10.1 Polar Coordinates and Polar Equations

# OBJECTIVE 1: Plotting Points Using Polar Coordinates

Given an ordered pair in the polar coordinate system, the **directed distance** *r* can be positive, negative, or zero.

• If , then *P* lies on the terminal side of angle .



• If , then *P* lies on the ray opposite of the terminal side of angle .



• If , then *P* lies on the pole regardless of the measure of angle .



When plotting polar coordinates and sketching polar equations, we will often use a **polar grid**. A polar grid consists of a series of concentric circles of different radii and pre-sketched angles in standard position. Polar grid paper is available for free online if you wish to print and use it.

 

# OBJECTIVE 2: Determining Different Representations of the Point

* Use the same value of *r* but choose an angle coterminal to . The coordinates will be of the form  where *k* is any integer.

 

* Use the opposite value of *r* but choose an angle coterminal to the angle located one-half of a rotation from angle . The coordinates will be of the form  where *k* is any integer.

 

Note: A point located at the pole has coordinates where  is **any** angle.

# OBJECTIVE 3: Converting a Point from Polar Coordinates to Rectangular Coordinates

**Relationships used when Converting a Point from Polar Coordinates to Rectangular Coordinates:**







# OBJECTIVE 4: Converting a Point from Rectangular Coordinates to Polar Coordinates

**Converting Rectangular Coordinates to Polar Coordinates for Points Lying Along an Axis**

In each case, assume that .

The point  lies along the positive *x-*axis and has polar coordinates of.



The point lies along the positive *y-*axis and has polar coordinates of .



The point lies along the negative *x-*axis and has polar coordinates of.

The point lies along the negative *y-*axis and has polar coordinates of .



**Converting Rectangular Coordinates to Polar Coordinates for Points Not Lying Along an Axis**

1. Determine the value of *r* using the equation.
2. Plot the point and determine the quadrant in which it lies.
3. Determine the value of the acute reference angle  by solving the equation .
4. Determine the value of  using  and the quadrant in which the point lines. There are four cases:
5. If  lies in Quadrant I, then .
6. If  lies in Quadrant II, then .
7. If  lies in Quadrant III, then .
8. If  lies in Quadrant IV, then .

 

 

# OBJECTIVE 5: Converting an Equation from Rectangular Form to Polar Form

A **polar equation** is an equation whose variables are *r* and . You will need to use the familiar relationships , , and  to convert equations in *x* and *y* (rectangular form) to polar form.

# OBJECTIVE 6: Converting an Equation from Polar Form to Rectangular Form

   