Unit 10.1-10.5 – Polars, Complex Numbers, and Vectors

By the end of this unit, you should be able to:

- □ plot points using polar coordinates
- convert between rectangular and polar coordinates
- □ transform equations between polar to rectangular form
- □ graph polar equations
- □ convert a complex number from rectangular form to polar form
- □ plot points in the complex plane
- □ find products and quotients of complex numbers in polar form
- □ use De Moivre's Theorem
- □ find complex roots
- □ graph vectors
- □ find a position vector
- □ add and subtract vectors algebraically
- □ multiply a vector by a scalar
- □ find the magnitude of a vector
- □ find a unit vector
- $\hfill\square$ find a vector from its direction and magnitude
- $\hfill\square$ find the dot product of two vectors
- □ find the angle between two vectors
- determine whether two vectors are parallel, orthogonal, or neither
- □ decompose a vector into two orthogonal vectors
- □ compute work

Assignments:

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10.1 – Polar Coordinates – pg. 721 #19-45odd, 55-61odd, 67, 69, 75, 79	
10.2 – Polar Graphs – pg. 736 #13, 17, 21, 25, 29-36, 37-49odd, 50	
10.3 – Complex Polar Plane – pg. 744 #11, 13, 23, 27, 33, 37, 41, 43, 49, 53, 57, 58	
10.4 – Vectors – pg. 755 #7, 9, 11, 27, 29, 33, 37, 39, 41, 45, 49	
10.5 – The Dot Product – pg. 763 #7, 9, 11, 19, 21, 25, 26, 29, 35	

Review Problems

1. Plot the points.

a)
$$\left(-2, \frac{2\pi}{3}\right)$$
 b) $\left(3, -300^{\circ}\right)$

2. Find the polar coordinates.

a)
$$\left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$$
 b) $\left(-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}\right)$

3. Find the rectangular coordinates

a)
$$\left(5,\frac{\pi}{2}\right)$$
 b) $\left(-1,\frac{3\pi}{4}\right)$

4. Graph.

a)
$$\theta = \frac{9\pi}{4}$$
 b) $r = 3 - 3\cos\theta$ c) $r = 2 + 3\sin\theta$ d) $r = 2\sin(2\theta)$

5. Write the polar equation in rectangular form.

a)
$$r = 5\cos\theta$$
 b) $4 = r\csc\theta$
(more on the back)



6. Given $z = 2(\cos 20^\circ + i \sin 20^\circ)$ and $w = 6(\cos 65^\circ + i \sin 65^\circ)$, find the following. Answer in polar form.

a) *zw* b) $\frac{w}{z}$ c) z^{6}

7. Plot each complex number in the complex plane. Then find the complex roots in polar form as indicated.

a) -8 - 8i (complex cube roots) b) -16i (complex fourth roots)

8. Let P = (4, -2) and Q = (1, 2) and **w** = 2**i** - **j**.

- a) Vector **v** is represented by the directed line segment PQ. Write **v** in the form $a\mathbf{i} + b\mathbf{j}$.
- b) Graph v + w.
- c) Find **w** 3**v**.
- d) Find $\|\vec{w}\|$.
- e) Find **v w**.
- f) Find the angle between **v** and **w**.
- g) Find the projector vector \mathbf{v}_1 of \mathbf{v} onto \mathbf{w} .
- h) Find the unit vector that is in the same direction as vector $\boldsymbol{v}.$
- 9. Determine whether **v** and **w** are parallel, orthogonal, or neither.
 - a) **v** = 2**i** + 3**j**; **w** = -4**i** 6**j**
 - b) v = 3i 4j; w = -3i + 4j
 - c) **v** = 3**i** 2**j**; **w** = 4**i** + 6**j**

10. A cargo ship has a speed of 20 miles per hour bearing S60°W. The constant water current is 8 miles per hour in the direction S60°E. What is the actual speed (relative to land) of the boat?

11. A wagon is pulled horizontally by exerting a force of 32 pounds on the handle at an angle of 50° to the horizontal. How much work is done in moving the wagon 40 feet?