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1 Overview

Your lab report needs to be typed. Equations need to be typed. Microsoft word can do this. There are other programs as well for typesetting mathematics. If you are interested in these, please contact me. This specific document is created using a program called LaTeX.

A good rule of thumb is to remember that a lab report should be a summary of what you did in lab. It should clearly spell out the motivation for the lab, the procedure used, the results, and any conclusions that can be drawn from the results. In addition, you should discuss any shortcomings of your experimental set up, how those shortcomings are reflected in the data, and how you might fix them if you were to do the lab again (these are often called "sources of error").

The report should be a single, cohesive document. While it is convenient to break the lab up into separate sections (which I will encourage you to do) there is by no means a formula for writing lab reports. Discussion of data and procedure, for example do not need to be reserved for the "analysis" or "conclusion" section! That said, I will now give a general outline of a good way to organize your report. *It is NOT, however, the only way to write a report, and I'd encourage you to think carefully about how you decide to present your data before doing it.*

The best tool you have for writing this report is NOT what follows in this packet. It's your own common sense! *The Sample Lab Reports found in the 1301 Lab Manual are also very helpful! I'd highly recommend reading over them first.*

2 Outline

Your lab report should *roughly* consist of the following sections. The only section that I have a very specific expectation for is the abstract, so please read that section carefully.

2.1 Abstract

The abstract is your first impression. In scientific writing it is how people decide whether or not the paper is worth reading. Therefore, you MUST have the following things in your abstract:

- A very brief mention of what was done: one to two sentences AT MOST that describe the lab. This might also include a motivation for the why the lab was undertaken to begin with.

- The results. The numerical results. This report is not a story. The ending should be given away as soon as possible. If you have numerical results, they need to go in the abstract. You should not include all of your results if there are 10-12 trials done, but a representative result MUST be included.

- A brief, one sentence, conclusion on how the data addresses the initial question that was asked.

2.2 Introduction and Prediction

These should be a brief summary of the question being investigated in this lab, along with the motivation for asking the question. In addition this section should include the background physics another 1301 student might need to know to be able to assess your prediction for the lab, followed by the prediction itself. Often students will include all of the physics necessary for the lab in these sections, and refer to them later in the analysis and conclusion sections. This is perfectly fine. Another perfectly fine method would be to introduce the question, give the prediction you have made (with maybe a qualitative argument), and reserve investigation of the question via mathematical expressions to the analysis section. The physics and mathematics must appear somewhere in the lab, though.

2.3 Procedure

This should be a description of the lab set up and the steps undertaken to collect and analyze data. It should describe the procedure well enough that another 1301 student could perform the lab with minimal reference to the lab manual. You can assume the person reading the report has some familiarity with the motion lab software (i.e. there is no need to include a click-by-click description of its use). Any specific, or non-obvious decisions you made in setting up the lab should go in this section. A diagram of the lab set up (or even a picture!) is always very helpful (and highly recommended). You might also choose to discuss soures of error here (although it is often useful to discuss these in the context of the data itself. Which means you might want to wait until after you've presented the data).

2.4 Data and Analysis

Here you present your data. You should do this in a clear and readable format. Pictures truly are worth a thousand words. That said, you should still caption them, and make sure all axes are labeled (WITH UNITS!!!) and graphs are titled. If your data isn't best represented by a graph, then a table is often helpful, but again remember to label everything with proper units and make the table easy to read! Any data presented in your report should include some form of uncertainty (if you did not estimate uncertainty explain why, and suggest how you might have done it!). If you are showing motion lab graphs, then obviously putting error on the motion lab graphs is difficult. However, if you are reporting a measurement you made, or you are reporting an acceleration or velocity taken from a motion lab graph then you need uncertainty.

Should you need to make any calculations in the course of your data anlysis then you need only show that calculation done for a single trial. However, each

DIFFERENT physics calculation you do on the data should appear once (if the mathematical expression appears in the intro or prediction, then reference to that section is fine!). For example, if you are asked to calculate magnitude and direciton of the initial velocity of a ball moving through the air, you should show the calculation you did to find these values for one trial. If you have more trials you may just report the values for these trials without explicitly showing the number crunching you did. If you were also then asked to find the average velocity for each trial you should then show that calculation for one trial and the rest of the trials just report the data, etc.

Any calculation you do that involves combining different quantities, each with some uncertainty, requires you to use the rules developed in the first week of lab for combining values with different uncertainties. I will assume that you know how to do this. However, if it is blatantly obvious that you are not using these rules for uncertainty, then points will be docked.

2.5 Conclusion

Here you discuss your data. Does your measured value agree with the theoretical (or assumed) value? For example, if you are measuring acceleration of a falling ball, does the acceleration you measure match, to within uncertainty, the accepted value of $9.8\frac{m}{s^2}$? How realistic is your lab set up in answering the question that was initially asked? You should then discuss any shortcomings in your set-up. What are some sources of error that could have contributed to uncertainty? Are these sources something intrinsic to your lab set up (i.e. could calibration of the video have been off)? These are called "systematic" sources of error. If the source of error you are referring to is something that is not the result of your lab set up, but something else, then it would be considered a source of "random" error. Please distinguish between the two when you are discussing error.