

Writing a High School Physics Lab Report (2023-2027)

Science is a collective field of study, and its growth depends on the exchange of data and information, including certain fundamentals of history, mathematics, and communication. It is a common misconception that students taking a science class do not need to be good writers. In fact, biologists, physicists, and chemists must be able to effectively communicate their research, explain a hypothesis, record data, and provide conclusions. While there are a few celebrated scientific writers, the majority of scientists are rarely given credit for the breadth of their writing tasks.

The purpose of scientific writing is to offer empirical evidence that is both observable and verifiable, so it is important to write with precision. Readers expect precise descriptions of procedures and findings, free of personal biases. The presentation of data is the core of scientific reporting and therefore is essential to communicate in a straightforward manner since scientists expect to be able to replicate the experiment or process that the researcher has carried out. AI Level 2 is allowed with appropriate citations for *portions* of physics level lab reports.

While the college level lab report involves abstract writing and intensive research with documentation, for this course there will be minimal research required beyond what is presented in the textbook and on-line assigned information. When you use a source other than your own brain, appropriate in-text and bibliographical citations using APA format are required. An authoritative source should support facts, theories, and laws, discussed in your writing.

Use of AI Guidelines

- AI use is only acceptable when the assignment's posted Level explicitly permits it (Level 2 or 3).
- **AI Usage Level 2:** Permitted ONLY when the teacher explicitly designates Level 2 for the assignment. AI or another individual was used to review, proofread, or discuss ideas: the student generated the substance of the work. Citation is required.
- When AI assistance is designated (Levels 2 or 3), no more than approximately 30% of a finished assignment should contain AI-generated content. The remaining 70% must reflect the student's own thinking, writing, analysis, research, or creativity to maintain academic integrity and ensure meaningful learning.
- When permitted, clearly acknowledge and attribute the use of the AI program in your work.
- Provide a transparent statement or citation indicating the AI's contribution — what tool was used, and for what purpose (e.g., brainstorming, proofreading, checking grammar).
- Follow the citation style required by the course (MLA, APA, etc.) to reference the AI tool and any external sources it drew from.

Example (MLA-style, in-text note): “*Response generated by ChatGPT (OpenAI, [version], [date]) to suggest an outline structure; final wording and analysis are the student's own.*”

Data Collection Documentation

While a paper sent to a scientific journal for publishing would not include the raw data collection pages, a scientist would keep a journal or lab book where all data would be recorded as collected. For this class, this data collection documentation will be submitted as a pre-lab page along with the final draft lab report. Data documentation should be neatly recorded in organized tables and should be labeled with appropriate significant digits and measurement units. Notes relating to methodology and labeled sketches of apparatus would also be appropriate but are not required to be duplicated here. While physics rarely uses chemicals or radioactive materials, any applicable safety information would also be documented on the data collection pages.

It is important to remember that numbers may not be used in any calculation or graph, or discussed in the conclusion unless they are brought into the lab report from a *measurement* or from *documented research*.

Lab Report

For the purposes of this class, the lab report will be written in a graph paper composition book that may be either bound or spiral bound. It should be written on the front right hand side of the paper *only* and all parts except graphs should be written or drawn in ink. As would be expected for any high school level report, correct spelling and grammar are important. Numbers *in text* that are not hyphenated or are less than twenty-one are expected to be written out when presented in paragraphs. Every number, whether written out or in numerical form requires a unit (except μ and π which are unitless numbers).

All parts of the lab should always be written in *third person, past tense*. This means that there will not be any personal pronouns like we, our, me, he, she, they, or especially I. By convention, cited research may be written in present tense.

All parts of the lab report should be indicated in the left hand margin by header markers. Header markers will include: title, purpose, materials and apparatus, procedure, data and observations, calculations, graph and paragraph (if a part of data analysis), and summary and conclusions, and they will occur in that order.

Information discussed in the report that is not *your direct measurement*, including scientific constants, must be cited. If the material comes from a lab handout, it should be cited as well. Many colleges use the APA format within text citation.

Title and Header

The title of a lab report can and will often be the same title as the lab handout. It is expected to be the first thing encountered by the reader. It may be centered at the top but it must be indicated that this is the title by the *Title* header. If the student is asked to create a title, or one is not listed for them, the title should be appropriate for the lab. Suggestions for determining an appropriate title include looking at the summary questions or the conclusion and determining what concept the lab is attempting to demonstrate. Titles should be descriptive and should clearly indicate to the reader what the lab is about.

The title section also includes the writer's name, section or period, and date. Any collaborators as well as the data collection partner should also be listed in the title section. This portion should be in the upper right hand corner of the first page of the report.

Purpose and Theory

(AI Level 2 permitted with required Citations)

The purpose and theory portion of the lab report describes the goal of the experiment. The purpose is often called the objective or reason for conducting the investigation. What is the experimenter trying to find out? In situations where a hypothesis would be appropriate, it would be stated in this section.

