.

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213. The freezing point of $0.20M$ solution of week acid HA is $272.5K$. The molality of the solution is $0.263 \mathrm{mol} kg^{-1}$. Find the pH of the solution on adding $0.25M$ sodium acetate solution.

K_f of water $=1.86Km^{-1}$

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214. Calculate the Van't Hoff factor (i) for the following if:

i.100% ionization or association takes place

b.50% ionization or association takes place

a.S ,b.Se , c.Te , d.P

e.As , f.Sb , g.B , h.$AlCl_3$

i. Hg_2Cl_2 , j.$HgCl_2$, k.Be_2C , l.Al_4C_3

m.CaC_2 , n. Mg_2C_3

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Solved Examples

1. Calculate the mole fraction of solute in a dilute aqueous solution from which ice begins to separate out at $-0.46^{\circ} C$. (K_f of H_2O = $1.86 K m^{-1}$)

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2. The vapour pressure of water at $293K$ is $17.51 mm$. The lowering of vapour pressure of sugar is $0.0614 mm$. 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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3. The vapour pressure of a 5% aqueous solution of a non-volatile organic substance at $373K$. Is $745 mm$. Calculate the molecular mass of the solute.

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4. 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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5. Liquids A and B form an ideal mixture, in which the mole fraction of A is 0.25. At temperature T, a small quantity of the vapour in equilibrium with the liquid is collected and condensed. This process is repeated for a second time with first condensate. The second condensate now contains 0.645 mole fraction of A. Calculate the ratio $\left(P_A^\circ / P_B^\circ\right)$. What will be the mole fraction of B in the third condensate?

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6. A certain solution of $1m$ benzoic acid in benzene has a freezing point of $3.1^\circ C$ and a normal boiling point of $82.6^\circ C$. The freezing point of benzene is $5.5^\circ C$. And its boiling point is $80.1^\circ C$. Analyze the state of the solute (benzoic acid) at two temperature and comment .

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7. In a study of aqueous solution of thorium nitrate, the freezing point depression of $0.0703^\circ C$ is observed for a $9.6 mmol kg^{-1}$ of the solution. How many ions are present in one thorium nitrate unit? "(K_f for $H_2O = 1.86 K m^{-1}$)"

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8. Two liquids A and B form an idea solution. What will be the vapour pressure at $27^{\circ} C$ of a solution having $1.5 mol$ of A and $4.5 mol$ of B? The vapour pressure of A and B at $27^{\circ} c$ is $0.116 atm$ and $0.140 atm$, respectively.

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9. 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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10. Calculate the osmotic pressure of a solution obtained by mixing $100 cm^3$ of 1.5% solution of urea (mol. Mass=60) and $100 cm^3$ 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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11. 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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12. A solution containing $25.6g$ of sulphur, dissolved in $1000g$ of naphthalene whose melting point is $80.1^\circ C$ gave a freezing point lowering of $0.680^\circ C$. Calculate the formula of sulphur (K_f for napthalene =$6.8Km^{-1}$)

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13. A mixture which contains $0.550g$ of camphor and $0.090g$ of an organic solute melts at $161^{\circ}C$. The solute contains $93.75\%C$ and 6.25% H by weight.What is the molecular formula of compound? K_f for camphor is $37.5^{\circ}C\text{mol}^{-1}kg$. The melting point of camphor is $209^{\circ}C$.

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14. A solution containing 0.1 mol of naphthalene and 0.9 mol of benzene is cooled out until some benzene freezes out. The solution is then decanted off from the solid and warmed upto $353K$ where its vapour pressure was found to be $670mm$. The freezing point and boiling point of benzene are $278.5K$ and $353K$ respectively, and its enthalpy of fusion is $10.67KJ\text{mol}^{-1}$. 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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15. A $10g$ mixture of glucose and urea present in $250mL$ solution shows the osomotic pressure of $7.4atm$ at $27^{\circ}C$. Calculate $\%$ composition of mixture.

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16. A tube of uniform cross-sectional area $1cm^2$ is closed at one end with semi-permeable membrane. A solution of $5g$ glucose per $100mL$ is placed inside the tube and is dipped in pure water at $27^{\circ}C$. When equilibrium is established, calculate:

a. The osmotic pressure of solution.

b.The height developed in vertical column.

Assume the density of final glucose solution $1gmL^{-1}$

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17. The freezing point of a 3% (by weight) aqueous solution of A is equal to the freezing point of 9% (by weight) aqueous solution of B. If the molecular weight of A is 60, then the molecular weight of B will be

a191 ,b.90 , c.45 , d.20

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18. $2.5g$ of a substance is present in $200mL$ of solution showing the osmotic pressure of $60cmHg$ at $15^\circ C$. Calculate the molecular weight of substance.What will be the osmotic pressure if temperature is raised to $25^\circ C$?

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19. Calculate osmotic pressure of a solution obtained by mixing $100mL$ of 3.4% solution "(weight/volume)" of urea "(molecular weight 60)" and $100mL$ of 1.6% solution "(weight/volume)" of cane sugar "(molecular weight 342)" at $20^{\circ}C$.

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20. Which has maximum osmotic pressure at temperature T?

a. $100mL$ of $1M$ urea solution

b. $300mL$ of $1M$ glucose solution

c. Misture of $100mL$ of $1M$ urea solution and $300mL$ of $1M$ glucose solution

d. All are isotonic

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21. $CNS^{\ominus}$ ions give red colour with Fe^{3+} ions in aqueous solution as:

$$Fe^{3+}(aq) + 3CNS^{\ominus}(aq) \rightarrow \underset{\text{red}}{Fe(CNS)_3}(aq)$$

If $0.1M\ KCNS$ solution is separated from $0.1MFeCl_3$ solution by means of a semi-permeable membrane, red colour will appear on:

a.$FeCl_3$ soluion , b. $KCNS$ solution side ,

c. Both sides , d. Neither side

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22. At $17^{\circ}C$, the osmotic pressure of sugar solution is 580 torr. The solution is diluted and the temperature is raised to $57^{\circ}C$, when the osmotic pressure is found to be 165 torr. The extent of dilution is

a.2 times ,b.3 times ,c.4 times ,d.5 times

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23. Among the following the solution which shows the lowest osmotic pressure is

a. 0.14 M NaCl , b. 0.05 M $CaCl_2$,

c. 0.04 M $K_3[Fe(CN)_6]$, d. 0.03 M $FeCl_3$

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24. A $0.1M$ solution of glucose (molecular weight $180 g \text{mol}^{-1}$) and a $0.1M$ solution of urea (molecular weight 60 g mol^{-1}) are placed on the two sides of a semi-permeable membrane to equal heights. In this context, which of the following statements is correct?

a. Glucose will flow across the membrane into the urea solution.

b. Urea will flow across the membrane into the glucose solution.

c. Water will flow across the membrane from the urea solution into the glucose solution.

d. There will be no net movement across the membrane.

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25. If the radiator of an automobile contains $12L$ of water, how much would the freezing point be lowered by the addition of $5kg$ of prestone $\left(\text{glycol}C_2H_4\left((OH)_2\right)\right.$. How many kg of Zeron (methyl alcohol) would be required to produce the same result?

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26. If the boiling point of an aqueous solution is $100.1^\circ C$, what is its freezing point ? Given $l_f = 80$,$l_v = 540\text{cal}g^{-1}$ respectively, of H_2O.

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27. The $K_{sp}(25^\circ C)$ of sparingly soluble salt $XY_2(s)$ is $3.56 \times 10^{-5}\left(\text{mol}L^{-1}\right)^3$ and at $30^\circ C$, the vapour pressure of its saturated solution in water is $31.78mm$of Hg.

Given: Vapour pressure of pure water=31.82 mm of Hg

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28. $0.5g$ 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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29. 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 $H_2O = 1.86Km^{-1}$. Assuming 100% ionization of the complex, write the ionization nature and formula or complex.

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30. Phenol associates in water to double molecules. The values of observed and calculated molecular weight of phenol are 161.84 and 94 , repectively. The degree of association of phenol will be

a. 60% , b. 84% , c. 45% , d. 80%

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31. Calculate the Van't Hoff factor when $0.1 mol NH_4Cl$ is dissolved in $1L$ of water. The degree of dissociation of NH_4Cl is 0.8 and its degree of hydrolysis is 0.1.

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32. $0.5m$ solution of acetic acid $(Mw = 60)$ in benzene $(Mw = 78)$ boils at $80.80^\circ C$. The normal boiling point of benzene is $80.10^\circ C$. And $\Delta_{vap}H = 30.775 kJmol^{-1}$. Calculate the percent of association of acetic acid in benzene.

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33. 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

34. The freezing point of a solution containing 0.2 g of acetic acid in benzene is lowered by $0.45^\circ C$. Colculate the degree of dimerization of acetic acid in benzene . K_f for benzene is 5.12 Kmol^{-1}kg:

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35. The degree of dissociation for $PtCl_4$ complex is 70%. Calculate the Van't Hoff factor.

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36. The degree of dissociation for $K_4[Fe(CN)_6]$ is 60%. Calculate the Van't Hoff factor.

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37. The degree of association is 70% for the following reaction . Calculate the Van't Hoff factor.

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38. Which of the following solutions in H_2O will show maximum depression in freezing point?

a.$0.1MK_2[HgI_4]$, b. $0.2MBa(NO_3)_2$

c.$0.3M$glucose , d.$0.4MNaCl$

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39. Elevation in boiling point studies of $Ca(NO_3)_2$ gives molar mass as 131.2. The degree of dissociation of $Ca(NO_3)_2$ is

a.100% , b.75% , c.50% , d.12.5% ,

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40. phenol associates in benzene to a certain extent in dimerisation reaction. A solution containing 0.02 kg of phenol in 1.0 kg of

benzene has its freezing point depressed 0.69 k. [$K_f(C_6H_6) = 5.12 kkg\text{mol}^{-1}$]. The degree of association:

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Exercises (Linked Comprehension)

1. An aqueous solution freezes at 272.4 K while pure water freezes at 273 K. Given $K_f = 1.86 Kkg\text{mol}^{-1}$,$K_b = 0.512 Kkg\text{mol}^{-1}$ and vapour pressure of water at 298 K = 23.756 mm Hg. Determine the following.

Molality of the solution is

A. 0.322

B. 0.222

C. 0.413

D. 0.5

Answer: A

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2. An aqueous solution freezes at 272.4 K while pure water freezes at 273 K. Given $K_f = 1.86 K kg \text{mol}^{-1}, K_b = 0.512 K kg \text{mol}^{-1}$ and vapour pressure of water at 298 K = 23.756 mm Hg. Determine the following.

Boiling point of the solution is

A. $300.73K$

B. $373.165K$

C. $400K$

D. $273.15K$

Answer: B

Watch Video Solution

3. An aqueous solution freezes at 272.4 K while pure water freezes at 273 K. Given $K_f = 1.86 K kg \text{mol}^{-1}$,$K_b = 0.512 K kg \text{mol}^{-1}$ and vapour pressure of water at 298 K = 23.756 mm Hg. Determine the following.

Lowering in vapour pressure at 298 K is

A. 0.13

B. 0.15

C. 0.16

D. 0.1378

Answer: D

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4. An aqueous solution freezes at 272.4 K while pure water freezes at 273 K. Given $K_f = 1.86 K kg mol^{-1}, K_b = 0.512 K kg mol^{-1}$ and vapour pressure of water at 298 K = 23.756 mm Hg. Determine the following.

Depression in freezing point of solution

A. 0.68

B. 0.43

C. 0.5989

D. 0.326

Answer: C

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5. A solution of sucrose (molar mass =342) is prepared by dissolving 688.4 g in 1000 g of water. Calculate

The vapour pressure of solution at 293 K.

A. 0.0229

B. 0.4

C. 0.5989

D. 0.326

Answer: A

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6. A solution of sucrose (molar mass =342) is prepared by dissolving 68.4 g in 1000 g of water. Calculate

The boiling point of solution.

A. 273

B. 373.104

C. 400

D. 500

Answer: B

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7. A solution of sucrose (molar mass =342) is prepared by dissolving 68.4 g in 1000 g of water. Calculate

The freezing point of solution.

A. 273

B. 373

C. 272.628

D. 271.628

Answer: C

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8. A solution of sucrose (molar mass =342) is prepared by dissolving 68.2 g in 1000 g of water. Calculate

The osmotic pressure at 273 K.

A. 2

B. 3

C. 4

D. 4.805

Answer: D

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9. The osomotic pressure π depends on the molar concentration of the solution $(\pi = CRT)$. If two solutions are of equal solute concentration and, hence, have the same omotic pressure, they are said to be isotonic. If two solutions are of unequal osmotic pressures, the more concentrated solution is said to be hypertonic and the more diluted solution is described as hypotonic.

Osmosis is the major mechanism for transporting water upward in the plants. Answer the following questions:

A plant cell shrinks when it is kept in:

A. Hypotonic solution

B. Hypertonic solution

C. Isotonic solution

D. Pure water

Answer: C

Watch Video Solution

10. The osomotic pressure π depends on the molar concentration of the solution $(\pi = CRT)$. If two solutions are of equal solute concentration and, hence, have the same omotic pressure, they are said to be isotonic. If two solutions are of unequal osmotic pressures, the more concentrated solution is said to be hypertonic and the more diluted solution is described as hypotonic.

Osmosis is the major mechanism for transporting water upward in the plants. Answer the following questions:

What would be the percent strength of solution of urea that would be isotonic with $4.5\,\%$ solution of glucose?

A. $4.5\,\%$

B. $13.5\,\%$

C. $1.5\,\%$

D. $9\,\%$

Answer: C

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11. The osomotic pressure π depends on the molar concentration of the solution $(\pi = CRT)$. If two solutions are of equal solute concentration and, hence, have the same omotic pressure, they are said to be isotonic. If two solutions are of unequal osmotic pressures, the more concentrated solution is said to be hypertonic and the more diluted solution is described as hypotonic.

Osmosis is the major mechanism for transporting water upward in the plants. Answer the following questions:

The glucose solution to be injected into the bloodstream and the blood itself should have the same.

A. "Molarity"

B. "Vapour pressure"

C. "Osmotic pressure"

D. "Viscosity"

Answer: B

Watch Video Solution

12. The osomotic pressure π depends on the molar concentration of the solution $(\pi = CRT)$. If two solutions are of equal solute concentration and, hence, have the same omotic pressure, they are said to be isotonic. If two solutions are of unequal osmotic pressures, the more concentrated solution is said to be hypertonic and the more diluted solution is described as hypotonic.

Osmosis is the major mechanism for transporting water upward in the plants. Answer the following questions:

Isotonic solutions have same

A. Density

B. Molarity

C. Osomotic pressure

D. Normality

Answer: D

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13. The osomotic pressure π depends on the molar concentration of the solution $(\pi = CRT)$. If two solutions are of equal solute concentration and, hence, have the same omotic pressure, they are said to be isotonic. If two solutions are of unequal osmotic pressures, the more concentrated solution is said to be hypertonic and the more diluted solution is described as hypotonic.

Osmosis is the major mechanism for transporting water upward in the plants. Answer the following questions:

Osmotic rise of a solution depends on

A. Density

B. Temperature

C. Nature of solvent

D. All of these

Answer: A::B

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14. The solution which boil at constant temperature like a pure liquid and possess same composition in liquid as well as vapour state are called azeotropes. The components of azetropes cannot be separated by fractional distillation. Only non-ideal solutions form azeotropes. Solutions with negative deviation form maximum boiling azeotrope and the solutions with positive deviation form minimum boiling azeotrope. The boiling point of an azeotrope is never equal to the boiling points of any of the components of the azeotrope.

Answer the following question:

The azeotropic solutions of two miscible liquids

A. Can be separated by simple distillation

B. May show positive or negative deviation from Raoult's law

C. Are supersaturated

D. Behave like single pure component and boil at a fixed temperature

Answer: B::D

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15. The solution which boil at constant temperature like a pure liquid and possess same composition in liquid as well as vapour state are called azeotropes. The components of azetropes cannot be separated by fractional distillation. Only non-ideal solutions form azeotropes. Solutions with negative deviation form maximum boiling azeotrope and the solutions with positive deviation form minimum boiling azeotrope. The boiling point of an azeotrope is never equal to the boiling points of any of the components of the azeotrope.

Answer the following question:

The azeotropic solutions of two miscible liquids

Solutions which distill without any change in composition or temperature are called

A. Saturated

B. Supersaturated

C. Ideal

D. Azeotrope

Answer: D

Watch Video Solution

16. The solution which boil at constant temperature like a pure liquid and possess same composition in liquid as well as vapour state are called azeotropes. The components of azetropes cannot be separated by fractional distillation. Only non-ideal solutions form azeotropes. Solutions with negative deviation form maximum boiling azeotrope and the solutions with positive deviation form minimum boiling azeotrope. The boiling point of an azeotrope is never equal to the boiling points of any of the components of the azeotrope.

