**AP Chemistry: How Much Copper is Present?**

**Part I: What is a Penny Made Of?**

1. Determine the mass of a post-1982 penny to the nearest 0.0001g and record this mass.
2. Using a metal file, scratch several deep marks into the edges of a post-1982 penny to reveal the zinc underneath. (See diagram at right)
3. Determine the mass of this filed post-1982 penny to the nearest 0.0001g and record.
4. Place the post-1982 penny in a 100 mL beaker labeled with your group member’s names. Carefully add 30.0 mL of 6.0 M HCl.
5. Cover with a watch glass. (See diagram.) Leave the beaker sitting in a safe place (away from flame) overnight. Do not leave the penny in acid longer than 24 hours. After 24 hours, a slow redox reaction occurs, dissolving the copper.
6. Once your penny is set up, go back to your seat and watch the demonstration done by your teacher. Record all data.
7. (Day 2) Carefully remove the penny “shell” from the solution. Dispose of the solution in the sink.
8. Gently pat the penny dry and when you are SURE that it is dry, take its mass to 0.0001g and record it.
9. Calculate the moles of copper and zinc present in the penny. SHOW ALL CALCULATIONS IN YOUR LAB NOTEBOOK!
10. Calculate the percent of copper in the penny. SHOW ALL CALCULATIONS IN YOUR LAB NOTEBOOK!

Questions

1. The reaction of the penny with the hydrochloric acid is a single replacement reaction. Write the balanced equation for this reaction.

**Part II: Making the Solution**

1. We will now make a solution of copper nitrate using the copper from the first part of the lab.
2. Add the TOTAL MASS of copper from each group in the class. Record this mass.
3. Add ALL of the copper to a 250 mL beaker and place it under the fume hood.
4. Observe your teacher as they add nitric acid to the copper. Record all observations of this reaction.
5. Your teacher will also react a sample of brass with nitric acid. Record all observations of this reaction, including the mass of the brass sample.

Questions

1. Based on the total mass of copper used, how many moles of copper will be in the solution?
2. If the solution is diluted to 500.0 mL, what will be the molarity of the solution?
3. Based on this molarity, write a set of procedures to describe how you are your partner plan on making four, 20 mL solutions of the following concentrations. 0.2M, 0.1M, 0.05M and 0.025M. Show any necessary calculations in your lab notebook.
4. The brass sample is an alloy.
   1. Research the components of brass. Write them down in your notebook.
   2. Brass is an alloy. What does that mean?
   3. What color should the final solution of brass be? Why?

**Part III: Beer’s Law**

1. Have your teacher approve your procedures for making your solutions.
2. Once approved, carry out your dilutions. Label each solution.
3. Use the colorimeter to find the absorbance of each solution. Record these values.
4. Graph your absorbance values on your calculator and find the equation of the line. Write this equation in your lab notebook.
5. Test the brass solution and find its absorbance.

Questions:

1. Using the equation of the line you found for the copper solutions, find the concentration of the copper in the brass solution. Show all work.
2. Using the concentration of the brass, find the percent of the copper in the shell casing.
3. A student is instructed to determine the concentration of a NiSO4 solution using a spectrophotometer or colorimeter. The student prepares these standards: 0.08 M, 0.16 M, 0.24 M, 0.32 M and 0.40 M NiSO4. The student then measures the absorption spectrum of the NiSO4 solution to determine an appropriate wavelength for the analysis. The following graph represents the data.
   1. Identify the optimum wavelength for the analysis.
   2. The student measures the absorbance of the 0.08 M, 0.16 M, 0.24 M, 0.32 M and 0.40 M solutions. The data is plotted below.



Absorbance of the unknown solution is 0.750. What is the concentration of the solution?

1. Beer’s Law is an expression that includes three factors that determine the amount of light that passes through a solution. Identify two of these factors.
2. A student handles the cuvette during the experiment and leaves fingerprints on the surface. How will this affect the calculated concentration of the unknown? Explain your answer (you may use equations).
3. Why is this method of determining the concentration of nickel (II) sulfate solution appropriate, whereas using the same method for measuring the concentration of a sodium chloride solution would not be appropriate?

**“How Much Copper is Present?” Grading Rubric**

Part I (30 points)

* 3 mass values for the penny
* Calculations from steps 9 and 10 (answers boxed)
* Balanced equation from question 1 (Write question and answer)

Part II (30 points)

* Total mass of class’ copper samples
* Observations of two reactions
* Questions written out and answers for questions 1-4 (For question 3, write out your numbered procedures)

Part III (40 points)

* Equation for the line for Beer’s Law plot
* Absorbance value for the unknown shell casing solution
* Questions 1-6, written out and answered (You do NOT have to redraw the graphs)
* Finally, a 4-6 sentence conclusion describing what you learned (techniques, etc), explaining if you accomplished each part of the lab successfully and describing any changes you might make to the lab.