PROBLEM SOLVING TECHNIQUES OF PHYSICAL CHEMISTRY FOR NEET

BY

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LIQUID SOLUTION

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BASIC EXERCISE

CONCENTRATION TERMS

1. 8 g NaOH is dissolved in one litre of solution, its molarity is :
(1) 0.8 M (2) 0.4 M (3) 0.2 M (4) 0.1 M

Ans. **(3)**

2. If 18 g of glucose is present in 1000 g of solvent, the solution is said to be :
(1) 1 molar (2) 0.1 molar (3) 0.5 molar (4) 0.1 molal

Ans. **(4)**

3. For preparing 0.1 M solution of H_2SO_4 in one litre, we need H_2SO_4 :
(1) 0.98 g (2) 4.9 g (3) 49.0 g (4) 9.8 g

Ans. **(4)**

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

Ans. **(3)**

5. 1000 g aqueous solution of $CaCO_3$ contains 10 g of calcium carbonate concentration of the solution is :
(1) 10 ppm (2) 100 ppm (3) 1000 ppm (4) 10,000 ppm

Ans. **(4)**

6. How much volume of 3.0 M H_2SO_4 is required for the preparation of 1.0 litre of 1.0 M solution ?
(1) 300 ml (2) 320 ml (3) 333.3 ml (4) 350.0 ml

Ans. **(3)**

7. What is the normality of 1M H_3PO_4 solution ?
(1) 0.5 N (2) 1.0 N (3) 2.0 N (4) 3.0 N

Ans. **(4)**

8. The molarity of 0.2 N Na_2CO_3 solution will be :
(1) 0.05 M (2) 0.2 M (3) 0.1 M (4) 0.4 M

Ans. **(3)**

9. A molal solution is one that contains one mole of a solute in
(1) 1000 g of the solvent (2) one litre of the solution
(3) one litre of the solvent (4) 22.4 litres of the solution

Ans. **(1)**

10. Molarity of 720 gm of pure water -
(1) 40M (2) 4M (3) 55.5M (4) Can't be determined

Ans. **(3)**

11. The mole fraction of oxygen in a mixture of 7g of nitrogen and 8g of oxygen is :

(1) $\frac{8}{15}$ (2) 0.5 (3) 0.25 (4) 1.0

Ans. **(2)**

12. Normality of 0.3 M phosphorous acid is:-

(1) 0.15 (2) 0.6 (3) 0.9 (4) 0.1

Ans. **(2)**

13. Which of the following statement is true :-

(a) Molarity is the no. of moles of solute dissolved per litre of solvent.

(b) The molarity and normality of a solution of sodium carbonate are same.

(c) Molality (m) of a solution is defined as the number of moles of solute dissolved is 1000 gm of solution

(d) The ratio of mole fraction of solute and solvent is in the ratio of there respective moles.

(1) a & c (2) a & d (3) b & c (4) Only d

Ans. **(4)**

14. The molarity of a solution of sodium chloride (mol wt. = 58.5) in water containing 5.85 gm of sodium chloride in 500 ml of solution is :-

(1) 0.25 (2) 2.0 (3) 1.0 (4) 0.2

Ans. **(4)**

15. 25 ml $\frac{N}{10}$ NaOH solution will exactly neutralize which of the following solution :-

(1) 25 ml $\frac{N}{10}$ KOH solution (2) 25 ml N H_2SO_4 solution

(3) 25 ml $\frac{N}{10}$ HCl solution (4) 2.5 ml $\frac{N}{10}$ HNO_3 solution

Ans. **(3)**

16. The volume of water added to 500 ml., 0.5 M NaOH so that its strength becomes 10 mg NaOH per ml.

(1) 100 ml (2) 200 ml (3) 250 ml (4) 500 ml

Ans. **(4)**

17. Equal weight of NaCl and KCl are dissolved separately in equal volumes of solutions molarity of the two solutions will be –

(1) Equal

(2) That of NaCl will be less than that of KCl

(3) That of NaCl will be more than that of KCl Solution

(4) That of NaCl will be half of that of KCl solution

Ans. **(3)**

18. How much water should be added to 200 cc of seminormal solution of NaOH to make it exactly decinormal :-

(1) 1000 cc (2) 400 cc (3) 800 cc (4) 600 cc

Ans. **(3)**

19. Normality of 10% (W\V) H_2SO_4 solution is nearly

(1) 0.1 (2) 0.2 (3) 0.5 (4) 2

Ans. **(4)**

20. 100 ml of 0.3 N HCl solution is mixed with 200 ml of 0.6 N H_2SO_4 solution what is the normality of H_2SO_4 in the final solution.

(1) 0.9 (2) 0.6 (3) 0.5 (4) 0.4

Ans. **(4)**

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

(1) $\frac{1}{6}$ (2) $\frac{1}{5}$ (3) $\frac{1}{2}$ (4) $\frac{1}{3}$

Ans. **(1)**

22. An X molal solution of a compound in benzene has mole fraction of solute equal to 0.2. The value of X is:-

(1) 14 (2) 3.2 (3) 1.4 (4) 2

Ans. **(2)**

23. A 500 g tooth paste sample has 0.02 gm fluoride concentration. What is the concentration of fluorine in terms of ppm level:-

(1) 250 (2) 40 (3) 400 (4) 1000

Ans. **(2)**

24. H_2O_2 solution used for hair bleaching is sold as a solution of approximately 5.0 gm H_2O_2 per 100 mL of the solution. The molecular mass of H_2O_2 is 34. The molarity of this solution is approximately:-

(1) 0.15 M (2) 1.5 M (3) 3.0 M (4) 3.4 M

Ans. **(2)**

25. Mole fraction of ethanol in ethanol water mixture is 0.25. Hence percentage concentration of ethanol by weight of mixture is :–

(1) 25% (2) 75% (3) 46% (4) 54%

Ans. **(3)**

26. Two bottles of A and B contains 1M and 1m aqueous solution (d =1 g/ mL) of sulphuric acid respectively-

(1) A is more concentrated than B (2) B is more concentrated than A

(3) Concentration of A = conc. of B (4) It is not possible to compare the concentration

