Department of Physics
303/273-3830

COLORADO SCHOOL OF MINES
GOLDEN, COLORADO 80401-1887

Memorandum for: PH 315B students
From: Matt Young
Subject: Submission of lab reports
Date: August 23, 2008

You may submit your lab reports in memo format or in report format, or you may present them as journal papers. See *Guide to Writing as an Engineer*, by Beer and McMurrey. This memo more or less follows the ANSI standard for scientific writing.

Title. If your report has a title, make it a short, meaningful title that begins with a key word and not some uninformative phrase such as "Study of" or "Investigation of." If you submit your report in memo format, make the subject line equally meaningful.

Abstract or summary. If you use a report or scientific-paper format, you may begin with an abstract or a summary. Please make the abstract or summary informative and give the conclusion or result of the paper. Do not include any background material or references in the abstract; abstracts must be self-contained, because they are often published separately from the paper.

Introduction or objective. Please do not begin with background material; rather,begin with a topic sentence that explains the purpose of the lab. Briefly describe the experiment. Give background material, such as a description of previous work, in this section, but only after you have introduced your own work. It sometimes helps to begin, "The purpose of this report is to ...," finish the sentence, and then delete the words in quotation marks. Summarize your conclusions or recommendations in the Introduction; readers who are just skimming a paper may want to read only the Introduction. Remember that, in principle, the reader does not know what you have done, so write for an uninformed reader who may have to duplicate your experiment.

Theory. Please describe the model that the experiment seeks to verify in a separate section. Then reduce the model to a working equation, one that relates the experimentally measured values. For example, if your model contains a variable that is not measured but calculated, you will have to account for that variable in your working equation.

Procedure. Describe the materials and the procedures you used. Present a block diagram of the equipment and a wiring diagram. Digital photographs are generally not useful; use schematic drawings instead.

Results. Please describe your observations. Outline the calculation of numerical results (you may show handwritten mathematical work, such as a sample calculation, as an Appendix).

Perform uncertainty analysis as appropriate. In particular, whenever you report an experimental number, estimate its uncertainty (95 % confidence, or 2 sigma). Report each number as a mean value plus or minus an uncertainty ($\bar{x} \pm 2S_m$ in Baird's notation).

Conclusion or Discussion. Do not outline the paper, but rather summarize your findings. State explicit conclusions or recommendations. Compare your results with those predicted by your model and, where appropriate, with handbook values. Does the predicted or handbook value fall within your 95 % confidence interval ($\pm 2S_m$)? If not, why not? Except possibly for handbook values, do not introduce new information into the Conclusion section.

References. Use superscripts to call out references in the text. Number the references in the order in which they appear in the text. Please use American Institute of Physics format for the references; see http://www.mines.edu/~mmyoung/Refs_AIP.pdf. If your word-processing program allows it, you may want to use automatic numbering of references.

Appendix. Do not put figures into an Appendix (unless they are part of the Appendix). Figures are an integral part of the paper, whereas the Appendix is devoted to supplementary material such as detailed calculations that you do not want to include in the body of the paper.

Writing style. Avoid *circumlocutions* like "the measurement of the quantity was performed" in place of "the quantity was measured." Avoid *vogue words* such as "create" for "design, build, plot, write, draw." Avoid "determine" for "measure, calculate, look up, ascertain." Write short, clear sentences, use lots of paragraphs and headings, don't try to write too formally or with big words. Don't capitalize words other than names and trade names ("detector circuit," not "Detector Circuit"). Do not begin sentences with -ing words unless the -ing word clearly refers to the subject of the sentence (dangling or misplaced modifier). Write the way you talk, then polish!

Miscellaneous. Please use 12-point type and 1-in margins. Please prepare the memo so that any person who has not been in the lab can understand and perhaps reproduce the experiment. It is acceptable, perhaps desirable, to write in the first person singular (or plural, if there are two or more of you). Be explicit about calculations or uncertainty analysis; for example, describe the calculations, rather than just saying that the calculation may be found in Appendix 1. Often a handwritten calculation is not clear to anyone but its author.

Please pay attention to details such as correct use of units and significant figures, and correct formatting of Figures and Tables (in scientific writing, there are no graphs or charts, only Figures and Tables). Refer to Figures and Tables in the text, and attach them to the report in the order in which they appear in the text. You may work them into the text or attach them at the end, as is convenient. Place a clear, explanatory title or caption on each Figure and Table. (By convention, Figure captions are located *below* the figures, whereas Table titles are located *above* the tables—think "table top".) Do not show printed data files anywhere in the body of the report; rather add them as Appendixes, but only if you have a need to refer to them in the text. Instead, reduce the data to a few numbers, such as the mean and standard uncertainty, or to a short table. Likewise, do not submit computer programs. In particular, do not use Mathematica calculations as substitutes for well-formatted Figures. Finally, make sure that each axis of each graph is labeled with a physical quantity and its units, and that the x and y axes intersect in the lower left corner of the graph.

