Final Exam Review: Math 125

- **What do I need?**

  You might keep a table of derivatives, integrals and sum formulas (pg A37) handy, as well as a calculator. As you study, keep notes of the things you're not sure about so you don't have to search through your textbook if you get stuck.

- **Format**

  The format will be identical to our last exam; the exam page in Canvas is just there to sign your name, download the file, then upload your solutions.

- **Weight of Topics**

  There is some crossover between the latest material and earlier, but generally speaking the exam will be weighted about 30% on the latest material (topics from Ch 5), and fairly evenly spread out over the remainder.

- **What should I study?**

  Study these notes, but also be sure to go back over your old exams and be sure that you're able to answer all the questions- They may show up again! Once you've gone through the old exams, page through the old study guides. For the new material, I've included a separate practice sheet on the class website (Extra Practice- 4.9 and Ch 5). Finally, save the two sample finals for when you think you've studied enough, just to see how you do.

- **Points**

  I want to see your work! It is your logical chain of arguments and algebra/calculus that is the most important thing for you to show. If you just write down the answer with no supporting work, or if your work is completely unorganized, you will lose points. However, if you have the wrong answer but have correct reasoning, you can get partial credit.

- **Timing**

  As for length, the exam is slightly longer than a normal exam- I think of it as an exam and a half. For time, a couple of hours is normally plenty, but there will be a time limit of 3 hours (plus 10 minutes for you to scan/upload it). **Everyone should upload their solution to Canvas in the time allotted**.

  I think time management can be an issue, so you might set some preliminary timers for yourself if you've had trouble with that in the past- Maybe a timer at one hour, at two hours, and at 2.5 hours to remind you to start wrapping up. If you do have any issues with uploading your exam, you can always send me a copy.

- Keep a copy of your scan somewhere safe (don't delete it)- it has a record of when it was created.

Overview of Calculus I

Calculus I has 4 main themes: The Limit, Continuity, the Derivative, and the Antiderivative (and FTC). The "big theorems" of Calculus I are the three "value theorems" and the Fundamental Theorem of Calculus (both parts). Additionally, we discussed how to apply the derivative to "story problems", resulting in "related rates" and optimization problems.

The Limit

1. Algebraic Methods. In particular, recall that we can "divide by a power of x", "multiply by a conjugate", l'Hospital's rule. Understand its use in finding vertical and horizontal asymptotes.

2. Understand when heuristics can be used, or when a form is indeterminant. If a form is indeterminant, know how to manipulate it to a form we can analyze- For l'Hospital's rule, we looked at the limit of $f(x) \cdot g(x)$ and $f(x)^{g(x)}$.

3. Be able to apply the limit laws.

Continuity

Know the definition and be able to apply it explicitly. Understand the difference between continuity and differentiability.

The Derivative

1. Know the definition and be able to compute f' using the definition. Memorize the standard table of derivatives. Understand the usual rules of differentiation (product, quotient and chain rules), with logarithmic and implicit differentiation. Be able to differentiate an inverse function.

2. Understand the meaning of "differentiable" and higher order derivatives.

Theorems

Understand Rolle's Theorem. Understand the three "value" theorems: Intermediate, Extreme and Mean. Be able to apply them under the right circumstances.

Main Applications

1. Understand what linearization is, and be able to compute the equation of the tangent line under different circumstances.

2. Optimization. Critical points, first and second derivative tests. Closed interval test. Be able to analyze where the first derivative is positive/negative (using "sign charts" typically).

3. Related Rates.

4. Problems involving velocity and acceleration. Find where a function is inc/dec, concave up/down.

Section 4.9

- Know the properties of the antiderivative and some basic antiderivatives (Table 2, p 345). The exceptions are the hyperbolic sine/cosine, which we have not covered ($\sinh(x), \cosh(x)$).

- Be able to find the antiderivative both algebraically (ex 1-22, 25-48) and graphically (51-54).

- Be able to solve some physics problems using acceleration, velocity, displacement, and distance. If you need the acceleration due to gravity (9.8 m/s^2), I will provide that. (Examples 6, 7. Exercises 59-65, 69).

Appendix E

Introduced sigma notation for sums. Be able to write a sum using sigma notation, given sigma notation, write the sum. Know the formulas:

$$\sum_{i=1}^{n} 1 = n \qquad \sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Sections 5.1, 5.2

- Know the definition of the definite integral, and how to compute it using right endpoints:

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i^*)\Delta x = \lim_{n\to\infty} \sum_{n=1}^{\infty} f\left(a + i\frac{b-a}{n}\right)\frac{b-a}{n}$$

  This defines the definite integral as "the area under a curve" (or net area, if f is sometimes negative).

- For what functions are we guaranteed that the definite integral exists (as a limit)? If f is continuous, or has only a finite number of jump discontinuities. (This is Theorem 3, p 373).

- Properties 1-8 of the Integral (starts p 379). The two middle equations in the middle of p 379: I won't ask you these specifically, but you should be able to use these in evaluating the integral.

- Be able to write the Riemann sum for a definite integral, then evaluate the sum and limit (ex 21-25, 27).

- Given a Riemann sum, be able to convert it to a definite integral (ex 17-20).

- Evaluate the definite integral graphically or using geometry (ex 33-34, 51-52, 53).

Section 5.3, 5.4, 5.5

- Know the Fundamental Theorem of Calculus, both parts. Be able to apply the FTC to evaluate the derivative, and to evaluate definite integrals.

- Understand the difference in notation:

$$\int f(x)\,dx \qquad \int_a^x f(t)\,dt \qquad \int_a^b f(x)\,dx$$

- The integral as antiderivative (the indefinite integral, the FTC)
  - Integrate using the table (that we've memorized)
  - Simplify first, then integrate.
  - u, du substitution (like 1-21 in 5.5).