Ans. **(1)**

27. Molar concentration of a solution in water is :

(1) Always equal to normality (2) More than molality of the solution

(3) Equal to molality of the solution (4) Less than the molality of the solution

Ans. **(4)**

28. What volume of 0.1 N HNO_3 solution can be prepared from 6.3 g of HNO_3 ?

(1) 1 litre (2) 2 litre (3) 0.5 litre (4) 5 litre

Ans. **(1)**

29. 100 ml of 0.5 N NaOH solution is added to 10 ml of 3 N H_2SO_4 solution and 20 ml of 1 N HCl solution. The mixture is:

(1) Acidic (2) Alkaline (3) Neutral (4) None of these

Ans. **(3)**

30. 0.7 g of $Na_2CO_3 . xH_2O$ is dissolved in 100 ml, 20 ml of which required 19.8 ml of 0.1 N HCl. The value of x is:

(1) 4 (2) 3 (3) 2 (4) 1

Ans. **(3)**

31. The normality of 10 ml of a '20 V' H_2O_2 solution is

(1) 1.79 (2) 3.58 (3) 60.86 (4) 6.086

Ans. **(2)**

32. If 8.3 ml of a sample of H_2SO_4 (36 N) is diluted by 991.7 ml of water, the approximate normality of the resulting solution is

(1) 0.4 (2) 0.2 (3) 0.1 (4) 0.3

Ans. **(4)**

33. 10 ml of an HCl solution gave 0.1435 gm of AgCl when treated with excess of $AgNO_3$. The normality of the HCl solution is :

(1) 0.1 (2) 3 (3) 0.3 (4) 0.2

Ans. **(1)**

34. If 20ml, 2M H_2SO_4 is diluted to 1 litre. Normality of the resulting solution

(1) 0.08 (2) 0.04 (3) 40 (4) 0.4

Ans. **(1)**

SOLUBILITY (HENRY'S LAW)

35. Henry law constant for dissolution of CH_4 in benzene at 298 K is 2×10^5 mm of Hg. Then solubility of CH_4 to benzene at 298 K under 760 mm of Hg is

(1) 1.2×10^{-5} (2) 3.8×10^{-3} (3) 4×10^{-4} (4) 1×10^{-3}

Ans. **(2)**

36. Which of the following gas will have most solubility in water ?

(1) NH_3 (2) H_2 (3) O_2 (4) He

Ans. **(1)**

VAPOUR PRESSURE (LIQUID-LIQUID MIXTURE)

37. 1 mole of heptane (V. P. = 92 mm of Hg) was mixed with 4 moles of octane (V. P. = 31 mm of Hg). The vapour pressure of resulting ideal solution is :

(1) 46.2 mm of Hg (2) 40.0 mm of Hg (3) 43.2 mm of Hg (4) 38.4 mm of Hg

Ans. (3)

38. 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 :

(1) 0.416 (2) 0.588 (3) 0.688 (4) 0.740

Ans. (4)

39. If P_A^0 and P_B^0 are 108 and 36 torr respectively. What will be the mole fraction of A is vapour phase if B has mole fraction in solution 0.5

(1) 0.5 (2) 0.75 (3) 0.60 (4) 0.35

Ans. (2)

40. What is correct relation between mole fraction in vapour phase (Y_A) of A in terms of X_A. If mole fraction in solution of A is (X_A) (If P_A^0 is vapour pressure of A in pure state)

(1) $(1-X_A)P_A^0$ (2) $\frac{X_A}{1-X_A}P_A^0$ (3) $\frac{1-X_A}{X_A}P_A^0$ (4) $\frac{P_A^0 X_A}{P_S}$

Ans (4)

IDEAL AND NON-IDEAL SOLUTIONS

41. Among the following, that does not form an ideal solution is :

(1) C_6H_6 and $C_6H_5CH_3$ (2) C_2H_5Cl and C_6H_5OH (3) C_6H_5Cl and C_6H_5Br (4) C_2H_5Br and C_2H_5I

Ans. (2)

42. Which condition is not satisfied by an ideal solution

(1) ΔH mixing = 0 (2) ΔV mixing = 0 (3) ΔS mixing = 0 (4) Obeyance of Raoult's law

Ans. (3)

COLLIGATIVE PROPERTIES

43. The relative lowering of vapour pressure is equal to the mole fraction of the nonvolatile solute, This statement was given by :

(1) Raoult (2) Henry (3) Joule (4) Dalton

Ans. (1)

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

(1) Mole fraction of the solvent (2) Mole fraction of the solute

(3) Mole fraction of the solvent and solute (4) The volume of the solution

Ans. (1)

45. Which one of the following is the incorrect form of Raoult's law

(1) $\frac{P_s}{P^0} = \frac{N}{n+N}$ (2) $\frac{P^0}{P^0 - P_s} = 1 + \frac{N}{n}$ (3) $\frac{P^0 - P_s}{P_s} = \frac{n}{n+N}$ (4) $\frac{P_s}{P^o - P_s} = \frac{N}{n}$

Ans. **(3)**

46. The vapour pressure of a solution having solid as solute and liquid as solvent is :

(1) Directly proportional to mole fraction of the solvent

(2) Inversely proportional to mole fraction of the solvent

(3) Directly proportional to mole fraction of the solute

(4) Inversely proportional to mole fraction of the solute

Ans. **(1)**

47. One mole of non volatile solute is dissolved in two moles of water. The vapour pressure of the solution relative to that of water is

(1) $\frac{2}{3}$ (2) $\frac{1}{3}$ (3) $\frac{1}{2}$ (4) $\frac{3}{2}$

Ans. **(1)**

48. The vapour pressure of a pure liquid 'A' is 70 torr at 27^0C. It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total vapour pressure of the solution is 84 torr at 27^0C. The vapour pressure of pure liquid B at 27^0C is -

(1) 14 (2) 56 (3) 140 (4) 70

Ans. **(3)**

49. The vapour pressure of water at room temperature is 23.8 mm of Hg. The vapour pressure of an aqueous solution of sucrose with mole fraction 0.1 is equal to :

(1) 23.9 mm Hg (2) 24.2 mm Hg (3) 21.42 mm Hg (4) 31.44 mm Hg

Ans. **(3)**

50. The vapour pressure of pure A is 10 torr and at the same temperature when 1 g of B is dissolved in 20 gm of A, its vapour pressure is reduced to 9.0 torr. If the molecular mass of A is 200 amu, then the molecular mass of B is :

