

TJ's Study Guide for Math 212

The best way to feel confident for the exam is to know your stuff cold. What do I mean by that? Most concepts and mathematical "objects" we've learned about have several facets. For each topic you should know:

- The definition/ the statement of the theorem.
- a set of examples and non-examples
- how to do a basic computation. This may including knowing how to break a lengthy computation into manageable components.
- how to visualize the geometry, and how the geometry relates to any formulae involved
- interpretations and heuristics. These can help in two ways. First, sometimes you can avoid a long computation. Second, it can almost always help you check the reasonableness of an answer.
- special properties an "object" might have. For example, what happens to a line integral when you reverse the orientation of the parametrized curve? what happens to a path integral under the same change?

This sounds like a lot, and it is. but these are the things you can consider to gain a fuller understanding of the material. Certainly, if you want to claim you have mastered the material in any math class, these are the key components.

In a way, the above represents the things you should try to get out of the "studying and reading" part of your preparation. Of course, it is also important to practice your skills to increase your speed and accuracy, and test your thinking. Do lots of practice problems.

Sources of practice problems:

- unassigned exercises from the text. especially the review sections.
- other/older textbooks (the material for this class hasn't changed in a hundred years at least.) You can find lots of other textbooks about vector calculus in the library under call number QA 303 and QA 433. Look for things with "vector calculus", "advanced calculus", in the title. Even many books just titled "calculus" have five chapters at the end which do a hurried account of what we covered this semester.

- My colleagues web sites: try

http://math.rice.edu/~friedl/math212_spring06_final_review.pdf

and

<http://math.rice.edu/~phorn/Sp06/practiceexams/practiceFinalProblems.pdf> .

Now, some terribly scary lists.

Things we've defined (in no particular order)

- partial derivatives
- grad, div, curl
- double and triple integrals
- directional derivatives
- oriented, parametrized curves and surfaces
- vector fields
- tangent vectors, tangent planes
- normal vectors
- dot product
- changes of variables
- the Jacobian
- cylindrical and spherical coordinates
- path integrals
- line integrals
- flux integrals
- scalar surface integrals
- conservative vector fields
- level surfaces
- arclength, speed, etc.
- flow of a vector field, differential equation
- critical points, maxima/minima/saddles, discriminant

Some skills we've learned

- Computing everything in the above list.
- Taylor polynomials and approximation
- Extremizing functions, including the Lagrange Multiplier method.
- Classifying Critical points
- Finding bounding curves/surfaces for objects in plane/space
- graphing functions

Some Important Theorems

- Chain Rule
- Existence of Extrema
- Taylor's Theorem
- Change of Variables for integration
- Fubini's theorem
- Equality of mixed partials for smooth functions
- independence of parametrization for the "fancy" integrals
- The fundamental theorem of Calculus in three forms
 - for line integrals
 - Green's theorem/Stokes' theorem
 - Gauss' divergence theorem

Study Hard. This class is a challenge, but you can do it.