

Montserrat 108N – Mathematics Through Time
Paper Assignment 2

General Information

Your second larger-scale formal writing assignment for the course will be an essay responding to one or more of the questions below about issues raised by Euclid’s *Elements*. Your paper should be prepared using MS Word or equivalent software, *about 5 double-spaced pages in length* (but don’t worry if you go a bit over or are a bit short – the length is not the main point). You will be saving the paper as a .doc file and submitting it by email to me by email to:

`little@mathcs.holycross.edu`

The due date/time is *5:00 p.m. on Friday, November 19*. Note: this is different from what the course schedule on the class web site originally said – the schedule has been adjusted slightly for the remainder of the semester (again).

Description

This is not primarily a “research paper” – you need not consult outside sources. Instead, as for the first paper, you should think of your paper as a detailed defense of a particular conclusion about, or response to, some group of the questions in one of the topics below, written in a reasonably formal style incorporating correct grammar, spelling, and usage.

The specific questions you are addressing and your response(s) to them should be clearly stated in the first paragraph. Then the body of the paper should be a presentation of the reasoning and the evidence that lead you to your conclusion. Your job is to convince your reader of the soundness of your conclusion, starting “from the beginning.” That is, you should not assume the reader has been present for any of the discussions that we have had in class. You might try explaining possible opposing points of view, then giving your reasons for rejecting them, as part of your argument.

If you do use sources other than our course texts and use quotations or other information, you should:

1. Identify direct quotations with quotes and a note in parentheses giving information where the quote can be found within your source,
2. List all your sources in a References (Bibliography) section at the end of your paper:
 - For books, give the author, the title, the publisher and year of publication.
 - For magazine or newspaper articles, give the author, the title of the magazine or newspaper, the date of publication, and the starting and final page of the specific article.
 - For web sites, give an author (if you can determine that), the full URL (web address) and the date you accessed it (since information on the web often changes!)

A Suggestion

I will be happy to discuss (or read a first draft of) your paper and give you some preliminary comments by email. Or, you can come by my office hours if you want to “run your paper by me.” Alternatively, I think you may find it very helpful to have a first draft of your paper read by another student in the class. I can set up “reading pairs” if you are interested.

Evaluation

I will provide written comments on your work, and assign two grades for each paper – one for how well your conclusions are presented and supported (in other words, for how convincing your arguments are), the other for how well your writing follows the standards for formal written English. (For instance, how well is the paper subdivided into paragraphs each addressing a particular item in your overall argument? Are the paragraphs arranged in a logical, recognizable sequence? Are the sentences within each paragraph ordered well? Are they grammatically correct? Are there awkward sentences? Are there overly flowery, overly colloquial, or incorrectly-used words or phrases? Is punctuation used correctly? Are there spelling and/or typographical errors?)

The Question: “Why Study Geometry?”

Note: A very good essay could be built around responses to one or two of the following quotations. Don’t feel that you need to address all of them.

As we have said in class several times, Euclid’s *Elements* was the standard textbook for elementary mathematics in ancient Alexandria and it, and later texts derived from it, have been a mainstay of mathematics teaching in modern times as well. But students have probably always asked “why do we have to study this?” Have you ever asked that (maybe even this semester)? What responses have you received? Were you convinced?

Right from the beginning comes a famous story passed down from antiquity, preserved in a work of a Latin author named Stobaeus (5th Century C.E.), and quoted in many histories of mathematics:

Someone who had begun to read geometry with Euclid, when he had learnt the first theorem, asked Euclid, “what shall I get by learning these things?” Euclid called his slave and said, “Give this man three *obols*, since he must profit from what he learns.”

(An *obol* was a small coin of the time – roughly equivalent to a modern penny.) How would you characterize this response? What was Euclid getting at? According to the attitude expressed here, how do think he might have answered the question “why study geometry?” On the other hand, how would you respond if you were the “target” of this sort of answer? Have you been the target of this sort of answer?

The Greek philosopher and mathematician Proclus (410 - 485 C.E.) who wrote extensive commentaries on Euclid said:

Mathematical science must be considered desirable in itself, though not with reference to the needs of daily life. If it is necessary to refer the benefit arising from it to

something else, we must connect that benefit with intellectual knowledge, to which it leads the way and is a *propaedeutic*, clearing the eye of the soul and taking away the impediments which the senses place in the way of the knowledge of universals.

(A *propaedeutic* is something studied as a preparation for something else.) Do you feel as though the “eye of your soul” has been cleared by our trip through Book I of the *Elements*? In what ways can the senses place impediments in the way of true knowledge? Can you see what Proclus is getting at with the “knowledge of universals” here? Is that a sufficient reason for devoting time and effort to the study of geometry, in your opinion?

A possibly related motivation for studying geometry is expressed in the poem by Edna St. Vincent Millay (1892-1950 C.E.) that I put in the course syllabus:

Euclid alone has looked on Beauty bare.
Let all who prate of Beauty hold their peace,
And lay them prone upon the earth and cease
To ponder on themselves, the while they stare
At nothing, intricately drawn nowhere
In shapes of shifting lineage; let geese
Gabble and hiss, but heroes seek release
From dusty bondage into luminous air.

O blinding hour, O holy, terrible day,
When first the shaft into his vision shone
Of light anatomized! Euclid alone
Has looked on Beauty bare. Fortunate they
Who, though once only and then but far away,
Have heard her massive sandal set on stone.

Do you personally find geometry beautiful? (And why is it “beauty *bare*?”) If so, can you say what it is about geometry that provokes that reaction? If not, what makes it not beautiful? How does this relate to the *kind of beauty* expressed in the poem?

Another possible (and very common) response to our question is that studying geometry, especially the process of finding proofs of statements, develops *logical reasoning*, which can then be applied to problem solving in other areas. This is probably the most common reason educators have given for the study of plane geometry by all students in high school. But how convincing is that reason? For instance, Blaise Pascal (1623 - 1664, a French mathematician, author, and Catholic philosopher) said that

Mathematicians, who are only mathematicians, have exact minds, provided all things are explained to them by means of definitions and axioms; otherwise they are quite inaccurate and insufferable, for they are only right when the principles are quite clear.”

What do you suppose Pascal is getting at with the “definitions and axioms?” Is learning the style of geometric proof that we have seen necessarily good training in the sort of logical thinking that is necessary to solve hard real world questions? Or is it too special and restricted? Might there be another subject besides geometry that would do this even better?