Answer the following question:

The azeotropic solutions of two miscible liquids

The azeotropic mixture of water and HCl boils at $108.5^{\circ} C$. This solution is

A. Ideal

B. Non-ideal with positive deviation

C. Non-ideal with negative deviation

D. None

Answer: C

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17. The solution which boil at constant temperature like a pure liquid and possess same composition in liquid as well as vapour state are called azeotropes. The components of azetropes cannot be separated by fractional distillation. Only non-ideal solutions form azeotropes. Solutions with negative deviation form maximum boiling azeotrope and the solutions with positive deviation form minimum boiling azeotrope. The boiling point of an azeotrope is never equal to the boiling points of any of the components of the azeotrope.

Answer the following question:

The azeotropic solutions of two miscible liquids

$100mL$ of liquid A and $50mL$ of liquid B are mixed to form $138mL$ solution. It is

A. Ideal solution

B. High boiling azeotrope

C. Low boiling azetrope

D. None of these

Answer: C

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18. The solution which boil at constant temperature like a pure liquid and possess same composition in liquid as well as vapour state are called azeotropes. The components of azetropes cannot be separated by fractional distillation. Only non-ideal solutions form azeotropes. Solutions with negative deviation form maximum boiling azeotrope and the solutions with positive deviation form minimum boiling azeotrope. The boiling point of an azeotrope is never equal to the boiling points of any of the components of the azeotrope.

Answer the following question:

The azeotropic solutions of two miscible liquids

Which among the following combinations is a maximum boiling azeotrope?

A. $H_2O + CH_3OH$

B. $CCl_4 + CHCl_3$

C. $(CH_3)_2CO + C_2H_5OH$

D. $H_2O + HNO_3$

Answer: D

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19. A $1.24M$ aqueous solution of KI has density of $1.15gcm^{-3}$.

Answer the following questions about this solution:

The percentage composition of solute in the solution is

A. 17.89

B. 27.89

C. 37.89

D. 47.89

Answer: A

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20. A $1.24M$ aqueous solution of KI has density of $1.15gcm^{-3}$.

Answer the following questions about this solution:

The molality of this solution will be

A. 2.61

B. 1.31

C. 4.12

D. 3.12

Answer: B

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21. A 1.24 M aqueous solution of KI has a density of $1.15 gcm^{-3}$. What is the freezing point of the solution if the KI is completely dissociated in the solution?

A. $-4.87^{\circ} C$

B. $-3.22^{\circ} C$

C. $-1.22^{\circ} C$

D. None of these

Answer: A

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22. A $1.24M$ aqueous solution of KI has density of $1.15gcm^{-3}$.

Answer the following questions about this solution:

The experimental freezing point of the solution is $-4.46^{\circ} C$.

What percentage of KI is dissociated?

A. 82%

B. 90%

C. 83%

D. None

Answer: C

Watch Video Solution

23. A $1.24M$ aqueous solution of KI has density of $1.15gcm^{-3}$.

Answer the following questions about this solution:

The normality of the solution is

A. 0.62

B. 1.24

C. 2.48

D. 3.72

Answer: B

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24. The electrolyte solutions show abnormal colligative porperties.To account for this effect we define a quantity called the Van't Hoff factor given by

$$i = \frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i = 1(\text{for non-electrolytes})$

$i > 1(\text{for electrolytes, undergoing dissociation})$

$i < 1(\text{for solutes, undergoing association})$

Answer the following questions:

Benzoic acid undergoes dimerization in bezene solution. The Van't Hoff factor i for the solutions is

A. $i = 2 - \alpha$

B. $i = 1 + \left(\frac{\alpha}{3}\right)$

C. $i = 1 - \left(\frac{\alpha}{2}\right)$

D. $i = 1 + \left(\frac{\alpha}{2}\right)$

Answer: C

Watch Video Solution

25. The electrolyte solutions show abnormal colligative porperties.To account for this effect we define a quantity called the Van't Hoff factor given by

$$i=\frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i=1(\text{for non-electrolytes})$

$i>1(\text{for electrolytes, undergoing dissociation})$

$i<1(\text{for solutes, undergoing association})$

Answer the following questions:

certain substances trimerize when dissolved in a solvent A. The Van't Hoff factor i for the solutions is

A. 2

B. $\frac{1}{3}$

C. 3

D. 0

Answer: C

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26. The electrolyte solutions show abnormal colligative porperties.To account for this effect we define a quantity called the Van't Hoff factor given by

$$i = \frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i = 1(\text{for non-electrolytes})$

$i > 1(\text{for electrolytes, undergoing dissociation})$

$i < 1(\text{for solutes, undergoing association})$

Answer the following questions:

For a solution of a non-electrolyte in water, the Van't Hoff factor is

A. $Always equal \rightarrow 0$

B. le1`

C. $Always equal \rightarrow 2$

D. $\geq but < 2$

Answer: C

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27. The electrolyte solutions show abnormal colligative porperties.To account for this effect we define a quantity called the Van't Hoff factor given by

$$i = \frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i = 1(\text{for non-electrolytes})$

$i > 1(\text{for electrolytes, undergoing dissociation})$

$i < 1(\text{for solutes, undergoing association})$

Answer the following questions:

$0.1MK_4[Fe(CN)_6]$ is 60% ionized. What will be its Van't Hoff factor?

A. 1.4

B. 3.4

C. 2.4

D. 4.4

Answer: B

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28. The electrolyte solutions show abnormal colligative porperties.To account for this effect we define a quantity called the Van't Hoff factor given by

$$i = \frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i = 1(\text{for non-electrolytes})$

$i > 1(\text{for electrolytes, undergoing dissociation})$

$i < 1(\text{for solutes, undergoing association})$

Answer the following questions:

A solution of benzoic acid is dissolved in benzene such that it undergoes molecular association and its molar mass apporaches 244. The benzoic molecules will exist as

A. Dimer

B. Monomer

C. Tetramer

D. Trimer

Answer: A

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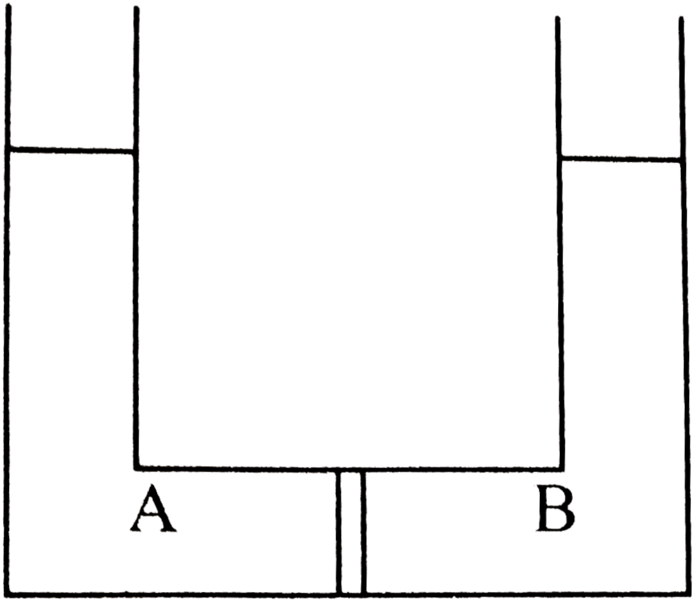

29.

Compartment A and B have the following combinations of solution:

	A	B
1	$0.1 M KCl$	$0.2 M KCl$
2	$0.1\%(m/V) NaCl$	$10\%(m/V) NaCl$
3	$18 gL^{-1}$glucose	$34.2 gL^{-1}$sucrose
3	$20\%(m/V)$glucose	$10\%(m/V)$glucose

Answer the following question:

Indicate the number of solutions which is/are isotonic.

A. $1 only$

B. $3 only$

C. $4 only$

D. $2 only$

Answer: B

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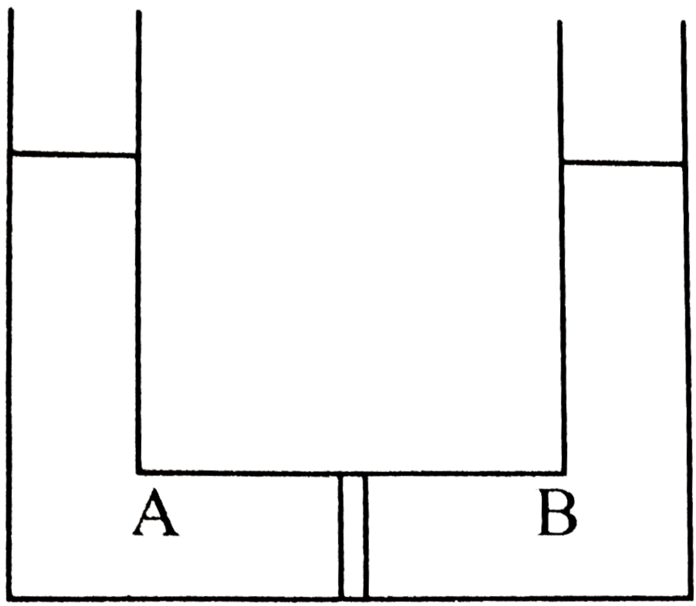
30.



Compartment A and B have the following combinations of solution:

	A	B
1	$0.1 M KCl$	$0.2 M KCl$
2	$0.1\%(m/V) NaCl$	$10\%(m/V) NaCl$
3	$18 g L^{-1}$ glucose	$34.2 g L^{-1}$ sucrose
3	$20\%(m/V)$ glucose	$10\%(m/V)$ glucose

The solutions in which compartment B is hypertonic.

A. 1, 2

B. 2, 3

C. 3, 4

D. 1, 4

Answer: A

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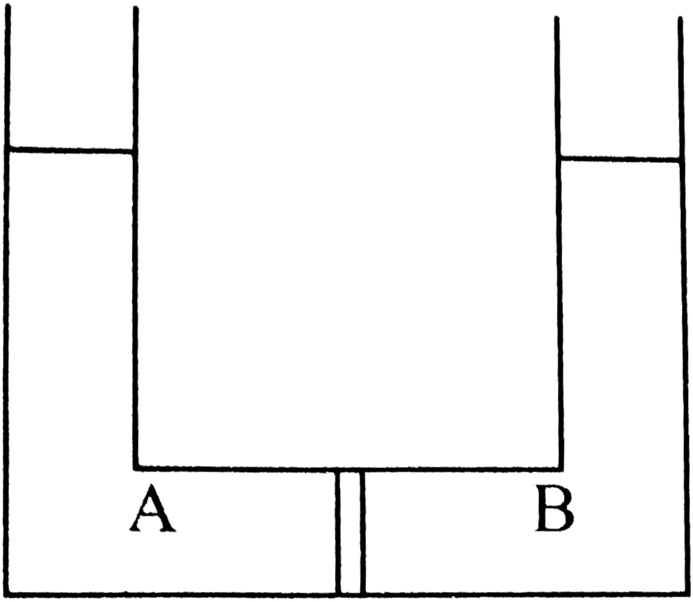
31.



Compartment A and B have the following combinations of solution:

	A	B
1	$0.1 M KCl$	$0.2 M KCl$
2	$0.1\,\%\,(m/V) NaCl$	$10\,\%\,(m/V) NaCl$
3	$18 g L^{-1}$ glucose	$34.2 g L^{-1}$ sucrose
3	$20\,\%\,(m/V)$ glucose	$10\,\%\,(m/V)$ glucose

Indicate the solution(s) in which compartment A will show an increases in volume.

A. 4

B. 2

C. 3

D. 5

Answer: A

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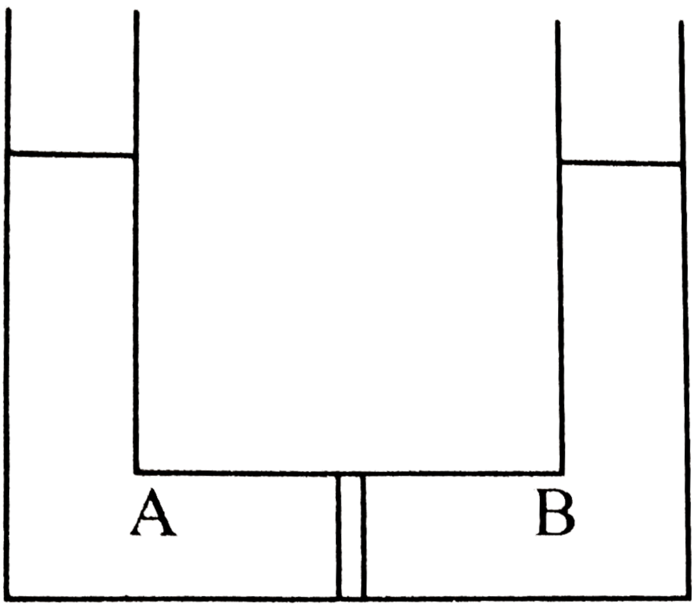
32. 

Compartment A and B have the following combinations of solution:

	A	B
1	$0.1 M KCl$	$0.2 M KCl$
2	$0.1\%(m/V) NaCl$	$10\%(m/V) NaCl$
3	$18 gL^{-1}$ glucose	$34.2 gL^{-1}$ sucrose
4	$20\%(m/V)$ glucose	$10\%(m/V)$ glucose

Indicate the solution(s) in which compartment B will show an

increases in volume.

1) 1, 2, 4

2) 1, 2

3) 2, 3

4) 3, 4

A. 1, 2, 4

B. 1, 2

C. 2, 3

D. 3, 4

Answer: B

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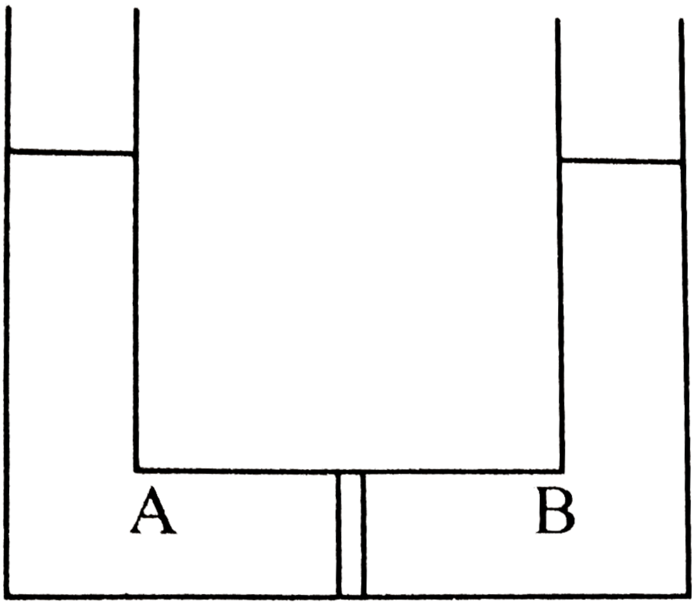
33.



Compartment A and B have the following combinations of solution:

	A	B
1	$0.1 M KCl$	$0.2 M KCl$
2	$0.1\,\%\,(m/V) NaCl$	$10\,\%\,(m/V) NaCl$
3	$18 g L^{-1}$ glucose	$34.2 g L^{-1}$ sucrose
3	$20\,\%\,(m/V)$ glucose	$10\,\%\,(m/V)$ glucose

Answer the following question:

Indicate the number of solutions which is/are isotonic.

A. 1

B. 2

C. 4

D. 3

Answer: D

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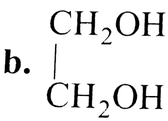
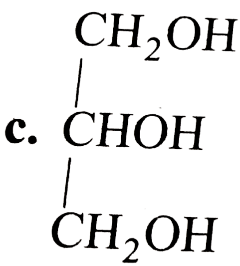
34. The boiling point elevation and freezing point depression of solutions have a number of partical applications. Ethylene glycol $(CH_2OH - CH_2OH)$ is used in automobile radiatiors as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as an antifreeze. In order for the boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at $65^\circ C$, is sometimes used as an antifreeze in automobile radiators.

Which of the following is a better reagent for depression in freezing point but not for elevation in boiling point?

A. CH_3OH

B. 

C. 

D. $C_6H_{12}O_6$

Answer: A

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35. The boiling point elevation and freezing point depression of solutions have a number of partical applications. Ethylene glycol (CH_2OH-CH_2OH) is used in automobile radiatiors as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as an antifreeze. In order for the boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at $65^{@}C$, is sometimes used as an antifreeze in automobile radiators.

$124g$ each of the two reagents glycol and glycerol are added in $5kg$ of water of the radiators in two cars. Which of the following statements is wrong?

(a)Both will act as antifreeze.

(b)Glycol will be better.

(c)Glycerol is better because its molar mass is greater than glycol.