(1) 100 amu (2) 90 amu (3) 75 amu (4) 120 amu

Ans. **(2)**

51. Which is not a colligative property ?

(1) Osmotic pressure (2) Lowering in vapour pressure

(3) Depression in freezing point (4) Refractive index

Ans. **(4)**

52. The lowering of vapour pressure of a solvent by addition of a non-volatile solute to it is directly proportional to :

(1) The strength of the solution (2) The nature of the solute in the solution

(3) The atmospheric pressure (4) All

Ans. **(1)**

53. The molal elevation constant is the ratio of the elevation in B.P. to :

(1) Molarity (2) Molality

(3) Mole fraction of solute (4) Mole fraction of solvent

Ans. (2)

54. Molal depression constant of water is 1.86 K Kg mol^{-1}. 0.02 mol of urea dissolved in 100 g of water will produce a depression in freezing point of :

(1) 0.186 °C (2) 0.372 °C (3) 1.86 °C (4) 3.72 °C

Ans. (2)

55. A solution of 1.25 g of a non-electrolyte in 20 g of water freezes at 271.94 K. If K_f = 1.86K molality^{-1} then the molecular wt. of the solute is :

(1) 207.8 g/mol (2) 179.79 g/mol. (3) 209.6 g/mol. (4) 109.6 g/mol.

Ans. (4)

56. Elevation in boiling point was 0.52 °C. When 6 g of a compound x was dissolved in 100 g of water. Molecular weight of x is : (K = 5.2 K mol^{-1} 100 g H_2O)

(1) 120 (2) 60 (3) 100 (4) 342

Ans. (2)

57. Pure benzene freezes at 5.45 °C at a certain place but a 0.374 m solution of tetrachloroethane in benzene freezes at 3.55 °C. The K_f for benzene is-

(1) 5.08 K Kg mol^{-1} (2) 508 K Kg mol^{-1} (3) 0.508 K Kg mol^{-1} (4) 50.8 °C Kg mol^{-1}

Ans. (1)

58. An aqueous solution containing 1g of urea boils at 100.25 °C. The aqueous solution containing 3g of glucose in the same volume will boil at -

(1) 100.75 °C (2) 100.5 °C (3) 100 °C (4) 100.25 °C

Ans. (4)

59. An aqueous solution freezes at –
0.186 °C (K_f = 1.86° ; K_b = 0.512°). What is the elevation in boiling point ?

(1) 0.186 (2) 0.512 (3) $\frac{0.512}{1.86}$ (4) 0.0512

Ans. (4)

60. If a thin slice of sugar beet is placed in concentrated solution of NaCl then

(1) Sugar beet will lose water from its cells (2) Sugar beet will absorb water from solution

(3) Sugar beet will neither absorb nor lose water (4) Sugar beet will dissolve in solution

Ans. (1)

61. At constant temperature the osmotic pressure of a solution is :

(1) Directly proportional to the concentration

(2) Inversely proportional to the concentration

(3) Directly proportional to the square of concentration

(4) Directly proportional to the square root of concentration

Ans. (1)

62. Which inorganic precipitate acts as semipermeable membrane ?

(1) Calcium sulphate (2) Barium oxalate (3) Nickel phosphate (4) Copper ferrocyanide

Ans. (4)

63. If 0.1 M solution of glucose and 0.1 M urea solution are placed on two sides of a semipermeable membrane to equal heights, then it will be correct to say that :

(1) There will be not net movement across the membrane

(2) Glucose will flow towards urea solution

(3) Urea will flow towards glucose solution

(4) Water will flow from urea solution towards glucose solution.

Ans. (1)

64. If mole fraction of the solvent in solution decreases then :

(1) Vapour pressure of solution increases (2) B. P. decreases

(3) Osmotic pressure increases (4) All are correct

Ans. (3)

65. The osmotic pressure of a solution increases if :

(1) Temperature is lowered (2) Volume is increased

(3) Number of solute molecules is increased (4) None

Ans. (3)

66. Osmotic pressure of a solution (density is 1g/ml) containg 3 g of glucose (molecular weight = 180) in 60 g of water at 15^0C is :

(1) 0.34 atm (2) 0.65 atm (3) 6.25 atm (4) 5.57 atm

Ans. (3)

67. Osmotic pressure of a sugar solution at 24^0C is 2.5 atmosphere. The concentration of the solution in mole per litre is:

(1) 10.25 (2) 1.025 (3) 1025 (4) 0.1025

Ans. (4)

68. A solution containing 4 g of a non volatile organic solute per 100 ml was found to have an osmotic pressure equal to 500 cm of mercury at 27^0C. The molecular weight of solute is :

(1) 14.97 (2) 149.7 (3) 1697 (4) 1.497

Ans. (2)

69. If a 6.84% (wt. / vol.) solution of cane-sugar (mol. wt. 342) is isotonic with 1.52% (wt./vol.) solution of thiocarbamide, then the molecular weight of thiocarbamide is :

(1) 152 (2) 76 (3) 60 (4) 180

Ans. (2)

70. 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

(1) 5 (2) 146 (3) 34200 (4) 50000

Ans. (4)

71. The 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 :

(1) 5.41% (2) 54.1% (3) 3.5% (4) 4.53%

Ans. **(1)**

72. Which of the following solutions at the same temperature will be isotonic :

(1) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in one litre water.

(2) 3.42 g of cane sugar in one litre water and 0.18 g of glucose in 0.1 litre water.

(3) 3.42 g of cane sugar in one litre water and 0.585g of NaCl in one litre water.

(4) 3.42 g of cane sugar in one litre water and 1.17 g of NaCl in one litre water.

Ans. **(2)**

73. 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 and 1.86 K molality^{-1} :

(1) –0.544 °C (2) –0.512 °C (3) –0.272 °C (4) –1.86 °C

Ans. **(3)**

74. In the depression of freezing point experiment, it is found that :-

(1) The vapour pressure of solution is more than of pure H_2O.

(2) The vapour pressure of solution is more than of pure solute.

(3) Only solute molecules solidify at freezing point.

(4) Only solvent molecules solidify at freezing point.

