

The Notebook Project – AP Calculus AB

This project is designed to improve study skills and organizational skills for a successful career in mathematics. You are to turn a composition notebook into a “Go To” textbook for easy reference and review.

*Table of Contents MUST BE located on the first several pages.

Topics covered:

1. Rules of Differentiation (provide examples with each)
 - a. Power Rule
 - b. Derivative of a Constant
 - c. Constant Multiple Rule of Derivatives
 - d. Sum & Difference Rule for Derivatives
 - e. Product Rule
 - f. Quotient Rule
 - g. Chain Rule
 - h. Derivative of Trigonometric Functions
 - i. Derivative of Inverse Trigonometric Functions

2. Limit
 - a. Definition of limit (with notation explanation)
 - b. Finding a limit via a table (example)
 - c. Finding a limit graphically (example)
 - d. One sided limit \rightarrow (notation explanation)
 - i. $\lim_{x \rightarrow c} f(x)$ exist if $\lim_{x \rightarrow c^-} f(x) = \lim_{x \rightarrow c^+} f(x)$
 - ii. Example
 - When limits do not exist [3 cases]
 - Properties of limits
 - Finding limits
 - Direct substitution (example)
 - e. Indeterminant form
 - i. Factoring
 - ii. Rationalizing
 - iii. Embedded denominator
 - iv. Trigonometric identity
 - v. Special case limits : $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$
 - vi. Limit involving infinity
 - Horizontal asymptote rules (with example)
 - End behavior model for rational function
 - Vertical asymptotes
 - vii. Continuity
 - Types of discontinuity

- Continuity of a point
 - Properties of continuity
 - Intermediate value theorem
3. Derivatives and Rates of Change
- a. Secant line
 - b. Average rate of change (with example)
 - c. Tangent line
 - d. Instantaneous rate of change
 - e. Slope of a curve at a point (with examples)
 - f. Equation of tangent line (with example)
 - g. Normal Line (with example)
 - h. Limit Definition of Derivative
 - i. Alternative definition of derivative

******| Diagram of Secant vs. Tangent Line |******

- j. Differentiability at a point postulate
 - k. Points that are not differentiable
 - l. Differentiability implies continuity
 - m. Calculator Key Strokes for Derivative at a point
 - n. Differentiability with piece wise function (example)
4. Instantaneous Rates of Change
- a. Displacement
 - b. Average Velocity vs. Instantaneous Velocity
 - c. Speed
 - d. Acceleration
 - e. Determining when speed is increasing or decreasing (table)
5. Implicit Differentiation (provide examples with each)
- a. Implicit Differentiation (steps)
 - b. Derivative of Inverse Functions (steps & theory)
 - c. Derivative of Natural Exponential & Log Functions
 - d. Properties of Logarithms
 - e. Derivatives of Exponential & Logarithmic Functions
6. Applications of Derivatives (provide examples with each)
- a. Extreme Value Theorem
 - i. Definitions of Relative Extrema
 - ii. Critical Points
 - iii. Finding Absolute Extrema
 - b. Mean Value Theorem
 - c. Information About $f(x)$ Given the Derivative

- i. Increasing/Decreasing
 - ii. First Derivative Test
 - iii. Concavity
 - 1. Test for Concavity
 - 2. Guidelines for Determining Concavity
 - 3. Points of Inflection
 - iv. 2nd Derivative Test
 - d. Optimization
 - i. Steps/Guidelines
 - ii. 3 Examples of your choice
 - e. Related Rates
 - i. Steps/Guidelines
 - ii. 3 examples of your choice
- 7. Integration
 - a. Riemann Sums (provide example for each)
 - i. Steps/Guidelines
 - ii. LRAM
 - iii. RRAM
 - iv. Midpoint Method
 - v. Trapezoidal Method
 - b. Integral
 - i. Geometric Process
 - 1. Semi-Circle ($y = \sqrt{a^2 - x^2}$)
 - 2. Triangle (Absolute Value)
 - 3. Rectangle (constant function)
 - ii. Anti-Derivatives
 - 1. Rules & Properties
 - 2. Trigonometric Functions
 - 3. Inverse Trig Functions
 - 4. Logarithmic & Exponential Functions
 - iii. Evaluating Definite Integrals $\int_a^b f(x) = F(b) - F(a)$
 - 1. Evaluating using a calculator
 - iv. Fundamental Theorem of Calculus
 - 1. Part 1 – The Evaluation Theorem
 - 2. Part 2 – Second Fundamental Theorem
 - a. 2nd FTC Extended
 - v. U-Substitution
 - 1. Steps & examples
 - 2. Algebraic Techniques
 - a. Long Division
 - b. Expanding
 - c. Split Fractions

- d. Completing the Square
3. Trigonometric Special Cases

8. Applications of Integration

- a. Net Change
- b. Area Between 2 Curves
- c. Volume
 - i. Cross Sections
 - ii. Disk Method
 - iii. Washer Method

9. Differential Equations

- a. Differential Equations
- b. Slope Fields
- c. Exponential Growth & Decay
- d. Linear Approximation
 - i. Using the equation of the tangent line to predict value of $f(x)$