The theory aspect of this section is used to explain relevant physics concepts, define appropriate terms, and explain equations used. What was this lab about? What physics content is this lab confirming or exploring? Research presented in this section is cited. Any numbers that are not directly measured and brought into the report as a part of data, need to be presented in this section. You might find it convenient to look up a few of the commonly used constants and document their source for later use. According to the Merriam Webster Dictionary, "the acceleration of a body in free fall under the influence of earth's gravity, expressed as the rate of increase of velocity per unit of time and assigned the standard value of 9.80665 meters per second per second is also called *g*." (Merriam-Webster, 2018) At the college level, this section would be called the abstract and would be written in abstract format.

Materials and Apparatus

This is one part of the lab report that is *not* written in paragraph form. It is actually two parts of the lab report written in the same area. Frequently in a physics lab there will be several different apparatus as a part of one experiment. Begin with a vertical list of *all of the materials and equipment* used in the lab and a sketch of the *first* apparatus placed beside the list. Include the balance scale number if mass is one of your measurements. Be sure to list quantities and sizes of various objects, 2-50 N weights or a 500 W light bulb. Include massing paper or a massing boat in your list if it is used. Be careful to include only the materials that were used. Oftentimes the materials list on the lab handout will include alternative pieces of equipment.

The apparatus is a drawing of how the materials are put together. It is not a drawing of each individual piece of equipment. Often the lab paper will have a picture of the apparatus on it. Is permissible to trace or cut and paste this diagram directly into the lab book. The apparatus should be labeled with the names of each piece of equipment that is visible in the drawing. Double check to make sure that items labeled on the apparatus are also listed in the equipment list. The apparatus should be well drawn and reconstructable.

Where there are multiple parts to a lab, each with their own apparatus and procedure, the entire materials list is given in this section and only the first apparatus.

Procedure

The procedure is in paragraph form and written in *third person, past tense*. Remember that by the time this lab report is written, the lab has already been done. It should clearly describe in a step by step manner what was done to achieve the result. A person *not* in this class should be able to use your procedure to repeat the lab and get your exact results. The procedure should clearly define the independent, dependent, and controlled variables.

Remember that plural nouns should have plural verbs. Be careful to correctly identify the nouns in the sentence. Watch out for nouns that occur in prepositional phrases and are therefore not the subject of the sentence.

Physics labs will often have several sections where an apparatus is changed in some way and a different procedure is completed. In this case, the apparatus, procedure, and data collected, and calculations for that specific part are grouped together for a Part 1 and then a second apparatus, procedure, and data collection, and calculations follow for a Part 2 and so on.

Data and Observations

This is another two-part section of the lab report. All **quantitative** information measured should appear in this section of the report. The best way to present data is in a table. The data table should be clearly labeled with the explanation of what the value is representing as well as the **unit of measurement**. For the purposes of this class, the unit is to be recorded directly after each number and *not* in the header of the table. All numbers should be written to the appropriate number of **significant digits**. A data table should be reserved for measurements only. Calculations have their own section of the report. Observations that are **qualitative** are written in paragraph form.

If there are multiple procedures, there will be multiple data sections, each for the specified procedure and apparatus.

Analysis: Calculations

Calculations related to specific sets of data should appear following the data table.

Calculations are not written in paragraph form.

For each type of mathematical manipulation, a word equation is written. Then below the word equation, the equation is rewritten using data values written to the **correct number of significant digits and with correct units**. Only one calculation example is needed for each type of calculation. Repeated calculations may be put into a calculations table after the first is written out. A calculation of discrepancy or percent difference calculation should either appear as a part of section calculations if appropriate or just before conclusions if it covers both sections.

Analysis: Graphs

If it is appropriate to display the data in the form of a graph, then the graph should appear after the calculations. If a graph is not used, this section may be omitted. Any attachments like ray diagrams would be placed in this area of the lab. Use a separate piece of graph paper to draw the graph and attach it to the left hand back side of the page opposite the descriptive paragraph.

A graph should always have a title. It is usually a comparison of the variables, for example, Mass versus Volume or Temperature Change over Time. The title is often placed in the upper right hand corner of the graph.

Each axis should be labeled with the variable name and its appropriate unit. Most physics graphs use a line of best fit rather than a 'connect the dots' line. Some lines will be direct relationships with straight lines, others will be curves. All lines or curves should be drawn with a ruler or a French curve. If the line requires linearization in order to determine slope and equation, the linearization occurs directly over the first graph with the linearized axis written under the first axis. The calculations for the slope of the line should appear on the front of the graph along with a data table of the data points. Slope and linearization calculations should also appear in the calculations section of the report.

Paragraph

Across from every graph, on the right hand side in the main lab report, there should be a **paragraph** explaining conclusions that can be drawn from the graph and stating the slope of the line on the graph. This paragraph should describe what the line shows as well as how the vocabulary applies. For instance, "The line graph of *Temperature Change versus Time* showed a quick linear increase in temperature indicating an exothermic reaction. The x-axis was time in minutes and the y-axis was temperature in degrees celsius. The slope of the line was 20.6 °C per minute and the line equation was Temperature (°C) = 20.6°C/minute x Time (Minutes) + 0 °C."

Notice that the line equation for the graph does not have unknown variables of x, y, or m. You have determined these variables, they are not unknowns, and they should be stated here.

