

Review for the Second Midterm Exam - Math 124 - Dr. Matthew Conroy

The primary topics for this exam are:

- **derivatives, including implicit differentiation**
- **related rates**
- **linear approximation**
- **local extrema and inflection points**

The relevant sections of the text are 3.5, 3.6, 3.9, 3.10, 4.1, and 4.3.

Here are some things to consider about each topic.

Derivatives

For this exam, you should know how to differentiate everything. That is, you should be able to find $f'(x)$ given $f(x)$, and $f(x)$ could be any combination of algebraic expressions, trigonometric and inverse trigonometric functions, logarithmic functions and exponential functions.

You should be able to determine $\frac{dy}{dx}$ of any point on a curve defined parametrically by, say, $x = f(t)$ and $y = g(t)$. You should be able to answer questions about tangent lines to such curves.

Also, you should be able to find $\frac{dy}{dx}$ given an implicit equation which relates y and x . Generally, this means using *implicit differentiation*.

You should understand and be able to use the technique of *logarithmic differentiation*.

There are tons of derivative problems in our textbook (or any calculus textbook) to practice, so make use of them.

Related Rates

Related rates problems come in a pretty wide variety; every problem in section 3.9 would be good practice. Try to work a bunch of different ones, particularly from the later problems in the section.

Be ready to apply, among other concepts,

- the pythagorean theorem
- similar triangles
- trigonometry
- volume and surface area formulas for cylinders, cones and spheres

Linear Approximation

You should understand how the tangent line to the graph of a function can be used to estimate the value of the function.

You should be ready for problems like, among others:

- Approximate $\sqrt{107}$ using a linear approximation.
- Determine the x -coordinate of a point with y -value 0.9 on the curve $(x^2 + y^2)^2 + x - y = 0$ using a linear approximation and the fact that the point $(0, 1)$ is on the curve.

Maxima and Minima, Increasing and Decreasing, and Inflection Points

You should know how to:

- Determine the maximum and minimum values of a function on a closed interval
- Classify local extrema of a function using the first derivative or second derivative test
- Determine where a function is increasing and where it is decreasing
- Determine where a function's graph is concave up and where it is concave down
- Determine the inflection points of a given function

Keep in mind that the second derivative test can fail: sometimes you have to use the first derivative test. Can you give an example of when the second derivative test fails?