Note: this is a slightly modified copy of the official syllabus. The font size is larger than in the original which accounts for some lines being too large to fit. Ordinary daily notes will look different and will fit on the page. You can always view or download an up to date version of the syllabus on our home page:

http://www.math.utah.edu/~pa/1210/

Mathematics 1210—4 Calculus I Fall 2017

SYLLABUS

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<th>Textbook</th>
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<td>Monotonicity and Concavity</td>
<td>3.2</td>
<td>hw</td>
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</table>
8 M 10/09/17  NO CLASS
8 T 10/10/17  NO CLASS
8 W 10/11/17  NO CLASS
8 F 10/13/17  NO CLASS
9 M 10/16/17  28 Review for Exam 2
9 T 10/17/17  29 Questions and Answers
9 W 10/18/17  30 Exam 2 (on Chapter 2).
9 F 10/20/17  31 local maxima and minima
10 M 10/23/17 32 more max min problems
10 T 10/24/17 33 Yet more max min problems
10 W 10/25/17 34 Sophisticated Graphing, Mean Value Theorem
10 F 10/27/17 35 Newton’s Method
11 M 10/30/17 36 Antiderivatives
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14 F 11/24/17  NO CLASS
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15 F 12/01/17 54 Exponentials and Logarithms
16 M 12/04/17 55 Semester Review
16 T 12/05/17 56 More Review
16 W 12/06/17 57 Questions and Answers

Notes

This is the syllabus for Math 1210–4 during the Fall of 2017. It gives you detailed technical information about this class, and it describes proven techniques to succeed in Calculus. Make sure you read every word, particularly in the section What It Takes (starting on page 5) and take it to heart.

Instructor and Office Hours: My contact info is:

Peter Alfeld, JWB 127, pa@math.utah.edu, 801-581-6842.

Email is the best way to get hold of me. I often don’t answer my phone while I am in the office. (You’ll be transferred to a secretary after three rings.) However, I’m usually around
and you should have no trouble finding me. In particular, I’ll be pleased to meet with you before class (i.e., MTWF, 8:35-9:25) in my office (JWB 127). You are also welcome just to drop by at any time. I may not be there, or busy, so if you need to make a special trip or arrangement let’s make an appointment so you can be sure I’ll be available. You are welcome to address me by my first name, or as Professor Alfeld. Choose whatever is most comfortable for you. I will use your preferred name (as indicated on my roll) to address you, or else you first name. When responding to your email I will usually use the name with which you sign your email. If you wish me to address you by any other name please let me know.

Class Home Page: There will be a large amount of information available on our home page:

    http://www.math.utah.edu/~pa/1210/

General Course Information: Math 1210 Calculus I is a 4 credit course. It is the first semester of a three semester introduction (Math 1210-1220-2210) to Calculus.

Course Description: Functions and their graphs, limits, differentiation of polynomial, rational and trigonometric functions, velocity and acceleration, geometric applications of the derivative, minimization and maximization problems, the indefinite integral, an introduction to differential equations, the definite integral and the Fundamental Theorem of Calculus, applications of integration.

Time and Place: Our class meets four times a week, on Mondays, Tuesdays, Wednesdays, and Fridays, 9:40am-10:30am, in JWB 335. It is supported by Lab sessions that take place on Thursdays. The Lab sessions are conducted by Learning Assistants (LAs). You sign up for one of the lab sessions (Math 1210-005 through math 1210-009) and you are automatically enrolled in Math 1210-4.

