Chem 1515
Problem Set #4
Fall 2001

Name_____

TA Name _____

Lab Section #_____

ALL work must be shown to receive full credit. **Due at the beginning of lecture on Friday, September 21, 2001.**

PS4.1. Calculate the vapor pressure for each of the following solutions at 25 ˚C;

a) 37.3 g sucrose, $C_{12}H_{22}O_{11}$,, dissolved in 200 g of water.

b) 11.2 g of $Ca(NO_3)_2$ dissolved in 100 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 25.0 mL of pentane (density = 0.63 $\frac{g}{mL}$) with 45.0 mL hexane (density = 0.66 $\frac{g}{mL}$).

PS4.2. To what temperature (˚C) would a solution containing 28.5 g of urea, $(NH_2)_2CO$, in 400. g of water have to be heated to have a vapor pressure of 122 mmHg?

PS4.3. Determine the freezing point and the boiling point of the solution in PS4.2.

PS4.4. What is the boiling point of an 8.7% (by mass) solution of benzoic acid ($C_6H_5CO_2H$) in benzene? Note: k_b for benzene is 2.53 ˚C·molal^{-1}.

PS4.5. 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		

PS4.5. (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.

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

PS4.5. (Continued)

d) Classify each compound as a strong, weak or nonelectrolyte.

PS4.6. Determine the ideal freezing point of a solution prepared by mixing 0.782 g of $MgSO_4$ in 650 g of water. The observed freezing point is –0.0284 ˚C. Explain this difference.

PS4.7. A 2.26 g sample of glycerol dissolved in 20.0 g of water elevated the boiling point by 0.388 ˚C.

a) What is the molar mass of glycerol?

b) Given the composition of urea is 39.1.0% C, 8.7% H, and 52.2% O, by mass, what is its molecular formula?

c) Glycerol is very soluble in water. Suggest a possible Lewis structure for the urea molecule.

PS4.8. When 2.60 g of sulfur is dissolved in 200. g of diethyl ether the boiling point of ether is elevated by 0.105 ˚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?

PS4.9. The freezing point depression of a 0.091 *m* solution of CsCl is 0.214 ˚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.