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PHY 121L: Elements of Physics I Lab Syllabus

Dr. Christensen

Fall '09 Term: T 8:30-11:30 S224

1 Policies

Late Work: Lab reports are due before I leave the office on Friday and lose **5 points per day** when turned in late. (Sat and Sun count as a single day.)

Office Hours: My office hours are posted on my office door. I am usually on campus between 8:00am and 5:00pm.

Attendance: Attendance is mandatory. If "something comes up," you must contact me (note, email, or voice mail) **before** the class in order for your absence to be excused. If you cannot contact me, then tell a friend to contact me that same day. I can be contacted via the information at the top of the page. YOU are responsible for my being informed. You will be allowed to make up one excused lab at the end of the term; additional excused labs will be dealt with on a case-by-case basis.

Goals of the Course: The primary goal of the lab is to provide you with the ability to derive equations from data measurements and linear regression analysis. The second goal of the course is to refine your written communication skills.

Disability Services: For those with a documented physical or learning disability, please see Jim Ross, Coordinator for Academic Student Support Services, Administration Building Rm. 3325, 344-3521.

2 Grading

There will be a lab final. It is worth 10% of the grade. Your lowest lab report will be dropped. Letter grades will be assigned as follows:

$$A \geq 90\% > B+ \geq 85\% > B \geq 80\% > C+ \geq 75\% > C \geq 70\% > D+ \geq 65\% > D \geq 60\% > F$$

Lab Notebooks and Reports: In lab, you will be learning with your hands. It is important to keep solid records of what you have done and why, of what not to do and why, of what you did wrong (so that you don't repeat it) and of what happened when you connected various components. It will be useful to refer back to this when you encounter future labs (or when you take the lab final).

You have some freedom to decide how to present your information (either all in your lab notebook or with a notebook and a separate report); however, you must organize it into the sections described below. These sections may be either in the notebook (hand-written or typed and taped in) or in the report.

Lab is on Tuesday; lab reports and notebooks are due Friday so that it can be graded and turned back in lab on the following Tuesday.

2.1 Notebooks and Reports

The audience for all parts[1] of the the lab write-up is a colleague in your class. Imagine that one of your friends has missed this lab. You should have enough information in it for them to read it and imagine doing the experiment themselves.

"Introduction" (5) Title, Author, Co-authors, Date of experiment. This is not a section and I do not want the word "Introduction" with this. This information should be at the very beginning of this portion of your notebook as well as heading your report (if you have a separate report).

Abstract (5) You will probably not have a clear sense of what to include in your abstract until after you have finished writing the analysis and conclusion of your lab. So leave room to include it at the very beginning of both your lab notebook and your report. The abstract should be a concise statement of what your data will allow you to prove or verify, include the results from which you will eventually base your conclusion. The audience (for this section only) is the professor, not the other students. Do not explain, merely state. The reader can read the rest of the report for detailed information. The abstract should not refer to the rest of the lab and the rest of the lab should not refer to the abstract.

Theory (15) Introduce the experiment by describing the underlying concept, then walk the reader through how

[1] . . . except the abstract

specific measurements allow you to calculate a result that will allow you to verify your hypothesis. You may need to explain, for example, what the spring constant means for Hooke's Law. The audience is a student in the class who missed this specific experiment, but attended the class up to this point. (This may seem slightly redundant with the abstract, but that's ok - the theory will explain the details that the abstract ignores.) Most of the information for this section will come from the pre-lab discussion, so take notes in your notebook and then later write out a coherent explanatory description of the concepts.

Focus on what you will do with the data, not how to make the measurement. This section will include an introduction to the variables used, an explanation of equations used during the calculation, as well as (and most importantly) a description of how any graph might enlighten the reader in the process of verifying your hypothesis (i.e., what does the slope mean? the intercept? what does the shape of the curve imply?)

Equipment (5) List of equipment. Your report should contain what items the reader would need to repeat the experiment, not the specific equipment identification of what you used. Your lab notebook, on the other hand, should include the specific detail of equipment identification. If you had not heard of some piece of equipment before this lab, then others probably would not recognize it either; draw a picture to give us a better idea. Sometimes it will be useful to draw a picture of how the equipment is set up. Use your best judgement.

Procedure (10) How would the reader make the necessary measurements? This should be sufficient for the reader to imagine the measurements, spiced with notes about problems they may encounter and where they should be careful or cautious.

Data (10) Excel Document organized for an at-a-glance summary of the journey from data-collection to useful result. Single page if possible. Label the data; use units and uncertainty. Display to appropriate sig.fig. Align the columns. Graphs will have a title and a label on each axis with variable name and units [such as: "velocity (m/s)"]. If one curve is graphed, then there is no legend. If multiple curves are graphed, then include a legend. Include an appropriate trendline with equation and R^2 on the graph. Do a linear regression. Calculate the propagation of uncertainty.

"Sample Calculations" (5) This is not a formal section; your report should not include sample calculations. Your lab notebook should have sufficient calculations that you can go back and figure out what you did to get your result. (Think of this as showing how Excel does its calculations.)

Analysis (15) This is not a summary of data. This is where you explain to the reader how your specific measurements provided your specific results. The theory told us what you expected to find; your analysis tells us what you actually found. Interpret the graph (slope and intercept with each uncertainty, R^2 value, p-value) and relate it to the expectations of the theory. Determine consistency with the uncertainty and validity by %-difference or %-error. If your graph is linear, interpret the regression analysis. Quantify your discussion by mentioning the data (values) that make your point.

Conclusion (10) Based on specific results discussed in the analysis, decide if your data verifies the hypothesis. State which specific results or aspects of the graph verify which specific portion of the hypothesis.

Clarity (10) This is not a section of the report; it is an overall impression regarding your ability to communicate the ideas of the lab. This grade will reflect spelling, grammar, coherence, clarity, and organization.

Lab Notebook (10) This is not a section of the report; it is an overall impression of how well I think you will be able to use the information in your notebook. I will skim over your pre-lab work; note if you took notes at the beginning of lab; and note your answers to the questions provided in the lab handout.

3 Schedule

You will be provided with a lab manual with all of the experiments. Please read through the experiment before coming to class.

8/25	Error Analysis
9/ 1	Statistics
9/ 8	Acceleration
9/15	Newton's Laws
9/22	Friction
9/29	Springs & Pendulums
10/ 6	Peer Review
10/13	Centripetal Force
10/20	Scaling Laws
10/29 – 11/ 3	Conservation of Energy
11/10	Ballistic Pendulum
11/17	Modeling the Human Forearm
11/24	Make-up Lab (T-giving)
12/ 1	Lab Final
12/ 8	(Finals Week)