Derryfield Science Department
AT Physics Lab Manual

compiled and written by
Jeffrey Cousineau

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PREFACE

This lab manual is the compilation of various labs from a variety of sources, both published physics laboratory manuals and some written by Mr. Cousineau, that are performed in the Physics class at The Derryfield School. The purpose for writing the lab manual is to bring together all of the activities and labs that are performed in the classroom and have the instructions match the equipment available to the Derryfield students. The labs and activities were gathered from the following sources and personal experiences:

I. "Physics with Calculators"
by John Gastineau, Clarance Bakken, Richard Sorensen and David Venier
Copyright © 2000
Vernier Software and Techology

II. PASCO Equipment
Various lab experiments written for PASCO equipment

III. "PSSC PHYSICS PROGRAM: Physics: Laboratory Guide"
by Uri Haber-Schaim, John Dodge and James Walter
Copyright © 1986
DC Heath and Company Publisher

IV. "Lab Guide – AP©_Physics"
by the College Entrance Examination Board
Copyright © 2003

LAB REPORT DESCRIPTION AND DEFINITIONS

Students will be expected to write several lab reports throughout the year. The length and complexity of each report will vary based on the demand of the experiment being conducted. Lab reports will be categorized in the following levels:

I. LEVEL 1 REPORT

Level 1 reports are typically used for class activities. For level 1 reports, students will simply answer the questions posed in the activity. This can include, but not limited to, sketches of generated graphs, mathematical work and answering questions. In some instances, a single report can be submitted for the lab group.

II. LEVEL 2 REPORT

a. Preliminary Questions and Prelab Calculations
b. Data and Graphs
c. Sample Calculations
d. Conclusions and Answer Questions

III. LEVEL 3 REPORT

a. Problem Statement
b. Preliminary Questions and Prelab Calculations
c. Data and Graphs
d. Sample Calculations
e. Conclusions and Answer Questions

IV. LEVEL 4 REPORT

a. Problem Statement
b. Preliminary Questions and Prelab Calculations
c. Procedure
d. Data and Graphs
e. Sample Calculations
f. Conclusions and Answer Questions

The lab report level will be indicated on the lab sheet in the expectations section.

LAB REPORT SECTION DEFINITIONS

Listed below are definitions of the sections in a lab report. Which parts will be required in a given report is defined by the type or level of report that is required. Refer to the lab report for the level rating.

I. Problem Statement
A sentence stating what the purpose of the lab is. The sentence must also include reference to the expected outcome, as decided prior to conducting the lab.

II. Preliminary Questions and Prelab Calculations
Some labs will have prelab work (*questions and/or calculations*) that the students must complete prior to conducting the lab. This should be exactly what you wrote or calculated prior to conducting the lab.

REMEMBER: It is very likely the answers to the questions will have incorrect answers. The only wrong answer is no answer given.

III. Procedure
For most labs, this will not be necessary, as the procedure will be given to you. However, for those labs where the students determine the procedure, it will be necessary to include a documentation of what was done to collect the data.

IV. Data and Graphs
This section lists and details all information collected and calculated during the lab.

Data Tables
Numbers and general data must be listed in a data table. The data table must have a title, column labels with listed units.

Graphs
CBL graphs viewed and used during the lab must be included in the lab. These reproductions will be simple sketches, but they must include titles and axis have labels and units.

Generated graphs from collected data must be created using excel spreadsheet. A procedure page for generating computer graphs will be supplied. These graphs must have titles and axis labeled with units.

V. Sample Calculations
A sample calculation, including equation and example data, must be included for all calculated values. Neatness is critical to this portion of the lab.

VI. Conclusions and Answers to the Questions
Answer the questions listed on the lab. The answers can be in bullet form, but the answers must be in completed sentences. Quality answers will include the “why” of how you know the answer and cite experiment data when applicable.

The following page is the grading rubric for lab reports. Each section is listed in the rubric.