Treat equations as parts of sentences. Use symbols, not words, in equations (Baird is incorrect in this regard). Define every symbol explicitly (except for π, e, and a very few other symbols). Use subscripts and superscripts; for example, write 3×10^6, not 3E06 and not 3*10^6. I will deduct 1 point for errors such as writing 3E06, using * for multiplication or ^ for exponentiation, using an incorrect number of significant figures, and for failing to use a spelling checker.

Please use the equation editor for complicated equations. (If you use Microsoft Word, use Tools – Options to add Equations, Symbols, Sub-, and Superscripts to your toolbar.) Precede all decimal points with a number, even if that number is 0: 0.76, not .76. Use the correct number of significant digits; in this lab, that usually means 2 (nonzero) digits and no more. Be careful, incidentally, not to include trailing zeros on the axis of any graph.

Use symbols, not words, for units: 3000 Pa, not 3000 pascals. Note the space between the number and the unit symbol. Do not pluralize unit symbols or follow them with a period: 70 cm, not 70 cm., and not 70 cms. Use a centered dot to show multiplication: 9.8 m s^{-2}, not 9.8 m s^{-2}, and certainly not 9.8 ms^{-2} (again, do not use Baird as a model). See http://www.mines.edu/~mmyoung/numbers.pdf for more details.

Finally, please provide a sample of any detailed calculations you describe in the text.

Appendix 1. Examples of Figures, Tables, and Equations displayed correctly

Table 1. Choosing a light bulb.[a, b]

Type of bulb	Initial cost	Operating cost	Color	Glare	Total
Incandescent	4	0	3	4	11
Compact fluorescent	0	4	2	4	10
Quartz halogen	3	2	4	1	10

[a] Scale of 0 to 4, with 4 the best

[b] Sodium lamp has been ruled out because of color

We calculate the force F using the equation [some authors would insert a comma here]

$$F = ma, \quad (1)$$

where m is the mass and a is the acceleration.

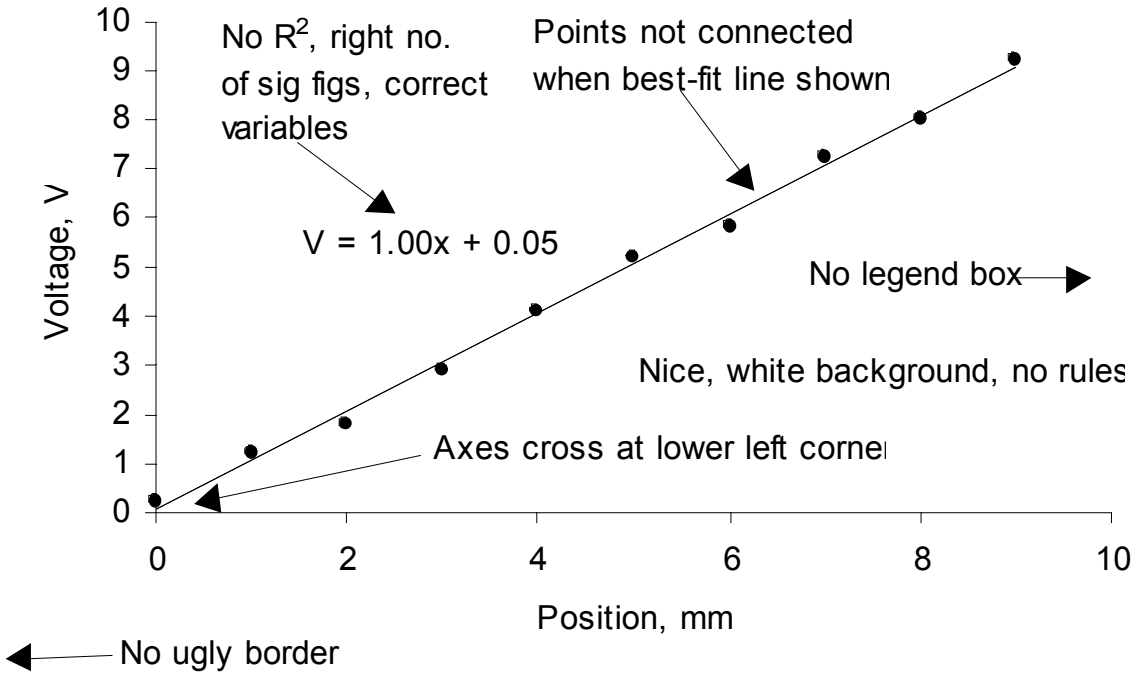

Figure 1. Well-formatted graph.