Spring 2006 Laude CH302 Worksheet 3 covering Chapter 8 on Physical Equilibrium

1. Separate these compound into those that are polar (water soluble) and a non-polar(hydrophobic):
NaCl, $NaCOOCH_3$, cooking oil, HCl, CH_4, CH_3OH, CH_3CH_2OH, gasoline, N_2

Water soluble	Non-polar solvent soluble

2. Rank the following substance in increasing order of vapor pressure:
NaCl, NH_3 solution, Vinegar (CH_3COOH), cooking oil, HCl, CH_4, He and H_2O.

3. Rank the following solutes in terms of increasing solubility in the solvent:

Solvent	Solutes	Increasing solubility
Water	NaCl, H_2S, CH_4, NH_3	
Hexane	$NaCOOCH_3$, cooking oil, CH_3OH, N_2	

4. A liquid is heated at atmospheric pressure. For each of the properties listed, predict whether they would increase or decrease in magnitude..
(a) Viscosity b) Density (c) Surface Tension (d) Vapor Pressure (e) Tendency to Evaporate

5. Calculate the amount of heat (J) required converting 180 g of water at 10.0°C to steam at 105.0°C. Use constants found in the lecture notes for this calculation.

6. The molar heat of fusion, ΔH_{fus}, of Na is 2.6 kJ/mol at its melting point, 97.5°C. How much heat must be absorbed by 5.0g of solid Na at 97.5°C to melt it?

7. How much heat would be required to convert 234.3 g of solid benzene, $C_6H_{6(s)}$, at 5.5 °C into benzene vapor, $C_6H_{6(g)}$, at 100.0 °C? Benzene has the following molar heat capacities: $C_6H_6(l)$ = 136 J/mol °C, and $C_6H_6(g)$ = 81.6 J/mol °C. The molar heat of fusion for benzene is 9.92 kJ/mol and the molar heat of vaporization for benzene is 30.8 kJ/mol. The melting point of benzene is 5.5 °C; and the boiling point of benzene is 80.1 °C. Benzene's molecular weight is 78.0 g/mol.

8. Choose the ion in each pair that would be more strongly hydrated in aqueous solution and justify your answer:
(a) Na^+ or Rb^+ **(b)** Cl^- or Br^- **(c)** Fe^{3+} or Fe^{2+} **(d)** Na^+ or Mg^{2+}

9. In Denver, the partial pressure of oxygen is 0.17 atm. What is the molar solubility of oxygen there at 20°C? Henry Law constant for oxygen at 20°C is 0.0013 mol/L atm.

10. What is the molality of a solution that contains 128 g of CH_3OH in 108g of water?

11. (a) How many grams of H_2O must be used to dissolve 50.0 g of sucrose, $C_{12}H_{22}O_{11}$, to prepare a 1.25 m solution of sucrose?

(b) Predict the boiling point of this solution; K_b for H_2O is 0.512°C/*m*.

(c) Calculate the freezing point of this solution; K_f for H_2O is 1.86°C/*m*.

(d) What osmotic pressure would this solution exhibit at 25°C? Its density is 1.34g/mL.

12. What are the mole fractions of CH_3OH and H_2O in the solution described in #1? The solution contains 128 g of CH_3OH and 108 g of H_2O.

13. (a) At 40°C, the vapor pressure of pure heptane is 92.0 torr and the vapor pressure of pure octane is 31.0 torr. Consider a solution that contains 1.00 mole of heptane and 4.00 moles of octane. Calculate the vapor pressure of each component and the total vapor pressure above the solution.

(b) Calculate the mole fractions of heptane and octane in the vapor that is in equilibrium with this solution.

14. When 15.0g of ethyl alcohol, C_2H_5OH, is dissolved in 750 grams of formic acid, the freezing point of the solution is 7.20°C. The freezing point of pure formic acid is 8.40°C. Solve for K_f for formic acid.

15. A 1.20 gram sample of an unknown covalent compound is dissolved in 50.0 g of benzene. The solution freezes at 4.92°C. Calculate the molecular weight of the compound. The freezing point of pure benzene is 5.48°C and K_f is 5.12°C/*m*.

16. 0.500 grams of a sample is dissolved in 30mL of aqueous solution. If this solution has an osmotic pressure of 8.92 torr at 27.0°C, estimate its molecular weight.

17. Rank the following in terms of increasing boiling point elevation when 0.1 moles of each is placed in 1 liter of water.
NaCl $BsSO_4$ $CaCl_2$ Urea (a nonionizable, water soluble organic molecule)

18. Predict the temperature at which water boils if it has a vapor pressure of 355 torr at 80°C. The ΔH^o_{vap} of water is 40.7 kJ/mol.