Math 261
Exam 3 Review Sheet

**Section 4.1** Extrema of Functions

• Know the definitions of increasing, decreasing, constant, maximum value, minimum value, local maximum, and local minimum and be able to identify where these properties occur in the graph of a function.
• Know the statement of the Extreme Value Theorem (EVT) and be able to use it to find the absolute extrema of a continuous function on a closed interval.
• Understand the connection between critical numbers and local extrema and be able to find the critical numbers of a given function by finding where the derivative is either zero or undefined.

**Section 4.2** The Mean Value Theorem

• Memorize the statements of the Mean Value Theorem (MVT) and the Intermediate Value Theorem (IVT).
• Be able to determine whether a given function satisfies the hypotheses of the MVT and/or the IVT.
• Be able to apply the MVT a function given by an equation in order to find points where the slope of a secant line to the function and the slope of the tangent line are equal to each other.
• Be able to apply the MVT and/or IVT to reach conclusions about a function given as a table of values.

**Section 4.3** The First Derivative Test

• Understand the connection between the sign of the first derivative of a function and the increasing/decreasing behavior of that function.
• Know how to find the intervals where a given function is increasing/decreasing and classify its local extrema by analyzing the first derivative of the function.
• Be able to reach conclusions about the shape of the graph of a function based on its graph or based on the graph of its first derivative.

**Section 4.4** Concavity and the Second Derivative Test

• Understand the definition of concave up and concave down and be able to apply this definition to solve qualitative problems.
• Understand the connection between concavity and the sign of the second derivative of a function.
• Know how to find the intervals where a given function is concave up/down and find any inflection points by analyzing the second derivative of the function.
• Know how to classify the local extrema of a function using the second derivative test.
• Be able to reach conclusions about the behavior of the graph of a function or its first derivative based on the graph of its second derivative.

**Section 4.5** Summary of Graphical Methods

• Understand how to find the vertical and horizontal asymptotes of a function and the intercepts of a function.
• Be able to analyze the first and second derivatives of a function in order to find the intervals where it is increasing/decreasing, concave up/down, and to find the coordinates of all local extrema and inflection points.
• Be able to combine information about asymptotes, intercepts, local extrema, inflection points, increasing/decreasing intervals, and concavity in order to draw an accurate graph of a function.

**Section 4.6** Optimization Problems

• Understand the idea of optimization and how to use information from the first and second derivatives in order to find maximum and minimum values for a given function under certain constraints.
• Be able to apply the method for solving optimization problems to a specific application.

**Section 4.7** Rectilinear Motion and Other Applications

• Understand the concepts of position/displacement, velocity, speed, and acceleration and how these function relate to one another.
• Be able to find equations for position, velocity, and acceleration given initial conditions.
• Be able to use these concepts to solve application problems involving motion.

**Section 4.8** Newton's Method

• Understand how to use Newton's method to approximate a zero of a function
• Be able to use Newton's method to approximate $n$th roots of numbers.