Physics - Lab Reports & Rubrics

Lab reports are formal documents. They should be typed or ***very neatly printed***. Lab reports require your ***best*** writing skills and will be assessed on grammar, logical organization, and quality of the conclusions. Use new, clean, standard 8 ½ by 11 sheets of paper. The paper should be the same for each page of the report.

Lab Format: All lab reports should include each of the following sections:

- Title
- Objectives
- Hypothesis
- Materials/Equipment
- Procedure
- Data/Graphs
- Calculations
- Conclusions

Title: The title should be an appropriate and descriptive name for the lab of your own devising.
Objective: This is a statement of the problem to be investigated. It provides the overall direction for laboratory/experiment investigation and must be addressed in the conclusion

Hypothesis

- The hypothesis is a statement of a possible explanation for what you believe will occur.
  - The statement should use clear and precise words.
  - The hypothesis should be written in an ***"If …, then …"*** format such as "If the net force acting on an object increases, keeping the mass constant, then the acceleration of the object will increase."

  After stating your hypothesis, explain why you thought it would happen that way. Your thoughts may be based on your previous experience, things learned in class, general knowledge, and common sense. Explanations gained from articles should be referenced.

Materials/Equipment:

- A list of all laboratory materials/equipment used in the investigation.
- A detailed and labeled diagram to illustrate the configuration of the apparatus

Procedure: A brief but complete description of what you did and how you did it.

- Identify and name all experimental variables.
- Briefly describe how the independent variables are controlled.
- Use of drawings, images, or photos to show the basic lab setup.
- Provide a sequence of clear and precise steps that you followed during the experimental activity. Therefore, someone who was not present during the lab should be able to understand how the experiment was performed and be able to reproduce the results by reading your procedure

Data and Graphs: What you actually measured. These are the raw, unprocessed measurements you made. Often the data will be displayed in a graph in order to determine the relationship between variables.

- The data, including units, should always be organized in a logical, sensible, readable manner. There is no single right or wrong way to do this. Any method that displays the data in an intelligible way is acceptable.

- Your measurements determine the number of significant figures which your results will have, so make sure your measurements reflect their proper level of precision.
- Do not present calculated values in the data section. For example you might measure the mass of an object and then calculate its weight. The weight is not data, it is a calculated value. Only the mass should be in the data section. The weight should be displayed in the calculations section of the lab report.
- Graphs should have a title. **Each axis must be labeled and the unit indicated**. An appropriate scale must be used. The data displayed on the lab should take up most of the x and y scales.
- Unusual results or trends should be noted and explained if possible.
- State the meaning of the slope and discuss the significance of the y-intercept when appropriate.
- For physical interpretations and graphical analysis refer to ***Student Laboratory Handbook available at:*** **http://my.ccsd.net/raquelsantana/resources/ (**PHYSICS LINKS)

Calculations: This is what you did with the data after you got it; how you used it.

- Use the problem solving format.
- When multiple, repetitive calculations have to be made, it is sufficient to show one set of calculation steps and indicate that all subsequent calculations were made in the same way.
- Your calculations must be clear and legible.
- If many calculations are to be made, you may want to display the results in some sort of table.

Conclusions: Here you present your proud results**.** This should be the **most extensive** section of the lab report. It will require a substantial amount of writing and thought. The conclusion section most includes the following:

- Report the results
- Discuss whether your results are reasonable. If they are not, comment on what may have happened to cause any inaccuracies.
- Explain the basic physics concepts that took place in the lab.
- Comment on whether you met the objective for the lab.
- Discuss any problems you encountered.
- Include your experimental error if appropriate (see below for particulars).
- Discuss what you ***learned and the meaning of this knowledge***. Try to be eloquent. Creativity is nice too.
- Use common sense and ask yourself if your results are logical. The whole idea of the labs is to get you to think and then formalize those thoughts into a well-written paper.
- Suggest changes in experimental design which might test your explanations or improve your results.

Further Guidance: Always use your **actual data**, even if you suspect it will yield poor results. Do not try to fudge the numbers to get a good answer. You will not lose major points for data errors that give you bad results as long as you recognize the situation and have a logical reason or reasons to explain the results. Of course, if the bad data is the result of a poorly conceived data collection plan, you will suffer a loss of points. Points will also be lost if the data and the results do not add up.

