

Grading Rubric for Papers

Physics 480

Spring 2021

The course syllabus alludes to a grading rubric for *all submissions*, comprising a diverse set of writing standards for good writing in physics, adapted to PHYS 480. This document is meant to introduce those adaptations to the student-author. The process of submission and resubmission is not treated here in detail, although it is pictured in Fig. 1. The rebuttal letter is described in detail elsewhere on the PHYS 480 public course website. Our goal in PHYS 480 is not only to help the student to write up to professional standards, *but also to simulate the actual experience of submitting a research paper to a journal, and to engage, as professional physicists do, with the reviewing process.*

There exist rules for acceptable formatting established by the American Institute of Physics (AIP), and the American Physical Society (APS) set forth in the AIP Manual of Style and the Physical Review style guide. These of course are the least of our concerns, as they can be satisfied by using the correct L^AT_EX template and ancillaries specific to a given journal. Do pay attention to formatting requirements of the peculiar journal that is chosen as the exemplar for the particular semester of PHYS 480 in you find yourself. But these professional societies also set out standards for scientific, mathematical prose, which are much more important. The basic principles for such scientific writing do not differ between these two societies, or their guides. Consult both guides for tips on mathematical writing, and writing in general.

Less easy to communicate and harder still to teach are the *sensibilities* of professional scientific discourse in physics, which students in PHYS 480 are encouraged (you know, with grades) to adopt. These sensibilities resulted from the work of learned persons over centuries and centuries, work that has informed the cultures of natural philosophy and physics. These sensibilities include the citation of published work relevant to the scientific questions being pursued by the author, the close comparison of empirical results with relevant physical models, along with a clear and generously disclosed methodology, and the scrupulous elimination of statements that cannot be or are not supported in these ways. No paper submitted in PHYS 480 can be considered proficiently written that is not imbued with these sensibilities, and more.

The evaluative categories for the papers are introduced below in the form of questions that the writer and the reviewer ask themselves as they write (and review) a manuscript. There are three main categories of evaluation: physics content, grammar and composition, and formatting. This set of questions is not exhaustive but representative.

Physics Content:

Correctness: Are the explanations, descriptions, definitions, calculations, and so forth, correct? Has the author (you!) adequately, correctly, grasped the essential physical theory and applied it correctly to the practical, experimental problem at hand? Has the writer described what is going on experimentally, correctly, and in such a fashion that the data as presented are understandable, and that the reader is in no doubt about the theoretical implications?

Uncertainty and discrepancy: Did the author give an adequate account of the reliability of the principal values reported? Were significant figures used correctly? Were discrepancies reported where possible? Were discrepancies carefully compared with experimental uncertainties? Were these results interpreted for the reader?

Completeness: Did the author address all aspects, all deliverables, of the experiments, as defined in the lab handout? Are all the results adequately explained, both from an experimental point of view, and from a theoretical point of view? Are all the principal parts of research paper (introduction, experimental design, theoretical model, results and discussion, etc., nice plots and tables, an abstract &.) present? **From a holistic point of view, is the paper imbued with the scientific sensibilities common to all professional research work published in peer-reviewed physics journals (suitably adapted to PHYS 480)? Note: if the submission is incomplete it will not go out for reviews. Inevitably, when this happens, the paper score is very low. Well, almost always. Whether or not a paper goes out for review is up to the discretion of the Tyrant Journal Editor (TJE).**

Grammar and Composition:

Level of prose style: Are all the sentences *sentences*? Do they have subjects and predicates? Does the writer write accurately, or does he or she often miss the mark? Does the author tend to take many sentences to express a single point? Is the prose plagued by vagueness and question begging? Is it clear that the paper has been revised for obvious errors? Would the misspellings fool a spell-checker (e.g. the checkers can't help with 'form' when 'from' was intended)? Are all words and terms used appropriately? Has the author referred to special terms without first adequately defining them for the intelligent non-practitioner? Does the introduction provide accurate and useful context for the experiments while drawing the reader's interest? Does the introduction end with a map of the paper's organization, and does the author stick to it? Does each section serve a clearly stated purpose or do the paragraphs seem to introduce a desultory set of things that the read needs to know? Does the theory section contain elements more suitable for the experimental apparatus section, or vice-versa? Does the paper flow logically from the introduction to the conclusion?

