Marietta City Schools

2025-2026 District Unit Planner

AP Calculus BC

Unit title	BC Unit 9: Parametric Equations, Polar Coordinates, and Vector-valued Functions and AP Exam review	Unit duration (hours)	BC Only: 4-5 weeks

Mastering Content and Skills through INQUIRY (Establishing the purpose of the Unit): *What will students learn?*

GA DoE Standards

Standards

AP Calc BC 9.1-9.9, 8.13

Concepts/Skills to be Mastered by Students

9.1 Defining and differentiating parametric equations
9.2 Second derivatives of parametric equations
9.3 Finding arc lengths of curves given parametric equations
9.4 Defining and differentiating vector-valued functions
9.5 Integrating vector-valued functions
9.6 Solving motion problems using parametric and vector-valued functions
9.7 Defining polar coordinates and differentiating in polar form
9.8 Find the area of a polar region or the area bounded by a single polar curve
9.9 Find the area of the region bounded by two polar curves

LEARNING OBJECTIVE

CHA-6.A
Determine the length of a curve in the plane defined by a function, using a definite integral. BC ONLY

ESSENTIAL KNOWLEDGE

CHA-6.A.1
The length of a planar curve defined by a function can be calculated using a definite integral. BC ONLY

8.13 The arc length of a smooth, planar curve and distance traveled

Published: 9,2025 Resources, materials, assessments not linked to SGO or unit planner will be reviewed at the local school level.

Notation

For a curve defined parametrically, the value of $\frac{dy}{dx}$ at a point on the curve is the slope of the line tangent to the curve at that point. $\frac{dy}{dx}$, the slope of the line tangent to a curve defined using parametric equations, can be determined by dividing $\frac{dy}{dt}$ by $\frac{dx}{dt}$, provided $\frac{dx}{dt}$ does not equal zero. **BC ONLY**

CHA-3.G.3

$\frac{d^2 y}{dx^2}$ can be calculated by dividing $\frac{d}{dt}\left(\frac{dy}{dx}\right)$ by $\frac{dx}{dt}$. **BC ONLY**

For a curve given by a polar equation $r = f(\theta)$, derivatives of r, x, and y with respect to θ, and first and second derivatives of y with respect to x can provide information about the curve.
BC ONLY

Essential Questions

- How can we model motion not constrained to a linear path?
- How does the chain rule help us to analyze graphs defined using parametric equations or polar functions?
- How can methods for calculating integrals of real-valued functions can be extended to parametric or vector-valued functions?

Assessment Tasks

List of common formative and summative assessments.

Formative Assessment(s):

Notecards, hw, quizzes, skills checks

Summative Assessment(s):
Unit test

Learning Experiences

Add additional rows below as needed.

Objective or Content	Learning Experiences	Personalized Learning and Differentiation
		All information included by PLC in the differentiation box is the responsibility and ownership of the local school to review and approve per Board Policy IKB.
	1 9.2 **Numbered Heads Together** Organize the class into groups of four and give each student a number. Give the class one set of parametric equations and have students individually find the second derivative. When all students in a group have finished, have them stand up to discuss their answers, make any necessary corrections, and then sit back down. Choose a group and call a specific student number so that the student can share the answer with the class. 2 9.5 9.6 **Scavenger Hunt** Create cards containing a parametric initial value question and the answer to a different question. Students can start at any question, moving around the room to make a full circuit of all questions once complete. Focus on giving students an initial value and asking for one or both component values at a different t- or x-value (e.g., $x'(t) = 2t$, $y'(t) = \cos(t)$, and position is $(2, 0)$ at $t = \pi$. Find position at $t = \dfrac{5\pi}{6}$.).	

Content Resources

- AP Classroom (within AP Central, collegeboard.org), AP daily videos, progress checks
- Calculus textbook: Calculus, 11e, Larson & Edwards
- Tony Record (Avon HS) created resources
- Khan Academy
- Delta Math
- Flippedmath.com
- Master Math Mentor (pdf files and videos)
- Interactive NB pages
- Teacher created resources

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