Unit 7 Applications of Integrals

Content Area: **Mathematics**
Course(s): **AP Calculus AB**
Time Period: **January**
Length: **Approximately 10 blocks**
Status: **Published**

Transfer Skills

The purpose of this unit is to use integration to solve differential equations, find the area between curves, and find the volume of solids of revolution.

Enduring Understandings

Antidifferentiation is an underlying concept involved in solving separable differential equations.

Solving differential equations involves determining a function or relation given its rate of change.

The definite integral can be used to find exact area, volume, or length by using the limit of Riemann sums.

Essential Questions

What characteristics of certain functions lend themselves naturally to one method but not another?

How can one approximate solution to differential equations graphically?

How can integrals be used to find volumes of complex figure?

What are the practical applications of finding such volumes?

Content

Vocabulary:

2nd Fundamental Theorem of Calculus, u-substitution, differential equation, contant of integration, exponential growth and decay, slope field, area, cross section, volume, disc method, washer method

Red Hot Topics:

* Graphing functions

* Separating variables

* Squaring binomial expressions

* Area of circles and triangles

* Basic Volume formulas

Skills

Understand and use the Second Fundamental Theorem of Calculus and functions defined by integrals.

Finding integrals by substitution, including changing of variables and limits of integration.

Find general and particular solutions for differential equations.

Identify and create slope fields that represent the general solutions of differential equations.

Find the area between two curves.

Find volumes of solids of revolution using the disk method.

Calculate volumes of solids of known cross sections.

Resources

Single Variable Calculus with Vector Functions by James Stewart Chapter 6 and Chapter 9

AP Calculus AB AP Central at collegeboard.com

Khan Academy: www.khanacademy.org

Standards

Mathematical Practice For AP Calculus 1: Reasoning with Definitions and Threorems

- Use definitions and theorems to build arguments,
- Justify conclusions or answers, and prove results;
- Confirm that hypotheses have been satisfied in order to apply the conclusion of a theorem;
- Apply definitions and theorems in the process of solving a problem; interpret quantifiers in definitions and theorems;
- Develop conjectures based on exploration with technology;
- Produce examples and counterexamples to clarify understanding of definitions, to investigate whether converses of theorems are true or false, or to test conjectures.

Mathematical Practice For AP Calculus 2: Connecting Concepts

- Relate the concept of a limit to all aspects of calculus;
- Use the connection between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process antidifferentiation) to solve problems;
- Connect concepts to their visual representations with and without technology;
- Identify a common underlying structure in problems involving different contextual situations.

Mathematical Practice For AP Calculus 3: Implementing algebraic/computational processes

- Select appropriate mathematical strategies;
- Sequence algebraic/computational procedures logically;
- Complete algebraic/computational processes correctly;
- Apply technology strategically to solve problems; attend to precision graphically, numerically, analytically, and verbally and specify units of measure;
- Connect the results of algebraic/computational processes to the question asked.

Mathematical Practice For AP Calculus 4: Building notational fluency

- Know and use a variety of notations (e.g., f '(x), y', dy/dx);
- Connect notation to definitions (e.g., relating the notation for the definite integral to that of the limit of a Riemann sum);
- Connect notation to different representations (graphical, numerical, analytical, and verbal);
- Assign meaning to notation, accurately interpreting the notation in a given problem and across different contexts.

Mathematical Practice For AP Calculus 5: Connecting Multiple Representations

- Associate tables, graphs, and symbolic representations of functions;
- Develop concepts using graphical, symbolical, or numerical representations with and without technology;
- identify how mathematical characteristics of functions are related in different representations;
- Extract and interpret mathematical content from any presentation of a function (e.g., utilize information from a table of values);
- Construct one representational form from another (e.g., a table from a graph or a graph from given information);
- Consider multiple representations of a function to select or construct a useful representation for solving a problem.

Mathematical Practice For AP Calculus 6: Communicating

- Clearly present methods, reasoning, justifications, and conclusions;
- Use accurate and precise language and notation;
- Explain the meaning of expressions, notation, and results in terms of a context (including units);
- Explain the connections among concepts;
- Critically interpret and accurately report information provided by technology;
- Analyze, evaluate, and compare the reasoning of others

MA.F-IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.
MA.K-12.4	Model with mathematics.
MA.F-IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
MA.K-12.5	Use appropriate tools strategically.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.