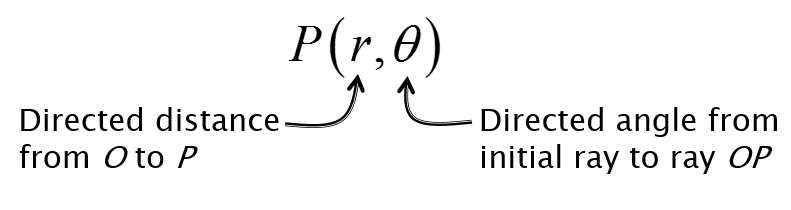
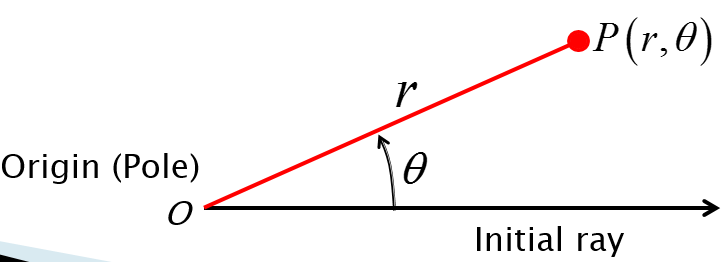
# Plotting Points Using Polar Coordinates

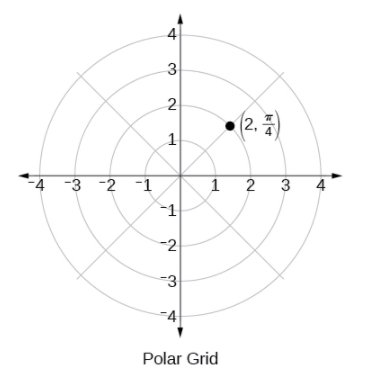
When we think about plotting points in the plane, we often think about rectangular coordinates in the Cartesian coordinate plane. However, there are other ways of writing a coordinate pair and other types of grid systems.

In this section, we will be graphing **polar coordinates**, which are points labeled and plotted on a polar grid. The polar grid is represented as a series of concentric circles radiating out from the **pole**, or the origin of the coordinate plane. The polar grid is scaled as the unit circle with the positive axis now viewed as the polar axis and the origin as the pole. The first coordinate , is the radius or length of the directed line segment from the pole. The angle , measured in radians, indicates the direction of . We move counterclockwise from the polar axis by an angle of and measure a directed line segment the length of in the direction of .

When graphing in polar coordinates, the radius of the circle gives us the distance from the origin, the lines guide us with the angles on the graph. If , the point lies on the terminal side. If , the point lies along the ray opposite the terminal side of . If, the point lies at the pole, regardless of the value of .

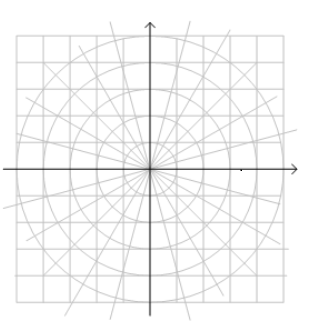
For example, to plot the point , we would move units in the counterclockwise direction and then a length of from the pole, as shown below.



Notice that with polar coordinates there are multiple ways to represent the same point. For instance, and , when plotted are the same point with different representations. Every point can be represented an infinite number of ways in polar coordinates.

Examples

For each of the following polar points, plot the point on the graph and then write three other representations of the point.



1)

2)

3)

# Converting from Polar Coordinates to Rectangular Coordinates

When given a set of polar coordinates, we may need to convert them to rectangular coordinates. We can do this with the known relationships that exist between , , , and .

**Converting from Polar Coordinates to Rectangular Coordinates**

To convert polar coordinates to rectangular coordinates , let

Given polar coordinates, convert to rectangular coordinates.

1) Given the polar coordinate , write and .

2) Evaluate and .

3) Multiply by to find the -coordinate of the rectangular form.

4) Multiply by to find the -coordinate of the rectangular form.

Examples: Write each of the following polar coordinates as rectangular coordinates.

# Converting from Rectangular Coordinates to Polar Coordinates

**Converting from Rectangular Coordinates to Polar Coordinates**

Examples: Convert each rectangular coordinate pair to polar coordinates.

# Transforming Equations between Polar and Rectangular Forms

Converting equations can be more difficult, since there are a number of polar equations that cannot be expressed clearly in Cartesian form, and vice versa. However, we can use the same procedures we used to convert points between the coordinate systems.

Examples

1. Write the Cartesian equation in polar form.
2. Rewrite the Cartesian equation as a polar equation.
3. Convert the polar equation to a rectangular equation and draw its corresponding graph.
4. Convert to a Cartesian equation. Write in the standard form of a conic if possible and identify the conic section represented.