A GUIDE TO LABORATORY REPORT WRITING

This note describes a general format to prepare and present a laboratory report for the Experiential Physics Laboratory courses in the Department of Engineering Physics.

Two example reports which may be template for the rules given here and a lecture notes on experimental errors and error propagation can be found at:
http://www1.gantep.edu.tr/~physics/eplab/

Paper form:

Size of paper should be A4.

- Margin should be 3.0 cm on the left side of each sheet and 2 cm at the top, right side and bottom.
- Font size should be in readable form or “12 type size-Times New Romans” for computer print out.
- Each page should be numbered and use one side of sheet.
- Report folder is optional (use of a metal binder clip or a plastic cover sheet).

Submission:

Reports must be submitted on time in order to receive full credit. Neither heavy assignments or exams in other classes nor unavailability of your partners will qualify you for an extension. (Exceptions will be made for demonstrated illness or religious holidays.) You may submit your reports earlier than the deadlines. The report should be presented by a team member (and also other members should know that the report is submitted on time!!!) to the instructor. To avoid a penalty for lateness (Lateness penalty may be different from Lecture to Lecture for each report whatever the lateness day), you can submit reports under the door of instructor's room but no later than 5 pm on the due date.

Structure of Main Body for Reports

Laboratory reports may be classified according to whether they are complete reports on a project, short reports on one or more tests, or short reports on one or more techniques. The structure of laboratory reports has evolved to serve the needs of the varied readership described in the previous section.

The laboratory report should always be written for the convenience of the reader. Thus, for example, each section of the report should be headlined and the sections should be arranged in an appropriate, easily-understood sequence. In the context of the course for which it is written, the laboratory report serves to describe what you did during the laboratory session, how you manipulated the raw data, and what you conclude as a result.

While it may seem logical to you to write a report in a chronological or historical sequence, such an approach is not the most useful for your readers, who would find such a
report difficult to scan for the items of interest. Think of the document as a performance
document, i.e., proof that you understand what you did and that you can apply it in practical
situations.

By the time you graduate from the Department, you are expected to understand the
format for a full report as well as some of the variations that are appropriate in different
contexts. The reports described above typically contain many different sections. The sections
required to complete your Physics lab reports should be written in the order listed below:

1. Title Page
2. Statement of Objective (The objective of the experiment must be stated clearly.)
3. Theory
4. Apparatus/List of Equipment Used (Give the full name of the equipments.)
5. Procedure (What you did/measured/observed in the experiment.)
6. Data (Numerical values you have measured/taken in the measurement)
7. Analysis of Data (What numerical values mean to you)
8. Discussion of Results
9. Conclusions
10. References
11. Appendix (If necessary)

The content of each of the sections in a laboratory report is described in the following: Most
of the descriptions are general enough to be valid for all reports. A few are related to the fact
that these reports are being prepared for a laboratory course at the Department.

1. Title page

The following information should appear on the title page:

• A brief but informative title that describes the report
• Your name
• Date(s) the experiment was performed
• Date the report was due
• Names of other group members who were present for the experiments
• Laboratory section number
• Name of the Teaching Assistant
2. Statement of Objective

State the objective(s) of the experiment concisely, in paragraph form. The laboratory manual or instruction sheet will help here. The fact that experiments in laboratory courses are being used to educate students is a secondary objective, and should not be stated in the report. In other words, the objective written in your report should never be to “familiarize students with the use of equipment.” Rather, the objective should state the problem that your procedure and data attempts to answer. Some key verbs that you will use in the objective might include “to investigate,” “to plot,” “to measure,” or “to compare.” The section should inform the reader precisely why the project was undertaken.

3. Theory

A concise description of the relevant theory should be provided when the theory is needed to understand other parts of the report, such as the data analysis or discussion sections. This section is sometimes combined with the introduction and background section, if this results in a more readable report. The relevant equations should be introduced and all the terms to be used in the report should be defined. Equations must be presented as parts of complete sentences. You will find examples of this later in this guide.

4. Description of Experimental Setup / List of Equipment Used

Provide a neat, correct and clear schematic drawing of the experimental set-up, showing all the interconnections and interrelationships. Include a short textual description that refers to all parts of the schematic drawing. This section should have all the information needed for a reader to duplicate the setup independently. List all the equipment and materials used in the experiment. Include identifying marks (usually serial numbers) of all equipment. This is a safeguard that allows you to trace faulty equipment at a later date, if necessary. The reader must be able to connect each item in this section to the item in the Description of Experimental Setup section.

5. Procedure

Detail the procedure used to carry out the experiment step-by-step. Sufficient information should be provided to allow the reader to repeat the experiment in an identical manner. Special procedures used to ensure specific experimental conditions, or to maintain a desired accuracy in the information obtained should be described. As with all sections of the report, the procedure describes what was done in the lab and should, therefore, be written in the past tense. Copying the procedure from a lab manual would be an inaccurate reflection of the work completed in the lab and is not acceptable.
6. Data

All the pertinent raw data obtained during the experiment are presented in this section. This section should contain only raw information, not results from manipulation of data. If the latter need to be included in the same table as the raw data in the interests of space or presentation style, the raw data should be identified clearly as such. The type of data will vary according to the individual experiment and can include numbers, sketches, images, photographs, etc. All numerical data should be tabulated carefully. Each table, figure and graph in the report must have a caption or label and a number that is referenced in the written text. Variables tabulated or plotted should be clearly identified by a symbol or name. Units, if any, should always be clearly noted.

