16

SOLUTIONS

MCQs with One Correct Answer

1. If $\frac{N}{10}$ 50 mL H_2SO_4, $\frac{N}{3}$ 30 mL HNO_3, $\frac{N}{2}$ 10 mL HCl is mixed and solution is made to 1L. Then normality of resultant solution is

(a) $\frac{N}{20}$ (b) $\frac{N}{40}$

(c) $\frac{N}{50}$ (d) N

2. 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 kbar. 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

3. 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

4. Equal masses of a solute are dissolved in equal amount of two solvents *A* and *B,* respective molecular masses being M_A and M_B. The relative lowering of vapour pressure of solution in solvent *A* is twice that of the solution in solvent *B*. If the solutions are dilute, M_A and M_B are related as

(a) $M_A = M_B$ (b) $2M_A = M_B$

(c) $M_A = 2M_B$ (d) $M_A = 4M_B$

5. When two liquids *A* and *B* are mixed they form an ideal solution. At certain temperature the V.P. of the solution, that contains 3 moles of *A* and 1 mole of *B* was found to be 550 mm of Hg. The vapour pressure of a solution containing 4 moles of *A* and 1 mole of *B* was found to be 560 mm of Hg. The vapour pressure of pure liquid *A* is

(a) 200mm (b) 300mm

(c) 400mm (d) 600mm

6. Two components A and B form an ideal solution. The mole fractions of A and B in ideal solution are X_A and X_B, while that of in vapour phase, these components have their mole fractions as Y_A and Y_B. Then, the slope and intercept of plot of $\frac{1}{Y_A}$ vs. $\frac{1}{X_A}$ will be:

(a) $\frac{P_A^o}{P_B^o}, \frac{P_B^o - P_A^o}{P_B^o}$ (b) $\frac{P_B^o}{P_A^o}, \frac{P_A^o - P_B^o}{P_A^o}$

(c) $\frac{P_B^o}{P_A^o}, \frac{P_B^o}{P_B^o - P_A^o}$ (d) $P_A^o - P_B^o, \frac{P_A^o}{P_B^o}$

7. The total vapour pressure of a 4 mole % solution of NH_3 in water at 293 K is 50.0 torr. The vapour pressure of pure water is 17.0 torr at this temperature. Applying Henry's and Raoult's laws, the total vapour pressure for a 5 mole % solution is

(a) 58.25 torr (b) 33 torr
(c) 42.1 torr (d) 52.25 torr

8. Vapour pressure of benzene at 30°C is 121.8 mm Hg. When 15 g of a non-volatile solute is dissolved in 250 g of benzene its vapour pressure decreased to 120.2 mm Hg. The molecular weight of the solute is (Mo. wt. of solvent = 78)

(a) 356.2 (b) 456.8
(c) 530.1 (d) 656.7

9. 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

10. π_1, π_2, π_3 and π_4 atm are the osmotic pressures of 5% (mass/volume) solutions of urea, fructose, sucrose and KCl respectively at certain temperature. The correct order of their magnitudes is :

(a) $\pi_1 > \pi_4 > \pi_2 > \pi_3$ (b) $\pi_1 > \pi_4 > \pi_2 > \pi_3$
(c) $\pi_4 > \pi_1 > \pi_2 > \pi_3$ (d) $\pi_4 > \pi_1 > \pi_3 > \pi_2$

11. 0.010M solution an acid *HA* freezes at –0.0205°C. If K_f for water is 1.860 K kg mol^{-1}, the ionization constant of the conjugate base of the acid will be (assume 0.010 M = 0.010 m)

(a) 1.1×10^{-4} (b) 1.1×10^{-3}
(c) 9.0×10^{-11} (d) 9.0×10^{-12}

12. $\Delta T_f / K_f$ has the same value of 1 mol kg^{-1} for 8% AB_2 and 10% A_2B by mass of solvent, both AB_2 and A_2B being non- electrolytes. Atomic masses of *A* and *B* will be respectively

(a) 20, 40 (b) 20, 50
(c) 40, 20 (d) 50, 40

13. 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

14. Which of the following pairs of solution are isotonic at the same temperature ?

(a) 0.1 M $Ca(NO_3)_2$ and 0.1 M Na_2SO_4
(b) 0.1 M NaCl and 0.1 M Na_2SO_4
(c) 0.1 M urea and 0.1 M $MgCl_2$
(d) 0.2 M urea and 0.1 M NaCl

15. 23.5 g of phenol was dissolved in 500 g of a solvent having depression constant K_f of 12.0 K Kg mol^{-1}. If the depression in freezing point of solution was found to be 3.60 K, the percent dimerization of phenol in the solvent is

(a) 89 (b) 85
(c) 80 (d) 92

16. A certain non-volatile electrolyte contains 40% carbon, 6.7% hydrogen and 53.3% oxygen. An aqueous solution containing 5% by mass of of the solute boils at 100.15°C. The molecular formula of the compound is ($K_b = 0.51$°C/m)