Here is a list of lecture and lab sessions, with their scheduled times and rooms:

<table>
<thead>
<tr>
<th>Section</th>
<th>Format</th>
<th>Days</th>
<th>Time</th>
<th>Room</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1210-004</td>
<td>Lecture</td>
<td>MTWF</td>
<td>9:40-10:35am</td>
<td>JWB 335</td>
<td>Alfeld</td>
</tr>
<tr>
<td>1210-005</td>
<td>Lab</td>
<td>H</td>
<td>8:35-9:25am</td>
<td>Bldg 72 117</td>
<td>TBA</td>
</tr>
<tr>
<td>1210-006</td>
<td>Lab</td>
<td>H</td>
<td>9:40-10:39am</td>
<td>BU C 212</td>
<td>TBA</td>
</tr>
<tr>
<td>1210-007</td>
<td>Lab</td>
<td>H</td>
<td>9:40-10:30am</td>
<td>AEB 340</td>
<td>TBA</td>
</tr>
<tr>
<td>1210-008</td>
<td>Lab</td>
<td>H</td>
<td>10:45-11:35am</td>
<td>JFB 102</td>
<td>TBA</td>
</tr>
<tr>
<td>1210-009</td>
<td>Lab</td>
<td>H</td>
<td>10:45-11:35am</td>
<td>WEB 2230</td>
<td>TBA</td>
</tr>
<tr>
<td></td>
<td>Offic Hours</td>
<td>MTWF</td>
<td>8:35-9:25-10:25am</td>
<td>JWB 127</td>
<td>Alfeld</td>
</tr>
</tbody>
</table>

Graded Written Assignments: The lab assignments are identical across all labs for section 1210-4 and each lab problem for all labs will be graded by the same TA.
The midterm exams take place on Wednesdays. They will be graded by myself, with the expectation that I will be able to return the graded exams on the Friday following the exam.

**Important Dates:**

- **8/21/17** Classes begin
- **8/25/17** Last day to add a class without a permission code
- **8/25/17** Last day wait list
  - **9/1/17** Last day to drop a class without being charged tuition
  - **9/1/17** Last day to add a class.
- **10/20/17** Last day to withdraw from a class. You will be charged tuition.
- **12/7/17** Classes end.
- **12/8/17** Reading Day
- **12/12/17** Final Exam (8:00-10:00am, JWB 335)

**Class Notes:** I prepare for class by writing notes before class. These will be online and you can look at them before class. They will contain gaps that we will fill in together, during class. I plan to project those notes onto a screen during class and fill them in by writing on my iPad. Later that day I will replace the online notes with their annotated version. An asterisk on our home page will mark that the replacement took place. The main purpose of making my notes available in this fashion is to enable you to pay full attention to our discussion without being distracted by having to take detailed notes yourself. However, otherwise these notes come without warranties expressed or implied. The notes may contain errors (that hopefully will be recognized and corrected in class), and I may deviate from them during class. In particular, these notes are not eligible for our one point contest (see below).


**Grading:** 14 WeBWorK Home Works (2% each), 1 final exam (29%), 4 midterm exams (7% each), Lab work 15%. As discussed below, the exams are closed books and notes, no electronics. You answer the questions on the exam itself. All you need to bring to an exam is a dependable writing utensil.
Fixed Scale: Grading is according to the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≥ 90%</td>
</tr>
<tr>
<td>A−</td>
<td>≥ 85%</td>
</tr>
<tr>
<td>B+</td>
<td>≥ 80%</td>
</tr>
<tr>
<td>B</td>
<td>≥ 75%</td>
</tr>
<tr>
<td>B−</td>
<td>≥ 70%</td>
</tr>
<tr>
<td>C+</td>
<td>≥ 65%</td>
</tr>
<tr>
<td>C</td>
<td>≥ 60%</td>
</tr>
<tr>
<td>C−</td>
<td>≥ 55%</td>
</tr>
<tr>
<td>D+</td>
<td>≥ 50%</td>
</tr>
<tr>
<td>D</td>
<td>≥ 45%</td>
</tr>
<tr>
<td>D−</td>
<td>≥ 40%</td>
</tr>
<tr>
<td>E</td>
<td>else</td>
</tr>
</tbody>
</table>

The fact that this scale is fixed means that you are not competing with your classmates. You are not going to get a worse grade because somebody else is getting a better grade, and your grade is up to you alone!

