Precalculus: Unit 4 – Vectors, Parametrics, *and Polars*

Topic	Instructional Foci
Topic 1: The Algebra of Vectors	Vector quantities represent magnitude and direction and can be represented as directed line segments. Vectors can be added, subtracted and multiplied by a scalar both geometrically and symbolically. Vectors can be multiplied using a dot product. Vectors can be used to solve problems involving velocity and other quantities. ***Background:*** The concept of a vector was introduced briefly in C2.0 Geometry as a way of describing translations in the plane. Students also learned to solve a triangle using trigonometric ratios and the Pythagorean Theorem. ***Concepts:*** 1. Define terminology and notation for vectors in two dimensions in terms of components, direction, and magnitude, and represent vectors as arrows in the coordinate plane. (Addison-Wesley §6.1, Glencoe §8.1) 2. Define addition, subtraction, and scalar multiplication of vectors, both algebraically and graphically. (Addison-Wesley §6.1, Glencoe §8.2) 3. Define the dot product of two vectors, and use dot products to find the angle between two vectors or the perpendicular components of a vector. (Addison-Wesley §6.2, Glencoe §8.4) 4. Apply operations on vectors to solve problems involving velocity and other quantities that can be represented by vectors. (Addison-Wesley §6.1, §6.2, Glencoe §8.5)

MCPS © 2016-2017

Topic	Instructional Foci
Topic 2: Parametrically-Defined Functions/*Vector-Valued Functions*	Parametrically-defined functions can be used to model motion in the plane. *Vector-valued functions can be used to model real-world situations.* ***<u>Background:</u>*** In C2.0 Algebra 2, students explored modeling circular motion using sine and cosine functions. C2.0 Honors Algebra 2 students were introduced to parametric equations to model the horizontal and vertical components of circular motion. ***<u>Concepts:</u>*** 1. Understand how parametric equations can be used to model the horizontal and vertical components of motion along a curve in a plane. (Addison-Wesley §6.3, Glencoe §8.6) 2. Understand the connection between the rectangular form of a function and the parametric form. (Addison-Wesley §6.3, Glencoe §8.6) 3. Use parametrically-defined functions to model the horizontal and vertical components of motion in a plane. (Addison-Wesley §6.3, Glencoe §8.7) 4. *Understand the connection between parametrically-defined functions and vector-valued functions.*

<table>
<tr><th>Topic</th><th>Instructional Foci</th></tr>
<tr><td>Topic 3: Polar Curves/Complex Numbers in Polar Form</td><td>

Complex numbers can be represented on the complex plane in rectangular (e.g., $a+bi$) and polar (e.g., $r(\cos\theta + i\sin\theta)$) form.

Arithmetic operations (addition, subtraction, multiplication, division, conjugation, exponentiation) can be represented geometrically on the complex plane and their polar representations can be used to perform these operations.

The distance between two complex numbers in the plane can be calculated.

Some functions can be represented more efficiently by a polar form. (e.g., $r = f(\theta)$)

Functions in polar form can be graphed on the coordinate plane.

A function in rectangular form can be rewritten in polar form and vice versa.

Systems of polar equations can be solved symbolically and graphically.

Background
In C2.0 Algebra 2, students explored the connection between complex zeros of polynomial functions and their graphs, and they learned to add, subtract, and multiply complex numbers algebraically as part of a complex number system. Students were not required to simplify radical expressions that occurred as real or imaginary parts of complex numbers. Honors Algebra 2 students also learned to graph complex numbers in the complex plane and explored the graphs of powers of *i*.

Concepts:

1. Understand the connection between rectangular and polar coordinates of a point in the plane, and be able to convert between them. (Addison-Wesley §6.4)
2. Graph a polar equation and convert between polar form and rectangular form. (Addison-Wesley §6.4)
3. Convert a polar equation to parametric form, and identify key features of a polar graph. (Addison-Wesley §6.5)
4. Solve a system of polar equations, identifying actual points of intersection.
5. Define the trigonometric (polar) form of a complex number, and explain why the rectangular form and polar forms of a given complex number represent the same number. (Addison-Wesley §6.6)
6. Multiply and divide complex numbers in polar form, and apply DeMoivre’s Theorem to find powers and roots of a complex number in polar form. (Addison-Wesley §6.6)

</td></tr>
</table>

MCPS © 2016-2017