(a) HCHO (b) CH_3OH
(c) C_2H_5OH (d) $C_6H_{12}O_6$

17. A storage battery contains a solution of H_2SO_4 38% by weight. At this concentration, van't Hoff factor is 2.50. The temperature of which the battery contents freeze is ($K'_f = 1.86$ K mol^{-1} kg)

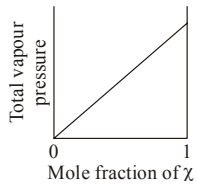
(a) 225.45 (b) 235.85
(c) 249.92 (d) 243.92

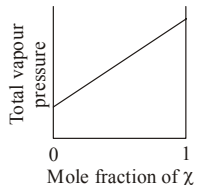
18. An industrial waste water is found to contain 8.2% Na_3PO_4 and 12% $MgSO_4$ by mass in solution. If % ionisation of Na_3PO_4 and $MgSO_4$ are 50 and 60 respectively then its normal boiling point is [$K_b(H_2O) = 0.50$ K kg mol^{-1}] :

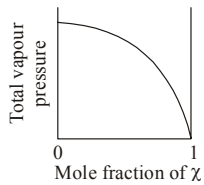
(a) 102.3°C (b) 103.35°C

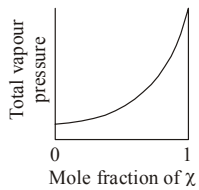
(c) 101.78°C (d) None of these

19. The plot of total vapour pressure as a function of mole fraction of the components of an ideal solution formed by mixing liquids X and Y is

(a)


(b)


(c)


(d)


20. The values of the Henry's law constant of Ar, CO_2, CH_4, and O_2 in water at 25 °C are 40.30, 1.67, 0.41.and 34.86 kbar, respectively. The order of their solubility in water at the same temperature and pressure is

(a) $Ar > O_2 > CO_2 > CH_4$

(b) $CH_4 > CO_2 > Ar > O_2$

(c) $CH_4 > CO_2 > O_2 > Ar$

(d) $Ar > CH_4 > O_2 > CO_2$

Numeric Value Answer

21. Two liquids *A* and *B* are miscible in all proportions and form ideal solution. At 350 K the vapour pressure of pure *A* is 24.0 kPa and that of pure *B* is 12.0 kPa. A mixture of 60% (by mole) of *A* and 40% of *B* is distilled at this temperature. A small amount of distillate is collected and redistilled at the same temperature. The mole percent of *A* in the second distillate at initial stage is _____.

22. Two beaker A and B present in a closed vessel. Beaker A contains 152.4 g aqueous solution of urea, containing 12 g of urea. beaker B contains 196.2 g glucose solution, containing 18 g of glucose. Both solutions allowed to attain the equilibrium. The mass % of glucose in its solution at equilibrium is _____.

23. A solution containing 10 g per dm^3 of urea (molecular mass = 60 g mol^{-1}) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non-volatile solute is _____.

24. The freezing point of 0.08 molal $NaHSO_4$ is –0.345°C. If assume 100% ionisation of $NaHSO_4$, calculate the percentage of HSO_4^- , ions that transfers a proton to water. (K_f for $H_2O = 1.86$ K molality^{-1}).

25. 2 g of benzoic acid dissolved in 25 g of C_6H_6 shows a depression in freezing point equal to 1.62 K. Molal depression constant of C_6H_6 is 4.9 K mol^{-1} kg. The percentage association of acid if it forms double molecule in solution is _____.

26. 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 _____.

27. 0.400 g of an acid HA (mol. mass = 80) was dissolved in 100 g of water. The solution showed a depression of freezing point of 0.12 K. The dissociation constant (in multiple of 10^{-3}) of the acid at about 0°C, given K_f (water) = 1.86 K Kg mol^{-1} is (Assume molarity of solution $\approx$ molality)

28. An element X (Atomic mass = 25) exists as X_4 is benzene. 51g of saturated solution of X in benzene was added to 50.0 g of pure benzene. The resulting solution showed a depression of freezing point of 0.55 K. The solubility of X per 100 g of benzene is (K_f for benzene = 5.5 K kg mol^{-1})

29. At 10°C, the osmotic pressure of urea solution is 500 mm. The solution is diluted and the temperature is raised to 25°C, when the osmotic pressure is found to be 105.3 mm. Determine extent of dilution.

30. A solution containing 28 g phosphorus in 315 g CS_2 (b. pt. 46.3°C) boils at 47.98°C. K′b for CS2 is 2.34 K mol^{-1} kg. _____ are the no. of atom of phosphorus present in its molecular formula.

ANSWER KEY																			
1	(c)	**4**	(c)	**7**	(a)	**10**	(c)	**13**	(b)	**16**	(d)	**19**	(b)	**22**	(14.49)	**25**	(99.2)	**28**	(2)
2	(a)	**5**	(d)	**8**	(a)	**11**	(c)	**14**	(a)	**17**	(d)	**20**	(c)	**23**	(300)	**26**	(3)	**29**	(5)
3	(b)	**6**	(b)	**9**	(b)	**12**	(c)	**15**	(c)	**18**	(c)	**21**	(0.857)	**24**	(31.9)	**27**	(6)	**30**	(4)