Whitman College
Department of Physics

Physics 255: General Physics II Laboratory
Fall 2012

Contents

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Information

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Office Hours: T 10-11, T 1-4, by appointment or if my office door is open.

The Course Goals

- Conduct a variety of classical and modern physics experiments.
- Provide a laboratory experience to help understand classroom material.
- Become more independent researchers.
- Develop a system for keeping a useful laboratory notebook.
- Introduction to technical writing.

To achieve these goals, everyone will perform eight experiments over the course of the semester. Some of the experiments will take one lab session and some will require two lab sessions to complete. The longer experiments are usually more free form and slightly more complex. There are two sections of this class, so expect that someone else will use the equipment before your second session. Also plan to have all of your work with the equipment done in the scheduled time periods; it will be hard to find time outside of class when you can use the equipment.

To help you become a more independent researcher, several of the experiments require you to design your own experiments. The lab packets contain some helpful information and suggestions, but you will need to determine the experimental procedure you pursue to complete the experiments. **You are expected to have read the labs before coming to class. I reserve the right to implement a pre-lab test if I sense you are not coming to lab prepared to begin work.** In particular, the experiments scheduled for one week will require you to be rather efficient at getting the experiment working. The two week experiments allow some more time for you to play with equipment before devising a specific experimental protocol.

Lab notebook – (Grid paper preferred)

Due after lab the week after you complete the experiment along with a typed summary of your results and analysis.
You should think of your laboratory notebook as a diary of your life in the lab. In addition to being a place to record data, your notebook should also contain your predictions about what you expect to observe, any observations about the experimental procedure that might need modification, and any ideas you have about the analysis of the measurements. **When you are writing in your lab notebook, assume that another person will be attempting to repeat your experiments with just your notebook as a guide**. To that end, your notebook should provide sufficient information and detail about the experiments, and it should be organized (and legible)

enough for the other person to follow your experiments. When you go back to analyze or debug experiments, your life will be much easier if you have written everything down clearly. In an active research laboratory, notebooks are read and signed by witnesses regularly, especially when working for a company. The notebook is crucial information when dealing with issues like patents and determining who made a discovery first.

What must be in your notebook: **Use an ink pen.**

1. **Plan:** Start each day with a summary of what you intend do accomplish experimentally. Your plan should lead to predictions since your measurement approach should have the expected result in mind. **Your prediction doesn't need to be correct; however, it will reflect your present understanding of the concepts important for the experiment.** If your observations differ from your predictions, then you need to assess whether the experimental procedure or your understanding is flawed.
2. **Data – Plot or Record:** Describe each distinct measurement you attempt. Keep data in a table if you are reading values from a meter of some sort. Data should be presented in graphical form whenever possible. Printed graphs and pictures should be a part of your lab summary (see below). We will use the line fitting option in DataStudio to obtain fits to data with uncertainty values for the parameters.
3. **Analyze:** Compare your data to theoretical models when appropriate. Your data needs to be analyzed so that you can draw some conclusions about your measurement. You don't have to derive all of the equations you use but you should **reference** the books or papers you consult for analyzing your work. **Include error analysis.**
4. **Typed summary:** This document should be one or two pages that pulls together the analysis of your data and your assessment of that analysis in light of the relevant theory. Think of this summary like a brief report you might submit to an experiment supervisor who would need to keep up with your progress after a day in the laboratory. Writeups should be double-spaced.

Uncertainty

You will be required to estimate experimental uncertainty when designing your protocols and taking data, as well as propagating the uncertainty through your calculations. Including your uncertainty in your lab report is essential.

Grading

Grading will be done with the rubrics below as guidelines. There are seven different areas I will look at, three from the lab notebook and four from the written summaries. Each week, I will evaluate and give you comments in all seven areas. Early in the semester your grade will be determined mainly from the first few areas. The written summaries will become more important for your grade later in the semester after you have received comments and know more about what I am expecting. See the schedule on page 6 for how this will be phased in. In order to pass the class, you must turn in a lab report for each of the eight experiments.