(d)all of these

A. Both will act as antifreeze.

B. Glycol will be better.

C. Glycerol is better because its molar mass is greater than glycol.

D. All of these

Answer: C

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36. The boiling point elevation and freezing point depression of solutions have a number of partical applications. Ethylene glycol $(CH_2OH - CH_2OH)$ is used in automobile radiatiors as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as an antifreeze. In order for the boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at $65^\circ C$, is sometimes used as an antifreeze in automobile radiators.

$620g$ glycol is added to $4kg$ water in the radiator of car. What amount of ice will separate out at $-6^\circ C$?

A. $800g$

B. $900g$

C. $600g$

D. $1000g$

Answer: B

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37. The boiling point elevation and freezing point depression of solutions have a number of partical applications. Ethylene glycol $(CH_2OH - CH_2OH)$ is used in automobile radiatiors as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as an antifreeze. In order for the boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at $65^\circ C$, is sometimes used as an antifreeze in automobile radiators.

If the cost of glycerol, glycol, and methanol is same, then the sequence of economy to use these compounds as antifreeze will be

A. Glycerol gt Glycol gt Methanol

B. Methanol gt Glycol gt Glycerol

C. Methanol = Glycol = Glycerol

D. Methanol gt Glycol $<$ Glycerol

Answer: B

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38. The boiling point elevation and freezing point depression of solutions have a number of partical applications. Ethylene glycol $(CH_2OH - CH_2OH)$ is used in automobile radiatiors as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as an antifreeze. In order for the boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at $65^\circ C$, is sometimes used as an antifreeze in automobile radiators.

Which among the following is the most volatile and the best antifreeze?

A. CH_3OH

B. C_2H_5OH

C. Glycol

D. Glycerol

Answer: A

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39. 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. Applications of colligative properties are very useful in day-tөday life. One of the examples is the use of the mixture of ethylene glycol and water as an 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

$K_f^{water} = 1.86 K kg mol^{-1}$

Freezing point depression constant of ethanol

$K_f^{ethanol} = 2.0 K kg mol^{-1}$

Boiling point elevation constant of water

$K_b^{water} = 2.52 K kg mol^{-1}$

Boiling point elevation constant of ethanol

$K_b^{ethanol} = 1.2 K kg mol^{-1}$

Standard freezing point of water = $273 K$

Standard freezing point of ethanol = $155.7K$

Standard boiling point of water = $373K$

Standard boiling point of ethanol = $315.5K$

Vapour pressure of pure water =$32.8mmHg$

Vapour pressure of pure ethanol=$40mmHg$

Molecular weight of water =$18gmol^{-1}$

Molecular weight of ethanol =$46gmol^{-1}$

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. $268.7K$

B. $268.5K$

C. $150.9K$

D. $268.7K$

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40. 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. Applications of colligative properties are very useful in day-today life. One of the examples is the use of the mixture of ethylene glycol and water as an 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

$K_f^{water} = 1.86 K kg mol^{-1}$

Freezing point depression constant of ethanol

$K_f^{ethanol} = 2.0 K kg mol^{-1}$

Boiling point elevation constant of water

$K_b^{water} = 2.52 K kg mol^{-1}$

Boiling point elevation constant of ethanol

$K_b^{ethanol} = 1.2 K kg mol^{-1}$

Standard freezing point of water = $273K$

Standard freezing point of ethanol = $155.7K$

Standard boiling point of water = $373K$

Standard boiling point of ethanol = $315.5K$

Vapour pressure of pure water =$32.8 mmHg$

Vapour pressure of pure ethanol=$40 mmHg$

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 solution M is

A. $39.3 mmHg$

B. $36.0 mmHg$

C. $29.5 mmHg$

D. $28.8 mmHg$

Answer: B

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41. 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. Applications of colligative properties are very useful in day-teday life. One of the examples is the use of the mixture of ethylene glycol and water as an 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

$K_f^{water} = 1.86 K kg mol^{-1}$

Freezing point depression constant of ethanol

$K_f^{ethanol} = 2.0 K kg mol^{-1}$

Boiling point elevation constant of water

$K_b^{water} = 2.52 K kg mol^{-1}$

Boiling point elevation constant of ethanol

$K_b^{ethanol} = 1.2 K kg mol^{-1}$

Standard freezing point of water = $273K$

Standard freezing point of ethanol = $155.7K$

Standard boiling point of water = $373K$

Standard boiling point of ethanol = $315.5K$

Vapour pressure of pure water =$32.8 mmHg$

Vapour pressure of pure ethanol=$40 mmHg$

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 freezing point of solution M is

A. $380.4K$

B. $376.2K$

C. $375.5K$

D. $354.7K$

Answer: B

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42. Properties such as boiling point, freezing point, and vapour pressure of a pure solvent change when solute molecules are added to get homogenous solution. These are called colligative properties. Anwer the following questions:

i.$0.001mNaCl$

ii.0.001 m urea

iii.$0.001mMgCl_2$

iv.$0.001 m CH_3COOH$

Increasing order of boiling points

A. $(ii) < (iv) < (i) < (iii)$

B. $(iv) < (i) < (ii) < (iii)$

C. $(iii) < (ii) < (i) < (iiv)$

D. $(i) < (ii) < (iii) < (iv)$

Answer: A

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43. Properties such as boiling point, freezing point, and vapour pressure of a pure solvent change when solute molecules are added to get homogenous solution. These are called colligative properties. Anwer the following questions:

i.0.1 M ethanol

ii.$0.1 m Ba_3(PO_4)_3$

iii.$0.1 m Na_2SO_4$

Increasing order of freezing points

A. $(ii) < (iii) < (i)$

B. $(iii) < (ii) < (i)$

C. $(i) < (ii) < (iii)$

D. $(ii) < (i) < (iii)$

Answer: A

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44. Properties such as boiling point, freezing point, and vapour pressure of a pure solvent change when solute molecules are added to get homogenous solution. These are called colligative properties. Anwer the following questions:

i.0.1 M glucose

ii.1% urea solution

iii.0.1 M common salt

Increasing order of osmotic pressure

A. $(i) < (iii) < (ii)$

B. $(i) < (ii) < (iii)$

C. $(ii) < (iii) < (i)$

D. $(iii) < (i) < (ii)$

Answer: B

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45. Properties such as boiling point, freezing point, and vapour pressure of a pure solvent change when solute molecules are added to get homogenous solution. These are called colligative properties.

Anwer the following questions:

i. $NaNO_3$ ii.$BaCl_2$

iii. $K_3\left[Fe(CN)_6\right]$ iv. $C_6H_{12}O_6$

Increasing order of Van't Hoff factor

A. $(iv) < (ii) < (i) < (iii)$

B. $(iv) < (i) < (ii) < (iii)$

C. $(iv) < (iii) < (ii) < (i)$

D. $(iv) < (i) < (ii) < (iii)$

Answer: D

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46. A certain vessel X has water and nitrogen gas at a total pressure of 2 atm and $300K$. All the contents of vessel was transferred to another vessel Y having half the capacity of the vessel X. The pressure of N_2 in this vessel was 3.8 atm at $300K$. The vessel Y is heated to $320K$ and the total pressure observed was 4.32 atm. Assume that the volume occupied by the gases in vessel is equal to the volume of the vessel. Calculate the following:

Pressure of H_2O in X at $320K$.

A. 0.1

B. 0.2

C. 1.0

D. 2.0

Answer: A

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47. A certain vessel X has water and nitrogen gas at a total pressure of 2 atm and $300K$. All the contents of vessel and transferred to another vessel Y having half the capacity of the vessel X. The pressure of N_2 in this vessel was 3.8 atm at $300K$. The vessel Y is heated to $320K$ and the total pressure observed was 4.32 atm. Assume that the volume occupied by the gases in vessel is equal to the volume of the vessel. Calculate the following:

Pressure of H_2 at $320K$.

A. 4.0

B. 4.05

C. 5.05

D. 1.05

Answer: B

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48. A certain vessel X has water and nitrogen gas at a total pressure of 2 atm and $300K$. All the contents of vessel and transferred to another vessel Y having half the capacity of the vessel X. The pressure of N_2 in this vessel was 3.8 atm at $300K$. The vessel Y is heated to $320K$ and the total pressure observed was 4.32 atm. Assume that the volume occupied by the gases in vessel is equal to the volume of the vessel. Calculate the following:

Pressure of water vapour at $320K$.

A. 0.27

B. 0.32

C. 4.0

D. 1.0

Answer: C

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49. A certain vessel X has water and nitrogen gas at a total pressure of 2 atm and $300K$. All the contents of vessel and transferred to another vessel Y having half the capacity of the vessel X. The pressure of N_2 in this vessel was 3.8 atm at $300K$. The vessel Y is heated to $320K$ and the total pressure observed was 4.32 atm. Assume that the volume occupied by the gases in vessel is equal to the volume of the vessel. Calculate the following:

Enthalpy of vapourization.

A. 30.00

B. 35.65

C. 38.65

D. 39.65

Answer: D

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50. A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vapourizes to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non-volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

Similarly, the greater randomness of the solution opposes the tendercy to freeze. In consequence, a lower temperature must be reached for achieving the equilibrium between the solid (frozen solvent) and the solution. The elevation in boiling point (ΔT_b) and depression in freezing point $\left(\Delta T_f\right)$ of a solution are the colligative properties which depend only on the concentration of particles of the solute and not their identity. For dilute solutions, (ΔT_b) and $\left(\Delta T_f\right)$ are proportional to the molarity of the solute in the solution.

Dissolution of a non-volatile solute into a liquid leads to

A. A decrease of entropy

B. An increase in tendency of the liquid to freeze

C. An increases in tendency to pass into the vapour phase

D. A decrease in tendency of the liquid to freeze

Answer: D

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51. A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vapourizes to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non-volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

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To aqueous solution of Nal, increasing amounts of solid Hgl_2 is added. The vapour pressure of the solution

A. decreases to a constant value

B. increases to a constant value

C. increases and then decreases

D. remains constant as Hgl_2 is sparingly soluble in water

Answer: D

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52. A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vapourizes to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non-volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

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A liquid possessing which of the following characteristics will be most suitable for determining the molecular mass of a compound by cryoscopic measurements?

A. That having low freezing point and small enthhalpy of freezing

B. That having high freezing point and small enthhalpy of freezing

C. Greater than the normal boiling point of either of the liquid.

D. Smaller than the normal boiling point of either of the liquid.

Answer: B

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53. A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vapourizes to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non-volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

Similarly, the greater randomness of the solution opposes the tendercy to freeze. In consequence, a lower temperature must be reached for achieving the equilibrium between the solid (frozen solvent) and the solution. The elevation in boiling point (ΔT_b) and depression in freezing point (ΔT_f) of a solution are the colligative properties which depend only on the concentration of particles of the solute and not their identity. For dilute solutions, (ΔT_b) and (ΔT_f) are proportional to the molarity of the solute in the solution.

A mixture of two immiscible liquids at a constant pressure of $1.0 atm$ boils at temperature

A. Equal to the normal boiling point of more volatile liquid.

B. Equal to the mean of the normal boiling points of the two liquids.

C. Greater than normal boiling point of either of liquids.

D. Smaller than the normal boiling point of either of the liquid.

Answer: D

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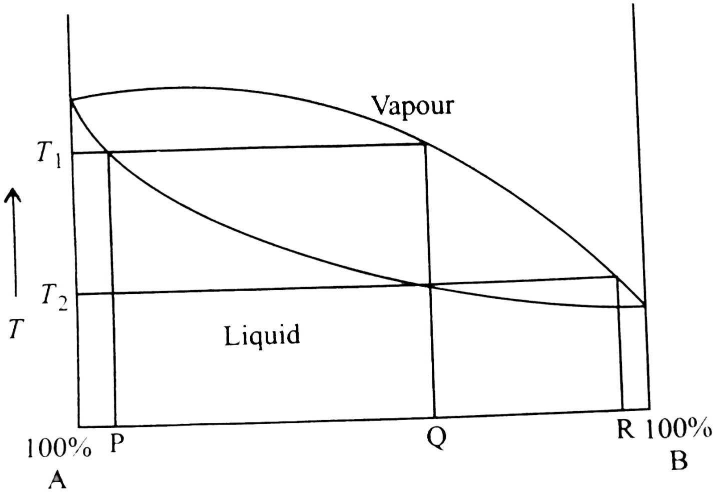
54. represents the distillation of mixture of liquid A and liquid B which gives both of pure liquid A and B . Represents the azeotropic mixture of HNO_3 and H_2O which distillation gives an azeotropic mixture and either of pure liquid. We cannot separate both the pure liquid, i.e., H_2O and HNO_3.



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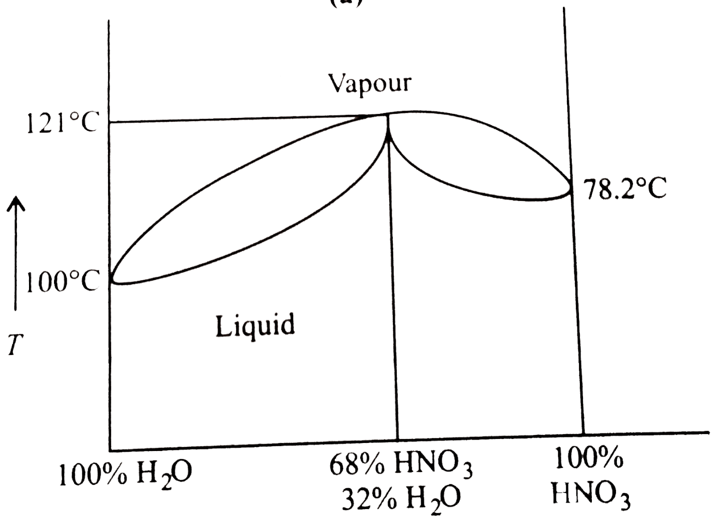

What is the result of distilling a mixture of $50\,\%\,HNO_3$ and $50\,\%\,H(2)O$?

a.Pure water and azeotropic mixtue can be separated.

b.Pure H_2O and pure HNO_3 can be separated.

c.Pure HNO_3 and azeotropic mixture can be separated.

d.None of these

A. Pure water and azeotropic mixtue can be separated.

B. Pure H_2O and pure HNO_3 can be separated.

C. Pure HNO_3 and azeotropic mixture can be separated.

D. None of these

Answer: A

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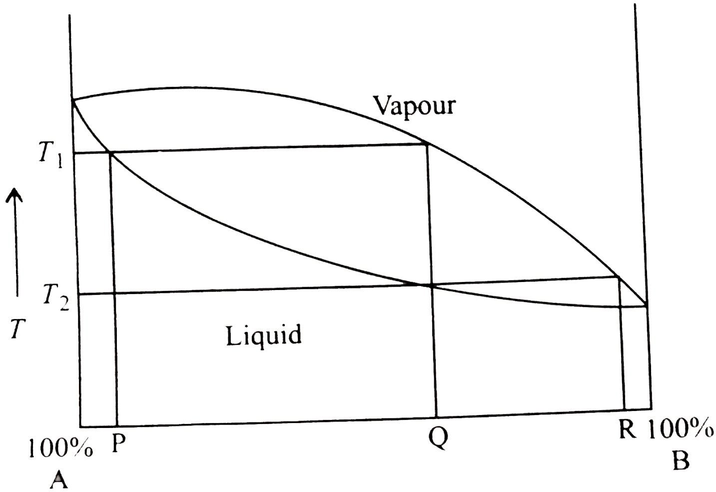
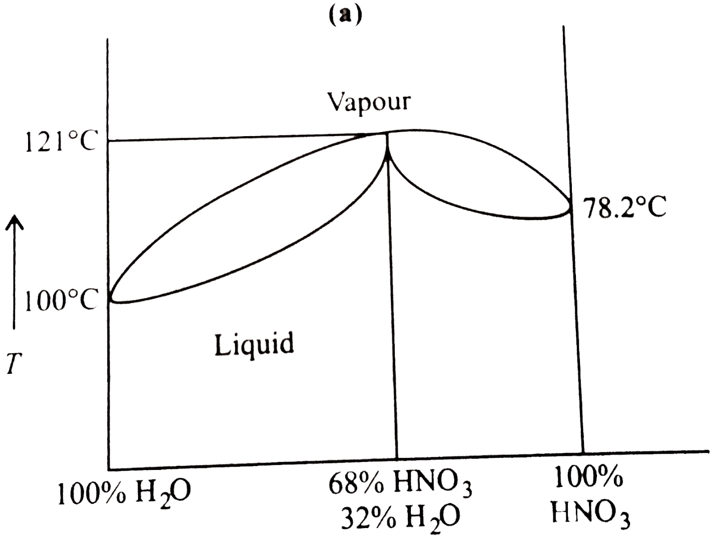
55. represents the distillation of mixture of liquid A and liquid B which gives both of pure liquid A and B . Represents the azeotropic mixture of HNO_3 and H_2O which distillation gives an azeotropic mixture and either of pure liquid. We cannot separate both the pure liquid, i.e., H_2O and HNO_3.

