Learning goals for the class and some specifics to achieve those goals

Revised Sept 17, 2003

1. Learn techniques of quantitative measurement
    a. Prepare before class:
    Read the lab manual
    Read the relevant sections of Taylor
    Do the homework
    Make an appointment with your TA if you don't understand something
    Quiz will test this preparation;
    b. Write your responses to "Questions for Discussion" in lab book before the experiment. You may discuss them with your lab partner beforehand
    c. Use good time management during class: be sure to do the important parts
        i. Write out a checklist before the lab of the measurements you need to do
        ii. Plan what tables you will need to make to organize your data
2. Keeping a **lab book**
    This is a blog of what you did during the lab. *Write the date on each page.*
    Write in pen—no pencils or erasers in lab
    Write legibly; it can't be graded if it can't be read
    Record original data measurements, with units
    Give the uncertainty for all measurements
    Give the **basis of estimate of uncertainty**
        (it might be bigger than the finest you can read the instrument!)
    Note significant decisions on procedure
    If you made a mistake, cross it out and say what you did wrong
3. Learning physics from the experiments by these steps
    In your lab notebook:
        Answer the Questions for Discussion
        Predict the outcome of each step before the measurement
        Refine the prediction by discussion with your lab partner
        Perform the experiment and record the outcome
    In your report:
        Compare the outcome with your expectation
        Say why your prediction was wrong, if necessary
4. Arrive at an understanding of random and systematic uncertainties.
    Estimate their magnitude
    Use them to estimate the uncertainty of calculated quantities
5. Analysis of results with Kaleidagraph and (to a lesser extent) Excel
    Calculate derived quantities from the original data and uncertainties
    Plot data with correct labeling and uncertainties
    The graph should have everything outlined in Exp0 (class info in upper right corner, a descriptive title, labeled axes with units, etc.) If you have two graphs of the same data, your titles should include something that distinguishes them from each other (i.e., a histogram of some quantity with 12 bins and another histogram of that same quantity with 16 bins)
    Check that your results make sense: smooth graphs; consistency in tables
    Find best fit lines and curves as needed
6. Testing for statistical consistency: learn to use formulae in Taylor
    a. Use uncertainties to compare two results (calculate the t value)
    b. Use uncertainties to compare a result with an expected value (calculate the t value)

Writing a good lab report

The goal is to clearly communicate your analysis and results

[h] = handwritten [p] = printout from Kgraph or excel [w] = Word, typically

In the upper right hand corner of the first page put:

Your name
Your partner's name
PHY191 section xxx (your section's number)
Experiment #

For each part of experiment, in the order given by the lab manual, your report should have

1. Formulae and sample calculation for each calculation type [h or w]
    a. In words, why did you choose this formula
    b. The sample calculation is required
2. Use summary tables to organize results (often, a spreadsheet) [p] or [w]
    a. Give a summary table for each part of lab
    b. Use an overall summary at the end if comparing results across parts

For example:

	δx(cm)	L(cm)	W(cm)	H(cm)	Mass(g)	V(cm^3)	Density g/cm^3	Material	Expected Density
Ruler	.1	1.5	2.0	1.3	100.0±.1	3.9±.4	2.5±.3	Aluminum	2.7
Caliper	.01	1.47	2.03	1.31	100.0±.1	3.92±.04	2.61±.07		

3. How did results differ from your predictions; why?
4. Staple in relevant pages from lab book [h] (see above)
5. Staple in graphs and tables of results [p]
    a. Give each a figure number in your descriptive text [h]
    b. Put the figures in order, with the relevant text

At the end, include the final discussion of the experiment

Answer the questions asked in the lab manual
Make quantitative compatibility comparisons where relevant
(for multiple measurements or experiment vs. theory)
What do you conclude based on the above comparisons?
What did you learn about physics from this lab? About procedure?
Do a critique of your group's performance:
what went well, what went wrong, why
Give the muddiest point(s) of the lab:
Give specifics! not "this was bogus" but "the readings didn't cover standard deviation but it was needed in part 4b"
suggest an improvement to the techniques, the lab manual, or Taylor

The report should be in this order. DO NOT make your grader hunt for things!

All the text doesn't have to be merged into a single word document, though that would be nice. But staple things in an order so the report can be read—figures should be near where they are referred to in the text.

A lab report missing critical elements may be returned for completion, or given a lower grade.