16 Solutions
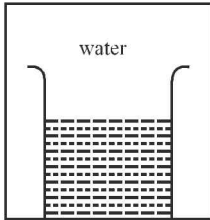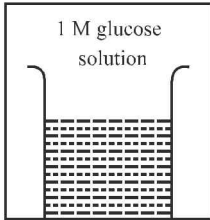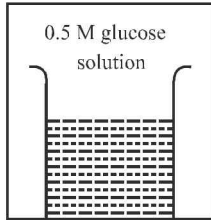
1. The molarity of pure water is :
   (a) 50 M (b) 18 M   (c) 55.6 M (d) 100 M

2. The mole fraction of the solute in one molal aqueous solution is:
   (a) 0.009 (b) 0.018 (c) 0.027 (d) 0.036

3. Which one of the following gases has the lowest value of Henry's law constant?
   (a) N_2 (b) He (c) H_2 (d) CO_2

4. How many Na^+ ions are present in 100 mL of 0.25 M of NaCl solution?
   (a) 0.025×10^{23} (b) 1.505×10^{22}
   (c) 15×10^{22} (d) 2.5×10^{23}

5. If 10 mL of 0.1 M aqueous solution of NaCl is divided into 1000 drops of equal volume. What will be the concentration of one drop?
   (a) 0.01 M   (b) 0.10 M
   (c) 0.001 M   (d) 0.0001 M

6. The volume of 4 N HCl and 10 N HCl required to make 1 litre of 6 N HCl are
   (a) 0.75 litre of 10 N HCl and 0.25 litre of 4 N HCl
   (b) 0.50 litre of 4 N HCl and 0.50 litre of 10 N HCl
   (c) 0.67 litre of 4 N HCl and 0.33 litre of 10 N HCl
   (d) 0.80 litre of 4 N HCl and 0.20 litre of 10 N HCl

7. In three beakers labelled as (A), (B) and (C), 100 mL of water, 100 mL of 1 M solution of glucose in water and 100 mL of 0.5 M solution of glucose in water are taken respectively and kept at same temperature.

   | water | 1 M glucose solution | 0.5 M glucose solution |
   | A | B | C |

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

8. A 0.5 molal solution of ethylene glycol in water is used as coolant in a car. If the freezing point constant of water be 1.86 °C per mole, the mixture shall freeze at :
   (a) 0.93 °C (b) −0.93 °C (c) 1.86 °C (d) −1.86 °C

9. If α is the degree of dissociation of Na_2SO_4, the Vant Hoff's factor (i) used for calculating the molecular mass is
   (a) $1 + \alpha$ (b) $1 - \alpha$
   (c) $1 + 2\alpha$ (d) $1 - 2\alpha$

10. A 10 mg effervescent tablet containing sodium bicarbonate and oxalic acid releases 0.25 mL of CO_2 at T = 298.15K and P = 1 bar. If molar volume of CO_2 is 25.0 L under such condition, what is the percentage of sodium bicarbonate in each tablet?
    [Molar mass of $NaHCO_3$ = 84 g mol^{-1}]
    (a) 0.84   (b) 33.6   (c) 16.8   (d) 8.4

11. For converting a solution of 100 mL of 0.4M KCl into a solution of KCl 0.05 M. The quantity of water added is:
    (a) 900 mL   (b) 700 mL
    (c) 500 mL   (d) 300 mL

12. Which statement is true for solution of 0.020 M H_2SO_4?
    (a) 2 litre of the solution contains 0.020 mole of SO_4^{2-}.
    (b) 2 litre of the solution contains 0.080 mole of H_3O^+.
    (c) 1 litre of the solution contains 0.020 mole of H_3O^+.
    (d) None of these

13. The amount of $K_2Cr_2O_7$ (eq. wt. = 49.04) required to prepare 100 mL of its 0.05 N solution is
    (a) 2.9424 g   (b) 0.4904 g
    (c) 1.4712 g   (d) 0.2452 g

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

15. A 500 g tooth paste sample has 0.2 g fluoride concentration. What is the concentration of F in terms of ppm level?
    (a) 250   (b) 200   (c) 400   (d) 1000

16. 5 cm^3 of acetone is added to 100 cm^3 of water, the vapour pressure of water over the solution will be:
    (a) equal to the vapour pressure of pure water.
    (b) less than the vapour pressure of pure water.
    (c) greater than the vapour pressure of pure water.
    (d) very large.

