Math 261
Exam 3 Review Sheet

**Section 4.1** Extreme Values of Functions

• Know the definitions of increasing, decreasing, constant, absolute maximum value, absolute minimum value, local maximum, local minimum, and critical point 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 all 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 values of a function and its derivatives based on a given table of values.
• Be able to illustrate the conclusion of the Mean Value Theorem on the graph of a function.

**Section 4.3** Monotonic Functions and 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, the Second Derivative Test, and Curve Sketching

• 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.
• 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 4.5** Applied Optimization

• 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 this method to solving optimization problems related to a specific application.

**Section 4.6** 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.

**Section 4.7** Antiderivatives

• Know the definition of an antiderivative of a function and how to find the indefinite integral of a function, including the arbitrary constant of integration.
• Understand integral notation.
• Know the properties of indefinite integrals, basic antidifferentiation formulas, and the inverse properties of integration and differentiation.
• Know how to solve differential equations by using initial conditions to solve for constants of integration.
• Be able to use antidifferentiation to solve application problems involving motion.