Home Work: The primary purpose of home work is to give you a guided opportunity to hone and improve your skills. In this class you will receive personalized home work assignments that you do on the web at a time that’s convenient for you. If you give the wrong answer the computer will tell you so and you can try again. That way you will receive immediate feedback. The underlying software is called WeBWorK and details will be announced. Home works will open every Friday morning one minute after midnight, and close eleven days later on Tuesday evenings, one minute before midnight. You should finish work on each home work assignment before the next one opens, but if you fall behind you do have a few days to catch up while two home work sets are open simultaneously.

You can find a link to your ww account on our home page. You can also go directly to

https://webwork4.math.utah.edu/webwork2/math1210fall2017-4/

You will be able to log into your account only after you receive login info by email at the beginning of the semester.

Final Exam: The final exam will be in our regular classroom on

Tuesday, December 12, 2017, 8:00am-10:00am.

Like the midterm exams, the exam will be closed books and notes, and no electronics.

One Point Contest: I want the assignments in this class to be perfect, and fix any errors as soon as possible. Therefore, if you discover a mathematical or factual error in the printed materials (i.e., the home work problems, exams, or exam answers) and you bring it to my attention before I can fix it, you will receive one extra percentage point towards your final grade. This is fair because it requires you to think deeply about a problem, and it may also alleviate your frustration due to, for example, WeBWorK having been given the wrong answer. But note that this contest only applies to mathematical and factual errors. I also appreciate if you bring other mistakes, like misspellings or grammatical errors, to my attention, but there are no extra points for those. The contest also does not apply to the daily class notes.

Make ups: You should make every effort to participate in all midterm exams. If you have to miss a midterm for a legitimate reason, then talk to me, preferably before, but no later than one week after the midterm. I will add the weight of what you missed to
the weight of your final. Thus effectively you will get the same percentage on the missed midterm as you will on the final. That’s reasonable since the final is comprehensive. If you need to be away on official University business during an exam, and this procedure does not meet your needs please talk with me. As far as the home works are concerned, since you will have a whole week for each home-work, a four day grace period, and you can submit your answers anywhere where you have internet access, there will be no make-up for home works. Any make-up or substitute for the final exam itself will be an oral exam, and will be available only in exceptional circumstances.

**Calculators and such:** I own several calculators and use them and several computers all the time. These are great tools. However, there are pitfalls. Suppose you prepare to climb a mountain and your training program calls for jogging around the block a few times every day. You’d defeat the purpose if you used your car to drive around the block, even though that may appear easier at the moment. Technological devices carry the same risks for learning mathematics, they may reduce your mental fitness. The skills that you will learn in this class will enable you to solve problems of a complexity that will amaze and gratify you, and that are quite inaccessible to your calculator. However, to build up to these skills you’ll be given simple exercises that you could in fact do on a calculator or computer. But using the calculator would deprive you of an opportunity to learn. It is also useful to build your number sense by doing simple calculations in your head rather than on a calculator. A calculator is good for handling messy arithmetic in a case where you already have a good idea of the answer. It’s much less useful, and may actually have a deleterious effect on your efforts, to get the first answer in a situation where you have no idea what to expect. I recommend you get into the habit of doing simple arithmetic in your head, and estimate mentally any answer before you actually compute it using some technological tool. To help you in this endeavor, calculators are not allowed on exams. The problems will be set up so that you don’t need them. Your numerical answers should consist of simplified algebraic expressions. For example, write

\[
\frac{2 + \sqrt{2}}{3}
\]

and just don’t worry about the fact that rounded to 6 digits this expression equals 1.138071. You may use any tools you like including calculators and computers for the homework. However, to prepare for the exams you should use these facilities only if you really need to, and always estimate mentally your expected answer before computing it. You can spend a lot of money on rather fancy calculators these days. Some calculators can manipulate mathematical expressions (rather than just numbers) and draw various graphs and data. However, much more powerful and convenient facilities for these latter two tasks are readily available on University computers, and can be purchased for home computers. In particular you may wish to explore the languages *maple* and *matlab*. The University has a site license for both of these programs. Also well known and widely used is *Mathematica*. I have owned several fancy graphing calculators but I have found that I only need a basic scientific calculator (that can evaluate trigonometric functions, exponentials, and logarithms), and that it is much better to use a full blown computer for more complicated tasks.

