SOLUTIONS

CHEMISTRY

Single Correct Answer Type

1. A super saturated solution is a metastable state of solution in which solute concentration.
   a) Is equal to the solubility of that substance in water
   b) Exceeds than its solubility
   c) Less than its solubility
   d) Continuously change
2. Colligative properties of a solution depends upon
   a) Nature of both solvent and solute
   b) Nature of solute only
   c) Number of solvent particles
   d) The number of solute particles
3. The partition coefficient of solute X in between immiscible liquids A and B is 10 in favour of A. The partition coefficient of X in favour of B is :
   a) 0.1
   b) 10
   c) 0.01
   d) 100
4. Which one is a colligative property?
   a) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction
   b) The osmotic pressure $(\pi)$of a solution is given by the equation $\pi = MRT$, where , M is the molarity of the solution
   c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose
   d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression
5. At25$°C$, the highest osmotic pressure is exhibited by 0.1 M solution of
   a) Urea
   b) Glucose
   c) KCl
   d) $CaCl_2$
6. The vapour pressure of two liquids $X$and $Y$are 80 and 60 Torr respectively. The total vapour pressure of the ideal solution obtained by mixing 3 moles of $X$and 2 moles of Ywould be
   a) 68 Torr
   b) 140 Torr
   c) 48 Torr
   d) 72 Torr
7. Dilute 1 L one molar H_2SO_4 solution by 5 L water, the normality of that solution is
   a) 0.33 N
   b) 33.0 N
   c) 0.11 N
   d) 11.0 N
8. Solution A contains 7 g/L of $MgCl_2$ and solution B contains 7 g/L of NaCl. At room temperature, the osmotic pressure of
   a) Solution A is greater than B
   b) Both have same osmotic pressure
   c) Solution B is greater than A
   d) Cannot be determine
9. Which one of the following aqueous solutions will exhibit highest boiling point?
   a) 0.01 M Na_2SO_4
   b) 0.01 M KNO_3
   c) 0.015 M urea
   d) 0.015 M glucose
10. The modal elevation constant of water is 0.52℃. The boiling point of 1.0 modal aqueous KCl solution (assuming complete dissociation of KCl), therefore, should be
    a) 98.96℃
    b) 100.52℃
    c) 101.04℃
    d) 107.01℃
11. The increase in boiling point of a solution containing 0.6 g urea in 200 g water is 0.50$°C$.Find the molal elevation constant.
    a) 10 K kg mol^{-1}
    b) 10 K g mol^{-1}
    c) 10 K kg mol
    d) 1.0 K kg mol^{-1}
12. Which is correct representation of phase rule?

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

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

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

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

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

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

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

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

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

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

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

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

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

25. Vapour pressure of a solvent containing non-volatile solute is :
a) More than the vapour pressure of a solvent
b) Less than the vapour pressure of solvent
c) Equal to the vapour pressure of solvent
d) None of the above

26. Among the following mixtures, dipole-dipole as the major interaction is present in :
a) Benzene and ethanol
b) KCl and water
c) Acetonitrile and acetone
d) Benzene and CCl_4

27. The vapour pressure of water depends upon :
a) Surface area of container
b) Volume of container
c) Temperature
d) All of these

28. Which of the following solution highest boiling point?
a) 0.1 M urea
b) 0.1 M sucrose
c) 0.1 M $NaNO_3$
d) 0.1 M $Al(NO_3)_3$

29. At certain temperature a 5.12% solution of cane sugar is isotonic with a 0.9% solution of an unknown solute. The molar mass of solute is
a) 60
b) 46.17
c) 120
d) 90

30. A mixture of ethane and ethene occupies 41 L at 1 atm and 500 K. the mixture reacts completely with $\frac{10}{3}$ mole of O_2 to produce CO_2 and H_2O. The mole fraction of ethane and ethene in the mixture are $(R = 0.082L \text{ atm K}^{-1} \text{ mol}^{-1})$ respectively
a) 0.50, 0.50
b) 0.75, 0.25
c) 0.67, 0.33
d) 0.25, 0.75

31. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mole of sodium sulphate is dissolved in 1 kg of water, is $(k_f = 1.86 \text{ Kkg mol}^{-1})$
a) 0.0372 K
b) 0.0558 K
c) 0.0744 L
d) 0.0186 K

32. 2.5 L of NaCl solution contain 5 moles of the solute.What is the molarity ?
a) 5M
b) 2M
c) 2.5M
d) 12.5M

33. If for a sucrose solution elevation in boiling point is 0.1°C then what will be boiling point of NaCl solution for the same molal concentration?
a) 0.1
b) 0.2
c) 0.16
d) 0.26

34. In two solutions having different osmotic pressure, the solution of higher osmotic pressure is called :
a) Isotonic solution
b) Hypertonic solution
c) Hypotonic solution
d) None of these

35. Isotonic solution have the same
a) Normality
b) Density
c) Molar concentration
d) None of these

36. Vapour pressure of pure $A = 100$ torr, moles = 2; vapour pressure of pure B=80 torr, moles = 3. Total vapour pressure of the mixture is
a) 440 torr
b) 460 torr
c) 180 torr
d) 88 torr

37. Which of the following is incorrect?
a) Relative lowering of vapour pressure is independent of the solute and the solvent.
b) The relative lowering of vapour pressure is a colligative property.
c) Vapour pressure of a solution is lower than the vapour pressure of the solvent.
d) The relative lowering of vapour pressure is directly proportional to the original pressure.

38. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is
a) 23.077%
b) 230.77%
c) 2.3077%
d) 0.23077%

39. The atmospheric pressure is sum of the
a) Pressure of the biomolecules
b) Vapour pressure of atmospheric constituents
c) Vapour pressure of chemicals and vapour pressure of volatiles
d) Pressure created on to atmospheric molecules

40. Lowering in vapour pressure is the highest for:
a) 0.2 m urea
b) 0.1 m glucose
c) 0.1 m $MgSO_4$
d) 0.1 m $BaCl_2$

41. 6.02×10^{20}molecules of urea are present in 100 mL of its solution. The concentration of urea solution is
a) 0.1 M
b) 0.01 M
c) 0.001 M
d) 0.02 M

42. The osmotic pressure (At27°C) of an aqueous solution (200 mL) containing 6 g of a protein is 2×10^{-3}atm . If R=0.080 L atm mol^{-1} K^{-1}, the molecular weight of protein is
a) 7.2×10^5
b) 3.6×10^5
c) 1.8×10^5
d) 1.0×10^5

43. 100 cc of 0.6 N H_2SO_4 and 200 cc of 0.3 N HCl were mixed together. The normality of the solution will be
a) 0.2 N
b) 0.4 N
c) 0.8 N
d) 0.6 N

44. Mole fraction ($\mathcal{X}$) of any solution is equal to
a) $\frac{\text{no. of moles of solute}}{\text{volume of solution in litre}}$
b) $\frac{\text{no. of gram} - \text{equivalent of solute}}{\text{volume of solution in litre}}$
c) $\frac{\text{no. of moles of solute}}{\text{mass of solvent in kg}}$
d) $\frac{\text{no. of moles of any constituent}}{\text{total number of moles of all constituents}}$

45. Which is not a colligative property in the following?
a) pH ofa buffer solution
b) Boiling point elevation
c) Freezing point depression
d) Vapour pressure lowering

46. The normality of 10% (weight/volume) acetic acid is
a) 1 N
b) 1.3 N
c) 1.7 N
d) 1.9 N

47. Two solutions have different osmotic pressure. The solution of lower osmotic pressure is called :
a) Isotonic solution
b) Hypertonic solution
c) Hypotonic solution
d) None of these

48. Osmatic pressure is 0.0821 atm at temperature of 300 K. Find concentration in mole per litre
a) 0.33
b) 0.22×10^{-2}
c) 0.33×10^{-2}
d) 0.44×10^{-2}

49. A 5% solution of cane sugar (molar mass 342) is isotonic with 1% of a solution of an unknown solute. The molar mass of unknown solute in g/mol is
a) 136.2
b) 171.2
c) 68.4
d) 34.2

50. The distribution law holds good for :
a) Heterogeneous systems
b) Homogeneous systems
c) Both (a) and (b)
d) None of these

51. Two solutions of KNO_3 and CH_3COOH are prepared separately. Molarity of both is 0.1 M and osmatic pressures are p_1 and $p_2$respectively. The correct relationship between the osmatic pressures is
a) $p_1 = p_2$
b) $p_1 > p_2$
c) $p_2 > p_1$
d) $\frac{p_1}{p_1 + p_2} + \frac{p_2}{p_1 + p_2}$

52. The freezing point of aqueous solution that contains 5% by mass urea, 1.0% by mass KCl and 10% by mass of glucose is : ($K_f H_2O = 1.86$ K molality^{-1})
a) 290.2 K
b) 285.5 K
c) 269.93 K
d) 250 K

53. Which of the following solutions has the highest normality?
a) 6 g of NaOH/100 mL
b) 0.5 M H_2SO_4
c) N phosphoric acid
d) 8 g of KOH/L

54. 100 mL of 0.3 HCl is mixed with 200 mL of 0.6 N H_2SO_4. The final normality of the resulting solution will be
a) 0.3 N
b) 0.2 N
c) 0.5 N
d) 0.1 N

55. A solute when distributed between two immiscible phases remains associated in phase II and dissociated in phase I. If α is the degree of dissociation and n is the number of molecules associated then :
a) $K = \frac{c_{\text{I}}}{c_{\text{II}}}$
b) $K = \frac{c_{\text{I}}}{\sqrt[n]{c_{\text{II}}(1-\alpha)}}$
c) $K = \frac{c_{\text{I}}}{c_{\text{II}}\,(1-\alpha)}$
d) $K = \frac{c_{\text{I}}(1-\alpha)}{\sqrt[n]{c_{\text{II}}}}$

56. Which solution would exhibit abnormal osmotic pressure?

a) Aqueous solution of urea
b) Aqueous solution of common salt
c) Aqueous solution of glucose
d) Aqueous solution of sucrose

57. If α is the degree of dissociation of Na_2SO_4 the van't Hoff factor (i) used for calculating the molecular mass is
a) $1-2\alpha$ b) $1+2\alpha$ c) $1-\alpha$ d) $1+\alpha$

58. The temperature at which vapour pressure of a solvent in its liquid and solid phase becomes same is called :
a) b. p. b) f. p. c) Krafft point d) None of these

59. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in a solution with liquid B is 32 mm Hg. What is the mole fraction of A in the solution if it obeys the Raoult's law?
a) 0.5 b) 0.6 c) 0.7 d) 0.8

60. Which of the following shows maximum depression in freezing point?
a) K_2SO_4 b) NaCl c) Urea d) glucose

61. The substances whose solubility decreases with increase in temperature :
a) $Ca(OH)_2$ b) Na_2CO_3 c) Na_2SO_4 d) All of these

62. 3.65 g of HCl is dissolved in 16.2 g of water. The mole fraction of HCl in the resulting solution is
a) 0.1 b) 0.2 c) 0.3 d) 0.4

63. How many moles of $Al_2(SO_4)_3$ would be in 50 g of the substance?
a) 0.083 mol b) 0.952 mol c) 0.481 mol d) 0.140 mol

64. Phenol dimerises in benzene having van't Hoff factor 0.54. What is the degree of association?
a) 1.92 b) 0.98 c) 1.08 d) 0.92

65. 0.004 M Na_2SO_4 is isotonic with 0.01 M glucose.Degree of dissociation of Na_2SO_4 is
a) 61 b) 244 c) 366 d) 122

66. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionised (k_f for water $= 1.86$ kg mol^{-1})?
a) -0.35°C b) -1.35°C c) -2.35°C d) -3.53°C

67. Choose the correct statement.
When concentration of a salt solution is increased
a) Boiling point increases while vapour pressure decreases.
b) Boiling point decreases while vapour pressure increases.
c) Freezing point decreases while vapour pressure increases.
d) Freezing point increases while vapour pressure decreases.

68. Which of the following aqueous solutions produce the same osmotic pressure?
(i)0.1 M NaCl solution
(ii) 0.1 M glucose solution
(iii)0.6 g urea in 100 mL solution
(iv)1.0 g of a non-electrolyte solute (X) in 50 mL solution (molar mass of $X = 200$)
a) (i), (ii), (iii) b) (ii), (iii), (iv) c) (i), (ii), (iv) d) (i), (iii), (iv)

69. In the case of osmosis, solvent molecules move from :
a) Higher vapour pressure to lower vapour pressure
b) Higher concentration to lower concentration
c) Lower vapour pressure to higher vapour pressure
d) Higher osmotic pressure to lower osmotic pressure

70. If the temperature increase from 0°C to 50°C at atmospheric pressure, which of the following processes is expected to take place more in case of liquids?
a) Freezing b) Vaporization c) Sublimation d) None of these

71. The freezing point of water is depressed by 0.37°C in a 0.01 mol NaCl solution. The freezing point of 0.02

molal solution of urea is depressed by

a) Hypotonic b) Isotonic c) Equimolar d) Hypertonic

72. Camphor is used as solvent to determine mol. wt. of non-volatile solute by Rast method because for camphor :

a) It is readily available
b) It is volatile
c) Molal depression constant is high
d) It is solvent for organic substances

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

a) Greater than one and greater than one
b) Less than one and greater than one
c) Less than one and less than one
d) Greater than one and less than one

74. The melting point of most of the solid substances increase with an increase of pressure acting on them. However, ice melts at a temperature lower than its usual melting point, when the pressure increase. This is because :

a) Ice is less denser than water
b) Pressure generates heat
c) The bonds break under pressure
d) Ice is not a true solid

75. Partition coefficient of benzoic acid-ether-water in favour of ether is 2. A solution containing 8 g/litre benzoic acid in ether layer is shaken with 2 litre water. The concentration of acid in water layer is :

a) 1 b) 2 c) 3 d) 4

76. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1L solution. The molarity of NaOH in the solution is
(Given, that molar mass of NaOH = 40.0 $g\ mol^{-1}$)

a) 1000 g of solvent b) 1 L of solvent c) 1 L of solution d) 1000 g of solution

77. Molecular weight of glucose is 180. A solution of glucose which contains 18 g/L, is

a) 0.1 molal b) 0.2 molal c) 0.3 molal d) 0.4 molal

78. The elevation in boiling point for one molal solution of a solute in a solvent is called :

a) Cryoscopic constant
b) Boiling point constant
c) Molal ebullioscopic constant
d) None of the above

79. 50 cm^3 of 0.2 N HCl is titrated against 0.1 N NaOH solution. The titration is discontinued after adding 50 cm^3 of NaOH. The remaining titration is completed by adding 0.5 NKOH. The volume of KOH required for completing the titration is

a) 12 cm^3 b) 10 cm^3 c) 25 cm^3 d) 10.5 cm^3

80. The depression in f. p. of 0.01 m aqueous solution of urea, sodium chloride and sodium sulphate is in the ratio :

a) 1 : 1 : 1 b) 1 : 2 : 3 c) 1 : 2 : 4 d) 2 : 2 : 3

81. Colligative properties are used for the determination of

a) Molar mass b) Equivalent weigh
c) Arrangement of molecules d) Melting and boiling points

82. In a solution of 7.8 g benzene (C_6H_6) and 46.0 g toluene ($C_6H_5CH_3$), the mole-fraction of benzene is

a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{1}{5}$ d) $\frac{1}{6}$

83. Mole fraction of solute in an aqueous solution which boils at 100.104. K_b for $H_2O = 0.52$ K molality^{-1}:

a) 3.6×10^{-3} b) 0.004 c) 5.6×10^{-3} d) 0.996

84. On a humid day in summer, the mole fraction of gaseous a H_2O (water vapour) in the air at 25°C can be as

high as 0.0287. Assuming a total pressure of 0.977 atm. What is the partial pressure of dry air?

a) 94.9 atm b) 0.949 atm c) 949 atm d) 0.648 atm

85. The natural semipermeable membrane is :

a) Gelatinous $Cu_2[Fe(CN)_6]$

b) Gelatinous $Ca_3[(PO_4)_2]$

c) Plant cell

d) Phenol layer

86. Which of the following is true when components forming an ideal solution are mixed?

a) $\Delta H_m = \Delta V_m = 0$ b) $\Delta H_m < \Delta V_m$ c) $\Delta H_m = \Delta V_m = 1$ d) $\Delta H_m > \Delta V_m$

87. The energy that opposes the dissolution of a solute in a solvent is called :

a) Solvent energy

b) Hydration energy

c) Lattice energy

d) Ionization energy

88. If molecular interaction of two different liquid molecules are stronger than the molecular interactions of the same liquid molecules the mixture is expected to show :

a) Positive deviations

b) Negative deviations

c) No deviations

d) Positive as well as negative deviations

89. Which of the following is not correct for ideal solution?

a) $\Delta V_{\text{mix}} = 0$ b) $\Delta H_{\text{mix}} = 0$ c) $\Delta S_{\text{mix}} = 0$ d) Obeys Raoult’s law

90. When mercuric iodide is added to the aqueous solution of potassium iodide, the

a) Freezing point is raised b) Freezing point is lowered

c) Freezing point does not change d) Boiling point does not change

91. Which statement is wrong for distribution law?

a) The two solvents should be mutually immiscible

b) The substance should not chemically react with any of the two solvents

c) The temperature should not change during experiment

d) The concentration of the solute in both the solvents must be kept high

92. How much of 0.1 M $H_2 SO_4$ solution is required to neutralise 50 mL of 0.2 M NaOH solution?

a) 50 mL b) 5.0 mL c) 0.50 mL d) 100 mL

93. A 0.5 molal aqueous solution of a weak acid (HX) is 20 per cent ionized. The lowering in freezing point of this solution is :

($K_f = 1.86$ K/m for water)

a) 0.56 K b) $-0.56\ K$ c) 1.12 K d) -1.12 K

94. A solution of 4.5 g of a pure non-electrolyte in 100 g of water was found to freeze at 0.465℃ . The molecular weight of the solute closest to ($k_f = 1.86$)

a) 135.0 b) 172.0 c) 90.0 d) 180.0

95. If P_0 and P_s are the vapour pressure of solvent and solution respectively and N_1 and N_2 are the mole of solute and solvent then :

a) $(P_0 - P_s)/P_0 = N_1/(N_1 + N_2)$

b) $(P_0 - P_s)/P_s = N_1/N_2$

c) $P_s = P_0 . N_2/(N_1 + N_2)$

d) All of the above

96. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1L solution. The molarity of NaOH in the solution is

(Given, that molar mass of NaOH = 40.0 $g\ mol^{-1}$)

a) 0.2450 M b) 0.6125 M c) 0.9800 M d) 1.6326 M

97. The relative lowering of vapour pressure of a dilute aqueous solution containing non-volatile solute is

0.0125. The molality of the solution is about

a) 0.70 b) 0.50 c) 0.90 d) 0.80

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

a) -2.3×10^{-2} b) -5.7×10^{-2} c) -5.7×10^{-3} d) -1.2×10^{-2}

99. If 0.15 g of a solute, dissolved in 15 g of solvent, is boiled at a temperature higher by 0.216°C than that of the pure solvent. The molecular weight of the substance (molal elevation constant for the solvent is 2.16°C) is

a) 100 b) 10.1 c) 10 d) 1.001

100. Molarity of 0.2 N $H_2\,SO_4$ is

a) 0.2 b) 0.4 c) 0.6 d) 0.1

101. When an ideal binary solution is in equilibrium with its vapour, molar ratio of the two components in the solution and in the vapour phase is :

a) Same
b) Different
c) May or may not be same depending upon volatile nature of the two components
d) None of the above

102. In a 0.2 molal aqueous solution of a weak acid HX, the degree of ionization is 0.3. Taking K_f for water as 1.85, the freezing point of the solution will be nearest to

a) −360°C b) 0.260°C c) +0.480°C d) −0.480°C

103. The distribution law was given by :

a) Henry b) Nernst c) van't Hoff d) Ostwald

104. Which of the following is incorrect?

a) 0.1 m sucrose b) 0.1 m urea c) 0.1 m ethanol d) 0.1 m glucose

105. When 20 g of naphthoic acid ($C_{11}H_8O_2$) is dissolved in 50 g of benzene ($k_f = 1.72\,K$ kg mol^{-1}), a freezing point depression of 2 K is observed. The van't Hoff factor (i) is

a) 0.5 b) 1 c) 2 d) 3

106. The vapour pressure of water at 20°C is 17.54 mm. When 20 g of a non-ionic, substance is dissolved in 100 g of water, the vapour pressure is lowered by 0.30 mm. What is the molecular mass of the substance?

a) 200.8 b) 206.88 c) 210.5 d) 215.2

107. The highest temperature at which vapour pressure of a liquid can be measured is :

a) b.p. of liquid
b) Critical temperature (Tc)
c) Critical solution temperature
d) Inversion temperature

108. Solution A contains 7 g/L of $MgCl_2$ and solution B contains 7 g/L of NaCl. At room temperature, the osmotic pressure of

a) 50 b) 180 c) 102 d) 25

109. When W_B g solute (molecular mass M_B) dissolves in W_A g solvent, the molality M of the solution is

a) $\frac{W_B}{M_B} \times \frac{1000}{W_A}$ b) $\frac{W_A}{M_B} \times \frac{1000}{W_B}$ c) $\frac{W_B}{W_A} \times \frac{M_A}{1000}$ d) $\frac{W_A}{W_B} \times \frac{M_B}{1000}$

110. The statement "the relative lowering of the vapour pressure is equal to th ratio ot moles of the solute to the total number of the moles in the solution" refers to

a) Hess's law b) Dalton's law c) Raoult's law d) Charles'law

111. Elevation in boiling point was 0.52°C when 6 g of a compound was dissolved in 100 g of water. Molecular weight of $X$is (k_b of water is 5.2°C per 100 g water)

a) 120 b) 60 c) 600 d) 180

112. The amount of anhydrous Na_2CO_3 present in 250 mL of 0.25 M solution is

a) 6.625 g b) 66.25 g c) 662.5 g d) 6625 g

113. The azeotropic mixture of water (b. pt.100°C) and HCl (b.pt. 85°C) boils at 108.5°C.When this mixture is

distilled it is possible to obtain

a) Pure HCl
b) Pure water
c) Pure water as well as HCl
d) Neither HCl nor H_2O in their pure states

114. A 5% solution of sugarcane (mol. wt. = 342) is isotonic with 1% solution of Xunder similar conditions. The molecular weight of $X$is

a) 136.2
b) 689.4
c) 34.2
d) 171.2

115. Van't hoff factor of $Ca(NO_3)_2$ is

a) One
b) Two
c) Three
d) four

116. Which of the following is incorrect?

a) Relative lowering of vapour pressure is independent
b) Vapour pressure of a solution is lower than the vapour pressure of the solvent
c) The vapour pressure is a colligative property
d) The relative lowering of vapour pressure is directly proportional to the mole fraction solute

117. One gram of silver gets distributed between 10 cm^3 of molten zinc and 100$\text{cm}^3$of molten lead at 8000°C. The percentage of silver still left in the lead layer in approximately

a) Henry
b) Van't Hoff
c) Nernst's
d) Ostwald

118. Two solutions of glucose have osmotic pressure 1.0 and 3.5 atm. If 1 L of first solution is mixed with V L of second solution, the osmotic pressure of the resultant solution becomes 2.5 atm. Volume of second solution is

a) 1.0 L
b) 1.5 L
c) 2.5 L
d) 3.5 L

119. 5% (wt./vol.) aqueous NaCl solution and 5% (wt./vol.) aqueous KCl solution are :

a) Isotonic
b) Isomolar
c) Equinormal
d) None of these

120. Azeotropic mixture are

a) Constant temperature boiling mixture
b) Those which boils at different temperatures
c) Mixture of two solids
d) None of the above

121. Boiling point of water is defined as the temperature at which :

a) Vapour pressure of water is equal to one atmospheric pressure
b) Bubbles are formed
c) Steam comes out
d) None of the above

122. When a solute distributes itself between two immiscible liquids in contact with each other, a mathematical constant ratio exists between :

a) The weight of the solute in the two liquids
b) The concentration of solute in the two liquids
c) The number of mole of the solute in the two liquids
d) The number of atoms of the solute in the two liquids

123. The molal elevation constant for water is 0.52. What will be the boiling point of 2 molar sucrose solution at 1 atm pressure? (Assume b.p. of pure water is 100°C)

a) 101.04°C
b) 100.26°C
c) 100.52°C
d) 99.74°C

124. The molal elevation/depression constant depends upon :

a) Nature of solvent
b) Nature of solute
c) Temperature
d) ΔH solution

125. When 10 g of a non-volatile solute is dissolved in 100 g of benzene, it raises boiling point by 1°C then molecular mass of the solute is (k_b for $C_6H_6 = 2.53 \text{ kg} - \text{mol}^{-1}$)

a) 223 g
b) 233 g
c) 243 g
d) 253 g

126. According to phase rule, if $P = 3, C = 1$, then F must be equal to :

a) 2
b) 1
c) Zero
d) 4

127. A thermometer which can be used only for accurate measurement of small differences in temperature is

known as a:
a) Beckmann thermometer
b) Contact thermometer
c) Clinical thermometer
d) Platinum resistance thermometer

128. When two liquids A and B are mixed then their boiling points becomes greater than both of them. What is the nature of this solution?
a) Ideal solution
b) Normal solution
c) Negative deviation with non-ideal solution
d) Positive deviation with non-ideal solution

129. The plots of $\frac{1}{X_A}$ $vs.$ $\frac{1}{Y_A}$ (where X_A and Y_A are the mole fraction of liquid A in liquid and vapour phase respectively) is linear with slope and intercepts respectively:
a) P_A^0/P_B^0 and $\frac{(P_A^0 - P_B^0)}{P_B^0}$
b) P_A^0/P_B^0 and $\frac{(P_B^0 - P_A^0)}{P_B^0}$
c) P_B^0/P_A^0 and $\frac{(P_A^0 - P_B^0)}{P_B^0}$
d) P_B^0/P_A^0 and $\frac{(P_B^0 - P_A^0)}{P_B^0}$

130. Which of the following liquid pair shows a positive deviation from Raoult's law?
a) Water-nitric acid
b) Acetone-chloroform
c) Water-hydrochloric acid
d) Benzene-methanol

131. What is the total number of moles of H_2SO_4 needed to prepare 5.0 L of a 2.0 M solution of H_2SO_4 ?
a) 2.5
b) 5.0
c) 10
d) 20

132. The van't hoff factor for 0.1 m $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is
a) 91.3%
b) 87%
c) 100%
d) 74%

133. The solubility of iodine in water is 0.8 g/L. If the partition coefficient of iodine between CCl_4 and water (in favour of CCl_4) is 82, the solubility of iodine in CCl_4 is :
a) 102.5 g/L
b) 65.6 g/L
c) 0.009 g/L
d) 81.2 g/L

134. An aqueous solution of 6.3 g oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N sodium hydroxide required to completely neutralise 10 mL of this solution is
a) 40 mL
b) 20 mL
c) 10 mL
d) 4 mL

135. One gram of silver gets distributed between 10 cm^3 of molten zinc and 100cm^3 of molten lead at 8000°C. The percentage of silver still left in the lead layer in approximately
a) 2
b) 5
c) 3
d) 1

136. Water will boil at 101.5°C at which of the following pressure?
a) 76 cm of Hg
b) 76 mm of Hg
c) $>$ 76 cm of Hg
d) $<$ 76 cm of Hg

137. Depression in freezing point is 6 K for NaCl solution if k_f for water is 1.86 K/kg mol, amount of NaCl dissolved in 1 kg water is
a) 3.42
b) 1.62
c) 3.24
d) 1.71

138. The density (in g mL^{-1}) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (molar mass $=$ 98 g mol^{-1}) by mass will be
a) 1.64
b) 1.88
c) 1.22
d) 1.45

139. The vapour pressure (VP) of a dilute solution of non-volatile solute is P and the VP of pure solvent is P_0, the lowering of the VP is :
a) +ve
b) –ve
c) P/P_0
d) P_0/P

140. Vapour pressure of CCl_4 at 25°C is 143 mm of Hg and 0.5 g of a non-volatile solute (mol. wt=65) is dissolved in100 mL CCl_4. Find the vapour pressure of the solution. (Density of CCl_4 $=$ 1.58 g/cm^2)
a) 94.39 mm
b) 141.93 mm
c) 134.44 mm
d) 199.34 mm

141. How many gram of NaOH will be required to prepare 500 g solution containing 10%$\frac{w}{w}$ NaOH solution?

a) 100 g b) 50 g c) 0.5 g d) 5.0 g

142. Conc H_2SO_4 has a density of 1.98 g/mL and is 98% H_2SO_4 by weight. Its normality is

a) 19.6 N b) 29.6 N c) 39.6 N d) 49.6 N

143. The phenomenon in which cells are shrinked down if placed in hypertonic solution is called :

a) Plasmolysis b) Haemolysis c) Endosmosis d) None of these

144. Beckmann thermometer are used to measure :

a) Boiling point of the solution
b) Freezing point of the solution
c) Any temperature
d) Elevation in boiling point or depression in freezing point

145. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of urea solution is (Avogadro constant, $N_A = 6.02 \times 10^{23} mol^{-1}$)

a) 0.001 M b) 0.01 M c) 0.02 M d) 0.1 M

146. When a crystal of the solute is introduced into a super saturated solution of the solute :

a) The solute dissolves
b) The excess solute crystallizes out
c) The solution becomes unsaturated
d) The solution remains super saturated

147. The mole fraction of the solute in one modal aqueous solution is

a) 0.018 b) 0.027 c) 0.036 d) 0.048

148. Which of the following solutions will have the highest boiling point ?

a) Camphor b) Naphthalene c) Benzene d) Water

149. The normality of mixture obtained by mixing 100 mL of 0.2 M H_2SO_4 +
100 mL of 0.2 M NaOH is

a) The nature of gas b) The temperature
c) The nature of the solvent d) All of the above

150. When attraction between $A-B$ is more than that of $A-A$ and $B-B$, the solution will show…..deviation from Raoult's law

a) Positive b) Negative c) No d) Cannot predicted

151. A solution containing 4 g of polyvinyl chloride polymer in one litre of dioxane was found to have an osmotic pressure of 4.1×10^{-4} atm at 27°C . The approximate molecular weight of the polymer is

a) 1.5×10^3 b) 2.4×10^5 c) 1.0×10^4 d) 2×10^{12}

152. The solubility of a gas in water depends on :

a) Nature of the gas b) Temperature c) Pressure of the gas d) All of these

153. Which of the following is not a colligative property?

a) Optical activity b) Osmotic pressure
c) Depression of freezing point d) Elevation of boiling point

154. The freezing point depression of 0.001 m, $K_x[Fe(CN)_6]$is 7.10×10^{-3}K. If for water, k_f is 1.86 K Kg mol^{-1}, value of x will be

a) 4 b) 3 c) 2 d) 1

155. The vapour pressure of benzene at a certain temperature is 640 mm of Hg. A non-volatile and non-electrolyte solid weighing 2.175 g is added to 39.08 g of benzene. If the vapour pressure of the solution is 600 mm of Hg, what is the molecular weight of solid substance?