17. The weight of $H_2C_2O_4.2H_2O$ required to prepare 500 mL of 0.2 N solution is:
    (a) 126 g (b) 12.6 g (c) 63 g (d) 6.3 g

18. The molal elevation constant of water = 0.52 °C kg mol^{-1}. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl), therefore should be :
    (a) 100.52 °C   (b) 101.04 °C
    (c) 99.48 °C   (d) 98.96 °C

19. Osmotic pressure of 0.4% urea solution is 1.64 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

20. If 0.1 M solution of glucose and 0.1 M solution of urea are placed on two sides of the semipermeable membrane to equal heights, then it will be correct to say that
    (a) there will be no net movement across the membrane
    (b) glucose will flow towards urea solution
    (c) urea will flow towards glucose solution
    (d) water will flow from urea solution to glucose

Application Based MCQs

21. 2 N HCl solution will have same molar conc. 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

22. The normality of orthophosphoric acid having purity of 70 % by weight and specific gravity 1.54 is :
    (a) 11 N   (b) 22 N   (c) 33 N   (d) 44 N

23. The density of a solution prepared by dissolving 120 g of urea (mol. mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is :
    (a) 1.78 M (b) 1.02 M   (c) 2.05 M   (d) 0.50 M

24. A binary liquid solution is prepared by mixing *n*-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution?
    (a) The solution is non-ideal, showing – ve deviation from Raoult's Law.
    (b) The solution is non-ideal, showing + ve deviation from Raoult's Law.
    (c) *n*-heptane shows + ve deviation while ethanol shows – ve deviation from Raoult's Law.
    (d) The solution formed is an ideal solution.

25. A solution contains 25% H_2O, 25% C_2H_5OH and 50% CH_3COOH by mass. The mole fraction of H_2O would be :
    (a) 0.25   (b) 2.5   (c) 0.510   (d) 5.10

26. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mol^{-1}) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 g cm^{-3}, molar mass of the substance will be :
    (a) 210.0 g mol^{-1} (b) 90.0 g mol^{-1}
    (c) 115.0 g mol^{-1} (d) 105.0 g mol^{-1}

27. If at certain temperature the vapour pressure of pure water is 25 mm Hg and that of a very dilute aqueous urea solution is 24.5 mm Hg, the molality of the solution is :
    (a) 0.02   (b) 1.2   (c) 1.11   (d) 0.08

28. At temperature 327 °C and concentration C osmotic pressure of a solution is P, the same solution at concentration C/2 and at temperature 427 °C shows osmotic pressure of 2 atm, value of P will be :
    (a) $\dfrac{12}{7}$ (b) $\dfrac{24}{7}$ (c) $\dfrac{6}{5}$ (d) $\dfrac{5}{6}$

29. The elevation in boiling point of a solution of 13.44 g of $CuCl_2$ in 1 kg of water using the following information will be (Molecular weight of $CuCl_2$= 134.4 g and K_b= 0.52 K kg mol^{-1})
    (a) 0.16   (b) 0.05   (c) 0.1   (d) 0.2

30. Which of the following 0.10 m aqueous solutions will have the lowest freezing point ?
    (a) $Al_2(SO_4)_3$ (b) $C_6H_{12}O_6$
    (c) KCl   (d) $C_{12}H_{22}O_{11}$

31. The molar mass of the solute sodium hydroxide obtained from the measurement of the osmotic pressure of its aqueous solution at 27 °C is 25 g mol^{-1}. Therefore its ionization percentage in this solution is:
    (a) 75   (b) 60   (c) 80   (d) 70

32. 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) $P_3 > P_1 > P_2$
    (c) $P_2 > P_1 > P_3$ (d) $P_2 > P_3 > P_1$

33. Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapor pressures of pure A and pure B are 7×10^3 Pa and 12×10^3 Pa, respectively. The composition of the vapor is in equilibrium with a solution containing 40 mole percent of A at this temperature is:
    (a) $x_A = 0.37; x_B = 0.63$ (b) $x_A = 0.28 ; x_B = 0.72$
    (c) $x_A = 0.4 ; x_B = 0.6$ (d) $x_A = 0.76 ; x_B = 0.24$

34. The vapour pressure of a solvent decreases by 10 mm of Hg when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of Hg ?
    (a) 0.8   (b) 0.6   (c) 0.4   (d) 0.2

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

36. The vapour pressure of water at 20 °C is 17.5 mm Hg. 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) 17.325 mm Hg   (b) 15.750 mm Hg
  (c) 16.500 mm Hg   (d) 17.500 mm Hg

37. An aqueous solution of 2% non-volatile solute exerts a pressure of 1.004 bar at the normal boiling point of the solvent. What is the molecular mass of the solute?
  (a) 23.4 g mol^{-1} (b) 41.35 g mol^{-1}
  (c) 10 g mol^{-1} (d) 20.8 g mol^{-1}

38. 58.5 g of NaCl and 180 g of glucose were separately dissolved in 1000 mL of water. Identify the correct statement regarding the elevation of boiling point (b.pt.) of the resulting solutions.
  (a) NaCl solution will show higher elevation of b.pt.
  (b) Glucose solution will show higher elevation of b.pt.
  (c) Both the solutions will show equal elevation of b.pt.
  (d) The b.pt. of elevation will be shown by neither of the solutions

39. Consider separate solutions 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?
  (a) They all have the same osmotic pressure.
  (b) 0.100 M $Mg_3(PO_4)_2$(aq) has the highest osmotic pressure.
  (c) 0.125 M Na_3PO_4(aq) has the highest osmotic pressure.
  (d) 0.500 M C_2H_5OH(aq) has the highest osmotic pressure.