To write accurately, precisely, compactly, and therefore powerfully, requires one to make many revisions. Everyone has a characteristic number of revisions they must make, R_r , in order for their prose to appear to have been composed by someone who has graduated from college. Mine is π^2 . Often, twice that. It is irrational for a number of reasons. In any case, the meaning that the reader takes from what is written must be subject to revision by the author, and many times, before the work is suitable for submission, the first submission. Then the external review process begins, (see Fig 1). There is time for only one pass through this process because of the number of experiments we do (3 or 4 in a semester). Note carefully that the flow through the peer and TJE review part is *irrotational*. It is *unfortunately (or thankfully) not* a cyclic process. These are, nevertheless, reasons to make $R_r \gg 1$.

Math is prose: Have the three rules associated with 'Math is prose' been scrupulously followed? Are equations seamlessly integrated into the prose? Are they cited in a useful way? A point to ponder: what is the use of numbering an equation which is never referred to? Is it really needed? How does Mermin answer? What *is Fisher's Rule* for? And if some of those equations are used as models for analysis, there must be at least a couple of places in which the *Good Samaritan Rule* would be used, yes? No manuscript can be proficient which is not proficient in the use of all 3 'Rools'.

Formatting:

L^AT_EX : Have the equations been formatted correctly? It should be mentioned that L^AT_EX mistakes range from unprintable output (sometimes denoted by ?? signs), to L^AT_EX output which is just incorrect, such as 87^{Rb} , or 87^{Rb} , when one really meant ^{87}Rb . It is assumed that the students will compose paper using OverLeaf (go to overleaf.com for a free, single-user account.)

AIP, or APS: Are the section headings correct? Are there references, and are they adequately formatted? Are the figures legible? Can the scales and labels be easily read?

Let's now try to make a rubric from all of the above.

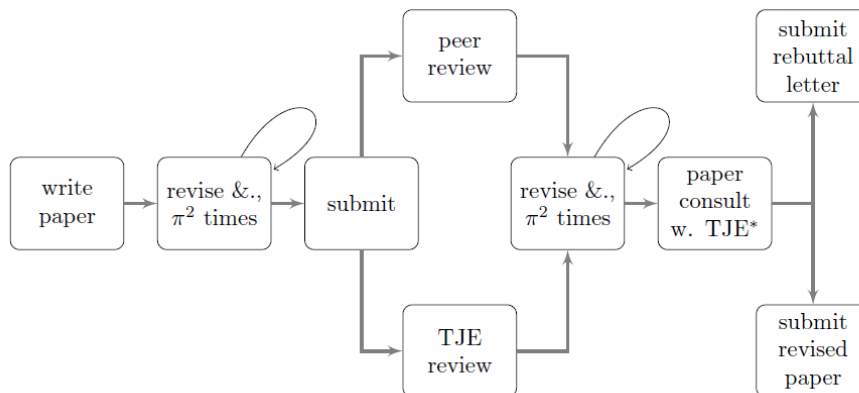


Figure 1: The most important loops are the ones the author performs autonomously. Note*, paper consults are initiated by the author, and that the submit → review → revise flow is irrotational.

Table 1: grading rubric: each evaluative category (row) is scored on a 3-2-1 basis. Each category is weighted (w , shown next to the category descriptor below) either 2, 1, or 1/2. The total number of points possible per row is then $3 \times w$, (i.e. 9 pts are possible for row 1). There are 9 total rows, and 30 total points possible. The grades recorded will be, however, a score out of 100 arrived at by dividing the student's score by the total possible, etc., etc. This table contains the rubric for physics content. Table II contains the rubric for language and formatting. Together, tables I & II compose the complete rubric. Note that physics content accounts for 18/30 of the total, or 60% of the total grade, more than half. On the other hand, one cannot write a passing paper without writing physics well.