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Official Information

Prerequisite Information: "C" or better in (((MATH 1050 AND 1060) OR MATH 1080 OR (MATH 1060 AND Accuplacer CLM score of 80+)) OR AP Calc AB score of 3+ OR Accuplacer CLM score of 90+ OR ACT Math score of 28+ OR SAT Math score of 630+.

Expected Learning Outcomes: Upon successful completion of this course, a student should be able to:

- Take limits of algebraic and trigonometric expressions of the form 0/0 (that simplify), non-zero number over 0, including limits that go to (positive or negative) infinity, limits that don’t exist and limits that are finite.
- Use the limit definitions of derivative and definite integral for polynomial, rational and some trigonometric functions; understand the definition of continuity.
- Differentiate all polynomial, rational, radical, and trigonometric functions and compositions of those functions; perform implicit differentiation and compute higher order derivatives.
- Use differentiation to find stationary, singular and inflection points, as well as domain and limit information to determine vertical and horizontal asymptotes, and then use all of that information to sketch the graph of a curve defined by the equation $y = f(x)$.
- Use differentiation to solve optimization and related rates problems.
- Compute indefinite and definite integrals, using the power rule, basic substitution, or the Fundamental Theorems of Calculus.
- Apply definite integrals to compute area between two curves, volumes of solids of revolutions, arc length, surface area for surfaces of revolution, and center of mass.

Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX (of the Education Amendments Act
of 1972) makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

**Student Information:** The instructors in our department have access to the following information about the students registered in their classes: Name, preferred name (if entered in your CIS account), your student ID number, and your photograph (to help us learn your names) on your University ID card. We do not have access to other parts of your University Record.

**Wellness Statement:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776. (Note: While I have no special expertise in these matters please don’t hesitate to talk with me privately about your personal circumstances if you believe this may be useful.)

**What it Takes:**

Many students will do very well in this class. The following paragraphs are directed mostly towards those who may not.

In our introductory classes, when students are unsuccessful this is usually due to one or more of three specific reasons:

1. **Failure to appreciate and utilize the fact that Mathematics is hierarchical.** You cannot understand new mathematics if you don’t understand the mathematics that precede it. On the other hand, if you do have a solid understanding of the prerequisites you can acquire a working knowledge of new mathematics easily and efficiently. Everything new that you learn will be just a small modification or extension of something you’ve learned before.

For this class this means you must understand the topics taught in College Algebra and Trigonometry. Some of these topics are reviewed in chapter 0 of the textbook and we will discuss some of the key concepts in class during the first couple of weeks. If you do not understand these topics then you would be spending your time inefficiently and unproductively in this class. You’ll be better off dropping the class, and going back and preparing yourself better for taking Calculus. If you have any doubts about your preparation for this class I’d be pleased to talk with you and make suggestions for your course of action.
Focus on understanding the subject rather than memorizing recipes for doing simple things. You understand a piece of mathematics if you can explain it in terms of simpler mathematics, you can make multiple logical connections between different facts and concepts, and you can figure out how to apply the mathematics to solve new problems. Too much teaching of mathematics is directed towards memorizing and rehearsing the application of simple recipes to narrow classes of problems. Focusing on the underlying connections and learning how to figure things out is vastly more efficient and empowering than trying to memorize countless formulas.

2. Failure to recognize the importance of acquiring and using precise language. If you don’t understand the language you cannot think clearly about the subject, and if you can’t think about your subject you can’t understand it.

It is crucial that whenever we introduce new terms and phrases you make sure that you understand precisely what those terms and phrases mean, and that you can and do use them when thinking about the subject and talking with fellow students, TAs, tutors, or me, about the subject. Making a point of doing so will save you time and effort, and it will deepen your understanding and appreciation of Calculus. Utilize the index of the textbook, and make a habit of having an ordinary dictionary handy when you study or work on your homework. Make sure you do use the dictionary or textbook whenever you encounter a word and you are not dead certain that you understand fully what the word means.

