FS/08 Chem 2 Midterm Review Questions

1. **(*Zinc*)** For the following data set (6.1, 7.2, 6.5, 4.9, 5.3, 5.9)

a. Determine the mean (average). (x_{AVG} = 5.98, but 2 significant figures so 6.0)

b. Determine the standard deviation estimate. (*Why are we using the standard deviation estimate and not the standard deviation?*) (s. dev. est = 0.83, because we have a small data set)

c. Determine the confidence interval for a single value at 90% and the confidence interval for the mean at 90% where t = 2.015. (CI_{sing} = 1.672 or 1.7, then CI_{mean} = 0.68 or 0.7)

d. How many degrees of freedom does this data set have? How do you determine degrees of freedom? (5, it is the number of trials minus one, so 6-1=5)

2. **(*Zinc*)** Pennies that have been made after 1982 are a composite of zinc and copper. The copper is plated on top of the zinc. The zinc can be removed from the penny by cutting the coin and creating a reaction between the zinc and concentrated hydrochloric acid. The copper does not react with hydrochloric acid.

The penny was measured using Vernier calipers. The diameter was 1.79 cm and the height was 0.13 cm. The penny was weighed and the mass determined to be 2.518 grams. The penny was cut and placed in excess hydrochloric acid. After the solution stopped bubbling, the penny shell was removed. The penny shell was weighed and the mass of copper was determined to be 0.071 grams. The density of copper is 8.94 g/cm^3.

a. What is the volume of copper (*the copper penny shell*) in the penny?
(d = m/v so v=m/d = 0.71/8.94 = 0.0079 cm^3)

b. Calculate the surface area of the copper. The surface area of the copper is equal to the surface area of the penny. The surface area of a penny can be approximated by using the equation for the surface area of a cylinder: $SA_{cylinder} = 2(\pi r^2) + 2\pi rh$.
(SA = 5.76 cm^2)

c. Determine the thickness of the copper coating present in the penny. (T=V/SA = 0.0014cm)

d. What is the mass percent of copper in the penny? (%M=97.2%)

e. Since 1982, pennies are composed of 97.5% zinc and 2.5% copper by mass. Calculate the percent error between the mass percent of copper in the previous answer and the expected value. (%E=10.7%)

3. **(*E.F.*)** A student analyzes a sample of a material that is known to contain no elements other than molybdenum (Mo) and sulfur (S). In the student's experiment, the mass of a sample of molybdenum sulfide, Mo_xS_y, is determined to be 0.583 g. The sample is heated in an acid solution and H_2S gas is liberated leaving only molybdenum. The final weight is 0.255 g.

a. Determine the mass percent of Mo in the sample of molybdenum sulfide, Mo_xS_y. (43.7)