	Proficient (3pts.)	Intermediate (2pts.)	Developing (1pt.)	total-whiff (0pts.)
Physics Content, 18 pts. total				
Correctness (w=3), 9pts. possible	<p>A clear and correct grasp of physics principles is conveyed,</p> <ul style="list-style-type: none"> • in the theory discussion, and • in the technical discussions of how the experiment works, • at both an advanced level, say, at a PHYS 330 level and • at the basic physics level, say, at the PHYS 27X level. 	<p>One of these requirements for proficiency is missing, or there is one specific instance in which the physics principle (wherever it appears in the paper) is presented in a somewhat flawed or misleading manner.</p>	<p>There are two or a few instances of such flaws in which some significant aspect of the theory or experiment is discussed incorrectly or misleadingly.</p>	<p>There are many such flaws.</p>
error-analysis (w=2), 6pts. possible	<p>Experimental uncertainty is</p> <ul style="list-style-type: none"> • estimated and explained or justified, • used to determine significant figures correctly, • compared quantitatively (the measured quantity, that is, with its experimental uncertainty) with values found in the literature along with acceptable citation. Discrepancies are discussed quantitatively and form the basis of interpretation of results. 	<p>One of these requirements for proficiency is missing from the manuscript.</p>	<p>Two or a few of these requirements are missing.</p>	<p>Most of these requirements are missing. Experimental uncertainty and discrepancy are not addressed in any meaningful way.</p>
completeness (w=1) 3pts. possible	<p>All aspects of the experiment are addressed, as defined by the laboratory handout for the experiment.</p>	<p>All but minor aspects of the experiment are addressed.</p>	<p>There is at least one significant omission.</p>	<p>There are major and minor omissions.</p>

Table 2: This table contains the rubric for language and formatting. Together, tables I & II compose the complete rubric. Refer to the table I caption for scoring information.

	Proficient (3pts.)	Intermediate (2pts.)	Developing (1pt.)	total-whiff (0pts.)
Grammar & Composition, 9 pts. total level of prose composition (w=1) 3pts. possible	The paper is written in a clear, accurate, and logical style. Accuracy here means pertinence, precision, appropriateness, and so on. The writer stays tightly focused on the point that the author is trying to prove or demonstrate. The entire composition and each paragraph is logically organized. Paragraphs are linked by meaningful transitions. The introduction draws the reader's interest, provides meaningful context (the student demonstrates learning by reading sources and by citing appropriately) and gives a map of the paper. The reader is impressed by the weight of the evidence that supports the assertions. The paper forms a coherent whole.	The paper is clear and accurate, but some aspects of the discussion, argument, descriptions, and so on, seem out of place or unsupported. One or two paragraphs do not seem to come to any purpose other than to state many things in a desultory fashion.	The paper wanders off target somewhat, paragraphs seem loosely connected, no organizational map is given, and material seems out of place, and a few or many paragraphs do not accomplish their stated purposes	The paper is as described to the immediate left, but is also fraught with nonsequiturs
level of sentence syntax (w=1) 3pts. possible	The prose is free from sentence pathologies.	There are one or two sentence pathologies, but the reader's progress through the paper is not markedly interrupted.	The number of sentence pathologies often interrupts the readers progress.	There are few grammatically correct sentences.
diction (w=1/2) 1.5pts. possible	Words are, in every instance, used with precision (technically as well as linguistically correct) and are correctly spelled. In other words, the prose is free from word pathologies.	One or two misspellings, or one or two words used imprecisely.	There are a number of misspellings and words used inappropriately.	There are many misspellings and many mistakes of diction.
"Math-is-prose" (w=1/2) 1.5pts. possible	Mermin's 3 rules for "Math is prose" are scrupulously followed, with the result that equations are seamlessly integrated into the prose, punctuated appropriately, and referred to correctly and usefully.	The 3 rules are followed, but equations are rather poked and prodded into the paper rather than fully integrated. The writer does not distinguish between equations deserving of being displayed and those that are better left within the text. References exit but are not maximally helpful.	Not all 3 rules are scrupulously followed. There are no references.	There are no equations, or none of the rules are followed at all.
Formatting, 3 pts. total				
L ^A T _E X-formatting (w=1/2) 1.5pts. possible	The paper is essentially free of L ^A T _E X mistakes.	There are one or two L ^A T _E X mistakes.	There are a few of these.	There are lots of these.
AIP or APS formatting (w=1/2) 1.5pts. possible	All headings, citations, references, have the correct formatting. The abstract spans the page. All graphs and tables have meaningful captions, all axes (and table) headings, annotations, &., meet standards of legibility and have appropriate units.	There are one or two mistakes in formatting.	There are a few of these.	There are lots of these.