a) 49.50 b) 59.60 c) 69.60 d) 79.82

156. For an aqueous solution, freezing point is −0.186°C. Elevation of the boiling point of the same solution is ($k_f = 1.86° mol^{-1}$ kg and $k_b = 0.512° mol^{-1} kg$)

a) 0.186° b) 0.0512° c) 1.86° d) 5.12°

157. The partial pressure of ethane over a saturated solution containing 6.56×10^{-2} g of ethane is 1 bar. If the solution contains 5.0×10^{-2} g of ethane, the partial pressure of ethane will be :

a) 0.762 bar b) 1.762 bar c) 0.1 bar d) 0.2 bar

158. The vapour pressure of benzene at 90°C is 1020 torr. A solution of 5 g of a solute in 58.5 g benzene has vapour pressure 990 torr. The molecular weight of the solute is :
a) 78.2 b) 178.2 c) 206.2 d) 220

159. The osmatic pressure of 0.4% urea solution is 1.66 atm. and that of a solutions of sugar of 3.42% is 2.46 atm. When both the solutions are mixed then the osmatic pressure of the resultant solution will be
a) 1.02 atm b) 2.06 atm c) 3.04 atm d) 0.02 atm

160. Vapour pressure of dilute aqueous solution of glucose is 750 mm of mercury at 373 K. The mole fraction of solute is
a) $\frac{1}{76}$ b) $\frac{1}{7.6}$ c) $\frac{1}{38}$ d) $\frac{1}{10}$

161. The relative lowering of vapour pressure produced by dissolving 71.5 g of a substance in 1000 g of water is 0.00713. The molecular weight of the substance will be :
a) 180 b) 18.0 c) 342 d) 60

162. 5 L of a solution contains 25 mg of $CaCO_3$. What is its concentration in ppm? (mol. wt. of $CaCO_3$ is 100)
a) 25 b) 1 c) 5 d) 2500

163. Binary liquid solutions which exhibit negative deviations from Raoult's law boil at temperature ….than the expected value :
a) Lower b) Higher c) Same d) Cannot be said

164. A substance will be deliquescent it its vapour pressure is :
a) Equal to the atmospheric pressure
b) Equal to that of water vapour in the air
c) Greater than that of water vapour in the air
d) Lesser than that of water vapour in the air

165. The distribution coefficient of I_2 in between CCl_4 and H_2O is 85 in favour of CCl_4 at 25°C. If solubility of I_2 in H_2O at 25°C is 0.33 g litre^{-1}, the solubility of I_2in CCl_4 is ……..g litre^{-1}.
a) 28.05 b) 30.05 c) 40.05 d) 26.05

166. 1.0 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant of benzene is 5.12 K kg mol^{-1}, the lowering in freezing point will be :
a) 0.5 K b) 0.2 K c) 0.4 K d) 0.3 K

167. Which of the following concentration term is/are independent of temperature?
a) Molarity b) Molarity and mole fraction
c) Mole fraction and molality d) Molality and normality

168. An azeotropic mixture of two liquids has boiling point lower than either of them, when it
a) Shows a 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

169. The molal elevation constant for water is 0.52 K molality^{-1}. The elevation caused in the boiling point of water by dissolving 0.25 mole of a non-volatile solute in 250 g of water will be :
a) 52°C b) 5.2°C c) 0.52°C d) 0.052°C

170. At 88°C benzene has a vapour pressure of 900 torr and toluene has a vapour pressure of 360 torr. What is the mole fraction of benzene in the mixture with toluene that will boil at 88°C at 1 atm pressure, benzene-toluene form an ideal solution?
a) 0.416 b) 0.588 c) 0.688 d) 0.740

171. Which one of the statements given below concerning properties of solutions, describes a colligative effect?
a) Vapour pressure of pure water decreases by the addition of nitric acid
b) Boiling point of pure water decreases by the addition of ethanol
c) Boiling point of pure benzene increases by the addition of toluene
d) Vapour pressure of pure benzene decreases by the addition of naphthalene

172. An example of a solution having liquid in gas is:
a) Moist air
b) Dry air
c) Au-Hg

d) $C_2H_5OH + H_2O$

173. Which of the given solutions has highest osmotic pressure?
a) $1N$ $NaNO_3$ b) $1N$ $Ba(NO_3)_2$ c) $1N$ $Al(NO_3)_3$ d) 1 N $Th(NO_3)_4$

174. At high altitude the boiling of water occurs at low temp. because :
a) Atmospheric pressure is low
b) Temperature is low
c) Atmospheric pressure is high
d) None of the above

175. If a 5.25% (wt./vol.) solution of a non-electrolyte is isotonic with 1.50% (wt./vol.) solution of urea, (mol-wt = 60) is the same solvent then the molecular weight of non-electrolyte is :
a) 210.0 g mol^{-1} b) 90.0 g mol^{-1} c) 115.0 g mol^{-1} d) 105 g mol^{-1}

176. Which solution will have least vapour pressure?
a) 0.1 M $BaCl_2$ b) 0.1 M urea c) 0.1 M Na_2SO_4 d) 0.1 M Na_3PO_4

177. The phenomenon in which cells are swelled up and then burst if placed in hypotonic solution is called :
a) Plasmolysis b) Haemolysis c) Exosmosis d) None of these

178. If 117 g NaCl is dissolved in 1000 g of water the concentration of the solution is said to be
a) 2 molar b) 2 molal c) 1 normal d) 1 molal

179. 0.1 molal aqueous solution of NaBr freezes at −0.335℃ at atmospheric pressure k_f for water is 1.86℃. The percentage of dissociation of the salt in solution is
a) 90 b) 80 c) 58 d) 98

180. Increasing the temperature of an aqueous solution will cause
a) Decrease in molarity b) Decrease in molarity
c) Decrease in mole fraction d) Decrease in % w/w

181. The vapour pressure of two liquids P and Q are 80 torr and 60 torr respectively. The total vapour pressure obtained by mixing 3 mole of P and 2 mole of Q would be :
a) 68 torr b) 20 torr c) 140 torr d) 72 torr

182. The molal boiling point constant of water is 0.53°C. When 2 mole of glucose are dissolved in 4000 g of water, the solution will boil at :
a) 100.53°C b) 101.06°C c) 100.265°C d) 99.47°C

183. One mole of non-volatile solute is dissolved in two mole of water. The vapour pressure of the solution relative to that of water is :
a) 2/3 b) 1/3 c) 1/2 d) 3/2

184. The K for I_2 between CS_2 and H_2O is 588 in favour of CS_2. One litre of aqueous solution containing 1 g of I_2 is shaken with 50 mL of CS_2. What will be the amount of I_2 in aqueous layer?
a) 0.035 g b) 0.010 g c) 0.05 g d) 0.04 g

185. How many grams of dibasic acid (mol. wt. 200) should be present in 100 mL of the aqueous solution to give 0.1 N?
a) 10 g b) 20 g c) 2 g d) 1 g

186. The vapour pressure of a dilute solution is not influenced by :
a) Temperature of solution
b) Melting point of solute
c) Mole fraction of solute
d) Degree of dissociation of solute

187. 35.4 mL of HCl is required for the neutralisation of a solution containing 0.275 g of sodium hydroxide. The normality of hydrochloric acid is
a) 0.97 N b) 0.142 N c) 0.194 N d) 0.244 N

188. Molal elevation constant of a liquid is :
a) The elevent in b.p. which would be produced by dissolving one mole of solute in 100 g of solvent
b) The elevation of b.p. which would be produced by dissolving 1 mole solute in 10 g of solvent.
c) Elevation in b.p. which would be produced by dissolving 1 mole of solute in 1000 g of solvent

d) None of the above

189. The solubility of gas in liquid depends upon :
a) Nature of gas
b) Nature of solvent
c) Temperature and pressure
d) All of the above

190. Relative lowering of vapour pressure of a dilute solution is 0.2. What is the mole fraction of the non-volatile solute ?
a) 0.8 b) 0.5 c) 0.3 d) 0.2

191. If 0.1 M solutions of each electrolyte are taken and if all electrolytes are completely dissociated, then whose boiling point will be highest ?
a) Glucose b) KCl c) $BaCl_2$ d) $K_2[Fe(CN)_6]$

192. A and B ideal gases. The molecular weights of A and B are in the ratio of 1:4. The pressure of a gas mixture containing equal weight of A and B is p atm. What is the partial pressure (in atm) of B in the mixture?
a) $\frac{P}{5}$ b) $\frac{P}{2}$ c) $\frac{P}{2.5}$ d) $\frac{3P}{4}$

193. What amount of water is added in 40 mL of NaOH (0.1 N) which is neutralised by 50 mL of HCl (0.2 N)?
a) 80 mL b) 60 mL c) 40 mL d) 90 mL

194. The amount of ice that will separate out on cooling a solute containing 50 g of ethylene glycol in 200 g water to −9.3°C will be
a) 8.37 g b) 161.3 g c) 3.87 g d) 38.7 g

195. The freezing point depression constant for water is $-1.86^{\circ}Cm^{-1}$. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is change by $-3.82^{\circ}C$, Calculate the van't Hoff factor for Na_2SO_4.
a) 0.381 b) 2.05 c) 2.63 d) 3.11

196. At$80^{\circ}C$, the vapour pressure of pure liquid 'A' is 520 mm Hg and that of pure liquid 'B' is 1000 mm Hg. If a mixture solution of 'A' and 'B' boils at $80^{\circ}C$ and 1 atm pressure, the amount of 'A' in the mixture is
(1 atm = 760 mm Hg)
a) 52 mole per cent b) 34 mole per cent c) 48 mole per cent d) 50 mole per cent

197. The elevation of boiling point method is used for the determination of molecular weight of:
a) Non-volatile and soluble solute
b) Non-volatile and insoluble solute
c) Volatile and soluble solute
d) Volatile and insoluble solute

198. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionised? ($k_f\ for\ water = 1.86\ K\ mol^{-1}$)
a) 0.85°C b) -3.53°C c) 0°C d) -0.35°C

199. Equimolal solutions will have the same boiling point, provided they do not show :
a) Electrolysis
b) Association
c) Dissociation
d) Association or dissociation

200. Volume of 0.1 M $K_2Cr_2O_7$ required to oxidise 35 mL of 0.5 M $FeSO_4$ solution is
a) 29.2 mL b) 17.5 mL c) 175 mL d) 145 mL

201. A solution of two liquids boils at a temperature more than the boiling point of either them. Hence, the binary solution shows
a) Negative deviation from Raoult's law
b) Positive deviation from Raoult's law
c) No deviation from Raoult's law
d) Positive or negative deviation from Raoult's law depending upon the composition

202. Vapour pressure of pure 'A' is 70 mm of Hg at $25^{\circ}C$. It from an ideal solution with 'B' in which mole fraction of A is 0.8. If the vapour pressure of the solution is 84 mm of Hg at 25°C, the vapour pressure of

pure ‘B’ at 25°C is
a) 28 mm b) 56 mm c) 70 mm d) 140 mm

203. Abnormal colligative properties are observed only when the dissolved non-volatile solute in a given dilute solution
a) Is a non-electrolyte b) Offers an intense colour
c) Associates of dissociates d) Offers no colour

204. As a result of osmosis, the volume of the concentrated solution :
a) Gradually decreases
b) Gradually increases
c) Suddenly increases
d) None of these

205. At a suitable pressure near the freezing point of ice, there exists :
a) Only ice
b) Ice and water
c) Ice and vapour
d) Ice, water and vapours, all existing side by side

206. Which of the following concentration units is independent of temperature?
a) Normality b) Molarity c) Molality d) ppm

207. In cold countries, ethylene glycol is added to water in the radiators of cars during winters. It results in :
a) Lowering in boiling point
b) Reducing viscosity
c) Reducing specific heat
d) Lowering in freezing point

208. Calculate the molal depression constant of a solvent which has freezing point 16.6℃ and latent heat of fusion 180.75 Jg^{-1}.
a) 2.68 b) 3.86 c) 4.68 d) 2.86

209. The freezing point depression constant for water is 1.86 K kgmol^{-1}. If 45 g of ethylene glycol is mixed with 600 g of water , the freezing point of the solution is
a) 2.2 K b) 270.95 K c) 273 K d) 275.35 K

210. The movement of solvent molecules through a semipermeable membrane is called
a) Electrolysis b) Electrophoresis c) Osmosis d) Cataphoresis

211. An aqueous solution of methanol in water has vapour pressure
a) Less than that of water b) More than that of water
c) Equal to that of water d) Equal to that of methanol

212. Which pair shows a contraction in volume on mixing along with evolution of heat?
a) $\text{CHCl}_3 + \text{C}_6\text{H}_6$ b) $\text{H}_2\text{O} + \text{HCl}$ c) $\text{H}_2\text{O} + \text{HNO}_3$ d) All of these

213. The vapour pressure of water at 20°C is 17.5 mmHg.
If 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water at 20°C, the vapour pressure of the resulting solution will be
a) 17.675 mmHg b) 15.750 mmHg c) 16.500 mmHg d) 17.325 mmHg

214. At 80°C, the vapour pressure of pure liquid $'A'$ is 520 mm Hg and that of pure liquid $'B'$ is 1000 mm Hg. If a mixture of solution $'A'$ and $'B'$ boils at 80°C and 1 atm pressure, the amount of $'A'$ in the mixture is : (1 atm = 760 mm Hg)
a) 50 mol per cent b) 52 mol per cent c) 34 mol per cent d) 48 mol per cent

215. Van’t Hoff factor(i):
a) Is less than one in case of dissociation
b) Is more than one in case of association
c) $i = \frac{\text{normal molecular mass}}{\text{observed molecular mass}}$
d) $i = \frac{\text{observed molecular mass}}{\text{normal molecular mass}}$

216. Following solutions at the same temperature will be isotonic :

a) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in one litre water
b) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in 0.1 litre water
c) 3.42 g of cane sugar in one litre water and 0.585 g of NaCl in one litre water
d) 3.42 g of cane sugar in one litre water and 1.17 g of NaCl in one litre water

217. The osmatic pressure of a 5% (wt./vol) solution of cane sugar at 150°C is

a) 3.078 atm b) 4.078 atm c) 5.078 atm d) 2.45 atm

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

a) 804.32 g b) 204.30 g c) 400.00 g d) 304.60 g

219. Mole fraction of solute in benzene is 0.2 then find molality of solute

a) 3.2 b) 2 c) 4 d) 3.6

220. When a solute is added in two immiscible solvents, it distributes itself between two liquids so that its concentration in first liquid is c_1 and that in the second liquid is c_2. If the solute forms a stable trimer in the first liquid, the distribution law suggests that :

a) $3c_1 = c_2$
b) $c_1/\sqrt[3]{c_2} =$ constant
c) $c_1/3 = c_2$
d) $c_2/\sqrt[3]{c_1} =$ constant

221. Which is not applicable to distribution law?

a) Parke's process
b) Solvent extraction
c) Pattinson's process
d) Partition chromatography

222. Which of the following is the expression of Raoult's law?
(p =vapour pressure of pure solvent, p_s =vapour pressure of the solution)

a) $\frac{p - p_s}{p} = \frac{n}{n + N}$ b) $\frac{p_s - p}{p} = \frac{N}{N + n}$ c) $\frac{p - p_s}{p_s} = \frac{N}{N - n}$ d) $\frac{p_s - p}{p_s} = \frac{N - n}{N}$

223. For determination of molar mass of colloids, polymers and protein, which property is used ?

a) Diffusion pressure b) Atmospheric pressure
c) Osmotic pressure d) Turgor pressure

224. 3.0 molal NaOH solution has a density of 1.110 g/mL. The molarity of the solution is

a) 3.9732 b) 2.9732 c) 1.9732 d) 0.9732

225. Sodium sulphate is soluble in water, while barium sulphate is sparingly soluble because :

a) The hydration energy of sodium sulphate is more than its lattice energy
b) The lattice energy of barium sulphate is less than the hydration energy
c) The lattice energy has no role to play in solubility
d) The hydration energy of sodium sulphate is less than its lattice energy

226. Distribution law is applicable when :

a) Temperature remains constant
b) Dilute solutions are employed
c) The two solvents are mutually insoluble
d) All are correct

227. 10 cm^3 of 0.1 N monobasic acid requires 15 cm^3 of sodium hydroxide solution whose normality is

a) 1.5 N b) 0.15 N c) 0.066 N d) 0.66 N

228. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is

a) 1.14 mol kg^{-1} b) 3.28 mol kg^{-1} c) 2.28 mol kg^{-1} d) 0.44 mol kg^{-1}

229. x gram of water is mixed in 69 g of ethanol. Mole fraction of ethanol in the resultant solution is 0.6. What is the value of x in grams?

a) 54 b) 36 c) 180 d) 18

230. Dissolution of a solute is an exothermic process if :
a) Hydration energy > lattice energy
b) Hydration energy < lattice energy
c) Hydration energy = lattice energy
d) None of the above

231. Molarity is expressed as
a) L/mol b) Mol/L c) Mol/1000 g d) g/L

232. The amount of anhydrous Na_2CO_3 present in 250 mL of 0.25 M solution is
a) 6.0 g b) 6.625 g c) 66.25 g d) 6.225 g

233. Which of the following compounds correspond to maximum van'thoff factor for dilute solution?
a) HCl b) $MgSO_4$ c) K_2SO_4 d) $K_4Fe(CN)_6$

234. Solute A is a ternary electrolyte and solute B is non-electrolyte. If 0.1 M solution of solute B produces an osmotic pressure of $2P$, then 0.05 M solution of A at the same temperature will produce an osmotic pressure equal to :
a) P b) 1.5 P c) 2 P d) 3 P

235. A solution of sucrose (molar mass 342 g mol^{-1}) has been produced by dissolving 68.5 g sucrose in 1000 g water. The freezing point of the solution obtained will be : (K_f for H_2O = 1.86 Kkg mol^{-1})
a) $-0.372^\circ C$ b) $-0.520^\circ C$ c) $+0.372^\circ C$ d) $-0.570^\circ C$

236. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. the vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be
a) 350 b) 300 c) 700 d) 360

237. How many grams of sulphuric acid is to be dissolved to prepare 200 mL aqueous solution having concentration of $[H_3O^+]$ ions 1 M at 25°C temperature.
$[H = 1, O = 16, S = 32\ g.mol^{-1}]$
a) 4.9g b) 19.6g c) 9.8g d) 0.98g

238. What is the molarity of H_2SO_4 solution if 25 mL is exactly neutralised with 32.63 mL of 0.164 M NaOH?
a) 0.107 M b) 0.126 M c) 0.214 M d) -0.428 M

239. What is the molality of ethyl alcohol (mol. wt. = 416) in aqueous solution which freezes at $-10^\circ C$?.(K_f for water = 1.86 K $molality^{-1}$)
a) 3.540 b) 4.567 c) 5.376 d) 6.315

240. The solubility order for the following gases is :
a) $NH_3 > CO_2 > O_2 > H_2$
b) $H_2 > O_2 > NH_3 > CO_2$
c) $CO_2 > NH_3 > O_2 > N_2$
d) $O_2 > H_2 > NH_3 > CO_2$

241. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution?
a) 1.100 b) 0.190 c) 0.086 d) 0.050

242. Equal masses of methane and oxygen are mixed in an empty container at 25°C. The fraction of the total pressure exerted by oxygen is
a) $\frac{2}{3}$ b) $\frac{1}{3} \times \frac{273}{298}$ c) $\frac{1}{3}$ d) $\frac{1}{2}$

243. Two liquids X and Y form an ideal solution. The mixture has a vapour pressure of 400 mm at 300 K when mixed in the molar ratio of 1:1 and a vapour pressure of 350 mm when mixed in the molar ratio of 1:2 at the same temperature. The vapour pressures of the two pure liquids X and Y respectively are
a) 250 mm, 550 mm b) 350 mm, 450 mm c) 350 mm, 700 mm d) 550 mm, 250 mm

244. The van't Hoff factor(i) for a dilute aqueous solution of Na_2SO_4 is :
a) $1 + \alpha$ b) $1 - \alpha$ c) $1 + 2\alpha$ d) $1 - 2\alpha$

245. p_A and p_B are the vapour pressure of pure liquid components A and B respectively of an ideal binary

solution. If xA represents the mole fraction of component A, the total pressure of the solution will be :

a) $p_B + x_A(p_B - p_A)$ b) $p_B + x_A(p_A - p_B)$ c) $p_A + x_A(p_B - p_A)$ d) $p_A + x_A(p_A - p_B)$

246. Formation of a solution from two components can be considered as

(1) pure solvent → separated solvent molecules, ΔH_1

(2) pure solute → separated solvent molecules, ΔH_2

(3) separated solvent and solute molecules → solution, ΔH_3

Solution so formed will be ideal if

a) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$ b) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$

c) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$ d) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$

247. Azeotropic mixture of HCl and water has

a) 48% HCl b) 22.2% HCl c) 36% HCl d) 20.2% HCl

248. What is the molarity of H_2SO_4 solution that has a density 1.84 g/cc at 35°C and contains 98% solute by weight?

a) 4.18 M b) 1.84 M c) 8.41 M d) 18.4 M

249. The osmotic pressure of 0.2 molar solution of urea at 27°C (R=0.082 L atm $mol^{-1}K^{-1}$)is

a) 4.92 atm b) 1 atm c) 0.2 atm d) 27 atm

250. In which ratio of volume 0.4 M HCl and 0.9 M HCl are to be mixed such that the concentration of the resultant solution becomes 0.7 M ?

a) 4 : 9 b) 2 : 3 c) 3 : 2 d) 1 : 1

251. The empirical formula of a nonelectrolyte is CH_2O. A solution containing 3 g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution. The molecular formula of the compound is

a) CH_2O b) $C_2H_4O_2$ c) $C_4H_8O_4$ d) $C_3H_6O_3$

252. Which of the following can be measured by the Ostwald-Walker dynamic method?

a) Relative lowering of vapour pressure b) Lowering of vapour pressure

c) Vapour pressure of the solvent d) All of the above

253. On shaking 10 mL of 0.1 molar solution of an organic compound in water with 10 mL of CCl_4 til equilibrium is attained, concentration of the organic compound in water would be ($K = 9$) in molar units :

a) 0.01 b) 0.09 c) 0.001 d) 0.009

254. A solution containing 1.8 g of a compound (empirical formula CH_2O) in 40 g of water is observed to freeze at $-0.465°C$. The molecular formula of the compound is

($K_f\ of\ water = 1.86\ kg\ K\ mol^{-1}$)

a) $C_2H_4O_2$ b) $C_3H_6O_3$ c) $C_4H_8O_4$ d) $C_6H_{12}O_6$

255. For dilute solution Raoult's law states that

a) The relative lowering of vapour pressure is equal to mole fraction of solute

b) The lowering of vapour pressure is equal to the mole fraction of solute

c) The vapour pressure of the solution is equal to mole fraction of the solvent

d) The relative lowering of vapour pressure is proportional to amount of solute in solution

256. For an ideal binary liquid solution with $P_A^0 > P_B^0$ which relation between X_A (mole fraction of A in liquid phase) and Y_A (mole fraction of A in vapour phase) is correct, X_B and Y_B are mole fraction of B in liquid and vapour phase respectively :

a) $X_A = Y_A$

b) $X_A > Y_A$

c) $\frac{X_A}{X_B} < \frac{Y_A}{Y_B}$

d) X_A, Y_A, X_B and Y_B cannot be corelated

257. The normality of 2.3 M H_2SO_4 solution is

a) 4.6 N b) 5.6 N c) 6.6 N d) 7.6 N

258. The molecular weight of NaCl determined by studying freezing point depression of its 0.5% aqueous solution is 30. The apparent degree of dissociation of NaCl is

a) 0.60 b) 0.50 c) 0.30 d) 0.95

259. A 5 molar solution of $H_2 SO_4$ is diluted from 1 L to 10 L. What is the normality of the solution?
a) 0.25 N b) 1 N c) 2 N d) 7 N

260. 100 mL of water and 50 mL ether mixture is shaken with succinic acid. At equilibrium ether layer contains 0.127 g and water layer contains 1.843 g of succinic acid. The partition coefficient of succinic acid in favour of water is :
a) 7.26 b) 10 c) 2 d) 4.5

261. The lubricating action of an oil is more if it possess :
a) High vapour pressure
b) Low vapour pressure
c) High surface tension
d) High density

262. Maximum lowering of vapour pressure is observed in the case of
a) 0.1 M glucose b) 0.1 M $\mathrm{Bacl_2}$ c) 0.1 M $\mathrm{MgSO_4}$ d) 0.1 NaCl

263. The solubility of a gas in liquid at a temperature is directly proportional to its :
a) Density b) Melting point c) Boiling point d) Pressure

264. A solution of sucrose (Molar mass = 342 g/mol) is prepared by dissolving 68.4 g of it per litre of solution, what is its osmotic pressure (R=0.082 L $\mathrm{atmK^{-1}\ mol^{-1}}$) at 273 K?
a) 3.92 atm b) 4.48 atm c) 5.92 atm d) 29.4 atm

265. Which of the following concentration factors is affected by change in temperature?
a) Molarity b) Molality c) Mole fraction d) Weight fraction

266. Which of the following mixture does not show positive deviation from the Raoult's law?
a) Benzene + acetone b) Acetone + ethanol
c) Acetone + chloroform d) Water + ethanol

267. The ratio of vapour pressure over solution phase on mixing two immiscible liquids is equal to :
a) Ratio of their weights in mixture
b) Ratio of their mol. weights
c) Ratio of their moles in liquid phase
d) Ration of their moles in vapour phase

268. The vapour pressure of benzene at 80°C is lowered by 10 mm by dissolving 2g of a non-volatile substance in 78 g of benzene. The vapour pressure of pure benzene at 80°C is 750 mm. The molecular weight of the substance will be :
a) 15 b) 150 c) 1500 d) 148

269. $\mathrm{I_2}$ is added to a system of $\mathrm{H_2O}$ and $\mathrm{CS_2}$. The concentration of $\mathrm{I_2}$ in water and $\mathrm{CS_2}$ is found to be c_1 and c_2 respectively. The ratio of c_1/c_2 will be constant only if :
a) The solutions are dilute
b) The temperature remains constant
c) The solute neither changing the immiscibility of solvents nor itself changing in molecular state
d) All of the above

270. The boiling point of an aqueous solution of a non-volatile solute is 100.15°C. What is the freezing point of an aqueous solution obtained by diluting the above solution with an equal volume of water? The values of K_b and K_f for water are 0.512°C and 1.86°C K $\mathrm{molality}^{-1}$
a) −0.544 °C b) −0.512 °C c) −0.272 °C d) −0.1.86 °C

271. A solution has an osmotic pressure of 0.821 atom at 300 K. its concentration would be :
a) 0.066 M b) 0.66 M c) 0.033 M d) 0.33 M

272. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is
a) 9 L b) 1.8 L c) 8 L d) 0.9 L

273. On adding 1 g arsenic to 80 g benzene, the freezing point of benzene is lowered by 0.19°C . The formula of arsenic is
a) As b) As_2 c) As_3 d) As_4

274. The process of getting fresh water from sea water is known as :

a) Osmosis
b) Filtration
c) Diffusion
d) Reverse osmosis

275. The statement “the relative lowering of the vapour pressure is equal to th ratio ot moles of the solute to the total number of the moles in the solution” refers to
a) Decrease the freezing point of water in the winter and increase the boiling point of water in the summer
b) Only decrease the freezing point of water
c) Only increase the boiling point of water
d) Be used for cleaning the radiator in a car

276. X is dissolved in water. Maximum boiling point is observed when X is ….(0.1 M each)
a) $CaSO_4$ b) $BaCl_2$ c) NaCl d) Urea

277. What is molarity of K^+ in aqueous solution that contains 17.4 ppm of K_2SO_4 (174 $g\ mol^{-1}$)?
a) $2 \times 10^{-2}\ M$ b) $2 \times 10^{-3}\ M$ c) $4 \times 10^{-4}\ M$ d) $2 \times 10^{-4}\ M$

278. Which of the following statement is true?
a) The relative lowering of vapour pressure of a solution is equal to the mole fraction of the solute present in the solution.
b) Passage of solute molecules towards solution side through semipermeable membrane is osmosis.
c) The boiling point of solution is always lower than the solvent.
d) The boiling point of a liquid is the temperature at which its vapour pressure becomes equal to 260 mm.

279. Calculate the molarity of 1 L solution of 93% H_2SO_4 (weight/volume). The density of the solution is 1.84 g/mL
a) 11.05 b) 12.05 c) 13.05 d) 14.05

280. If 0.15 g of a solute dissolved in 15 g of solvent is boiled at a temperature higher by 0.216°C than that of the pure solvent, the molecular weight of the substance is (molal elevation constant for the solvent is 2.16°C)
a) 100 b) 102 c) 104 d) 1.02

281. The vapour pressure of a liquid in a closed container depends upon
a) Amount of liquid b) Surface area of the container
c) Temperature d) None of the above

282. The vapour pressure of a solution is proportional to :
a) Mole fraction of solute
b) 1/(mole fraction of solute)
c) Mole fraction of solvent
d) None of the above

283. At 25°C a 5% aqueous solution of glucose (molecular weight = 180 g mol^{-1}) is isotonic with 2% aqueous solution containing an unknown solute. What is the molecular weight of the unknown solute.
a) 60 b) 80 c) 72 d) 63

284. The spontaneous movement of solute particles from a more concentrated solution to less concentrated solution is called :
a) Osmosis b) Diffusion c) Plasmolysis d) Fusion

285. How many grams of a sucrose (mol wt. = 342) should be dissolved in 100 g water in order to produce a solution with a 105.0°C difference between the freezing point and boiling temperature? ($k_f =$ 1.86 C/m, $k_b = 0.151$°C)
a) 34.2 g b) 72 g c) 342 g d) 460 g

286. A solution of urea (mol. mass 56) boils at 100.18˚C at atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K molality^{-1} respectively, the above solution will freeze at :
a) − 6.54˚C b) 6.54˚C c) − 0.654˚C d) 0. 654˚C

287. 19.85 mL of 0.1 N NaOH reacts with 20 mL of HCl solution for complete neutralization. The molarity of HCl solution is

a) 9.9 b) 0.99 c) 0.099 d) 0.0099

288. The vapour pressure will be lowest of

a) 0.1 M sugar solution b) 0.1 M KCl solution
c) 0.1 M $Cu(NO_3)_2$ solution d) 0.1 M $AgNO_3$ soution

289. Which one is correct?

a) Molality changes with temperature. b) Molality does not change with temperature.
c) Molarity does not change with temperature. d) Normality does not change with temperature.

