

# multivariable calculus

"Mathematics is not a careful march down a well-cleared highway, but a journey into a strange wilderness, where the explorers often get lost. Rigour should be a signal to the historian that the maps have been made, and the real explorers have gone elsewhere."

– W.S. Anglin, "Mathematics and History", *Mathematical Intelligencer*, v. 4, no. 4.

---

## course expectations

PACKER COLLEGIATE INSTITUTE | 2008-2009

Mr. Shah | [sshah@packer.edu](mailto:sshah@packer.edu) | math office F410

---

### beginnings...

This is my first time teaching this course, and it's different than all the other math classes at Packer. We only have a few students and the material gets pretty difficult. At the same time, in a very real sense, you've proven your mathematical mettle. You've taken the hardest math classes and you're now at a stage where we can start focusing less on formulaic problems and more on challenging that brain.

I want this course to do that – set your brain on fire. And by the subject's very nature, you're going to be forced to think in ways you might not have before. Conceptually, geometrically, intuitively. And since we have such few students, *I want us to be a merry band of mathematical explorers*<sup>1</sup> – not individuals competing for the highest grade. My hope is that when you leave this class, you're going to remember a room of real intellectual inquiry and collaboration.

### grading

This course will not have frequent tests. Although tests are useful – and in college classes you definitely will be confronted with them, and they will be worth a huge part of your grade – with a class this size, I would like to experiment with only giving three tests (one at the end of quarters 1, 2 and 3). And they will assess you only on basic concepts *and not worth a huge fraction of your grade*. This course is going to be designed with the premise that you are intellectually responsible for your own learning – and that when you are having difficulties with a concept, you will be proactive in overcoming those difficulties. With this said...

your grade will be primarily based on your daily homework, problem sets, and projects.

### *tests*

There will be in-class, closed-book tests at the end of quarters 1, 2, and 3. The questions will assess your basic knowledge of the concepts. The problems will be similar to the routine problems assigned during homework.

### *homework*

---

<sup>1</sup> I know, I know, corny as heck. But I really mean it 100%.

Homework will be assigned each night. There will be two categories of homework: required homework and extra practice homework. Homework will come from the textbook. The required homework is simply that: required. They form the basics of the topics being learned. When we go over homework in class, we will be going over this set of problems. You also will be given a set of extra practice homework. These are optional – to a degree. If you had difficulty with any of the required homework problems, I ask you spend an extra few minutes doing an additional problem or two to hammer down that particular skill. Why?

*The only way to become good at math is to do math.* Reading the solution to a problem gets you only so far. Remembering *techniques*, applying them, synthesizing them, requires so much more than just reading about them: you need to work with them, see how far they can bend, how they work in practice.

Higher mathematics is about honing intuition. Practice, practice, practice is the only way to hone intuition.

So take ownership of your learning and do the extra practice problems when you need to!

I will be checking your homework aperiodically to make sure you are keeping up with the course. So keep up with the homework. When checked, homework will be graded on a 3 point scale.

3	Homework is neatly done with all the required problems completed, or nearly completed. Problems which aren't completed show a serious attempt. Work for each problem is shown.
2	Homework has been attempted and mainly completed. A few problems have been left unanswered, but an attempt has been shown. Work for some problems is sloppy or nonexistent.
1	Homework has been attempted, but is missing many problems or work for many problems have not been shown.
0	No homework

If you do not complete your homework, you may show it to me the next class day for 1 point. (If you get a 1 or 2 on the homework, you may fix it up and show it to me the next class day for an additional point.)

### *problem sets*

The majority of your grade will come from problem sets; normally two will be assigned each chapter. These will be sets of more difficult problems, which ask you to really apply your understanding of the basics. Many of the questions will not ask for a single number for an answer, but instead of *show* or *prove* or *derive* something. So your grade on these problems will come from more than simply “getting the right answer.” Your grade will be based on your work and explanation. (A rubric and samples will be provided to you.)

There are four important things that I would like to emphasize when it comes to the problem sets:

- (1) I ask that you attempt the problems by yourself first.
- (2) You are welcome and encouraged to collaborate with your classmates – meaning you may talk with them about how to solve the problems and your answers. Seriously! However, when you work on the formal write up, I ask that you do this alone.
- (3) If you do work with your classmates on any of the problems, please write who you worked with next to the problem.

