

### Section 5.1 Area and Estimating with Finite Sums

- Know how to estimate the area between a function  $f(x)$  and the  $x$ -axis over an interval  $[a, b]$  using rectangular approximations such as: upper sums, lower sums, left hand sums, right hand sums, and midpoint sums based on equally sized subintervals or unequally sized subintervals.
- Understand that these approximations become more accurate as more rectangles are used.
- Be able to solve application problems involving displacement or total distance traveled.

### Section 5.2 Sigma Notation and Limits of Finite Sums

- Understand summation notation and the basic properties of sums. Be able to apply them to find the value of a specific sum.
- Be able to find a summation notation representation for a given sequence of numbers.
- Memorize the summation formulas:  $\sum_{k=1}^n c = nc$ ,  $\sum_{k=1}^n k = \frac{n(n+1)}{2}$ ,  $\sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}$ , and  $\sum_{k=1}^n k^3 = \left[ \frac{n(n+1)}{2} \right]^2$
- Be able to apply these summation formulas to find the value of a given sum either as a number or as an expression in  $n$ .
- Be able to use a finite sum to **approximate** the area under a continuous function on an interval  $[a, b]$ .
- Be able to take the limit of a finite sum in order to find the **exact area** under a continuous function on an interval  $[a, b]$ .

### Section 5.3 The Definite Integral

- Understand the definition of a partition  $P$  of a closed interval  $[a, b]$  and the definition of the norm of a partition.
- Understand how to find the Riemann sum associated with a particular partition.
- Know the definition of the definite integral of a function  $f$  on an interval  $[a, b]$  (i.e. the limit of Riemann sums on the interval as the norm  $\|P\| \rightarrow 0$ , provided the limit exists).
- Understand the connection between the definite integral and area between a function and the  $x$ -axis.
- Know that continuous functions are integrable, but that not all functions are integrable on a given interval  $[a, b]$ .
- Know the basic properties of definite integrals and be able to apply them to carry out computations (see pg. 266 in your textbook).
- Be able to find the average value of a function on a given interval.

### Section 5.4 The Fundamental Theorem of Calculus

- Memorize the statement of the Mean Value Theorem for definite integrals.
- Memorize both parts of the statement of the fundamental theorem of calculus.
- Be able to apply the fundamental theorem of calculus to compute definite integrals of continuous functions.
- Understand the relationship between differentiation, integration, and the first part of the Fundamental Theorem and be able to perform related computations.
- Understand the meaning of the definite integral of a rate of change and be able to solve related application problems.
- Understand the difference between signed area and unsigned area and be able to decide which is appropriate to use in a given situation.

### Section 5.5, 5.6a Indefinite Integrals and the Substitution Method

- Understand the method of substitution and be able to use it to solve indefinite integrals.
- Be able to use the method of substitution to compute the value of a definite integral.
- Be able to use trigonometric identities to find antiderivatives involving  $\sin^2(u)$  and  $\cos^2(u)$ .
- Be able to use substitution to solve initial value problems.

### Section 5.6b Area Between Curves

- Be able to find the Area between a function and the  $x$ -axis using the Fundamental Theorem of Calculus.
- Be able to find the area of a region enclosed between two functions  $f(x)$  and  $g(x)$  with  $f(x) > g(x)$  (perhaps on an given interval) by setting up a definite integral and applying the Fundamental Theorem of Calculus.
- Be able to find the area of a region enclosed between two functions  $f(y)$  and  $g(y)$  with  $f(y) > g(y)$  (perhaps on an given interval) by setting up a definite integral and applying the Fundamental Theorem of Calculus.
- Be able to find the area of a region bounded by more than two functions or a region bounded by functions that cross each other one or more times.

### Section 5.7 Numerical Integration

- Know how to estimate a definite integral using the Trapezoid Rule.