SECTIONS FOR ANALYSIS	D Needs More Work	C Nearing Standard	B Good Work and meets standard	A Excellent work and exceeds standards
Problem Statement	• Overly simplistic • Fails to address the goal of the lab. • Does not include the expected outcome.	• Reflects an attempt to address the goal of the lab. • Expected outcome too vague.	• Clear and concise statement about the lab' s goal. • Expected outcome is specific.	• Clear and concise statement about the lab' s goal. • Expected outcome is specific and incorporates a deep understanding.
Preliminary Work	• Incomplete sentences • Overly simplistic answers. No real thought put into answers. • Math work messy and incomplete.	• Reflects an attempt to answer the questions. • Math work is complete but lacks proper format.	• Reflects a thoughtful answer to the question. • Math work is complete and properly formatted.	• Reflects a thoughtful answer to the question. • Math work is complete and properly formatted.
Procedure	• Illogical order. • Missing information. • Missing steps.	• Confusing directions. • Jumbled and nonsensical • Too much information	• Coherent and concise. • No pronouns • Too much detail.	• Coherent and concise. • No pronouns • Logical order.
Results, D.Tables and Graphs	• Data incomplete, insignificant or incorrect (high % error). • Tables and figures missing. • Lacks logical order. • Tables and graphs missing titles, labels, and/or units. • Unit-less numbers. • Graphs not generated by computer or not on graph paper. • Poor significant numbers.	• Data incmplete or significant. • Not all data properly formatted and displayed. • Tables and figures display trends in data. • Lacks logical order. • Unit-less numbers. • Poor significant figures.	• Data is complete and properly formatted and displayed. • Tables and figures display trends. • Logical order of data. • Graphs and tables with titles, labels and units. • Trend lines shown.	• Data is complete, properly formatted and displayed. • Tables, figures display trends. • Logical order of data. • Graphs and tables with titles, labels and units. • Trend lines shown. • Tables and figures are an important piece of lab and used as evidence.
Sample Calculations	• Not included or incomplete. • Not properly formatted with equation and units.	• Missing a few calculations. • Not properly formatted with equations and units.	• All calculations included. • Properly formatted with equations and units.	• All calculations included. • Properly formatted with equations and units.
Discussion and Questions	• Missing section or questions. • Failed to answer question. • Poor writing or grammar. • Significant conceptual errors and misunderstanding.	• Answered all the questions but failed to include proof or evidence for answer. • Had some conceptual errors or misunderstanding.	• Answered all the questions and included some evidence for the answer. • Displayed good conceptual understanding of the material.	• Answered all the questions and included some evidence for the answer. • Displayed strong conceptual understanding of the material.
Feedback	Fails to respond to feedback.	Begins to address problems witnessed in other labs.	Uses teacher feedback to revise content, strengthen argument.	Revises beyond teacher suggestions; Rethinks work and answers.

COMMENTS ON COLLABORATIVE AND INDIVIDUAL WORK

The very nature of a laboratory experiment is community work. However, there is point in the crafting and writing of the report that the work moves from collaborative to individual effort. Listed below is a general guideline to the lab writing process:

Collaborative Work
The collaborative portion of the lab occurs during the data collection and interpretation of the data. Lab partners are encouraged to discuss and critique their data. Lab partners can even discuss the possible conclusions that can be drawn from the data, graphs and solved values. The discussion between individuals can be held at any time.

Individual Work
After the data has been collected and discussed, it is expected that each student transposes and/or translates the lab group's conclusions into their own words. Student must not read or view each other's rough draft or final written conclusions.

Everything appearing in the lab must be generated and/or created by the student; this includes data tables, graphs, sample calculations and answers to questions. No part of a lab can be a duplication (by hand or machine) of someone else's work.

COMMON PITFALLS
Here are a few common trouble spots that seem to trip up students:

- Data Table and Graphs: The process of organizing, formatting and creating a data tables and graphs is a critical skill that each person must master on their own. It is tempting to copy or print a second copy. Either case is cheating.
  Solution: *Transcribe all data when the lab was performed. Seeking data at a later date leads to trouble. If you have trouble creating a graph, see Mr. C.*

- Writing Conclusions and Answers to Questions: Reading over or sharing a finished lab (even a lab from previous years) is cheating. It is also cheating for lab partners to work together during the writing process. It is expected that each student crafts their own answers to the questions on their own and in their own words.
  Solution*: When it comes time to write your lab, make sure you understand your lab results and how they apply to the questions. It is OK to talk with your lab partner about the results and the themes associated with the questions. However, you must not ask for specifics on how to answer the question. If you have further questions, meet with Mr. C during the writing process to discuss your answers. Consider meetings with Mr. C similar to writing conferences in Composition class.*

- Deadlines: Waiting till the night before the lab is due is always a bad idea and leads to further bad choices, some of which are listed above. Students must realize that it is not possible to write a quality lab the night before it is due.
  Solution*: Start the writing process earlier, even the first night the lab is completed. Review the results with your partner and meet with Mr. C to review your conclusions.*