Lab Assignment BEFORE First Lab Session

I expect your lab reports, which require **proper** data collection, **proper** graphs with **proper** slope calculation, and **thoughtful** error analysis in the results, to be **correct all semester**, including the first.

This assignment covers the concepts you'll use.

1. Read attached 2-part handout with titles "A. Lab Policies ...etc." & B. Data Measurement .. etc."
2. Read Appendix III of the lab manual (p.399).
3. Read Appendices IV thru VI of the lab manual (starting on p.403)
   
   • Understand that since errors are unavoidable in **measured** data, its graph points must **NOT** be **connected** "dot-to-dot." **Use a "best-fit" curve.**
4. Read attached handout titled "Lab Procedures for Graphing & Slope Calculation."
5. Now read Appendices I and II of lab manual (p.395) and understand why the procedure in step 4 above is the **one I expect you to use.**

Any questions on this? Make sure you ask them at the **beginning** of the first lab session.
A: LABORATORY POLICIES, REPORTS & LAB EXTRA CREDIT

B. Important Procedures For: DATA MEASUREMENT, RECORDING PRECISION, & CALCULATED SIGNIFICANT FIGURES

General

• Bring to each lab session your lab manual, textbook, calculator, and a ruler or other straight edge.

Preparation

• For each experiment, you will get a sheet of "HINTS, ADDITIONS, AND CHANGES." Read it and the lab book procedure before the experiment date and note in the lab book which procedure steps have been changed or modified.

Data Sheets

• These are in the Lab Book, and may be filled out in pencil.

• One filled in Data Sheet must be SIGNED BY THE INSTRUCTOR before you leave the lab session. This verifies your attendance for the experiment.

Lab Reports

• Do whatever is asked for each experiment, using the blank spaces and graph paper in the lab manual.

• Do ALL PARTS of the report EXCEPT Invitation to Inquiry, unless instructed otherwise in the "CHANGE" sheet or verbally at the beginning of the Lab Period.

• Carefully tear the pages out of the manual and attach the "HINTS, ADDITIONS, AND CHANGES" sheet behind them. Write your name, the experiment date and your lab partners' names on the first page.

• Any pages NOT in the following order will be considered missing (-10 points):
  • Lab Book pages with numbers in numerical order.
  • Any extra data sheets that YOU create.
  • Graphs in the order you are asked to do them.
  • Any other information that you are including.
  • The "CHANGE" sheet, which sometimes has an alternate or added data sheet.

• Reports are due at the BEGINNING of the next lab session (except for the last lab, which will be due sooner). If you are absent then, turn it in before CLASS the day you return.

• Otherwise, reports will be docked 20 points per week late.

CONTINUED
Lab Extra Credit

I will add 5 (five) points to the lab average of everyone who sends me an E-Mail message telling me which lab experiment was the best and which was the worst for them. I will add up to another 5 (five) points for meaningful reasons (1 for each) supporting your choices. My E-Mail address is: abramson@udel.edu. The specific rules are:

1. The message must be sent from your own E-mail account to my account.
2. The message must be sent no later than 11:59 PM, the last day of CLASSES (Wednesday).
3. Meaningful reasons must have some relationship to the science involved in the experiment. "It was fun." or "I learned a lot." are not meaningful reasons. I will be the final judge.
4. Keep your answers brief and to the point. Always try to fit E-Mail messages on one screen, because that makes the most impact on your recipient.

In summary: you get five points just for choosing, up to another five for saying why.

SUGGESTION: If you are new to E-Mail, or if you just want a trial run before the message is due, send me a "test message". After I read it, I'll send you an E-Mail reply.

B. Important Procedures For: Data Measurement, Recording Precision, and Calculated Significant Figure (S.F.) Rules For Lab Reports

- Your Data sheets contain 2 types of entry: Measured or Calculated (from the measured).

- As a general rule, all measurements with the same instrument or device should be recorded with the same precision. Precision is the number of decimal places that can actually be measured, and may include estimating between two marks on a scale.

1. Record ALL MEASURED DATA with the same precision. This may mean adding one or more zeros after the decimal point for some measurements. The number of Significant Figures (SFs) for each recorded measurement includes: the leftmost non-zero digit and all digits after that, including all zeros.

- Calculated Entries also fall into 2 sub-types: Final Results or Intermediate Numbers (used to calculate the final results. Final Results always have the same accuracy (Number of S.F.) as the least accurate contributing MEASUREMENT.

2. Calculate any intermediate values used in multi-step calculations WITHOUT rounding. This will improve the value of the calculated Final RESULT.

3. ALL Final Results MUST be rounded to and recorded with the proper number of S.F.s. The procedure for doing this is the subject of the "Math" lecture.

4. AVERAGING two or more measurements of the same thing increases the accuracy of the data. Averaging SIX or more lets you increase the number of S.F.s of the average by ONE.

LABORATORY PROCEDURES FOR GRAPHING & SLOPE CALCULATION
ATTACH this page in front of Appendix I of the Lab Manual

USE the two Procedures below for ALL Graphs

Steps to an ACCEPTABLE Graph

• Reference Lab Manual Appendix I.

1  Title the graph (usually at the top).

2  Select proper values for the Major Divisions of the two axes. To make interpolation between minor divisions easier, the values should be 1, 2, 5, 10, 20 50, etc.

3  Label the division values with NO skips down to the origin. Label the name of the Data quantity for each axis, including units.

4  Draw all data points on the graph using dots (or other small symbol).

5  Most of our lab graphs can be represented by straight lines. For these graphs use a straight edge to draw a best fit straight line.

5a  Most of these straight lines will have (0, 0) as an exact data point (no error). In this case, the best fit straight line should start exactly at the origin. Thus the straight line in the Appendix I graph is not completely correct.

6  For those that are not straight, start at the origin and draw a freehand best fit curve.

CORRECTED Procedure for Calculating Slope of a Straight Line

• Reference: Lab Manual Appendix II and Corrected graph on back of this page.

•• Do NOT use Data Points for Slope calculation. This Appendix correctly explains why.

•  This Appendix also correctly shows that the slope is defined as the ratio \( \Delta y/\Delta x \), but incorrectly illustrates its calculation with a figure that does not show the best choice of the two points used for the following reasons:

1  To minimize error in any ratio calculation, the 2 values should be as large as possible. With the graph shown, Volume = 50 and 250 would be a better choice.

2  Like most of the graphs in our experiments, this one should start at the origin. That means that the lower point chosen for the slope should be (0, 0).

   The slope is then very easily calculated as:

   \[
   \text{Slope} = \frac{(250-0)g}{(250-0)\text{cm}^3} = \frac{250g}{250\text{cm}^3} = 1.00 \frac{g}{\text{cm}^3}
   \]
   \[3 \text{ Significant Figures.}\]

CONTINUED
Use Highest Convenient Point

Use Lowest Convenient Point. \([0, 0]\) if it's a point.