PHY 151/251-152/252
General Information for the Physics Laboratory

Purpose of the Laboratory

1. To experimentally verify relationships which were established theoretically in lecture.
2. To practice experimental methods commonly used in science.
3. To observe experimentally the relationships between physical quantities that are allowed to vary and their effect on other physical quantities.
4. To become familiar with specific techniques and pieces of equipment that may be essential for subsequent work.
5. To become familiar with the limitations imposed on the conclusions derived from experimental results due to the precision of the equipment.
6. To develop skills in keeping adequate and careful records and in the proper reporting of scientific research.

General Instructions

1. Do not try to perform the experiment until you understand what is to be done and how to do it. Failure to do so may damage equipment and/or yourself.
2. All experiments must be completed in the laboratory.
3. All calculations should be finished to ensure proper results.
4. You are not to leave the lab until your instructor has accepted your work.
5. When your experiment is finished, be sure that equipment is as you found it, or neater.
6. Lab reports are to be completed and turned in as directed by your instructor.

Experiment Write-Up

Lab reports must be typed. To make a complete report of your laboratory experiment, there are certain elements which are desirable, or even essential. Most write-ups should include the following items, though some experiments may not require all of the items. In every case, the order of items included should be as follows:

1. Name of experiment, your name, and date
2. Names of lab partners
3. Objectives: This is a brief statement about the purpose of the lab. It should answer the question: what physical theory are you attempting to experimentally verify?
4. Theory: Provide some background, including any laws and/or formulas involved with the physical theory under test.
5. Procedure: Discuss the steps involved in performing the experiment. (This can be combined with #6).
6. Data: Data is collected from the Procedure section of your lab instructions. In the lab report, you should present your data in a neat and orderly fashion (a table is a great way to do this). Include units for all data that is presented.
7. Results: Results are generated from the Calculations section of your lab instructions. All results and percentages of error must be presented. Construct tables and graphs when these are effective and clear ways to display results. Explain any large percentage errors or unusual results. If a calculation is complex, a sample calculation should be shown. It is not necessary to show every calculation, just the end result.
8. Questions: Answer any questions which may be asked as part of the instructions for that lab.

9. Conclusions: Give a brief summary of the conclusions that can be drawn from the experiment. **It must include how the theory discussed in the lecture was either supported or refuted experimentally**.
10. List of references

Grading of Lab Reports

Your performance in lab constitutes 20% of your final course grade. Lab reports will be graded on the basis of 20 points per lab, broken down as follows:

1. Report format, content, detail, neatness (5 points)
2. Data and Results accuracy and appropriate presentation, tables, graphs, etc. (8 points)
3. Answers to Questions (3 points) (if there are no Questions on the lab, these points are distributed among #'s 1,2, and 4)
4. Conclusions (4 points)

Late reports: No late lab reports will be accepted.

Labs are performed in groups of 2. **Lab reports, however, must represent your own individual effort. You and your lab partners will lose significant points if identical lab reports are turned in and may be subject to disciplinary action under University Policy 2.19.**

Data Tables

Experimental data needs to be presented in such a manner that is clear what the data represent and what factors control each datum value. This requirement is usually best achieved by showing the data in a table. A good data table is one for which a person mildly acquainted with the experiment can readily access the data at a glance, and put to immediate use if desired. The following criteria are usually accepted as those necessary for a good data table:

1. Each data table should be headed by a table number and a title (see illustration)
2. The table should be subdivided into columns. Each column should be labeled clearly, and the units in which the quantities are measured should be denoted in the heading of the column. One of the columns can be reserved for remarks, if needed.
3. The data table should be delineated; that is, columns will be separated from other columns by a straight line, boundary lines must be placed at the top, bottom, and sides of a table (see illustration).
4. If certain data are constants they may either be included in the table or by footnotes to the table.
5. Data tables should be neat and carefully laid out.
6. All data and result table and graphs must be properly numbered and titled with the names of the quantities listed or plotted.
7. Appropriate units should be indicated for all quantities.

