

## **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. 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

### 2. 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)
3. 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
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. 2<sup>nd</sup> 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. 2<sup>nd</sup> FTC Extended
    - v. U-Substitution
      - 1. Steps & examples
      - 2. Algebraic Techniques
        - a. Long Division
        - b. Expanding
        - c. Split Fractions

Due Date: \_\_\_\_\_

- d. Completing the Square
- 3. Trigonometric Special Cases
- 8. Applications of Integration
  - a. Net Change
  - b. Area Between 2 Curves