Ans. **(4)**

ABNORMAL COLLIGATIVE PROPERTIES

75. If total concentration of dissolved particles inside red blood cells is 0.3 M (approximate) and the membrane surrounding the cell is semipermeable. Find osmotic pressure inside the cell if cell were removed from blood plasma and placed in pure H_2O at 298 K

(1) 7.34 atm (2) 1.78 atm (3) 2.34 atm (4) 0.74 atm

Ans. **(1)**

76. Phenol associates in benzene as

$$C_6H_5OH \rightleftharpoons \frac{1}{2}(C_6H_5OH)_2$$

If degree of association of phenol is 40%, Van't Hoff factor i is

(1) 1 (2) 0.8 (3) 1.4 (4) 0.6

Ans. **(2)**

77. If α is the degree of dissociation of $K_4[Fe(CN)_6]$, then abnormal mass of complex in the solution will be :-

(1) $M_{normal}(1+2\alpha)^{-1}$ (2) $M_{normal}(1+3\alpha)^{-1}$ (3) $M_{normal}(1+\alpha)^{-1}$ (4) $M_{normal}(1+4\alpha)^{-1}$

Ans. **(4)**

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

(1) Normal (2) Associated (3) Hydrolysed (4) Dissociated

Ans. **(2)**

79. Van't Hoff factor is :

(1) Less than one in case of dissociation (2) More than one in case of association

(3) Always less than one (4) Less than one in case of association

Ans. **(4)**

80. The Vant Hoff factor (i) for a dilute solution of $K_3[Fe(CN)_6]$ is :

(1) 10 (2) 4 (3) 5 (4) 0.25

Ans. **(2)**

81. The experimental molecular weight of an electrolyte will always be less than its calculated value because the value of vant Hoff factor, 'i' is :

(1) Less than 1 (2) Greater than 1 (3) One (4) Zero

Ans. **(2)**

82. The vant Hoff factor (i) for a dilute aqueous solution of Glucose is :

(1) Zero (2) 1.0 (3) 1.5 (4) 2.0

Ans. **(2)**

83. The substance A when dissolved in solvent B shows the molecular mass corresponding to A_3. The vant Hoff's factor will be -

(1) 1 (2) 2 (3) 3 (4) $\frac{1}{3}$

Ans. **(4)**

84. The ratio of the value of any colligative property for KCl solution to that for sugar solution is nearly ..... time :

(1) 1 (2) 0.5 (3) 2 (4) 2.5

Ans. **(3)**

85. The lowering of vapour pressure of 0.1M aqueous solutions of NaCl, $CuSO_4$ and K_2SO_4 are :

(1) All equal (2) In the ratio of 1 : 1 : 1.5

(2) In the ratio of 3 : 2 : 1 (4) In the ratio of 1.5 : 1 : 2.5

Ans. **(2)**

86. The freezing point of 1 molal NaCl solution assuming NaCl to be 100% dissociated in water is: ($K_f = 1.86$ K Molality^{-1})

(1) –1.86 °C (2) –3.72 °C (3) +1.86 °C (4) + 3.72 °C

Ans. **(2)**

87. The molal elevation constant of water is 0.51. The boiling point of 0.1 molal aqueous NaCl solution is nearly :

(1) 100.05 °C (2) 100.1 °C (3) 100.2° C (4) 101.0° C

Ans. **(2)**

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

(1) 100.52^{0}C (2) 101.04^{0}C (3) 99.48^{0}C (4) 98.96^{0}C

Ans. (2)

89. Solute A is ternary electrolyte and solute B is non-electrolyte. If 0.1 M solution of solute B produces an osmotic pressure of 2P, then 0.05M solution of A at the same temperature will produce an osmotic pressure equal to :

(1) P (2) 1.5 P (3) 2 P (4) 3 P

Ans. (4)

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

(1) 25% (3) 50 (3) 75% (4) 60%

Ans. (3)

91. A 0.004M solution of Na_2SO_4 is isotonic with a 0.010M solution of glucose at the 25°C temperature. The apparent degree of dissociation of Na_2SO_4 is

(1) 25% (2) 50% (3) 75% (4) 85%

Ans. (3)

92. A 5.8% (wt./vol.) NaCl solution will exert an osmotic pressure closest to which one of the following :

(1) 5.8% (wt./vol) sucrose solution (2) 5.8% (wt./vol) glucose solution

(3) 2 M sucrose solution (4) 1 M glucose solution

Ans. (3)

93. Which salt shows maximum osmotic pressure in its 1M solution :

(1) $AgNO_3$ (2) Na_2SO_4 (3) $(NH_4)_3PO_4$ (4) $MgCl_2$

Ans. (3)

94. Which solution will exert highest osmotic pressure?

(1) 1M glucose solution (2) 1M urea solution (3) 1M Alum solution (4) 1M NaCl solution

Ans. (3)

95. Which is the correct relation between osmotic pressure of 0.1M NaCl solution and 0.1M Na_2SO_4 solution ?

(1) The osmotic pressure of Na_2SO_4 is less than NaCl solution

(2) The osmotic pressure Na_2SO_4 is more than NaCl solution

(3) Both have same osmotic pressure

(4) None of the above

Ans. (2)

96. The osmotic pressure of equimolar solutions of $BaCl_2$, NaCl, and glucose will be in the order :

(1) Glucose > NaCl > $BaCl_2$ (2) $BaCl_2$ > NaCl > Glucose

(3) NaCl > $BaCl_2$ > Glucose (4) NaCl > Glucose > $BaCl_2$

Ans. (2)

97. The correct relationship between the boiling points of very dilute solutions of $AlCl_3(T_1)$ and $CaCl_2(T_2)$, having the same molar concentration is :

