Chem 1515.001 - 006
Problem Set #6
Spring 2002

Name_____

TA's Name _____

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ALL work must be shown to receive full credit. **Due in lecture at 8:30 a.m. on Monday, March 4, 2002.**

PS6.1. Calculate the vapor pressure for each of the following solutions at 25 ˚C;

a) 25.0 g of sucrose, $C_{12}H_{22}O_{11}$ dissolved in 250 g of water.

b) 3.2 g of Na_2CO_3 dissolved in 400 g of water.

c) The vapor pressure of pentane and hexane at 25 ˚C are 511 mmHg and 150 mmHg respectively. Assuming ideal behavior determine the total vapor pressure above a solution prepared by mixing 45.0 mL of pentane (density = $0.63 \frac{g}{mL}$) with 85.0 mL hexane (density = $0.66 \frac{g}{mL}$).

PS6.2. To what temperature (˚C) would a solution containing 18.5 g of urea, $(NH_2)_2CO$, in 300. g of water have to be heated to have a vapor pressure of 89.5 mmHg?

PS6.3. Determine the freezing point and the boiling point of the solution in PS6.2.

PS6.4. What is the boiling point of an 12.5% (by mass) solution of benzoic acid ($C_6H_5CO_2H$) in benzene? Note: k_b for benzene is 2.53 ˚C·molal^{-1}.

PS6.5. Given the following data;

Compound	(Experimental) ΔT_f of 1 mol of cmpd in 1 kg of H_2O	(Ideal) ΔT_f of 1 mol of cmpd in 1 kg of H_2O	Strong Weak or Nonelectrolyte
$C_6H_{12}O_6$	1.85 ˚C		
$(NH_2)_2CO$	1.87 ˚C		
NH_3	1.96 ˚C		
CH_3CO_2H	1.97 ˚C		
NaI	3.44 ˚C		
KBr	3.50 ˚C		
H_2SO_4	3.73 ˚C		
K_2SO_4	5.40 ˚C		

PS6.5. (CONTINUED)

a) If each of the solutions is prepared by adding 1 mole of compound to 1 kg of water why does each have a different ΔT_f ?

b) Determine the ideal ΔT_f for the above compounds, except NH_3 and CH_3CO_2H. Why can't we determine an ideal freezing point for NH_3 and CH_3CO_2H?

c) Why does the ideal ΔT_f differ from the experimental ΔT_f?

PS6.5. (CONTINUED)

d) Classify each compound as a strong, weak or nonelectrolyte. (Place answers in the Table on Page 2.)

PS6.6. Determine the ideal freezing point of a solution prepared by mixing 2.52 g of $Ca(NO_3)_2$ in 300 g of water. The observed freezing point is –0.240 ˚C. Explain this difference.

PS6.7. A 4.56 g sample of glycerol dissolved in 18.2 g of water elevated the boiling point by 1.38 ˚C.

a) What is the molar mass of glycerol?

b) Given the composition of glycerol is 39.1% C, 8.7% H and 52.2% O, by mass, what is its molecular formula?

c) Suggest a possible Lewis structure for the glycerol molecule.

PS6.8. When 6.30 g of sulfur is dissolved in 450. g of diethyl ether the boiling point of ether is elevated by 0.115 ˚C. Note: k_b for ether is 2.10 ˚C·molal^{-1}.

a) What is the molar mass of sulfur dissolved in ether?

b) What is the molecular structure of sulfur in ether?

PS6.9. The freezing point depression of a 0.091 *m* solution of CsCl is 0.302 ˚C. The freezing point depression of a 0.091 *m* solution of $CaCl_2$ is 0.440 ˚C. In which solution does "ion-pairing" appear to be greater. Explain.