

The Montana Department of Streams and Ecology
123 Main Street
Hypothetical County
Waterway, MT 12345

April 14, 2015

Dear Calculus Student:

Due to environmental concerns, we are planning to divert the flow of an existing stream and we need your help in designing a new path for the flow. Because of surrounding developments, the new path must go in a straight line for a distance of one mile, as it drops 300 feet in altitude from beginning to end. We need your help in deciding how the altitude of the streambed should vary along this path.

We could choose to give the stream a constant slope, so that it followed a straight line as it dropped steadily in altitude from the beginning to the end, however this would not create the most favorable ecological environment for fish, plants, and insects. Biologists recommend that in order to create a system capable of sustaining a high level of biodiversity, the stream should pass through a series of ponds as it follows its course. Biologists further recommend that these ponds should vary in length and depth, in order to produce a wide range of water environments. We can build ponds into stream's path by giving the altitude of the streambed a series of local minima, which will each fill with water until the water level rises above the following local maxima.

Due to erosional concerns, we must require that at no point in the stream's course should the steepness of the stream bed exceed an angle of 30 degrees from the horizontal. For each of the ponds produced by your streambed design, we will need you to calculate the surface length, the maximum depth, and the cross-sectional area of the pond. We would like the total cross sectional area of all the ponds to be at least $100,000 \text{ ft}^2$.

The engineering contractor that will be constructing the streambed requires you to describe the shape of this streambed with mathematical function where the input x is the horizontal position along the stream's path, ranging from $x = 0$ ft at the start of the path to $x = 5,280$ ft at the end. Thus, in order to have the right overall altitude drop, this function will need to have $f(0) = 300$ and $f(5280) = 0$. We will of course want to see a graphical plot of this function for verification. We would further like a full report describing your rationale for why this will be a particularly good stream path, why the series of ponds produced by it will promote the greatest possible biodiversity, and verifying that all our requirements are met by your design. And since we may have to divert other streams in the future, please describe how you created your design.

Thank you so much for your help!

Sincerely yours,

The Montana Department of Streams and Ecology

MA 131 - Grading Outline for Projects

Project

	SCORE	POSSIBLE POINTS
Summary – not more than one page; problem is clearly stated; general approach is discussed; results are clearly stated		10
Introduction - the problem to be solved is clearly stated; the approach to be taken is clearly explained		10
The Function - the method of creating the altitude function is clearly discussed, various attempts are plotted, and we verify that the final function begins and ends at the right altitudes.		15
Erosional Consideration –verification that the slope never exceeds an angle of 30 degrees.		10
The Ponds -explaining how we calculate the surface length, maximum depth, and cross sectional area of each pond. Verification that we have exceeded the minimum cross-sectional area.		30
Biodiversity -A discussion of why this particular streambed and the resulting ponds will produce a stream ecosystem with a large biodiversity		10
References – text and any other sources are listed and they are cited if necessary		5
Spelling/Grammar – paper uses correct spelling, grammar, and punctuation		10
Presentation		20
TOTAL		120

Presentation

Mathematics

- 6 pts. All mathematics is correct. Proper mathematical notation is used. All unknown terminology is explained. Presentation demonstrates an understanding of the mathematics.
- 4 pts. The above is mostly done well, but there are occasional minor problems with one or more areas.
- 2 pts. One of the above is done badly, or there are many minor problems.

Communication

- 6 pts. Presenters communicate material effectively. Demonstrate enthusiasm, interest, and creativity. All team members contribute to the presentation.
- 4 pts. The above is mostly done well, but there are occasional minor problems with one or more areas. Presenters talk to the screen or a paper instead of the class
- 2 pts. One of the above is done badly, or there are many minor problems.

Organization

- 6 pts. The presentation is organized and the method of presentation is well chosen. The problem is clearly described. Ideas are connected to the topic and each other. The timing and pace is appropriate for a 10- minute talk.
- 4 pts. The above is mostly done well, but there are occasional minor problems with one or more areas.
- 2 pts. One of the above is done badly, or there are many minor problems.

