Things You Should Know For the Third Exam

Exam covers 3.2, 3.7-3.9, 4.1-4.5, 5.1

1) The Mean Value Theorem: the statement and how to use the theorem to show a function has exactly one zero.

2) Antiderivatives (same as indefinite integrals)

- How to compute them
- Any two antiderivatives differ by a constant

3) Newton's Method: how to use it, when it fails.

4) Optimization problems

- Draw a picture and label it
- Determine an equation in one variable for the quantity you want to optimize
- Take the derivative of the equation, set it equal to zero
- If necessary, use either the first or second derivative tests to check that your answer actually satisfies the required properties

5) Integration

- The definition of a definite integral

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

  provided the limit exists!

- How to use an integral to find the area between two curves, especially if one of those curves is the x-axis
  - find all points where the curves intersect by setting them equal to eachother
  - determine which function is bigger between two consecutive points where they are equal and integrate the bigger one minus the smaller one over those points
  - add all the answers to get the area
- Properties of integrals. The first two hold for indefinite integrals as well.
  1. $\displaystyle\int_a^b (f(x) \pm g(x))\ dx = \int_a^b f(x)\ dx \pm \int_a^b g(x)\ dx$
  2. $\displaystyle\int_a^b cf(x)\ dx = c\int_a^b f(x)\ dx$ if "c" is a constant
  3. $\displaystyle\int_a^b f(x)\ dx = \int_a^c f(x)\ dx + \int_c^b f(x)\ dx$ if $a \leq c \leq b$
  4. $\displaystyle\int_a^a f(x)\ dx = 0$
  5. if $f \leq g$ on $[a, b]$, then $\displaystyle\int_a^b f(x)\ dx \leq \int_a^b g(x)\ dx$.
- The Fundamental Theorem of Calculus: know the statement (both parts) and how to use it.
- Substitution: how to use it, for both definite and indefinite integrals