290. What is molality of a solution in which
(18 g glucose mol. wt. = 180) is dissolved in 500 g of water?

a) 1 m b) 0.5 m c) 0.2 m d) 2 m

291. Which of the following solution in water possesses the lowest vapour pressure?

a) 0.1 (N) $BaCl_2$ b) 0.1 (M)NaCl c) 0.1 (M) KCl d) None of these

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

a) 90.0 g mol^{-1} b) 115.0 g mol^{-1} c) 105.0 g mol^{-1} d) 210.0 g mol^{-1}

293. Which of the following solutions will have highest boiling point

a) 0.1 M $FeCl_3$ b) 0.1 M $BaCl_2$
c) 0.1 M NaCl d) 0.1 M urea (NH_2 $CONH_2$)

294. At25°C , the highest osmotic pressure is exhibited by 0.1 M solution of

a) Decinormal aluminium sulphate
b) Decinormal barium chloride
c) Decinormal sodium chloride
d) A solution obtained by mixing equal volumes of (b) and (c) and filtering

295. Molarity of 0.2 N H_2SO_4 is

a) 0.1 b) 0.2 c) 0.3 d) 0.4

296. The ionic strength of solution containing 0.1 mol/kg of KCl and 0.2 mol/kg of $Cu\ SO_4$ is

a) 0.3 b) 0.6 c) 0.9 d) 0.2

297. 25 mL of a solution of barium hydroxide on titration with 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was

a) 0.07 b) 0.14 c) 0.28 d) 0.35

298. The freezing point of equimolal aqueous solution will be highest for

a) $C_6H_5NH_3Cl$ b) $La(NO_3)_3$ c) $C_6H_{12}O_6$ d) $Ca(NO_3)_2$

299. The normality of a 100 mL solution of sodium hydroxide which contains 4 g of NaOH, is

a) 0.5 b) 1.0 c) 1.5 d) 2.0

300. For determination of molecular weights, Raoult's law is applicable only to

a) Dilute solutions of electrolytes b) Concentration solution of electrolytes
c) Dilute solutions of non electrolytes d) Concentration solution of non electrolytes

301. Osmotic pressure of a solution at a given temperature

a) Increases with concentration b) Decreases with concentration
c) Remains same d) Initially increases and then decreases

302. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressures of pure hydrocarbons at 20°C are 440 mm Hg for pentane and 120 mm Hg for hexane. The mole fraction of pentane in vapour phase would be :

a) 0.786 b) 0.549 c) 0.478 d) 0.200

303. Distribution law cannot be applied for the system in which I_2 is distributed between :

a) H_2O and CS_2
b) H_2O and CCl_4

c) H_2O and ether
d) H_2O and ethanol

304. The vapour pressure of pure liquid A is 0.80 atm. When a non-volatile B is added to A its vapour pressure drops to 0.60 atm. The mole fraction of B in the solution is
a) 0.125 b) 0.25 c) 0.5 d) 0.75

305. When a non-volatile solute is dissolved in a solvent, the relative lowering of vapour pressure is equal to
a) Mole fraction of solute
b) Mole fraction of solvent
c) Concentration of the solute in gram per litre
d) Concentration of the solute in gram per 100 mL

306. The freezing point of one modal NaCl solution assuming NaCl to be 100 % dissociated in water is (modal depression constant=1.86)
a) −2.72℃ b) −3.72℃ c) 2.72℃ d) 3.72℃

307. On mixing, heptane and octane form an ideal solution. At 373 K, the vapour pressures of the two liquid components (heptanes and octane) are 105 kPa and 45kPa respectively. Vapour pressure of the solution obtained by mixing 25 g of heptanes and 35 g of octane will be (molar mass of heptanes = 100 g mol^{-1} and of octane = 114 gmol^{-1}).
a) 72.0 kPa b) 36.1 kPa c) 96.2 kPa d) 144.5 kPa

308. The van't Hoff factor of $BaCl_2$ at 0.01 M concentration is 1.98. The percentage of dissociation of $BaCl_2$ at this concentration is
a) 49 b) 69 c) 89 d) 98

309. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is
a) 0.70 b) 0.50 c) 0.60 d) 0.80

310. An aqueous solution of glucose was prepared by dissolving 18 g of glucose in 90 g of water. The relative lowering in vapour pressure is
a) 0.01 b) 0.02 c) 1 d) 20

311. In a 0.2 molal aqueous solution of a weak acid HX, the degree of ionisation is 0.3 Taking k_f for water as 1.85, the freezing point of the solution will be nearest to
a) MeV b) Cal c) Cm/s d) Atm

312. The unit of molality is
a) mol L^{-1} b) mol kg^{-1} c) mol^{-1} L^{-1} d) mol L

313. An azeotropic solution of two liquids has boiling point lower than either when it
a) Shows a negative deviation from Raoult's law b) Shows a positive deviation from Raoult's law
c) Shows no deviation from Raoult's law d) Is saturated

314. The statement, "The mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent" is
a) Henry's law b) Law of mass action c) Dalton's law d) None of these

315. The freezing point of water is depressed by 0.37℃ in a 0.01 mol NaCl solution. The freezing point of 0.02 molal solution of urea is depressed by
a) 0.37℃ b) 0.74℃ c) 0.185℃ d) 0℃

316. A solution of protein (extracted from crabs) was prepared by dissolving 0.75 g in 125 cm^3 of an aqueous solution. At 4°C an osmotic pressure rise of 2.6 mm of the solution was observed. Then molecular weight of protein is : (Assume density of solution is 1.00 g/cm^3)
a) 9.4×10^5 b) 5.4×10^5 c) 5.4×10^{10} d) 9.4×10^{10}

317. 2 N HCl solution will have same molar concentration as a
a) 4.0 N H_2SO_4 b) 0.5 N H_2SO_4 c) 1 N H_2SO_4 d) 2 N H_2SO_4

318. Molarity of a given orthophosphoric acid solution is 3 M. It's normality is
a) 9N b) 0.3 N c) 3 N d) 1 N

319. Which of the following is a colligative property?

a) Boiling point b) Freezing point c) Osmotic pressure d) Vapour pressure

320. A liquid is in equilibrium with its vapours at its boiling point. On the average the molecules in the two phases have equal :
a) Potential energy
b) Total energy
c) Kinetic energy
d) Intermolecular forces

321. You are given 100 mL of CCl_4 to extract iodine from 200 mL of its aqueous solution. For extracting maximum amount of iodine, which one of the following processes would you use?
a) Use all 100 mL of CCl_4 at one time
b) Use 50 mL of CCl_4 twice
c) Use 10 mL of CCl_4 10 times
d) Use 25 mL of CCl_4 4 times

322. Normality of 2 M sulphuric acid is
a) 2N b) 4N c) $\frac{N}{2}$ d) $\frac{N}{4}$

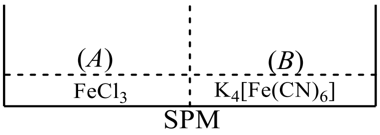
323. The elevation in boiling point of a solution of13.44 g of $CuCl_2$in 1 kg of water using the following information will be (molecular weight of $CuCl_2 = 134.4$ and $k_b = 0.52\ Km^{-1}$)
a) 0.16 b) 0.05 c) 0.1 d) 0.2

324. The degree of dissociation (α) of a weak electrolyte , A_xB_y is related to van't Hoff factor (i) by the expression
a) $\alpha = \frac{i-1}{(x+y-1)}$ b) $\alpha = \frac{i-1}{x+y+1}$ c) $\alpha = \frac{x+y-1}{i-1}$ d) $\alpha = \frac{x+y+1}{i-1}$

325. On adding a solute to a solvent having vapour pressure 0.80 atm vapour pressure reduces to 0.60 atm. Mole fraction of solute is
a) 0.25 b) 0.75 c) 0.50 d) 0.33

326. Generally those gases are soluble in water to a greater extent which :
a) Are easily liquefied
b) Are ionized in water
c) React with water
d) All are correct

327. Two solutions (A) containing $FeCl_3(aq)$ and (B) containing $K_4[Fe(CN)_6]$ are separated by semipermeable membrane as shown below. If $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$, produces blue colour of $Fe_4[Fe(CN)_6]$, the blue colour will be noticed in :



a) (A)
b) (B)
c) In both (A) and (B)
d) Neither in (A) nor in (B)

328. The difference between the boiling point and freezing point of an aqueous solution containing sucrose (mol wt. = 342 $gmol^{-1}$) in 100 g of water is $105.0°C$. If $K_f$and K_b of water are 1.86 and 0.51 K kg mol^{-1} respectively, the weight of sucrose in the solution is about
a) 34.2 g b) 342 g c) 7.2 g d) 72 g

329. Pressure cooker reduces cooking time for food because
a) Boiling point of water involved in cooking is increased
b) Heat is more evenly distributed in the cooking space
c) The higher pressure inside the cooker crushes the food material

d) Cooking involves chemical changes helped by a rise in temperature

330. 9.8 g of H_2SO_4 is present in 2 L of a solution. The molarity of the solution is

a) 0.05 M b) 0.01 M c) 0.03 M d) 0.02 M

331. At 95°C, an aqueous solution of iodine containing 0.0156 g/litre is in equilibrium with a CCl_4 solution containing 4.412 g/litre. If the solubility of I_2 in water at 95°C is 0.34 g/litre, then its solubility in CCl_4 is :

a) $\frac{4.412 \times 0.0156}{0.34}$

b) $\frac{0.0156 \times 0.34}{4.412}$

c) $\frac{4.412 \times 0.34}{0.0156}$

d) $\frac{0.0156}{4.412 \times 0.34}$

332. Calculate the normality of 250 mL aqueous solution of H_2SO_4 having pH = 0.00.

a) 0.25 N b) 0.50 N c) 1 N d) 2 N

333. Van't hoff factor of $Ca(NO_3)_2$ is

a) Benzoic acid is an organic solute

b) Benzoic acid has higher molar mass than benzene

c) Benzoic acid gets associated in benzene

d) Benzoic acid gets dissociated in benzene

334. A solution of 5 g of iodine in CS_2 was shaken with the same volume of water. The amount of iodine in water is : (Given K in favour of $CS_2 = 420$

a) 0.119 g b) 0.0119 g c) 0.00119 g d) 1.19 g

335. From the colligative properties of solution which one is the best method for the determination of molecular weight of proteins and polymers :

a) Osmotic pressure

b) Lowering in vapour pressure

c) Lower in freezing point

d) Elevation in boiling point

336. Observe the following abbrevations

π_{obs} = observed colligative property

π_{cal} = theoretical colligative property assuming normal behaviour of solute.

Van't Hoff factors (i) is given by

a) $i = \pi_{obs} \times \pi_{cal}$ b) $i = \pi_{obs} + \pi_{cal}$ c) $i = \pi_{obs} - \pi_{cal}$ d) $i = \frac{\pi_{obs}}{\pi_{cal}}$

337. The vapour pressure of two pure liquid (A) and (B) are 100 torr and 80 torr respectively. The total pressure of solution obtained by mixing 2 mole of (A) and 3 mole of (B) would be :

a) 120 torr b) 36 torr c) 88 torr d) 180 torr

338. On the basis of intermolecular forces predict the correct order of decreasing boiling points of the compounds:

a) $CH_3OH > H_2 > CH_4$ b) $CH_3OH > CH_4 > H_2$ c) $CH_4 > CH_3OH > H_2$ d) $H_2 > CH_4 > CH_3OH$

339. Which has the highest freezing point at one atmosphere?

a) 0.1 M NaCl solution b) 0.1 M sugar solution c) 0.1 M $BaCl_2$ solution d) 0.1 M $FeCl_3$ solution

340. Binary liquid mixtures which exhibit positive deviations from Raoult's law boil at.... temperature than the expected b. p.:

a) lower b) Higher c) Same d) Cannot be said

341. Which has minimum osmotic pressure?

a) 200 mL of 2 M NaCl solution b) 200 mL of 2 M glucose solution

c) 200 mL of 2 M urea solution d) All have same osmotic pressure

342. Which of the following solutions will have the highest boiling point?

a) 0.1 M $BaCl_2$ b) 0.1 M $FeCl_3$ c) 0.1 M NaCl d) 0.1 M urea

343. Solubility of solutes which dissolve with the liberation of heat decreases with :
a) Decrease in temperature
b) Increase in temperature
c) No change in temperature
d) None of the above

344. A binary liquid solution ois prepared by mixing *n*-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution?
a) The solution formed is an ideal solution
b) The solution is non-ideal, showing positive deviation from Raoult's law
c) The solution is non-ideal, showing negative deviation from Raoult's law
d) *n*-heptane shows positive deviation while ethanol show negative deviation from Raoult's law

345. A 0.0020 m aqueous solution of an ionic compound $Co(NH_3)_5(NO_2)Cl$ freezes at $-0.00732^\circ C$. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be : ($K_f = +1.86°C/m$)
a) 1 b) 2 c) 3 d) 4

346. Solutions *A, B, C* and *D* are respectively 0.1 M glucose, 0.05 M NaCl, 0.05 M $BaCl_2$ and 0.1 M $AlCl_3$. Which one of the following pairs is isotonic?
a) *A* and *B* b) *B* and *C* c) *A* and *D* d) *A* and *C*

347. Colligative properties of a solution depends upon
a) Nature of both solvent and solute
b) Nature of solute only
c) Nature of solvent only
d) The relative number of solute and solvent particles

348. A solution of sucrose (molar mass=342 g/mol) is prepared by dissolving 68.4 g of it per litre of the solution, what is its osmotic pressure ($R = 0.082$ L atm K^{-1} mol^{-1}) at 273 K?
a) 3.92 atm b) 4.48 atm c) 5.92 atm d) 29.4 atm

349. The values of observed and calculated molecular weights of silver nitrate are 92.64 and 170 respectively. The degree of dissociation of silver nitrate is :
a) 60% b) 83.5% c) 46.7% d) 60.23%

350. Saturated solution of NaCl on heating becomes :
a) Super saturated b) Unsaturated c) Remains saturated d) None of these

351. 20 g of hydrogen is present in a 5 L vessel. The molar concentration of hydrogen is
a) 1 b) 2 c) 3 d) 4

352. The molarity of pure water is
a) 55.6 b) 5.56 c) 6.55 d) 65.5

353. Assuming that sea water is a 3.50 weight per cent aqueous solution of NaCl. What is the molality of sea water?
a) 0.062 m b) 0.0062 m c) 0.62 m d) 6.2 m

354. The condition under which Nernst distribution law will not hold true is :
a) Temperature is constant
b) The molecular state of the solute is the same in both solvents
c) The solute does not cause any change in the mutual solubility of the two solvents
d) None of the above

355. An ideal solution is that which
a) Obey Raoult's law b) Shows positive deviation from Raoult's law
c) Shows negaitive deviation from Raoult's law d) Has no connection with Raoult's law

356. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is
a) 0.1 M NaCl b) 0.1 M $BaCl_2$ c) 0.1 M sucrose d) 0.1 M KCl

357. Among the following substances, the lowest vapour pressure is exerted by :

a) Water b) Mercury c) Kerosene d) Rectified spirit

358. If 5.85 g NaCl (molecular weight 58.5) is dissolved in water and the solution is made up to 0.5 L, the molarity of the solution will be

a) 0.1 b) 0.2 c) 0.3 d) 0.4

359. The sum of mole fractions of A, B and C in an aqueous solution containing 0.2 moles of each A, B and C is

a) 0.6 b) 0.2 c) 1.0 d) 1.2

360. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H_3PO_3),the volume of 0.1 M aqueous KOH solution required is

a) 10 mL b) 20 mL c) 40 mL d) 60 mL

361. At temperature 327°C and concentration C osmotic pressure of a solution is p, the same solutions at concentration $C/2$ and a temperature 427°C shows osmotic pressure 2 atm, value of p will be

a) $\frac{12}{7}$ b) $\frac{24}{7}$ c) $\frac{6}{5}$ d) $\frac{5}{6}$

362. Molarity of a solution prepared by dissolving 75.5 g of pure KOH in 540 mL solution is

a) 1.50 M b) 2.50 M c) 3.50 M d) 5.01 M

363. The relationship between the values of osmotic pressure of 0.1 M solution of $KNO_3(p_1)$ and $CH_3COOH(p_2)$ is

a) $\frac{p_1}{p_1+p_2} = \frac{p_2}{p_1+p_2}$ b) $p_1 > p_2$ c) $p_2 > p_1$ d) $p_1 = p_2$

364. At 40°C the vapour pressures of pure liquids, benzene and toluene, are 75 torr and 22 torr respectively. At the same temperature, the partial vapour pressure of benzene in a mixture of 78 g benzene and 46 g toluene in torr assuming the ideal solution should be :

a) 50 b) 25 c) 375 d) 53.5

365. The reverse of fusion is freezing and it is :

a) Endothermic
b) Exothermic
c) Neither exothermic nor endothermic
d) May be exothermic or endothermic

366. 50 g of an acid is dissolved in one litre aqueous solution. Distribution coefficient in favour of ether is 3. Acid left in aqueous layer when solution is shaken with one litre ether :

a) 25 g b) 12.5 g c) 6.25 g d) None of these

367. When the vapour pressure of solutions of two liquids are less than those expected from ideal solutions, they are said to show :

a) Positive deviations from ideal behaviour
b) Negative deviations from ideal behaviour
c) Positive deviations for lower concentrations and negative deviations for higher concentration
d) None of the above

368. Which method cannot be used to find out the molecular weight of non-volatile solute?

a) Victor Meyer's method
b) Osmotic pressure method
c) Cryoscopic method
d) Ebullioscopic method

369. The equilibrium in a heterogeneous system can be studied by :

a) Distribution law b) Phase rule c) Both (a) and (b) d) None of these

370. At Abu mountains water boils at 96°C. What amount of NaCl be added in 1 kg water so that it boils at 100°C. K_b for $H_2O = 0.52$ K molality^{-1}

a) 225 g b) 450 g c) 200 g d) 125 g

371. The normality of 0.3 M phosphorous acid (H_3PO_3) is

a) 0.2 b) 0.4 c) 0.6 d) 0.8

372. If the various terms in the below given expressions have usual meanings, the van't Hoff factor (i) cannot be

calculated by which one of the expressions?

a) $\pi V = \sqrt{inRT}$ b) $\Delta T_f = ik_f.m$

c) $\Delta T_b = ik_b.m$ d) $\frac{p^{\circ}_{\text{solvent}} - p_{\text{solution}}}{p^{\circ}_{\text{solvent}}} = i\left(\frac{n}{N+n}\right)$

373. Which of the following liquid pairs shows a positive deviation from Raoult's law?

a) Water-hydrochloric acid b) Benzene-methanol

c) Water-nitric acid d) Acetone-chloroform

374. How much $K_2Cr_2O_7$ (Mol. wt. = 294.19) is required to prepare one litre of 0.1 N solution?

a) 9.8063 g b) 7.3548 g c) 3.6774 g d) 4.903 g

375. The boiling point of C_6H_6, CH_3OH, $C_6H_5NH_2$ and $C_6H_5NO_2$ are 80 °C, 65°C, 184°C and 212 °C respectively. Which will show highest vapour pressure at room temperature?

a) C_6H_6 b) CH_3OH c) $C_6H_5NH_2$ d) $C_6H_5NO_2$

376. In a pair of immiscible liquids, a common solute dissolves in both and the equilibrium is reached. The concentration of solute in upper layer is :

a) Same as in lower layer

b) Lower than the lower layer

c) Higher than the lower layer

d) In fixed ratio with that in the lower layer

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

a) 4.8×10^5 b) 9×10^5 c) 3×10^5 d) 5.17×10^6

378. Volume of 0.6 M NaOH required to neutralise 30 cm^3 of 0.4 M HCl is

a) 20 cm^3 b) 40 cm^3 c) 45 cm^3 d) 30 cm^3

379. The freezing point of the 0.05 molal solution of non-electrolyte in water is

a) −0.093°C b) 1.86°C c) 0.93°C d) 0.093°C

380. A molar solution of NaCl has a density of 1.21 g mL^{-1}. The molarity of this solution is

a) 2.35 b) 1.143 c) 2.95 d) 1.356

381. Osmotic pressure of blood is 7.65 atm at 310 K. An aqueous solution of glucose that will be isotonic with blood is ……….wt./vol.

a) 5.41% b) 3.54% c) 4.53% d) 53.4%

382. A substance is completely trimerised on dissolution in a solvent. The van't Hoff factor (i) for such change is :

a) 1 b) 2 c) 3 d) 1/3

383. A liquid is kept in a closed vessel. If a glass plate (negligible mass) with a small hole is kept on top of the liquid surface, then the vapour pressure of the liquid in the vessel is :

a) More than what would be if the glass plate were removed

b) Same as what would be if the glass plate were removed

c) Less than what would be if the glass plate were removed

d) Cannot be predicted

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

a) 38.71 g b) 38.71 mg c) 42 g d) 42 mg

385. The number of moles of a solute in its solution is 20 and total number of moles are 80. The mole fraction of solute is

a) 0.25 b) 0.50 c) 1.00 d) 1.25

386. The order of osmotic pressure of isomolar solution of $BaCl_2$, NaCl and sucrose is

a) $BaCl_2$ >NaCl>sucrose b) NaCl> $BaCl_2$> sucrose

c) Sucrose>NaCl> $BaCl_2$ d) $BaCl_2$ >sucrose>NaCl

387. At STP, a container has 1 mole of Ar, 2 moles of CO_2, 3 moles of O_2 and 4 moles of N_2. Without changing the total pressure if one mole of O_2 is removed, the partial pressure of O_2 is

a) Changed by about 16%
b) Halved
c) Changed by 26%
d) Unchanged

388. A solute is soluble in two immiscible liquids which are present in a mixture. The concentration of the solute in the upper layer will be :
a) Same as in the lower layer
b) Less than in the lower layer
c) More than in the lower layer
d) In fixed ratio with that in the lower layer

389. During osmosis, flow of water through a semipermeable membrane is :
a) From both sides of semipermeable membrane with unequal flow rates
b) From solution having lower concentration only
c) From solution having higher concentration only
d) From both sides of semipermeable membrane with equal flow rates

390. According to distribution law, the distribution of solute in two phases is given by the expression,
$K = \frac{\text{concentration of solute in phase I}}{\text{concnetration of solute in phase II}}$,
the numerical Value of constant K depends upon :
a) The temperature of the system
b) The nature of solute distributed
c) The nature of two immiscible solvents used
d) All of the above

391. The experimental molecular weight of an electrolyte will always be less than its calculated value because the value of van't Hoff factor, 'i' is :
a) Less than one
b) Greater than one
c) One
d) Zero

392. The freezing point of 1% solution of lead nitrate in water will be
a) 2°C
b) 1°C
c) 0°C
d) Below 0°C

393. The osmotic pressure of a solution at 0°C is 2 atm. What will be its osmotic pressure at 273°C under similar conditions?
a) 0.5 atm
b) 2 × 273 atm
c) 4 atm
d) 273/2 atm

394. Which of the following statements is false?
a) Two sucrose solution of same molality prepared in different solvent will have the same freezing point depression
b) Osmotic pressure (π) of a solution is given by $\pi = MRT$ where M is molarity of the solution
c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ Sucrose
d) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction

395. When 25 g of a non-volatile solute is dissolved in 100 g of water, the vapour pressure is lowered by 2.25×10^{-1}mm. If the vapour pressure of water at 20°C is 17.5 mm, what is the molecular weight of the solute?
a) 206
b) 302
c) 350
d) 276

396. The volume of water to be added to $\frac{N}{2}$ HCl to prepare 500 cm^3 of $\frac{N}{10}$ solution is
a) 450 cm^3
b) 100 cm^3
c) 45 cm^3
d) 400 cm^3

397. Lowering of vapour pressure is highest for
a) 0.1 M $BaCl_2$
b) 0.1 M glucose
c) 0.1 M $MgSO_4$
d) Urea

398. One component of a solution follows Raoult's law over the entire range $0 \le x_1 \le 1$. The second component must follow Raoult's law in the range when x_2 is
a) Close to zero
b) Close to 1
c) $0 \le x_2 \le 05$
d) $0 \le x_2 \le 1$

399. The mole fraction of water in 20% aqueous solution of H_2O_2 is
a) $\frac{20}{80}$
b) $\frac{80}{20}$
c) $\frac{68}{77}$
d) $\frac{77}{68}$

400. What will be the molality of a solution having 18 g of glucose (mol. wt. = 180) dissolved in 500 g of water?

a) 1 m b) 0.5 m c) 0.2 m d) 2 m

401. The empirical formula of a non-electrolyte is CH_2O . A solution containing 6g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution at the same temperature. The molecular formula of the compound is

a) $C_2H_4O_2$ b) $C_3H_6O_3$ c) $C_5H_{10}O_5$ d) $C_4H_5O_4$

402. At 40°C, the vapour pressure (in torr) of methyl alcohol (A) and ethyl alcohol (B) solution is represented by :
$P = 120\, X_A + 138$; where X_A is mole fraction of methyl alcohol. The value of lime
$X_A \longrightarrow 0, \frac{P_B^0}{X_B}$ and lime $X_B \longrightarrow 0, \frac{P_A^0}{X_A}$ are :

a) 138, 258 b) 258, 138 c) 120, 138 d) 138, 125

403. Freezing point of an aqueous solution is $-0.186\,^{\circ}\mathrm{C}$. Elevation of boiling point of same solution would be: ($K_b = 0.512$ and $K_f = 1.86$ K molality^{-1})

a) 0.186 °C b) 0.0512 °C c) 0.092 °C d) 0.237 °C

404. What is the amount of urea dissolved per litre if its aqueous solution is isotonic with 10% cane sugar solution? (mol.wt.of urea =60)

a) 200 g/L b) 19.2 g/L c) 17.54 g/L d) 16.7 g/L

405. Distribution law holds good for the distribution of a dissolved substance between :

a) Liquid-liquid phases
b) Liquid-liquid and liquid-gas phases
c) Liquid-liquid and liquid-solid phases
d) Liquid-gas, liquid-liquid and liquid-solid phases

406. 0.004 M Na_2SO_4 is isotonic with 0.01 M glucose.Degree of dissociation of Na_2SO_4 is

a) 75% b) 50% c) 25% d) 85%

407. 10 g of iodine is allowed to distribute between H_2O and CCl_4. If the partition coefficient is 85 in favour of CCl_4, the ratio between volumes of H_2O and CCl_4 such that 5 g of iodine will be present in aqueous layer is :

a) 1 : 85 b) 85 : 1 c) 170 : 1 d) 1 : 170

408. What happens when an egg is kept in saturated solution of NaCl after removing its hard shell in dilHCl?

a) Egg will swell b) Egg will shrink
c) Egg will remain same d) Egg will first shrink and then swell

409. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 25°C are 200 mm Hg and 41.5 mm Hg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at the same temperature will be :
(Molecular mass of $CHCl_3 = 119.5\, u$ and molecular mass of $CH_2Cl_2 = 85\, u$)

a) 173.9 mm Hg
b) 615.0 mm Hg
c) 347.9 mm Hg
d) 90.952 mm Hg

410. If the elevation in boiling point of a solution of 10 g of solute (mol. wt. = 100 g of water is ΔT_b, the ebullioscopic constant of water is

a) 10 b) $100\Delta T_b$ c) ΔT_b d) $\frac{\Delta T_b}{10}$

411. A 0.001 molal solution of $[Pt(NH_3)_4Cl_4]$ in water has a freezing point depression of 0.0054°C. If K_f for water is 1.80, the correct formulation of the above molecule is :

a) $[Pt(NH_3)_4Cl_3]Cl$ b) $[Pt(NH_3)_4Cl_2]Cl_2$ c) $[Pt(NH_3)_4Cl]Cl_3$ d) $[Pt(NH_3)_4Cl_4]$

412. The weight of $H_2C_2O_4 \cdot 2H_2O$ required to pressure 500 mL of 0.2 N solution is

a) 63 g b) 6.3 g c) 0.63 g d) 126 g

413. Equimolar solutions of two non-electrolytes in the same solvent should have :

a) Same b. p but different f. p
b) Same f. p. but different b. p.

c) Same b. p. and same f. p.
d) Different b. p. and different f. p.

