Sample Questions for Chem 002 Final FS10

1. **MSDS (the rest listed on review):**
   a. Proper attire –
   b. Acid Spill –
   c. Bunsen Burners –
   d. Phenolphthalein –
   e. Types of radiation (listed below) are stopped by what type of material?
      alpha –
      beta –
      gamma –
      neutron –
2. **Radioactive Decay:**
   a. Balance the following radioactive decay equations:

$$^{222}_{86}Rn \rightarrow \_\_\_\_\_\_ + ^{4}_{2}He$$

$$^{234}_{90}Th \rightarrow \_\_\_\_\_\_ + ^{0}_{-1}e + \textit{anti-}\upsilon$$

b. Determine the specific decay constant, initial activity and half-life of a radioactive isotope. Given

Time, minutes	**Counts/Min**	**ln (Counts/Min)**
0		
2	14472	
3	14328	
4	14248	
5	14095	
6	13920	
10	13359	

1. Determine the specific decay constant, k, for this radioactive decay.

2. Determine the initial activity, A_o.

3. Determine the half-life.

3. Heat of Neutralization:

A reaction of 100mL of 1.35M HCl and 100mL of 1.76M NaOH is monitored and the following temperatures were recorded: starting temperature = 24.6 ^{o}C; and final temperature = 38.8 ^{o}C. Calculate the ΔH of this reaction.

Given: **C_p of solution (J/K) = 4.13 J/(g · K)*Volume of solution in mL** **(1 mL ≈ 1 g for aqueous soln)**

C_p of calorimeter (J/K) = 50

Q = (-total C_p* ΔT) **$\Delta T = T_f - T_i$**

ΔH = Q/n **n = # of moles reacted**

a. Determine the change in temperature for the system.

b. Determine the **C_p of the solution** (J/K).

c. Determine the **total C_p** of the system.

d. Determine the number of moles of the acid and the base. Which is the **limiting reagent**?

e. Determine the **Heat Transfer, Q**, for the reaction.

f. Determine the **change in enthalpy, ΔH**, for the reaction.

4. Heat of Fusion. An ice cube with mass 9.53 grams (presume $T_i = 0\ ^oC$) is placed in a calorimeter containing 111.24 grams of distilled water at a temperature of 23.2 ^oC. After equilibration, the final temperature was 15.8 ^oC.

Given: $\Delta H_{total} = \Delta H_{ice} + \Delta H_{water} + \Delta H_{calorimeter} + \Delta H_{fus} = 0$

ΔH_{water} (J) = $C_{p,H2O}$ *(mass)*ΔT ΔH_{ice} (J) = $C_{p,ice}$ *(mass)*ΔT $H_{calorimeter}$ (J) = $C_{p,Cal}$ *ΔT

$C_{p,H2O} = 4.18$ J/(g·^oC) $C_{p,Cal} = 50$ J/^oC $\Delta T = T_f - T_i$

a. Determine the ΔH_{water}.

b. Determine the ΔH_{ice}. (***Hint*** *for* C_p – *The ice has melted*.)

c. Determine the $\Delta H_{calorimeter}$.

d. Determine the ΔH_{fus} for **<u>one gram</u>** of ice.
(***Hint***: For a calorimeter (i.e., closed systems) ΔH_{total} **= 0**)

f. If heat transfers from the system (solute) to the surroundings (solvent), then ΔH is negative (ΔH < 0), and the reaction is defined as (endothermic / exothermic) and the temperature of the solvent will go (up / down).

g. If heat transfers from the surroundings (solvent) to the system (solute), then ΔH is positive (ΔH > 0), and the reaction is defined as (endothermic / exothermic) and the temperature of the solvent will go (up / down).

h. The heat of neutralization experiment was an (endothermic / exothermic) reaction .

i. The heat of fusion experiment was an (endothermic / exothermic) reaction.

j. This term means "the techniques that are used to measure enthalpy":

k. This term means "the energy needed to raise the temperature of an object 1^o C":

l. This term means "the energy needed to raise the temperature of one gram of a substance 1^o C":

m. The heat capacity is an extrinsic property. Define intrinsic and extrinsic properties and give an example of each.