Some labs will ask you to make predictions and explain the how and why of the thing. You will not lose any points if your prediction is incorrect, just as long as you have a reasonable explanation for why you made it. Physics can be tricky - there are lots of logical little traps that will fool you. This is one of the joys of physics. So do not worry if your common sense lets you down.

Experimental error: Experimental error is found by comparing the results you obtained in your experiment with what you know is the accepted value. Experimental error is expressed as a per cent, and is sometimes called percent error.

$$Experimental\,Error = \left(\frac{Accepted\ \ Value - Experimental\ Value}{Accepted\ \ Value} \right) 100\%$$

Obviously, to get an experimental error, you must have an accepted value to compare your results with. This does not always happen. For example, a lab may task you with determining your average speed over a 50.0 m course using a stopwatch and a tape measure. Clearly, you don't know what your actual speed was; only the one you calculated, so in this instance you would need a percent of uncertainty in measurements in your lab report.

On the other hand, you might do a lab where you obtain an experimental value for *g*, the acceleration of gravity on earth. The accepted value that we will use is 9.8 m/s^2. For example, let us assume you obtain a value of 10.3 m/s^2. Here's how you calculate the experimental error:

$$Experimental\,Error = \left(\frac{Accepted\ \ Value - Experimental\ Value}{Accepted\ \ Value} \right) 100\%$$

$$Experimental\ \ Error = \left(\frac{9.8\,\frac{m}{s^2} - 10.3\,\frac{m}{s^2}}{9.8\,\frac{m}{s^2}} \right) 100\%$$

The units all cancel and you are left with a percent; in this case, the experimental value turns out to be:

Experimental Error = -5.1 %

It would be nice if you got perfect results for every lab, but that is not easy to obtain. Generally, you will have only a few trials for any one lab and often the instruments and measurements will be quite simple. You may well find that your experimental errors are between 10 % and 25 %.

For other experimental errors such as uncertainty in measurements, accuracy and precision, absolute and relative error refer to the Student *Laboratory Handbook available at:* http://my.ccsd.net/raquelsantana/resources/ (PHYSICS LINKS)

Lab Title: _____
Student Name: _____ Period_____
Circle the box for each item to indicate points earned.

	Does Not Meet	Meets	Exceeds
Title	Title does not define goal of lab +2	Specifies what lab is being performed +3	Clearly specifies what lab goal is & gives extra information +5
Objectives	Does not talk about lab's scientific principles +2	Gives a clear scientific principle being tested +4	Gives clear purpose and includes important ideas that led you to design and perform the experiment +6
Hypothesis	Hypothesis is not clear or is fragmented +3	Hypothesis is a clear statement and written in an "if…., then…" format +6	Hypothesis is a clear statement of fact utilizing higher order thinking including "if…,then….." format +9
Materials	Present but lacking key materials +1	Has most of the essential materials +3	Has all essential elements listed and labeled diagram +5
Procedure	Does not define or list most steps, materials, and/or technology resources +6	Defines appropriate materials and/or technology resources. List most steps and materials. Provide a diagram of basic lab setup +12	Clearly defines all appropriate materials resources. List all steps and materials. Provide a diagram of basic lab setup +15
Data/Graphs	Important data elements are missing. Graph/diagram displays major errors. +10	Most required data is displayed. Graph/diagram is neat, but a few errors are present +16	Data collection is clearly and properly displayed. Graph/diagram is neat, titled, variables placed correctly, units, appropriate range +20
Calculations/ Results	Does not adequately write what occurred or lacks details. Includes wrong calculations +10	Clearly write what occurred and includes at least one data descriptions and calculation. Minor mistakes are present +16	Very detail oriented on what occurred and includes data descriptions, correct calculations ,and experimental errors +20
Analysis/ Conclusions	Conclusions are not clearly defined. Some required elements are included +10	Conclusion are clearly defined whether right or wrong. Most required elements are included +16	Conclusions are clearly defined and correct or if wrong, an explanation of what occurred and what needs to be changed to correct outcomes. All required elements are included +20

Reviewer: _____ Total Points: _____