Unit 9 Parametric, Polar, and Vector Functions

Content Area: **Mathematics**
Course(s): **AP Calculus BC**
Time Period: **April**
Length: **Approximately 5 blocks**
Status: **Published**

Enduring Understandings

Functions and relations can be represented using vector, parametric equations, and polar coordinates.

Vectors, parametric equations, and polar coordinates are useful in solving real-world problems.

Sometime representing a function in a different form can extend our understanding and knowledge of the function.

Essential Questions

How can graphs be represented with functions, parametric equations, polar coordinates, or vectors?

How can representing a curve with differently defined equations (parametric, vectors, and polar) allow for further understanding of the curve's behavior?

Content

Vocabulary:

Parameter, parametric equation, initial point, terminal point, vector, displacement vector, zero vector, vector addition, scalar multiplication of vectors, component form, magnitude or length, position vector, standard basis vectors, vector valued function, velocity vector, acceleration vector, polar coordinate system, pole, polar axis, polar coordinates

Red Hot Topics:

*Writing Parametric Equations

*Graphing Parametric Equations

*Graphing with polar coordinates

*Polar form to standard form and vice versa

*Writing vectors in component form

*Graphing vectors

*Basic operations with vectors

Skills

Sketch a graph given a function expressed parametrically.

Find the slope of the tangent line of a function (dy/dx) expressed parametrically.

Calculate the second derivative of a function expressed parametrically.

Determine the arc length of a given curve expressed parametrically.

Find the velocity vector of a function.

Find the acceleration vector of a function.

Calculate the speed of a parametric function at a given point time.

Plot points in the polar plane.

Convert from polar coordinates to rectangular coordinates.

Convert from rectangular coordinates to polar coordinates.

Sketch polar curves on the polar plane.

Convert equations from rectangular to polar.

Convert equations from polar to rectangular.

Find the slope of the tangent line (dy/dx) of a polar curve.

Calculate the area enclosed by a polar curve.

Calculate the area between polar curves.

Resources

Single Variable Calculus with Vector Functions by James Stewart Chapter 10

AP Calculus BC 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.K-12.2	Reason abstractly and quantitatively.
MA.K-12.5	Use appropriate tools strategically.

TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS3	Develop cultural understanding and global awareness by engaging with learners of other cultures.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.