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| **Subject:** Mathematics | **Course**: Honors Calculus | **Grade Level**: 12 |

**Course Description**: This course is designed to foster within its students an intuitive yet rigorous understanding of Differential Calculus. Instructional methods promote both independent and collaborative problem solving. Within the problem solving structures, logical and analytical thinking, leading to the discovery of possible solutions is developed. The students are prepared tp continue their mathematics education at the college level.

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| **Objectives**  **Topic**: Absolute Value (Review)  Students will be able to:   * Understand the concept of slope as a rate of change between points. * Recognize and manipulate different forms of an equation of a line. * Define and solve linear, rational, and polynomial absolute value sentences algebraically. * Apply piece wise definitions to graph absolute value sentences.   **Topic**: Composite and Inverse Functions (Review)   * Construct a composite function from two or more functions * Given the composite function determine the initial and secondary functions. * Determine if a function is 1-1, if not restrict the domain to make it 1-1. * Solve for the inverse function * Understand the relationship between a function and it’s inverse function and their graphs to y=x.   **Topic**: Transcendental Functions (Review)   * Graph Exponential functions in relation to each other. * Graph same using transformations * Graph logarithmic functions as an inverse function of an exponential function with respect to y=x. * Simplifying and expanding logarithmic expressions. * Solving logarithmic and exponential equations.   **Topic**: Limits and Continuity   * Understand intuitively and explain the concept of a limit. * Develop and use techniques to evaluate limits in one of three ways, graphically, analytically and algebraically. * Determine and understand when and why a limit does not exist. * Prove continuity in terms of a limit.   **Topic:** The Derivative   * Understand that Calculus is the study of change. * Compute the average rate of change as the slope of the secant line. * Understand and compute the instantaneous rate of change at a point as the limit of the slope of the secant line, which is the slope of the tangent line. * Derive, understand, and use the limit of the slope of all tangent lines in a curve using the limit definition of the derivative. * Calculate the slope of a tangent line for a curve and a point on the curve, and find the equation of the tangent line. * Understand and prove why and when a derivative does not exist. * Recognize and interpret Lagrange, Leibniz, and Newton notations for a derivative. * Understand and compute the derivative of an absolute value and why the derivative does not exist at the vertex. * Explain continuity in terms of a derivative.   **Topic**: Power Rule   * Derive and use the power rule for finding a derivative if f(x)=x^n. * Understand and explain why the derivative of a constant is 0. * Understand a derivative as a function of change and a higher derivative as the derivative of a function of change. * Compute higher derivatives.   **Topic**: Velocity and Acceleration   * Define and understand velocity as a rate of change in position, therefore a derivative of the position function. * Define and determine initial displacement and initial velocity. * Construct displacement (position) function. * Compute velocity function. * Understand how to compute maximum height and distance an object travels. * Define and understand acceleration as a rate of change in velocity.   **Topic**: Differentiation Rules   * Derive using the limit definition of a derivative and apply the Product rule to differentiate a series of factors. * Derive using the limit definition of a derivative and apply the quotient rule in differentiating a series of quotients. * Understand and use the chain rule to differentiate a function raised to a power. * Understand and use the chain rule to differentiate a composite function. * Use the chain rule to differentiate a quotient as a product.   **Topic**: Implicit Differentiation   * Understand the relationship between the coordinates of a function and the coordinates of its inverse. * Derive by discovery; the derivative of an inverse equals the reciprocal of the derivative of its function. * Understand a derivative is, of the variable with respect to itself or with respect to another variable. * Relate an implicit function to an explicit equivalent. * Find the derivative implicitly. * Find tangent and normal lines and higher derivatives using implicit differentiation. * Analyze word problems, relating rates of change to find the unknown rate of change implicitly.   **Topic**: Trigonometric Functions   * Prove lim sin(x)/x as x->0 = 1 and lim cos(x)-1/x x->0= 0 and use with various techniques to evaluate the limit of trigonometric functions. * Derive the derivative of sin(x) and cos(x) using the limit definition of a derivative. * Recognize all trigonometric functions are composite functions and therefore differentiation involves the chain rule. * Apply the derivative rules to trigonometric functions explicitly and implicitly. * Analyze word problems, relating rates of change to find the unknown rate of change implicitly.   **Topic:** Exponential and Logarithmic  Functions   * Derive the rules for the derivatives of exponentia and logarithmic functions * Determine the derivatives of logarithmic and exponential functions, then simplify.   **Topic**: Linearization   * Understand the thought process of approximating a solution by use of the tangent line close to the value of interest.   **Topic**: Maxima and Minima   * Understand and explain Rolle’s Theorem geometrically. * Understand the purpose of Rolle’s Theorem to imply a max or min. * Apply Rolle’s Thm. to maxima and minima on graphs of simple polynomials. * Understand Rolle’s Theorem is a special case of the Mean Value Theorem. * Derive the Mean Value based on Rolle’s Thm. * Understand the meaning and use the Mean Value Thm. to find the slope of the slope of the tangent at any and all points on the curve. * Derive and use the first derivative test based on the slope of the tangent lines increasing and decreasing to find maximum and minimum points of a function. * Derive and use the second derivative test based on interpreting the first derivative test to find changes in concavity and points of inflection. * Use Mean Value Theorem., first and second derivative tests and a graphing calculator to accurately sketch the curve of a function. * Interpret the graph of a derivative in order to reach conclusions about the function and vice versa. * Apply maxima and minima concepts and techniques to solve optimization problems.   **Topic**: Anti-derivative   * Understand an anti-derivative as an inverse operation. * Derive the anti-derivative rule. * Find the anti-derivative of polynomial functions. * Determine the initial value function   **Topic**: Indefinite Integral   * Utilize integration rules, including u substitution, and techniques to find f(x) given f’ (x) for specific algebraic functions.   **Topic**: Definite Integral   * Understand the concept of a definite integral and find same by the Fundamental Theorem of Calculus Part I * Understand and utilize summation of a finite sum of rectangular areas to approximate the area under a curve. * Understand, appreciate and utilize the limit of an infinite sum of rectangular areas using left and right endpoints and midpoints to find the approximate area under a curve. * Derive and use the Gaussian summation formulas as a limit of an infinite amount of rectangles to find the area under a curve defined as The Riemann Sum. * Define and apply Riemann Sum as a definite integral to find the area above the x axis and below f(x). * Derive methods to find area below x axis and above curve. * Derive methods to find area bounded by the y axis and f(y).   **Optional Topics:** Integration by Parts and Volume | **Resources**  Larson, Hostetler, Edwards, Calculus, Boston MA, Houghton Mifflin, 2010  Texas Instrument Graphing Calculator TI-84 plus  [**https://kahoot.com**](https://kahoot.com) **online assessment**  **very engaging for students of all ages.**  [All](https://www.bing.com/search?q=khan+academy&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past 24 hours](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez1%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past week](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez2%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past month](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez3%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)   1. [Khan Academy **-**](https://www.khanacademy.org/)   https://**www.khanacademy.org**  You can learn anything. Expert-created content and resources for every subject and level. Always free.  IXL Software  Stewart, Calculus, Pacific Grove, CA, Brooks/Cole 2016  Texas Instrument TI 84 plus and emulator.  TI 84 plus Graphing calculator emulator.  Thomas, Finney. Calculus of a Single Variable. New York, NY, 2015  Use TI Graphing Calculator to calculate numerical derivatives of composite functions  TI graphing Calculator to calculate the numerical derivative of a trigonometric function  Use TI 84 plus graphing calculator.  Use TI graphing calculator to find max and min points  Use TI graphing calculator to find real roots  Find the definite integral using TI graphing calculator | **Assessments**  Textbook assignment graphing, and solving linear equations as a homework quiz  Quiz on defining and solving absolute value sentences  Test on solving and graphing absolute value sentences  Teacher generated assignment on finding a composite function and breaking down a composite, making functions 1-1 and finding their inverse functions  Test on composites, functions and their inverses  Teacher generated assignment on graphing exponential and logarithmic functions as a homework quiz  Teacher generated test on solving transcendental functions and their graphs  Resource generated worksheet as a homework quiz  Teacher generated quiz on limits and continuity.  Teacher generated quiz on limit definition of derivative and tangent lines  Teacher generated test limit def. of a derivative, tangent and normal lines, Power Rule, calculator generated numerical derivatives.  Teacher generated test on Power rule, Tangent lines, and Velocity and Acceleration.  Resource generated worksheet assignment as a homework quiz  Teacher generated test on Derivative Rules and applying to tangent and normal lines and calculator computed numerical derivatives  **MID-TERM EXAM**  Teacher generated quiz on implicit differentiation  Teacher generated test on derivative rules, implicit differentiation, and related rates.  Resource generated worksheet as homework quiz  Teacher generated test on limits and derivatives of Trigonometric functions  Teacher generated test on trigonometric derivatives and related rates  Teacher generated quiz on linearization.  Teacher generated quiz on Rolle’s Thm.  Resource generated worksheet for homework quiz on curve sketching  Teacher generated quiz sketching rational functions  Teacher generated test on curve sketching and derivative graph interpretation  Teacher generated test on maxima, minima and optimization  Teacher generated quiz on finding anti-derivatives and initial value function  Teacher generated test on anti-derivatives and indefinite integrals  Teacher generated quiz finding the definite integral  Teacher generated quiz to find area under a curve using Gaussian Summation as a Riemann Sum  Teacher generated test on finding area bounded by an axis and f(x) or f(y).  **FINAL EXAM** |