(1) $T_1 = T_2$ (2) $T_1 > T_2$ (3) $T_2 = T_1$ (4) $T_2 \geq T_1$

Ans. **(2)**

98. Which of the following 0.1 M aqueous solutions will have the lowest freezing point :

(1) Potassium Sulphate (2) Sodium Chloride (3) Urea (4) Glucose

Ans. **(1)**

99. Which aqueous solution has minimum freezing point

(1) 0.01 M NaCl (2) 0.005 M C_2H_5OH (3) 0.005 M MgI_2 (4) 0.005 M $MgSO_4$

Ans. **(1)**

100. Which solution will have least vapour pressure :

(1) 0.1 M $BaCl_2$ (2) 0.1 M urea (3) 0.1 M Na_2SO_4 (4) 0.1 M Na_3PO_4

Ans. **(4)**

101. Which has maximum freezing point :

(1) 1 molar of NaCl solution (2) 1 molar of KCl solution

(3) 1 molar of $CaCl_2$ solution (4) 1 molar of urea solution

Ans. **(4)**

102. The freezing point of 1% aqueous solution of calcium nitrate will be :

(1) 0^0C (2) Above 0^0C (3) 1^0C (4) Below 0^0C

Ans. **(4)**

103. The following aqueous solution in the correct order of decreasing freezing point is -

(1) 0.2M $BaCl_2$, 0.2M KCl, 0.1M Na_2SO_4 (2) 0.2M KCl, 0.1M Na_2SO_4, 0.2M $BaCl_2$

(3) 0.1M Na_2SO_4, 0.2M KCl, 0.2M $BaCl_2$ (3) 0.1M Na_2SO_4, 0.2M $BaCl_2$, 0.2M KCl

Ans. **(3)**

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

(1) 1% Glucose in water (2) 1% Sucrose in water

(3) 1% NaCl in water (4) 1% Urea in water

Ans. **(3)**

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

(1) $C_6H_5NH_3Cl$ (2) $Ca(NO_3)_2$ (3) $La(NO_3)_3$ (4) $C_6H_{12}O_6$(Glucose)

Ans. **(4)**

106. When Mercuric Iodide is added to the aqueous solution of Potassium Iodide ?

(1) The boiling point does not change (2) Freezing point is raised

(3) The freezing point is lowered (4) Freezing point does not change

Ans. **(2)**

107. The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to:

(1) Ionisation of benzoic acid (2) Dimerization of benzoic acid

(3) Trimerization of benzoic acid (4) Solvation of benzoic acid

Ans. **(2)**

Analytical Exercise

1. One litre of N/2 HCl solutions is heated in a beaker. It was observed that when the volume of the solution was reduce to 600 mL, 3.25 g of HCl in lost, calculate the normality of the new solution

(1) 1.70 (2) 0.685 (3) 0.018 (4) 0.009

Ans. **(2)**

2. The molality of a solution obtained by mixing 750 mL of 0.5(M)HCl with 250 mL of 2(M)HCl will be :-

(1) 0.875 M (2) 1.00 M (3) 1.75 M (4) 0.975 M

Ans. **(1)**

3. A 0.2 molal aqueous solution of a weak acid (HX) is 20% ionised. The elevation in boiling point of this solution is (given $K_b = 0.52°C\ kg\ mol^{-1}$ for H_2O)

(1) 0.81 (2) 0.125 (3) 0.48 (4) 1.3

Ans. **(2)**

4. Consider separate solution of 0.500 M C_2H_5OH(aq). 0.100 M $Mg_3(PO_4)_2$(aq), 0.250 M KBr(aq) and 0.125 M Na_3PO_4(aq) at 25°C. Which statement is true about these solutions, assuming all salts to be strong electrolytes ?

(1) 0.125 M Na_3PO_4(aq) has the highest osmotic pressure.

(2) 0.500 M C_2H_5OH (aq) has the highest osmotic pressure.

(3) They all have the same osmotic pressure.

(4) 0.100 M $Mg_3(PO_4)_2$ (aq) has the highest osmotic pressure.

Ans. **(3)**

5. Which of the following solutions has the highest normality :-

(1) 8 grams of KOH per litre (2) 1N phosphoric acid

(3) 6 gms of NaOH per 100 ml (4) 0.5 M H_2SO_4

Ans. **(3)**

6. Hydrochloric acid solution A and B have concentration of 0.5 N and 0.1 N respectively. The volume of solutions A and B required to make 2 litres of 0.2 N HCl are :-

(1) 0.5 lit. of A + 1.5 lit. of B (2) 1.5 lit. of A + 0.5 lit. of B

(3) 1.0 lit. of A + 1.0 lit. of B (4) 0.75 lit. of A + 1.25 lit. of B

Ans. **(1)**

7. An aqueous solution of glucose is 10% in strength. The volume in which 2gm mole of it is dissolved will be:-

(1) 18 litre (2) 3.6 litre (3) 0.9 litre (4) 1.8 litre

Ans. **(2)**

8. The relationship between the values of osmotic pressure of solutions obtained by dissolving 6.00 gL^{-1} of CH_3COOH (π_1) and 7.45 gL^{-1} of KCl (π_2) is :-

(1) $\pi_1 > \pi_2$ (2) $\pi_1 < \pi_2$ (3) $\pi_1 = \pi_2$ (4) None of these

Ans. **(2)**

9. A mixture of liquid showing positive deviation in Raoult's law is :-

(1) $(CH_3)_2CO + C_2H_5OH$ (2) $(CH_3)_2CO + CHCl_3$ (3) $(C_2H_5)_2O + CHCl_3$ (4) $(CH_3)_2CO + C_6H_5NH_2$

Ans. **(1)**

10. The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74 . The degree of dissociation is :-

(1) 91.3% (2) 87% (3) 100% (4) 74%

Ans. **(2)**

11. Osmosis of A into solution B will not take place if :-

(1) A is hypertonic (2) A is hypotonic (3) A is isotonic (4) Either 1 or 3 may correct

Ans. **(4)**

12. Among 0.1M solutions of urea, Na_3PO_4 and $Al_2(SO_4)_3$:-

(a) The vapour pressure and freezing point are the lowest for urea

(b) The vapour pressure and freezing point are the highest for urea

(c) The elevation in boiling point is the highest for $Al_2(SO_4)_3$

(d) The depression in freezing point is the highest for $Al_2(SO_4)_3$

(1) Only a (2) b & c both (3) b, c and d (4) a, b, c and d

Ans. **(3)**

13. Glucose is added to 1 litre water to such an extent that $\frac{\Delta T_f}{K_f}$ becomes equal to $\frac{1}{1000}$, the wt. of glucose added is:-

(1) 180 g (2) 18 g (3) 1.8 g (4) 0.18 g

Ans. **(4)**

14. The vapour pressure of a solution of 5gm. of non electrolyte in 100gm. of water at a particular temperature is 2985 Nm^{-2}. The vapour pressure of pure water at that temperature is 3000Nm^2. The molecular weight of the solute is :-