3. Not being able or motivated to spend the time necessary to learn the subject. You can’t learn mathematics in a hurry. On the other hand, if you do spend the time it takes, and spend it wisely this process feeds on itself and you will become much more effective and efficient in your studies.

Taking any math class is a serious enterprise that requires your commitment, time, and energy. We are all busy, and there are many competing claims to our attention, all of which are legitimate. It’s not a moral problem if you don’t have enough time to dedicate to this class. But it is a fact of life that understanding new mathematics takes a great deal of time and effort, and if you are not prepared to spend that time and effort you will not understand the mathematics. As a guideline, when taking a math class on a subject you are not yet familiar with, you should count on spending two to three hours out of class studying and doing homework, for every hour in class. You are meeting five times a week for this class, so you should count on spending a total of about 15–20 hours per week (five hours in class, and 10 to 15 studying and doing homework), approximately and on average. Moreover, you should be able to spend that time in good sized chunks without distractions. If you are unable to spend that kind of time, you are better off taking Calculus during another semester when you do have the time.

Almost inevitably, when I mention to people that I am a mathematician I hear a response such as, I’m not a Math Person or I’m just not good at math. But note that the above three reasons do not include a general inaptitude for mathematics. Many people feel they are intrinsically unable to learn mathematics. This feeling is usually sincere, but it’s also
irrational, a poor excuse, and unnecessarily self-limiting. You may not be able to make mathematics your career, but anybody can study mathematics successfully. If you follow the suggestions given here in the next few paragraphs you will succeed.

**Study Tips**

**Make sure you do not fall behind:** This is the most important suggestion in these pages! If you miss just one key idea you will not properly understand what we are doing next, and your subsequent time and effort will be wasted. Saving two hours today may result in wasting days and weeks later.

**Come to class each time:** I will keep reminding you of the big picture, point out what parts of the subject are crucial, explain the key ideas, and make suggestions for your study. Even though this is a large class, you will have the opportunity to ask questions during class. If you have to miss class on occasion make sure you study the relevant section in the textbook, look at my notes, and ask a friend or myself what happened in class.

**Before attending class:** Read the relevant section of the textbook. Enabling you to do this is the main reason for giving you the detailed schedule on the first two pages of this syllabus. You will receive updates if the schedule changes. Even if you don’t understand everything at your prior reading, the discussion in class will be much clearer for you, and overall you will save time.

**After attending class:** Make sure you understand what we did. Go over the notes (mine and any of yours), write a summary in your own words, do examples, choose and work exercises (see below), make sure you understand any new language, think about the big picture, question assertions made in class or in the textbook, try different arguments to get the same result, check things for plausibility and consistency.

**Seek Help:** Work with friends or study partners. One of the most enjoyable aspects of being a student is that you get to meet new people, and that you are exposed to new ideas, and new ways of thinking. Make use of that opportunity in the context of this class. To find study partners you can of course just ask the person sitting next to you. But if you like send me a detailed and complete message stating that you are looking for study partners and giving contact details and information on what places and times are suitable for you. I will forward that information verbatim to the whole class, and then it is up to your fellow students to contact you. It’s OK if you and your partner or partners have different levels of experience or ability. One of you will benefit from explaining something and the other from having something explained again in a different way. If there’s something none of you can figure out, use our free tutoring service (see the next item) or talk with me.

The **T Benny Rushing Mathematics Student Center** is located on the President’s Circle between the Widtsoe and Cowles buildings (JWB and LCB). It offers very pleasant study space, free tutoring, and a computer lab. My office is just down the hall from the center. For information on facilities and hours of the center call our director of student services, Aryn DeJulis, at 801-585-9478, send her e-mail at dejulis@math.utah.edu, or check out

http://www.math.utah.edu/ugrad/mathcenter.html
Private Tutors. The Math Center has a list of private tutors you can hire for a fee. The ASUU tutoring center

http://www.sa.utah.edu/tutoring/

also offers private tutoring (at subsidized rates). However, keep in mind that while tutors may be a great resource, they do not know exactly what we discussed in class. They know the mathematics, but they may tell you about a technique of solving a certain problem, or use a concept, that requires information which we did not discuss in class. I recommend that instead of spending money on tutors you find study partners in our class, as described above.