What is the result of distilling a mixture of $80\,\%\,HNO_3$ and



(a)



$20\,\%\,H_2O$?

(a)Pure H_2O and azeotropic mixture can be separated.

(b)Pure H_2O and pure HNO_3 can be separated.

(c)Pure HNO_3 and azeotropic mixture can be separated.

(d)None of these

A. Pure H_2O and azeotropic mixture can be separated.

B. Pure H_2O and pure HNO_3 can be separated.

C. Pure HNO_3 and azeotropic mixture can be separated.

D. None of these

Answer: C

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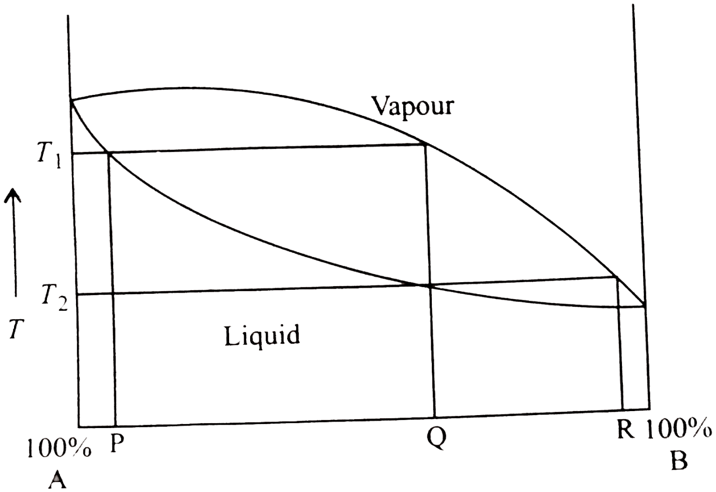
56. represents the distillation of mixture of liquid A and liquid B which gives both of pure liquid A and B . Represents the azeotropic mixture of HNO_3 and H_2O which distillation gives an azeotropic mixture and either of pure liquid. We cannot separate both the pure liquid, i.e., H_2O and HNO_3.

Which of the following statements is/are correct?

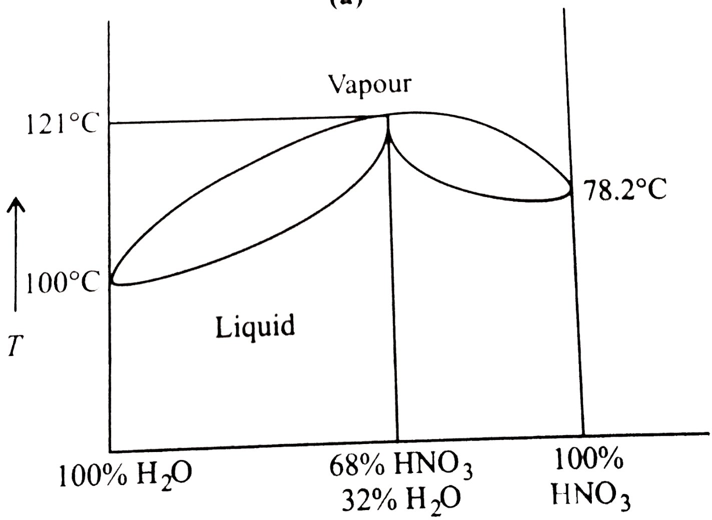
i. HNO_3 solution is not obeying the Raoult's law.

ii. More the difference in vapour pressure of pure compounds forming a mixture, easier to separate them through distillation.

iii. T_2 is less than T_1 because the liquid of composition Q is richer in more volatile component.



(a)



A. (ii) and (iii)

B. (ii)

C. (i) and (ii)

D. (i),(ii) and (iii)

Answer: D

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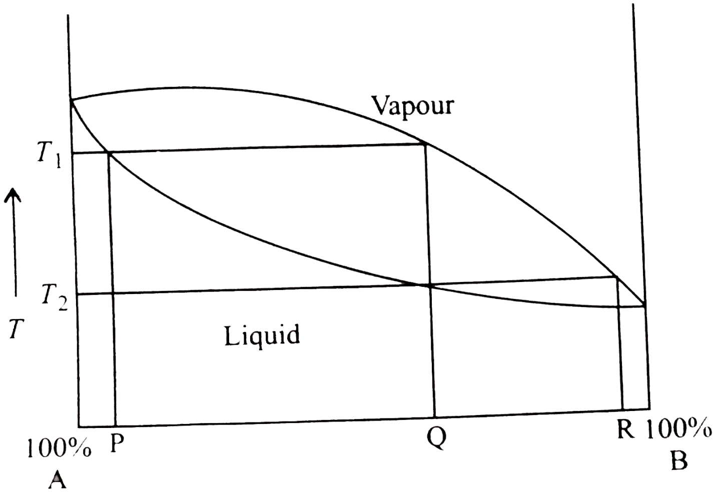
57. represents the distillation of mixture of liquid A and liquid B which gives both of pure liquid A and B . Represents the azeotropic mixture of HNO_3 and H_2O which distillation gives an azeotropic mixture and either of pure liquid. We cannot separate both the pure liquid, i.e., H_2O and HNO_3.

a solution of 50% of A and 50% of B on distillation results into



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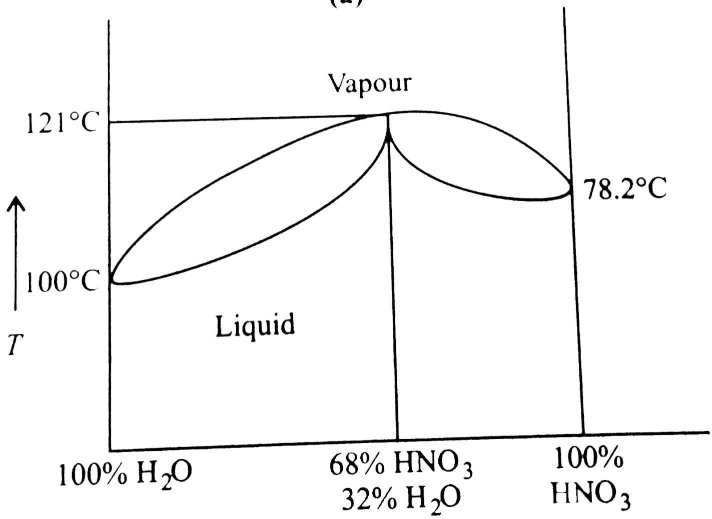

Separation of an azeotropic mixture and pure A .

Separation of an azeotropic mixture and pure B .

Separation of both pure A and pure B .

None of these

A. Separation of an azeotropic mixture and pure A.

B. Separation of an azeotropic mixture and pure B.

C. Separation of both pure A and pure B.

D. None of these

Answer: C

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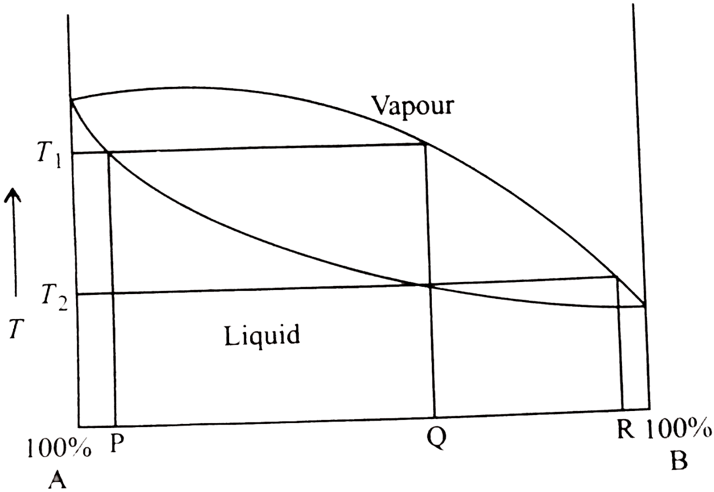
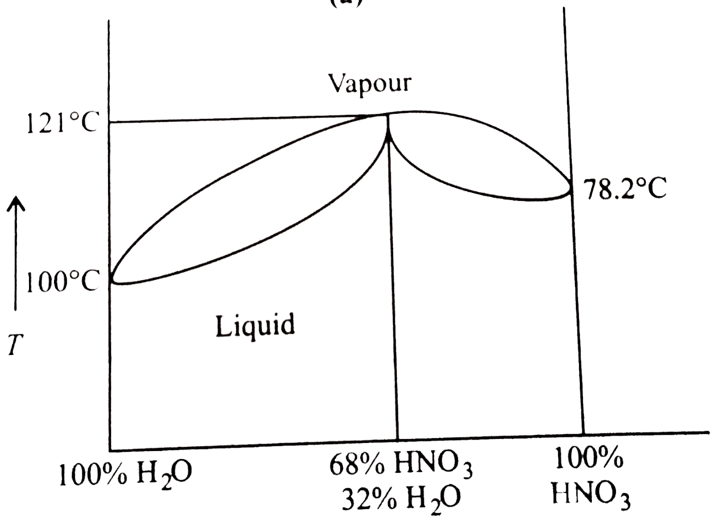
58. represents the distillation of mixture of liquid A and liquid B which gives both of pure liquid A and B . Represents the azeotropic mixture of HNO_3 and H_2O which distillation gives an azeotropic mixture and either of pure liquid. We cannot separate both the pure liquid, i.e., H_2O and HNO_3.

At temperature T_1 and composition Q, which of the following is true?



(a)



a.Vapour phase is richer in B while liquid phase is richer in A .

b.Distillation of composition Q gives only pure A .

c.Distillation of composition Q gives only pure A and pure B .

d.Distillation of composition Q gives higher percentage of B and A .

A. Vapour phase is richer in B while liquid phase is richer in A.

B. Distillation of composition Q gives only pure A.

C. Distillation of composition Q gives only pure A and pure B.

D. Distillation of composition Q gives higher percentage of B and A.

Answer: A::C::D

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Exercises (Multiple Correct)

1. Two miscible liquids A and B having vapour pressure in pure state P_A° and P_B° are mixed in mole fraction χ_A and χ_B to get a mixtue having total vapour vapour pressure of mixture P_M. Which of the following relations are correct?

A. $\chi_A = \dfrac{P_M - P_B^\circ}{P_A^\circ - P_B^\circ}$

B. $\dfrac{\chi_A(l)}{\chi_A(V)} = \dfrac{P_M}{P_A^\circ}$

C. $\dfrac{\chi_A(l)}{\chi'_A(V)} = \dfrac{P_M}{P_B^\circ}$

D. All of these

Answer: A::B

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2. A mixture of two immiscible liquids A and B, having vapour pressure in pure state obeys the following relationship if χ_A and χ_B are mole fractions of A and B in vapour phase over the solution

A. $P'_A = P_M \chi'_A$

B. $\dfrac{P_A'}{P_B'} = \dfrac{W_A \times Mw_B}{Mw_A \times W_B}$

C. If $P_A' > P_B' then \chi'_A < \chi_B$

D. If $P_A' > P_B' then n_A < n_B$

Answer: A::B::D

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3. Which relations are not correct for an aqueous dilute solution of K_3PO_4 if its degree of dissociation is α?

A. $\Delta\frac{P}{P^\circ} = \frac{Molality \times 18 \times (1+3\alpha)}{1000}$

B. $\Delta\frac{P}{P^\circ} = \frac{\pi_{obs} \times 18 \times (1+3\alpha)}{RT \times 1000}$

C. $\Delta\frac{P}{P^\circ} = \frac{\Delta T_{f\_}(obs) \times 18}{K_f \times 1000}$

D. Mw of $K_3PO_4) = Mw_{obs} \times (1+3\alpha)$

Answer: A::C::D

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4. Osmotic pressure of a solution is

A. Directly proportional to the molar concentration of the solution.

B. Inversely proportional to the molecular weight of the solue.

C. Inversely proportional to the temperature.

D. Directly proportional to the volume of the solution.

Answer: A::B

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5. Which of the following is/are ture?

A. For the same solution, elevation in boiling point =depression in freezing point.

B. The Van't Hoff factor for a dilute solution of $BaCl_2$ is 3.

C. The elevation in boiling point is due to increase in vapour pressure.

D. The depression in freezing point is due to decrease in vapour pressure.

Answer: B::D

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6. Which of the following statements is/are correct?

A. Minimum boiling azeotropic mixtue boils at temperature lower than either of the two pure components.

B. Maximum boiling azeotropic mixtue boils at temperature higher than either of the two pure components.

C. Minimum boiling azeotropic mixture shows positive deviation.

D. Maximum boiling azeotropic mixture shows negative deviation.

Answer: A::B::C::D

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7. For a non-volatile solute

A. The vapour pressure of a solute is zero.

B. Vapour pressure of solution = Vapour pressure of pure solvent.

C. Vapour pressure of solution = Vapour pressure of pure solvent in solution.

D. All of these

Answer: A::C

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8. To $10mL$ of $1MBaCl_2$ solution $5mL$ of $0.5MK_2SO_4$ is added. $BaSO_4$ is precipitated out. What will happen?

A. Freezing point will increase.

B. Boiling point will increase.

C. Freezing point will lower down.

D. Boiling point will lower down.

Answer: B::C

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9. A difference between diffusion and osmosis is

A. A semi-permeable membrane is required for osmosis while diffusion requires no semi-permeable membrane.

B. In osmosis movement of molecules is only in one direction whereas in diffusion movement is on both sides.

C. In osmosis only the solvent moves while in diffusion both solute and solvent move.

D. None of these

Answer: A::B::C

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10. 1 mol benzene $(P^{\circ}\_(\text{benzene}) = 42mm)$ and 2 mol toluence $(P^{\circ}\_(\text{toluene}) = 36mm)$ will have

A. Total vapour pressure of $38mm$.

B. Mole fraction of vapour of benzene above liquid mixture is $7/19$.

C. Positive devaition from Raoult's law.

D. Negative devaition from Raoult's law.

Answer: A::B

Watch Video Solution

11. Which of the following statements is/are correct?

A. The freezing point of water is depressed by the addition of glucose.

B. The degree of dissociation of a weak electrolyte decrease as its concentration decreases.

C. Energy is released when a substance dissolves in water provided that the hydration energy of the substance is more than its lattice energy.

D. If two liquids that form an ideal solution are mixed, the change in entropy is positive.

Answer: A::C::D

Watch Video Solution

12. Consider the two solutions:

I: $0.5 M NaCl$ aqueous solution at $25^{\circ} C$,

$NaCl$ is complete ionized.

II:$2.0 M C_6H_5COOH$ in benzene at $25^{\circ} C$,

C_6H_5COOH dimerizes to the full extent.

Which of the following statements(s) is (are) correct?

A. Both the solutions display equal osmotic pressure.

B. Both have equal vapour pressure.

C. Solution II is hypertonic.

D. Solution II has greater depression in freezing point than solution I.

Answer: A::D

Watch Video Solution

13. Which pair(s) of liquids on mixing is/are expected to show no net volume change and no heat effect?

A. Acetone and ethanol

B. Chlorobenzene and bromobenzene

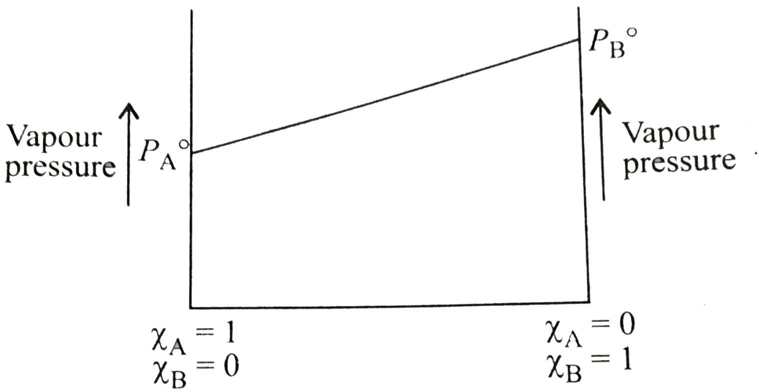
C. Chloroform and benzene

D. n-Butyl chloride and n-butyl bromide

Answer: B::D

Watch Video Solution

14. The following is a graph plotted between the vapour pressure of two volatile liquids against their respective mole fractions. Which of the following statements is/are correct?



A. When $\chi_A = 1$ and $\chi_B = 0$, then $P = P_A^\circ$.

B. When $\chi_B = 1$ and $\chi_A = 0$, then $P = P_B^\circ$.

C. When $\chi_A = 1$ and $\chi_B = 0$, then $P < P^\circ$.

D. When $\chi_B = 1$ and $\chi_A = 0$, then $P > P^\circ$.

Answer: A::B

Watch Video Solution

15. Consider the following solutions:

I.1 M sucrose , II. 1 M KCl

III.1 M benzoic acid in benzene

IV.$1M(NH_3)_3PO_4$

Which of the following is/are true?