414. The vapour pressure of a solution of a non-volatile electrolyte (A) in a solvent (B) is 95% of the vapour pressure of the solvent at the same temperature. If $M_B = 0.3\ M_A$, where M_B and M_A are molecular weights of B and A respectively, the weight ratio of the solvent and solute are :
a) 0.15 b) 5.7 c) 0.2 d) 4.0

415. Y g of non-volatile organic substance of molecular mass M is dissolved in 250 g benzene. Molal elevation constant of benzene of K_b. Elevation in its boiling point is given by :
a) $\frac{M}{K_bY}$ b) $\frac{4K_bY}{M}$ c) $\frac{K_bY}{4M}$ d) $\frac{K_bY}{M}$

416. If 10^{-4} dm^3 of water is introduced into a 1.0 dm^3 flask at 300 K, how many moles of water are in the vapour phase when equilibrium is established?
(Given : Vapour pressure of H_2O at 300 K is 3170 Pa ; $R = 8.314$ J K^{-1} mole^{-1})
a) 1.27×10^{-3} mol b) 5.56×10^{-3} mol c) 1.53×10^{-2} mol d) 4.46×10^{-2} mol

417. Two liquids X and Y form an ideal solution at 300K, vapour pressure of the solution containing 1 mol of X and 3, mol of Y is 550 mmHg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mmHg. Vapour pressure (in mmHg)of X and Y in their pure states will be, respectively
a) 200 and 300 b) 300 and 400 c) 400 and 600 d) 500 and 600

418. By dissolving 5g substance in 50 g of water, the decrease in freezing point is 1.2°C. The gram molal depression is1.85°C. The molecular weight of substance is
a) 105.4 b) 118.2 c) 137.2 d) 154.2

419. Which characterises the weak intermolecular forces of attraction in a liquid?
a) High boiling point
b) High vapour pressure
c) High critical temperature
d) High heat of vaporization

420. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionised?
(k_f for wt. = 1.86 K mol^{-1})
a) $0.85°C$ b) $-3.53°C$ c) $0°C$ d) $-0.35°C$

421. Consider the following aqueous solutions and assume 100% ionisation in electrolytes
I. 0.1 m urea
II. 0.04 m $Al_2(SO_4)_3$
III. 0.05 m $CaCl_2$
IV. 0.005 m NaCl
The correct statement regarding the above solution is
a) Freezing point will be lowest for solution I b) Freezing point will be highest for solution IV
c) Boiling point will be highest for solution IV d) Vapour pressure will be highest for solution II

422. A certain substance 'A' tetramerises in water to the extent of 80%. A solution of 2.5 g of A in 100 g of water lowers the freezing point by 0.3°C. The molar mass of A is
a) 31 b) 62 c) 122 d) 244

423. The average osmotic pressure of human blood is 7.8 bar at 37°C. What is the concentration of an aqueous NaCl solution that could be used in the blood steam?
a) 0.16 mol/L b) 0.31 mol/L c) 0.60 mol/L d) 0.45 mol/L

424. Which is correct representation for $K = \frac{c_1}{c_2}$ relation?
a) The distribution coefficient K is in favour of phase I
b) The distribution coefficient K is in favour of phase II
c) The distribution coefficient is K
d) None of the above

425. The relationship between osmotic pressure at 273 K when 10 g glucose (p_1), 10 g urea (p_2) and 10 g sucrose (p_3) are dissolved in 250 mL of water is
a) $p_1 > p_2 > p_3$ b) $p_3 > p_2 > p_1$ c) $p_2 > p_1 > p_3$ d) $p_2 > p_3 > p_1$

426. The molarity of a solution made by mixing 50 mL of conc H_2SO_4 (36 N) with 50 mL of water is
a) 9 m b) 10 m c) 11 m d) 12 m

427. Equimolar solution in the same solvent have
a) Different boiling and different freezing points
b) Same boiling and same freezing points
c) Same freezing point but different boiling point
d) Same boiling point but different freezing point

428. Blood cells retain their normal shapes in solutions which are :
a) Isotonic to blood
b) Hypotonic to blood
c) Hypertonic to blood
d) Equinormal to blood

429. Volume of water needed to mix with 10 mL N HCl to get 0.1 N HCl is
a) 900 mL b) 9 mL c) 90 mL d) 100 mL

430. A 0.025 M solution of monobasic acid had a freezing point of -0.060°C. The pK_a for the acid is
a) 1.2 b) 2 c) 2.5 d) 5.7

431. The solubility of a solid in a liquid depends on :
a) Nature of solute b) Nature of solvent c) Temperature d) All of these

432. Temperature coefficient is the variation in the :
a) Distribution coefficient for 1° rise in the temperature
b) Concentration of solution for 10° rise in the temperature
c) Concentration of solution for 1° rise in the temperature
d) Distribution coefficient for 10° rise in the temperature

433. At low concentrations, the statements that equimolal solutions under a given set of experimental conditions have equal osmotic pressure is true for
a) Solutions of non-electrolytes only
b) Solutions of electrolytes only
c) All solutions
d) None of the above

434. The van't Hoff factor(i) for a dilute solution of $K_3[Fe(CN)_6]$ is :
a) 10 b) 4 c) 5 d) 0.25

435. Van't Hoff factor of aq K_2SO_4 at infinite dillution has value equal to
a) 1 b) 2 c) 3 d) Between 2 and 3

436. A solution containing 500 g of a protein per litre is isotonic with a solution containing 3.42 g of sucrose per litre. The molecular mass of protein is :
a) 5 b) 146 c) 34200 d) 50000

437. Two solutions of substance (non-electrolyte) are mixed in the following manner.
480 mL of 1.5 M first solution +520 mL of 1.2 M second solution.
What is the molarity of the final mixture ?
a) 2.70M b) 1.344 M c) 1.50 M d) 1.20M

438. Osmotic pressure of 0.4% urea solution is 1.60 atm and that of 3.42% cane sugar is 2.46 atm. When the above two solutions are mixed, the osmotic pressure of the resulting solution is
a) 0.82 atm b) 2.46 atm c) 1.64 atm d) 4.10 atm

439. Dissolving 120 g of urea (mol. Wt. 60) in1000 g of water gave a solution of density 1.15 g/mL. The molarity of the solution is
a) 1.78M b) 2.00M c) 2.05M d) 2.22M

440. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is
a) Vapour pressure b) Osmotic pressure c) Boiling point d) Freezing point

441. Volume of water needed to mix with 10 mL 10 N HNO_3 to get 0.1 N HNO_3 is
a) 1000 mL b) 990 mL c) 1010 mL d) 10 mL

442. Volume of 0.6 M NaOH required to neutralise 30 cm^3 of 0.4 M HCl is

a) 3 : 4 b) 1 : 2 c) 1 : 4 d) 1 : 1

443. At 40°C the vapour pressure in torr, of methyl alcohol-ethyl alcohol solutions is represented by the equation. $P = 119\, X_A + 135$; where X_A is mole-fraction of methyl alcohol, then the value of $\lim_{X_A \to 1} \frac{P_A}{X_A}$ is :

a) 254 torr b) 135 torr c) 119 torr d) 140 torr

444. An 1% solution of KCl (I), NaCl (II), $BaCl_2$ (III) and urea (IV) have their osmotic pressure at the same temperature in the ascending order (molar masses of NaCl, KCl, $BaCl_2$ and urea are respectively 58.5, 74.5, 208.4 and 60 g mol^{-1}). Assume 100% ionisation of the electrolytes at this temperature

a) I< III< II< IV b) III< I <II< IV c) I <II <III <IV d) III< IV< I <II

445. The vant's Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is

a) 91.3% b) 87% c) 100% d) 74%

446. The vapour pressure of water at 23°C is 19.8 mm. 0.1 mole of glucose is dissolved in 178.2 g of water. What is the vapour pressure (in mm) of the resultant solution?

a) 19.0 b) 19.602 c) 19.402 d) 19.202

447. To form a super saturated solution of salt one must :

a) Cool slowly b) Cool rapidly c) Add some salt to cold solution d) Use a clear vessel

448. An aqueous solution of glucose is 10% in strength. The volume in which 1 g-mole of it is dissolved will be

a) 0.18 L b) 1.8 L c) 0.9 L d) 9.0 L

449. Molal depression of freezing point of water is 1.86°C per 1000 g of water. 0.02 mole of urea dissolved in 100 g of water will produce a lowering of temperature of :

a) 0.186 °C b) 0.372 °C c) 1.86 °C d) 3.72 °C

450. The process of extracting a solute from its solution by an immiscible solvent can be more fruitful only if :

a) A large quantity of the solvent is used at once

b) The number of extractions is increased, using small quantities of the solvent

c) The process is carried out at a high temperature

d) Small quantities of the solution are added to the extracting solvent in several instalments

451. If a solution containing 0.072 g atm of sulphur in 100 g of a solvent ($k_f = 7.0$) gave a freezing point depression of 0.84°C, the molecular formula of sulphur in the solution is

a) S_6 b) S_7 c) S_8 d) S_9

452. The osmotic pressure of a solution can be accurately measured in the shortest possible time by :

a) Berkeley and Hartley method

b) Morse and Frazer method

c) Pfeffer method

d) None of the above

453. A solution contains 1.2046×10^{24} hydrochloric acid molecules in 1 dm^3 of the solution. The strength of the solution is

a) 6 N b) 2 N c) 4 N d) 8 N

454. Acetic acid on dissolution in benzene will show :

a) Two times of its normal molecular weight

b) Its normal molecular weight

c) Half of its normal molecular weight

d) None of the above

455. Who gave the phase rule?

a) Nernst

b) Willard Gibbs

c) Ostwald

d) Raoult

456. The volume of water to added to 100 cm^3 of 0.5 N H_2SO_4 to get decinormal concentration is

a) 400 cm^3 b) 450 cm^3 c) 500 cm^3 d) 100 cm^3

457. In which ratio of volume 0.4 M HCl and 0.9 M HCl are to be mixed such that the concentration of the

resultant solution becomes 0.7 M ?

a) Air b) Brass c) Amalgam d) Benzene in water

458. In a mixture of A and B, components show negative deviation when

a) $A—B$ interaction is stronger than $A—A$ and $B—B$ interaction

b) $A—B$ interaction is weaker than $A—A$ and $B—B$ interaction

c) $\triangle V_{mix} > 0, \triangle S_{mix} > 0$

d) $\triangle V_{mix} = 0, \triangle S_{mix} > 0$

459. When a substance is distributed between two immiscible solvents and remains in the same state in the solvent I, while, dissociates in the solvent II. If the concentration of solute are c_{I} and c_{II} in phase I and II respectively then :

a) $\dfrac{c_{\text{I}}}{c_{\text{II}}(1-\alpha)} = K$

b) $\dfrac{c_{\text{I}}(1-\alpha)}{c_{\text{II}}} = K$

c) $\dfrac{c_{\text{I}}(1-\beta)}{c_{\text{II}}} = K$

d) $\dfrac{c_{\text{I}}}{\sqrt{c_{\text{II}}(1-\alpha)}} = K$

460. A non-ideal solution was prepared by mixing 30 mL chloroform and 50 mL acetone. The volume of mixture will be

a) >80 mL b) <80 mL c) =80 mL d) ≥80 mL

461. The values of observed and calculated molecular weights of calcium nitrate are respectively 65.6 and 164. The degree of dissociation of calcium nitrate will be :

a) 25% b) 50% c) 75% d) 60%

462. After adding a solute freezing point of solution decreases to -0.186. Calculate $\Delta T_b \; if \; k_f = 1.86$ and $k_b = 0.512$

a) 0.512 b) 0.0512 c) 1.86 d) 0.0186

463. At 27 °C, the osmotic pressure of a solution containing 4.0 g solute (molar mass = 246) per litre at 27°C is : $(R = 0.0821 \text{ atms. mol}^{-1} K)$

a) 0.1 atm b) 0.4 atm c) 0.2 atm d) 0.8 atm

464. When 50 g of lactic acid was mixed with a mixture of equal volume of water and chloroform, the concentration of lactic acid in water was found to be 49.03 g litre^{-1} and in chloroform 0.97 g litre^{-1}. The distribution coefficient of lactic acid in favour of water is:

a) 50.55 b) 55.55 c) 60.55 d) 45.55

465. At a constant temperature, which of the following aqueous solutions will have the maximum vapour pressure?

(Mol. wt NaCl =58.5, $\text{H}_2\text{SO}_4 = 98.0 \text{ g. mol}^{-1}$)

a) 1 molal NaCl (aq) b) 1 molar NaCl (aq)

c) 1 molal H_2SO_4 (aq) d) 1 molar H_2SO_4 (aq)

466. A solution containing 10 g per dm^3 of urea (mol. mass = 60) is isotonic with a 5% (wt. by vol.) solution of a non-volatile solute. The molecular mass (in g mol^{-1}) of non-volatile solute is :

a) 350 b) 200 c) 250 d) 300

467. Non- volatile solute when dissolved in water :

a) Decreases the vapour pressure of water

b) Increases the boiling point of water

c) Decreases the freezing point of water

d) All of the above

468. The solubility of I_2 in water increases in the presence of :

a) Alcohol b) KI c) CCl_3 d) NaOH

469. Normality of 2 M $H_2 \, SO_4$ is

a) 2 N b) 4 N c) $\frac{N}{2}$ d) $\frac{N}{4}$

470. The solubility of a gas increases in a liquid with
a) Decrease in temperature b) Increases in temperature
c) Reduction of gas pressure d) Amount of liquid taken

471. The energy that favours dissolution of a solute in water is known as :
a) Hydration energy
b) Lattice energy
c) Ionization energy
d) Exothermic energy

472. Aqueous solution of 0.004 M Na_2SO_4 and 0.01 M glucose are isotonic. The degree of dissociation of Na_2SO_4 is :
a) 25% b) 60% c) 75% d) 85%

473. The most suitable method for the determination of molecular weight of oxyhaemoglobin, a compound of high molecular weight is :
a) Osmotic pressure method
b) Vapour pressure lowering method
c) Elevation of boiling point method
d) None of the above

474. The difference between the boiling point and freezing point of an aqueous solution containing sucrose (mol wt. = 342 $gmol^{-1}$) in 100 g of water is $105.0°C$. If K_f and K_b of water are 1.86 and 0.51 K kg mol^{-1} respectively, the weight of sucrose in the solution is about
a) 1 M solution of glucose b) 0.05 M solution of glucose
c) 6% solution of glucose d) 25% solution of glucose

475. In a mixture A and B components show negative deviation as :
a) $\Delta V_{\text{mix}} = +\text{ve}$
b) $\Delta H_{\text{mix}} = -\text{ve}$
c) $A - B$ interaction is weaker than $A - A$ and $B - B$ interaction
d) None of the above reason in correct

476. Which statement is not correct if two immiscible liquids of mol. wt. A and B respectively are mixed in equal amount to have a mixture?
a) $\frac{P'_A}{P'_B} = \frac{m_B}{m_A}$
b) The liquid having high mol. wt. will show lower values of P'
c) $P_M = P_A^0(X_A)_l + P_B^0(X_B)_l$
d) $P_M = P'_A + P'_B$

477. 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

478. The molar freezing point constant for water is 1.86°C mol^{-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°C b) −2.86°C c) +1.86°C d) +2.86°C

479. Two bottles A and B contains 1M and 1 m aqueous solution of sulphuric acid respectively
a) A is more concentrated than B
b) B is more concentrated than A
c) Concentration of A is equal to concentration of B
d) It is not possible to compare the concentrations

480. 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2g of water. the vapour pressure of water for this aqueous solution at 100°C is

a) 759.00 torr b) 7.60 torr c) 76.00 torr d) 752.40 torr

481. Benzene and toluene form nearly ideal solutions. At 25°C, the vapour pressure of benzene is 75 torr and that of toluene is 22 torr. The partial vapour pressure of benzene at 20°C for a solution containing 78 g of benzene and 46 g of toluene in torr is

a) 53.5 b) 37.5 c) 25 d) 50

482. The amount of urea dissolved in 500 cc of water ($K_f = 1.86$℃) to produce a depression of 0.186℃ in the freezing point is

a) 9 g b) 6 g c) 3 g d) 0.3 g

483. Distribution law is a special application of ….and $vice - versa$.

a) Raoult’s law
b) Henry’s law
c) Dalton’s law
d) None of these

484. In a 0.2 molal aqueous solution of a weak acid HX, the degree of ionisation is 0.3 Taking k_f for water as 1.85, the freezing point of the solution will be nearest to

a) -0.480℃ b) -0.360℃ c) -0.260℃ d) $+0.480$℃

485. The molality of a urea solution in which 0.0100 g of urea, $[(NH_2 0_2 CO]$is added to 0.3000 dm^3 of water at STP is

a) 0.555m b) 5.55×10^{-4}m c) 33.3m d) 3.33×10^{-2}m

486. Iodine was added to a system of water and CS_2. The concentration of I_2 in water and CS_2were found to be C_1/C_2 respectively. The ratio of C_1/C_2 will change if :

a) More I_2 is added
b) More CS_2 is added
c) More water is added
d) Temperature is changed

487. A solution of sucrose (Molar mass = 342 g/mol) is prepared by dissolving 68.4 g of it per litre of solution, what is its osmotic pressure (R=0.082 L atmK^{-1} mol^{-1}) at 273 K?

a) 0.01 M Na_2SO_4 b) 0.01 M KNO_3 c) 0.015 M urea d) 0.015 M glucose

488. At 25°C, the total pressure of an ideal solution obtained by mixing 3 moles of ‘A’ and 2 moles of ‘B’, is 184 torr. What is the vapour pressure (in torr) of pure ‘B’ at the same temperature? (Vapour pressure of pure ‘A’ at 25°C is 200 torr)

a) 180 b) 160 c) 16 d) 100

489. If 20 mL of 0.4 N NaOH solution completely neutralizes 40 mL of a dibasic acid, the molarity of the acid solution is

a) 0.1 M b) 0.3 M c) 0.5 M d) 0.7 M

490. 25 mL of a solution of barium hydroxide on titration with 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was

a) ppm b) Mg/100 cc c) g/L d) g/100 cc

491. Which of the following solutions will have the highest boiling point ?

a) 0.1 M $FeCl_3$ b) 0.1 M $BaCl_2$ c) 0.1 M NaVl d) 0.1 M urea

492. The relative lowering of vapour pressure of a dilute aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is about

a) 0.70 b) 0.50 c) 0.90 d) 0.80

493. The vapour pressure of pure liquid is 1.2 atm. When a non-volatile substance B is mixed in A, then its vapour pressure becomes 0.6 atm. The mole fraction of B in the solution is

a) 0.15 b) 0.25 c) 0.50 d) 0.75

494. If liquids A and B form an ideal solution, the

a) Enthalpy of mixing is zero
b) Entropy of mixing is zero
c) Free energy of mixing is zero

d) Free energy as well as the entropy of mixing are each zero

495. Which has the minimum freezing point?
a) One molal NaCl aqueous solution
b) One molal $\mathrm{CaCl_2}$ aqueous solution
c) One molal KCl aqueous solution
d) One molal urea aqueous solution

496. The depression in f.p. is directly proportional to :
a) Normality
b) Molality
c) Molarity
d) None of these

497. The vapour pressure will be lowest of
a) Hypertonic solution
b) Hypotonic solution
c) Isotonic solution
d) None of the above

498. In countries nearer to polar region, the roads are sprinkled with $\mathrm{CaCl_2}$. This is
a) To minimise the wear and tear of the roads
b) To minimise the snow fall
c) To minimise pollution
d) To minimise the accumulation of dust on the road

499. What is the molarity of 0.2 N Na_2CO_3solution?
a) 0.1 M
b) 0 M
c) 0.4 M
d) 0.2 M

500. Solubility of deliquescent substances in water is generally :
a) High
b) Low
c) Moderate
d) Cannot be said

501. An aqueous solution is 1.0 molal in KI. Which change will cause the vapour pressure of solution to increase :
a) Addition of NaCl
b) Addition of $\mathrm{Na_2SO_4}$
c) Addition of 1.0 molal KI
d) Addition of water

502. Which one of the following is not correct for an ideal solution?
a) It must obey Raoult's law
b) $\triangle \mathrm{H} = 0$
c) $\triangle \mathrm{V} = 0$
d) $\triangle \mathrm{H} = \mathrm{V} \neq 0$

503. A solution containing 4 g of polyvinyl chloride in 1 litre of dioxane was found to have an osmotic pressure of 6×10^{-4} atm at 300 K. The molecular mass of the polymer is :
a) 3×10^3
b) 1.6×10^5
c) 5×10^4
d) 6.4×10^2

504. The normality of mixture obtained by mixing 100 mL of 0.2 M $H_2SO_4 +$
100 mL of 0.2 M NaOH is
a) 0.2
b) 0.01
c) 0.1
d) 0.3

505. For a dilute solution, Raoult's law states that
a) The lowering of vapour pressure is equal to mole fraction of solute
b) The relative lowering of vapour pressure is equal to mole fraction of solute
c) The relative lowering of vapour pressure is proportional to the amount of solute in solution
d) The vapour pressure of the solution is equal to the mole fraction of solvent

506. 1 kg of NaOH solution contains 4 g of NaOH. The approximate concentration of the solution is
a) About 0.1 N
b) Decinormal
c) 0.1 molal
d) 0.1 molar

507. 6 g urea is dissolved in 90 g water. The relative lowering of vapour pressure is equal to :
a) 0.0196
b) 0.06
c) 1.10
d) 0.0202

508. The molar freezing point constant for water is 1.86°C/mol. 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°C
b) 1.86°C
c) −3.92°C
d) 2.42°C

509. Which is correct about Henry's law?
a) There should not be any chemical interaction between the gas and liquid
b) The gas in contact with the liquid should behave as an ideal gas
c) The pressure applied should be high
d) All of the above

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

a) 1 g b) 3 g c) 6 g d) 18 g

511. The volume of 10 N and 4 N HCl required to make 1L of 7 N HCl are

a) 0.50 L of 10 N HCl and 0.05 L of 4 N HCl b) 0.60 L of 10 N HCl and 0.40 L of 4 N HCl

c) 0.80 L of 10 N HCl and 0.20 L of 4 N HCl d) 0.75 L of 10 N HCl and 0.25 L of 4 N HCl

512. A solution of sulphuric acid in water exhibits :

a) Negative deviations from Raoult's law

b) Positive deviations from Raoult's law

c) Ideal properties

d) The applicability of Henry's law

513. The molarity of the solution obtained by dissolving 2.5g of NaCl in 100 mL of water is

a) 0.00428 moles b) 428 moles c) 0.428 moles d) 0.0428 moles

514. Which one is a colligative property?

a) Boiling point b) Vapour pressure c) Osmotic pressure d) Freezing point

515. A solution contains non-volatile solute of molecular mass M_2. Which of the following can be used to calculate the molecular mass of solute in terms of osmotic pressure?

a) $M_2 = \left(\frac{m_2}{\pi}\right) VRT$

b) $M_2 = \left(\frac{m_2}{V}\right) \frac{RT}{\pi}$

c) $M_2 = \left(\frac{m_2}{V}\right) \pi RT$

d) $M_2 = \left(\frac{m_2}{V}\right) \frac{\pi}{RT}$

($m_2 =$ mass of solute $V =$ volume of solution, $\pi =$ osmotic pressure)

SOLUTIONS

CHEMISTRY

: ANSWER KEY :

1)	b	2)	d	3)	a	4)	d	169)	c	170)	d	171)	a	172)	a
5)	d	6)	d	7)	a	8)	c	173)	a	174)	a	175)	a	176)	d
9)	a	10)	c	11)	a	12)	b	177)	b	178)	b	179)	b	180)	a
13)	a	14)	a	15)	c	16)	a	181)	d	182)	c	183)	a	184)	a
17)	c	18)	a	19)	a	20)	a	185)	d	186)	b	187)	c	188)	c
21)	d	22)	c	23)	a	24)	a	189)	d	190)	d	191)	d	192)	a
25)	b	26)	c	27)	c	28)	d	193)	b	194)	d	195)	c	196)	d
29)	a	30)	c	31)	b	32)	b	197)	a	198)	b	199)	d	200)	a
33)	b	34)	b	35)	c	36)	d	201)	a	202)	d	203)	c	204)	b
37)	d	38)	a	39)	b	40)	d	205)	d	206)	c	207)	d	208)	b
41)	b	42)	b	43)	b	44)	d	209)	b	210)	c	211)	b	212)	d
45)	a	46)	c	47)	c	48)	c	213)	d	214)	a	215)	c	216)	b
49)	c	50)	a	51)	b	52)	c	217)	c	218)	a	219)	a	220)	d
53)	a	54)	c	55)	d	56)	b	221)	c	222)	a	223)	c	224)	b
57)	b	58)	b	59)	d	60)	a	225)	a	226)	d	227)	c	228)	c
61)	d	62)	a	63)	d	64)	d	229)	d	230)	a	231)	b	232)	b
65)	b	66)	d	67)	a	68)	b	233)	d	234)	d	235)	a	236)	a
69)	a	70)	b	71)	b	72)	c	237)	c	238)	a	239)	c	240)	a
73)	d	74)	a	75)	b	76)	c	241)	c	242)	c	243)	d	244)	c
77)	a	78)	c	79)	b	80)	b	245)	b	246)	c	247)	d	248)	d
81)	a	82)	d	83)	b	84)	b	249)	a	250)	b	251)	b	252)	d
85)	c	86)	a	87)	c	88)	b	253)	a	254)	d	255)	a	256)	c
89)	c	90)	b	91)	d	92)	a	257)	a	258)	d	259)	b	260)	a
93)	c	94)	d	95)	d	96)	b	261)	b	262)	b	263)	d	264)	b
97)	a	98)	a	99)	a	100)	d	265)	a	266)	c	267)	d	268)	d
101)	c	102)	d	103)	b	104)	c	269)	d	270)	c	271)	c	272)	d
105)	a	106)	c	107)	b	108)	c	273)	d	274)	d	275)	a	276)	b
109)	a	110)	c	111)	b	112)	a	277)	d	278)	a	279)	d	280)	a
113)	d	114)	b	115)	c	116)	d	281)	c	282)	c	283)	c	284)	b
117)	c	118)	b	119)	d	120)	a	285)	b	286)	c	287)	c	288)	c
121)	a	122)	b	123)	a	124)	a	289)	b	290)	c	291)	a	292)	d
125)	d	126)	c	127)	a	128)	c	293)	a	294)	a	295)	a	296)	a
129)	b	130)	d	131)	c	132)	b	297)	a	298)	c	299)	b	300)	c
133)	b	134)	a	135)	c	136)	c	301)	a	302)	c	303)	d	304)	b
137)	b	138)	c	139)	a	140)	b	305)	a	306)	b	307)	a	308)	a
141)	b	142)	c	143)	a	144)	d	309)	a	310)	b	311)	d	312)	b
145)	b	146)	b	147)	a	148)	a	313)	b	314)	a	315)	a	316)	b
149)	d	150)	b	151)	b	152)	d	317)	a	318)	a	319)	c	320)	c
153)	a	154)	b	155)	c	156)	b	321)	c	322)	b	323)	a	324)	a
157)	a	158)	d	159)	b	160)	a	325)	a	326)	d	327)	d	328)	d
161)	a	162)	c	163)	b	164)	d	329)	a	330)	a	331)	c	332)	b
165)	a	166)	c	167)	c	168)	c	333)	c	334)	b	335)	a	336)	d

337)	c	338)	b	339)	b	340)	a	429)	c	430)	c	431)	d	432)	d
341)	b	342)	b	343)	b	344)	b	433)	a	434)	b	435)	c	436)	d
345)	b	346)	a	347)	d	348)	b	437)	b	438)	d	439)	c	440)	b
349)	b	350)	b	351)	b	352)	a	441)	b	442)	a	443)	a	444)	d
353)	c	354)	d	355)	a	356)	b	445)	b	446)	b	447)	b	448)	b
357)	b	358)	b	359)	c	360)	c	449)	b	450)	b	451)	a	452)	a
361)	b	362)	b	363)	b	364)	a	453)	b	454)	a	455)	b	456)	a
365)	b	366)	b	367)	b	368)	a	457)	d	458)	a	459)	a	460)	b
369)	c	370)	a	371)	c	372)	a	461)	c	462)	b	463)	b	464)	a
373)	b	374)	d	375)	b	376)	d	465)	a	466)	d	467)	d	468)	b
377)	d	378)	a	379)	a	380)	b	469)	b	470)	a	471)	a	472)	c
381)	a	382)	d	383)	b	384)	a	473)	a	474)	a	475)	b	476)	c
385)	a	386)	a	387)	c	388)	d	477)	a	478)	a	479)	a	480)	d
389)	a	390)	d	391)	b	392)	d	481)	d	482)	c	483)	b	484)	a
393)	c	394)	a	395)	c	396)	d	485)	b	486)	b	487)	a	488)	b
397)	a	398)	d	399)	c	400)	c	489)	a	490)	a	491)	a	492)	a
401)	d	402)	a	403)	b	404)	c	493)	c	494)	a	495)	b	496)	b
405)	d	406)	a	407)	b	408)	b	497)	c	498)	a	499)	a	500)	a
409)	d	410)	c	411)	b	412)	b	501)	d	502)	d	503)	b	504)	c
413)	c	414)	b	415)	b	416)	a	505)	b	506)	c	507)	a	508)	a
417)	c	418)	d	419)	b	420)	b	509)	b	510)	b	511)	a	512)	a
421)	b	422)	b	423)	b	424)	a	513)	c	514)	c	515)	b		
425)	c	426)	a	427)	b	428)	a								

SOLUTIONS

CHEMISTRY

: HINTS AND SOLUTIONS :

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

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

3 **(a)**

$K = \frac{c_A}{c_B} = 10$

$\therefore\ K' = \frac{c_B}{c_A} = \frac{1}{10} = 0.1$

4 **(d)**

1. $P_A = X_A p_A^\circ$ true

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

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

y= number of ions,

x = degree of ionization,

i=3 for $BaCl_2 x$=1(strong electrolyte)

i=(1+x) for $CH_3COOH\ x \ll 1 (weak)$

i=1for sucrose (non-electrolyte)

i(for$BaCl_2$) >KCl>$CH_3COOH >$ sucrose

Thus ,(c) is also true.

4. $\Delta T_f = k_f m$

k_f is dependent on solvent

Thus, freezing points [=T(solution)-ΔT_f) are different.

Thus, (d) is false.

5 **(d)**
Osmotic pressure is a colligative property *i.e.*, depends only upon the number of particles or ions in solution. More the number of ions in solution, more will be the osmotic pressure of solution

(i) 0.1 M urea and 0.1 M glucose will have same number of molecules in solution as they do not ionise.

(ii) KCl $\rightarrow K^+ + Cl^-$ (2 ions)

5. $CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$ (3 ions)

$\therefore CaCl_2$ produces maximum number of ions.

$\therefore$ It will have highest osmotic pressure.

6 **(d)**

Mole of $X, n_x = \frac{3}{3+2} = \frac{3}{5}$

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

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

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

Nacl solution

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

$\therefore$ Concentration

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

NaCl dissociates as follows

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

$\therefore$ Concentration of ions in solution

=2× 0.119 M

=0.0238 M

MgCl solution

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

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

$MgCl_2$ dissociates as follows

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

$\therefore$ Concentration of ions in solution =3×0.074 M

=0.222 M

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

9 **(a)**

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

10 **(c)**

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

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

11 **(a)**

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

$= \frac{1000 \times w_1}{m_1 W_1}$

$= \frac{1000 \times 0.6}{60 \times 200}$

$= 0.05$

[∴ *Molecular weight of* $NH_2CONH_2 = 60$]

Given, $\Delta T_b = 0.05$

$\Delta T_b = K_b \times m$

or $0.05 = K_b \times 0.05$

∴ $K_b = 10\, K\, mol^{-1}$

12 **(b)**

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

13 **(a)**

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

where, *M* = molecular weight of the solute

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

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

From Eqs. (i)and(ii)

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

Weight of solute = 480 g

14 **(a)**

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

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

m=100

Actual molecular mass =100

∴ The degree of ionisation of the electrolyte is 0% .

15 **(c)**

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

16 **(a)**

For a given amount of solute in two solvents,

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

17 **(c)**

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

18 **(a)**

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

Before dissociation 1 0 (

After dissociation 0 3

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

∴ van't Hoff's fator, $i = 4$

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

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

$= 2.3 \times 10^{-2}\,°C$

∴ $T'_f = 0 - 2.3 \times 10^{-2}$

$= -2.3 \times 10^{-2}\,°C$

19 **(a)**

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

mole-fraction

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

In 10 mole solubility is 4×10^{-4}.

20 **(a)**

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

21 **(d)**

All are conditions for Henry's law.

22 **(c)**

2 % acetic acid solution

$= \frac{2 \times 1000}{60 \times 100}$M acetic acid

=0.33 M acetic acid

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

Mol.wt. of "*X*"$= \frac{5 \times 1000}{0.33 \times 100} = 150$

23 **(a)**

Osmotic pressure is a colligative property.

24 **(a)**

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

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

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

25 **(b)**

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

26 **(c)**

Both the molecules are polar and possess dipole.

27 **(c)**

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

28 **(d)**

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

29 **(a)**

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

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

π (cane sugar)=π (unknown solute)

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

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

$$=60$$

30 **(c)**

$p\text{V} = n\text{RT}$

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

$n = 0.998$ mol

The no. of moles of ethane = x

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

Reaction of ethane and ethene with O_2:

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

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

According to (i) reactions

2 mole ethane reacts with =7 mole O_2

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

According to (ii) reactions

1 mole ethene reacts with = 3 mole O_2

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

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

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

0.5x = 3.333 - 2.994 = 0.3393

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

moles of ethene = 0.998 – 0.678 =0.32

31 **(b)**

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

van't Hoff factor for Na_2SO_4 =3

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

$$=3 \times 1.86 \times 0.01$$

$$\left[\because \quad m = \frac{0.01}{1} = 0.01\right]$$

$$=0.0558 \text{ K}$$

32 **(b)**

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$$

$$\Rightarrow \text{molarity} = \frac{5}{205} = 2\text{M}$$

33 **(b)**

Elevation in boiling point is a colligative property as it depends upon the number of particles

$\Delta T_b \propto n$

For sucrose $n = 1$ $\Delta T_b = 0.1$°C

For NaCl, $n = 2, \Delta T_b = 0.2$°C

34 **(b)**

In a pair of two solution, the one having higher osmotic pressure is called hypertonic and the other having lower osmotic pressure is called hypotonic.

36 **(d)**

$P_{total} = P_A^\circ X_A + P_B^\circ X_B$

where , P= vapour pressure

X= mole fraction

Total moles of A and B= 5

Mole fraction of compound A= $\frac{2}{5}$

Mole fraction of compound B= $\frac{3}{5}$

then, $\quad P_{total} = 100 \times \frac{2}{5} + 80 \times \frac{3}{5}$

= 88 torr

37 **(d)**

According to Raoult's law the relative lowering of vapour pressure of a dilute solution is equal to the mole fraction of the solute present in the solution, *i.e.*,

$$\frac{p - p_s}{p} = \frac{n}{n + N}$$

38 **(a)**

If $H_2O = x$ mol = 18x g

Then urea = x mol = 60x g

Total mass of the solution

=18x + 60x=78xg

Mass % of urea = $\frac{18x}{78x} \times 100$

=23.077%

40 **(d)**

$\frac{P_0 - P_s}{P_0}$ = molality × (1 − **α** + x**α** + y**α**)

The value of $P_0 - P_s$ is maximum for BaCl_2.

