

**CH302H – Principles of Chemistry II: Honors**  
Fall 2014, Unique 51880

**Homework, Week 1**

1. Molarity and molality are two measurements of solution concentration. Although molarity is more commonly reported, molality is a more useful measurement of solution concentration under certain circumstances. Suggest two experimental conditions under which molality would be the more useful concentration to report.
2. Methyl butyrate ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_3$ ) and butanoic acid sodium salt ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{COONa}$ ) both dissolve well in water. What is the difference between these two solutions once the solid has completely dissolved?
3. The vapor pressure of pure chloroform is 0.42 atm. When water and chloroform ( $\text{CHCl}_3$ ) are mixed, the Henry's law constant for chloroform is 0.11 atm.
  - a) Is this solution ideal, and if not, how and why does it deviate from ideality?
  - b) Determine the vapor pressure of chloroform from a solution where the mole fraction of chloroform is 0.20.
  - c) Determine the vapor pressure of chloroform from a solution where the mole fraction of chloroform is 0.90.
  - d) Based on your answers to the three previous questions, describe an experiment to measure possible contamination of chloroform in ground water.
4. When a solution of acetone (A) and methanol (M) are in equilibrium at  $57.2^\circ\text{C}$  at 1.0 atm, the mole fraction of acetone in the liquid phase was found to be 0.40, while the mole fraction of acetone in the vapor phase was found to be 0.516. Determine the vapor pressures of both liquids and comment on your answer. For these two components,  $P_A^* = 105 \text{ kPa}$  and  $P_M^* = 73.5 \text{ kPa}$ .
5. Methane ( $\text{CH}_4$ ) is dissolved into water held at  $25^\circ\text{C}$  by bubbling the gas through the water then shaking vigorously. 1.0 kg of the solution is removed and then heated to  $45^\circ\text{C}$  to expel the methane from solution. The methane is collected in the headspace above the liquid, and is found to occupy a total volume of 3.01 L at 1.0 atm. With this information, determine the Henry's law constant for methane in water.
6. The vapor pressure of pure  $\text{CS}_2(\text{l})$  is 0.3915 atm at  $25^\circ\text{C}$ . When 40.0 g of  $\text{S}_8$  (so called "rhombic sulfur") is dissolved in 1.00 kg of  $\text{CS}_2$ , the vapor pressure of the  $\text{CS}_2$  decreases to 0.3868 atm. Determine the molecular formula for sulfur dissolved in  $\text{CS}_2(\text{l})$ .