5. Antacids: You are given 1.12 M HCl and 1.48 M NaOH. The antacid you use contains 300 mg of $CaCO_3$ and 100 mg of $Al(OH)_3$. If the antacid dissolved in 35.0 ml of HCl and was then back titrated with 21.8 ml of NaOH, find the following:

a. The original number mmoles of HCl used to dissolve the antacid and neutralize the base.

b. The number of mmoles of NaOH used to backtitrate the acid.

c. The number of mmoles of antacid used to neutralize only the antacid (a.k.a. the excess HCl).

d. Write the balanced equations for the neutralization of the antacid (Both $CaCO_3$ and $Al(OH)_3$).

e. Using the number of mg in the tablet, calculate the mmoles of each component (Both $CaCO_3$ and $Al(OH)_3$).

f. Based on the mmoles of each component, calculate the theoretical number of mmoles of HCl that should have been needed to neutralize the antacid. (*Hint: Use the mole ratios*.)

g. What was the total number of theoretical mmoles of HCl that should have been neturalized?

h. Compare the theoretical (g.) to the actual (c.). What are possible reasons this discrepancy could have occurred?

6. Spectrophotometry: Using a Spectrophotometer (Spec 20), a student recorded below the Percent Transmittance data for the following solutions:

Red Dye Standard (6.30 ppm)
Blue Dye Standard (5.05 ppm)
Purple Unknown

	400 nm	**450 nm**	**500 nm**	**550 nm**	**600 nm**	**650 nm**
Red Std	63.5	48.5	23.5	38.6	78.3	98.5
Blue Std	80.5	99.0	82.5	56.5	8.5	72.4
Purple Unk	79.3	72.5	35.5	85.8	45.5	65.3

a. Calculate the Absorbance for each of the %T listed above .

	400 nm	**450 nm**	**500 nm**	**550 nm**	**600 nm**	**650 nm**
Red Std						
Blue Std						
Purple Unk						

b. Determine the following from the data calculated in Part 1 (*2 pts*):

Red Dye Max. Absorbance = __________ at __________nm (λ Max)

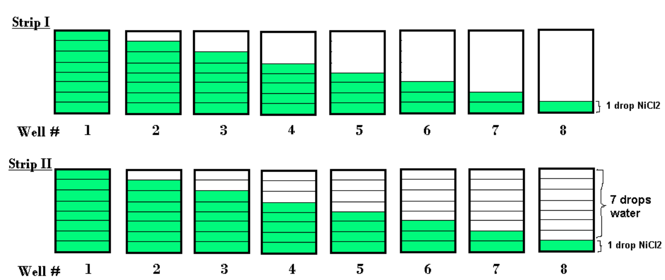
Blue Dye Max. Absorbance = __________ at __________nm (λ Max)

c. Calculate the Absorbance Ratio of the Unknown/Standard at (λ Max).

d. Calculate the Dye Concentration in the Unknown. *(Standard Concentrations given above.)*

	Abs of Unknown (at λ Max)	**Abs of Standard (at λ Max)**	**Abs Ratio Unk/Std (at λ Max)**	**Dye Conc. in Unknown**
Red in Purple				
Blue in Purple				

7. Colorimetry: Using the well strips below, the student put the following number of drops in the wells. In strips I& II, 1-8 drops of blue dye standard solution (5.05 ppm) were added as shown in the diagram. In strip II, additional drops of water were added in order to have the same total volume of 8 drops for each well.



Given: The student found that the unknown solution of blue dye matched well #7 on Strip II.

a. What is changing in the first well strip – concentration or pathlength?

b. What is changing in the second well strip – concentration or pathlength?

c. Looking from the top how does the intensity compare for Strip 1 to Strip 2?

more intense – the same – less intense

d. Using $C_1V_1 = C_2V_2$, what is the approximate concentration in ppm for the unknown?

8. Equilibrium Constant & Beer's Law:

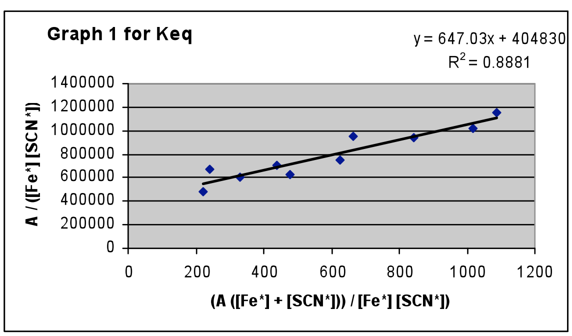
1. Why is it important that you avoid any loss of solutions when transferring and measuring solutions in an equilbrium experiment similar to the one done in class?

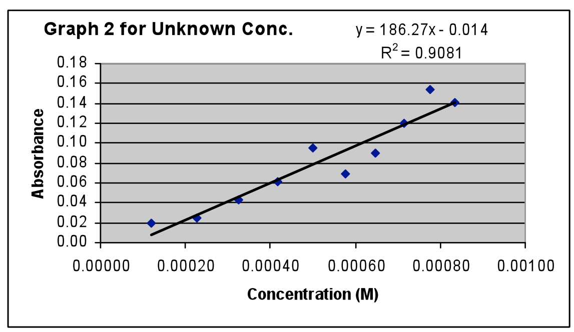
2. According to the Beer's Law equation, A = abc. Why is it you did not need to know the value for the molar absorptivity constant or the pathlength for the calculations you did in this experiment?

