CHM 1046 - JOENS WORKSHEET #3 Due date: Monday, September 25^{th}

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) What is a colloid? How are colloids similar to solutions, and how do they differ from solutions?

A colloid is a homogeneous mixture of particles within a solvent, where each particle is composed of a number of individual molecules. Colloids are similar to solutions in that both are homogeneous (the same composition throughout). Colloids are different from solutions in that different particles making up a colloid will contain different numbers of molecules, and so will not all be exactly the same.

2) An isotonic saline solution is an aqueous solution that has the same value for osmotic pressure as human body cells. Isotonic saline contains 9.0 g of sodium chloride (NaCl, MW = 58.44 g/mol) per liter of solution.

a) What is the molarity of sodium chloride in an isotonic saline solution?

$$M = \frac{\text{mol NaCl}}{\text{L soln}} \qquad \text{mol NaCl} = 9.00\ \text{g}\ \frac{1\ \text{mol}}{58.44\ \text{g}} = 0.1540\ \text{mol}$$

So $$M = \frac{0.1540\ \text{mol NaCl}}{1\ \text{L soln}} = 0.1540\ \text{mol/L NaCl}$$

b) What is the osmotic pressure (relative to pure water) of an isotonic saline solution? Assume T = 37. °C. Give your final answer in units of atm.

We may use our answer in a to find the molarity of solute particles

$$M(\text{particles}) = \frac{0.1540\ \text{mol NaCl}}{\text{L soln}}\ \frac{2\ \text{mol particles}}{1\ \text{mol NaCl}} = 0.3080\ \text{mol/L particles}$$

$$\Pi = [B]RT = (0.3080\ \text{mol/L})(0.08206\ \text{L}\cdot\text{atm/mol}\cdot\text{K})(310.\ \text{K}) = 7.84\ \text{atm}$$

c) Based on your answer to b, explain why red blood cells rupture when placed in deionized water.

The osmotic pressure for the fluid inside a red blood cell, relative to that for pure water, should be the same as for an isotonic saline solution, and so should be about 7.8 atm. This is such a large value for pressure that the membrane of the red blood cell will rupture.

3) Enthalpy (H) is a state function. What does it mean to say something is a state function, and why is being a state function important in thermodynamic calculations?

When we say a function is a state function we mean that the change in the value for the function depends only on the initial and final state, and is independent of the path used to go between them. Some thermodynamic quantities (such as q and w) are not state functions, and so to find values for these we need, in addition to the initial and final state, information on the path used to go from the initial to the final state. All other things being equal, it is easier to work with state functions than things that are not state functions, since we need less information to do calculations for changes in state functions than we do to find values for non-state quantities.

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 combustion reaction for ethanol, and $\Delta H°_{rxn}$ represents the heat generated when ethanol is metabolized in the human body.

$$CH_3CH_2OH(\ell) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(\ell)$$

$$\Delta H°_{rxn} = [\ 2\ \Delta H°_f(CO_2(g)) + 3\ \Delta H°_f(H_2O(\ell))\ ] – [\ \Delta H°_f(CH_3CH_2OH(\ell)) + 3\ \Delta H°_f(O_2(g))\ ]$$

$$= [\ 2\ (-\ 393.5\ kJ/mol) + 3\ (-\ 285.8\ kJ/mol)\ ] – [\ (-\ 276.98\ kJ/mol) + 3\ (0.0\ kJ/mol)\ ]$$

$$= -\ 1644.4\ kJ/mol – (-\ 276.98\ kJ/mol) = -\ 1367.4\ kJ/mol$$