CHM 1046 - JOENS   WORKSHEET #1   Due date: M,W,F Wednesday, August 31
T,R Thursday, September 1

* While I prefer you turn in a hard copy of the worksheet, I will accept scanned copies sent to my email address, joensj@fiu.edu

NAME ______________________________   Panther ID ____________________________

Section: (circle one)   M,W,F   Tu,Tr

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

1) What is the difference (if any) between a homogeneous mixture and a heterogeneous mixture)?

In a heterogeneous mixture different regions of the mixture have different compositions (for example, sand + sugar). In a homogeneous mixture, the composition of the mixture is the same throughout the volume of the mixture (for example, sugar + water).

2) Consider an experiment where two liquids, A and B, are mixed. It is more likely a solution will form if

a) Forming the solution lowers the energy ($\Delta H < 0$)
b) Forming the solution raises the energy ($\Delta H > 0$)
A c) Forming the solution decreases the randomness ($\Delta S < 0$)
d) Both a and c
e) Both b and c

Processes in general, including solution formation, are more likely to happen if they lower the energy and increase the randomness. So the correct answer is A.

3) A solution is formed by adding 3.826 g of carbon tetrachloride (CCl_4, MW = 153.82 g/mol) to liquid cyclohexane (C_6H_{12}, MW = 84.16 g/mol). The final volume of the solution is V = 250.0 mL. What is the molarity of carbon tetrachloride in the solution?

$$M = \frac{\text{moles of solute}}{\text{volume of solution}} = \frac{n}{V}$$

From the information in the problem, V = 250.0 mL = 0.2500 L

For the moles of solute

$$n = 3.826 \text{ g } CCl_4 \; \frac{1 \text{ mol}}{153.82 \text{ g}} = 2.487 \times 10^{-2} \text{ mol } CCl_4$$

$$\text{So } M = \frac{2.487 \times 10^{-2} \text{ mol } CCl_4}{0.2500 \text{ L soln}} = 0.09949 \text{ mol/L}$$

A note on significant figures. You should try to give your answers with the correct number of significant figures, but I generally only take off for major mistakes (for the above, for example, if your answer was 0.1 mol/L (too few) or 0.099492914 mol/L (too many) I might take off a point or two on an exam).

4) The mole fraction of toluene ($C_6H_5CH_3$, MW = 92.14 g/mol) in a solution of toluene and benzene (C_6H_6, MW = 78.11 g/mol) is $X_T = 0.1529$ Based on this information, find the molality of toluene and the percent by mass of toluene in the solution.

To help focus on what you need to find I like writing down the definitions for the concentrations I am looking for. We will let T = toluene, B =benzene.

$$m_T = \frac{\text{moles toluene}}{\text{kg benzene}} \qquad \%\text{ toluene by mass} = \frac{\text{mass toluene}}{\text{mass toluene + mass benzene}} \times 100\ \%$$

Since solutions have the same concentration throughout, we can pick any amount of solution to work with. A convenient amount is 1.000 mol solution. Then

moles toluene = X_T (moles solution) = 0.1529 (1.000 mol) = 0.1529 mol toluene

Since $X_T + X_B = 1$, $X_B = 1 - X_T = 1.0000 - 0.1529 = 0.8471$

moles benzene = X_B (moles solution) = 0.8471 (1.000 mol) = 0.8471 mol benzene

We also need the mass of toluene and benzene

$$\text{mass toluene} = 0.1529\ \text{mol toluene}\ \frac{92.14\ \text{g}}{1\ \text{mol}} = 14.088\ \text{g toluene}$$

$$\text{mass benzene} = 0.8471\ \text{mol benzene}\ \frac{78.11\text{g}}{1\ \text{mol}} = 66.170\ \text{g benzene} = 0.066170\ \text{kg benzene}$$

And so $$m_T = \frac{0.1529\ \text{mol toluene}}{0.066170\ \text{kg benzene}} = 2.311\ \text{mol/kg}$$

$$\%\text{ toluene by mass} = \frac{14.088\ \text{g}}{14.088\ \text{g} + 66.170\ \text{g}} \times 100\ \% = 17.55\ \%\ \text{toluene by mass}$$

Several things to note:

1) In looking at the solution to this problem, you should focus both on how to solve this particular problem and also on general problem solving strategies.

2) We could have assumed any amount of moles of solution and we would still get the same final answer (to within roundoff error). We assumed 1.000 moles simply because that amount is easy to work with.

3) Because the same symbol, m, is used for both molality and mass, you need to determine what m refers to in context. To avoid confusion, some books now use the symbol b for molality, but Burdge and OpenStax both use m. I will therefore use m as well.

4) I usually carry one extra significant figure when doing a problem, and then round off to the correct number of significant figures at the end of the problem.