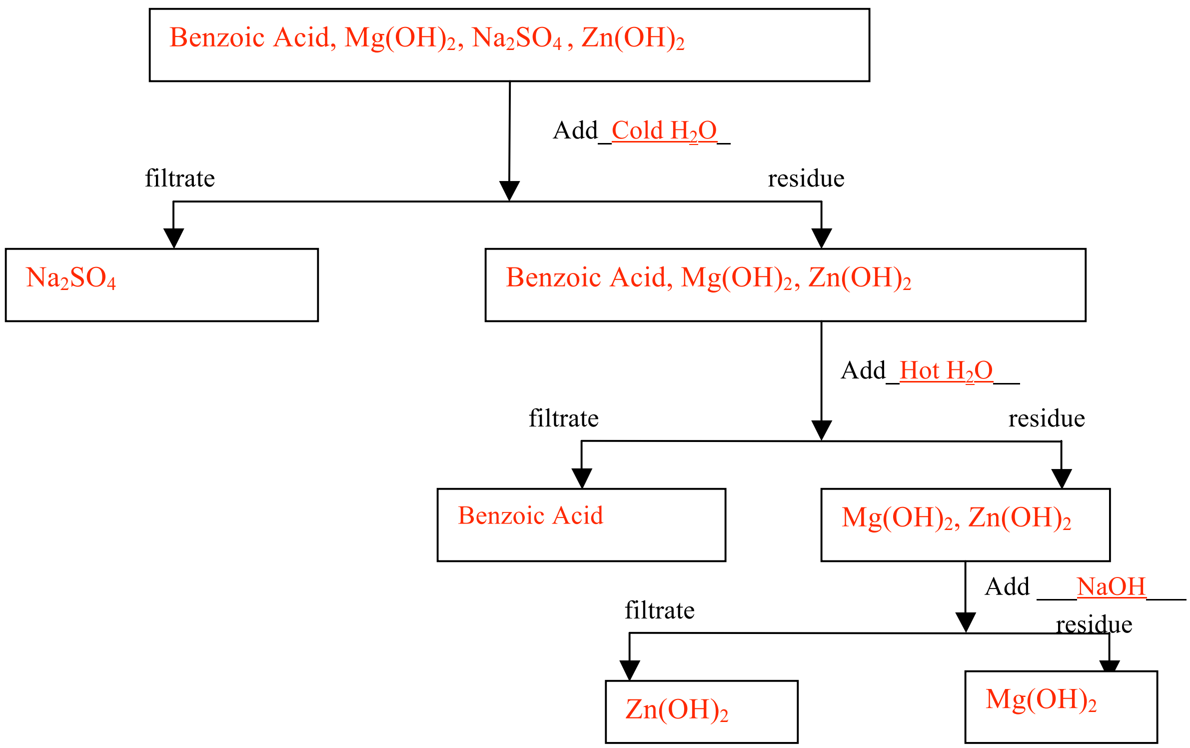
b. Determine the mass of the S in the sample of molybdenum sulfide, Mo_xS_y. (0.328)

c. Determine the mass percent of S in the sample of molybdenum sulfide, Mo_xS_y. (56.3)

d. Determine the empirical formula of the molybdenum sulfide sample based on the values closest to the values calculated in a & b. The Empirical Formula for this compound is:
Mo_2S_3, MoS, MoS_3, or MoS_4

4. **(*T.M.*)** A mixture is known to contain the four compounds in the table. A.) Draw a flow chart to show the steps that you would use to separate the following compounds. B.) The initial mass was 5.025g. The resulting masses were benzoic acid = 1.760g, $Mg(OH)_2$ = 0.754g, Na_2SO_4 =1.005g, and $Zn(OH)_2$ 1.256g. Calculate the percent recovery of each component and the total percent recovery.

	Cold water	**Hot water**	**3M HCl**	**3M NaOH**
benzoic acid	no	yes	no	yes
$Mg(OH)_2$	no	no	yes	no
Na_2SO_4	yes	yes	yes	yes
$Zn(OH)_2$	no	no	yes	yes



Percent Recovery = (Final Mass / Initial Mass) x 100

Benzoic acid	35%
$Mg(OH)_2$	15%
Na_2SO_4	20%
$Zn(OH)_2$	25%
Total	95%

5. (***13 TT***) Balance and complete the overall reactions, then give the net ionic reactions for each of the following reactions:

a. $H_2SO_{4\,(aq)} + Ba(NO_3)_{2\,(aq)} \rightarrow BaSO_{4\,(s)} + 2\ HNO_{3\,(aq)}$

$SO_4{}^{2-}{}_{(aq)} + Ba^{2+}{}_{(aq)} \rightarrow BaSO_{4\,(s)}$

b. $2\ NH_4OH_{(aq)} + Cu(NO_3)_{2\,(aq)} \rightarrow Cu(OH)_{2\,(s)} + NH_4NO_{3\,(aq)}$

$2\ OH^-{}_{(aq)} + Cu^{2+}{}_{(aq)} \rightarrow Cu(OH)_{2\,(s)}$

c. $K_2CrO_{4\,(aq)} + Ba(NO_3)_{2\,(aq)} \rightarrow BaCrO_{4\,(s)} + 2\ KNO_{3\,(aq)}$

$CrO_4{}^{2-}{}_{(aq)} + Ba^{2+}{}_{(aq)} \rightarrow BaCrO_{4\,(s)}$

d. $Fe(NO_3)_{2\,(aq)} + 2\ KSCN_{(aq)} \rightarrow 2\ KNO_{3\,(aq)} + Fe(SCN)_{2\,(s)}$