40. Solution A contains 7 g L^{-1} of $MgCl_2$ and solution B contains 7 g L^{-1} of NaCl. At room temperature, the osmotic pressure of

  (a) Solution A is greater than B.
  (b) Both have same osmotic pressure.
  (c) Solution B is greater than A.
  (d) Can't determine

41. The vapour pressure lowering caused by the addition of 100 g of sucrose (molecular mass = 342) to 1000 g of water if the vapour pressure of pure water at 25°C is 23.8 mm Hg.
  (a) 1.25 mm Hg   (b) 0.125 mm Hg
  (c) 1.15 mm Hg   (d) 0.12 mm Hg

42. 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 solution of '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) 52 mol percent   (b) 34 mol percent
  (c) 48 mol percent   (d) 50 mol percent

43. 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) 1/2   (b) 2/3   (c) $\frac{1}{3} \times \frac{273}{298}$ (d) 1/3.

44. 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 kg mol^{-1})
  (a) 0.85 K   (b) −3.53 K   (c) 0 K   (d) −0.35 K

45. 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 mol of sodium sulphate is dissolved in 1 kg of water, is (K_f = 1.86 K kg mol^{-1}) :
  (a) 0.372 K (b) 0.0558 K   (c) 0.0744 K (d) 0.0186 K

Skill Based MCQs

46. The amount of urea to be dissolved in 500 c.c. of water (K = 1.86 °C mol^{-1}) to produce a depression of 0.186 °C in the freezing point is :
  (a) 9 g   (b) 6 g   (c) 3 g   (d) 0.3 g

47. Two solutions of HCl, A and B, have concentrations of 0.5N and 0.1M respectively. The volume of solutions A and B required to make 2 litres of 0.2N HCl are :
  (a) 0.5 L of A+1.5 L of B   (b) 1.5 L of A + 0.5 L of B
  (c) 1.0 L of A+1.0 L of B   (d) 0.75 L of A+1.25 L of B

48. Pure benzene freezes at 5.3°C. A solution of 0.223 g of phenylacetic acid ($C_6H_5CH_2COOH$) in 4.4 g of benzene (K_f = 5.12 K kg mol^{-1}) freezes at 4.47 °C. From the observation, one can conclude that

  (a) phenylacetic acid exists as such in benzene.
  (b) phenylacetic acid undergoes partial ionization in benzene.
  (c) phenylacetic acid undergoes complete ionization in benzene.
  (d) phenylacetic acid dimerizes in benzene.

49. 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

50. The amount of solute (molar mass 60 g mol^{-1}) that must be added to 180g of water so that the vapour pressure of water is lowered by 10% is :
  (a) 30 g   (b) 60 g   (c) 120 g   (d) 12 g

51. A solution of urea (mol. mass 56 g mol⁻¹) boils at 100.18°C at the atmospheric pressure. If K_f and K_b for water are 1.86 and 0.512 K kg mol⁻¹ respectively, the above solution will freeze at
    (a) 0.654°C   (b) −0.654°C
    (c) 6.54°C   (d) −6.54°C

52. When a gas is bubbled through water at 298 K, a very dilute solution of the gas is obtained. Henry's law constant for the gas at 298 K is 100 k bar. If the gas exerts a partial pressure of 1 bar, the number of millimoles of the gas dissolved in one litre of water is :
    (a) 0.555   (b) 5.55   (c) 0.0555   (d) 55.5

53. 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) $C_4H_8O_4$

54. The freezing point of benzene decreases by 0.45°C when 0.2g of acetic acid is added to 20 g of benzene. If acetic acid associates to form a dimer in benzene, percentage association of acetic acid in benzene will be
    (K_f for benzene $= 5.12$ K kg mol⁻¹)
    (a) 64.6%   (b) 80.4%   (c) 74.6%   (d) 94.6%

55. The vapour pressure of acetone at 20 °C is 185 torr. When 1.2 g of a non-volatile substance was dissolved in 100 g of acetone at 20 °C, its vapour pressure was 183 torr. The molar mass (g mol⁻¹) of the substance is :
    (a) 128   (b) 488   (c) 32   (d) 64

ANSWER KEY																			
Conceptual MCQs																			
1	(c)	3	(d)	5	(b)	7	(d)	9	(c)	11	(b)	13	(d)	15	(c)	17	(d)	19	(d)
2	(b)	4	(b)	6	(c)	8	(b)	10	(d)	12	(b)	14	(c)	16	(b)	18	(b)	20	(a)
Application Based MCQs																			
21	(a)	24	(b)	27	(c)	30	(a)	33	(b)	36	(a)	39	(a)	42	(d)	45	(b)		
22	(c)	25	(c)	28	(b)	31	(b)	34	(b)	37	(b)	40	(c)	43	(d)				
23	(c)	26	(a)	29	(a)	32	(c)	35	(b)	38	(a)	41	(b)	44	(b)				
Skill Based MCQs																			
46	(c)	47	(a)	48	(d)	49	(c)	50	(b)	51	(b)	52	(a)	53	(d)	54	(d)	55	(d)