41 **(b)**

Mole of urea $= \frac{6.02\times10^{20}}{6.02\times10^{23}} = 10^{-3}\text{mol}$

Conc. of solution (in molarity)$= \frac{10^{-3}}{100} \times 1000 =$ 0.01 M

42 **(b)**

$\pi V = \frac{w}{m} RT$

$\text{M}=\frac{wRT}{\pi V}$

Here, w=6 g, $\pi = 2 \times 10^{-3}\ atm$, T=300 K, R=0.080 L-atm $\text{mo}l^{-1}\ K^{-1}$, V =200 mL =0.2 L

$\text{M}= \frac{6 \times 0.080 \times 300}{2\times10^{-3}\times0.2} = 3.6 \times 10^{5}$

43 **(b)**

Normality of the mixed solution

$$= \frac{N_1V_1+N_2V_2}{V_1+V_2}$$

$$= \frac{0.6\times\frac{100}{1000}+0.3\times\frac{200}{1000}}{\frac{100+200}{1000}}$$

$$=\frac{0.6\times0.1+0.3\times0.2}{0.3}$$

$$=\frac{0.06+0.06}{0.3}$$

$$= \frac{0.12}{0.3} = 0.4\text{ N}$$

45 **(a)**

Colligative properties certain properties of dilute solution containing non-volatile solute do not depend upon the nature of the solute dissolved but depend only upon the number of particles of the solute present, are called colligative properties. Some colligative properties are boiling point elevation, freezing point depression, lowering of vapour pressure,

46 **(c)**

$$N = \frac{w \times 1000}{\text{eq. wt.}\times V(\text{mL})}$$

$$= \frac{10 \times 1000}{60 \times 100} = 1.66\text{ N}$$

47 **(c)**

In a pair of two solution, the one having higher osmotic pressure is called hypertonic and the other having lower osmotic pressure is called hypotonic.

49 **(c)**

Two solutions are isotonic if their osmotic pressure are equal.

$\pi_1 = \pi_2$

$M_1ST_1 = M_2ST_2$

($M_1$and M_2 are molarities)

At a given temperature,

$M_1 = M_2$

$\frac{1000w_1}{m_1V_1} = \frac{1000w_2}{m_2V_2} \quad (V_1 = V_2 = 100mL)$

Cane sugar unkown

$\therefore \quad \frac{w_1}{m_1} = \frac{w_2}{m_2}$

$\frac{5}{329} = \frac{1}{m_2}$

$m_2 = \frac{342}{5}$=68.4 g mol^{-1}

50 **(a)**

The two solvents in which a solute is to be distributed shows $K = c_1/c_2$ only when two liquids are immiscible, $i.e.$, No. of phase ≥ 2 or heterogeneous systems.

51 **(b)**

KNO_3 dissociates completely while CH_3COOH dissociates to a small extent hence, $p_1 > p_2$

52 **(c)**

$\Delta T = \Delta T$ for glucose $= \Delta T$ for KCl $+ \Delta T$ for urea

$$= \frac{1000 \times 1.86 \times 10}{100 \times 180} + \frac{1000 \times 1.86 \times 1 \times 2}{74.5 \times 100} + \frac{1000 \times 1.86 \times 5}{100 \times 60}$$

$= 3.069$

$\therefore$ f. p. $= 273 - 3.069 = 269.93$ K

53 **(a)**

$$N = \frac{6 \times 1000}{40 \times 100} = 1.5\text{ N}$$

54 **(c)**

$N_1V_1 + N_2V_2 = N_3V_3$

$0.3 \times 100 + 0.6 \times 200 = N_3 \times 300$

$0.3 + 1.2 = 3N_3$

$N_3 = 0.5$

55 **(d)**

This is the mathematically modified form of distribution law when solute undergoes association in either of the solvent.

56 **(b)**

Common salt dissociates to furnish ions.

57 **(b)**

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

van't Hoff factor i=[1+(y-1) α]

where y is the number of ions from one mole solute, (in this case =3), α the degree of dissociation.

i=(1+2 α)

58 **(b)**

It is definition of freezing point.

59 **(d)**

According to Raoult's law,

$P_A = P_A^\circ\, \varkappa_A$

or $\varkappa_A = \frac{P_A}{P_A^\circ}$

$= \frac{32\text{mm Hg}}{40 \text{ mm Hg}} = 0.8$

60 **(a)**

Depression in freezing point is a colligative property. It depends on number of particles. More the number of particles, more will be depression in freezing point.

6. $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

It gives 3 particles.

7. $NaCl \rightarrow Na^+ + Cl^-$

It gives 2 particles.

8. Urea→ No dissociation

9. Glucose → No dissociation.

∴ K_2SO_4 produces maximum number of particles

∴ K_2SO_4 has maximum depression in freezing point.

61 **(d)**

All get dissolved with evolution of heat.

62 **(a)**

$\mathcal{X} = \frac{n}{n+N}$

$n = \frac{w}{m} = \frac{3.65}{36.5} = 0.1$

$N = \frac{W}{M} = \frac{16.2}{18} = 0.9$

$\mathcal{X} = \frac{0.1}{0.1 + 0.9} = 0.1$

63 **(d)**

Moles $= \frac{\text{mass}}{\text{molecular weight}}$

Given, mass of $Al_2\ (SO_4)_3 = 50$ g

molecular mass of $Al_2\ (SO_4)_3 = 342$

∴ Moles of $Al_2\ (SO_4)_3\ = \frac{50}{342} = 0.14$ mol

64 **(d)**

We have, i=1-$\frac{x}{2}$

where, x = degree of association

Here, i=0.54

0.54=1-$\frac{x}{2}$

$or \quad 0.54 - 1 = -\frac{x}{2}$

$or \quad -0.46 = -\frac{x}{2}$

x= 0.92

65 **(b)**

Benzoic acid dimerises in beneze.

Mol. wt. of benzoic acid

=78+12+32=122

Hence , moleculer weight of benzoic acid in benzene is

=122+122=244

66 **(d)**

$$\underset{(1-\alpha)}{HBr} \rightleftharpoons \underset{\alpha}{H^+} + \underset{\alpha}{Br^-}$$

i Total $= (1-\alpha) + \alpha + \alpha = (1+\alpha)$

$i = 1 + 0.9 = 1.9$

$\Delta T_f = ik_f m = 1.9 \times 1.86 \times \frac{8.1}{81} \times \frac{1000}{100} = 3.53$℃

$T_f = T - \Delta T_f = 0 - 3.53$℃ $= -3.53$℃

67 **(a)**

On increasing the concentration of a salt solution, the boiling point of salt solution increases while vapour pressure of the solution decreases.

68 **(b)**

(ii) 0.1 M glucose,

$\pi = CRT = 0.1RT$

(iii) 0.6 g urea in 100 mL solution

$\pi = \frac{n}{V}RT = \frac{w/m}{V}RT = \frac{0.6/60 \times 1000}{100} \times RT$

$= 0.1RT$

(iv)1.0 g of non electrolyte solute (x) is 50 mL solution

$\pi = \frac{1.0/200}{50} \times 1000RT = 0.1RT$

Hence, option (ii), (iii), (iv) have some osmotic pressure, osmotic pressure of 0.1 M NaCl is higher than (ii), (iii), (iv) because it dissociates to give maximum number

69 **(a)**

Osmosis is explained in terms of vapour pressure theory, *i.e.*, movement of solvent particles from higher vapour pressure to lower vapour pressure. Note that a solution of high osmotic pressure is concentrated in comparison to other having low osmotic pressure.

70 **(b)**

An increase in temperature favours evaporation due to increase in average kinetic energy of molecules.

72 **(c)**

Due to higher K_f of camphor (40 K molality^{-1}) about 20 times more than K_f(1.86) of water, the depression is 20 times more in case of camphor used as solvent than water.

73 **(d)**
On dissociation, number of particles increases, thus $i > 1$ On association, number of particles decreases thus $i < 1$.

74 **(a)**
$V_{\text{ice}} \longrightarrow V_{\text{water}}$ and thus, increase in pressure favours forward reaction.

75 **(b)**

$$K = 2 = \frac{\frac{8-a}{1}}{\frac{a}{2}}$$

$\therefore\ a = 4\text{g}$

$\therefore$ Concentration of acid $= \frac{4}{2} = 2$ g litre^{-1}.

76 **(c)**
Molarity $= \frac{\text{moles of solute}}{V \text{ of soution in litre}}$

$\therefore$ Molar solution means 1 mole of solute is present in 1 L of solution.

77 **(a)**

$$\text{Molality} = \frac{18}{180} = 0.1 \text{ molal}$$

78 **(c)**
$\Delta T = K_b \times \text{molality};$
Molality $= 1$, $\quad \therefore\ \Delta T = K_b$

79 **(b)**
When 0.1 n NaOH is used,
$N_1V_1 = N_2V_2$
(For HCl) (For KOH)
$0.2N \times V_1 = 50 \times 0.1N$
$V_1 = \frac{50 \times 0.1}{0.2} = 25cm^3$
When 0.5 N KOH is used,
$N_1V_1 = N_3V_3$
(For remaining HCl) (for KOH)
$0.2N \times 25 = 0.5\, N \times V_3$
$V_3 = \frac{0.2 \times 25}{0.5}$
$= 10cm^3$

80 **(b)**
1 mole urea gives 1 mole
1 mole NaCl gives 2 mole
1 mole Na_2SO_4 gives 3 mole
$\therefore\ \Delta T$ ratio 1 : 2 : 3

81 **(a)**
Colligative properties are used for the determination of molar mass

82 **(d)**

$$\text{Mole fraction of } C_6H_6 = \frac{\frac{7.8}{78}}{\frac{7.8}{78}+\frac{46}{92}} = \frac{1}{6}$$

83 **(b)**

$$\Delta T = \frac{K_b \times 1000 \times w \times 18}{m \times W \times 18}$$

$\therefore \quad 0.104 = \frac{0.52 \times 1000 \times n}{N \times 18}$

$\therefore \quad \frac{n}{N} = 3.6 \times 10^{-3}$

or $\quad 1 + \frac{n}{N} = 1.0036$

or $\quad \frac{N}{n+N} = 0.996$

$\therefore \quad \frac{n}{n+N} = 0.004$

84 **(b)**
$P_{H_2O} = X_{H_2O}\, p_{\text{total}}$
$= 0.0287 \times 0.977$
$=0.028\text{atm}$
$p_{\text{total}} = p_{\text{dry air}} + p_{H_2O}$
$p_{\text{dry air}} = p_{\text{total}} + p_{H_2O}$
$= 0.977\text{-}0.028 = 0.949$ atm

85 **(c)**
A natural semipermeable membrane is one which exist in nature.

87 **(c)**
More is the lattice energy of an ionic solute, lesser is its solubility.

88 **(b)**
The tendency to evaporation will decrease and this will lead to lower value of experimental vapour pressure than those calculated from Raoult's law.

90 **(b)**
HgI_2 although insoluble in water but shows complex formation with KI and therefore, freezing point decreases

91 **(d)**
Solutions should be dilute to hold distribution law correct.

92 **(a)**
For complete neutralisation,
m. wq of $H_2SO_4 =$ m. eq. of NaOH
$0.1 \times 2 \times V = 50 \times 0.2 \times 1$
$(\because 0.1M\ H_2SO_4 = 0.2N\ H_2SO_4)$
$V = 50\text{mL}$

93 **(c)**
$\Delta T = \text{molality} \times K'_f \times (1 + \alpha)$
Given $\alpha = 0.2$, Molality $= 0.5$, $K'_f = 1.86$
$\therefore \quad \Delta T = 0.5 \times 1.2 \times 1.86 = 1.116\, K$

94 **(d)**
$\text{M} = \frac{1000 \times k_f \times w}{\Delta T_f \times W}$
$= \frac{1000 \times 1.86 \times 4.5}{0.465 \times 100}$
$= 180\ g$

95 **(d)**

According to Raoult's law $\frac{P^0-P_s}{P_0}=\frac{N_1}{N_1+N_2}$

$\therefore \quad 1-\frac{P_s}{P_0}=\frac{N_0}{N_1+N_2}$

or $\frac{P_s}{P_0}=1-\frac{N1}{N_1+N_2}=\frac{N_2}{N_1+N_2}$ or $\boxed{P_s=P_0\times\frac{N_2}{N_1+N_2}}$

Also, we can derive from $\frac{P_0-P_s}{P_0}=\frac{N_1}{N_1+N_2}$

$\therefore \quad \frac{P_0}{P_0-P_s}=\frac{N_1+N_2}{N_1}=1+\frac{N_2}{N_1}$

or $\frac{P_s}{P_0-P_s}=\frac{N_2}{N_1}$ or $\boxed{\frac{P_0-P_s}{P_s}=\frac{N_1}{N_2}}$

96 **(b)**

Given, w = 24.5 g

V= 1L = 100 mL

M=?

Mol. wt. of NaOH = 23+16+1=40

We know that,

$M=\frac{w\times1000}{m\times V}=\frac{24.5\times1000}{40\times1000}$

∴ Molarity of solution = 0.6125 M

97 **(a)**

Relative lowering of vapour pressure = mole fraction of solute

(Raoult,s law)

$\frac{P-P_s}{P}=X_2$

$\frac{P-P_s}{P}=\frac{wM}{mW}$

where, w=wt. of solute

M=mol. wt. of solvent

m= mol. wt. of solute

W= wt. of solvent

$0.0125=\frac{wM}{mW}$

or $\frac{M}{mW}=\frac{0.0125}{18}=0.00070$

Hence, molality

$=\frac{w}{mW}\times1000=0.0007\times1000=0.70$

98 **(a)**

Van't Hoff's factor (i)=4 $\{3K^+[Fe(CN)_6]^{3-}\}$

Molality $=\frac{0.1}{329}\times\frac{1000}{100}=\frac{1}{329}$

$\Rightarrow \quad -\triangle T_f=iK_f.m$

$=4\times1.86\times\frac{1}{329}=2.3\times10^{-2}$

$\Rightarrow \quad T_f=-2.3\times10^{-2}{}^\circ\text{C}$

(As freezing point of water is $0^\circ C$)

99 **(a)**

w=0.15 g, W=15 g,

ΔT_b =0.216℃

k_b = 2.16℃

$\therefore$ M$=\frac{k_b\times w\times100}{\Delta T_b\times W}$

$=\frac{2.16\times0.15\times1000}{0.216\times15}=100$

100 **(d)**

Normality of acid = molarity × basicity

Molarity $=\frac{N}{\text{basicity}}$

$=\frac{0.2}{2}$=0.1M

101 **(c)**

Vapour phase composition over liquid phases of mixture may have any value.

Recall that $P'_A=P_M\times X_{A(\text{in vapour phase})}=P^0\times X_{A(\text{in liquid phase})}$

102 **(d)**

H$X \rightleftharpoons$ H$^+ + X^-$

1 mole 0 0 initial

1 − 0.3 0.3 0.3 after dissociation

Total moles = 0.7 + 0.3 + 0.3 = 1.3

$\therefore \quad i=\frac{1.3}{1}=1.3$

$\Delta T_f=i\times k_f\times m=1.3\times1.85\times0.2=0.481$℃

$\therefore T_f=T-\Delta T_f=0-0.481$℃ $=-0.481$℃

103 **(b)**

It is therefore also known as Nernst distribution law.

104 **(c)**

Sucrose, urea and glucose are non-electrolytes. They do not dissociate but ethanol dissociates into$C_2H_5O^-$ and H^+ ions, so, it has highest number of ions among given choices. (Colligative property ∝ number of ions of solute.)

105 **(a)**

Actual molecular weight of naphthoic acid $(C_{11}H_8O_2)$=172

Molecular mass (calculated)

$=\frac{1000\times k_f\times w}{W\times\Delta T_f}$

$=\frac{1000\times 1.72\times 20}{50\times 2}=344$

van't Hoff factor $(i)=\frac{\text{actual mol.wt.}}{\text{calculated mo.wt.}}=\frac{172}{344}$

$=0.5$

106 **(c)**

$$\frac{p^0-p_s}{p^0}=\frac{w}{m}\times\frac{M}{w}$$

$$\frac{0.30\text{ mm}}{17.54\text{ mm}}=\frac{20}{m}\times\frac{18}{100}\Rightarrow m=\frac{20\times 18\times 17.54}{0.30\times 100}$$

$$=210.48$$

107 **(b)**

Liquid phase does not exist above T_c.

108 **(c)**

According to Raoult's law

$$\frac{p-p_s}{p}=\frac{n}{n+N}=\frac{0.05}{2.5+0.05}$$

$$=\frac{0.05}{2.55}=\frac{1}{51}$$

weight of solute $=\frac{w}{W}\times M\times\frac{p}{p-p_s}$

$$=\frac{10\times 18}{90}\times 51$$

$=102$ g

110 **(c)**

According to Raoult' law,

$$\frac{p-p_s}{p}=\frac{n}{n+N}$$

111 **(b)**

$\text{M}=\frac{100\times k_b\times w}{\Delta T_b\times W}$

Given, $k_b=5.2$

w= mass of solute = 6 g

W=mass of solvent =100 g

ΔT_b = elevation in boiling point = 0.52℃

M= molecular weight =?

$\therefore$ M $=\frac{100\times 5.2\times 6}{0.52\times 100}=60$

113 **(d)**

Azerotropic mixture has constant boiling mixture, it is not possible to separate the components of azeotropic mixture by boiling

114 **(b)**

For isotonic solutions,

$$\frac{w_1}{m_1}=\frac{w_2}{m_2}\Rightarrow\frac{5}{342}=\frac{1}{m_2}\Rightarrow m_2=\frac{342}{5}=68.4$$

115 **(c)**

$Ca(NO_3)_2\leftrightharpoons Ca^{2+}+2NO_3^-$

It furnishes 3 ions per formula unit.

So, its van't Hoff factor is 3.

116 **(d)**

According to Raoult's law, the relative lowering in vapour pressure of a dilute solution is equal to mole fraction of the solute present in the solution

117 **(c)**

Nernst's distribution law at constant temperature, when different quantities of a solute are allowed to distribute between two immiscible solvents in contact with each other then at equilibrium the ratio of the concentration of the solute in two layers is constant for similar species which may be present.

Distribution coefficient

$$K_D=\frac{\text{concentration of X in solvent }A(C_1)}{\text{concentration of X in solvent }B(C_2)}$$

118 **(b)**

$\pi_1V_1+\pi_2V_2=\pi_R(V_1+V_2)$

$1\times 1+3.5V=2.5(1+V)$

$1+3.5V=2.5+2.5V$

or $V=1.5$ L

119 **(d)**

Each has different molarity.

121 **(a)**

It is the definition of boiling point.

122 **(b)**

$K=\frac{c_1}{c_2}$

123 **(a)**

$\Delta T_b=k_b\times molality$

for dilute solution

molarity=molality=2(given)

and $k_b=0.52$(given)

$\therefore$ $\Delta T_b=0.52\times 2=1.04$℃

Now ,

$\Delta T_b=$ boiling point of solution – boiling point of solvent

(*i.e.*, H_2O)

$\therefore$ boiling point of solution $=\Delta T_b+b.pt\ of\ H_2O$

=1.04+100

=101.04℃

124 **(a)**

It is a characteristic of given solvent.

125 **(d)**

$$\Delta T_b=\frac{k_b\times w\times 1000}{m\times W}$$

$$\therefore m=\frac{k_b\times w\times 1000}{\Delta T_b\times W}=\frac{2.53\times 10\times 1000}{1\times 100}$$

$$=253\text{ g}$$

126 **(c)**

$F+P=C+2$

127 **(a)**

Beckmann thermometers do not read actual b. p. or f. p., but they give b. p., f. p. values on their scale.

128 **(c)**

The one whose boiling point is more than that of either of the two pure components is known as azeotropic mixture with maximum boiling point.

This is formed by non-ideal solutions showing negative derivation

129 **(b)**

$P'_A = P_A^0 X_A$ and $P_B^0 X_B$

$P'_A = P_M Y_A$ and $P'_B = P_M Y_B$

$\therefore \quad \frac{P'_A}{Y_A} = \frac{P'_B}{Y_B}$

or $\quad \frac{P_A^0 X_A}{Y_A} = \frac{P_B^0 X_B}{Y_B} = \frac{P_B^0 (1-X_A)}{(1-Y_B)}$

or $\quad \frac{P_B^0}{X_A} = \frac{P_A^0}{Y_A} + (P_B^0 - P_A^0)$

or $\quad \frac{1}{X_A} = \frac{1}{Y_A} \cdot \frac{P_A^0}{P_B^0} + \frac{(P_B^0 - P_A^0)}{P_B^0}$

or $\quad y = mx + C$

$\therefore$ slope $= m = \frac{P_A^0}{P_B^0}$ and intercept C $= \frac{(P_B^0 - P_A^0)}{P_B^0}$

131 **(c)**

Number of moles = Molarity × Volume (in L)

$\Longrightarrow$ Number of moles of $H_2\,SO_4 = 2.0\,M \times 5.0\,L$

$= 10$ moles

132 **(b)**

	$Ba(NO_3)_2$	$\rightleftharpoons$ Ba^{2+}	+ $2NO_3^-$
At t=0	0.1 M	0	0
At equilibrium	(0.1-x)M	xM	2xM

$i = \frac{(0.1-x)+x+2x}{0.1}$

$2.74 = \frac{0.1+2x}{0.1}$

$0.1+2x = 0.274$

$2x = 0.274 - 0.1 = 0.174$

$x = \frac{0.174}{2} = 0.087$

$\therefore$ Degree of dissociation $= \frac{0.087}{0.1} \times 100 = 87\%$

133 **(b)**

$$K = 82 = \frac{[\text{conc. of } I_2] \text{in } CCl_4}{[\text{conc. of } I_2\,] \text{in } H_2O}$$

$$= \frac{[\text{conc. of } I_2] \text{in } CCl_4}{0.8}$$

$\therefore$ [conc. of I_2] in $CCl_4 = 65.6$ g/L

134 **(a)**

$W = \frac{NE\,V}{1000}$

$N = \frac{W \times 1000}{E \times V}$

$= \frac{6.3 \times 1000}{63 \times 250} = 0.4N$

$N_1 V_1 = N_2 V_2$

$0.1 \times V_1 = 0.4 \times 10$

$V_1 = \frac{0.4 \times 10}{0.1}$

$V_1 = 40$ mL

135 **(c)**

$K_D = \frac{concentration\ of\ X\ in\ solvent\ A}{concentration\ of\ X\ in\ solvent\ B}$

Concentration of Ag in 10 cm^3 Zn=x

Concentration of Ag in 100 cm^3 Pb=$\frac{1-x}{10}$

Concentration of Ag in 10 cm^3 Pb=$\frac{1-x}{10}$

$300 = \frac{x \times 10}{(1-x)} \quad or\ x = \frac{300}{100} = 0.967 \quad = 97\%$

Concentration of Ag in zinc =1 -0.967=0.033

=3.3%

136 **(c)**

Water boils at higher temperature than its b. p. if atmosphere pressure is more than 1 atm.

137 **(b)**

$\Delta T_f = i \times k_f \times \frac{n}{W} \times 1000$

$6 = 2 \times 1.86 \times \frac{n}{1} \times 1$

$$n = \frac{6}{2 \times 1.86} = 1.62$$

138 **(c)**

Molarity $= \frac{10 \times \text{density} \times \text{wt.of solute}}{\text{mol.wt.of the solute}}$

density $= \frac{3.60 \times 98}{10 \times 29} = 1.21$

% by weight of solute × density

139 **(a)**

Lowering is always positive.

140 **(b)**

$$\frac{p^0 - p_s}{p^0} = \frac{w \times M}{m \times W}$$

$$\frac{143 - p_s}{143} = \frac{0.5}{65} \times \frac{154}{1.58 \times 100}$$

[$\because$ molecular weight of $CCl_4 = 154$ and weight=density×volume]

$143 - p_s = 1.07 \Rightarrow p_s = 141.93$ mm

141 **(b)**

Given, in 100 g of solution NaOH present

= 10 g

$\therefore$ In 500 g of solution NaOH present

$= \frac{10 \times 500}{100} = 50$ g

So, 50 go NaOH will be required to prepare 500 g 10%$\frac{w}{w}$ NaOH solution.

142 **(c)**

Strength of $H_2SO_4 = 98 \times 19.8$ g/L

$S =$ eq. wt.$\times N$

$$N = \frac{S}{\text{eq. wt.}} = \frac{98 \times 19.8}{49} = 39.6$$

143 **(a)**

The exosmosis occurs from cell to solution (hypertonic or high osmotic pressure or high concentration).

144 **(d)**

Beckmann thermometer does not read actual b.p. or f.p. of solution but gives their value on its scale. This leads to evaluation of ΔT_f or ΔT_b upto a least count of 0.01°C.

145 **(b)**

Avogadro's number

$N_A = 6.02 \times 10^{23} = 1$ mol

$\therefore$ 6.02×10^{20} molecules = 0.001 Mol in 100 mL (0.1 L) solution

$\therefore$ Molar concentration $= \frac{\text{mol}}{\text{volume in L}}$

$= \frac{0.001}{0.1} = 0.01$ M

146 **(b)**

Super saturated state is a meta stable state.

147 **(a)**

$w = 1000\ \text{g}(\text{H}_2\text{O}); n = 1$ mol

$$N = \frac{W}{M} = \frac{1000}{18} = 55.55$$

$$\mathcal{X}_{\text{solute}} = \frac{n}{n + N} + \frac{1}{1 + 55.55}$$

$= 0.018$

148 **(a)**

The molal depression constant (k_f) for camphor is maximum. Hence depression of freezing point (ΔT_f) will be maximum for camphor.

150 **(b)**

When $A - B$ interactions are greater less vapour are formed *ie*, solution shows negative deviation

151 **(b)**

Given, weight of PVC, w= 4g

Volume of solution, V= 1 L

Osmotic pressure, $\pi = 4.1 \times 10^{-4}$

Temperature, T=27°C =27+273=300K

$\Rightarrow$ πV=nRT

Or πV=$\frac{w}{M}RT$(M=moleclular weight)

$4.1 \times 10^{-4} \times 1 = \frac{4}{M} \times 0.0821 \times 300$

M=$\frac{4 \times 0.0821 \times 300}{4 \times 10^{-4} \times 1}$

$\therefore$ M=2.4×10^5

152 **(d)**

These are facts.

153 **(a)**

Colligative properties depends only upon the number of solute particles. Since, optical activity depends upon the nature of substance (through which plane polarised light is passed), it is not a colligative property.

154 **(b)**

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

$7.10 \times 10^{-3} = i \times 1.86 \times 0.001$

$i = 3.817$

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

$$\therefore 1 = \frac{3.817 - 1}{(x + 1) - 1}$$

$x = 2.817 \approx 3$

$\therefore$ molecular formula of the compound is $\text{K}_3[\text{Fe(CN)}_6]$

155 **(c)**

Given, vapour pressure of benzene,

$p°$=640 mm Hg

Vapour pressure of solution,

p=600 mm Hg

Weight of solute, w= 2.175 g

Weight of benzene, W= 39.08 g

Molecular weight of benzene,

M=78 g

Molecular weight of solute, m=?

According to Raoult's law,

$$\frac{P° - P}{P°} = \frac{w \times M}{m \times W}$$

$$\frac{640 - 600}{640} = \frac{2.175 \times 78}{m \times 39.08}$$

$$\frac{40}{640} = \frac{2.175 \times 78}{m \times 39.08}$$

$$m = \frac{16 \times 2.175 \times 78}{39.08}$$

m=69.60

156 **(b)**

$\Delta T_b = mk_b$

$\Delta T_f = mk_f$

$$\frac{\Delta T_b}{\Delta T_f} = \frac{k_b}{k_f} = \frac{0.512}{1.86}$$

$$\Delta T_b = \frac{0.512}{1.86} \times 0.186$$

=0.0512°

157 **(a)**

$a \propto P$

$\therefore$ $6.56 \times 10^{-2} \propto 1$

$5.0 \times 10^{-2} \propto P$

$\therefore$ $P = 0.762$ bar

158 **(d)**

$$\frac{P_0 - P_s}{P_s} = \frac{w \times M}{m \times W};$$

$$\frac{1020 - 990}{990} = \frac{5 \times 78}{m \times 58.5}; m = 220$$

159 **(b)**

$$\pi = \frac{1.66 + 2.46}{2} = 2.06 \text{ atm}$$

160 **(a)**

According to Raoult's law

Mole fraction of solute $= \frac{p - p_s}{p}$

$$= \frac{760 - 750}{760} = \frac{10}{760} = \frac{1}{76}$$

161 **(a)**

$$\frac{P_0 - P_s}{P_0} = \frac{w/m}{\frac{w}{m} + \frac{1000}{18}};$$

$$\therefore\ 0.00713 = \frac{71.5/m}{\frac{71.5}{m} + \frac{1000}{18}};$$

$\therefore$ $m = 180$

162 **(c)**

$$\text{ppm} = \frac{\text{weight of solute} \times 10^6}{\text{weight of solution}}$$

$$= \frac{25 \times 10^{-3} \times 10^6}{5000} = 5$$

163 **(b)**

Liquid mixtures showing negative deviations from Raoult's law possess higher b. p.

164 **(d)**

Higher vapour pressure of H_2O in atmosphere will derive H_2O vapours to solute particles.

165 **(a)**

$K = 85 = \frac{a}{0.33}$; $\therefore a = 28.05$ g litre^{-1}

166 **(c)**

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

$$= \frac{1000 \times 5.12 \times 1}{250 \times 51.2}$$

$$= 0.4 \text{ K}$$

167 **(c)**

Mole fraction and molality does not involve volume therefore they are independent of temperature.

168 **(c)**

(i)Azeotropic mixtures having boiling point less than either of the two pure components show positive deviation from Raoult's law.

(ii) Azeotropic mixtures having boiling point more than either of two pure components show negative deviation from Raoult's law.

169 **(c)**

$$\Delta T_f = \frac{1000 \times 0.52 \times 0.25}{250} = 0.52^\circ\text{C}$$

170 **(d)**

$P_m = 760$ torr, because solution boils at 88°C.

Now, $760 = 900 \times$ m. f. of $C_6H_6 + 360 \times (1 -$ m. f. of $C_6H_6)$

$\therefore \; 760 = 900a + 360 - 360a$;

$\therefore \; a = 0.74$

Where a is mole fraction of C_6H_6.

171 **(a)**

Due to addition of nitric acid in water, the vapour pressure of pure water decreases

172 **(a)**

Moist air contains H_2O vapours in air.

173 **(a)**

$M_{NaNO_3} = 1 \times 1$ $\therefore$ No. of particles $= 1 \times 2 = 2$

$M_{Ba(NO_3)_2} = 1 \times \frac{1}{2}$ $\therefore$ No. of particles $= \frac{1}{2} \times 3 = 1.5$

$M_{Al(NO_3)_3} = 1 \times \frac{1}{3}$ $\therefore$ No. of particles $= \frac{1}{3} \times 4 = 1.33$

$M_{Th(NO_3)_4} = 1 \times \frac{1}{4}$ $\therefore$ No. of particles $= \frac{1}{4} \times 5 = 1.25$

174 **(a)**

The boiling occurs at lower temperature if atmospheric pressure is lower than 76 cm Hg.

