MOUNT HOLYOKE COLLEGE

2003 Fall Semester — Light, Universe and Everything *i42* — Math style sheet

A. General advice

1 **Read the question carefully!**

2 Treat your answer as a short essay, in which the mathematics is embedded in complete English sentences. That helps the reader understand what you are doing, and helps you clarify your thinking.

3 Sometimes your "essay" (A.2) can be written entirely "in mathematics"; in that case the left-hand-side (l.h.s.) of the first equation should clearly identify what the subject. E.g.,

$$\text{apparent diam of M31} = \alpha = \ldots$$

4 Pictures are often useful (a) to clarify your thinking and (b) indicate the meaning of symbols.

B. Units

1 A scale factor is a dimensionless number.

2 When a number first appears, its units (if any) should be included.

3 Conversely, **never** allow units just to "pop into existence" at the very end of a problem.

4 **ALWAYS** include the units, if any, with a number which is your final answer or which is included in the "english part" of a sentence.

5 Carry the units through the intermediate steps of your calculations in those cases in which they can serve as a check on your method and/or algebra.

6 Show the cancellation of units explicitly.

7 When you define unknowns, **it is best** to write them without units: "let x = the distance to the moon", **if you do** write"let x km = the distance to the moon", remember that x is a pure (unitless) number.

C. Scientific notation

1 **Know thy calculator!**

2 Express your answers "artfully". Usually this means using scientific notation only if it helps understand the result, and choosing a power that is useful. So, for example

5.85 m	is better than	58.5×10^{-1} m
31.6×10^6 sec	may be better than	3.16×10^7 sec
3 m	may be better than	3×10^3 mm
20 mm	may be better than	2×10^1 mm

3 **Significant figures**

a. Do not use more significant figures than are justified by the input information, but

b. do not "throw away" a lot of significant figures unless there is a clear reason for doing so.

4 Be especially careful in the intermediate stages of a calculation to carry more significant figures than you will retain in the final result; otherwise you may lose precision by *propagation of roundoff error*. The best strategy is to arrange the calculation so you don't have to re-enter numbers. It is enough in a short calculation (such as the ones we will be doing in this class) to carry one or two more significant figures than you will retain in the final result.

5 **Use** scientific notation for your calculations. Do not do out a calculation "long hand" and then "count zeros" to express the answer in proper scientific notation.

D. Algebra

1 Write complete equations, just as you write complete sentences.

2 **Algebra first, then arithmetic!** Go as far as you can using symbols, and substitute in numerical values only at the very end. This will almost always save a lot of writing, and prevent many chances for making errors. Often, also, it will reveal interesting meaning which would be obscured by the premature insertion of a particular set of "plugging in" of particular numbers.

3 **"=" is the magic of algebra.** If you don't use it correctly, the magic won't work right, and may lead you dangerously astray.

a. Mean it when you say it.

b. Make it easy for the reader to determine exactly what is on each side of the =.

c. Do not use the symbol "$\rightarrow$" as a substitute for "=". You may find it useful for "implies", for example if you want to show that two equations are equivalent:

$$x = y \rightarrow y = x.$$

4 Show me your work, but perhaps not all of it.

a. Frequently it is best to *solve* the problem on scratch paper (i.e., a "first draft") before you "write it up" in a form suitable to be turned in ("final draft").

b. If you like to scribble a lot, do that on a separate sheet of paper.

c. If the problem calls for an essay answer, solve the the arithmetic part separately.

d. If you want feedback on you scribbles, copy it over if necessary to present it in an organization, and label it as separate from the problem itself. (You may find that in the rewriting you clarify the problem for yourself!)

5 If you introduce a symbol (e.g., "x") which doesn't have a well defined meaning in the context of this course, *be sure* to define it. (cf. A.2, A.3)

6 Be efficient. If a problem entails doing the same calculation for many similar cases, "parse" the solution in such a work that you have to repeat as little work as possible.

E. The Essay

1 Give the reader a "lead" or "topic" and a "conclusion" — even if the "essay" is only one or two sentences.

2 Usually an equation which is doing the work of a sentence or phrase needs a left-hand side of words, or an (already-defined!) symbol.

3 Incorporate the equations *into* the essay; don't put them into a pre- or post- script.

4 Say what you mean, and mean what you say.

5 The English usage should be as least as careful as in an English course; be careful with

a. overall organization,

b. sentence structure, and

c. details such as spelling and punctuation.