A. All solutions are isotonic.

B. III is hypotonic of I,II, and IV.

C. I,II, and III are hypertonic of IV.

D. IV is hypertonic of I,II, and III.

Answer: B::C::D

Watch Video Solution

16. The osmotic pressure of a solution depends on

A. Nature of solute

B. Nature of solvent

C. Temperature

D. Molar concentration of solute

Answer: C::D

Watch Video Solution

17. $1.2575g$ sample of $[Cr(NH_3)_6]SO_4Cl(Mw = 251.5)$ is dissolved to prepare $250mL$ solution showing an osmotic pressure of $1.478 atm$ of Hg at $27^{\circ} C$. Which of the following statements is/are correct about this solution?

A. Each molecule funishes three ions in solution.

B. The Van't Hoff factor is =3.

C. The equilibrium molarity of $\left[Cr(NH_3)_6\right]SO_4Cl = 0.$

D. The equilibrium molarity of $\left[Cr(NH_3)_6\right]^{3+} = 0.02M.$

Answer: A::B::C::D

Watch Video Solution

18. $2L$ of $1 molal$ solution of a complex salt $CrCl_3.6H_2O(Mw = 266.5)$ shows an osmotic pressure of $98.52 atm$. The solution is now treated with $1L$ of $6M AgNO_3$, which of the following are correct?

A. Weight of $AgCl$ precipitated is $861g$.

B. The clear solution will show an osmotic pressure of $98.52 atm$.

C. The clear solution will show an osmotic pressure of $65.68 atm$.

D. $2 mol$ of $\left[Cr(H_2O)_6\right](NO_3)_3$ will be present in the solution.

Answer: A::C::D

Watch Video Solution

19. Which of the following combinations are correct for a binary solution, in which the solute as well as solvent are liquid?

A. $C_6H_6 \text{ and } C_6H_5CH(3), \Delta_{sol}H > 0, \Delta_{sol}V = 0$

B. $CH_3 - \overset{\overset{O}{||}}{C} - CH_3$ and $CHCl_3, \Delta_{sol}H < O, \Delta_{sol}V < O$

C. H_2O and $HCl, \Delta_{sol}H < O, \Delta_{sol}V < O$

D. H_2O and $CH_2OH, \Delta_{sol}H < O, \Delta_{sol}V < O$

Answer: B::D

Watch Video Solution

20. Effect of adding a non-volatie solute to a solvent is"

A. to lower the vapour pressure

B. to increase its freezing point

C. to increase its boiling point

D. to decrease its osmotic pressure

Answer: A::C

Watch Video Solution

21. Which of the following forms is an ideal solution?

A. Ethyl bromide + Ethyl iodide

B. Ethyl alcohol + water

C. Chloroform + Benzene

D. Benzene + Toluene

Answer: A::D

Watch Video Solution

22. For a given value of degree of dissociation, which of the following have correct Van't Hoff factor?

A. $NaCl, i = 2 + \alpha$

B. $Ca(NO_3)_2, i = 1 + 2\alpha$

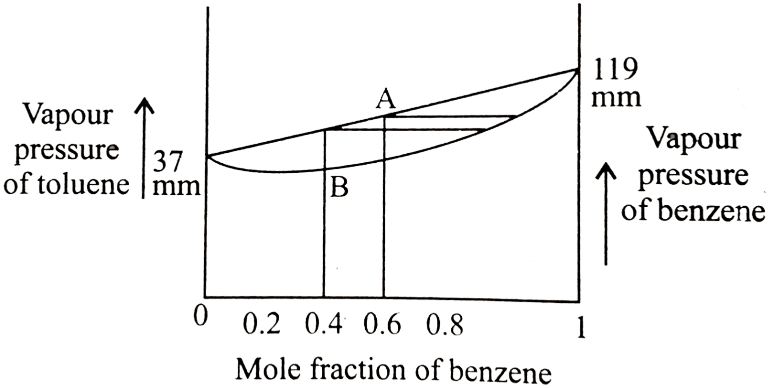
C. $K_4[Fe_3(CN_6)], i = 1 + 4\alpha$

D. $(NH_3)_3PO_4, i = 3 + \alpha$

Answer: B::C

Watch Video Solution

23. Choose the correct option:



A. A represents vapour composition and B represents liquid composition.

B. A as well as B represent liquid composition.

C. both A and B represent vapour coposition.

D. A represents liquid coposition and B represents vapour composition.

Answer: A::B::C

Watch Video Solution

24. When acetone and chloroform are mixed, hydrogen bonding takes place between them. Such a liquid pair will cause

A. Positive deviation from Raoult's law.

B. Negative deviation from Raoult's law.

C. No deviation from Raoult's law.

D. Cannot be predicted.

Answer: C

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25. A maxima or minima is obtained in the temperature composition curve of a mixture of two liquids indicates

A. That the liquids are immiscible with one another

B. That the liquids are partially miscible at the maximum or minimum.

C. An azeotropic mixture.

D. A eutectic formation.

Answer: A::B::D

Watch Video Solution

Exercises (Single Correct)

1. The use of common salts, e.g., $NaCl$ or $CaCl_2$ anhydrous, is made to clear snow on the roads. This causes:

A. A lowering in the freezing point of water.

B. A lowering in the melting point of ice.

C. Ice melts at the temperature of atmosphere present at that time.

D. All of these

Answer: D

Watch Video Solution

2. The relative lowering of vapour pressure is equal to the mole fraction of the non-volatile solute. This statement was given by

A. Raoult

B. Henry

C. Joule

D. Dalton

Answer: A

Watch Video Solution

3. Assuming each salt to be 90% dissociated which of the following will have the highest osmotic pressure?

A. Decinormal $Al_2(SO_4)_3$

B. Decinormal $BaCl_2$

C. Decinormal Na_2SO_4

D. A solution obtained by mixing equal volumes of (b) and (c) and filtering

Answer: A

Watch Video Solution

4. When a solution is separated from a solvent by a semi-permeable membrane, then the phenomenon taking place is called as

A. Osmosis

B. Diffusion

C. Solubility

D. None

Answer: A

Watch Video Solution

5. If a thin slice of sugar beet is placed in concentrated solution of $NaCl$, then

A. Sugar beet will lose water from its cells.

B. Sugar beet will absorb water from solution.

C. Sugar beet will neither absorb nor lose water

D. Sugar beet will dissolve in solution.

Answer: A

Watch Video Solution

6. The boiling point of an azeotropic mixture of water - ethanol is less than that of both water and ethanol. Then:

A. The solution is highly saturated.

B. Positive deviation from Raoult's law.

C. Negative deviation from Raoult's law.

D. Nothing can be said.

Answer: B

Watch Video Solution

7. Which salt shows maximum osmotic pressure in its $1m$ solution.

A. $AgNO_3$

B. Na_2SO_4

C. $(NH_4)(3)PO_4$

D. $MgCl_2$

Answer: C

Watch Video Solution

8. Solution distilled without change in composition at a temperature is called

A. Amorphous

B. Azeotropic mixture

C. Ideal solution

D. Super saturated solution

Answer: B

Watch Video Solution

9. Azeotropic mixtures are

A. Constant boiling point mixture without changing the composition.

B. Those which boil at different temperatures.

C. Mixtures of two solids.

D. None of the above

Answer: A

Watch Video Solution

10. Which solution will show maximum elevation in boiling point?

A. $0.1MKCl$

B. $0.1MBaCl_2$

C. $0.1MFeCl_3$

D. $0.1MFe_2(SO_4)_3$

Answer: D

Watch Video Solution

11. On mixing $10mL$ of acetone with $40mL$ of chloroform,the total volume of the solution is

A. $< 50mL$

B. $> 50mL$

C. $= 50mL$

D. Cannot be predicted.

Answer: A

Watch Video Solution

12. When common salt is dissolved in water

A. The melting point of the solution increases.

B. The boiling point of the solution decreases.

C. Both melting point and boiling point decrease.

D. The boiling point of the solution increases.

Answer: D

Watch Video Solution

13. Which of the following substances will lose its whose solubility with increase in temperature?

A. $NaOH$

B. Na_2CO_3

C. Na_2SO_4

D. All

Answer: D

Watch Video Solution

14. On mixing $10mL$ of carbon tetrachloride with $10mL$ of benzene the total volume of the solution is:

A. $> 20mL$

B. $< 20mL$

C. $= 20mL$

D. Cannot be predicted.

Answer: C

Watch Video Solution

15. A teacher one day pointed out to his students the peculiar fact that water is a unique liquid which freezes exactly at $0^\circ C$.and boils exactly at $100^{\circ} C$. He asked the students to find the correct statement based on this fact.

A. Water dissolves anything, however sparingly the dissolution maybe.

B. Water is a polar molecule.

C. Boiling and freezing temperatures of water were used to define a temperature scale.

D. Liquid water is denser than ice.

Answer: C

Watch Video Solution

16. The osmotic pressure of a dilute solution is directly proportional to the

A. Diffusion rate of the solute

B. Ionic concentration

C. Boiling point

D. Flow of solvent form a concentrated solution

Answer: B

Watch Video Solution

17. If Raoult's law is obeyed, the vapour pressure of the solvent in a solution is directly proportional to

A. The mole fraction of the solvent.

B. The mole fraction of the solute.

C. The mole fraction of the solvent and solute.

D. The volume of the solution.

Answer: A

Watch Video Solution

18. The freezing point of 1% aqueous solution of calcuim nitrate will be

A. $0^{\circ}C$

B. Above $0^{\circ}C$

C. $1^{\circ}C$

D. Below $0^{\circ}C$

Answer: D

Watch Video Solution

19. A perfectly semi-permeable membrane when used to separate a solution from its solvent permits through it the passage of

A. Solute only

B. Solvent only

C. Both (a) and (b)

D. None

Answer: B

Watch Video Solution

20. Each pair forms ideal solution except

A. C_2H_5Br and C_2H_5I

B. C_2H_5Cl and C_2H_5Br

C. C_6H_6 and $C_6H_5CH_3$

D. C_2H_6I and C_2H_5OH

Answer: D

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21. Which statement is incorrect about osmotic pressure(π), volume (V), and temperature (T)?

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

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22. Semi-permeable membrane is chemically

A. Copper ferrocyanide

B. Copper ferricyanide

C. Copper sulphate

D. Potassium ferrocyanide

Answer: A

Watch Video Solution

23. 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

Answer: C

Watch Video Solution

24. The depression in freezing point is maximum if the solvent used is

A. Camphor

B. Naphthalene

C. Benzene

D. Water

Answer: A

Watch Video Solution

25. The osmotic pressure of a dilute solution is given by

A. $P = P_0 \times N_1$

B. $\pi V = nRT$

C. $\Delta P = P_0 N_2$

D. $\frac{\Delta P}{P^\circ} = \frac{P^\circ - P_s}{P^\circ}$

Answer: B

Watch Video Solution

26. Which is not a colligative property?

A. Lowering of vapour pressure

B. Freezing point

C. Osmotic pressure

D. Elevation in boiling point

Answer: B

Watch Video Solution

27. Blood has been found to be isotonic with

A. Normal saline solution

B. Saturated $NaCl$ solution

C. Saturated KCl solution

D. Saturated solution of a 1:1 mixture of $NaCl$ and KCl

Answer: A

Watch Video Solution

28. Which condition is not satisfied by an ideal solution?

A. $\Delta_{mix} H = 0$

B. $\Delta_{mix} V = 0$

C. $\Delta_{mix} S = 0$

D. Obeyance of Raoult's law

Answer: C

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29. Isotonic solutions are those which have

A. Same osmotic pressure

B. Same molarity

C. Same density

D. Same normality

Answer: A

Watch Video Solution

30. The correct relationship between the boiling point of very dilute solutions of $AiCI_3(t_1)$ and $caCI_2(t_2)$ having the same molar concentration is:

A. $t_1 - t_2$

B. $t_1 > t_2$

C. $t_2 > t_1$

D. $t_2 \geq t_1$

Answer: B

Watch Video Solution

31. Two solutions of KNO_3 and CH_3COOH are prepared separately. The molarity of both is $0.1M$ and osmotic pressure is P_1 and P_2, respectively.

The correct relationship between the osmotic pressure is

A. $P_2 > P_1$

B. $P_1 = P_2$

C. $P_1 > P_2$

D. $\dfrac{P_1}{P_1 + P_2} = \dfrac{P_2}{P_1 + P_2}$

Answer: C

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32. Boiling point elevation is

A. Additive property

B. Constitutive property

C. Colligative property

D. Partly additive and partly constitutive

Answer: C

Watch Video Solution

33. An example of colligative property is

A. Freezing point

B. Boiling point

C. Vapour pressure

D. Osmotic pressure

Answer: D

Watch Video Solution

34. A mixture of benzene and toluence forms

A. An ideal solution

B. Non-ideal solution

C. Suspension

D. Emulsion

Answer: A

Watch Video Solution

35. The colligative properties of a solution depend on

A. The number of solute particles present in it

B. The chemical nature of the solute particles present in it

C. The nature of the solvent used

D. None of these

Answer: A

Watch Video Solution

36. Osmosis is the spontaneous flow through a semi-permeable membrane of

A. A less concentrated solution into more concentrated

B. The solvent form a solution of lower concentration to one of higher concentration

C. Solute particles from a solution of higher concentration to one of lower concentration

D. None of these

Answer: B

Watch Video Solution

37. The osmotic pressure of a non-aqueous solution is measured by

A. Berkeley and Hartley method

B. Pfeffer's method

C. Morse and Frazer method

D. Townend's method

Answer: D

Watch Video Solution

38. A pressure cooker reduces cooking time for food because:

A. Heat is more evenly distributed

B. Boiling point of water inside the cooker is increased

C. The high pressure tenderizes the food

D. All of these

Answer: B

Watch Video Solution

39. The osmotic pressure of a solution increases if

A. Temperature is lowered

B. Volume is increased

C. Number of solute molecules is increased

D. None of these

Answer: C

Watch Video Solution

40. The ratio of the value of any colligative property of KCl solution to that of sugar solution is

A. 1

B. 0.5

C. 2

D. 4

Answer: C

Watch Video Solution

41. Equimolal solutions A and B show depression in freezing point in the ratio $2:1$. A remains in the normal state in solution. B will be

A. Normal in solution

B. Dissociated in solution

C. Associated in solution

D. Hydrolysed in solution

Answer: C

Watch Video Solution

42. The vapour pressure (VP) of a dilute solution of non-volatile solute is P and the VP of a pure solvent is P°. The lowering of the VP is

A. $+ve$

B. $-ve$

C. P / P°

D. P° / P

Answer: A

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43. If P° and P_s are vapour pressure of solvent and its solution, respectively, χ_1 and χ_2 are mole fractions of solvent and solute, respectively, then

A. $P_s = P^{\circ} / \chi_2$

B. $P^{\circ} - P_s = P^{\circ} \chi_2$

C. $P_s = P^{\circ} \chi_2$

D. $\dfrac{P^{\circ} - P_s}{P_s} = \dfrac{\chi_1}{\chi_1 + \chi_2}$

Answer: B

Watch Video Solution

44. The value of $K_f$for water is 1.86°, calculated from glucose solution, The value of $K_f$for water calculated for NaCl solution will be,

A. $= 1.86$

B. < 1.86

C. > 1.86

D. Zero

Answer: A

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45. What will be the molecular weight of $NaCl$ determined experimentally from elevation in the boiling point or depression in freezing point method?