175 **(a)**

For two non-electrolytic solution if isotonic $c_1 = c_2$,

$$\therefore \frac{5.25 \times 1000}{m \times 100} = \frac{1.50 \times 1000}{60 \times 100}$$

$\therefore \; m = 210$ g mol^{-1}

176 **(d)**

Na_3PO_4 will furnish more ions. More is vapour pressure lowering, lesser is vapour pressure.

177 **(b)**

The endosmosis occurs from solution (hypotonic or low osmotic pressure or low concentration) to cells.

178 **(b)**

The number of moles or gram molecules of solute dissolved in 1000 g of solvent = molality

117 g NaCl = 2 mol

Hence, concentration of solution = 2 molal

179 **(b)**

$\Delta T_f = ik_f m$

$0.335 = i \times 1.86 \times 0.1$

$i = 1.80$

For NaBr, $i = 1 + \alpha$

$\alpha = 0.80 = 80\%$

180 **(a)**

An increases in temperature increase the volume of the solution and thus, decreases its molarity

181 **(d)**

$$P_M = 80 \times \frac{3}{5} + 60 \times \frac{2}{5}$$

$$= 48 + 24 = 72 \text{ torr}$$

182 **(c)**

$$\Delta T = \frac{1000 \times K \times w}{m.W};$$

$$\therefore \; \Delta T = \frac{1000 \times 0.53 \times 2}{4000} = 0.265,$$

$$\therefore \; T_b = 100 + 0.265 = 100.265^\circ\text{C}$$

183 **(a)**

$$\frac{P_0 - P_s}{P_0} = \frac{1}{1+2} = \frac{1}{3};$$

$$\therefore \; 1 - \frac{P_s}{P_0} = \frac{1}{3}$$

Thus, $\frac{P_s}{P_0} = 1 - \frac{1}{3} = \frac{2}{3}$

184 **(a)**

$$K = 588 = \frac{x/50}{\frac{(1-x)}{1000}}$$

$\therefore\ x = 0.965$ g

Where, x is amount of I_2 in CS_2. Thus, it aqueous layer $I_2 = 1 - 0.965 = 0.035$ g

185 **(d)**

$$\text{Normality} = \frac{\text{no.of g−equivalents of solute}}{\text{volume of solution in litre}}$$

Given, basicity = 2, mol. wt. = 200,

V= 100 mL = 100/1000L

Normality = 0.1

$$\text{Eq. wt.} = \frac{\text{mole.wt.}}{\text{basicity}} = \frac{200}{2} = 100$$

$$\text{N} = \frac{\text{mass /eq. wt.}}{\text{volume of solution in litre}}$$

or $0.1 = \frac{\text{mass /100}}{100/1000}$

or $0.1 = \frac{\text{mass /100}}{0.1}$

or mass = 0.1 × 0.1× 100= 1.0 g

186 **(b)**

Vapour pressure of a solution increases with temperature, decreases with increase in mole fraction of solute and decreases with degree of dissociation of solute.

187 **(c)**

We know that 1 g equivalent weight of NaOH = 40 g

$\therefore$ 40 g of NaOH = 1 g eq. Of NaOH

$\therefore$ 0.275 g of NaOH $= \frac{1}{40} \times 0.275$ eq.

$= \frac{1}{40} \times 0.275 \times 1000$

=6.88 meq

$\therefore$ $N_1V_1 = N_2V_2$

(HCl) (NAOH)

$N_1 \times 35.4 = 6.88$ ($\because$ meq = NV)

$N_1 = 0.194$

188 **(c)**

$\Delta T_b = \frac{1000K'b \times w}{m.W}$; if $w/m = 1, W = 1000$ g.

$\Delta T_b = K'_b$

189 **(d)**

All are desired condition for Henry's law.

190 **(d)**

According to Raoult's law the relative lowering in vapour pressure of an ideal solution containing the non-volatile solute is equal to the mole fraction of the solute.

$\because$ Relative lowering of vapour pressure =0.2

$\therefore$ Mole fraction of the solute =0.2

191 **(d)**

Elevation in boiling point is a colligative property, i.e., depends upon the number of particles. Hence, the electrolyte which give largest number of particles in the solution, has the highest boiling point.

Since $K_2[Fe(CN)_6]$ gives largest number of particles, *i.e.*, 5, hence it has the highest boiling point.

192 **(a)**

Mol wt. ratio of A and B=1:4

$\therefore$ Mole ratio of A and B, if equal weight of A and B are taken = 4:1

$\therefore$ Partial pressure of $B = \frac{1}{(1+4)} \times p$

$= \frac{p}{5}$

193 **(b)**

10. $N_1V_1 = N_2V_2$

11. Amount of water to be added

= total volume – volume of NaOH

Given, normality of NaOH =N_1 =0.1 N

Volume of NaOH =V_1=?

Normality of HCl(N_2)= 0.2 N

Volume Of HCl = V_2 = 50mL

$N_1V_1 = N_2V_2$

$0.1 \times V_1 = 0.2 \times 50$

$V_1 = \frac{0.2 \times 50}{0.1} = 100$mL

$V$of NaOH = 40 mL

Amount of water to be added =100 - 40=60 mL

194 **(d)**

$$M = \frac{1000 \times k_f \times w}{\Delta T \times W}$$

$$62 = \frac{1000 \times 1.86 \times 50}{9.3 \times W}$$

$W = 161.3$ g

Total water =200 g

Hence, ice separated= (200 − 161.3)g = 38.7 g

195 **(c)**

$$\Delta T = \frac{100 \times K_f \times w}{m.W} \times i$$

$\Delta T = 0 - (-3.82) = 3.82$°C

$$3.82 = \frac{1000 \times 1.86 \times 5 \times i}{142 \times 45}$$

$i = 2.63$

196 **(d)**

$P_T = P_A^\circ X_A + P_B^\circ x_B$

Mixture solution boil at 1 atm = 760 mm = total pressure.

$760 = 520\,X_A + 100(1 - X_A)$

$X_A = 0.5$, mol% of A =50%

197 **(a)**

To show colligative properties solute should be non-volatile and soluble in given solvent.

198 **(b)**

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

i for HBr=1 +α

where, α =degree of dissociation

i=1+0.9=1.9

$\therefore \quad \Delta T_f = 1.9 \times 1.86 \times \frac{8.1 \times 1000}{100 \times 81}$

=3.534℃

Freezing point =-3.534℃

199 **(d)**

The formula $\Delta T = K_b \times$ molality is valid when solute neither dissociates nor associate. In case of dissociation :

$\Delta T = K_b \times$ molality $(1 - \boldsymbol{\alpha} + x\boldsymbol{\alpha} + \mathrm{y}\boldsymbol{\alpha})$. In case of association

$\Delta T = K_b \times$ molality $(1 - \boldsymbol{\alpha} + \boldsymbol{\alpha}/n)$. In case of association

200 **(a)**

$$\mathrm{Cr_2O_7^{2-}} + 6\mathrm{Fe^{2+}} + 14\mathrm{H^+} \longrightarrow 6\mathrm{Fe^{3+}} + 2\mathrm{Cr^{3+}} + 7\mathrm{H_2O}$$

Hence, 1 mol of $\mathrm{Cr_2O_7^{2-}}$ = 6 moles of Fe^{2+}

$$\frac{M_1V_1}{1} = \frac{M_2V_2}{6}$$

$$\frac{0.1 \times V_1}{1} = \frac{0.5 \times 35}{6}$$

$$V_1 = \frac{0.5 \times 35}{6 \times 0.1}$$

$$V_1 = 29.2 \text{ mL}$$

202 **(d)**

$\mathrm{p} = P_A^\circ X_A + P_B^\circ x_B$

$\Rightarrow \quad 84 = 70 \times 0.8 + P_B^\circ \times 0.2$

$84 = 56 + P_B^\circ \times 0.2$

$P_B^\circ = \frac{28}{0.2} = 140$ mm

203 **(c)**

As the colligative properties depend only upon the number of particles of solute, so if the non-volatile solute dissociate or associates in the solution, the value of colligative properties deviates, *i.e.,* abnormal colligative properties are obtained.

204 **(b)**

Osmosis a slow process occurs from dilute to concentrated solution.

205 **(d)**

At triple point, all the three phase exist together.

$(P = 2.56 \text{ mm}, T = 0.0098^\circ\text{C})$

206 **(c)**

Molality depends only upon weights, not on volumes whereas other given concentration terms depend upon the volume of solution. Volume of solution increases with rise in temperature but temperature does not affect the weights, therefore molality is independent of temperature .

207 **(d)**

Addition of glycol lowers the freezing point of water and thus, glycol water mixture is used as antifreeze in radiators of cars.

208 **(b)**

Given,

R=8.314 JK^{-1} mol^{-1}

$T_f = 273 + 16.6 = 289.6\,K$

$L_f = 180.75\ Jg^{-1}$

k_f =?

$$k_f = \frac{R.T_f^2}{1000 \times L_f}$$

$$= \frac{8.314 \times (289.6)^2}{1000 \times 180.75}$$

$$k_f = 3.86$$

209 **(b)**

$\Delta T_f = K_f m$

$= \frac{1.86 \times 45 \times 1000}{62 \times 600}$

$= 2.2$

Freezing point of solution =273.15K-2.2 K

=270.95 K

210 **(c)**

The phenomenon in which, when two solutions of different concentration (one may be solvent) are kept separated by semipermeable membrane, the solvent molecules start flowing from dilute solution to concentrate solution. This is called osmosis. Osmosis is a slow process and keeps on happening until the concentration of both solutions become equal.

211 **(b)**

Methanol has low boiling point than $\mathrm{H_2O}$, lower is boiling point of solvent more is vapour pressure

212 **(d)**

Each system is non-ideal and shows $\Delta H_{\text{mix}} < 0$.

213 **(d)**

Moles of glucose $= \frac{18}{180} = 0.1$

Moles of $H_2O = \frac{178.2}{18}$ 9.9

According to Raoult's law

$$\frac{P^\circ - P_S}{P^\circ} = X_{\text{solute}}$$

$$\frac{17.5 - P_S}{17.5} = \frac{0.1}{10}$$

so, $P_s = 17.325\text{mm Hg}$

214 **(a)**

$$P_M = P_A^0 . X_A + P_B^0 . X_B$$
$$P_M = P_A^0 . X_A + P_B^0\,(1 - X_A)$$
$$760 = 520 . X_A + 1000 - 1000\,X_A$$
$$\therefore \quad X_A = \frac{240}{480} = 0.5$$
$$\therefore \quad \text{mole \%} = 50$$

215 **(c)**

$$i = \frac{\text{Exp. colligative properties}}{\text{Normal colligative properties}}$$

Put colligative properties $\propto \frac{1}{\text{mol.wt.}}$

216 **(b)**

For isotonic solutions, $\pi_1 = \pi_2$(and for non-electrolytes also $c_1 = c_2$).

217 **(c)**

$$C = \frac{5}{342} \times \frac{1}{100} \times 1000 = \frac{50}{342}\,\text{mol/L}$$
$$\pi = \frac{50}{342} \times 0.082 \times 423 = 5.07\text{ atm}$$

218 **(a)**

$$\triangle T_f = \frac{1000\,K_f w_1\,(i)}{m_1 w_2}$$
$$\therefore \quad 6 = \frac{1000 \times 1.86 \times w_1 \times 1}{62 \times 4000}$$
$$w_1 = 800\,g$$

219 **(a)**

Let molality of solution $= x$

Moles of solute in 1000 g benzene

$$= \frac{1000}{78} = 12.82$$

Mole fraction of solute $= \frac{x}{x+12.82}$

$$0.2 = \frac{x}{x+12.82}$$

or $\quad 0.2(x+12.82) = x$

or $\quad 0.2x + 2.564 = x$

$$2.564 = x - 0.2x$$
$$x = \frac{2.564}{0.8} = 3.2$$

220 **(d)**

This is the mathematically modified form of distribution law when solute undergoes association in either of the solvent.

221 **(c)**

Rest all are applications of distribution law.

222 **(a)**

According to Raoult's law, for non volatile solute, the relative lowering of vapour pressure of a solution is equal to the mole fraction of the solute

$$\frac{p - p_s}{p} = \frac{n}{n + N}$$

224 **(b)**

$$\text{Molarity}(m) = \frac{M}{1000d - MM'} \times 1000$$

Where M' =molar mass of solute

$$3 = \frac{M \times 1000}{1000 \times 1.11 - M \times 40}$$
$$1000M = 3330 - 120\text{ M}$$
$$1120\,M = 3330$$
$$M = \frac{3330}{1120} = 2.9732$$

225 **(a)**

An ionic compound having $\Delta H_\text{l} > \Delta H_\text{h}$ is insoluble in water.

226 **(d)**

These are conditions for the validity of distribution law.

227 **(c)**

Volume of monobasic acid $= 10cm^3$

Normality of monobasic acid $= 0.1$ N

Volume of NaOH solution$= 15cm^3$

Normality of NaOH solution =?

$$N_1\,V_1 \quad = \quad N_2\,V_2$$

(for monobasic acid) (for NaOH)

$$10 \times 0.1\,N = 15 \times N_2$$
$$N_2 = \frac{1N}{15} = 0.066\,N$$

228 **(c)**

$$\text{Molality }(m) = \frac{M}{1000d - MM_1} \times 100$$

M = Molarity

M_1 = Molecular mass

d = density

$$= \frac{2.05}{(1000 \times 1.02) - (2.05 \times 60)} \times 100$$
$$= 2.28\text{ mol kg}^{-1}$$

229 **(d)**

According to question,

$w_A = x\text{g}, \; m_A = 18, \; X_A = 1 - 0.6 = 0.4$

$w_B = 69\text{g}, \; m_B = 46, \; X_B = 0.4$

We know that,

$$X_A = \frac{n_A}{n_A + n_B}$$

or $\quad 0.4 = \dfrac{w_A/m_A}{\frac{w_A}{m_A} + \frac{69}{46}}$

$$0.4 = \frac{x/18}{\frac{x}{18} + \frac{3}{2}}$$
$$0.4 \times \left(\frac{2x+54}{36}\right) = \frac{x}{18}$$

or $\quad 2x+54=5x$

or $\quad 3x=54, x=18$ g

230 **(a)**

$\Delta H_\text{solution} = \Delta H_\text{hydration} + \Delta H_\text{lattice energy}$

$\Delta H_\text{h} = -\text{ve}$

$\Delta H_\text{l} = +\text{ve}$

231 **(b)**

Molarity Molarity of a solution is the number of moles of the solute per litre of solution. Unit of molarity is mol/L.

232 **(b)**

$M = \frac{w}{m \times V(\text{L})}$

$0.25 = \frac{w}{106 \times 0.25}$

$\therefore w = 6.625$ g

233 **(d)**

$K_4[Fe(CN)_6]$ furnishes maximum ions (*ie*, 5) thus, it has maximum value of van't Hoff factor

234 **(d)**

For ternary electrolyte;

$P_1 = CST = 0.05 \times 3 \times S \times T;$

For B; $2P = 0.1 \times S \times T;$

$\therefore \quad P_1 = 3P$

235 **(a)**

$\Delta T_f = \text{molality} \times K_f$

$= \frac{68.5 \times 1000}{342 \times 1000} \times 1.86$

$= 0.372$

$\therefore T_f = 0 - 0.372 = -0.372^\circ\text{C}$

236 **(a)**

According to Raoult's law

$p = p_A^\circ X_A + p_B^\circ X_B$

$= 290 = 200 \times 0.4 + p_B^\circ \times 0.6$

$p_B^\circ = 350$

237 **(c)**

Molarity, $M = \frac{W_2 \times 1000}{M_2 \times Vol.(mL)}$; where w_2 mass of H_2SO_4 in g, M_2 is the molar mass of H_2SO_4

$w_2 = \frac{1 \times 98 \times 200}{1000} = 19.6\ g$

$H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{2-}$

But according to equation 1 mole of H_2SO_4 gives 2 mole of $[H_2O^+]$ ions. So, the amount of H_2SO_4 to prepare 200 mL solution having the 1 M concentration oH_3O^+ ions is 19.6/2 = 9.8 g.

238 **(a)**

$N_1V_1 = N_2V_2$

0.164 M NaOH ≅ 0.164 N NOH

$N_1 = ?, V_1 = 25$ mL, $N_2 = 0.164$, $V_2 = 32.63$ mL

$N_1V_1 = N_2V_2$

or $\quad N_1 = \frac{N_2V_2}{V_1}$

$= \frac{0.164 \times 32.63}{25}$

$= 0.214$ N H_2SO_4

0.214 N $H_2SO_4 \cong \frac{0.214}{2}$ M H_2SO_4 ($\because$ Basicity of $H_2SO_4 = 2$)

≅0.107 M H_2SO_4

239 **(c)**

$\Delta T = K_f \times m,$

$\therefore \quad 10 = 1.86 \times m;$

or $\quad m = 5.376$

240 **(a)**

A gas is more soluble if (i) More are forces of attractions among molecules of gases,

ii) More being the tendency of ionization in a solvent and

iii) More is H-bonding .

241 **(c)**

Molality $\frac{Moles\ of\ solute}{kg\ of\ solvent} = \frac{5.2\ mol\ CH_3OH}{kg\ (=100g) H_2O}$

$n_1(CH_3OH) = 5.2$

$n_2(H_2O) = \frac{1000}{18} = 55.56$

$\therefore n_1 + n_2 = 5.20 + 55.56 = 60.76$ mol

$\therefore X_{CH_3OH} = \frac{n_1}{n_1+n_2} = \frac{5.2}{60.76} = 0.086$

242 **(c)**

Suppose the equal mass of methane and oxygen = w= 1g

Mole fraction of oxygen $= \frac{w/32}{\frac{w}{32} + w/16}$

$= \frac{\frac{1}{32}}{\frac{3}{32}} = \frac{1}{3}$

Let the total pressure $= p$

Pressure exerted by oxygen (partial pressure)

$= X_{o_2} \times p_{total} = p \times \frac{1}{3}$

243 **(d)**

In Ist case,

When two liquids X and Y are mixed in the molar ratio 1:1.

Moles of X= 1

Moles of Y=1

Mole fraction of $X(\varkappa_x) = \frac{1}{2}$

Mole fraction of $Y(\varkappa_Y) = \frac{1}{2}$

We know that

p=$p_X^\circ \varkappa_x + p_Y^\circ \varkappa_Y$ (p=total pressure of mixture)

$400 = \frac{1}{2} p_X^\circ + \frac{1}{2} p_Y^\circ$

$400 \times 2 = p_X^\circ + p_Y^\circ$ ...(i)

For case IInd ,

When liquids are mixed in the molar ratio of 1:2,

Mole fraction of X=1

Mole fraction of Y= 2

Mole fraction of $X(\varkappa_x) = \frac{1}{3}$

Mole fraction of $Y(\varkappa_y) = \frac{2}{3}$

$P = p_X^\circ \varkappa_X + p_Y^\circ \varkappa_Y$

$350 = \frac{1}{3} p_X^\circ \frac{2}{3} p_Y^\circ$

$350 \times 3 = p_X^\circ + 2p_Y^\circ$ ...(ii)

From Eqs (i) and (ii) , we get

$p_X^\circ = 550mm$

$$p^{\circ}_Y = 250\ mm$$

244 **(c)**

$Na_2SO_4 = 2Na^+ + SO_4^{2-}$

$\underset{1-\alpha}{1} \qquad \underset{2\alpha}{0} \qquad \underset{\alpha}{0}$

Where α is degree of dissociation

∴ $i = 1 - \alpha + 2\alpha + \alpha = 1 + 2\alpha$

245 **(b)**

$p_M = p'_A + p'_B$

$= p_A \cdot x_A + p_B \cdot x_B \qquad (\because p'_A = p_A \cdot x_A)$

$= p_A \cdot x_A + p_B(1 - x_A) \quad (\because x_A + x_B = 1)$

$= p_B + x_A(p_A - p_B)$

246 **(c)**

For ideal solution,

$\triangle H_{\text{solution}} = \triangle H_1 + \triangle H_2 + \triangle H_3$

247 **(d)**

Azeotropic mixture of HCl and water has 20.24% of HCl. It boils at 108.5°C under a pressure of one atmosphere.

248 **(d)**

Molarity

$$= \frac{\text{weight \% of solute} \times \text{density of the solution} \times 10}{\text{molecular weight of the solution}}$$

$$= \frac{98 \times 1.84 \times 10}{98}$$

$= 18.4$

249 **(a)**

$\pi = CRT$

Hence, $C = 0.2$ M

$R = 0.082$ L atm $mol^{-1}K^{-1}$

$T = 27 + 273 = 300$ K

$\pi = 0.2 \times 0.082 \times 300\ K$

$= 4.92$ atm.

250 **(b)**

Let the volume of 0.4 M HCl is V_1 and that of 0.9 M HCl is V_2.

We know that,

$NV = N_1V_1 + N_2V_2$

(Mixture) (for 0.4 M HCl) (for 0.9 M HCl)

$0.7(V_1 + V_2) = 0.4 \times V_1 + 0.9 \times V_2$

[∵1m HCl = 1N HCl]

$0.7V_1 + 0.7V_2 = 0.4\ V_1 + 0.9\ V_2$

$0.7V_1 + 0.4V_1 = 0.9V_2 + 0.7V_2$

$0.3V_1 = 0.2V_2$

$\frac{V_1}{V_2} = \frac{0.2}{0.3} = \frac{2}{3}$

251 **(b)**

(π) glucose $= (\pi)$ unknown compound

$0.05 = \frac{3}{M}$

$M = \frac{3}{0.05} = 60$

$n = \frac{60}{30} = 2$ (e.f.m. for $CH_2O = 30$)

so, molecular formula$= C_2H_4O_2$

252 **(d)**

By Ostwald-walker dynamic method, the relative lowering of vapour pressure, lowering of vapour pressure and vapour pressure of the solvent, all can be measured.

In this method, the apparatus used, contains two bulbs: bulb A contains solution and bulb B contains solvent. The loss of weight in bulb B gives the lowering vapour pressure and total loss of weight in both the tubes gives the vapour pressure of the solvent and

Relative lowering of vapour pressure

$$= \frac{\text{lowering of vapour pressure}}{\text{vapour pressure of solvent}}$$

253 **(a)**

$$K = 9 = \frac{a \times 10}{(0.1 - a) \times 10}$$

Where a is the molarity of organic compound in CCl_4 at equilibrium

∴ $a = 0.09\ M$

Thus, molarity of organic compound left in water

$= 0.1 - 0.09$

$= 0.01\ M$

254 **(d)**

$$M_2 = \frac{K_f \times w_2 \times 1000}{\triangle T_f \times w_1}$$

$or \quad M_2 = \frac{1.86 \times 1.8 \times 1000}{0.465 \times 40} = 180$

$n = \frac{180}{\text{emp.formula mass}} = \frac{180}{30} = 6$

Molecular formula of the compound is $C_6H_{12}O_6$.

255 **(a)**

According to Raoult's law in a solution of a non-volatile solute, the the relative lowering in vapour pressure is always equal to the mole fraction of the solute.

$$\frac{p - p_s}{p} = X_A = \frac{N_A}{N_A + N_B}$$

256 **(c)**

$P'_A = P_A^0 \cdot X_A + P_M \cdot Y_A$

$P'_A = P_B^0 \cdot X_B = P_M \cdot Y_B$

$\therefore \frac{P_A^0}{P_B^0} \cdot \frac{X_A}{X_B} = \frac{Y_A}{Y_B}$

$\because \frac{P_A^0}{P_B^0} > 1 \qquad \therefore \frac{X_A}{X_B} < \frac{Y_A}{Y_B}$

257 **(a)**

Normality of 2.3 M $H_2SO_4 = M \times$ basicity

$= 2.3 \times 2 = 4.6$ N

258 **(d)**

$i = 1 + \alpha$

$= \frac{\text{cal. mol. weight}}{\text{exp. mol. wt}} = \frac{58.5}{30} = 1.95$

$\therefore 1 + \alpha = 1.95$

$\alpha = 0.95$

259 **(b)**

Molarity of H_2SO_4 =5 M

Normality of $H_2SO_4 = 2 \times 5$ =10 N

$N_1V_1 = N_2V_2$

$10 \times 1 = N_2 \times 10$ or N_2 =1 N

260 **(a)**

$$K = \frac{\text{[Succinic acid] in water}}{\text{[Succinic acid] in ether}} = \frac{\frac{1.843}{M\times100}}{\frac{0.127}{M\times50}}$$

$= 7.26$

261 **(b)**

Substances of high vapour pressure (*e*.g., gasoline) evaporates more quickly than substances of low vapour pressure (*e*.g., motor oil).

262 **(b)**

Lowering of vapour pressure is a colligative property, *i.e.,* depends only upon the number of particles of solute and not on the nature of solute.

$\because$ 0.1 M Glucose ⟶ remains undissociated

0.1 m $BaCl_4 \rightarrow Ba^{2+} + Cl^- \Rightarrow 3\ ions$

0.1 m $MgSO_4 \rightarrow Mg^{2+} + SO_4^{2-} \Rightarrow 2\ ions$

0.1 M NaCl $\rightarrow Na^+ + Cl^- \Rightarrow 2\ ions$

$\therefore$ 0.1 m $BaCl_2$gives maximum number of particles, hence it exhibits maximum lowering of vapour pressure.

263 **(d)**

Amount of gas dissolved per unit volume $\propto$ pressure of gas; this is Henry's law.

264 **(b)**

Osmotic pressure (π)=CRT

Here, C = concentration of solution

C=$\frac{n}{V}$

n=$\frac{w}{m} = \frac{\text{weight in gram of substance}}{\text{mol.weight ofsubstance}}$

V=1L

C=$\frac{68.4}{342}$

$\pi = \frac{68.4}{342} \times 0.082 \times 273$

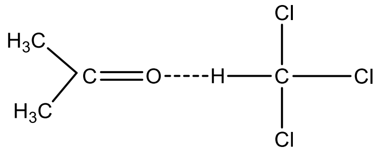
=4.48 atm

265 **(a)**

Molarity gets affected as it is the number of moles per unit volume (volume increases with increase of temperature).

266 **(c)**

The solution of acetone and chloroform shows negative deviation from Raoult's law because acetone and chloroform make the hydrogen bond.



So

$\triangle H_{mix}$ *and* $\triangle V_{mix}$ *both are negative.*

267 **(d)**

$P'_A = P_A^0 \,.X_A$ and $P'_A = P_M \cdot X'_A$

$P'_B = P_M \cdot X'_B$

$\therefore \frac{P'_A}{P'_B} = \frac{X'_A}{X'_B} = \frac{(n_A)_V}{(n_B)_V}$

268 **(d)**

$$\frac{P_0 - P_s}{P_s} = \frac{w \times M}{m \times W}$$

$$\frac{10}{(750-10)} = \frac{2 \times 78}{m \times 78'}$$

$\therefore \quad m = 148;$

m comes 150 if formula $\frac{P_0 - P_s}{P_0}$; $\frac{w \times M}{m \times W}$ is used. But this is only for dilute solutions.

269 **(d)**

—do—

270 **(c)**

For same solution $\frac{\Delta T_f}{\Delta T_b} = \frac{K'_f}{K'_b}$ *or* $\Delta T_f = \Delta T_b \times \frac{K'_f}{K'_b}$

or $\Delta T_f = \frac{0.15 \times 1.86}{0.512} = 0.545$

Now on diluting the solution to double

$\Delta T_f \propto \frac{1}{\text{wt. of solvent}}$

$\therefore \quad \Delta T_f = \frac{0.545}{2} = 0.272$

$\therefore \quad$ f.p.$= -0.272$°C

271 **(c)**

$\pi V = nST$

or $\pi = cST$

$\therefore c = \frac{0.821}{0.0821 \times 300} = 0.033\ M$

272 **(d)**

$\because$ 20 g glucose is dissolved in 100 mL solution

$\therefore$ 1 g glucose is dissolved in $=\frac{100}{20}$

180 g (g-mole) glucose is dissolved in

$= \frac{100 \times 180}{20} =$ 900 mL

$=$ 0.9L

273 **(d)**

$\Delta T_f = \frac{1000\, k_f w}{mW}$

$\Delta T_f = 0.19$°C; k_f =5.08 kg mol^{-1}, w=1g, W=80g

M=$\frac{1000 k_f w}{\Delta T_f W}$

$=\frac{1000\times5.08\times1}{0.19\times80} = 334.21$

Atomic weight of As =74.92

Hence, number of atoms $=\frac{334.21}{74.92} \approx 4$

Hence, the formula of arsenic is As_4.

274 **(d)**

Reverse osmosis involves movement of solvent particles through semipermeable membrane from concentrated solution to dilute solution under pressure.

275 **(a)**

When ethylene glycol is added to H_2O as antifreeze, it decreases the freezing point of H_2O in winter and increase the boiling point of water in the summer.

276 **(b)**

Elevation in boiling point is colligative property and depends upon number of ions of molecules or particles.

$CaSO_4 \rightarrow Ca^{2+} + SO_4^{2-}$ ∴ 2 ions

$BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$ ∴ 3 ions

NaCl $\rightarrow Na^+ + Cl^-$ ∴ 2 ions

urea → no dissociation ∴ 1 molecule

∵ $BaCl_2$ furnishes maximum ions.

∴ $BaCl_2$ will have maximum boiling point.

277 **(d)**

K_2SO_4 is 17.4 ppm *i.e.*

10^6 g (≅mL)has $K_2SO_4 = 17.4$ g K_2SO_4

10^3 mL has $K_2SO_4 = \frac{17.4\times10^3}{10^6} = 0.0174$ g / L

$=\frac{0.0174}{174}$ mol/L

∴ $[K_2 SO_4] = 1\times 10^{-4}$ M

$K_2 SO_4 \rightleftharpoons 2K^+ + SO_4^{2-}$

∴ $[K^+] = 2 \times 10^{-4} M$

278 **(a)**

$\frac{p^\circ - p_s}{p^\circ} = X_1$ (mole fraction of solute)

280 **(a)**

$$m = \frac{k_b \times w \times 1000}{\Delta T_b \times W} = \frac{2.16\times0.15\times1000}{0.216\times15} = 100$$

281 **(c)**

Vapour pressure of a liquid in a closed container increases with increase in temperature

282 **(c)**

From Raoult's law : $\frac{P_0-P_s}{P_0} = \frac{N_1}{N_1+N_2}$

$$1 - \frac{P_s}{P_0} = \frac{N_1}{N_1+N_2}$$

or $\frac{P_s}{P_0} = \frac{N_2}{N_1+N_2}$

i.e., $P_s = P_0 = \frac{N_2}{(N_1+N_2)}$

P_s

$= P_0 \times$ mole fraction of solvent.

283 **(c)**

Solutions having same osmotic pressure are called isotonic solutions. π gloucose = π unknown solute

$$\frac{5}{180} = \frac{2}{M} \quad or \quad M = \frac{180\times2}{5} = 72$$

284 **(b)**

Follow definition of diffusion.

