Title of the report

Author 1[*], Author 2[†], ...,Author N[‡]

Equipo X, Grupo X. Fluidos, Ondas y Temperatura.
División de Ciencias e Ingenierías, Universidad de Guanajuato
A.P. E-143, C.P. 37150, León, Guanajuato, México.

May 14, 2018

Abstract

The abstract should be written concisely in normal rather than highly abbreviated English. The author should assume that the reader has some knowledge of the subject but has not read the paper. Thus, the abstract should be intelligible and complete in itself; particularly it should not cite figures, tables, or sections of the paper. The opening sentence or two should, in general, indicate the subjects dealt with in the paper and should state the objectives of the investigation. It is also desirable to describe the treatment by one or more such terms as brief, exhaustive, theoretical, experimental, and so forth.

The body of the abstract should indicate newly observed facts and the conclusions of the experiment or argument discussed in the paper. It should contain new numerical data presented in the paper if space permits; otherwise, attention should be drawn to the nature of such data. In the case of experimental results, the abstract should indicate the methods used in obtaining them; for new methods the basic principle, range of operation, and degree of accuracy should be given. The abstract should be typed as one paragraph. Its optimum length will vary somewhat with the nature and extent of the paper, but it should not exceed 200 words.

1 Introduction

The "Introduction" of a laboratory report identifies the experiment to be undertaken, the objectives of the experiment, the importance of the experiment, and overall background for understanding the experiment. The objectives of the experiment are important to state because these objectives are usually analyzed in the conclusion to determine whether the experiment succeeded. The background often includes theoretical predictions for what the results should be.

2 Procedures

The "Procedures," often called the "Methods," discusses how the experiment occurred. Documenting the procedures of your laboratory experiment is important not only so that others can repeat your results but also so that you can replicate the work later, if the need arises. Historically, laboratory procedures have been written as first-person narratives as opposed to second-person sets of instructions. Because your audience expects you to write the procedures as a narrative, you should do so.

Achieving a proper depth in laboratory procedures is challenging. In general, you should give the audience enough information that they could replicate your results. For that reason, you should include those details that affect the outcome. Consider as an example the procedure for using a manometer and strain indicator to find the static calibration of a pressure transducer. Because calibrations are considered standard, you can assume that your audience will have access to many details such as possible arrangements of the valves and tubes. What you would want to include,

[*]email:author1@server.edu
[†]email:author2@server.edu
[‡]email:authorn@server.edu.

then, would be those details that might cause your results to differ from those of your audience. Such details would include the model number of the pressure transducer and the pressure range for which you calibrated the transducer. Should you have any anomalies, such as unusual ambient temperature, during your measurements, you would want to include those.

When the procedure is not standard, the audience would expect more detail including theoretical justification for the steps. Given below is such a procedure–this one for an experiment devised to determine whether the frictional torque associated with a multi-turn film potentiometer is strictly the Coulomb friction between the slider and the film [Counts, 1999].

The test performed on the potentiometer was accomplished by winding a string around the potentiometer shaft, attaching a mass to the string, and letting the mass fall. The change in resistance of the potentiometer with time indicated the acceleration of the mass. In this experiment it was assumed that the constant Coulomb friction torque was the only friction affecting the potentiometer. If this assumption were true, the friction force from the torque would be $Ff = T/r$ *(where* T *is the torque and* r *is the radius of the potentiometer's shaft). Likewise, the gravity force would be* $Fg = mg$ *(where* m *is the mass tied to the string and* g *is the gravitational acceleration). A force balance then gives*

$$T = mr(g - a) \tag{1}$$

where a *is the acceleration of the mass. If the assumption holds that the only friction affecting the potentiometer was constant Coulomb friction, then each mass would undergo a constant acceleration.*

The potentiometer measured voltage versus time for the masses as they dropped, but the measurement of interest to us was position versus time. For that reason, a 'calibration' was performed before we measured any data. In the calibration, the potentiometer's initial voltage was measured. Then the string was pulled a set distance (2 inches), and the voltage was recorded. This process of pulling the string a set distance and recording the voltage continued another two times (see Appendix A for the results). To determine the relationship between voltage and position, the differences in the voltages were averaged and divided by the length. The resulting relationship was 0.9661 volts/inch.

Five different masses were used to test the assumption of constant acceleration. For each mass, the string was rolled up on the shaft, the oscilloscope was triggered, and the shaft was released. As each mass dropped, the oscilloscope collected the potentiometer's voltage versus the time. After obtaining plots for each mass, we used the voltage-position relationship, mentioned above, to convert the data from the form voltage versus time to the form position versus time squared.The residuals of the data determined whether the assumption of constant acceleration was valid.

3 Results and Discussion

The heart of a laboratory report is the presentation of the results and the discussion of those results. In some formats, "Results" and "Discussion" appear as separate sections. However, P.B. Medawar [1979] makes a strong case that the two should appear together, particularly when you have many results to present (otherwise, the audience is faced with a "dump" of information that is impossible to synthesize). Much here depends upon your experiment and the purpose of your laboratory report. Therefore, pay attention to what your laboratory instructor requests. Also, use your judgment. For instance, combine these sections when the discussion of your first result is needed to understand your second result, but separate these sections when it is useful to discuss the results as a whole after all results are reported.

In discussing the results, you should not only analyze the results, but also discuss the implications of those results. Moreover, pay attention to the errors that existed in the experiment, both where they originated and what their significance is for interpreting the the reliability of conclusions. One important way to present numerical results is to show them in graphs.

4 Conclusions

In longer laboratory reports, a "Conclusion" section often appears. Whereas the "Results and Discussion" section has discussed the results individually, the "Conclusion" section discusses the results in the context of the entire experiment. Usually, the objectives mentioned in the "Introduction" are examined to determined whether the experiment succeeded. If the objectives were not met, you should analyze why the results were not as predicted. Note that in shorter reports or in reports where "Discussion" is a separate section from "Results," you often do not have a "Conclusion" section.

5 References

A fundamental aspect is the references, these should appear in the bibliography or reference list.

You can then cite entries from it, like this: [**?**], or by using increasing numbers.

6 Appendices

In a laboratory report, appendices often are included. One type of appendix that appears in laboratory reports presents information that is too detailed to be placed into the report's text. For example, if you had a long table giving voltage-current measurements for an RLC circuit, you might place this tabular information in an appendix and include a graph of the data in the report's text. Another type of appendix that often appears in laboratory reports presents tangential information that does not directly concern the experiment's objectives.

If the appendix is "formal," it should contain a beginning, middle, and ending. For example, if the appendix contains tables of test data, the appendix should not only contain the tabular data, but also formally introduce those tables, discuss why they have been included, and explain the unusual aspects that might confuse the reader. Because of time constraints, your instructor might allow you to include "informal" appendices with calculations and supplemental information. For such "informal" situations, having a clear beginning, middle, and ending is not necessary. However, you should still title the appendix, place a heading on each table, place a caption beneath each figure, and insert comments necessary for reader understanding.