Calculus 1, Chapter 4 "Applications of Derivatives" Study Guide

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The following is a *brief* list of topics covered in Chapter 4 of *Thomas' Calculus*.

4.1 Extreme Values of Functions on Closed Intervals. Absolute minimum and maximum, extreme values, Extreme-Value Theorem for Continuous Functions (Theorem 4.1), local maximum and minimum (relative extrema), Local Extreme Values (Theorem 4.2), critical point, finding extrema of continuous function on a closed and bounded interval.

4.2 Mean Value Theorem. Rolle's Theorem (Theorem 4.3), Mean Value Theorem (Theorem 4.4), Functions with Zero Derivatives are Constant Functions (Corollary 4.1), Functions with the Same Derivative Differ by a Constant (Corollary 4.2), position/velocity/acceleration, Algebraic Properties of Natural Logarithms (Theorem 1.6.1/Theorem 4.2.A), Properties of Natural Exponentials (Theorem 4.2.B).

4.3 Monotone Functions and the First Derivative Test. increasing/decreasing function on an interval, monotonic function, First Derivative Text for Increasing and Decreasing (Corollary 4.3), First Derivative Test for Local Extrema (Theorem 4.3.A), sign tests of f'.

4.4 Concavity and Curve Sketching. Increasing/decreasing y', concave up and concave down functions on open intervals, convex function, Second Derivative Test for Concavity (Theorem 4.4.A), concavity emojis, point of inflection, sign tests of f'', Second Derivative Test for Local Extrema (Theorem 4.5), "Procedure for Graphing $y = f(x)$" (seven steps).

4.5 Indeterminate Forms and L'Hôpital's Rule $0/0$ and ∞/∞ indeterminate forms of limits, L'Hôpital's Rule (Theorem 4.6), L'Hôpital's Rule for ∞/∞ Indeterminate Forms (Theorem 4.5.A), $\infty - \infty$ indeterminate form, $0 \cdot \infty$ indeterminate form, 1^∞ indeterminate form, 0^0 indeterminate form, ∞^0 indeterminate form, limits and exponentials (Theorem 4.5.B), Cauchy's Mean Value Theorem (Theorem 4.7), proof of L'Hôpital's Rule.

4.6 Applied Optimization Problems. Solving Applied Optimization Problems (the 5 steps), cost/revenue/profit functions, marginal revenue, marginal cost, marginal profit, average cost function.

4.7 Newton's Method. The iterative procedure for Newton's Method, problems with Newton's Method (see Figures 4.53 and 4.54).

4.8 Antiderivatives. Antiderivative, indefinite integral, integral sign, variable of integration, the form of an indefinite integral and the "$+C$" notation (see Theorem 4.8), differential equation, initial value problem, antiderivative formulas (Tables 4.2 and 4.2.A), Constant Multiple Rule and Sum or Difference Rule, general solution of a differential equation, initial conditions, and solution to an initial value problem.