Online Lectures: The department offers online lectures covering Math 1010, 1030, 1050, 1060, 1210, and 1220, and 2210. To see them start at

http://www.math.utah.edu/lectures/

Exercises: You can learn mathematics only by doing mathematics. In the context of a class like this, this means you work exercises. In this class you will of course do many exercises using WeBWorK, but you have to go beyond that.

Which and how many additional exercises you should do depends on your background, your current understanding, and your interests. Rather than giving you a list of exercises I believe you are better served by your picking the exercises yourself and me giving you just some general guidelines. The best way to find good exercises is to make them up yourself, but there are also a great many (more than 6,500) exercises in the book, ranging from very simple problems letting you practice just one specific technique to quite sophisticated and deep questions. Also, don’t hesitate to make up your own exercises. Ask yourself ”what if . . .” and see where it takes you. Follow these guidelines:

• It’s more useful to do a few involved exercises carefully and thoroughly than rushing through a large number of routine problems.

• Particularly useful are the ”Concept Reviews” in the book where you are asked to fill in the blanks or respond with true or false. These aren’t really “problems”, rather they are statements designed to check and improve your understanding. In every section that we cover you should go through these and if it isn’t obvious to you whether a statement is true or false then go back to your notes and the text and figure out the correct answer (and why it’s correct).

• Regarding the other exercises you should be able to do any of them unless they call for some mathematics that we didn’t cover, or there are some arcane details of a word problem that you are unfamiliar with.

• However, this does not mean you should do all of those problems. Instead, look over the problems. If it’s obvious how to do a particular problem, and it’s not otherwise interesting to you, skip it. If you are not sure, start the problem, and either finish it, or once it becomes clear what’s happening, drop it. If you have no idea how to do a problem, and your difficulties are related to the math we are doing, then go back over your notes, talk with people, figure out what you are missing, and then return to the problem.
Simplify Your Problem: A major problem solving technique that is often ignored by students is simplification. You will not solve a difficult problem on the first attempt. When a problem seems hopeless, then simplify it until you reach a problem that’s still related to the original problem but that you can solve. Then solve the simpler problem and use what you learned in the process for the solution of the more difficult problem. We’ll see many applications of this idea in the course of the semester.

Always Check your Answers: Everybody makes mistakes, and you simply have to recognize this fact and guard against it. You should always check your answers. The answers to odd numbered problems are in the book, but that should not discourage you from working even numbered problems or making up your own\(^1\). You can check your answers by computing the same result in different ways, by checking for plausibility and consistency, or by using more specific techniques such as substituting in the original function or equation, checking integration by differentiation, drawing a graph, or making sure that physical units are consistent. (For example, if your analysis calls for adding two seconds to a square foot than something must have gone wrong.) One major checking technique deserves it own paragraph:

Always Have Expectations: Before you enter into any calculations think about what kind of answer you expect. When you are through compare your answer to your expectations. There are several possibilities. Your answer may meet your expectations. That’s great, it will give you a warm and gratifying feeling, even though you may not have learned a lot. If the answer differs from your expectations then there are two possibilities: you made a mistake and you are now alerted to that fact, and you can figure out what went wrong. Or, and this is the most exciting case, there is something you misunderstood before you began work on this problem, and now you can improve and correct your understanding, and learn something new!

Hostile Testing: When checking your answers, to be effective in finding errors, apply what the air and space industry calls *hostile testing*. This means that you approach your answer with the expectation that it’s wrong and you try to prove that it is wrong. That way, if you fail, then maybe your answer is actually correct! Apply the same attitude to your textbook and to what your teacher tells you. (If you think I’m making a mistake in class, don’t hesitate to speak up!) You are more likely to find errors, and you end up processing what you read or hear with a much higher degree of awareness and effectiveness.