285 **(b)**

Boiling point $(T_b) = 100 + \Delta T_b = 100 + k_b m$

Freezing point $(T_f) = 0 - \Delta T_f = -k_f m$

$T_b - T_f = (100 + k_b m) - (-k_f m)$

$105 = 100 + 0.51\text{m} + 1.86\text{m}$

$2.37\,m = 5$ or $m = \frac{5}{2.37} = 2.11$

∴ Weight of sucrose to be dissolved in 100 g water

$= \frac{2.11\times342}{1000}\times100 = 72\text{g}$

286 **(c)**

$\frac{\Delta T_b}{\Delta T_f} = \frac{K_b}{K_f}$

∴ $\Delta T_f = \frac{K_f}{K_b}\times\Delta T_b = \frac{1.86}{0.512}\times0.18$

$= 0.654$

∴ f. pt. $= 0 - 0.654 = -0.654$°C

287 **(c)**

$$\text{Molarity of base} = \frac{\text{Normality}}{\text{Acidity}} = \frac{0.1}{1} = 0.1$$

$M_1V_1 = M_2V_2$

$0.1\times19.85 = M_2\times20$

$M_2 = 0.09925 \approx 0.099$

288 **(c)**

Vapour pressure of a solvent is lowered by the presence of solute in it. Lowering in vapour pressure is a Colligative property. *i.e.*, it depends on the number of particles present in the solution. $Cu(NO_3)_2$ give the maximum number of ions (*i.e.*, 3)so, it causes the greatest lowering in vapour pressure of water.

289 **(b)**

In the molarity and normality the volume of the solution is considered while in molality the mass of the solvent is considered. Molarity and normality change with temperature because of expansion of contraction of the liquid with temperature. However, molality does not change with temperature because mass of the solvent does not change with temperature.

290 **(c)**

$$\text{Molality} = \frac{n\times 1000}{\text{mass of solvent (g)}}$$

$$= \frac{18\times 1000}{180\times 500} = 0.2 \text{ m}$$

291 **(a)**

$BaCl_2$gives maximum ion hence, it shows lowest vapour pressure

292 **(d)**

Solution is isotonic.

$$\Rightarrow \quad C_1RT = C_2RT$$

$$C_1 = C_2$$

Density of both the solutions are assumed to be equal to

1.0 g cm^{-3}.

5.25% solution of a substance means 100g solution contains

5.25 g solute and 1000g solution contain 52.5g solute.

Hence, $\frac{52.5}{M} = \frac{15}{60}$,

M= molecular mass of the substance

$M = \frac{52.5\times 60}{15} = 210$

293 **(a)**

Elevation in boiling point is a colligative property, *i.e.*, depends only on number of particles of ions. 0.1 M $FeCl_3$ gives maximum number of ions, thus has highest boiling point.

294 **(a)**

$Al_2(SO_4)_3$ produces maximum number of ions so, it will have highest osmotic pressure.

295 **(a)**

Normality of acid=molarity ×basicity

$0.2 = M \times 2$

$$\therefore M = \frac{0.2}{2} = 0.1$$

296 **(a)**

In solution the KCl and $CuSO_4$ produces same number of ions in solution.

$$KCl \rightleftharpoons K^+ + Cl^-$$

$$CuSO_4 \rightleftharpoons Cu^{2+} + {SO_4}^{2-}$$

Both produced two ions in solution.

So, ionic strength of a solution is combined ionic strength of both of the salt.

=0.1+.02=0.3 mol/kg

297 **(a)**

Let molarity o $Ba(OH)_2 = M_1$

$\therefore$ Normality $= 2M_1$

Molarity of HCl $= 0.1$ M $= 0.1$ N

$$N_1V_1 = N_2V_2$$

$$2M_1 \times 25 = 0.1 \times 35$$

$$M_1 = 0.07 \text{ M}$$

298 **(c)**

Glucose ($C_6H_{12}O_6$) is a non-electrolyte, hence i=1, while others are electrolyte, hence $i > 1$.

$$\therefore \Delta T_f = i \times k_f \times molality$$

The value of ΔT_f is lowest for glucose, hence its freezing point is maximum.

299 **(b)**

$$N = \frac{w \times 1000}{\text{eq. wt.} \times V(\text{mL})} = \frac{4\times 1000}{40\times 100} = 1.0 \text{ N}$$

301 **(a)**

According to the Boyle-van't Hoff law, at constant temperature the osmotic pressure of a solution is directly proportional to its concentration and inversely proportional to its dilution.$\pi \propto C$ (where, C= concentration).

Hence, the osmotic pressure of a solution at a given temperature increases with concentration.

302 **(c)**

$$P_M = P^0_{C_5H_{12}}.X^0_{C_5H_{12}} + P^0_{C_6H_{14}}.X_{C_6H_{14}};$$

Thus, $P_M = 440 \times \frac{1}{5} + 120 \times \frac{4}{5} = 184$

Now, $P_{C_5H_{12}} = P^0_{C_5H_{12}} \cdot X_{C_5H_{12}(l)} = PM \cdot X_{C_5H_{12}(g)}$

$$\therefore \quad 440 \times \frac{1}{5} = 184 \times X_{C_5H_{12}(g)}$$

$$\therefore \quad X_{C_5H_{12}(g)} = 0.478$$

303 **(d)**

H_2O and ethanol are miscible.

304 **(b)**

According to the Raoult's law the relative lowering vapour pressure which is produced by dissolving a non-volatile solute in a solvent is equal to mole fraction of the solute.

$$\frac{P-P_s}{P} = X_B$$

where, p= vapour pressure of solvent

$P_s =$ vapour pressure of solution

$X_B =$ mole fraction of B

Given, P=0.80 atm

$P_s = 0.60$ atm

$$\therefore \quad X_B = \frac{0.80-0.60}{0.80} = \frac{0.20}{0.80} = 0.25$$

306 **(b)**

For NaCl, $i = 2$

$\Delta T_f = 2k_f \times m = 2 \times 1.86 \times 1 = 3.72$

$T_s = T - \Delta T_f = 0 - 3.72 = -3.72$°C

307 **(a)**

$$P_T = X_H.P^\circ_H + P^\circ_O$$

$$X_H = \frac{\frac{25}{100}}{\frac{25}{100}+\frac{35}{114}} = 0.45 \textit{ and } \therefore \quad X_o = 0.55$$

$$P_T = 0.45 \times 105 + 0.55 \times 45 = 72kPa$$

308 **(a)**

$$BaCl_2 \rightleftharpoons Ba^{2+} + 2Cl^-$$

Initial 0.01 M

At equilibrium (0.01-x) M xM 2xM

$$i=\frac{(0.01-x)+x+2x}{0.01}$$

$$=\frac{0.01+2x}{0.01}=1.98$$

x=0.0049

$$\%\ \alpha=\frac{x}{0.01}\times 100=\frac{0.0049\times 100}{0.01}=49\%$$

309 **(a)**

According to Raoult's law relative lowering of vapour pressure ∝ mole fraction of solute

Thus, mole fraction of solute = 0.0125

Mole fraction of a solute is related to the molality by the following expression.

$$\left(\frac{1}{X}-1\right)=\frac{1000}{m_B\times m}$$

where, X = mole fraction of solute

m_B = moleular weight of solvent

m = molality

$$\left(\frac{1}{0.0125}-1\right)=\frac{1000}{18\times m}$$

$$\text{m}=\frac{12.5}{(1-0.0125)\times 18}$$

$$=\frac{12.5}{17.775}$$

$$=0.70$$

310 **(b)**

$$\frac{p^0-p_s}{p^0}=\frac{w}{m}\times\frac{M}{W}=\frac{18}{180}\times\frac{18}{90}=0.02$$

311 **(d)**

Osmotic pressure (π)=CRT

Unit of osmotic pressure is atm.

312 **(b)**

Unit of molality mole per kilogram (mol kg^{-1}).

313 **(b)**

Azeotropic mixture which boils at a lower temperature than either of two components is formed by non-ideal solution showing positive deviation

315 **(a)**

$$\triangle T_f=ik_fm$$

where $\triangle T_f$ = depression in freezing point

i=van,t Hoff factor

m= molality and

and k_f= freezing point depression constant

For 0.01 molal NaCl solution

$$0.37=2\times k_f\times 0.01$$

$$\therefore\quad k_f=\frac{0.37}{2\times 0.01}\quad\text{-----(i)}$$

For 0.02 molal urea solution

$$\triangle T_f=1\times k_f\times 0.02$$

$$\therefore\quad k_f=\frac{\triangle T_f}{0.02}\quad\text{-----(ii)}$$

From Eqs (i) and (ii)

$$\frac{0.37}{2\times 0.01}=\frac{\triangle T_f}{0.02}$$

$$\triangle T_f=\frac{0.37\times 0.02}{2\times 0.01}$$

$$\therefore\quad \triangle T_f=0.37^\circ C$$

316 **(b)**

Given, $h=2.6\ mm$

$$\therefore\quad \pi=hdg=\frac{2.6}{10}\times 1\times 980\ \text{dyne cm}^{-2}$$

Also $\pi=\frac{w}{V.m}ST$

$$\frac{26\times 1\times 980}{10}=\frac{0.75\times 8.314\times 10^7\times 277}{125\times m}$$

$$\therefore\quad m=5.4\times 10^5$$

317 **(a)**

Relationship between normality and molar concentration is

Normality = $n\times$ molarity (M)

Where, n = the number of moles of H^+ per mole of the compound that solute is capable of releasing [acid] on reacting with base.

In case of HCl,

n = 1

Hence, 2 N HCl solution ≈ 2 M H_2SO_4 solution.

In case of H_2SO_4

n= 2

Hence, 4.0 NH_2SO_4 solution ≈ 2 MH_2SO_4 solution.

318 **(a)**

Orthophosphoric acid (H_3PO_4) is a tribasic acid.

∵ Normality = molarity × basicity

∴ Normality = 3 M × 3 = 9 N

320 **(c)**

Kinetic energy in liquid and vapour phase $=\frac{3}{2}RT$.

321 **(c)**

The extraction is more efficient when little volume of extracting liquid is used for large number of operations.

322 **(b)**

Normality of acid= Molarity × basicity

= 2 × 2 = 4 N

323 **(a)**

$\text{CuCl}_2$is an electrolyte which ionise in solution as follows.

$$CuCl_2 \rightleftharpoons Cu^{2+} + 2Cl^-$$

At t=0 1 mole 0 0

After ionisation$(1-\alpha)mole$ $\alpha mole$ $2\alpha mole$

Thus, number of particles after ionisation

$$=1\text{-}\alpha+\alpha+2\alpha=1+2\alpha$$

∴ van,t Hoff factor (i)

$$=\frac{\text{number of particloes after ionisation}}{\text{number of particles before ionisation}}$$

$$or\quad (i)=\frac{1+2\alpha}{1}\ \text{(On 100 \% ionisation α = 1)}$$

$$= \frac{1 + 2 \times 1}{1} = 3$$

The elevation in boiling point (when colligative property is abnormal)

$\Delta T^b = i \times k_b \times m$

m →molality of solution

Molality of $CuCl_2$ solution

$$\frac{\frac{\text{weight of CuCl}_2\text{in gram}}{\text{mol.weight of CuCl}_2}}{\text{weight of water (solvent)in kg}} = \frac{\frac{13.44}{134.4}}{1} = 0.1 \text{ m}$$

Thus, $\Delta T_b = 3 \times 0.52 \times 0.1 = 0.156 \approx 0.16°\text{C}$

324 **(a)**

$A_xB_y \quad \rightleftharpoons \quad xA^{y+} \quad + \quad yB^{x-}$

After dissociation (1-α) $\qquad x\alpha \qquad y\alpha$

i=n(A_xB_y)+n(A^{y+}) + $n(B^{x-}$)

=2-α+x $\alpha + y\alpha = 1 + \alpha(x + y - 1)$

∴ $\alpha = \frac{i-1}{(x+y-1)}$

325 **(a)**

According to Raoult's law

$\frac{p-p_s}{p} = x_{\text{solute}}$

Where, p= vapour pressure of pure solvent =0.80 atm

p_s = vapour pressure of solute =0.60 atm

X_{solute} = mole fraction of solute

$\frac{0.80-0.60}{0.80} = X_{\text{solute}}$

or $\qquad \frac{0.20}{080} = X_{\text{solute}}$

$x_{solute} = 0.25$

326 **(d)**

These are characteristics which reflect for high solubility of gases in water. It is therefore SO_2 and NH_3 having lower critical temperature or easily liquefied, HCl which ionises in water and CO_2 which reacts with water are more soluble.

327 **(d)**

In osmosis only solvent particles move.

328 **(d)**

Given, $T_b - T_f = 105.0°C$

⇒ $(100 = \triangle T_b) - (0 - \triangle T_f) = 105.0°C$

$\triangle T_b + \triangle T_f = 5$

$\triangle T_b + \triangle T_f(k_b + k_f) \times m$ (m =molality)

⇒ 5= $(1.86 \times 0.51) \times \frac{w\times1000}{342\times100}$

∴ $w = \frac{1710}{23.7} = 72\ g$

329 **(a)**

Due to higher pressure inside the boiling point elevated

330 **(a)**

$$M = \frac{w \times 1000}{\text{mol. mass} \times \text{volume in mL}}$$

$$= \frac{9.8 \times 1000}{98 \times 2000} = 0.05 \text{ M}$$

331 **(c)**

$K = \frac{4.412}{0.0156} = \frac{s}{0.34}$

∴ $S = \frac{4.412 \times 0.34}{0.0156}$

332 **(b)**

pH $= -\log[\text{H}^+]$

$\log[\text{H}^+] = -\text{pH} = 0.00$

$[H^+]$=antilog(0.00)

$[H^+]$= 1.0 M

M H_2SO_4 = 2NH_2SO_4

∴ Normality of 250mL solution =$\frac{2\times250}{1000}$

=0.50 N

333 **(c)**

Benzoic acid in benzene exists as a dimer. So, number of molecules decreases and hence, osmotic pressure decreases.

334 **(b)**

$K = 420 = \frac{5 - x}{x}$

∴ $x = 0.0119$ g

335 **(a)**

If mol. wt. is high, $\Delta T_f, \Delta T_b$ and ΔP will be too small to read out accurately.

336 **(d)**

Van't Hoff factor (i) is given by

$i = \frac{\text{observed value of colligative property}}{\text{normal value of colligative property}}$

The normal value of colligative property is the theoretically calculated value assuming no association or dissociation.

∴ $\qquad i = \frac{\pi_{obs}}{\pi_{cal}}$

337 **(c)**

$P_m = P_A^0 X_A + P_B^0 X_B$

$P_m = 1000 \times \frac{2}{5} + 80 \times \frac{3}{5}$

$= 40 + 48 = 88$ torr

338 **(b)**

Alcohol involves H-bonding; also mol. wt. of $CH_4 >$ mol. wt. of H_2. Greater is molecular weight of covalent compound, higher is its b.p.

339 **(b)**

Lesser is ΔT_f, more is freezing point.

340 **(a)**

Liquid mixtures showing positive deviations from Raoult's law posses lower b. p.

341 **(b)**

Osmotic pressure ∝ number of particles.

∴ Solution with least number of particles will have minimum osmotic pressure.

(i) NaCl → $Na^+ + Cl^-$ (2 *ions*)

∴ Concentration of particles in NaCl=2×2M =4M

(ii) Glucose does not dissociate

∴ Concentration of particles = 1×1M= 1M

12. Urea does not dissociate

∴ Concentration of particles 1×2M=2M

∴ Glucose solution will have minimum osmotic pressure.

342 **(b)**

As concentration of particles is maximum in $FeCl_3$ solution so deviation in boiling point will be maximum. Hence, actual boiling point will be highest

343 **(b)**

An increase in temperature favours backward reaction if,

Solute + Solvent ⟶ Solution; $\Delta H = -ve$.

344 **(b)**

n-heptane and ethanol forms non-ideal solution. In pure ethanol, Molecules are hydrogen bonded. On adding *n*-heptane, its molecules get in between the host molecules and break sme of the hydrogen bonds between them. Due to weaking of interactions, the solution shows positive deviation from Raoult's law.

345 **(b)**

$\Delta T_f = i \times K_f \times \text{molality}$

$0.00732 = i \times 1.86 \times 0.002$

∴ $i = 1.96 = 2$

∴ $[Co(NH_3)_5 \cdot (NO_2)]Cl \longrightarrow [Co(NH_3)_5NO_2]^+ + Cl^-$

346 **(a)**

Isotonic solutions have same molar concentration of solute particles in solution. Molar concentration of particles in solution are 0.1 M in glucose, 2×0.05 M in NaCl, 3×0.05 in $BasCl_2$ and 4×0.1 in $AlCl_3$. Therefore, 0.1 M glucose and 0.05 in M NaCl solutions are isotonic.

348 **(b)**

$\pi = CRT$

$$\pi = \frac{68.4}{342} \times 0.082 \times 273 = 4.48 \text{ atm}$$

349 **(b)**

$$i \text{ for } AgNO_3 = \frac{\text{normal mol. wt.}}{\text{observed mol. wt.}} = 1 + \alpha,$$

$$\therefore \alpha = \frac{170}{92.64} - 1 = 0.835 = 83.5\%$$

350 **(b)**

On heating solubility of NaCl increases.

351 **(b)**

$$\text{Molar concentration } [H_2] = \frac{\text{moles}}{V(\text{L})} = \frac{20/2}{5} = 2$$

352 **(a)**

$$\text{Molarity of pure water} = \frac{100}{18} = 55.6$$

353 **(c)**

3.50 wt% of aqueous solution of NaCl means 100 g of sea water contains 3.50 g NaCl.

Water in sea water = 100-3.5 = 96.5 g =0.0965 kg

$$\text{Molality} = \frac{3.5}{58.5 \times 0.0965} = 0.62 \text{ m}$$

354 **(d)**

In a, b, c the choices reflect for the validity of law.

356 **(b)**

Colligative properties depend upon number of particles in solution and concentration of solution. Larger the number of particles in solution, higher is the colligative properties.

Hence, highest boiling point is found in 0.1 M $BaCl_2$.

$$BaCl_2(aq) \longrightarrow B^{2+} + 2Cl^-$$

357 **(b)**

Hg has higher attractive forces among molecules.

358 **(b)**

$$M = \frac{W}{\text{mol. wt.} \times V(\text{L})} = \frac{5.85}{58.5 \times 0.5} = 0.2 \text{ M}$$

(a)6g of NaOH/100 mL

(b)0.5 M H_2SO_4

$N = M \times \text{basicity} = 0.5 \times 2 = 1.0$

(c)N phosphoric acid Normality=1

(d)8 g of KOH/L

$$\text{Normality} = \frac{\text{strength in g/L}}{\text{equivalent weight}} = \frac{8}{56} = 0.14 \text{ N}$$

360 **(c)**

H_3PO_3 is a dibasic acid (containing two ionisable protons attached to O directly).

$$H_3PO_3 \rightleftharpoons 2H^+ + HPO_3{}^{2-}$$

∴ $0.1\,M\ H_3PO_3 = 0.2\,NH_3\,PO_3$

and 0.1 M KOH = 0.1N KOH

$$N_1V_1 = N_2V_2$$

(KOH) (H_3PO_3)

$$0.1V_1 = 0.2 \times 20$$

$$V_1 = 40\text{mL}$$

361 **(b)**

$\pi V = nRT$

$\pi = \frac{n}{V} RT$

$\pi = CRT$

$\frac{\pi_1}{\pi_2} = \frac{C_1 R T_1}{C_2 R T_2}$

$\pi_1 = p, \pi_2 = 2atm\ C_1 = C,\ C_2 = \frac{C}{2}$

T_1=600 K, T_2 = 700 K

$\frac{P}{2} = \frac{2 \times C \times R \times 600}{C \times R \times 700}$

p=$\frac{24}{7}$

362 **(b)**

$$M = \frac{w \times 1000}{m \times V(\text{mL})} = \frac{75.5 \times 1000}{56 \times 540} = 2.50\ \text{M}$$

363 **(b)**

$\text{KN}O_3$ is a strong binary electrolyte. Its van't Hoff factor is 2. CH_3COOH is a very eak electrolyte . Its van't Hoff factor is less than that for KNO_3.
Hence osmotic pressure of 0.1 M KNO_3
(Colligative molarity =0.1 M × 2)
>O.P. of 0.1 M CH_3COOH
(Colligative molarity is 0.1 M)

364 **(a)**

$P_M = P'_{\text{Benzene}} + P'_{\text{Toluene}}$

$$P_M = 75 \times \frac{\frac{78}{78}}{\frac{78}{78} + \frac{46}{92}} + 22 \times \frac{\frac{46}{82}}{\frac{78}{78} + \frac{46}{92}}$$

$$P_M = 75 \times \frac{2}{3} + 22 \times \frac{1}{2} \times \frac{2}{3}$$

$$= 50 + 7.3 = 57.3$$

Also $P'_A = 50$

365 **(b)**

Fusion requires heat ($i.e$, endothermic), thus freezing is exothermic.

366 **(b)**

$$K = \frac{a/1}{\frac{50-a}{1}} = 3;$$

$\therefore$ a (or acid in ether) = 37.5 ; acid in water = 12.5 g

367 **(b)**

Liquid mixtures showing positive deviations possess higher value of experimental vapour pressure than those obtained from Raoult's law.

368 **(a)**

Victor Meyer's method is used for volatile solutes. Rest all are used for non-volatile solute.

369 **(c)**

Both phase rule and distribution law are applied to heterogeneous systems.

370 **(a)**

$$\Delta T_b = \frac{1000 \times K_b \times w}{m \times W}(1 + \boldsymbol{\alpha})$$

$$\therefore \quad w = \frac{\Delta T_b \times m \times W}{1000 \times K_b(1 + \alpha)} = \frac{4 \times 58.5 \times 1000}{1000 \times 0.52 \times 2}$$

$$= 225\ \text{g}$$

372 **(a)**

13. Van't Hoff equation is

$$\pi V = inRT$$

14. For depression in freezing point,

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

15. For elevation in boiling point,

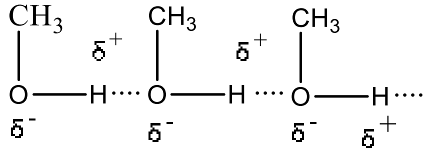
$$\Delta T_b = i \times k_b \times m$$

16. For lowering of vapour pressure,

$$\frac{p^\circ_{\text{solvent}} - p_{\text{solution}}}{p^\circ_{\text{solvent}}} = i\left(\frac{n}{N+n}\right)$$

373 **(b)**

Water and hydrochloric acid; and water and nitric acid form miscible solutions. They show negative deviation.
In case of CH_3 COCH_3 and CHCl_3, there is interaction between them, thus force of attraction between CH_3COCH_3 .. $CHCl_3$ is larger than between $CHCl_3$ .... $CHCl_3$ or CH_3 COCl_3 ... CH_3 COCH_3 and thus vapour pressure is less than expected. –a negative deviation.
In case of CH_3 OHthere is association by intermolecular h-bonding. When benzene is added to CH_3OH, H-bonding breaks and thus force of attraction between CH_3OH and benzene molecules is smaller than between CH_3OH or benzene molecules (in pure state).
Vapour pressure of mixture is greater than expected—a positive deviation.



374 **(d)**

Equivalent weight of

$\text{K}_2\text{Cr}_2\text{O}_7 = \frac{\text{molecular weighty of } \text{K}_2\text{Cr}_2\text{O}_7}{\text{oxidation number of Cr}}$

Oxidation number of Cr in $\text{K}_2\text{Cr}_2\text{O}_7$

2[+1]+2(x)+7(-2)= 0
2+2x-14 = 0
2x=12
x=6

Equivalent weight $=\frac{294.19}{6} = 49.08$

$\frac{\text{weight of } K_2Cr_2O_7}{\text{equivalent wt.(E)}} = N \times V(L)$

$w = 0.1 \times 1 \times 49.03 = 4.903$ g

375 **(b)**

Lower is the b. p. of solvent more is its vapour pressure.

376 **(d)**

$K = c_1/c_2$

377 **(d)**

$$\pi V = \frac{w}{m} ST$$

$$\therefore \ \pi = \frac{w}{V} . \frac{ST}{m}$$

$$\pi = c'.\frac{ST}{m} (c' \text{ is in g/litre.})$$

The plots of π $vs. c$ (g/cm^3) have slope $= \frac{ST \times 1000}{m}$

$$\therefore \ \frac{ST \times 1000}{m} = 4.65 \times 10^{-3}$$

$$m = \frac{0.0821 \times 293 \times 1000}{4.65 \times 10^{-3}} = 5.17 \times 10^6$$

378 **(a)**

According to molarity equation

$$\text{NaOH} = \text{HCl}$$

$$M_1V_1 = M_2V_2$$

$$0.6 \times V_1 = 0.4 \times 30$$

$$V_1 = \frac{0.4 \times 30}{0.6} = 20cm^3$$

379 **(a)**

For non-electrolyte

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

Given, m =0.05,

$\therefore$ $\Delta T_f = 1.86 \times 0.05 = 0.093$°C

Freezing point of solution

$k_f = 1.86 = 0 - \Delta T_f$

=0-0.093=-0.093°C

380 **(b)**

$$M = \frac{m \times d}{1 + \frac{mM_2}{1000}} = \frac{1 \times 1.21}{1 + \frac{1 \times 58.5}{1000}}$$

$$= \frac{1.21 \times 1000}{1000 + 58.5}$$

$= 1.143$ M

381 **(a)**

$\pi V = nST$ for glucose and blood; If isotonic

$\pi_{\text{glucose}} = \pi_{\text{blood}}$;

Thus, $7.65 \times V = \frac{w}{180} \times 0.0821 \times 310$

$\therefore \frac{w}{V} = 54.1$ g/litre or 5.41%

382 **(d)**

Van't Hoff factor for association$(i) = 1 - \alpha + \frac{\alpha}{n}$

Given $\alpha = 1$ and $n = 3$.

383 **(b)**

Vapour pressure is characteristic property of a solvent at a temperature.

384 **(a)**

$$\therefore \quad \Delta T = \frac{1000 \times K'_f \times w}{W.m}$$

$$9.3 = \frac{1000 \times 1.86 \times 50}{62 \times W}$$

$\therefore$ $W = 161.29$

$\therefore$ Ice separated $= 200 - 161.29 = 38.71$ g.

386 **(a)**

The order of osmotic pressure of $BaCl_2$, NaCl and sucrose is

$BaCl_2$ >NaCl>sucrose

Since, BaCl_2 gives maximum ion (3 ions) in the solution.

387 **(c)**

Mole fraction of $A = \frac{\text{moles of } A}{\text{total moles}}$

Given,

moles of Ar = 1, moles of $CO_2 = 2$,
moles of $O_2 = 3$, moles of $N_2 = 4$,
moles of O_2 removed = 1

Mole fraction of O_2 at initial stage

$$=\frac{3}{1+2+3+4} \times 100 = \frac{3}{10} \times 100 = 30$$

Mole fraction of O_2 at final stage

$$= \left(\frac{3}{10} - \frac{2}{1+2+2+4}\right) \times 100$$

$$= \left(\frac{3}{10} - \frac{2}{9}\right) \times 100 = \frac{70}{9} \cong 8$$

$\therefore$ % change $= \frac{8}{30} \times 100 = 26\%$

388 **(d)**

$$K = \frac{c_1}{c_2}$$

389 **(a)**

Osmosis is a bilateral movement of solvent particles through semipermeable membrane and only net flow (more from dilute solution to concentrate solution) is noticed.

390 **(d)**

These are conditions for the validity of distribution law.

391 **(b)**

$$i = \frac{\text{Normal mol. wt.}}{\text{Exp. mol. wt.}}$$

392 **(d)**

Aqueous solution of any substance (non-volatile) freezes below 0°C because the vapour pressure of the solution becomes lower than that of pure solvent.

393 **(c)**

$$\frac{\pi_1}{\pi_2} = \frac{T_1}{T_2};$$

$$\therefore \frac{\pi_1}{2} = \frac{546}{273}; \quad \therefore \pi_1 = 4 \text{ atm.}$$

394 **(a)**

ΔT_f depends upon K_f of solvent.

395 **(c)**

Given,

Weight of non-volatile solute,

w= 25 g

Weight of solvent, W=100 g

Lowering of vapour pressure,

$$p^\circ - p_s = 0.225 \text{ mm}$$

Vapour pressure of pure solvent,

$$p^\circ = 17.5 \text{ mm}$$

Molecular weight of solvent (H_2O), M=18 g

Molecular weight of solute, m=?

According to Raoult's law

$$\frac{p^\circ - p_s}{p^\circ} = \frac{w \times M}{m \times W}$$

$$\frac{0.225}{17.5} = \frac{25 \times 18}{m \times 100}$$

$$m = \frac{25 \times 18 \times 17.5}{22.5}$$

$$= 350\ g$$

396 **(d)**

Let x mL of HCl are taken , then

$$N_1V_1 = N_2V_2$$

$$\frac{1}{2} \times x = \frac{1}{10} \times 500$$

$$x = 100\text{mL}$$

Hence, water needed to add

= 500-100= 400mL

397 **(a)**

$$\frac{p^0 - p_s}{p^0} = \text{molality} \times (1 - \alpha + x\alpha + y\alpha)$$

The value of $p^0 - p_s$ is maximum for $BaCl_2$

398 **(d)**

Ideal solution obeys Raoult's law at every range of concentration. So, the second component must follow.

Raoult's law in the range. When x_2 is $0 \leq x_2 \leq 1$.

399 **(c)**

$$\text{Mole fraction of } H_2O = \frac{\frac{80}{18}}{\frac{80}{18} + \frac{20}{24}} = \frac{68}{77}$$

400 **(c)**

$$\text{Molality} = \frac{\text{mole of solute}}{\text{wt.of water in kg}} = \frac{18 \times 1000}{180 \times 500} = 0.2\ m$$

401 **(d)**

Solutions having same osmotic pressure, at a given temperature, have same concentration.

Concentration of compound = concentration of glucose

$$\frac{6}{M \times 1} = 0.05$$

$$\text{M} = \frac{6}{0.05} = 120$$

Empirical formula mass (CH_2O)= 12+2+16

=30

$$n = \frac{\text{molecular mass}}{\text{empirical formula mass}}$$

$$= \frac{120}{30} = 4$$

Hence, molecular formula = $(CH_2O)_4 = C_4H_8O_4$

402 **(a)**

If $X_A = 0$, then pure B $\therefore P_B^0 = 138$

If $X_A = 1$, then pure A $\therefore P_A^0 = 120 + 138 = 258$

403 **(b)**

$$\Delta T_f = K_f \times \text{molality}$$

$$\Delta T_b = K_b \times \text{molality}$$

$$\therefore \Delta T_b = \frac{K_b}{K_f} \times \Delta T_f = \frac{0.512}{1.86} \times 0.186 = 0.0512^\circ\text{C}$$

404 **(c)**

$$\pi V = \frac{w}{m} RT$$

for isotonic solutions, osmotic pressure (π) is same

$$\frac{W_1}{m_1V_1} = \frac{W_2}{m_2V_2}$$

$$V_1 = 1L, V_2 = 100\ mL = 0.1L$$

$$\frac{W_1}{60 \times 1} = \frac{10}{342 \times 0.1}$$

$$W_1 = 17.54 \frac{g}{L}$$

405 **(d)**

Distribution law can be used for any heterogeneous system.