(1) 180 (2) 90 (3) 270 (4) 200

Ans. **(1)**

15. How many grams of a non volatile solute having a molecular weight of 90 are to be dissolved in 97.5 g water in order to decrease the vapour pressure of water by 2.5 percent :-

(1) 25 (2) 18 (3) 12.5 (4) 9

Ans. **(3)**

16. Colligative properties depend on the :-

(1) Relative no. of solute molecules in soln. and the nature of the solvent

(2) Relative no. of solute molecules in solvent and the nature of solute

(3) Relative no. of solute molecules and the nature of solute and solvent

(4) Relative no. of solute molecules, irrespective of the nature of solvent and solute

Ans. **(1)**

17. The vapour pressure of two pure liquids (A) and (B) are 100 and 80 torr respectively. The total pressure of the solution obtained by mixing 2 mol of (A) and 3 mol of (B) would be

(1) 20 torr (2) 36 torr (3) 88 torr (4) 180 torr

Ans. **(3)**

18. When equimolar aqueous solutions of glucose, sodium chloride and barium nitrate are compared the vapour pressure of the solutions will be in the following order :-

(1) Glucose > NaCl > $Ba(NO_3)_2$ (2) Glucose = NaCl = $Ba(NO_3)_2$

(3) $Ba(NO_3)_2$ > NaCl > Glucose (4) NaCl > $Ba(NO_3)_2$ > Glucose

Ans. **(1)**

19. What is the freezing point of a solution containing 8.1 gm. of HBr is 100gm. water assuming the acid to be 90% ionised (K_f for water = 1.86 K molality^{-1}) :-

(1) 0.85°C (2) –3.53°C (3) 0°C (4) –0.35°C

Ans. **(2)**

20. The concentration of a solution of H_2O_2 is 6.8% then the volume concentration of the solution is:-

(1) 22.4 (2) 11.2 (3) 20 (4) 5

Ans. **(1)**

21. For a solution of two liquids A and B, it was proved that $P = X_A (P_A^0 - P_B^0) + P_B^0$. The solution is:–

(1) Ideal (2) Non ideal (3) Semiideal (4) None of the above

Ans. **(1)**

22. The molar mass of NaCl determined by the osmotic pressure method will be :–

(1) Higher than the theoretical value (2) Lower than the theoretical value

(3) The same as the theoretical value (4) None of these

Ans. **(2)**

23. The vapour pressure of pure benzene and toluene are 160 and 60 torr respectively. The mole fraction of toluene in vapour phase in contact with equimolar solution of benzene and toluene is:

(1) 0.50 (2) 0.6 (3) 0.27 (4) 0.73

Ans. **(3)**

24. The vapour pressure of ethanol and methanol are 42.0 mm and 88.5 mm Hg respectively. An ideal solution is formed at the same temperature by mixing 46.0 g of ethanol with 16.0 g of methanol. The mole fraction of methanol in the vapour is :

(1) 0.467 (2) 0.502 (3) 0.513 (4) 0.556

Ans. **(3)**

25. Azeotropic mixture are :

(1) Mixture of two solids (2) Those which boil at different temperatures

(3) Those which can be fractionally distilled (4) Constant boiling mixtures

Ans. **(4)**

26. The azeotropic mixture of water (B.P 100^{0}C) and HCl (B.P. 85^{0}C) boils at 108.5^{0}C. When this mixture is distilled, it is possible to obtain :

(1) Pure HCl (2) Pure water

(3) Pure water as well as HCl (4) Neither HCl nor H_2O in their pure states

Ans. **(4)**

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

(1) 4.8×10^5 (2) 9×10^5 (3) 3×10^5 (4) 5.16×10^6

Ans. **(4)**

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

(1) 1.14 mol kg^{-1} (2) 3.28 mol kg^{-1} (3) 2.28 mol kg^{-1} (4) 0.44 mol kg^{-1}

Ans. (3)

29. 18g 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 :

(1) 759.00 torr (2) 7.60 torr (3) 76.00 torr (4) 752.40 torr

Ans. (4)

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

(1) 115.0 g mol^{-1} (2) 105.0 g mol^{-1} (3) 210.0 g mol^{-1} (4) 90.0 g mol^{-1}

Ans. (3)

31. 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

(1) 1.88 (2) 1.22 (3) 1.45 (4) 1.64

Ans. (2)

32. 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 presure (in mm) at the same temperature will be

(1) 300 (2) 700 (3) 360 (4) 350

Ans. (4)

33. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression :-

(1) $\alpha = \frac{x+y-1}{i-1}$ (2) $\alpha = \frac{x+y+1}{i-1}$ (3) $\alpha = \frac{i-1}{(x+y-1)}$ (4) $\alpha = \frac{i-1}{x+y+1}$

Ans. (3)

34. 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°C will be: (K_f for water = 1.86 K $kgmol^{-1}$, and molar mass of ethylene glycol = 62 $gmol^{-1}$)

(1) 400.00 g (2) 304.60 g (3) 804.32 g (4) 204.30 g

Ans. (3)

35. The molality of a urea solution in which 0.0100g of urea, $[(NH_2)_2CO]$ is added to 0.3000 dm^3 of water at STP is :-

(1) 0.555 m (2) 5.55×10^{-4} m (3) 33.3 m (4) 3.33×10^{-2} m

Ans. (2)

36. A gaseous mixture was prepared by taking equal mole of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) n the mixture is :

(1) 0.5 atm (2) 0.8 atm (3) 0.9 atm (4) 1 atm

Ans. (1)

37. 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 ?

