PRE-LAB: Experiment 2: Metric Measurement

Format & Clarity of the Report: See lab report checklist. You are graded on how you format the lab and record your data, not just data collection.

Before class starts: Read the lab for the week carefully before you start writing your pre-lab. The purpose, introduction, and procedure should be neatly written in your lab book before class starts. Keep the introduction and the purpose separate. Pre-lab questions need to be correctly answered.

Spacing: You will **probably** use 1 page for your purpose and introduction, 1-2 pages for the procedure, 1-2 pages for data tables, 1 page for calculations -this includes showing your graph set up data, 1 page for the graph of aluminum if assigned, 1 page for the questions, and 2 pages for the supplemental graph (usually a solution) if assigned. If you allot an appropriate amount of space, you will not have to mix both labs together. it makes life neater!

Purpose: Read the introduction to the lab. The title implies that you are doing metric measurement in this lab. You are using metric measurements, but that is not the purpose of the lab experiment. The purpose should answer the following question, "What will you ultimately determine in this lab?"

Introduction: Think about the concepts presented in this lab with respect to the material in Chapter 1 of the lecture. Your introduction should answer the following questions: Why are you working with two pieces of aluminum? What is the difference between intensive and extensive properties? What is density and what is the formula for density? The metal used in this lab is aluminum; the density of aluminum is 2.70 g/cm^3. Will you determine the density of other materials? Which ones? The answers to these questions should be integrated in a cohesive paragraph, not answered separately.

Prelab questions: None

Procedure: Read the procedure of the lab carefully then take note of the following information.

1. Notes: You will need two pieces of the same type of metal for this lab. Make sure that the metal pieces fit in the graduated cylinder. Watch the significant figures and units on your measuring tools.
    a. **Part 1: THERE IS <u>NO</u> LIST!** Some of the slugs don't have unknown numbers! Record the unknown number, if there is one, record that there is no unknown number if there is not one.
    b. **Part 2:** we will be using calipers to measure the linear dimensions of the metal slug.
    c. **Part 3:** when you add the metal to the **<u>glass</u>** graduated cylinder, tip the cylinder 45°and slide the metal gently into the barrel of the cylinder.
    d. Take the temperature of the air in the room for the aluminum measurements

e. **Part 5:** pour a sample of water into a beaker when the lab starts and allow the water to come to thermal equilibrium. Take the temperature of the water. Then, use a sample of that water to determine the density of water. Use the CRC value as the actual value for the density of water to determine the % error of your measurement.
f. Part 6: You need to use a second piece of metal. Measure the volume by displacement and determine the mass of this piece. Use the density calculated in Part 4 to find the predicted volume. You will calculate the % difference between the actual and predicted volumes.

2. The two formulas listed in the experiment are very important. The % error is a measure of the accuracy of your measurement. Since you know the density of water at room temperature to 3 sf, the % difference is a measure of the precision. The formula should read:

$$\%\ difference = \frac{(\text{highest value in the set - lowest value in the set})}{(\text{average of the set})} x100$$

3. Skip parts 7 and 8
4. Use the same balance for all your measurements. Switching balances adds error to your measurements.

Qualitative Observations/Data Collection: For this experiment, you should have: metal that you will use for this lab is aluminum. For this experiment, you should have a) recorded the appearance of the metal(s), b) the mass of your 1st unknown metal, c) the linear units for your 1st metal using calipers, d) initial volume of water before you added the 1st metal, e) final volume of water after you added your 1st metal, f) mass of the empty graduated cylinder, g) the mass of the graduated cylinder with water, h) the volume of water in the graduated cylinder, i) the mass of a 2nd unknown metal, j) the initial volume of water before you added the 2nd metal and k) the final volume of water after you added your 2nd metal.

You should label and assign the proper units and significant figures to each piece of data.

FOR THIS AND FUTURE EXPERIMENTS DO NOT USE WHITE OUT OR SCRIBBLE OUT MISTAKES. YOU WILL LOSE POINTS. NEATLY CROSS OUT THE ERROR AND INITIAL IT.