406 **(a)**

When 0.004 M Na_2SO_4 solution is isotonic with 0.01 M solution of glucose, so their osmotic pressures are equal to each other.

Osmotic pressure of 0.01 M glucose $(\pi)_{\text{glucose}}$ =CST

$\therefore$ C= concentration of solution =0.01 M

S= solution constant =0.0821 L atm/K/mol

T= absolute temperature

$$\therefore \pi_{\text{glucose}} = 0.01 \times 0.0821\ T \qquad \text{---(i)}$$

$$\pi_{\text{glucose}} = \pi_{Na_2SO_4}$$

Na_2SO_4 is present in ionic state in solution

So, $Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$

At t=0 1 0 0

At equilibrium $1 - \alpha$ 2α α

(where, α is the degree of dissociation of Na_2SO_4)

$(\pi_{cal})_{Na_2SO_4} = C \times S \times T$= 0.004 ×0.0821× T ---(ii)

By van't Hoff facter

$$\frac{(\pi_{obs})_{Na_2SO_4}}{(\pi_{cal})_{Na_2SO_4}} = \frac{\text{number of particles after dissociation}}{\text{number of particles before dissociation}}$$

$$= \frac{1-\propto+2\propto+\propto}{1}$$

$\because \quad (\pi_{obs})_{Na_2SO_4} = \pi_{\text{glucose}}$

$\therefore \quad \frac{0.01 \times 0.0821\, T}{0.004 \times 0.0821 \times \mathrm{T}} = \frac{1+2\alpha}{1}$

Or $\quad \frac{10}{4} = \frac{1+2\propto}{1}$ or $\quad 10=4+8\propto$

$\propto = \frac{10-4}{8} = 0.75$

%of $\propto = 75\%$

407 **(b)**

$$K = \frac{\frac{10-5}{X}}{\frac{5}{Y}} = 85$$

Where X is volume of I_2 and Y is volume of water,

Thus, $\frac{Y}{X} = 85$.

408 **(b)**

When an egg is kept in saturated solution of NaCl after removing its hard shell in dilHCl, its shrinks. This is due to the fact that water comes out of the egg as salt solution is more concentrated than the egg fluid

409 **(d)**

$$n_{\mathrm{CHCl_3}} = \frac{25.5}{119.5} = 0.213$$

$$n_{\mathrm{CH_2Cl_2}} = \frac{40}{85} = 0.47$$

$\therefore \; n_{\text{Total}} = 0.683$

$$x_{\mathrm{CHCl_3}} = \frac{0.213}{0.683} = 0.312;$$

${}^{x}\mathrm{CH_2Cl_2} = 1 - 0.312 = 0.688$

$P°_{\mathrm{CHCl_3}} = 200$ mm Hg and $P°_{\mathrm{CH_2Cl_2}} =$ 41.5 mm Hg

$$P_T = (200 \times 0.312) + (41.5 \times 0.688)$$

$$= 62.4 + 28.52 = 90.952 \text{ mm H}$$

410 **(c)**

$\mathrm{m} = \frac{1000 \times k_b \times w}{W \times \Delta T_b}$

$\Delta T_b = \frac{1000 \times k_b \times w}{W \times m}$

$\Delta T_b = \frac{1000 \times k_b \times 10}{100 \times 100}$

$\Delta T_b = k_b$

411 **(b)**

$[\mathrm{Pt(NH_3)_4Cl_4}]$ =Gives n moles of ions on complete ionization, $i.e.$, $\alpha = 1$

$$\Delta T = Kf \times \text{molality} \times (1 - \alpha + n\alpha)$$

$$0.0054 = 1.80 \times 0.001 \times (n)$$

$\therefore \qquad n = 3$

Thus, $[\mathrm{Pt(NH_3)_4\,Cl_2]Cl_2} \longrightarrow [\mathrm{Pt(NH_3)_4Cl_2}]^{2+} +$ $2\mathrm{Cl^-}$

$\begin{matrix}1\\0\end{matrix} \qquad \begin{matrix}0\\1\end{matrix} \qquad \begin{matrix}0\\2\end{matrix}$

$\therefore \qquad n = 3$

412 **(b)**

Eq. wt. of $\mathrm{H_2C_2O_4 \cdot 2H_2O}$

$$= \frac{2 + 24 + 64 + 2(2+16)}{2}$$

$= 63$

$$w = \frac{NEV}{1000} = \frac{0.2 \times 63 \times 500}{1000} = 6.3 \text{ g}$$

413 **(c)**

$\Delta T_b = K_b \times$ molality

$\Delta T_f = K_f \times$ molality

$\therefore \qquad \Delta T_{b_1} = \Delta T_{b_2}$ as $m = 1$ and K_b constant

$\qquad \Delta T_{f_1} = \Delta T_{f_2}$ as $m = 1$ and K_f constant

414 **(b)**

$$\frac{P_0 - P_s}{P_s} = \frac{n}{N} = \frac{w \times M}{m \times W}$$

or $\quad \frac{P_0 - \frac{95}{100}P_0}{\frac{95}{100}P_0} = \frac{w \times 0.3\, m}{W \times m}$ $(M = 0.3\, m)$

or $\quad \frac{W}{m} = 5.7$

415 **(b)**

$$\Delta T = \frac{1000 \times K_b \times Y}{250 \times M} = \frac{4K_bY}{M}$$

416 **(a)**

$P' \times V = nRT$

$3170 \times 1 \times 10^{-3} = n \times 8.314 \times 300$

$\therefore \; n = 1.27 \times 10^{-3}$

417 **(c)**

$P_T = P_A^\circ X_A + p_B^\circ X_B$

$550 = P_A^\circ \times \frac{1}{4} + p_B^\circ \times \frac{3}{4}$

Thus, $\qquad P_A^\circ + 3p_B^\circ = 2200 \quad$ ...(i)

When, 1 mol of $Y$is further added to the solution

$560 = P_A^\circ \times \frac{1}{5} + p_B^\circ \times \frac{4}{5}$

Thus, $P_A^\circ + 4p_B^\circ = 2800 \qquad$ ...(ii)

On subtraction II-I

p_B°=2800-2200

$p_B^\circ = 600$

Putting the value of p_B° in Eq. (i)

$P_A^\circ + 3 \times 600 = 2200$

P_A° = 2200-1800=400.

418 **(d)**

We know that $m = \frac{1000 k_f \times w}{\Delta T W}$

Hence, $\Delta T = 1.2$°C, $k_f = 1.85°$

w=5 g, W=50 g

$\therefore \qquad \mathrm{m} = \frac{1000 \times 1.85 \times 5}{1.2 \times 50} = 154.2$

419 **(b)**

Weaker are the intermolecular forces of attractions, more is the tendency for evaporation, more is vapour pressure, lower is b.p.

420 **(b)**

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

$$\text{HBr} \longrightarrow \text{H}^+ + \text{Br}^-$$

Ions at equilibrium $1\text{-}\alpha \quad \alpha \quad \alpha$

$\therefore$ Total ions $= 1 - \alpha + \alpha + \alpha$

$= 1 + \alpha$

$\therefore \quad i = 1 + \alpha$

Given, $k_f = 1.86 \text{ K mol}^{-1}$

Mass of HBr = 8.1 g

Mass of H_2O =100 g

(α) = degree of ionization = 90%

m(molality) $= \frac{\text{mass of solute mol.wt.of solute}}{\text{mass of solvent in kg}}$

$= \frac{8.1/81}{100/1000}$

$i = 1 + \alpha$

$=1+90/100$

$=1.9$

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

$= 1.9 \times 1.86 \times \frac{8.1/81}{100/1000}$

$= 3.534°C$

$\triangle T_f$ =(depression in freezing point) = freezing point of water - freezing point of solution 3.534 = 0 – freezing point of solution.

$\therefore$ Freezing point of solution = -3.534°C

421 **(b)**

According to colligative property, freezing point will be highest for IV solution due to lower concentration of NaCl.

422 **(b)**

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

$$0.8 = \frac{1-i}{1-\frac{1}{4}}$$

$i = 0.4$

$\because \ \Delta T = i \times k_f \times m$

$$0.3 = 0.4 \times 1.86 \times \frac{w_B \times 1000}{m_B \times w_A}$$

$$0.3 = 0.4 \times 1.86 \times \frac{2.5 \times 1000}{m_B \times 100}$$

$$m_B = \frac{0.4 \times 1.86 \times 2.5 \times 1000}{0.3 \times 100} = 62$$

423 **(b)**

$$\pi = CRT : C = \frac{\pi}{RT} = \frac{7.8}{0.0821 \times 310} = 0.31 \text{ mol/L}$$

424 **(a)**

If $K = \frac{c_1}{c_2}$; K is in favour of phase I;

If $K = \frac{c_2}{c_1}$; K is in favour of phase II;

425 **(c)**

$p = \frac{w}{mV}RT$, Since, $wRT/V$are constant thus, $p \propto \frac{1}{m}$

$\therefore p_2 > p_1 > p_3$

426 **(a)**

$N_1V_1 = N_2V_2$

$36 \times 50 = N_2 \times 100$

$$\therefore N_2 = \frac{36 \times 50}{100} = 18$$

$$\because \text{Molarity of acid} = \frac{\text{Normality}}{\text{Basicity}} = \frac{18}{2} = 9 \text{ M}$$

427 **(b)**

Boiling point and freezing point depend on k_b (molal elevation constant) and k_f (molal depression constant) of the solvent. Thus, equimolar solution (of the non-electrolyte) will have same boiling point and also same freezing point.

$\Delta T_f = k_f \times molality$

$\Delta T_b = k_b \times molality$

Note In this question nature of salute has not been mentioned. Hence, we have assumed that solute is non-electrolyte.

428 **(a)**

Osmosis does not take place if two solutions are isotonic.

429 **(c)**

$$N_1V_1 = N_2V_2$$

$$10 \times 1 = 0.1 \times V_2$$

$$V_2 = \frac{10}{0.1}$$

$$V_2 = 100mL$$

Hence, water needed to mix

= 100-10=90 mL

430 **(c)**

$$m = \frac{\Delta T}{k_b} = \frac{-0.060}{-1.86} = 3.2 \times 10^{-2} = 0.032$$

ie, 0.032 = total particle

$\therefore$ The number of $\text{H}^+ = (0.032 - 0.025)m =$ 0.007 MH^+

$HA \rightleftharpoons \text{H}^+ + A^-$

$[\text{H}^+] = [A^-] = 0.007$ M

$HA = 0.018$

$$\therefore K_a = \frac{(0.007)^2}{0.018} = 3 \times 10^{-3}$$

$\text{p}K_a = 2.5$

431 **(d)**

These are factors on which solubility depends.

432 **(d)**

Temperature coefficient $= \frac{\text{Distribution coefficient at } (t+10)°\text{C}}{\text{Distribution coefficient at } t°\text{C}}$

433 **(a)**

Equal osmatic pressure only applicable to non-electrolytes solution at low concentration

434 **(b)**

$K_3Fe(CN)_6 \rightleftharpoons 3K^+ + Fe(CN)_6^{3-}$

1 0 0 (Before dissociation)

$1-\boldsymbol{\alpha}$ $3\boldsymbol{\alpha}$ $\boldsymbol{\alpha}$ (After dissociation)

van't Hoff factor$(i) = 1- \boldsymbol{\alpha} + 3\boldsymbol{\alpha} + \boldsymbol{\alpha} = 1 + 3\boldsymbol{\alpha}$

In very dilute state $\boldsymbol{\alpha} = 1$; Thus, $i = 4$

435 **(c)**

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

It given 3 ions, hence , the van't Hoff factor = 3.

436 **(d)**

For two non-electrolyte solutions to be isotonic;

$$c_1 = c_2,$$

$$\therefore \quad \frac{500}{m \times 1} = \frac{3.42}{342 \times 1}$$

$\therefore m = 50{,}000$

437 **(b)**

$$\text{Total molarity } = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$$

$$= \frac{1.5 \times 480 + 1.2 \times 520}{480+520}$$

$$= 1.344 \text{ m}$$

438 **(d)**

Osmotic pressure of two solutions will be added. Hence, osmotic pressure of resulting solution

=1.64+2.46

=4.10 atm.

439 **(c)**

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution(L)}}$$

moles of urea $= \frac{120}{60} = 2$

weight of solution =weight of solution + weight of solute

=1000 + 120 =1120 g

$$\Rightarrow \ Volume \ = \frac{1120g}{\frac{1.15g}{mL}} \times \frac{1}{1000mL/L}$$

=0.974 K

$$\Rightarrow \text{Molarity} = \frac{2.000}{0.974} = 2.05 \text{ M}$$

441 **(b)**

$$N_1V_1 = N_2V_2$$

Given, $N_1 = 10$ N HNO_3, $N_2 = 0.1$ N HNO_3

$V_1 = 10$ mL, $V_2 = ?$

$\therefore \ 10 \times 10 = 0.1 \times V_2$

$$\therefore \quad V_2 = \frac{10 \times 10}{0.1}$$

$$= 1000\text{mL}$$

$\therefore$ 10 mL water is already there in solution.

$\therefore$ Water to be added =1000-10

=990mL

442 **(a)**

Number of moles of ethyl alcohol $= \frac{138}{46} = 3$

Number of moles of water $= \frac{72}{18} = 4$

$$X_{C_2H_5OH} = \frac{3}{3+4} = \frac{3}{7}$$

$$X_{H_2O} = \frac{4}{3+4} = \frac{4}{7}$$

$$\frac{X_{C_2H_5OH}}{X_{H_2O}} = \frac{\frac{3}{7}}{\frac{4}{7}} = \frac{3}{4}$$

443 **(a)**

$P = 119\,X_A + 135;\ \lim\limits_{X_A \to 1} \frac{P_A}{X_A} = 119 + 135 =$

254 torr.

444 **(d)**

1% solution means 1 g solute is present in 100 mL of water.

Osmotic pressure, $\pi = \frac{iw \times RT}{M \times V}$

$$\pi_{KCl} = \frac{2 \times 1 \times 1000 \times RT}{74.5 \times 100}$$

$$= 2 \times 0.134 \text{ RT}$$

$$\pi_{NaCl} = \frac{2 \times 1 \times 1000 \times RT}{58.5 \times 100}$$

$$= 2 \times 0.171\,RT$$

$$\pi_{BaCl} = \frac{3 \times 1 \times 1000 \times RT}{208.4 \times 100}$$

$$= 3 \times 0.048\,RT$$

$$\pi_{urea} = \frac{1 \times 1 \times 1000 \times RT}{60 \times 100}$$

$$= 1 \times 0.167\,RT$$

Since, temperature is same in all cases, the ascending order of osmotic pressure is

$$III < IV < I < II$$

445 **(b)**

$Ba(NO_3)_2 \rightleftharpoons Ba^{2+} + 2NO_3^-$

1 mole 0 0 initial

$1-\alpha$ α 2αafter dissociation

Total moles $= 1 + 2\alpha$

$i = 1 + 2\alpha$

$$\alpha = \frac{i-1}{2} = \frac{2.74-1}{2} = 0.87 = 87\%$$

446 **(b)**

Given p_s =19.8 mm

$$n_A = 0.1$$

$$n_B = \frac{178.2}{18} = 9.9$$

According to Raoult's law

$$\frac{p_s - p}{p_s} = \frac{n_A}{n_A + n_B}$$

$$\frac{19.8-p}{19.8} = \frac{0.1}{9.9+0.1}$$

or 198-10 p = 19.8 ×0.1

10 p = 198-1.98

10 p =196.02

p = 19.602 mm

447 **(b)**

On rapid cooling, temperature falls rapidly, crystallization occurs but slowly. Thus, meta stable state or super saturated solution state exist for a short while.

448 **(b)**

10% glucose solution means 10 g $= \frac{10}{180}$mol glucose is present in 100 cc. *ie*, 0.1 L

Hence, 1 mol will be present in $= \frac{0.1 \times 180}{10} = 1.8$ L

449 **(b)**

$$\Delta T_f = \frac{1000 \times 1.86 \times 0.02}{100} = 0.372^\circ\text{C}$$

451 **(a)**

Given, mass of solvent (w) =100 g

Depression in freezing point $(\Delta T_f) = 0.84°\text{C}$

$$k_f = 7.0$$

$$\frac{\text{mass of solute(w)}}{\text{molecular mass of solue (M)}} = 0.072$$

$$\Delta T_f = \frac{1000 \times k_f}{n \times w}\left(\frac{w}{M}\right)$$

$$0.84 = \frac{1000 \times 7.0 \times 0.072}{n \times 100}$$

n=6

∴ S is in S_6 form in solution.

452 **(a)**

It is more precise and takes minimum time.

453 **(b)**

6.023×10^{23}molecules of HCl ≅ 1mole HCl

Hence, 1.2046×10^{24} molecules of

HCl $\cong \frac{1.2046 \times 10^{24} \times 1}{6.023 \times 10^{23}} \cong$ 2 moles HCl

Thus, two moles (= two gram-equivalents) of HCl are dissolved in one dm^3(one litre) solution. Therefore the solution will be 2N.

454 **(a)**

Acetic acid dimerises in benzene.

455 **(b)**

Gibbs gave phase rule for heterogeneous systems.

456 **(a)**

$$N_1V_1 = N_2V_2$$
$$0.5 \times 100 = 0.1 \times V_2$$
$$V_2 = 500\ cm^3$$

∴ Water to be added to 100 cm^3 solution

$= 500 - 100 = 400\ cm^3$

458 **(a)**

In a mixture A and B components show negative deviation when A—B interaction is stronger than A—A and B—B interaction.

459 **(a)**

This is the mathematically modified form of distribution law when solute undergoes association in either of solvent.

460 **(b)**

Chloroform and acetone form a non-ideal solution, in which A…B type interaction are more than A…A and B…B type interactions due to H-bonding. Hence, the solution shows negative deviation form Raoult's law. *i.e.,*

$\triangle V_{mix}$=-ve,

$\triangle H_{mix}$=-ve,

∴ Total volume of solution = less than (30+50)mL

or <80mL

461 **(c)**

For $\text{Ca(NO}_3)_2$: $i = \frac{\text{normal mol.wt.}}{\text{exp.mol.wt.}}$

$= 1 + 2\alpha$;

∴ $\frac{164}{65.6} = 1 + 2\alpha$

∴ $\alpha = 0.75$ or 75%

462 **(b)**

Given , $T_f = -0.186$, ΔTb =?

$k_f = 1.86$

$k_b = 0.512$

We know ,

$$\Delta T_f = k_f \times m$$
$$0.186 = 1.86 \times m$$
$$m = \frac{0.186}{1.86} = 0.1$$

so, $\Delta T_b = k_b \times m$

$\Delta T_b = 0.521 \times 0.1$

$= 0.0521°$

463 **(b)**

$$\pi \times \frac{1000}{1000} = \frac{4}{246} \times 0.0821 \times 300, \quad \therefore \pi = 0.4 \text{ atm}$$

464 **(a)**

$$K = \frac{49.03}{0.97} = 50.55$$

465 **(a)**

One molar (1 M) aqueous solution is more concentrated than one molal aqueous solution of the same solute. In solution, H_2SO_4 provides three ions. While NaCl provides two ions. Hence, vapour pressure of solution of NaCl is higher (as it gives less ions). Therefore, 1 molal NaCl will have the maximum vapour pressure.

466 **(d)**

For isotonic solutions of two non-electrolytes

$C_1 = C_2$

∴ $\frac{10}{60 \times 1000} = \frac{5}{m \times 100}$ $(1\ \text{dm}^3 = 10^3\ \text{cm}^3)$

∴ $m = 300\ \text{g mol}^{-1}$

467 **(d)**

Addition of solute to a solvent lowers the vapour pressure and freezing point but increase the boiling point of solution.

468 **(b)**

Due to complex formation

$2KI + I_2 \longrightarrow 2KI_3$

469 **(b)**

$\because$ Basicity of $H_2SO_4 = 2$

Normality = molarity× basicity of acid

=2×2=4

$\therefore \quad 2\,M\ H_2SO_4 = 4\,N\ H_2SO_4$

471 **(a)**

More is the hydration energy of an ionic solute, more is its solubility.

472 **(c)**

For two solutions to be isotonic

$$\pi_{Na_2SO_4} = \pi_{glucose}$$

$$C_1RT\,(1+2\alpha) = C_2RT$$

$$0.004 \times (1+2\alpha) = 0.01$$

$$\therefore \qquad \alpha = 0.75 \text{ or } 75\%$$

473 **(a)**

All are methods to determine mol. wt. of non-volatile solute but elevation and depression methods may bring in changes in haemoglobin molecule. Also a little error in measurement may show higher abnormality in mol. mass.

474 **(a)**

Molarity of urea $=\dfrac{\frac{6}{60}}{\frac{100}{1000}} = 1M$

Hence, 1 M solution of glucose is isotonic with 6% urea solution.

475 **(b)**

For negative deviation $\Delta V_{\text{mixing}} = -$ve, $\Delta H_{\text{mixing}} = -$ve

476 **(c)**

Raoult's law is not valid for immiscible liquid mixtures.

477 **(a)**

During freezing of a solution only solvent freezes out and the equilibrium exists between solid and liquid forms of solvent.

478 **(a)**

$$\Delta T_f = 1.86 \times \frac{342}{342} = 1.86°\text{C}$$

$$\therefore T_f = T - \Delta T_f = 0 - 1.86 = -1.86°\text{C}$$

479 **(a)**

$1MH_2SO_4$ means 1 moleH_2SO_4 in 1000 cc of solution whereas 1m means 1 moleH_2SO_4 in 1000 g of water (=1000 cc of water). Total volume of 1 m solution will be > 1000cc due to extra 1 mol H_2SO_4 . Hence, number of moles per 1000 cc will be less. Thus 1 m is less concentrated than 1 M.

480 **(d)**

$$\frac{P^\circ - P_s}{P_s} = \frac{n}{N}$$

$$\frac{760 - P_s}{P_s} = \frac{18/180}{178.2/18}$$

$$= \frac{0.1}{9.9}$$

$$760\text{-}P_s = \frac{1}{99}P_s$$

$$P_s = 752.4$$

481 **(d)**

Mixture contains 78 g benzene = 1 mole benzene and 46 g toluene = 0.5 mole toluene

Total mole of benzene and toluene=1.5 mol

Mole fraction of benzene in mixture

$$= \frac{1}{1.5} = \frac{2}{3}$$

VP of benzene p_b° =75 torr

$\therefore$ Partial vapour pressure of benzene $= p_b^\circ\, X_b$

$$= 75 \times \frac{2}{3} = 50\ torr$$

482 **(c)**

We know that,

w(mass of solute) $= \dfrac{m \times \Delta T_f \times W}{1000 \times k_f}$

m= mol. wt. of urea (60)

$\Delta T_f = 0.186$°C

k_f =1.86°, W =500 g

$$= \frac{60 \times 0.186 \times 500}{1000 \times 1.86}$$

=3g

483 **(b)**

Henry's law involves two immiscible phases as gas-liquid; Distribution law involves two immiscible phases as liquid-liquid.

484 **(a)**

Given, m=0.2

$k_f = 1.85$

$\alpha = 0.3$

$\therefore$ i=1+α=1.3

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

=0.2× 1.85 × 1.3

=0.481°

$\therefore$ freezing point =-0.481°C

485 **(b)**

Molality $=\dfrac{\text{mole of solute}}{\text{kg of water}}$

Moles of urea $= \dfrac{0.010}{60}$ mol

Water at STP (d 1g/cm^3 = 1kg/dcm^3) = 0.3 dcm^3 = 0.3 kg

$\therefore$ Molality $= \dfrac{0.010}{60 \times 0.3} = 5.55 \times 10^{-4}$ molal

486 **(b)**

$K = c_1/c_2$ is constant for a particular solute in a given solvent-solvent system at constant temperature.

487 **(a)**

Boiling point

$=T_0(solvent) + \Delta T_b$(Elevation in b.p.)

$\Delta T_b = mik_b$

where, m is the molality

i.e., the van't Hoff factor (i)

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

$k_b = molal$ elevation constant.

Thus, $\Delta T_b \propto im$

Assume 100% ionisation

(a) $mi(Na_2SO_4) = 0.01 \times 3 = 0.03$

(b) $mi(KNO_3) = 0.01 \times 2 = 0.02$

(c) mi(urea)=0.015

(d) mi(glucose)=0.015

488 **(b)**

$$P = p_A^\circ \left(\frac{n_A}{n_A + n_B}\right) + p_B^\circ \left(\frac{n_B}{n_A + n_B}\right)$$

$$184 = 200\left(\frac{3}{3+2}\right) p_B^\circ \left(\frac{2}{3+2}\right)$$

$$184 = 200 \times \frac{3}{5} + p_B^\circ \times \frac{2}{5}$$

$$184=200+p_B^\circ \frac{2}{5}$$

$$64=p_B^\circ \frac{2}{5}$$

$p_B^\circ=\frac{64\times5}{2}$ =160 torr

489 **(a)**

$20 \times 0.4 = 40 \times N$ ($\because N_1V_1 = N_2V_2$)

or $N = 0.2$

$$\therefore M = \frac{0.2}{2} = 0.1 \text{ M}$$

490 **(a)**

The concentration is expressed in parts per million (ppm) when one part of solute is dissolved in one million parts of solvent.

491 **(a)**

0.1 M $FeCl_3$ will give the maximum number of particles (*i.e.,*ions) in the solution. Hence, its elevation in boiling point is maximum and therefore, it has highest boiling point.

$$FeCl_3 \rightleftharpoons Fe^{3+} + 3Cl^-$$

492 **(a)**

Relative lowering of vapour pressure = mole fraction of solute (**Raoult's law**)

$$\frac{p-p_s}{p} = x_2$$

$$\frac{p-p_s}{p} = \frac{wM}{mW}$$

$$0.0125= \frac{wM}{mW}$$

Or $\frac{w}{mW} = \frac{0.0125}{18} = 0.00070$

Hence, molality $=\frac{w}{mW} \times 1000$

$= 0.0007 \times 1000 = 0.70$

493 **(c)**

According to Raoult's law

$\frac{p-p_s}{p} = X_B$ (mole fraction of solute)

$$X_B = \frac{1.2-0.6}{1.2} = \frac{0.6}{1.2}$$

$=0.5$

494 **(a)**

Ideal solution $\triangle H = 0$

$\triangle V = 0$

$F_{A-A} = F_{B-B} = F_{A-B}$

495 **(b)**

Depression in freezing point is colligative property. The solute which produces highest number of ions will have minimum freezing point .

17. One molal NaCl aqueous solution

$$NaCl \rightarrow Na^+ + Cl^-$$

$\therefore$ 2 ions/molecule

18. One molal $CaCl_2$ solution

$$CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$$

$\therefore$ 3 ions/molecule

19. One molal KCl aqueous solution

KCl $\rightarrow K^+ + Cl^-$

$\therefore$ 2 ions/molecule

20. One molal urea aqueous solution →no dissociation

$\because$ CaCl_2 solution has highest number of ions

$\therefore$ It has lowest freezing point.

496 **(b)**

$\Delta T_b \propto$ molality.

497 **(c)**

Living cells shrinks in hypertonic solution (plasmolysis) while bursts in hypotonic solutions (endosmosis). There is no effect when living cells are kept in isotonic solution.

498 **(a)**

In countries nearer to polar region, the roads are sprinkled with $CaCl_2$ because $CaCl_2$ decreases the freezing point of ice and therefore, minimise the wear and tear of the roads.

499 **(a)**

Molarity $=$ normality $\times \frac{\text{equivalent weight}}{\text{molecular weight}}$

Given, normality of Na_2CO_2 solution $=0.2$ N

Equivalent weight $= M$

Molecular weight 2 M (∵ Na_2CO_3 is dipositive.)

$\therefore$ Molarity $=$ $0.2 \times \frac{M}{2M}$

$= 0.1$ M

500 **(a)**

A deliquescent solid is one which absorbs so much amount of water that it forms a saturated solution of it.

501 **(d)**

P_s ∝ mole fraction of solvent.

502 **(d)**

The ideal solution must

(i) Obey Raoult's law at all temperatures and pressures

(ii) $\triangle H=0$

(iii) $\triangle V=0$

$\therefore$ (d) statement $\triangle H = \triangle V \neq 0$ is wrong.

503 **(b)**

$\pi V = \dfrac{w}{m} ST;$

$\therefore 6 \times 10^{-4} \times 1 = \frac{4}{m} \times 0.0821 \times 300;$

$m = 1.64 \times 10^5$

504 **(c)**

Given

H_2SO_4 - V=100mL, N=0.2 M

NaOH - V=100mL, N=0.2 M

Milliequivalent of $H_2SO_4 = 100 \times 0.2 \times 2 = 40$

(∴ It is dibasic acid)

Milliequivalent of NaOH $=100 \times 0.1 \times 2 = 20$

$\therefore$ Moilliequivalent Of H_2SO_4 left $=40-20=20$

Total volume = 100mL+100mL=200mL

Normality of H_2SO_4 (left0)$=\frac{20}{200}=0.1$ N

506 **(c)**

Molecular mass of NaOH = 23+17=40

Hence, molality $(m)=\frac{4}{40\times 0.996}=0.1$

507 **(a)**

$$\frac{P_0 - P_s}{P_0} = \frac{6/60}{6/60 + 90/18} = \frac{1}{51} = 0.0196$$

508 **(a)**

Molality of cane sugar solution

$= \frac{342}{342\times1} = 1m$

We know that $\Delta T_f = k_f . m$

$=1.86 \times 1$

$=1.86°$

Hence , freezing point of solution

$=0.00-(1.86)=-1.86°C$

509 **(b)**

According to Henry's law, the gas in contact with the liquid should behave as an ideal gas

510 **(b)**

$\frac{p-p_s}{p}=\frac{w_1M_2}{w_2M_1}$

To produce same lowering of vapour pressure, $\frac{p-p_s}{p}$ will be same for both cases.

So, $\frac{W_{(\text{Glucose})}\times18}{50\times180}=\frac{W_{(\text{urea})}\times18}{50\times60}$

$W_{(\text{Glucose})}$=weight of glucose

$W_{(\text{urea})}$ =weight of urea

or $\frac{W_{(\text{Glucose})}\times18}{50\times180} = \frac{1\times18}{50\times60}$

$W_{(\text{urea})}=3$

511 **(a)**

Let V litre of 10 N HCl be mixed with (1 - V) litre of 4 N HCl to give (V+1-V) = 1L of 7 N HCl.

$N_1V_{1+} N_2V_2 = N\ V$

$10V + 4\ (1-V) = 7 \times 1$

$10V + 4 - 4V = 7$

$6V = 7 - 4$

$V = \frac{3}{6} = 0.50$L

Volume of 10 N HCl = 0.50L

Volume of 4N HCl = 1- 0.50=0.50 L

512 **(a)**

The interaction between H_2SO_4 and H_2O is more than $H_2SO_4 - H_2SO_4$ or $H_2O - H_2O$ interaction.

513 **(c)**

Molarity (M)

$= \frac{\text{weight of solute}}{\text{mol.wt.of solute} \times \text{ volume of the solution}} \times 1000$

$= \frac{2.5 \times 1000}{58.5 \times 100} = 0.428$ mol

514 **(c)**

Osmotic pressure is a colligative property because it depends upon the number of solute particles but not on the nature of the solute.

515 **(b)**

$\pi V = \dfrac{m_2}{M_2}\ RT$