(1) 27 g (2) 72 g (3) 93 g (4) 39 g

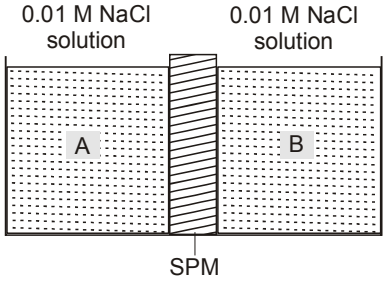
Ans. (3)

38. 100 ml of 1 M NaOH is mixed with 50 ml of 1 N KOH solution. Normality of mixture is

(1) 1 N (2) 0.5 N (3) 0.25 N (4) 2 N

Ans. **(1)**

39. Two solutions marked as A and B are separated through semipermeable membrane as below. The phenomenon undergoing



(1) Na^+ moves from solution A to solution B

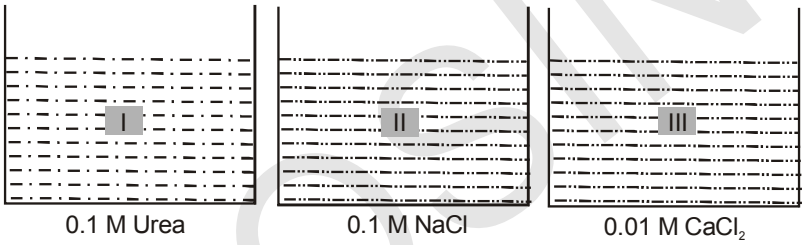
(2) Both Na^+ and Cl^- moves from solution (A) to solution (B)

(3) Both Na^+ and Cl^- moves from solution (B) to (A)

(4) Solvent molecules moves from solution (A) to (B)

Ans. **(4)**

40. Correct observation



(1) Vapour pressure of solution I is lowest

(2) Relative lowering of vapour pressure is maximum in III

(3) Freezing point is maximum for III

(4) Boiling point is minimum for II

Ans. **(2)**

41. An aqueous solution of sugar is taken in a beaker. A freezing point of solution

(1) Crystals of sugar separated

(2) Crystals of glucose and fructose are separated

(3) Crystals of ice separated

(4) Mixture of ice and some sugar crystals separated

Ans. **(3)**

42. 15 g urea and 20 g NaOH dissolved in water. Total mass of solution is 250 g. Mole fraction of NaOH in the mixture

(1) 0.036 (2) 0.62 (3) 0.5 (4) 0.4

Ans. **(1)**

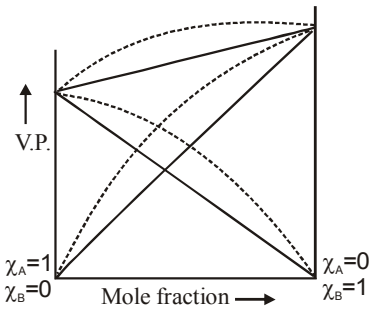
43. Which of the following concentration terms is temperature independent ?

I. Molarity II. Molality III. Normality IV. Mole fraction

(1) I & II (2) I & III (3) II only (4) II & IV

Ans. **(4)**

44. Vapour phase diagram for a solution is given below if dotted line represents deviation



Correct observation for this solution

(1) ΔH_{mix} : +ve (2) ΔS_{mix} : +ve (3) ΔV_{mix} : +ve (4) All of these

Ans. **(4)**

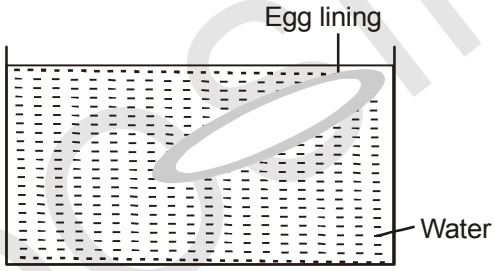
45. A mixture of two liquids A and B having boiling point of A is 70°C, and boiling point of B is 100°C, distills at 101.2° as single liquid, hence this mixture is

(1) Ideal solution (2) Non ideal solution showing +ve deviation

(3) Non ideal solution showing –ve deviation (4) Immiscible solution

Ans. **(3)**

46. The phenomenon taking place



(1) Exo-osmosis (2) Endo-osmosis

(3) Reverse-osmosis (4) All of these

Ans. **(2)**

47. 1 molar aqueous solution is _____ concentrated than 1 m aqueous solution

(1) More (2) Less (3) Equally (4) Very less

Ans. **(1)**

48. Osmotic pressure of solution containing 0.6 g urea and 3.42 g sugar in 100 ml at 27°C

(1) 492 atm (2) 4.92 atm (3) 49.2 atm (4) 28.1 atm

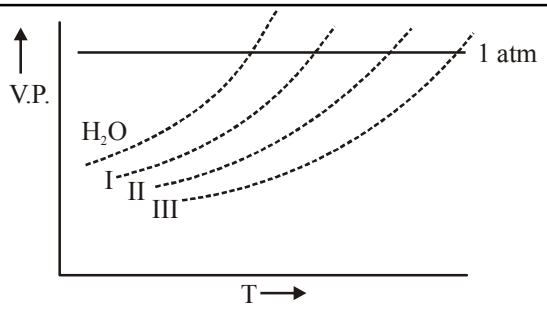
Ans. **(2)**

49. Which gas is most soluble in water ?

(1) He (2) H_2 (3) NH_3 (4) CO_2

Ans. **(3)**

50.

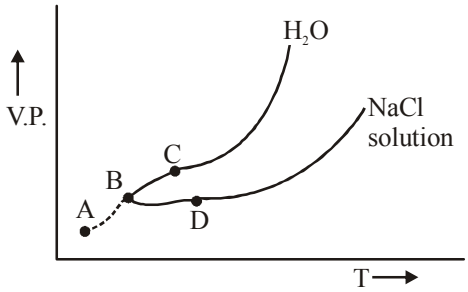


Which is having highest elevation in boiling point ?

(1) H_2O (2) Solution I (3) Solution II (4) Solution III

Ans. **(4)**

51.