A. < 58.5

B. > 58.5

C. $= 58.5$

D. None

Answer: A

Watch Video Solution

46. The van't Hoff factor of $NaCl$ assuming 100% dissociation is:

A. $\frac{1}{2}$

B. 2

C. 1

D. 3

Answer: B

Watch Video Solution

47. The solution in which the blood cells remain their normal shape, with regard to the blood, are

A. Isotonic

B. Hypertonic

C. Hypotonic

D. None of these

Answer: A

Watch Video Solution

48. The factor $\left(\Delta T_f / K_f\right)$ represents

A. Molarity

B. Formality

C. Normality

D. Molality

Answer: D

Watch Video Solution

49. Which aqueous solution has minimum freezing point?

A. $0.01 M NaCl$

B. $0.005 M C_2H_5OH$

C. $0.005 M MgI_2$

D. $0.005 M MgSO_4$

Answer: A

Watch Video Solution

50. Which aqueous will have the highest boiling point?

A. 1% glucose in water

B. 1% sucrose in water

C. 1% NaCl in water

D. $1\ \% \ CaCl_2$ in water

Answer: C

Watch Video Solution

51. Which of the following solutions has the minimum freezing point

A. 1 molal NaCl solution

B. 1 molal KCl solution

C. $1 molal CaCl_2$ solution

D. 1 molal urea solution

Answer: C

Watch Video Solution

52. The osmotic pressure of equimolar solutions of $BaCl_2$,$NaCl$,and glucose follow the order

A. $BaCl2 > NaCl > Glu\cos e$

B. $Glu\cos e > NaCl > BaCl_2$

C. $NaCl > BaCl_2 > Glu\cos e$

D. $NaCl > Glu\cos e > BaCl_2$

Answer: A

Watch Video Solution

53. Which of the following solutions has the maximum freezing point?

A. 1 molal of NaCl solution

B. 1 molal of KCl solution

C. $1 molal of CaCl_2$ solution

D. 1 molal of urea solution

Answer: D

Watch Video Solution

54. The osmotic pressure of a $5\%\,(weight/volume)$ solution of cane sugar at $150^{\circ}C$ is

A. $4atm$

B. $3.4atm$

C. $5.07atm$

D. $2.45atm$

Answer: C

Watch Video Solution

55. The freezing point of a 0.05 molal solution of a non-electrolyte in water is:

$(K_f = 1.86\text{molality}^{-1})$

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

B. $-0.93^{\circ}C$

C. $-0.093^{\circ}C$

D. $0.093^{\circ}C$

Answer: C

Watch Video Solution

56. The freezing point of 1 molal $NaCl$ solution assuming $NaCl$ to be 100% dissociated in water is:

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

B. $-3.72^{\circ}C$

C. $+1.86^{\circ}C$

D. $+3.72^{\circ}C$

Answer: B

Watch Video Solution

57. The molal freezing point constant of water is $1.86 K m^{-1}$. If $342 g$ of cane sugar $(C_{12}H_{22}O_{11})$ is dissolved in $1000 g$ of water, the solution will freeze at

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

B. 1.86°

C. $-3.92^{\circ} C$

D. $2.42^{\circ} C$

Answer: A

Watch Video Solution

58. The osmotic pressure of a solution containing $0.1 mol$ of solute per litre at $273K$ is

A. $\frac{0.1}{1} \times 0.08205 \times 273 atm$

B. $0.1 \times 2 \times 0.08205 \times 273 atm$

C. $\frac{1}{0.1} \times 0.08205 \times 273 atm$

D. $\frac{0.1}{1} \times \frac{273}{0.08205}$ atm

Answer: A

Watch Video Solution

59. Osmotic pressure of 40% (wt./vol.) urea solution is $1.64 atm$ and that of 3.42% (wt./vol.) cane sugar is $2.46 atm$. When equal volumes of the above two solutions are mixed, the osmotic pressure of the resulting solution is:

A. $1.64 atm$

B. $2.46 atm$

C. $4.10 atm$

D. $2.05 atm$

Answer: D

Watch Video Solution

60. Dry air was passed successively through solution of $5g$ of a solute in $180g$ of water and then through pure water. The loss in weight of solution was $2.50g$ and that of pure solvent $0.04g$. The molecualr weight of the solute is:

A. 31.25

B. 3.125

C. 312.5

D. None

Answer: A

Watch Video Solution

61. The osmotic pressure of a solution (density is 1 g mL^{-1}) containing $3g$ of glucose (molecular weight =180) in $60g$ of water at $15^{\circ}C$ is

A. $0.34atm$

B. $0.65atm$

C. $6.25atm$

D. $5.57atm$

Answer: C

Watch Video Solution

62. What should be the freezing point of aqueous solution containing $17g$ of $C_2H(5)OH$ is $1000g$ of water (K_f for water = $1.86 deg kg mol^{-1}$)?

A. $-0.69^\circ C$

B. $-0.34^\circ C$

C. $0.0^\circ C$

D. $-0.34^\circ C$

Answer: A

Watch Video Solution

63. A solution containing 8.6g per dm^3 of urea (mol. wt. 60) was found to be isotonic with a 5 per cent solution of an organic non volatile solute. Calculate molecular weight of the latter.

A. 348.9

B. 34.89

C. 3489

D. 361.2

Answer: A

Watch Video Solution

64. A solution containing $4g$ of a non-volatile organic solute per $100mL$ was found to have an osmotic pressure equal to $500cm$ of mercury at $27^\circ C$. The molecular weight of solute is

A. 14.97

B. 149.7

C. 1697

D. 1.497

Answer: B

Watch Video Solution

65. The molal elevation constant of water =$0.52 K m^{-1}$. The boiling point of $1.0 molal$ aqueous KCl solution (assuming complete dissociation of KCl) should be

A. $100.52^{\circ} C$

B. $101.04^{\circ} C$

C. $99.48^{\circ} C$

D. $98.96^{\circ} C$

Answer: B

Watch Video Solution

66. If a $6.84\,\%\,(weight\,/\,volume)$ solution of cane sugar (molecular weight=342) is isotonic with $1.52\,\%\,(weight\,/\,volume)$solution of thiocarbamide, then the molecular weight of thiocarbamide is

A. 152

B. 760

C. 60

D. 180

Answer: B

Watch Video Solution

67. The osmotic pressure of a sugar solution at $24^{\circ}\,C$ is $2.5atm$. The concentration of the solution in mole per litre is

A. 10.25

B. 1.025

C. 1025

D. 0.1025

Answer: D

Watch Video Solution

68. At $40^{\circ}C$ the vapour pressure of pure liquids, benzene and toluene, are $160 mmHg$ and $60 mmHg$ respectively. At the same temperature, the vapour pressure of an equimolar solution of the liquids, assuming the ideal solution will be:

A. $140 mmHg$

B. $110 mmHg$

C. $220 mmHg$

D. $100mmHg$

Answer: B

Watch Video Solution

69. The Van't Hoff factor of very dilute solution of $Ca(NO_3)_2$

A. 1

B. 2

C. 3

D. 4

Answer: C

Watch Video Solution

70. Lowering in vapour pressure is highest for

A. $0.2 m urea$

B. $0.1 m glu\cos e$

C. $0.1 m MgSO_4$

D. $0.1 m BaCl_2$

Answer: D

Watch Video Solution

71. An azeotropic mixture of HCl and water has

A. 84% of HCl

B. 22.2% of HCl

C. 63% of HCl

D. 20.2% of HCl

Answer: D

Watch Video Solution

72. Which of the following will have the highest boiling point at $1atm$ pressure?

A. $0.1MNaCl$

B. $0.1Msucrose$

C. $0.1MBaCl_2$

D. $0.1Mglu\cos e$

Answer: C

Watch Video Solution

73. An ideal solution was obtained by mixing methanol and ethanol. If the partial vapour pressure of methanol and ethanol are $2.619 kPa$ and $4.556 kPa$, respectively, the composition of vapour (in terms of mole fraction) will be

A. $0.635 MeOH, 0.365 EtOH$

B. $0.365 MeOH, 0.635 EtOH$

C. $0.574 MeOH, 0.326 EtOH$

D. $0.173 MeOH, 0.827 EtOH$

Answer: B

Watch Video Solution

74. An aqueous solution freezes at $-0.186^{\circ} C\left(K_f = 1.86^{\circ}, K_b = 0.512^{\circ}\right.$. What is the elevation in boiling point?

A. 0.186

B. 0.512

C. $\frac{0.512}{1.86}$

D. 0.0512

Answer: D

Watch Video Solution

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

A. 0.8

B. 0.6

C. 0.4

D. 0.2

Answer: C

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76. The molal depression constant for water is $1.86^\circ C$. The freezing point of a $0.05 - molal$ solution of a non-electrolyte in water is

A. $-1.86^\circ C$

B. $-0.93^\circ C$

C. $0.093^\circ C$

D. $0.93^\circ C$

Answer: C

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77. The freezing point of a solution prepared from $1.25g$ of non-electrolyte and $20g$ of water is $271.9K$. If the molar depression constant is $1.86Kmol^{-1}$, then molar mass of the solute will be

A. 105.7

B. 106.7

C. 115.3

D. 93.9

Answer: A

Watch Video Solution

78. A 5% solution of cane sugar (molecular weight=342) is isotonic with 1% solution of substance X.The molecular weight of X is

A. 171.2

B. 68.4

C. 34.2

D. 136.2

Answer: B

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79. The mole fraction of toluene in the vapour phase which is in equilibrium with a solution of benzene $\left(P_B^\circ = 120\text{torr}\right)$ and toluene $\left(P_T^\circ = 80\text{torr}\right)$ having $2.0 mol$ of each, is

A. 0.5

B. 0.25

C. 0.6

D. 0.4

Answer: D

Watch Video Solution

80. Total Vapour pressure of mixture of 1molA$\left(p_A^0 = 150\text{torr}\right)$and 2molB $\left(p_B^0 = 240\text{torr}\right)$is 200torr. In this case

A. There is positive deviation from Raoult's law.

B. There is negative deviation from Raoult's law.

C. There is no deviation from Raoult's law.

D. Molecular masses of A and B are also required.

Answer: B

Watch Video Solution

81. The vapour pressure of pure benzene C_6H_6 at $50^\circ C$ is 268torr. How many moles of non-volatile solute per mole of benzene is required to prepare a solution of benzene having a vapour pressure of 167torr at $50^\circ C$?

A. 0.377

B. 0.605

C. 0.623

D. 0.395

Answer: A

Watch Video Solution

82. Osmotic pressure of blood is 7.40 atm, at 27°C. Number of moles of glucose to be used per litre for an intravenous injection that is to have same osmotic pressure of blood is :

A. 0.3

B. 0.2

C. 0.1

D. 0.4

Answer: A

Watch Video Solution

83. $PtCl_4.6H_2O$ can exist as a hydrated complex. $1m$ aqueous solution has the depression in freezing point of 3.72°. Assume 100% ionization and $K_f(H_2O) = 1.86^\circ mol^{-1}kg$, then the complex is

A. $[Pt(H_2O)_6]Cl_4$

B. $[Pt(H_2O)_4Cl_2]Cl_2.2H_2O$

C. $[Pt(H_2O)_3Cl_3]Cl_3.3H_2O$

D. $[Pt(H_2O)_2Cl_4].4H_2O$

Answer: C

Watch Video Solution

84. For 1 molal solution of each compound maximum freezing point will be assuming compete ionisation in each case :

A. $[Fe(H_2O)_6]Cl_3$

B. $[Fe(H_2O)_5Cl]Cl_2.\ H_2O$

C. $[Fe(H_2O)_4Cl_2]Cl.2H_2O$

D. $[Fe(H_2O)_3Cl_3].3H_2O$

Answer: D

Watch Video Solution

85. 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

86. pH of 0.1 M monobasic acid is found to be 2 . Hence its osmotic pressure at a given temp. T K is :

A. $0.1RT$

B. $0.11RT$

C. $1.1RT$

D. $0.01RT$

Answer: A

Watch Video Solution

87. The lowering of vapour pressure due to a solute in a $1m$ aqueous solution at $100^\circ C$ is

A. 13.44 torr

B. 14.12 torr

C. 312 torr

D. 352 torr

Answer: A

Watch Video Solution

88. The most likely of the following mixtures to be an ideal solution is

A. $NaCl - H_2O$

B. $C_2H_5OH - C_6H_6$

C. $C_6H_{16}(l) - H_2O$

D. $C_6H_5OH - H_2O$

Answer: A

Watch Video Solution

89. Mole fraction of component A in vapour phase is χ_1 and that of component A in liquid mixture is χ_2, then (p_A°)= vapour pressure of

pure A, p_B° = vapour pressure of pure B), the total vapour pressure of liquid mixture is

A. $\dfrac{P_A^\circ \chi_2}{\chi_1}$

B. $\dfrac{P_A^\circ \chi_1}{\chi_2}$

C. $\dfrac{P_A^\circ \chi_1}{\chi_2}$

D. $\dfrac{P_B^\circ \chi_2}{\chi_1}$

Answer: A

Watch Video Solution

90. Which has the maximum osmotic pressure at temperature T?

A. $100 mL$ of $1M$ urea solution.

B. $300 mL$ of $1M$ glucose solution.

C. Mixture of $100mL$ of $1M$ urea solution and $300mL$ of $1M$ glucose solution.

D. All are isotonic.

Answer: D

Watch Video Solution

91. The relative decreases in the vapour pressure of an aqueous solution containing 2 mol $[Cu(NH_3\_(3)Cl]$ in $3mol H_2O$ is 0.50. On reaction with $AgNO_3$, this solution will form

A. $1mol AgCl$

B. $0.25mol AgCl$

C. $2mol AgCl$

D. $0.40mol AgCl$

Answer: A

Watch Video Solution

92. Mixture of volatile components A and B has a total vapour pressure (in torr)p=$254 - 119x_A$is where$x_A$mole fraction of A in mixture .HenceP_A° and P_B° are(in torr)

A. $254, 119$

B. $119, 254$

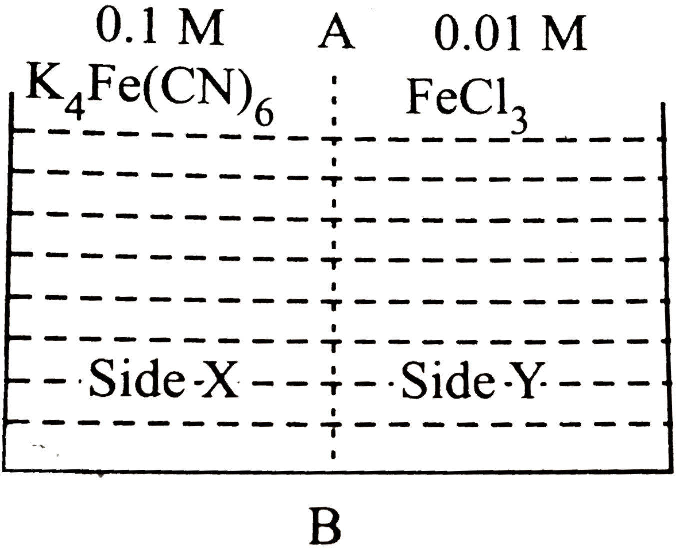
C. $135, 254$

D. $154, 119$

Answer: C

Watch Video Solution

93. $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ in aqueous solution gives blue colour. These are separated by a semi-permeable membrane AB as shown. Due to osmosis, there is



A. Blue colour formation in side X.

B. Blue colour formation in side Y.

C. Blue colour formation in both of side X and Y.

D. No blue colour formation.

Answer: D

Watch Video Solution

94. $12.2g$ of benzoic acid $(Mw = 122)$ in $100g$ benzene has depression in freezing point $2.6^{\circ}, K_f = 5.2^{\circ} kgmol^{-1}$. If there is 100%` polymerzation, the number of molecules of benzoic acid in associated state is

A. 1

B. 2

C. 3

D. 4

Answer: B

Watch Video Solution

95. $25mL$ of an aqueous solution of KCl was found to requires $20mL$ of $1MAgNO_3$ solution when titrated using a K_2CrO_4 as indicator. Depression in freezing point of KCl solution with 100% ionisation will be :

$(K_f = 2.0mol^{-1}kg\text{and molarity} = \text{molality})$

A. 5.0°

B. 3.2°

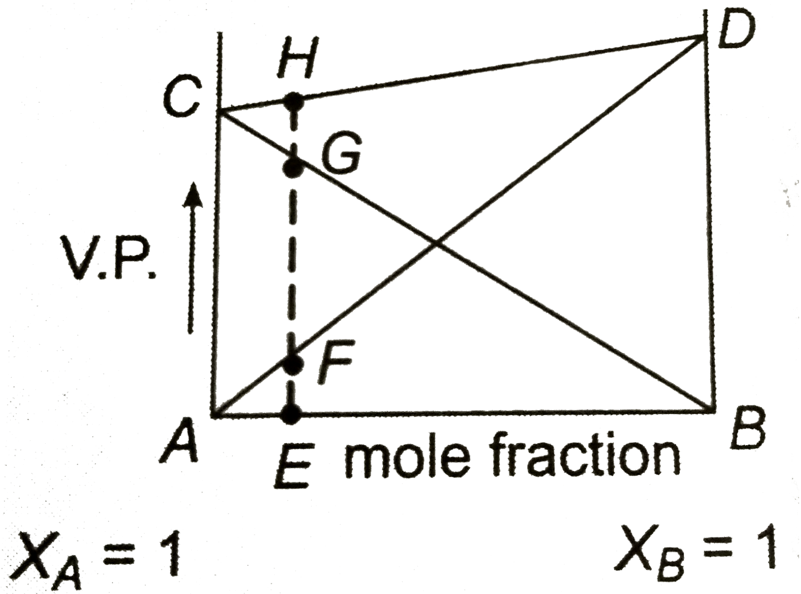
C. 1.6°

D. 0.8°

Answer: B

Watch Video Solution

96. Based on the given diagram, which of the following statements regarding the homogenous solution of two volatile liquids are correct? (1) Plots AD and BC show that Raoult's law is obeyed for the solution in which B is a solvent and A is the solute and as well as for that in which A is solvent and B is solute. (2) Plot CD shows that Dalton's law of partial pressures is obeyed by the binary solution of components A and B. (3) EF + EG = EH; and AC and BD correspond to the vapour pressure of the pure solvents A and B respectively.