Example: Table 1. Wheatstone Bridge Measurements of Resistance Coils

Sample No.	L_1 (cm)	L_2 (cm)	R (Ω)	X (Ω)	Remarks
1	86	14	18	2.93	
	82	18	18	3.95	See Note 1
	80	20	18	4.5	
2	78	22	18	5.1	See Note 1
	76	24	18	5.7	

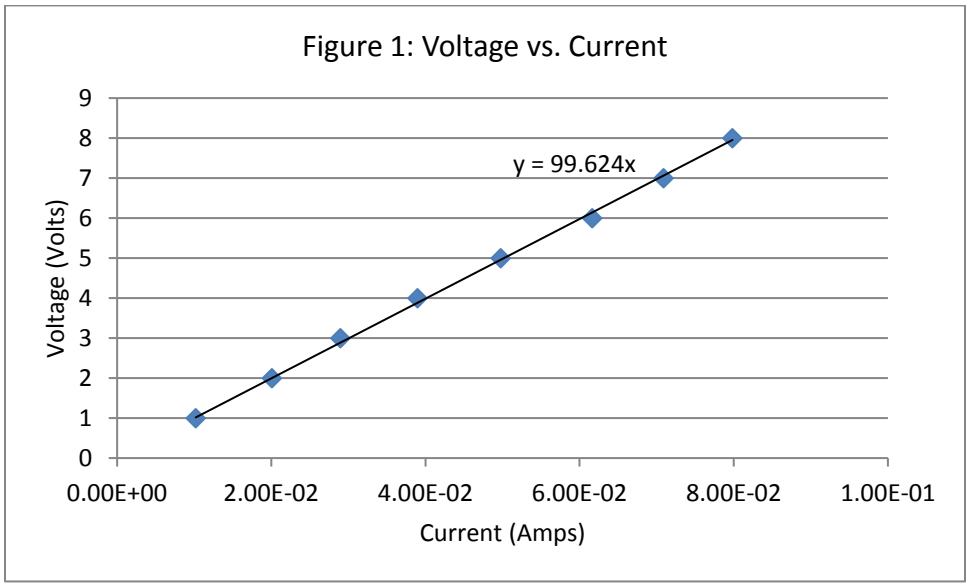
Note 1: Galvanometer shows considerable drift. Electrical contacts tightened.

Graphs

Graphs are a good way to show a range of data in a simple, easy-to-read manner. They allow even the casual reader to see facts about an experiment at a glance, such as trends, scatter of data points, or comparison to theoretical predictions. In order to best achieve these results, a graph should be constructed in a careful manner, with obedience to several features of construction. The following specifications and illustrations designate the usually accepted criteria for a good graph:

1. The graph should be given a figure number and a title. The graph should be included in the report at the appropriate place.
2. The graph should be constructed with an appropriate choice of scale. The scale on each coordinate should be chosen so that the graph nearly fills the space allotted to it. The same scale need not be used on both axes.
3. The axes of the graph should be clearly labeled with the quantity being plotted, the units of measure in parentheses, the scale divisions used, and enough numbers to establish the scale. Avoid cluttering.
4. Unless otherwise instructed, the independent variable (abscissa) should be plotted along the horizontal axis and the dependent variable (ordinate) along the vertical axis.
5. Experimental points are never connected. In some experiments, a smooth curve should be drawn through the plotted points. The curve need not pass exactly through all the points, but should be drawn in such a way as to fit the points as closely as possible; in general, as many points will be on one side of the curve as on the other. See the example graph. In other experiments, you will give a theoretical curve as a continuous line.
6. If a theoretical curve is calculated for the data, the values of the parameters should be shown on the graph and thoroughly discussed in the report.

Example:



Percent Difference and Percent Error

Sometimes scientists will want to compare their results with those of others, or with a theoretically derived prediction. Each of these types of comparisons call for a different type of analysis: percent difference and percent error, respectively.

Percent Difference: Applied when comparing two experimental quantities, E_1 and E_2, neither of which can be considered the "correct" value. The percent difference is the absolute value of the difference over the mean times 100%.

$$\%\,\text{Difference} = \frac{|E_1 - E_2|}{\frac{1}{2}(E_1 + E_2)} \bullet 100\%$$

Percent Error: Applied when comparing an experimental quantity, E, with a theoretical quantity, T, which is considered the "correct" value. The percent error is the absolute value of the difference divided by the "correct" value times 100%.

$$\%\,\text{Error} = \left|\frac{T - E}{T}\right| \bullet 100\%$$

Missed Labs

It is extremely important that you do not miss a lab experiment. However, if you do have to miss a lab, make prior arrangements with your lab instructor to make up the lab during another one of the lab sections meeting that week. **Without prior approval from the instructor, no lab can be made up by a student without a valid doctor's excuse or a valid excuse from the Mississippi College Office of Academic Affairs.**