How to take Exams: There is only one fundamental way to prepare for an exam: make sure you understand the material. Rather than worrying about what specific problems might or might not be on the test, just make sure the mathematics covered by the test make sense to you, following the suggestions above. Here are some more suggestions specifically with respect to exams:

- Cramming does not work. That is particularly true in mathematics. Instead study steadily throughout the semester, and relax and do something fun the day or the night before the exam. Make sure that you are well rested for the exam.

\(^1\) If you are not sure of an answer to an even numbered problem, or one you made up, talk to me.
• There is always someone late for the exam. It seems a trite thing to say, but make sure you come to the exam on time and unflustered by having to rush and worry. Just allocate a little more time to coming to class than you would normally.

• When you actually receive the exam, relax, and read all the instructions and all the problems, before you start working on any of them.

• Then do those problems that are easy or obvious. Not only does that give you a good start but also it may teach you or remind you of something that’s useful for the other problems. There is rarely a good reason to do the problems in exactly the sequence in which they appear on your piece of paper.

• If you get stuck put that problem aside and return to it after you are done with the more tractable problems.

• When you are through and there is time left, don’t leave! Instead, check your answers and make sure they are correct. You’ve spent a lot of time and money getting to the stage where you are taking that exam, and a lot is riding on it. Being able to correct a mistake you made far outweighs the benefits of being able to spend 20 minutes more on whatever else you like to do.

• Even if you feel you don’t understand a question, or several questions, at all, don’t just leave. Write what you do understand and spend all the time you have available trying to figure out even those problems that appear hopeless.

• After the exam go over the answers (which in this class you will receive as you walk out the door). The exam is not an end in itself, you are here to learn the subject, and reading and thinking about problems you have just wrestled with is extremely helpful in this process.

**Great Study-Guide:** Go to Google, enter the phrase ”Understanding Mathematics”, and click on ”I’m feeling lucky”. The information you’ll find will resolve all your math issues.

**Great Math Book:** The book by Courant and Robbins: ”What is Mathematics” (566 pages, 2nd edition, August 1996, Oxford Univ Press, ISBN: 9780195105193) was first published in the 1940s. The book has been phenomenally successful and is still in print. It has turned on untold numbers of youngsters to mathematics (including myself some time ago). It’s available as an inexpensive and highly recommended paperback.

**The TeXbook:** During this semester you will receive a number of handouts (like this syllabus, tests, answer sets) containing typeset mathematics. I’m using the TeX typesetting system which is a true work of genius−2. You can use it yourself easily, and you may enjoy learning about it. To use it you need a computer supporting TeX, which is in the public domain. Let me know if you are interested and I can tell you how to get going.

**The Keynote Speech** for this class is given by Sir Isaac Newton who lived 1643-
1727 and was one of two independent inventors\textsuperscript{3} of Calculus. You want to learn how to reason nimbly and judiciously, rather than turn into a vulgar mechanic:

A Vulgar Mechanick can practice what he has been taught or seen done, but if he is in an error he knows not how to find it out and correct it, and if you put him out of his road, he is at a stand; Whereas he that is able to reason nimbly and judiciously about figure, force and motion, is never at rest till he gets over every rub.

	extit{Isaac Newton to Nathaniel Hawes, 25 May 1694}

The \textbf{Fundamental Theorem of Calculus}: In hopes of stirring your curiosity, I’ll mention that when you are through with this class the following strange looking formula will make perfect sense to you:

\[
\frac{d}{dx} \int_{a}^{x} f(s) \, ds = f(x).
\]

This is known as the Fundamental Theorem of Calculus. Recognizing this fact ranks as one of the greatest accomplishments of the human species.

\textbf{Basic Principle}: I used to write long explanations of the dire consequences of waiting too long to begin work on a project, but after many years I managed to condense those treatises into three words. Believe me:

\begin{center}
\textbf{Procrastination is Hazardous!}
\end{center}

You are going to learn some powerful stuff, and hopefully you’ll even have some fun in this class, but get going right away and make sure that you stay on top of things!

\textsuperscript{3} The other was Gottfried Leibniz, 1646-1716. Newton invented Calculus first, but Leibniz published his work first. The two of them, carried on a bitter quarrel about who deserved credit.