A. 1 and 2

B. 2 and 3

C. 1 and 3

D. 1,2, and 3

Answer: D

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97. Following questions are based on the following activites (A) with observatons (O) and results or reason (R) .

	Activity (A)	Observation (O)	Result/ reason (R)
97.	0.01 M $K_3[Fe(CN)_6]$ and 0.1 M $FeCl_3$ solutions are separated by a semi-permeable membrane.	Osmosis takes place from 0.01 M solution to 0.1 M solution but no blue colour formation either of side.	Osmosis takes place from dilute to concentrated solution and it solvent (H_2O) that flows.
98.	1 mol each of benzene and toluene are mixed.	$P_{total}^{\circ} = P_B^{\circ}\chi_B + P_T^{\circ}\chi_T$	This is positive deviation from Raoult's law.
99.	Ether is added to H_2O.	Boiling point is elevated	Boiling point is elevated when a volatile solute is added to a solvent.

A. If A and O are correct and R is incorrect, mark

B. If A and O are correct and R is correct, mark

C. If A,O, and R are all correct, mark

D. If A is correct, and O and R are incorrect, mark

Answer: C

Watch Video Solution

98. Following questions are based on the following activites (A) with observatons (O) and results or reason (R) .

	Activity (A)	Observation (O)	Result/ reason (R)
97.	0.01 M $K_3[Fe(CN)_6]$ and 0.1 M $FeCl_3$ solutions are separated by a semi-permeable membrane.	Osmosis takes place from 0.01 M solution to 0.1 M solution but no blue colour formation either of side.	Osmosis takes place from dilute to concentrated solution and it solvent (H_2O) that flows.
98.	1 mol each of benzene and toluene are mixed.	$P_{total}^{\circ} = P_B^{\circ}\chi_B + P_T^{\circ}\chi_T$	This is positive deviation from Raoult's law.
99.	Ether is added to H_2O.	Boiling point is elevated	Boiling point is elevated when a volatile solute is added to a solvent.

A. If A and O are correct and R is incorrect, mark

B. If A and O are correct and R is correct, mark

C. If A,O, and R are all correct, mark

D. If A is correct, and O and R are incorrect, mark

Answer: A

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99. Following questions are based on the following activites (A) with observatons (O) and results or reason (R) .

	Activity (A)	Observation (O)	Result/ reason (R)
97.	0.01 M $K_3[Fe(CN)_6]$ and 0.1 M $FeCl_3$ solutions are separated by a semi-permeable membrane.	Osmosis takes place from 0.01 M solution to 0.1 M solution but no blue colour formation either of side.	Osmosis takes place from dilute to concentrated solution and it solvent (H_2O) that flows.
98.	1 mol each of benzene and toluene are mixed.	$P_{total}^{\circ} = P_B^{\circ}\chi_B + P_T^{\circ}\chi_T$	This is positive deviation from Raoult's law.
99.	Ether is added to H_2O.	Boiling point is elevated	Boiling point is elevated when a volatile solute is added to a solvent.

A. If A and O are correct and R is incorrect, mark

B. If A and O are correct and R is correct, mark

C. If A,O, and R are all correct, mark

D. If A is correct, and O and R are incorrect, mark

Answer: D

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Exercise (Assertion-Reasoning)

1. Assertion (A): The dissolution of gases in water is always an endothermic process.

Reason (R) : The dissolution of gases in water proceed with a negative value of ΔS.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: C

Watch Video Solution

2. Assertion (A): Water boiling at $100^{\circ} C$ at 1 atmospheric pressure in a beaker is not at equilibrium.

Reason (R): If refers to an open system.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

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3. Assertion (A): The sum of mole fractions of all the component of a solution is unity.

Reason (R): The mole fraction is a temperature dependent quantity.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: C

Watch Video Solution

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4. Assertion (A): Iodine is more soluble in CCl_4 than in water.

Reason(R): Non-polar solutes are more soluble in non-polar solvents.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

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5. Assertion (A): Vapour pressure of $0.5M$ sugar solution is more than $0.5MKCl$ solution. Reason (R): Relative lowering of vapour pressure is directly proportional to the number of species present in the solution.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

6. 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.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is not correct.

Answer: C

Watch Video Solution

7. Assertion (A): Camphor is used as a solvent in the determination of the molecular mass of naphthalene and anthracene.

Reason (R): camphor has high molal elevation constant.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

8. 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 (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: C

Watch Video Solution

9. Assertion (A): Larger the value of cryoscopic constant of the solvent, lesser will be the freezing point of the solution.

Reason (R): Depression in the freezing point depends on the nature of the solvent.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

10. Assertion (A): $0.1M$ solution of $NaCl$ has greater osmotic pressure than $0.1M$solution of glucose at same temperature.

Reason (R): In solution, $NaCl$ dissociates to produce more number of particles.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

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11. Assertion (A): Henry's law and Raoult's law are not independent, i.e., one can be derived from the other.

Reason (R): The partial pressure is directly proportional to the mole fraction of the concerned species for ideal solutions.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: B

Watch Video Solution

12. Assertion (A): $\Delta_{mix}H$ and $\Delta_{mix}V$ are zero for an ideal solution.

Reason (R): The interactions between the particles of the components of a solution are almost identical as between the particles in liquids.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

13. Assertion (A): The increasing pressure on water decreases its freezing point.

Reason (R):The density of water is maximum at $273K$.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: C

Watch Video Solution

14. Assertion (A): Cooking time in pressure cooker is reduced.

Reason (R): The boiling point inside the pressure cooker is raised.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: B

Watch Video Solution

15. Assertion (A): Sodium chloride used to clear snow on the roads.

Reason (R): Sodium chloride depresses the freezing point of water.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

16. Assertion (A): The osmotic pressure of $0.1M$ urea solution is less than $0.1MNaCl$ solution.

Reason (R): Osmotic pressure is not a colligative property.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: C

Watch Video Solution

17. Assertion (A): The elevation in boiling point for two isotonic solutions may not be same.

Reason (R): The boiling point depends upon the concentration of the solute.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If both (A) and (R) are incorrect.

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18. Assertion (A): The molecular mass of polymers cannot be calculated using the boiling point or freezing point method.

Reason (R): The boiling point method for determining the molecular masses is used for compounds stable at high temperature.

A. If both (A) and (R) are correct, and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is correct, but (R) is correct.

Answer: A

Watch Video Solution

Exercise (Interger)

1. $12.2g$ of benzoic acid $(Mw = 122)$ in $100g$ water has elevation in boiling point of 0.27. $K_b = 0.54 K kg mol^{-1}$.If there is 100%

polymerization, the number of molecules of benzoic acid in associated state is

A. 2

B. 1

C. 3

D. 4

Answer: A

Watch Video Solution

2. The ratio of the value of any colligative property for $BaCl_2$ solution of urea solution under similar condition is

A. 2

B. 3

C. 1

D. 4

Answer: B

Watch Video Solution

3. The Van't Hoff factor for a solute which does not dissociate or associate in solution is

A. 0

B. 2

C. 3

D. 1

Answer: A

Watch Video Solution

4. Compound $PdCl_4.6H_2O$ is a hydrated complex, $1m$ aqueous solution of it has freezing point $269.28K$. Assuming $100\,\%$ ionization of complex, calculate the number of ions furnished by complex in the solution.

A. 1

B. 2

C. 4

D. 0

Answer: B

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5. The total number of colligative properties are

A. 1

B. 2

C. 3

D. 4

Answer: D

Watch Video Solution

6. If for a sucrose, elevation in boiling point is $1.0^{\circ} C$, then what will be the boiling point of $NaCl$ solution for same molal concentration?

A. $1.0^{\circ} C$

B. $2.0^{\circ} C$

C. $3.0^{\circ} C$

D. $4.0^{\circ} C$

Answer: B

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7. The osmotic pressure of urea solution at $10^{\circ} C$ is $200mm$ .becomes $105.3mm$ when it is diluted and temperature raised to $25^{\circ} C$. The extent of dilution is

A. 8 times

B. 5 times

C. 4 times

D. 2 times

Answer: D

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8. The osmotic pressure of a solution containing $40g$ of solute (molecular mass 246) per litre at $27^{\circ} C$ is $(R = 0.0822 atm L mol^{-1})$

A. $3.0 atm$

B. $4.0 atm$

C. $2.0 atm$

D. $1.0 atm$

Answer: B

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Exercise(Fill In The Blanks)

1. For an ideal solution, $\Delta_{mix} V$ is ....and $\Delta_{mix} H$ is ....

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

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3. A solution having $\Delta_{mix}H$=-ve will exhibit ....deviation from ideal behaviour.

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4. A solution having $\Delta_{mix}H$=+ve will exhibit ....deviation from ideal behaviour.

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5. Two solutions having same osmotic pressure are called as ....solution.

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

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7. A solution of benzene and toluene is an example of ....solution.

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8. The boiling point of $0.1 M KCl$ solution is ....than $100^{\circ} C$.

Watch Video Solution

9. The mole fraction of solute in one molal aqueous solution is ....

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10. When a solution of $CHCl_3$ and acetone is formed, the solution is non-ideal with ....deviation from Raoult's law. The vapour pressure of such a solution will be ....than the corresponding ideal solution.

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11. The semi-permeable membrane of any substance allows ....molecules to pass through it.

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12. In cold countries ....is used as an anti-freezing agent in the radiator of car.

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13. The solution showing positive deviation from ideal behaviour have ....azeotrope.

Watch Video Solution

14. The boiling point of solution is ....than the boiling point of pure solvent.

Watch Video Solution

15. The freezing point of solution is ....than the freezing point of pure solvent.

Watch Video Solution

16. In reverse osmosis the solvent molecules flow from ....to solvent side.

Watch Video Solution

17. The solution which has higher osmotic pressure than some other solution is known as.........

Watch Video Solution

18. The Van't Hoff factor of sulphur solution is ....

Watch Video Solution

19. $1 molal$ solution of $NaCl$ has ....osmotic pressure than $1 molal$ solution of urea.

Watch Video Solution

Exercise (True/False)

1. For a solution of $AlCl_3$ in water, the Van't Hoff factor (i) is greater than 1.

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

Watch Video Solution

3. Mixture of HNO_3 and HCl is an example of maximum boiling point azeotrope.

Watch Video Solution

4. Hypertonic solutions have same osmotic pressure.

Watch Video Solution

5. The solubility of gas in liquid is directly proportional to the pressure over the solutions at a given temperature.

Watch Video Solution

6. Colligative properties depend on ___

Watch Video Solution

7. Isotonic solutions have different osmotic pressure.

Watch Video Solution

8. For the same solution the elevation in boiling point has higher values than depression in freezing point.

Watch Video Solution

9. On hills, water boils quickly.

Watch Video Solution

10. An ideal solution follows Raoult's law over all ranges of concentrations and pressure.

Watch Video Solution

11. For electrolytic solution, the Van't Hoff factor (i) is always equals to unity.

Watch Video Solution

12. The sum of mole fraction of all components of a solution is unity.

Watch Video Solution

13. The liquid pair of acetone-chloroform shows a positive deviation form Raoult's law.

Watch Video Solution

14. The phenol-water system has a upper critical solution temperature.

Watch Video Solution

15. A solution of ethyl alcohol and water shows positive deviation from Raoult's law.

Watch Video Solution

16. Addition of impurity into water lowers the freezing point of water.

Watch Video Solution

17. Azeotropic mixtures can be separated by distillation of solution.

Watch Video Solution

18. Raoult's law is for solvent and Henry's law is for solute.

Watch Video Solution

19. In association of solute, the Van't Hoff factor is greater than unity.

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Exercises Archives (Linked Comprehension)

1. 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. Applications 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. Thus moel fraction of ethanol in the mixture is 0.9.

Given: Freezing point depression constant of water

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

Freezing point depression constant of ethanol

$\left(K_f^{\text{ethanol}}\right) = 2.0 K kg mol^{-1}$

Boiling point elevation constant of water

$\left(K_b^{\text{water}}\right) = 0.52 K kg mol^{-1}$

Boiling point elevation constant of ethanol

$\left(K_b^{\text{ethanol}}\right) = 1.2 K kg mol^{-1}$

Standard freezing point of water $= 273 K$

Standard freezing point of ethanol $= 155.7K$

Standard boiling point of water $= 373K$

Standard boiling point of ethanol $= 351.5K$

vapour pressure of pure water $= 32.8mmHg$

Vapour pressure of pure ethanol $= 40mmHg$

Molecualr weight of water $= 18gmol^{-1}$

Molecular weight of ethanol $= 46gmol^{-1}$

In asweering the following questions, consider the solutions to be ideal dilute solutions and solutes to be non-volatile and non-dissociative.

The freezing point of the solution M is :

A. $268.7K$

B. $268.5K$

C. $234.2K$

D. $150.9K$

Answer: D

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Molecular weight of ethanol $= 46 g mol^{-1}$

In asweering 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. $39.3 mmHg$

B. $36.0 mmHg$

C. $29.5 mmHg$

D. $28.8 mmHg$

Answer: B

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3. 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. Applications of colligative properties are very useful in day-toeday life. One of the examples is the use of the mixture of ethylene glycol and water as an 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

$K_f^{water} = 1.86 K kg mol^{-1}$

Freezing point depression constant of ethanol

$K_f^{ethanol} = 2.0 K kg mol^{-1}$

Boiling point elevation constant of water

$K_b^{water} = 2.52 K kg mol^{-1}$

Boiling point elevation constant of ethanol

$K_b^{ethanol} = 1.2 K kg mol^{-1}$

Standard freezing point of water = $273K$

Standard freezing point of ethanol = $155.7K$

Standard boiling point of water = $373K$

Standard boiling point of ethanol = $315.5K$

Vapour pressure of pure water =$32.8 mmHg$

Vapour pressure of pure ethanol=$40 mmHg$

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 freezing point of solution M is

A. $380.4K$

B. $376.2K$

C. $375.5K$

D. $354.7K$

Answer: B

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Exercises Archives (Multiple Correct)

1. For the depression in freezing point experiment, the correct statement(s) is/are:

A. The vapour pressure of the solution is less than that of pure solvent.

B. The vapour pressure of the solution is more than that of pure solvent.

C. Only solute molecules solidify at freezing point.

D. Only solvent molecules solidify at freezing point.

Answer: A::D

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2. Benzene and naphthalene from an ideal solution at room temperature. For this process, the true statement(s) is(are)

A. ΔG is positive

B. ΔS_{system} is positive

C. $\Delta S_{\text{surrounding}}$=0

D. $\Delta H = 0$

Answer: B::C::D

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3. An azeotropic solution of two liquid has boiling point lower than either of them when it

A. Shows negative deviation from Raoult's law.

B. Shows no deviation from Raoult's law.

C. Shows positive deviation from Raoult's law.

D. Is saturated.

Answer: C

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4. For a dilute solution, Raoult's low states that :

A. The lowering of vapour pressure is equal to the mole fraction of the solute

B. The relative lowering of vapour pressure is equal to the mole fraction of the solute

C. The relative lowering of vapour pressure is proportional to the amount of solute in the solution.

D. The vapour pressure of the solution is equal to the mole fraction of the solvent.

Answer: B

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5. A molal solution is one that contains 1 mol of a solute in

A. $1000g$ of $solvent$

B. $1L$ of solvent

C. $1L$ of solution

D. $22.4L$ of solution

Answer: A

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6. When mercuric iodide is added to the aqueous solution of KI, then the :

A. Freezing point is raised.

B. Freezing point is lowered.

C. Freezing point does not change.

D. Boiling point does not change.

Answer: A

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7. Which of the following $0.10m$ aqueous solution will have the lowest freezing point?

