Review for Exam 2

What follows is intended as a guide to focus your study for Exam 2. Read the Overview and the Study Tips. After that there is list, arranged by section, of the ideas and techniques that you must know for the exam.

Overview

• Expect to see somewhere from eight to ten problems that look very much like homework problems.

• The exam will last 50 minutes, so you have to average one problem every 5 to 6 minutes.

• I intend that about 50% to 60% of the exam will be fairly routine problems, that another 30% to 40% will look like the more involved homework problems, and that perhaps 10% will be something new that that requires an original application of the ideas and/or techniques you have learned so far.

• More often that not, integration problems will be “set up, but do not evaluate”. These problems will require a correctly set up iterated integral.

• If a problem does require integration, you must be able to perform the following maneuvers, showing all your work and not using a calculator.

  1. $\int x^r \, dx$, for any value of $r$.
  2. $\int \sin x \, dx$
  3. $\int \cos x \, dx$
  4. $\int e^x \, dx$
  5. Integration by parts.

Study Tips

• Do lots of homework!

• Your goal should be to do so much homework that you can look at a problem and immediately know what to do with it.

• Once you know what to do, you should be able to do it quickly.

• The only way to get to this point is to work a large number of homework problems. At a minimum, you should have worked all of the ungraded problems that I assigned.

• Your test problems will not be divided up into sections on, say, “polar coordinates.” It will be your job to recognize the problem type and the most suitable method. I recommend that you go through the Chapter 15 review problems, perhaps with a study partner, and try to identify the problem type without working the problem.
Section 14.6

- Know how to compute the gradient of a function. Also recognize the notation $\nabla f$.
- Know how to compute directional derivatives.
- Know how to find the direction of greatest rate of change.
- Know how to compute the greatest rate of change.
- Be able to do all of this from either an algebraic formula or from a contour plot.
- Know the things that $\nabla f$ can be used for:
  1. $\nabla f$ points in the direction of greatest rate of change.
  2. $|\nabla f|$ is that rate of change.
  3. $\nabla f \cdot \mathbf{u}$ is the same as a directional derivative along $\mathbf{u}$.
  4. $\nabla f$ is the normal vector to any level curve (in 2 dimensions), or level surface (in 3 dimensions.)

Section 14.7

- Be able to locate all critical points.
- Be able to classify all critical points by computing curvature and concavity.
- Be able to compute absolute maxima and minima.
- Know that this can involve some detailed work on the boundary of the domain.

Section 14.8

- Be able to compute min/max subject to a constraint. (Note that this a lot like boundary part of a min/max problem from Section 14.7)
- Be able to do this with more than one constraint.
- Be able to apply this method, or the method of Section 14.7, to word problems.

Section 15.1

- Know that $\iint_R f \, dA$ means ADD STUFF UP. Specifically, add up outputs of $f$, each multiplied by a little bit of area.
- Be able to do this, at least approximately, given a formula for $f$, a table of values, or a contour plot.
- Know that it is your job to choose a sensible grid that gives a decent approximation.
Section 15.2

• Be able to convert an addition problem $\iint_R f \, dA$ into an iterated integral.

• Know that it is your job to decide on an order of integration and to obtain the correct limits on each integral.

• Know that the order of integration can affect the algebraic difficulty of a problem.

Section 15.3

• Know how to describe non-rectangular regions with algebra.

• Be able to do all Section 15.2 problems, but with non-rectangular regions.

Section 15.4

• Know when polar coordinates are appropriate for describing a region.

• Know how to describe a region in polar coordinates.

• Know how to do Section 15.3 problems in polar coordinates.

• In particular, memorize the fact that $dA = r \, dr \, d\theta$.

Section 15.7

• Know that $\iiint_S f \, dV$ means ADD STUFF UP. Specifically, add up outputs of $f$, each multiplied by a little bit of volume.

• Be able to do this, at least approximately, given a formula for $f$, a table of values, or a contour plot.

• Know that it is your job to choose a sensible grid that gives a decent approximation.

• Be able to convert $\iiint_S f \, dV$ into an iterated integral.

• Know that it is your job to decide on an order of integration and to obtain the correct limits on each integral.

• Know that the order of integration can affect the algebraic difficulty of a problem.

Section 15.8

• Know that some Section 15.7 problems are well suited for set up in cylindrical coordinates.

• Know how to do this.

More Integration

• You will have to do at least one physical application problem. (See Worksheet 3 for examples.)