- (4) You are more than welcome to come talk with me about questions you are stuck on.
- (5) **I strongly recommend doing questions on the problem sets as we encounter the topics in class.**  
(Do them as we go along.) The problems are difficult enough that you will not be able to knock them off in one night without sacrificing work from other classes.

Problem sets turned in after the due date will be docked 10% for each school day late. If we don't happen to have class the next school day, you still must leave the problem set on my desk or it will count as a day late.

## *projects*

There will be a few "project" grades this year. In the fourth quarter, I would like each of you to pick a topic in multivariable calculus to do a project & presentation. We will talk more about this later in the year, but as we go through the course, keep your mind alert to topics you are especially intrigued by or questions you think might be fun to think about. I will provide you with some ideas, but I'm really all about you picking something that you *want* to work on.

As might be clear through the use of problem sets, one of the skills I want you to develop in this course is how to communicate mathematics. And since we have such a small class and a lot of latitude, I want you to take charge of the material! So at least once per chapter, two students will be responsible for teaching a one (or two) day lesson together. Again, we will talk more about this as the year gets into full swing, but the crux is: students will teach one of the introductory unit topics, one of the concluding unit topics, or provide a unit review. And of course I'll work with y'all figure out how you want to plan things – *you definitely won't be alone in this*. You can teach a traditional lesson, or go off the beaten path! Totally up to you!

The lessons you teach will be worth one problem set grade.

## *grading breakdown*

H=Homework, T=Test, P=Problem Sets and Projects

Quarters 1-3:  $0.25H + 0.10T + 0.65P$  or  $0.25H + 0.25T + 0.50P$  (whichever helps you more)  
 Quarter 4:  $0.25H + 0.75P$

Semester 1 Grade:  $0.50Q1 + 0.50Q2$   
 Semester 2 Grade:  $0.50Q1 + 0.50Q2$

Please note that the tests, comparatively, are not worth a lot. Assuming 5 problem sets in a quarter, you'll notice that the test will be worth less than one problem set in the first grading scheme. And if you happen to rock the test, it is worth about two problem sets in the second grading scheme.

## **an moment of naked honesty**

Here it is. This course requires a lot of visualization and graphing and thinking in 3D. I am terrible at visualizing in 3D, terrible at graphing 3D by hand, and really nervous about how to best present this

material to you. Seriously. So be kind if my drawings in class are awful. (I will be using a bunch of different programs to show you 3D graphs. But just be sympathetic to a terrible non-geometric thinker.)

Also, I can *absolutely promise you* that there will be questions that you will come up with that I won't be able to answer on the spot. But I can also promise you that I will try to find out the answers to them and get back to you.

I am looking at this class like a journey we'll be taking together. It's different because of the tiny class size and the abstract material. So let's look at us as a band of intrepid math explorers that are working to conquer the material together. And if something doesn't seem to be working in the class (the student lectures, the amount of homework, etc.), we can change things.

## the fine print

### Materials:

I ask that you buy a 1/4" or 1/2" binder for this class, and fill it with hole punched graph paper, for your homework. Do each nightly homework assignment on this graph paper, and label the top of the sheet with the date the homework is assigned, and the homework assignment. That way on certain days I can collect your homework without taking your notebook. (Take class notes however you want.)

### Absences:

If you are absent for one class day (and with college visits, sports, sicknesses, field trips, etc., this *will* happen), you are still responsible for learning the day's material and doing the homework. You will have to give me the homework due the day you were absent the next time we meet as a class.

If you are absent for  $n$  class days, you have  $n$  school days to turn in your missing homework.

Since the material on problem sets are cumulative in nature, the due date for them is *firm*, unless special arrangements have been made. If you are absent the day the problem set is due, you must turn it in the time we meet as a class. It is your responsibility to manage your absences and your work.

### Extra Help:

I'm here for you! I don't know if you are going to finish. Please definitely feel free to meet with me. Since I'm terrible with dates and places and things like that, I rely on doing everything in my planner – so send me an email with a couple days you want to meet, and all the periods you are free to meet.