Conclusions

(AI Level 1 - this should be your original work)

This is the most important part of the lab report. It is used to indicate to the reader whether or not the writer really understands what has been measured and why the results occurred. It should be well organized and written in **third person, past tense**. Often, the reader will read only this section and refer back to other sections as needed for understanding as to why you arrive at your conclusions. While each section may have several paragraphs, as a minimum, start a new paragraph for each part.

The **first part** of the conclusion is to describe what was expected to occur according to research. This research may come from your textbook, an online source such as *The Physics Classroom*, or a reference book. The research needs to be cited using APA format. Expectations regarding content to include are presented in the lab handout as prompt questions and should have been addressed in the purpose of the lab report.

The **second step** in writing the conclusion is to summarize your findings: the calculated answers and their implications. For example, one might say, "The R_f value for the yellow dye was 0.1151 mm." After stating the results of the calculations, then interpret them. "Since this is the lowest R_f value, it indicated that the yellow dye was most attracted to the filter paper."

The **third part** of the conclusion is to describe how your results compare to the researched results. How do your lab results compare to the physics theory presented in your purpose and your research? As a part of this section, summarize the concepts brought up in the handout questions as they should have been the focus of your research and data collection. One thorough paragraph each would be an appropriate amount of discussion. Be sure to consider any equations that are being discussed in class or in the assigned chapters. This is the place to show that you know your stuff.

When the lab has a numerical result that can be compared to an expected result, the results should be compared using % **discrepancy** and a list of possible reasons for the discrepancy. It is not acceptable to lump the blame on student error or error in using the scale. These errors **should not exist**. If the scale sticks and causes the measurer to not really be sure that the results are correct, then the measurements should be repeated until you are sure they are precise.

The **fourth part** of the conclusion is to extend your findings to a worldly application. How is this theory used to explain phenomena we observe in our daily lives?

The **final part** of the conclusion is recommendations for further study. What other variables could be explored? What variables were poorly controlled in this example and what recommendations would be made to a fellow student who is doing follow up and trying to reproduce your results? Sometimes this paragraph begins with "Further study would include..." This paragraph would not be written in past tense.

Proofreading

It is recognized that proofreading by a second person is amazingly helpful in writing your labs. The proofreader should

check for completeness in answering all of the sections in the conclusion, correct mathematical computations and associated numerical units, as well as grammar and punctuation. Your instructor is willing to proofread reports submitted in advance as his/her time permits. You will also find that allowing the paper to rest for 24 hours also helps in finding writing errors.

I prefer to type my report first into a word processor that checks my grammar and spelling and then after allowing the paper to simmer for a day or two, I do a final proofread and then copy it into my lab books.

Bibliography for all in text citations.

Grades and Scores

Refer to the course targets and rubrics for grading expectations. Lab reports are scientific essay-style summative assessments of your knowledge regarding the physics concepts and will be graded. There are no “retakes” on lab reports. Proofreading is done in advance of grading, not after.

Comments on cheating - it is expected that work with your name on it is your own. While data and calculations should be the same among lab groups, the written portions of a lab report will be unique to each individual. Papers that show inappropriate levels of similarity will not receive scores.

References:

Acceleration of gravity. (n.d.). Retrieved July 3, 2018 from

[https://www.merriam-webster.com/dictionary/acceleration of gravity](https://www.merriam-webster.com/dictionary/acceleration%20of%20gravity)

Writing a Short Form Lab Report

(AI Level 1 only)

A short form lab report is used when only data, analysis and conclusions are requested. This is frequently called a “mini-lab.”

Generally a mini-lab requires a **header** with an appropriate title, a list of partners, and any scale or unknown numbers in the header. **Data** should be presented in table form and **observations** in paragraph format. Analysis in a mini-lab can take the form of **calculations, graphs, or diagrams**.

Calculations should be shown in seven point problem solving where appropriate. A calculations table may be used after the first sample calculation is shown.

Graphs and diagrams require an accompanying **paragraph** describing for the reader what the visual representation shows. Graph paragraphs require all the same information as in a formal lab report. Diagram and graph paragraphs should describe in enough detail that the reader would not need to look at the diagram or graph to understand its contents.

The **five paragraph conclusion** is required. The first paragraph is research on what should have happened including citations for sources used. Often the introduction to a lab exercise contains information that could be used as an authoritative source. They may be cited.

The second paragraph is a description of what was observed. The third paragraph compares the expected results to the observed results. This should be a thorough comparison, simply saying that they are the same is not complete enough.

The fourth paragraph is an application. This paragraph requires that you apply the concept to something in your experience. The final paragraph is extending the lab to further study. It should include suggestions for other variables to investigate or variables that should be refined when the study is repeated. Sources of error would be considered suggestions for refinement. Remember that you should correct measurement errors long before you submit data. Measurement corrections to improve accuracy are not appropriate suggestions for further research.

Be sure to **cite your sources as in text citations**. Since the first paragraph of a conclusion requires an authority for your expectations, every conclusion should have at least one citation. It is helpful to write citations in an easy to find location since you will frequently use textbooks and certain online sources. Use a standard APA or MLA format for your citations both in text and in the bibliography.