Chemistry 101

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REVIEW QUESTIONS
Final Exam

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1. A solution is prepared by mixing 20.0 mL of CH_3OH (d = 0.791 g/mL) with 100.0 mL of CH_3CN (d= 0.786 g/mL). Calculate the mole fraction of CH_3OH and the molality of this solution.

2. At 63.5°C, the vapor pressure of water is 175 mmHg and that of ethanol (C_2H_5OH) is 400 mmHg. A solution is made by mixing equal masses of water and ethanol. What is the mole fraction of ethanol in the vapor above this solution?

3. Shown below is the structural formula for acetylsalicylic acid, better known as aspirin.
   a) What are the approximate bond angles marked 1, 2 and 3?

   b) What are the hybridization of the central atoms in each of these angles?
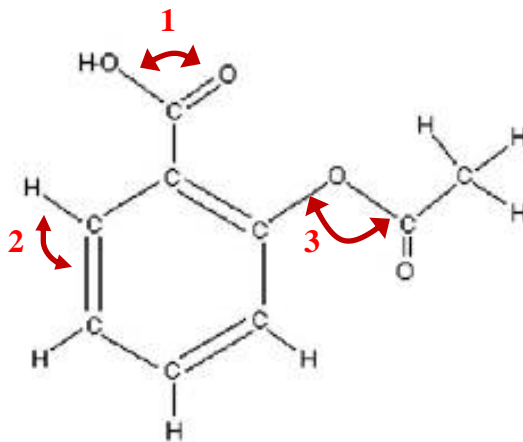
4. Allene (C_3H_4) is an important intermediate in synthesis of many organic compounds.

    a) Draw a Lewis structure for allene (all carbons are bonded together).

    b) How many sigma and pi bonds are present in this molecule?

5. When 0.55 g of a nonelectrolyte solute is dissolved in 32.0 g of benzene, the freezing point of the solution is measured to be 0.36°C lower than the freezing point value the pure solvent. Calculate the molar mass of this solute. (K_f for benzene = 5.12°C/m)

6. Calculate the freezing and boiling points of each aqueous solution, assuming complete dissociation of solute:

    a)   21.5 g of $CuCl_2$ in 450. g of water

    b)   5.5% $NaNO_3$ (in water)

7. What mass of salt (NaCl) must be added to 1.00 L of water in an ice cream maker to make a solution that freezes at -10.0 °C? Assume complete dissociation of the NaCl and density of 1.00 g/mL for water.

8. A solution of a nonvolatile solute in water has a boiling point of 102.30 °C. Calculate the vapor pressure above this solution at 65 °C. The vapor pressure of pure water at this temperature is 188 mmHg.

Answers:

1) molality = 6.28 m ; X_{solute} = 0.205

2) $X_{ethanol}$ in vapor = 0.472

3) (**1**) 120°; sp^2 (**2**) 120°; sp^2 (**3**) 109.5°; sp^3

4) 6 sigma bonds and 2 pi bonds

5) 2.4×10^2 g/mol

6) a) $T_f = -1.98$ °C $\qquad\qquad$ $T_b = 100.546°$ C

   b) $T_f = -2.5$ °C $\qquad\qquad$ $T_b = 100.70°$ C

7) 157 g

8) 174 mmHg