

## A SUMMARY OF CALCULUS

- Covers all content required for the AP Calculus Test – both AB and BC.
- The course starts with five major problems that introduce the big ideas of calculus: optimization, limits, differential equations, exponential functions, the relationship between distance and velocity, piecewise functions, volumes of revolution, volumes by slicing, and the Fundamental Theorem of Calculus. Each of these five major problems is revisited again later in the course for students to solve using new calculus knowledge.
- Each chapter reviews the concepts developed previously and builds on them.
- The curriculum contains several key labs and hands-on activities throughout the course to introduce concepts, such as when students recognize that the rate of a walker relates to the slope of a graph in the "Slope Walk." Labs also develop conceptual understanding, such as when the students discover instantaneous velocity in the "Ramp Lab."
- Students learn about derivatives and integrals simultaneously during the first four chapters and both are presented geometrically and in context.
- The first four chapters cover:
  - Pre-calculus topics, such as trigonometric functions, domain and range, and composite functions
  - Limits and continuity
  - Applications of rates of change, such as velocity and acceleration
  - The difference between average velocity and instantaneous velocity
  - The definition of a derivative and the Power Rule
  - Slope Functions – functions that find the slope of another function for all values in the domain
  - Differentiability and non-differentiability
  - Increasing and decreasing functions and concavity
  - Estimating the area under a curve with a Riemann Sum
  - Area functions – functions that find the area under a curve from 0 to all values in the domain
- The fifth chapter connects derivatives and integrals together with the Fundamental Theorem.
- Chapters six through nine cover:
  - How to find the distance, velocity and acceleration of an object when given information about its position, velocity or acceleration
  - Optimization
  - Related Rates
  - Derivative tools such as the Product, Quotient and Chain Rules, as well as implicit differentiation and finding derivatives of all trigonometric and inverse trigonometric functions
  - The derivative and integral of the natural logarithm and  $y = e^x$

- The Mean Value Theorem
- Integration using Substitution
- Differential Equations and Slope Fields
- Volumes of Revolutions and volumes of known cross-section
- Some material required for the BC Calculus Exam is introduced throughout the course in optional extensions of Chapters 5 - 9. These topics include:
  - Newton's Method
  - l'Hôpital's Rule
  - Improper Integrals, as well as integrating with partial fractions and integrating by parts
  - Arclength
- Chapters ten through thirteen cover additional BC Calculus content, including:
  - Convergence and divergence of infinite series
  - Differentiation and integration of polar functions, as well as parametric functions and vector functions
  - Logistic Curves
  - Approximating functions with polynomials
  - Taylor and Maclaurin Polynomials, as well as the error