A. Potassium sulphate

B. Sodium chloride

C. Urea

D. Glucose

Answer: A

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8. The freezing point of equimolal solution will be highest for :

A. $C_6H_5NH_3Cl$(aniline hydrochloride)

B. $Ca(NO_3)_2$

C. $La(NO_3)_3$

D. $C_6H_{12}O_6$(glucose)

Answer: D

Watch Video Solution

9. When $0.004 M Na_2SO_4$ is an isotonic acid with $0.01 M$glucose, the degree of dissociation of Na_2SO_4 is

A. 75%

B. 50%

C. 25%

D. 85%

Answer: A

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10. The molecular weight of benzoic acid in benzene as determined by depression in the freezing point method corresponds to

A. Ionization of benzoic acid

B. Dimerization of benzoic acid

C. Trimerization of benzoic acid

D. Solvation of benzoic acid

Answer: B

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11. During depression of freezing point in a solution, the following are in equilibrium:

A. Liquid solvent, solid solvent

B. Liquid solvent, solid solute

C. Liquid solute, solid solute

D. Liquid solute, solid solvent

Answer: A

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12. The elevation in boiling point of a solution of 13.44g of $CuCl_2$ (molecular weight =134.4, $k_b = 0.52K\text{molality}^{-1}\big)$ in 1 kg water using the following information will be:

A. 0.16

B. 0.05

C. 0.1

D. 0.2

Answer: A

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13. When $20g$ of naphthoic acid $(C_{11}H_8O_2)$ is dissolved in $50g$ of benzene $(K_f = 1.72 K kg mol^{-1})$, a freezing point depression of $2K$ is observed. The Van't Hoff factor (i) is

A. 0.5

B. 1

C. 2

D. 3

Answer: A

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14. The henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm . The mole fraction of N_2 in air is 0.8 . The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is

A. $4.0 \times 10^{-4} atm$

B. $4.0 \times 10^{-5} atm$

C. $5.0 \times 10^{-4} atm$

D. $4.0 \times 10^{-6} atm$

Answer: A

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15. The freezing point $(.^\circ C)$ of a solution containing $0.1g$ of $K_3[Fe(CN)_6]$ (molecular weight 329) on $100g$ of water

$(K_f = 1.86 K kg mol^{-1})$

A. 2.3×10^{-2}

B. 5.7×10^{-2}

C. 5.7×10^{-3}

D. -1.20×10^{-2}

Answer: A

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16. For a dilute solution containing $2.5g$ of a non-volatile non-electrolyte solution in $100g$ of water, the elevation in boiling point at 1 atm pressure is $2^{\circ} C$. 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

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17. Consider separate solutions of $0.500 M C_2H_5OH(aq)$, $0.100 M Mg_3(PO_4)(aq)$,$0.250 M KBr(aq)$, 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. $0.125 M Na_3PO_4(aq)$ has the highest osmotic pressure.

B. $0.500 M C_2H_5OH$ has the highest osmotic pressure.

C. They all have the same osmotic pressure.

D. $0.100 M Mg_3(PO_4)_2(aq)$ has the highest osmotic pressure.

Answer: C

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Exercises Archives (Integer)

1. MX_2 dissociates into M^{2+} and $X^{\ominus}$ ion in an aqueous solution, with a degree of 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 absence of ionic dissociation is

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Exercises Archives (Fill In The Blanks)

1. Given that ΔT_f is the depression in freezing point of the solvent in a solution of a non-volatile solute of molarity m,the quantity $\underset{m \to 0}{Lt}\left(\Delta T_f / m\right)$ is equal to ....

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Exercises Archives (Subjective)

1. What is the molarityk and molality of a 13% solution (by weight) of sulphric acid with a density of $1.02 mL^{-1}$? To what volume should $100 mL$ of this acid be diluted in order to preapre a $1.5 N$ solution?

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2. The vapour pressure of pure benzene is $639.7 mmHg$ and the vapour pressure of solution of a solute in benzene at the temperature is $631.9 mmHg$. Calculate the molality of the solution.

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3. Two liquids A and B form an ideal solution. At $300K$, the vapour pressure of a solution containing $1 mol$ of A and $3 mol$ fo B is $550 mmHg$. At the same temperature, if $1 mol$more of B is added to this solution, the vapour pressure of the solution increases by $10 mmHg$. Determine the vapour pressure of A and B in their pure states.

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4. An organic compound $C_xH_{2y}O_y$ was burnt with twice the amount of oxygen needed for complete combustion of CO_2 and H_2O. The hot gases when cooled to $0^{\circ}C$ and 1 atm pressure, measured 2.24 L, the water collected during cooling weighed 0.9 g The vapour pressure of pure water at $20^{\circ}C$ is 17.5 mm Hg and is lowered by 0.104 mm when 50 g of the organic compound is dissolved in 1000 g of water. Give the molecular formula of the organic compound.

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5. The following statements is true only under some specific conditions. Write the condition for it "Two volatile and miscible liquids can be separated by fractional distillation into pure components."

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6. The vapour pressures of ethanol and methanol are 44.5 and $88.7 mmHg$, respectively. An ideal solution is formed at the same temperature by mixing $60g$ of ethanol with $40g$ of $methanol$. Calculate the total vapour pressure of the solution and mole fraction of methanol in the vapour.

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7. The vapour pressure of a dilute aqueous solution of glucosse $(C_6H_{12}O_6)$ is $750 mmHg$ at $273K$. Calculate (a) molality and (b) mole fraction of the solute.

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8. The vapour pressure of pure benzene at a certain temperature is $640 mm$ of Hg. A non-volatile non-electrolyte solid weighing $2.175g$

added $39.0g$ of benzene. The vapour pressure of the solution is $600mm$ of Hg. What is the molecular weight of solid substance?

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9. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution, containing $7.0g$ of the salt per $100g$ of water at $100^\circ C$ is 70%. If the vapour pressure of water at $100^\circ C$ is $760mm$, calculate the vapour pressure of the solution.

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10. 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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11. What weight of the non-volatile urea $(NH_2 - CO - NH_2)$ needs to be dissolved in 100g of water in order to decrease the vapour pressure of water by 25%? What will be molality of the solution?

Watch Video Solution

12. A motor vehicle raditor was filled with $8L$of water to which $2L$of methyl alcohol $\left(density 0.8 gmL^{-1}\right)$ was added. What is the lowest temperature at which the vehicle can be parked outdoors without the danger that the water in the raditor will freeze? Given that K_f for water is $1.86 K kg mol^{-1}$

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13. The molar volume of liquid benzene (density $0.877 gmL^{-1}$) increases by a factor of 2750 as it vapourises at $20^{\circ} C$ and that of liquid toluene(density $0.867 gmL$) increases by a factor of 7720at $20^{\circ} C$. A solution of benzene and toluene 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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14. A solution of a non-volatile solute in water freezes at $-0.30^{\circ} C$. The vapour pressure of pure water at $298K$ is $23.51 mmHg$ and K_f for water is $1.86 degree / molal$. Calculate the vapour pressure of this solution at $298K$.

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15. Nirtobenzene is formed as the major product along with a minor product in the reaction of benzene with a hot mixture of nitric acid and sulphuric acid. The minor product consists of carbon 42.86%, hydrogen 2.40%, nitrogen 16.67% and oxygen 38.07%.

a. Calculate the empirical formula of the minor product.

b. When $5.5g$ of the minor product is dissolved in $45g$ of benzene, the boiling point of the solution is $1.84C$ higher than that of pure benzen. Calculate the molar mass of the minor product and determine its molecular and structural formulae. (Molar elevation constant of benzene is $2.53Kkgmol^{-1}$)

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16. 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.

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17. When $1.22gC_6H_5COOH$ is added into two solvents, the following data of ΔT_b and K_b are obtained:

i. In $100gCH_3COCH_3$,$\Delta T_b = 0.17$,$K_b = 1.7kgKmol^{-1}$.

ii. In $100g$ benzene,$\Delta T_b = 0.13$ and $K_b = 2.6kgKmol^{-1}$.

Find out the molecular weight of C_6H_5COOH in both cases and interpret the results.

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18. In an experiment, $72.5g$ of C_6H_5OH (phenol) is dissolved in a solvent of $K_f = 14$. If the depression in freezing point is $7K$, find the percentage of phenol that dimerizes.

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Ex 2.1 (Objective)

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

a. $50mol\ \%$, b.$52mol\ \%$,c.$34mol\ \%$,d.$48mol\ \%$

A. 0.448

B. 44.8

C. 0.224

D. 2.24

Answer: A

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2. Two liquids A and B form an ideal soluton. The vapour pressure of pure A and pure B are $66 mmHg$ and $88 mmHg$, respectively. Calculate the composition of vapour A in the solution which is equilbrium and whose molar volume is 36%.

A. 0.43

B. 0.7

C. 0.3

D. 0.5

Answer: A

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3. At $27^{\circ} C$.the vapour pressure of an ideal solution containing 1 mole of A and 1 mole and B is $500 mm$ of Hg. At the same temperature, if 2 mol of B is added to this solution the vapour pressure of solution increases by $50mm$ of Hg. The vapour pressure of A and B in their pure states is respectively.

A. $600mm, 400mm$

B. $400mm, 600mm$

C. $300mm, 700mm$

D. $200mm, 800mm$

Answer: B

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4. Mixture of volatile components A and B has a total vapour pressure (in torr)p=$254 - 119x_A$is where$x_A$mole fraction of A in mixture .HenceP_A° and P_B° are(in torr)

A. $254, 119$

B. $119, 254$

C. $135, 254$

D. $154, 119$

Answer: C

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5. Negative deviations from Raoult's law are exhibited by binary mixtures

A. in which the molecules tend to attract each other and hence their escape into the vapour phase is retarded.

B. in which the molecules tend to repel each other and hence their escape into the vapour phase is retarded.

C. in which the molecules tend to attract each other and hence their escape into the vapour phase is speeded up.

D. in which the molecules tend to repel each other and hence their escape into the vapour phase is speeded up.

Answer: A

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6. Mole fraction of component A in vapour phase is χ_1 and that of component A in liquid mixture is χ_2, then (p_A°)= vapour pressure of pure A, p_B° = vapour pressure of pure B), the total vapour pressure of liquid mixture is

A. $\dfrac{p_A^\circ \chi_2}{\chi_1}$

B. $\dfrac{p_A^\circ \chi_1}{\chi_2}$

C. $\dfrac{p_B^\circ \chi_1}{\chi_2}$

D. $\dfrac{p_B^{\circ}\chi_2}{\chi_1}$

Answer: A

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7. At $25^{\circ}C$, the vapour pressure of pure methyl alcohol is 92.0 torr. Mol fraction of CH_3OH in a solution in which vapour pressure of CH_3OH is 23.0 torr at $25^{\circ}C$, is:

A. 0.25

B. 0.75

C. 0.5 0

D. 0.66

Answer: A

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8. The vapour pressure of pure benzene at 50° is $268 mm$ of Hg. How many moles of non-volatile solute per mole of benzene are required to prepare a solution of benzene having a vapour pressure of $16.0 mm$ of Hg at $50^{\circ} C$?

A. 0.377

B. 0.605

C. 0.623

D. 0.395

Answer: B

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9. The vapour pressure of pure liquid solvent A is 0.80 atm. When a non-volatile substance B is added to the solvent, its vapour pressure drops to 0.60 atm, the mole fraction of component B in the solution is

A. 0

B. 0.25

C. 2. 0

D. 3. 0

Answer: B

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10. 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:

A. 0.8

B. 0.5

C. 0.2

D. 0.4

Answer: A

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Ex 2.2 (Objective)

1. An aqueous solution at $-2.55^{\circ}C$. What is its boiling point $\left(K_b^{H_2O} = 0.52Km^{-1}, K_f^{H_2O} = 1.86Km^{-1}\right.$?

A. $107.0^{\circ}C$

B. $100.6^{\circ}C$

C. $100.1^{\circ}C$

D. $100.7^{\circ} C$

Answer: D

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2. The relative decrease in VP of an aqueous glucose dilute solution is found to be 0.018. Hence, the elevation in boiling point is (it is given $1 molal$ aqueous urea solution boils at $100.54^{\circ})C$ at $1 atm$ pressure)

A. 0.018°

B. 0.18°

C. 0.54°

D. 0.03°

Answer: C

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3. $10.0g$ of glucose (π_1), $10.0g$ of (urea(π_2), and $10.0g$ of sucrose (π_3) are dissolved in $250.0mL$ of water at $273K(\pi = \text{osmotic pressure of a solution})$. The relationship between the osmotic pressure pressure of the solutions is

A. $\pi_1 > \pi_2 > \pi_3$

B. $\pi_3 > \pi_1 > \pi_2$

C. $\pi_2 > \pi_1 > \pi_3$

D. $\pi_2 > \pi_3 > \pi_1$

Answer: C

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4. $0.6g$ of a solute is dissolved in 0.1 litre of a solvent which develops an osmotic pressure of 1.23 at m at $27^{\circ}C$. The molecular mass of the substance is

A. $149.5 g mol^{-1}$

B. $120.0 g mol^{-1}$

C. $430.0 g mol^{-1}$

D. None of these

Answer: B

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5. A 5% solution of cane sugar (M.W.=342) is isotonic with 1 % solution of substance X. The molecular weight of X is

A. 342

B. 171.12

C. 65.6

D. 136.8

Answer: C

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6. What mass of urea be dissolved in $171g$ of water so as to decrease the vapour pressure of water by 5% ?

A. $15g$

B. $20g$

C. $25g$

D. $30g$

Answer: D

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7. The vapour pressure at a given temperature of an ideal solution containing $0.2 mol$ of non-volatile solute and $0.8 mol$ of a solvent is $60 mm$ of Hg. The vapour pressure of the pure solvent at the same temperature will be

A. $120 mmHg$

B. $150 mmHg$

C. $60 mmHg$

D. $75 mmHg$

Answer: D

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8. Vapour pressure of a solution of $5g$of non-electrolyte in $100g$ water at a particular temperature is$2985N/m^2$.The vapour pressure of pure water is$3000N/m^2$.The molecular weight of the solute is

A. 60. 0

B. 120. 0

C. 180. 0

D. 380. 0

Answer: C

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9. The molal boiling point constant for water is$0.513^{\circ}Ckgmol^{-1}$. When 0.1mole of sugar is dissolved in 200ml of water , the solution boils under a pressure of one atmosphere at

A. $100.513^{\circ} C$

B. $100.0513^{\circ} C$

C. $100.256^{\circ} C$

D. $101.025^{\circ} C$

Answer: C

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Ex 2.3 (Objective)

1. The molal elevation constant of water $=0.52 K m^{-1}$. The boiling point of $1.0 molal$ aqueous KCl solution (assuming complete dissociation of KCl) should be

A. $100.52^{\circ} C$

B. $101.04^{\circ} C$

C. $99.48^{\circ} C$

D. $98.96^{\circ} C$

Answer: B

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2. The ratio of freezing point depression values of $0.01M$ solutions of urea, common salt, and Na_2SO_4 are

A. $1:1:1$

B. $1:2:1$

C. $1:2:3$

D. $2:2:3$

Answer: C

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3. From a measurement of the freezing point depression of benzene, the molecular weight of acetic acid in a benzene solution was determined to be 100. The percentage association of acetic acid is

A. $79\ \%$

B. $93\ \%$

C. $80\ \%$

D. $100\ \%$

Answer: C

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4. An aqueous solution containing an ionic salt having molality equal to 0.19 freezes at $-0.704^{\circ}C$. The Van't Hoff factor of the ionic salt is (K_f for water=$1.86Km^{-1}$)

A. 3

B. 2

C. 4

D. 5

Answer: B

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5. The Van't Hoff factor of a $0.1MAl_2(SO_4)_3$ solution is 4.20. The degree of dissociation is

A. $80\ \%$

B. $90\ \%$

C. $78\ \%$

D. $83\ \%$

Answer: A

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6. The degree of dissociation α of a week electrolyte is

where n is the number of ions given by $1 mol$ of electrolyte.

A. $\dfrac{i-1}{n+1}$

B. $\dfrac{i-1}{n-1}$

C. $\dfrac{n-1}{i-1}$

D. $\dfrac{n+1}{i-1}$

Answer: B

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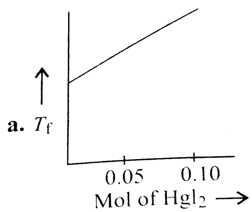
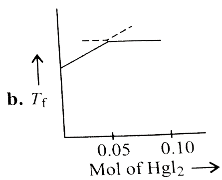
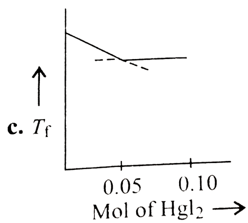
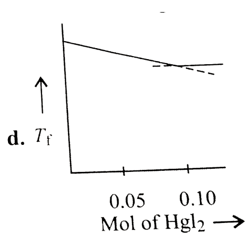
7. Increasing amount of solid Hgl_2 is added to $1L$ of an aqueous solution containing $0.1molKI$. Which fo the following graphs do represent the variation of freezing point of the resulting with the amount of Hgi_2 added?

A. 

B. 

C. 

D. 

Answer: B

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8. Equimolal solutions KCl and compound X in water show depression in freezing point in the ratio of $4:1$, Assuming KCl to be completely ionized, the compound X in solution must

A. Dissociate to the extent of $50\ \%$

B. Hydrolyze to the extent of $80\ \%$

C. Dimerize to the extent of $50\ \%$

D. Trimerize to the extent of $75\ \%$

Answer: D

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9. Arrange the following solutions as:

Increasing order of boiling points-

$0.001 m NaCl$, 0.001 m urea

$0.001 m MgCl_2$, $0.001 m CH_3COOH$

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