Data Tables: See sample on handout; Exp. 2 Data table s

Calculations: For this experiment, you should have: Part 2: a) calculated the volume of your metal based on linear measurements, part 3: b) the volume of your metal based on water displacement, Part 4: c) the density of your 1st unknown using two methods, Part 5: d) the density of water, f) the % error in your density determination of water, Part 6: g) the predicted volume of your unknown, h) the volume by displacement of water for your 2nd unknown, i) the % difference of what you predicted compared to your experimental value The calculations showed the proper significant figures and units; The calculations were labeled; The setups showed units; The data was labeled with units

Results Tables: Tabulate your results in a table that is clear. (Use the examples as a guideline)

☞Evaluation/Discussion of Results and Errors: In this lab you <u>WILL NOT</u> write-up an evaluation of either error or results. You will be evaluating pre written

evaluations, and determining the best grade for each. First, read the handout 'How to write a summary". I have printed up the checklist from that handout on writing a result statement. Use these questions above in the evaluation process.

1. Did the author address the purpose? What is the purpose of the lab?
    a. **WHY DID I DO THIS LAB?** "The purpose of this lab was to identify an unknown organic liquid ..... My unknown organic liquid , # 53, was _____."
2. Were there observations that were integral to the lab? What were they? How did these observations support the results?
    a. **WHAT DID I DO IN THE LAB? WHAT DID I OBSERVE IN THE LAB?** Now tell me how you reach this result. Start with your observations. What did you observe in each part?
3. What were the ultimate results for each part?
4. What did the results mean to you?
5. Did you find that the results supported the purpose?
6. If there was a graph, what did the results of the graph indicate? Make sure you refer to the graphs by page and figure number.
7. Were there any conclusions that were drawn from these observations?
    a. **BASED ON YOUR PROCEDURE AND OBSERVATIONS, HOW DID YOU REACH THE CONCLUSION FOR YOUR RESULTS?** Is density an intensive property? What evidence do you have to support this conclusion? Was the density of aluminum comparable to the known value? How close?
8. What did you learn from doing this lab?
9. Thinking about what you learned in lecture and in the lab, do your results make sense? In other words, were there assumptions made that affected the results?
    a. **WHERE DID I MAKE AN ASSUMPTION THAT COULD LEAD TO AN ERROR? "Now think of one place where an error occurred that might influence your results.** There are so many to choose from but one assumption is that piece of aluminum is uniform, even though we measured only three parts of the slug.
10. How does the lab relate to lecture material?
11. Compare the results with theories outlined in the introduction. Do they match? Explain why they might vary.
12. Were there parts that you did not quite understand?
13. What were they? Summarize what you did not understand or had questions about.

Questions:

1. An empty graduated cylinder weighs 71.360 g. When it is filled to the 50.0 mL mark with an unknown liquid it weighs 110.810 g. What is the density of the unknown liquid?
2. An unknown rectangular metal sample measures 1.2 cm by 6.5 cm by 2.3 cm. The mass of this piece of metal is 84.43 g. Calculate the density of this metal sample. If the true value for the density of this metal is 4.50 g/cm^3, calculate the percent error in the density.
3. If you are instructed to measure the length of a sample to the nearest 0.1 cm, you should not record the length of the object to be " 7 cm". Explain why not. How should you record the length instead? Explain thoroughly.
4. We have learned in class that the density of matter is dependent on temperature (and pressure!). The pressure dependency for solids and liquids is small compared to gases. Based on how we define a solid, liquid, and gas, give one reason why solids and liquids do not respond to pressure changes as much as a gas would.

5. Two materials have a similar mass, but are not at the same temperature. Sample A has a measured temperature of 70°C while sample B has a measured temperature of 10°C. Which sample has the higher density? What is the effect of temperature on the volume of the samples?
6. Read the section on SMOG in the link https://www.thoughtco.com/temperature-inversion-layers-1434435, titled Learn about thermal inversions.
    a. What is smog?
    b. What happens in the atmosphere when smog is occurring?
    c. How is this related to density?
    d. What are the dangers of smog?
    e. What are cities and countries doing to reduce smog?

Attachments and other information:

There is a second graph that you will do related to density. Please do this in your lab notebook **AFTER** you finish your lab report and turn it in separately from the lab report. Show how you calculated your scale and have all the parts as shown in 'How to Make a Graph' handout. This part will have a separate grade; turn them in separately please.