Freezing point of solution is marked as

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

Ans. **(2)**

52. van't Hoff factor for acetic acid in aqueous medium at infinite dilution is

(1) 2 (2) 1 (3) 1/2 (4) 3

Ans. **(1)**

53. Correct order of freezing point of given solution

I. 0.1 M glucose II. 0.2 M urea III. 0.1 M NaCl IV. 0.05 M $CaCl_2$

(1) I < II < III < IV (2) I > II > III > IV (3) III = II < IV < I (4) IV > II > III > I

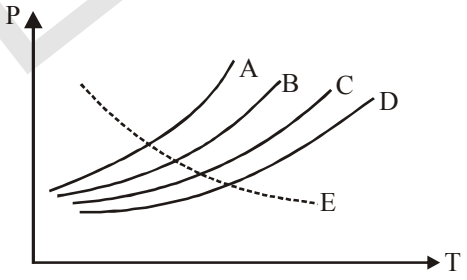
Ans. **(3)**

54. Boiling point of 0.01 M AB_2 which is 10% dissociated in aqueous medium $(K_{b_{H_2O}} = 0.52)$ as A^{+2} and B^-

(1) 273.006 K (2) 373.006 K (3) 0.006 K (4) 272.006 K

Ans. **(2)**

55. Vapour pressure diagram of some liquids plotted against temperature are shown below



Most volatile liquid

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

Ans. **(1)**

56. At higher altitude, the boiling point of water is lowered because

(1) Atmosphere pressure is low (2) Temperature is low

(3) Atmospheric pressure increase (4) Water solidifies to ice

Ans. **(1)**

57. During evaporation of liquid

(1) The temperature of liquid rises (2) The temperature of liquid falls

(3) The temperature of liquid remains uneffected (4) The liquid molecules becomes inert

Ans. **(2)**

58. What is the concentration of NO_3^- ions when equal volumes of 0.1 M $AgNO_3$ and 0.1 M NaCl are mixed together?

(1) 0.1 N (2) 0.25 M (3) 0.05 M (4) 0.2 M

Ans. **(3)**

59. If any solute 'A' dimerises in water at 1 atm pressure and the boiling point of this solution is 100.52°C. If 2 moles of A is added to 1 kg of water and k_b for water is 0.52°C/molal, calculate the percentage association of A

(1) 50% (2) 30% (3) 25% (4) 100%

Ans. **(4)**

60. 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

(1) 122 (2) 31 (3) 244 (4) 62

Ans. **(4)**

61. $K_4[Fe(CN)_6]$ is supposed to be 40% dissociated when 1M solution prepared. Its boiling point is equal to another 20% mass by volume of non-electrolytic solution A. Considering molality = molarity. The molecular weight of A is

(1) 77 (2) 67 (3) 57 (4) 47

Ans. **(2)**

ASSERTION & REASON QUESTIONS

These questions consist of two statements each, printed as *Assertion* and *Reason.* While answering these Questions you are required to choose any one of the following four responses.

A. If both *Assertion* & *Reason* are True & the *Reason* is a correct explanation of the *Assertion*.

B. If both *Assertion* & *Reason* are True but *Reason* is not a correct explanation of the Assertion.

C. If *Assertion* is True but the *Reason* is False.

D. If both *Assertion* & *Reason* are False.

1. ***Assertion :–*** The molality of the solution doesn't change with change in temperature.
Reason :– The molality is expressed in units of moles per 1000 ml. solution.

Ans. **(C)**

2. ***Assertion :–*** Isotonic solution don't show net phenomenon of osmosis.
Reason :– Isotonic solution have equal osmotic pressure at constant temp.

Ans. **(A)**

3. ***Assertion :–*** When Benzoic acid is dissolved in benzene its Vant Hoff factor is less than one.
Reason :– In benzene, benzoic acid has tendency to form dimer.

Ans. **(A)**

4. ***Assertion :–*** The sum of the mole fraction of all the components are unity.
Reason :– Mole fraction is a temperature dependent mode of concentration.

Ans. **(C)**

5. ***Assertion :–*** In positive deviation of non-ideal solution attraction between solute solvent is less than the attraction between solute-solute & solvent-solvent.
Reason :– In negative deviation of non-ideal solution attraction between solute-solvent is more than the attraction between solute-solute & solvent-solvent.

Ans. **(B)**

6. ***Assertion :–*** A solution which contains one gram equivalent of solute per litre of the solution is called normal solution.
Reason :– A normal solution mean a solutions in which the solute doesn't associate or dissociate.

Ans. **(C)**

7. ***Assertion :–*** Non-ideal solutions form azeotropic mixture.
Reason :– Boiling point of azeotropic mixture is only higher than boiling points of both the components.

Ans. **(C)**

8. ***Assertion :–*** Van't Hoff factor for benzoic acid in benzene is one.
Reason :– Benzoic acid behaves as a weaker electrolyte in benzene.

Ans. **(D)**

9. ***Assertion :–*** Ideal solutions are one which obeys raoult's law at all temp. & concentration.
Reason :– Very dilute solution can be treated as ideal solution.

Ans. **(B)**

10. ***Assertion :–*** Van't Hoff factor is always more or equal to one.
Reason :– Van't Hoff factor is the ratio of experimental C.P. to observed C.P.

Ans. **(D)**

11. ***Assertion :–*** Azeotropic mixture can't be separated by fractional distillation.

Reason :– Azeotropic mixtures are constant boiling mixtures.

Ans. **(A)**

12. ***Assertion :–*** $\Delta H_{mix.}$ & $\Delta V_{mix.}$ for the preparation of ideal solution is zero.

Reason :– A-B interaction in ideal solution are same as between A-A & B-B in the two liquids before mixing.

Ans. **(A)**

13. ***Assertion :–*** The molarity & normality of a solution of sodium carbonate are same.

Reason :– Normality is the product of molarity & valency factor.

Ans. **(D)**

14. ***Assertion :–*** 0.1M solution of NaCl have low freezing point than 0.1M urea solution.

Reason :– Van't Hoff factor for NaCl is more than urea.

Ans. **(A)**

15. ***Assertion :-*** A non volatile solute is mixed in a solution then elevation in boiling point and depression in freezing poing both are 2K. **[AIIMS-2011]**

Reason :- Elevation in boiling point and depression in freezing point both depend on melting point of non-volatile solute

Ans. **(D)**

16. ***Assertion :–*** Elevation in boiling point of 0.1 M KCl and 0.1 M $CaCl_2$ is same.

Reason :– Because colligative properties depends on molarity only.

Ans. **(D)**

17. ***Assertion :–*** Hexane and heptane forms ideal solution.

Reason :– ΔH, ΔS and ΔG are zero for such type of solution.

Ans. **(C)**

18. ***Assertion :–*** Observed molecular mass of $CaCl_2$ determined by any colligative property is less than ideal molecular mass.

Reason :– $CaCl_2$ gets ionised in water as it is a strong electrolyte.

Ans. **(A)**

19. ***Assertion :–*** Raoult's law applicable for dilute solution only.

Reason :– Henry's law is applicable for solution of gas in liquid.

Ans. **(B)**