LAB [25 pts] ***Name_____***

Molarity and Absorption ***Lab partners_____***

With Analysis of Aspirin ***Period _____ Date_____***

Purpose: To become familiar with making solutions by dissolving solids into water and by diluting solutions. The concentration of the solutions will be tested by determining their absorption of light. Also, you will test for the contamination of salicylic acid in your aspirin sample you made earlier this year.

Procedure Part A: [4 pts] Making solutions of $CuSO_4$ and testing their absorbance.

Complete parts 1a, 1b, 2a & 2b as prelab

1) **Make 50.0 mL of 0.50 M $CuSO_4$ sol'n from solid $CuSO_4 \cdot 5\ H_2O$ crystals and measure its absorbance**
   a) Determine the mass of $CuSO_4 \cdot 5\ H_2O$ needed to make 50.0 mL of 0.5 M $CuSO_4$ (aq). Show work here.

   b) Explain how you will make this 0.50 M solution here. Teacher initials: _____

   c) Make solution and measure the absorbance of the solution just made. *Record below.* *See directions below to learn how to measure absorbance.*
2) **Make a Solution by dilution and measure its absorbance**
   a) Make **25.0 mL of a 0.35 M $CuSO_4$** solution by diluting your 0.50 M solution you just made. Show needed calculation here and briefly

   b) Briefly explain how you will make this 0.35 M solution. Teacher initials: _____

   c) Make solution and measure its absorbance**.** *Record below*.
3) **Making four more solutions by dilution of your 0.50 M $CuSO_4$ solution.**
   a) Label four large test tubes-- #1,2,3,4. Place them in your test tube rack.
   b) Obtain two graduated pipets and a filler. Use pipets to make 4 different dilutions of your 0.50 M solution by filling each test tube with the amounts of each solution shown in the table below.

Test tube #	**#1**	**#2**	**#3**	**#4**
Vol of water (mL)	8	6	4	2
Vol of 0.50 M $CuSO_4$ (mL)	2	4	6	8
Molarity of solution (M)	*0.10 M*	*0.20 M*	*0.30 M*	*0.40 M*

   c) Measure the absorbance of each of the solutions just made. *Record below*

***** To measure Absorbance:** Use the colorimeter/computer setup. To do so-

   a) Carefully fill a colorimeter cuvet (plastic container) ~ ¾ with one of the solutions. **Wipe dry!!!**
   b) Take the filled cuvet to the colorimeter/computer. Put the sample into the sample chamber. *(Make sure that the clear sides align with the white line on the colorimeter.)* Close the lid of the colorimeter. Read the **absorbance** off the computer screen. Record value.
   c) Take cuvet out. Go back to lab bench. Pour back old solution, and repeat with another solution.

Data Chart [1 pt]

Molarity (M)	**0.10 M**	**0.20 M**	**0.30 M**	**0.35 M**	**0.40 M**	**0.50 M**
Absorbance						

Procedure for Part B: Analysis of the purity of Aspirin

1) Make your solution of your aspirin sample. (Don't make solution until the spec 20 is free.)
   a) Place 0.10 g of your aspirin sample into a 100 mL (or 150 mL) beaker.
   b) Dissolve the solid by adding 5.0 mL of 95% ethanol. (Use graduated cylinder)
   c) Also add 5.0 mL of 0.025 M $Fe(NO_3)_3$ in 0.5 M HCl. (Use graduated cylinder)
   d) Lastly, add 40.0 mL of distilled water. Stir with glass rod until most of the solid is dissolved.
2) Measure the absorbance of the solution using the "spec 20." (The yellow machine in hoods.)
   a) Do not touch the wavelength value (It should be set at 524 nm)
   b) Make sure the spec 20 is zeroed. (transmittance = 0 when nothing is in machine)
   c) Blank the machine. (Put the blank in holder, close top. Make sure it reads at 100 % absorbance)
   d) Pour some of your aspirin solution into a clean cuvet. Measure its absorbance. (NOT %T) *You must measure the absorbance within 5 minutes of dissolving your aspirin in the ethanol since aspirin slowly decomposes in the solution.*
   e) Rinse out your sample cuvet with some water and put in the beaker labeled "used cuvets."

   *** *Note: The blank solution was prepared by mixing 5 mL of 95% ethanol, 5 mL of 0.025 M $Fe(NO_3)_3$ in 0.5 M HCl and 40 mL of distilled water.*

DATA: absorbance of your aspirin sample =

CLEAN UP: If everything seems reasonable in part A, dispose of your four solutions by placing them in the appropriate bottles (correct molarity). Rinse out all glassware with deionized water.

Write-up: *All done on separate sheets of paper*.

Graphs: [8 pts] ****** You are to make one manual graph and one on Excel.***

a) Make a manual graph of the absorbance vs. concentration for your six solutions. Remember-- labels, units, title. *Absorbance goes on the y-axis and concentration goes on the x-axis*. **The best fit line** includes the (0,0) as a plotted point, but **does not** necessarily need to go through this point.
b) Next make an Excel-generated graph. Be sure to get the equation of the trendline (see instructions).

Post-Lab Questions:

1) [2 pt] Calculate the slope and y-intercept for your manual graph. Rewrite the equations for your lines using the letters "A" and "c" ("A" is absorption and "c" is concentration) instead of the letters "x" and "y" in your equation, for both the manual and Excel graph.
2) [2 pts] Suppose you have a solution of $CuSO_4$ of unknown molarity. You measure its absorbance-- it is 0.55. Plug this value and your slope value into the Excel equation of your line and solve for the molarity of this unknown solution. *Show calculation.*
3) [2 pts] Is absorbance directly or inversely related to molarity? Explain for your choice.
4) [2 pts] By looking at your data, you know that absorption of light increases with increasing concentration. How would you have known this just be looking at your solutions?
5) **Part B calculations**: *Determination of the percent salicylic acid impurity in your aspirin sample*.
   Absorbance and molarity are directly related, thus, an equation can be written which relates absorbance and molarity. The equation is known as Beer's law: **A = a b c**
   *where **A** is the absorbance, **a** is the molar absorptivity (depends on substance & l), **b** is the path length that the light must pass through the sample (usually, 1 cm) and **c** is the concentration (molarity).*
   When testing your aspirin sample, the solution will become purple if there is some salicylic acid impurity. This is due to the formation of an Fe^{+3}– salicylic acid complex ion. This complex ion has a molar absorptivity (a) = 1200 M^{-1} cm^{-1}. The "b" value is 1 cm with our spectrophotometer. The y-intercept is 0.
   a) **[1 pt] Determine the value of c**. Solve the equation for "c". Substitute in your value of A. Put in values of a and b as described above. This is the molarity of salicylic acid in your solution.
   b) [1 pt] Determine the moles of salicylic acid in your solution. *(Remember-- you made a 50.0 mL solution)*
   c) [1 pt] Determine the grams of salicylic acid in your solution. *(MM of salicylic acid is 138.13 g/mole)*
   d) [1 pt] Determine the percent (by mass) of salicylic acid in your aspirin sample. *(Remember you had made the solution using 0.10 grams of your aspirin sample.)*