2 pts. will be given for attending all talks. (This will be done on an individual, rather than a group, basis.)

Total presentation points: _____ (20 possible)

MA 131 – Group Project

Guidelines and Important Dates

Important Dates

May 4, 5, & 6 – Oral Presentations (~10 minutes each)

May 7 – Written report due via moodle

Guidelines:

You must work in groups of 2 or 3 students. You should turn in one written report for your group, and your oral presentation will be done as a group. Every student should have an equal part in the oral presentation, and the presentation should be done with Power Point.

The main purpose of a paper in mathematics is to explain a series of calculations, so that the reader can clearly understand what math is being done and why. Explaining your math is the heart and soul of your paper. A good paper will often alternate between an equation and a paragraph explaining exactly what is being done and the purpose of this calculation. Your written report should be done in Microsoft Word, using equation editor, LaTeX, or some other comparable word processor with mathematics capabilities. It must be broken into sections (beginning with section titles in large bold letters), including an **introduction**, a **conclusion**, and **references**. You should use the introduction to briefly summarize the problem in your own words and set the stage for your paper. In the conclusion you should summarize your results and tie things together. Your textbook should be listed as a reference, as should any other sources (books or web sites) you consult.

One other requirement for the written report is that it must begin with a **one-page summary**. This should be an abstract, a brief overview of your entire project, including a very short problem description (shorter than in the introduction), the main methodologies used, and a brief statement of the main results you achieved. Think of this as possibly the only part of your report that a senior manager might read. It needs to clearly and succinctly summarize what you have done.

No rough draft is required, but I strongly encourage all groups to schedule a meeting with me to discuss the project and presentation.

Some Writing Suggestions

Write in the first person, and use the active voice whenever reasonable. For example, rather than, “It was discovered that...”, write “We discovered...”.

Show your equations and figures clearly. Label all tables and figures, and be sure to explain them in the text. If a figure or table isn’t explained in the text, then it should not be included in the paper. Plots should clearly label both the x and y axes.

The paper should be more than just a list of answers to homework-style questions – it should tell the story of your project. It is not necessary, nor even desirable, to list the number of the question you are answering. Instead, collect your answers and tell your story with them. Also, feel free to let your personality shine through; it's great to insert humor or invent characters to support your problem scenario.

Spelling and grammar count – proofread carefully!

The introduction and conclusion should *not* be judgments about the problem – refrain from saying, for example, “In conclusion, this was a worthwhile project. I learned a lot.” Your introduction should set the stage for your paper – sort of an overview of the problem. Your conclusion should tie together the paper and highlight the major result(s).

Some Presentation Suggestions

Have fun making your slides, but beware of getting so fancy that it detracts from your content. Very plain slides with no moving words are perfectly acceptable.

You will probably not have time during your presentation to discuss every aspect of your problem. Do be sure, though, that you appropriately introduce your problem.

Make sure you can access your presentation in two different ways (for example, from your X drive and on a flash drive). I have seen several groups in the past have trouble with corrupted disks. You are responsible for having your presentation in working order at the time you are scheduled to present.

Contributions, References, Plagiarism, & Integrity:

Each team must submit a page, signed by all team members, either stating that all team members contributed equally to the project or offering an explanation and relative efforts if contributions were not equal. All papers must contain a “References” section in the APA style that lists our textbook: Our text was the original source of most of the techniques that you will use in this project. If you get any other help on this project from other books, web sites, other student work/papers, or even if you talk to other classmates outside of your team, you need to include these in your reference section, acknowledging that not everything in your paper was your own original idea. It is very important that there is no file sharing, of Word documents, Matlab commands, or any other electronic files of any kind: That is considered cheating. You and your team must type in everything yourselves, into Word, into Matlab, and any other tools that you may use. You may talk to your classmates outside of your team about the general ideas of the project, but you may not copy the specifics: We expect all teams to create their own unique functions.