Lab Notebook

	A Exemplary	**A-/B+ Very good**	**B,B- Good**
Lab Notebook			
1. Plan (6 points)	• Overall question clearly stated • Detail sufficient to reproduce experiment • Includes predictions	• Overall question clearly stated but lacks detail or predictions	• Clearly stated but lacks detail and/or predictions
2.Data/Results (8 Points)	• Adequate sampling • Well executed with good data • Presentation is easy to follow • Graphs labeled; units and uncertainties (where appropriate) are given for all values • Formulas from excel spreadsheets written in symbolic form • Includes some qualitative observations – e.g. assessment of data quality, potential improvements • Strong participation in designing and executing the experiment	• Adequate sampling • Well executed; minor data issues • Good presentation • Minor problems with graphs and/or units & uncertainties • Formulas from excel spreadsheets written in symbolic form • Includes some qualitative observations – e.g. assessment of data quality, potential improvements	• Adequate to minimal sampling • Good execution with reasonable results • Good presentation • Some problems with graphs and/or units & uncertainties • Harder to decipher excel spreadsheets and tables • No qualitative assessment of the data.
3. Analysis (10 points)	• Easy to follow • Error propagation complete and in symbolic form • Comparison made to expected values (where appropriate)	• Error propagation completed for major results.	• Error info is collected – some analysis indicated.
Written Summary			
4. Writing (8 points)	• Well written with precise language and no use of colloquialisms. Reads easily.	• Occasional use of colloquial language or value judgments.	• Good writing but with some colloquial language and/or value judgments. Some grammatical and spelling errors.
5. Analysis (5 Points)	• Data fully assessed in terms of physical principles.	• Most results are related to physical principles.	• Little effort to handle data outside of expectations
6. Conclusions (5 Points)	• Supported by data – show extension of the data to subtle points.	• Supported by data – superficial report of basic results	• Conclusions not always connected to the data.
7.Evidence of Learning (5 Points)	Connections made to physical principles. Careful Assessment of what went well and what didn't.	Results are compared to expectations.	Basic presentation of results. Little effort to discuss data.

	C+,C OK	<C- Not OK!
Lab Notebook		
Plan 6 points	• Stated without detail or predictions	• Poorly stated
Data/Results 8 Points	• Minimal sampling • Not all data collection completed • Presentation harder to follow • Graphs,tables not clearly labeled; uncertainties not given. • Spreadsheets give with data but without symbolic form • No qualitative assessment of data	• Poor sampling/absent data • Poor data quality/ improper measurement. • Graphs,tables unlabeled • No qualitative assessment of data • Little participation in designing and executing the experiment
Analysis 10 points	• Data errors not analyzed	• None indicated
Written Summary		
Writing 8 Points	• Extensive use of colloquial language; choppy flow.	• Grammatical errors. Incomplete sentences. Poor flow.
Analysis: content 5 Points	• Comments limited to reporting data.	
Conclusions 5 Points	• Focus on results: make data fit to "right" answer.	• Little or no effort to state a result. .
Evidence of Learning 5 Points	Little effort to connect results to physics principles.	• Poorly written. Just a report on results with no assessment of validity or suggestions for improvements.

Absences – You are responsible for making up missed work. If you know of an upcoming time conflict with lab make arrangements with your partner(s) to set up a separate time for your group to perform the experiment. If you are ill, check in at the health clinic so there is a paper trail of your health status.

Physics 255 Schedule • Fall 2012 [1]

			Lab Group					
Date	**Week**	**Cycle**	**1**	**2**	**3**	**4**	**5**	**6**
Sep 3	1	1	Error Prop	Error Prop	Error Prop	Error Prop	Error Prop	Error Prop
Sep 10	2	1	Abs Zero	Abs Zero	Abs Zero	Abs Zero	Abs Zero	Abs Zero
Sep 17	3	1	Specific Heat	Specific Heat	Specific Heat	Specific Heat	Specific Heat	Specific Heat
Sep 24	4		No Lab - Specific Heat Lab Due on Tuesday in Class					
Oct 1	5	2	Index	Index	PE[2]	Stefan's[2]	Diffraction	Diffraction
Oct 8			No Lab – Fall Break					
Oct 15	6	2	Index	Index	Stefan's[2]	PE[2]	Diffraction	Diffraction
Oct 22	7	2	PE[2]	Stefan's[2]	Diffraction	Diffraction	Index	Index
Oct 29	8	2	Stefan's[2]	PE[2]	Diffraction	Diffraction	Index	Index
Nov 5	9	2	Diffraction	Diffraction	Index	Index	PE[2]	Stefan's[2]
Nov 12	10	2	Diffraction	Diffraction	Index	Index	Stefan's[2]	PE[2]
Nov 19	No Lab – Thanksgiving Break							
Nov 26	11	3	TBA	TBA	TBA	TBA	TBA	TBA
Dec 3	12	3	TBA	TBA	TBA	TBA	TBA	TBA

Group	**Monday**	**Tuesday**
1		
2		
3		
4		
5		
6		

[1]Lab notebooks (with summaries) due in lab on the week after the lab is completed.
[2]Stefan's Law & PE (Photoelectric Effect) will be turned in as a single lab writeup.

Weighting Scheme for Grading

Week	Notebook Weight	Summary Weight
1	1	-
2	0.8	0.2
3	0.8	0.2
5-6	0.7	0.3
7-8	0.6	0.4
9-10	0.5	0.5
11-12	0.5	0.5