Chapter 14: Solutions

1. Would you expect carbon dioxide (CO_2) or methanol (CH_3OH) to be more soluble in water? Explain.

2. Potassium chloride has a lattice energy of −715 kJ/mol and a heat of hydration of −690 kJ/mol.

    a. Calculate the heat of solution for KCl.

    b. How many grams of KCl must dissolve in water to release 5.00×10^2 kJ of heat?

3. Which compound would you expect to be the most soluble in hexane (C_6H_{14})?

    a. CH_3COOH

    b. CCl_4

    c. H_2O

    d. NH_3

4. Use Henry's law to determine the molar solubility of nitrogen gas (N_2) at a pressure of 2.50 atm and 25 °C.

    - $kH = 6.40 \times 10^{-4}$ M/atm

5. A solution is prepared by dissolving 35.0 mL of ethanol (C_2H_5OH) in 125.0 mL of water at 25 °C. The density of ethanol is 0.789 g/mL, and the density of water is 1.00 g/mL.

    Calculate:

    a. Molarity

b. Percent by mass

c. Mole percent of ethanol

6. An aqueous solution contains 28.0% HNO_3 by mass.

   Calculate:

   a. The molality of HNO_3.

   b. The mole fraction of HNO_3.

7. Calculate the vapor pressure of water above a solution containing 45.0 g of glucose ($C_6H_{12}O_6$) dissolved in 150.0 mL of water at 30.0 °C. The vapor pressure of pure water at 30.0 °C is 31.8 torr. Assume the density of water is 1.00 g/mL.

8. A solution contains a mixture of benzene and toluene at room temperature. The total vapor pressure of the solution is 92.5 torr. Determine the mole fraction of benzene and toluene in the solution.
    - Benzene: 95.1 torr
    - Toluene: 28.4 torr

9. Calculate the freezing point and boiling point of a solution containing 12.5 g of glucose ($C_6H_{12}O_6$) dissolved in 150.0 g of water.
    - Kf=1.86C◦/m
    - Kb=0.512 C◦/m

10. A solution contains 10.5 g of $CaCl_2$ in 500.0 mL of solution and has an osmotic pressure of 7.85 atm at 25 °C. Calculate the experimental van't Hoff factor for $CaCl_2$ at this concentration.

11. Calculate the osmotic pressure of a solution containing 25.0 g of sucrose ($C_{12}H_{22}O_{11}$) in 250.0 mL of solution at 298 K.