Introduction to Ph101 Laboratory

In the 300 years since the time of Galileo and Newton physics courses have come to rely on a somewhat formal approach, in which the 'laws' of physics are presented like mathematical axioms and various results are obtained by logical deduction. This approach is convenient for compressing centuries of insight into 12 weeks of study. However, it de-emphasizes the fact that the 'laws' of physics are descriptions of behavior observed in nature.

Thus physics is an interpretation by people of their experience of the universe around them. If physics can claim to be an 'objective' description of nature it is because all who try can validate the 'laws' of physics by direct test, independent of their cultural background and other variables of human existence.

Ph101 Laboratory will give you the opportunity to explore various simple situations from which you can form your own assessment as to the validity of the 'laws' of physics. The emphasis is not on discovery of novel phenomena but on an understanding of the accuracy of the physics description of basic aspects of motion.

An important tool in this exploration is 'error analysis' which allows you to be quantitative as to the significance of your results, as well as advising you as to whether you have achieved results as accurate as can be expected with the instruments available.

The first laboratory is an introduction to measurement techniques, including error analysis. Labs 2 to 7 explore motion in various situations in which friction is minimized. As a contrast, Lab 8 explores fluid motion where frictional effects are prominent.

Location

The Ph101 Lab is held in room Palmer 201.

Lab Notebook

Please purchase a spiral bound, 5 × 5 quadrille ruled, 11″ × 8 1/2″ notebook at the University Bookstore (Ampad #WW-15, $2.79). Write your name, lab time and day of the week on the cover. Lab reports not in a notebook will be graded down 1 point out of 10.

Calculator

Please bring a calculator to Lab with you to assist in data analysis.

Lab Procedures

In laboratory research most of one's time is spent in building the apparatus and devising a procedure to conduct a desired measurement. Data collection and analysis are often relatively rapid. In Ph101 Lab you should complete each set of measurements and their analysis in a 3-hour period. To assist in keeping this schedule a set of equipment has been chosen for each lab and sample procedures are included *in slant type* in these notes. Computer commands are indicated in sans serif type.

A critical aspect of laboratory activity is making the equipment work – and revising the procedures if necessary to accomplish this.

Lab Partners

The Ph101 Laboratory has 16 setups of each experiment. Enrollment in each Lab section will be restricted to 48, or 3 people per setup. Most experiments require at least two people to operate the apparatus.

Lab partners will in many cases share data sets, but should not therefore expect identical lab grades.

Computers

The Ph101 labs have been revised to incorporate more extensive interfacing to computers as well as more options for data analysis via computers. Particularly for the data analysis there are numerous paths towards the common goal and you are encouraged to find your own. The Lab notes typically include a description of one such path, perhaps in more detail than necessary. If the challenge appeals to you, see how much of the Lab you can accomplish with minimal reference to the notes.

Whenever you have used the computer to collect a data file, Save the file to disk before processing it.

The Lab Report

You should complete your Lab report within the 3-hour Lab period. Do not take your Lab book home with you; rather, leave it in the designated storage area in Palmer 201.

Given the 3-hour time limit your Lab Report will more of a set of lab notes than a literary document. Do include:

1. The Lab title, the date and time, and the names of your lab partners.

2. Brief headings as to what measurements you are making. It is not necessary to transcribe procedure from these Lab notes, nor to copy figures. Do record any significant variations from the procedures suggested in the notes.

3. All measurements. If the computer recorded the data, Print a table of the data for your Lab notebook. When sharing data (and analyses) among your Lab group, each person should include a copy of the measurements (and analyses) in their book.

4. Data Analysis, including tables, graphs, spreadsheets and statistical summaries generated by hand or by computer.

5. A brief summary as to what has been accomplished.

Lab Grade

Each Lab will be graded on a basis of 10 points. The total grade for the eight Labs constitutes 10% of the Ph101 course grade.

A good Lab report includes not just computer printouts, but brief statements as to how the measurements were taken, estimates of the accuracy of the measurements, plus a brief interpretation of your analysis.