$Fe^{2+}{}_{(aq)} + 2\ SCN^-{}_{(aq)} \rightarrow Fe(SCN)_{2\,(s)}$

e. $Na_2S_{(aq)} + SnCl_{2\,(aq)} \rightarrow SnS_{(s)} + 2\ NaCl_{(aq)}$

$S^{2-}{}_{(aq)} + Sn^{2+}{}_{(aq)} \rightarrow SnS_{(s)}$

f. $K_2C_2O_{4\,(aq)} + Ba(NO_3)_{2\,(aq)} \rightarrow BaC_2O_{4\,(s)} + 2\ KNO_{3\,(aq)}$

$C_2O_4{}^{2-}{}_{(aq)} + Ba^{2+}{}_{(aq)} \rightarrow BaC_2O_{4\,(aq)}$

g. $H_2SO_{4\,(aq)} + Na_2S_{(aq)} \rightarrow H_2S_{(g)} + Na_2SO_{4\,(aq)}$

$2\ H^+{}_{(aq)} + S^{2-}{}_{(aq)} \rightarrow H_2S_{(g)}$

6. (***D.A.***) Unit conversions:

a. (1) We have a measured mass of mercury (2.00g) and a density of mercury (13.6g/ml). Solve for the volume in liters. (0.000147 L or 1.47×10^{-4} L)
b. (1) How many weeks did it take you to read Lord of the Rings, if it took you 302,400 seconds to read it. (0.5 weeks)
c. (2) Find the number of moles of 100.0 grams of $Cu(NO_3)_2$. (0.5332 moles)
d. (2) Find the mass of 1.25 moles of C_4H_{10}. (72.655g)
e. (3) Determine the percent composition of carbon in C_4H_{10}. (82.7%: %H = 17.3%)

7. (***S.F***) Scientific (a.k.a. Exponential) Notation and Significant Figures:

a. Convert to scientific notation 0.08206 (8.206×10^{-2})
b. What is the numerical value of 3.000×10^1 ? (30.00)
c. How many significant figures are there in the number 0.030100 ?
   5 easier to see in scientific notation (3.0100×10^{-2})
d. Write 0.0654234 to **3** significant figures. (0.0654)
e. Using the correct number of significant figures, what is the answer to 3.67 kg + 12.498 kg? (16.17)
f. Using the correct number of significant figures, what is the answer when 5.18 is multiplied by 4.2 ?

8. Safety and General Information:

a. In case of emergency, you may call the MS&T campus police at what number?
   (341-4300)

b. What is proper attire to wear in the lab?
   goggles, long pants, closed toe shoes, when necessary gloves, aprons, labcoats

c. In case you spill 3M HCl, what will the TA use to neutralize the spill?
   $NaHCO_3$ a.k.a., baking soda or sodium bicarbonate

d. If you break an empty beaker in the lab, what should you do?
   Notify your TA to clean up the broken glass.

e. What is the most important reason that you not eat or drink in the lab?
   So your food/drink does not become contaminated and harm you.

f. Why is it important that separate waste containers are used for each experiment?
   So the chemicals do not react in the waste containers.

g. Give examples of qualitative vs. quantitative observations.
   Quantitative involve numbers / Qualitative do not.
   e.g., Quantitative – The worm was 4.5 cm long.
   Qualitative – The worm was pink in color.

h. What is the difference between a homogeneous and a heterogeneous mixture? Give an example of each.
   Homogeneous mixtures are uniform throughout. Heterogeneous are not.
   Homogeneous = Juice
   Heterogeneous = Chocolate chip cookies

i. What are some physical properties of oxygen? What are some chemical properties?
   Physical: Oxygen is a gas at 23 ^{o}C.
   Chemical: Oxygen and hydrogen react to form water.

j. What are some indications that a chemical reaction has occurred?
   Bubbles indicate a gas has formed.
   Temperature change. Exothermic = hotter, endothermic = cooler.
   Color change.
   Precipitate formation.

k. What is the main hazard of a reaction where hydrogen gas is produced?
   Hydrogen is flammable in small quantities and explosive in large quantities.