7. Analysis of Data

This section describes in textual form how the formulaic manipulation of the data was carried out and gives the equations and procedures used. If more than one equation is used, all equations must carry sequential identifying numbers that can be referenced elsewhere in the text. The final results of the data analysis are reported in this section, using figures, graphs, tables or other convenient forms. The end result of the data analysis should be information, usually in the form of tables, charts, graphs or other figures that can be used to discuss the outcome of the experiment or project. This section must include statements about the accuracy of the data, supported where necessary by an error analysis. Sample calculations, details of calculations, and error analyses should also be included.

8. Discussion of Results

This is the most important single item in the report. In this section the student should show how the results bear out the conclusions and fulfill the objective. She/he should also compare her/his results with theoretical predictions and with the results of other comparable experiments, where possible, in order to verify them. Anomalies and discrepancies should be explored and explained in physical and mathematical terms. The explanations should be keyed to the results section by referring to the Figures and Tables by number. This section should answer the question “What do the data tell me?” Describe any logical projections from the outcome, for instance, the need to repeat the experiments or to measure certain variables differently. Assess the quality and accuracy of your procedure. Compare your results with expected behavior, if such a comparison is useful or necessary, and explain any unexpected behavior.

9. Conclusions

This section includes what students have learned in the experiment and what their comments on the experiment’s results are. Using your calculations, base all conclusions on your actual results. Explain the meaning of the experiment and the implications of your results. Examine
the outcome in the light of the stated objectives. This section should answer the question “So what?” Seek to make conclusions in a broader context in the light of the results.

10. References

Using standard bibliographic format, cite all the published sources you consulted during the conduct of the experiment and the preparation of your laboratory report. List the author(s), title of paper or book, name of journal, or publisher as appropriate, page number(s) if appropriate and the date. If a source is included in the list of references, it must also be referred to at the appropriate place(s) in the report. References that are not actually used should not be included, and all references should be keyed to the text in the following way [1,2,3,5-8] using a numbered reference list.

11. Appendix

Details of analysis, computations, etc. that were referenced in the main body of the report should be included in the appendix. If the appendix contains more than one item, each one is designated by a specific letter (Appendix A, Appendix B, etc.) and listed in the table of contents. Thus, report ends with supplementary materials that include the following;

Appendix A: Data Sheet,

Appendix B: Figures & Tables (if not given in the main text.)

FORMATTING and LANGUAGE

1. Tables, Graphs and Equations

All tables, graphs and equations should be introduced by a sentence of explanation. They should also have an explanatory label. The labels should be executed using the same formatting and numbered sequentially throughout the report. Units and variables must always be identified (see sample lab report). Don't expect figures or equations to serve where sentences and paragraphs are needed. Visual and verbal descriptions must always go together. There are two reasons for this coupling: first, it assures that the information contained in the report is clear; second, it allows the author of the report to take credit for interpreting the significance of the data. Good reports will demonstrate to readers that the author is more than just a technician plugging numbers.
i) Presentation of Table

**Table Number**

Table 1. Experimental Value of wavelengths for different diffraction angles and its Error%.

<table>
<thead>
<tr>
<th>Diffraction Angle (θ, degree)</th>
<th>Experimental Wavelength (λ, nm)</th>
<th>Known Wavelength (λ, nm)</th>
<th>Percent Error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.0</td>
<td>403.2</td>
<td>410.2</td>
<td>1.70</td>
</tr>
<tr>
<td>15.5</td>
<td>445.4</td>
<td>434.0</td>
<td>2.60</td>
</tr>
<tr>
<td>17.1</td>
<td>490.1</td>
<td>486.1</td>
<td>0.80</td>
</tr>
<tr>
<td>23.4</td>
<td>661.9</td>
<td>656.3</td>
<td>0.85</td>
</tr>
</tbody>
</table>

ii) Presentation of Figure

**Figure 1.** S-wave phase-shifts for the potentials $V_{DEEP}$, $V_{nonSUSY-PEP}$ and $V_{SUSY-PEP}$. 

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2. Verb Tense
Reports should be written in the past tense in an impersonal style.

NO: The TA set up the equipment before we began the experiment.
YES: The equipment was set up before the experiment was begun.

NO: We calculated distance using the data from table 2.
YES: Distance was calculated using the data from table 2.

3. Objective
The “objective” of the lab is RARELY, IF EVER, to learn how to use a piece of equipment (It is true that there may be some exceptional experiments). Use action verbs such as “investigate”, “determine”, “measure”, or “plot” in stating your objective.

4. Equations
Equations should be embedded in the text of report and formatted using the “Equation Editor” tool on your word processor, as in the following example:

\[ T = 2\pi\sqrt{L/g} \]

Using the results listed in Table 1, a percentage error was calculated for each set of readings taken by the same instrument. Equation 1 was used to calculate this percentage error.

It is extremely important to define all variables used although it is necessary to define a variable only one time in the report (i.e., if \( \lambda_1 \) is defined in Equation 1, it is not necessary to define it again in Equation 2, 3, 4, etc.). The equations should be numbered sequentially throughout the report.

5. Section Headings
Use separate headings for each section. The headings should be in bold type. The format used for the headings should be consistent throughout the report. Allow space between sections.

6. Language
As you edit your report, delete unnecessary words, rewrite unclear phrases and clean up grammatical errors.

7. Note on Plagiarism
Experiments are usually carried out by groups of students. It is therefore expected that each member of a group has followed an identical procedure in the laboratory and has the same set of data. Members of a group are also encouraged to discuss the analysis of data with one another. However, preparation of the report and the discussion and interpretation of the results contained therein must be the sole effort of the individual student submitting the report.
References

[1]. “Experiments in Nuclear Physics” B. Gonul, M. Yılmaz, O. Ozer and I. Zorba


[3]. “Writing Lab Reports and Scientific Papers”,
http://www.mhhe.com/biosci/genbio/maderinquiry/writing.html