CHM 1046 - JOENS WORKSHEET #2 Due date: Monday, May 14th
WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME _____ Panther ID _____

For problems involving calculations you must show your work for credit.

1) Which of the following aqueous solutions will have the highest value for boiling point (at p = 1.000 atm)?

a) 5.00 g of calcium nitrate ($Ca(NO_3)_2$, MW = 164.10 g/mol) dissolved in 500.0 g water
b) 5.00 g glucose ($C_6H_{12}O_6$, MW = 180.16 g/mol) dissolved in 500.0g water
c) 5.00 g of potassium bromide (KBr, MW = 119.00 g/mol) dissolved in 500.0 g water
d) 5.00 g of sodium chloride (NaCl, MW = 58.44 g/mol) dissolved in 500.0 g water
e) All of the above solutions will have the same boiling point

_____D_____

Since all of the substances are dissolved in the same mass of water, whichever gives the largest number of moles of particles will have the highest value for boiling point elevation, and so the highest boiling point.

$Ca(NO_3)_2$ - 0.0914 moles particles (i=3) KBr - 0.0840 moles particles (i=2)
$C_6H_{12}O_6$ - 0.0277 moles particles (i=1) NaCl - 0.1711 moles particles (i=2)

Therefore the answer is NaCl (D).

2) The density of a 0.900 % by mass aqueous solution of sodium chloride (NaCl, MW = 58.44 g/mol) is D = 1.0046 g/mL at T = 25.0 °C. What is the osmotic pressure of the above solution (in atm), relative to pure water, at this temperature?

Assume 1.000 L of solution. Then the mass of the solution is 1004.6 g. Since the solution is 0.900 % by mass NaCl, the mass of NaCl is

mass = (0.00900) (1004.6 g) = 9.04 g NaCl

The moles of NaCl is n = 9.04 g NaCl $\frac{1 \text{ mol}}{58.44 \text{ g}}$ = 0.1547 moles NaCl

NaCl ionizes in water by the process $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$

The moles of particles is (0.1547 moles NaCl) $\frac{2 \text{ moles particles}}{1 \text{ mole NaCl}}$ = 0.3094 moles particles

So [B] = $\frac{0.3094 \text{ moles particles}}{1 \text{ L solution}}$ = 0.3094 mol/L

Since $\Pi = [B]RT$

Π = (0.3094 mol/L) (0.08206 L•atm/mol•K) (298.2 K) = 7.57 atm

Note that since the colligative properties are in terms of particle concentration, ionization of an ionic compound in water must be accounted for.

3) Which of the following is a state function?

a) q (heat)
b) w (work)
c) U (internal energy)
d) both a and b
e) both a and b and c

_____C_____

q and w are not state functions, but U (and H, S, and G) are state functions.

4) Using the data contained in Appendix 2 of the textbook, find the value for $\Delta H°_{rxn}$ for the following process, carried out at T = 25.0 °C. Note that this process represents the oxidation of glucose, and $\Delta H°_{rxn}$ represents the heat generated when glucose is metabolized in the human body.

$$C_6H_{12}O_6(s) + 6\ O_2(g) \rightarrow 6\ CO_2(g) + 6\ H_2O(\ell)$$

$$\Delta H°_{rxn} = [\ 6\ \Delta H°_f(CO_2(g)) + 6\ \Delta H°_f(H_2O(\ell))\ ] - [\ \Delta H°_f(C_6H_{12}O_6(s)) + 6\ \Delta H°_f(O_2(g))\ ]$$

$$= [\ 6\ (-393.5) + 6\ (-285.8)\ ] - [\ (-1274.5) + 6\ (0.0)\ ] = -2801.3\ kJ/mol$$

This reaction releases quite a bit of heat (it is an exothermic reaction), which can be used to provide energy for a variety of metabolic processes.