3. While doing the Beer's Law experiment, Bob and his lab partner used ~5ml of solution for each determination of the %T. Their classmate Suzy and her lab partner used ~10ml of solution for each determination. Explain briefly what differences if any would result from doubling the amount of solution.

4. While doing a Beer's Law experiment, Frank thought that he would run out of solution. Rather than go get more from the hood. He diluted his original solution to half its original concentration. How would this effect his absorbance readings compared to a student who had used the solution with the original concentration?

5. Trina's lab partner generated the following graphs for her and told her to finish the lab on her own.





Looking at the graphs,

a.) Determine the Keq for this reaction.

b.) Determine the concentration of an unknown solution when %T = 61.1.
(Assume the pathlength was 1.00cm.)

9. Atomic Spectra: Using the Rydberg equation (where R = 3.29×10^{15} Hz) and the speed of light (C = 2.998×10^{8} m/s):

a. Calculate the expected frequencies in Hertz (s^{-1}) of the radiation emitted by a hydrogen atom for the following electronic transitions.

$$\nu = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

b. Calculate the expected wavelengths in nanometers (nm) of the radiation emitted by a hydrogen atom for the same electronic transitions.

$$\mathbf{C = \lambda\upsilon}$$

c. Label which wavelengths correspond to the Balmer series and which wavelengths correspond to the Lyman series.

Transitions	**Frequency (s^{-1})**	**Wavelength (nm)**	**Balmer / Lyman**
$n_2 = 3$ & $n_1 = 1$			
$n_2 = 2$ & $n_1 = 1$			
$n_2 = 5$ & $n_1 = 2$			
$n_2 = 4$ & $n_1 = 2$			
$n_2 = 3$ & $n_1 = 2$			

d. Why did the Hydrogen spectrum have the fewest lines?

e. For the Hydrogen spectra, why was the red line more intense (brighter) than the other lines?

10. Flame Tests – What color flame is produced by each of the following elements?

a. copper –

b. iron –

c. lithium –

d. potassium –

e. sodium –

f. strontium –

f. Why did we need the copper wire for the Beilstein reaction?

11. Gas Laws: Using the ideal gas law calculate the volume of the system.

Given: pressure = 738 mmHg, mass = 0.725 grams, MW_{butane} = 58.000 g/mole, T = 20°C, R = 0.08206 Latm/molK

a. What is the number of moles of butane?

b. What is the pressure in atm?

c. What is the temperature in K?

d. What is the volume of the system?

e. What would the volume be at STP?

12. Statistics:

a. For the following data set (2.10, 3.20, 3.50, 4.90, 4.30, 2.90) find the mean (average).

b. For the average of the data set above, calculate the % Error if the expected answer was 3.500.

b. For this data set would you calculate the standard deviation or the standard deviation estimate? Explain why.

13. Dimensional Analysis: Choose problems from sets 1, 2, 4 or 5 and work them.

14 Scientific Notation & Significant Figures:

a. Choose problems form sets 1 & 2 and work them.

b. Review problems from the midterm exam.

****Note:** Most of the questions on the final will be similar to those on review and on quizzes.

15. People – How did these people contribute to the experiments we did in Chem 2?

a. Henri Becquerel (Nuclear)

b. Pierre and Marie Curie (Nuclear)

c. Ernst Rutherford (Nuclear)

d. Svante Arrhenius (Antacid)

e. Johannes Nicolaus Brønsted and Thomas Martin Lowry (Antacid)

f. Gilbert N. Lewis (Antacid)

g. August Beer & Johann Heinrich Lambert (Equilibrium)

h. Henry Louis Le Chatelier (Equilibrium)

i. Ibn Alhazen (Atomic Spectra)

j. Joseph von Fraunhofer (Atomic Spectra)

k. Bunsen & Kirchhoff (Atomic Spectra)

l. Johann Balmer (Atomic Spectra)

m. Max Planck (Atomic Spectra)

n. Neils Bohr (Atomic Spectra)

o. Robert Boyle (Gas Laws)

p Jacques-Alexandre Charles (Gas Laws)

q. Amedeo Avogadro (Gas Laws)

r. Joseph-Louis Gay-Lussac (Gas Laws)

s. John Dalton (Gas Laws)

t. Johannes Diderik van der Waals (Gas Laws)

u. My TA's name is…