Introductory Physics Lab Syllabus

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Attendance, Submission, and Grading

The course includes labs and recitations. Attendance of labs is mandatory. Missing more than two lab results in F for the whole Introductory Physics course. If you cannot attend the lab at your assigned time, go for a makeup. Labs are graded out of 10.

Attending recitations is optional. For any attended recitation, a student receives 10 points automatically. The average grade is computed as the total number of collected points divided by the number of labs and attended recitations.

Prepare your report using MS Word or similar text editor and upload it to Brightspace preferably as a PDF file. I create an Assignment for each lab where reports should be uploaded. Please, upload lab reports exactly where they belong. In the case of a misplaced or wrong upload, I will give you 0 points, after which you have to email me and I will ignore your attempt so that you can reupload and get a proper grade. Reports are due within one week. (If labs are held on Tuesday, reports must be uploaded until the end of next Monday). If you are unsure about your results, ask your instructor for help. Do not submit in time at the expense of correctness.

I also create Assignments for recitations for which I assign 10 points after which recitation session for the students who attended.

This class gives you maximum 20 points out of total 100 for the Introductory physics course. That is, your average score for labs and recitations will be multiplied by 2. Your grades will be sent to your lecturer who will give you the final grade (A, B, C, etc.)

How to succeed

1. **Attend** and complete all labs.
2. **Read the manual** *before* coming to the class. This will help you to understand the instructor's introduction and quickly start working.
3. **Listen to the instructor**'s introductions carefully. The manual is still far from perfect, and the instructor will show how to do better in the class. Make photos of this with your phones and use them in the preparation of the reports.
4. **Upload lab reports on time**
5. **Avoid plagiarism.** Although the experimental data are collected in teams, lab reports have to be written individually. If you are giving your report to another student for copying, you risk to be accused of plagiarism (see below).
6. **Report has to be well readable** for a general reader. Always look at what you are writing and try to assess if a reader (not the instructor!) is able to understand it.
7. **Don't lose points!**

a. To extract the slope of straight lines, always use plotting-fitting software. Never try to find the slope using only two data points – this is an illegal method that nobody is officially teaching.
b. Take care of the units – this is the main source of mistakes. In most cases, before substituting numerical values into the formula, convert them to SI: m, kg, s, etc. If there is a disagreement by a large factor, this is because of a unit error, not because of bad data.
c. Be critical to the results you obtain – always check if they are realistic and discard erroneous results. Never average good results with bad results – this will kill your good results. If you are unable to obtain correct results, contact your instructor before submitting the report to receive help. Do not show the attitude: "This is what it is and I don't care".

8. If you have **difficulties** in your life which make learning difficult, tell the instructor right away. Do not come up with this at the very end of the semester when you are failing.

How to write Lab Reports?

Lab reports should be typed in Microsoft Word (or a similar program), including tables and formulas (using the "Equation" menu under the "Insert" tab). Insert graphs generated by Excel (or a similar program) and photos of hand-drawn sketches etc. (if needed) into your report. Photocopies of parts of the manual (for instance, pages with filled data tables) are not accepted for reporting. However, copies of the data page signed by the student and by the instructor should be included at the end of the report as a proof of your participation.

Graphs must be computer generated. Create graphs using Microsoft Excel or another preferred computer program. Graphs should have a title, and each axis should be labeled with the unit indicated. Usually, data points on the graphs should not be connected by lines. If the slope of the graph has to be extracted, use the fitting function of Excel that finds the best straight line approximating the data with the least-square method. The fitting formula should be seen on the graph.

Proofread your reports before turning them in. When you are looking at your submission on the Blackboard, do the formulas look well or there are strange characters?

The structure of Lab Report approximately follows that of the Manual
To write a good report, read the detailed description of its structure below.

- **The name** of the student, and those of other students working in the same group, the name of the instructor, number of the lab, date, (clearly visible) weekday of lab classes.
- **Title** of the lab (in a large font).
- **Introduction**: General idea of the lab, planned experiments and comparisons, expected results, formulas to be used in calculations (very important!). Do not reproduce derivations and intermediate formulas from the manual. Do not include formulas non-specific for the particular experiment, such as the error formulas.
- **A brief description of the experimental setup** (do not copy everything from the manual). Here you can insert a photo of your setup or a sketch from the web.
- **Experimental data**: All raw data gathered during the experiment put into tables shown in the manual. In many cases, these tables can be extended to include the quantities you

calculate. This will improve the structure and readability of the report. Suggestions will be made by the instructor on the blackboard in the class. Make photos of them by your phones!

- **Calculations and Analysis**: As said above, it is usually advantageous to include some calculated values already in the data tables. Here, make remaining calculations in free form. Always start with a short sentence describing what you are doing and the formula you are using. Do not produce computational part that consists of mere numbers. At the end of every line of your calculation, put the appropriate unit. Include plots, if needed. Calculate percent deviations from the accepted values or percent discrepancy between the results of different experiments. In some cases, statistical uncertainties have to be calculated.
- **Conclusion**: Include the answer to the following main question: Do your results support the physical law being tested? As a rule, if the error, with respect to the accepted value, is within 10%, you can conclude that the expected results were obtained and the physics law was confirmed. If you are measuring the same quantity by different methods and there is no accepted value, use the percentage deviation between the results obtained by different methods. If the percentage error is higher than, say, 20%, it means that the experiment was not accurate enough and the physics law was not confirmed. Everything between 10% and 20% error is a gray zone. Whether the physics law was confirmed or not confirmed because of the experimental inaccuracies will not affect your grade. If the error is like 100%, it means there are blunders and you have to debug your calculations before submitting the report. If you submit your report with such grave mistakes, points will be taken off. If the errors are significant, you should name possible error sources. Do not give light-minded answers such as "there were human errors". Are there ways you could have improved your experimental results? Also, answer questions at the end of the lab description in the manual if there are such.

Additional suggestions:

- Writing a report is also an exercise in scientific writing. Try to write it vividly, engaging, accessible to general reader. Do not itemize your report according to the manual, such as "Question 1, Question 2", etc. If you do so, it makes an impression that you are not creative and you are doing your job mechanically.
- If two experiments are being done, say, A and B, than the best structure is: Data A, Calculations A, Data B, Calculations B. If you use the sequence usually suggested in the manual: Data A, Data B, Calculations A, Calculations B, the material is poorly organized, incoherent, and difficult to read.
- Accepted values are the values that you can find online or in books: physical constants, material parameters. However, the height of a holder in a college lab cannot be considered as an accepted value.

Plagiarism

Plagiarism includes, but is not limited to, copying all or even part of another student's lab report and copying from any text without properly quoting and citing your source. **Plagiarized work will result in a grade of zero for that lab.** In the case of work copied from another student, both

students' labs will receive a zero. Please, keep in mind, that, although all students in a team have the same experimental data, lab reports should be prepared independently. NEVER let other students copy your lab report, including computed numbers! You can find Lehman College's official statement on academic integrity in the 2013-2015 Undergraduate Bulletin or online at http://www.lehman.edu/undergraduate-bulletin/academicintegrity.htm.