THE GURUKUL INSTITUTE

PLOT 5C, 2ND FLOOR, GANAPATI COMPLEX, SEC-13, OPP. JAIPURIA SCHOOL, VASUNDHARA, GHAZIABAD (U.P)

SOLUTIONS

1. An antifreeze solution is prepared from 222.6g of ethylene glycol ($C_2H_4(OH)_2$) and 200 g of water. Calculate the Molality of the solution. If the density of this solution be 1.072g ml^{-1}, what will be the molarity of the solution?
2. A 0.1539 molal aqueous solution of cane sugar (mol. Mass = 342 $gmol^{-1}$) has a freezing point of 271 K while the freezing point of pure water is 273.15K. What will be the freezing point of an aqueous solution containing 5g of glucose (mol. Mass = 180 g mol^{-1}) per 100 g of solution?
3. a. Why is the vapor pressure of a solution of glucose in water lower than that of water?
   b. A 6.90 M solution of KOH in water contains 30% by mass of KOH. Calculate the density of the KOH solution. [Molar mass of KOH = 56 g mol^{-1}]
4. a. Urea forms an ideal solution in water. Determine the vapor pressure of an aqueous solution 10% by mass of urea at 40°C(vapor pressure of water at 40^0C= 55.3 mm of Hg).
   b. Why is freezing point depression of 0.1M sodium chloride solution nearly twice that of 0.1 M glucose solution?
5. At 300 K, 36 g of glucose ($C_6H_{12}O_6$) present per litre in its aqueous solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another solution of glucose is 1.52 bar at the same temperature, what would be its concentration?
6. A 0.2 percent aqueous solution of a non-volatile solute exerts a vapor pressure of 1.004 bar at 100°***C***. What is the molar mass of the solute? (Given: Vapor pressure of pure water at 100°***C*** is 1.013 bar and molar mass of water is 18 g mol^{-1})
7. Give reasons for the following:
   a. When 50 ml of ethyl alcohol and 50 ml of water are mixed, the volume of resulting solution is more than 60 ml.
   b. Copper is conducting as such while copper sulphate is conducting only in molten state or in aqueous solution.
8. a. A 4% solution of sucrose is isotonic with 3% solution of an unknown organic substance. Calculate the molecular mass of unknown substance.
   b. What is the mole fraction of a solute, in 2.5 m aqueous solution?
9. A solution is made by dissolving 30 g of a non- volatile solute in 90 g of water. It has a vapor pressure of 2.8 kPa at 298 K. At 298 K, vapor pressure of pure water is 3.64 kPa. Calculate the molecular mass of unknown substance.
10. State Henry's law for solubility of a gas in a liquid. Explain the significance of Henry's law constant (K_H). At the same temperature, hydrogen is more soluble in water than helium. Which of them will have a higher value of K_H and why?
11. Calculate the osmotic pressure at 25°C and f.p. of 1.8 % aqueous solution of glucose ($C_6H_{12}O_6$). Assume ideal behavior of the solution. Take density to be 1 g mol^{-1} and K_f for water to be 1.86K kg mol^{-1}. (R = 0.082 L atm $mol^{-1}K^{-1}$)
12. Two elements A and B form purely covalent compounds having molecular formulae AB_2 and AB_4. When dissolved in 20 g off benzene, 1 g of AB_2 lowers the freezing point by 2.3 K, whereas 1 g of AB_4 lowers it by 1.3 K. the molal depression constant for benzene is 5.1 K kg mol^{-1}. Calculate the atomic mass of A and atomic mass of B.
13. 2 g of benzoic acid (C_6H_5COOH) dissolved in freezing in 25 g of benzene shows a depression in freezing point equal to 1.62 K. Molal depression constant for benzene is 4.9 K kg $mol^{-1.}$ What is the percentage association of acid if it forms dimer in solution?
14. 45 g of ethylene glycol ($C_2H_6O_2$) is mixed with 600 gof water. Calculate :
   a. Freezing point depression
   b. Freezing point of the solution (K_f for water = 1.86 K kg mol^{-1}; Atomic masses : C = 12, H =1, O=16 u)

15. Explain as to why there is a rise in boiling point when a non-volatile solid is dissolved in a liquid. 0.90g of a non-electrolyte was dissolved in 87.90 g of benzene. This raised the boiling point of benzene by 0.25°C. if the molecular mass of the non-electrolyte is 103.0 g mol^{-1}, Calculate the molal elevation constant for benzene.
16. An aqueous solution containing 1.248 g of barium chloride (molar mass = 208.34 g mol^{-1}) in 100 g of water boils at 100.0832°C. Calculate the degree of dissociation of barium chloride. [K_b for water = 0.52 K kg mol^{-1}]
17. What is meant by Van't Hoff factor? The osmotic pressure of a 0.0103 molar solution of an electrolyte is found to be 0.70 atm at 27°C. Calculate the Van't Hoff factor.
18. When does the measurement of colligative properties of a solution lead to abnormal molecular masses?
    The freezing point depression of 0.1 m NaCl solution is 0.372°C. What conclusion would you draw about the state of its formula?
19. The molal freezing point depression constant of benzene (C_6H_6) is 4.90 K kg mol^{-1}. Selenium exists as a polymer of the type Se_x. When 3.26 g of selenium is dissolved in 226 g of benzene, the observed freezing point is 0.112°C lower than for pure benzene. Deduce the molecular formula of selenium.
    (Atomic mass of Se = 78.8 g mol^{-1})
20. Calculate the freezing point of a solution containing 0.520g of glucose ($C_6H_{12}O_6$) dissolved in 80.20 g of water.
21. Assuming complete ionization, calculate the expected freezing point of solution prepared by dissolving 6.00 g of Glaber's salt, $Na_2SO_4.10H_2O$ in 0.1 kg of H_2O. (K_f for H_2O = 1.86 K kg mol^{-1})[At. Mass of Na= 23, S= 32, O=16, H= 1u]
22. The vapor pressure of pure benzene at 25°C is 639.7 mm Hg and the vapor pressure of a solution of a non-volatile solute is 631.9 mm Hg. Calculate mole fraction of solute and Molality of solution.
23. One litre aqueous solution of sucrose (molar mass = 342 g mol^{-1}) weighing 1015 g is found to record an osmotic pressure = 4.82 atm at 293 K. what is the molality of the sucrose solution / [R = 0.082 L atm K^{-1} mol^{-1}]
24. A solution containing 12.5 g of a non- electrolyte substance in 175g of water gave a boiling point elevation of 0.70 K. Calculate the molar mass of the substance. (K_b = 0.52 K kg mol^{-1}).
25. At 25°C, the vapor pressure of pure water is 23.76 mm of Hg and that of aqueous dilute solution of urea is 22. 98 mm of Hg. Calculate the molality of the solution.