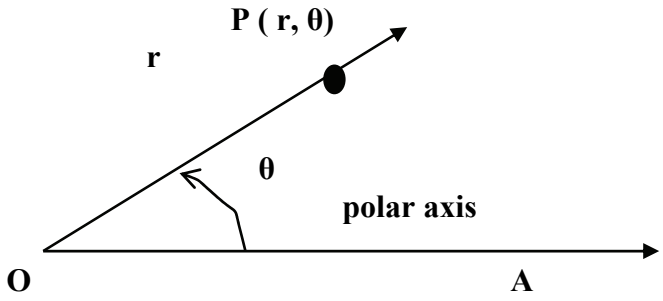
Unit 10 Lesson 1: Polar Coordinate System

Polar Coordinate System:

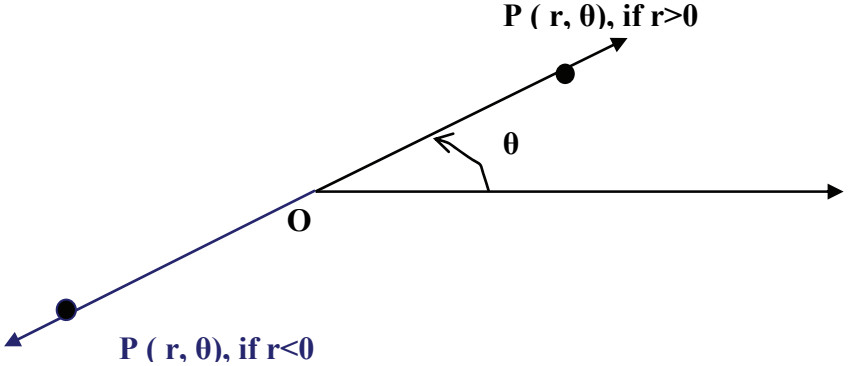
Polar Coordinate System – is an alternate system of graphing that differs from the rectangular system for plotting points in a plane. The polar system consists of a pole and a ray with the vertex at the pole and a fixed ray $\overrightarrow{OA}$ (called the polar axis). See the diagram below. The pole is similar to the origin of the rectangular system and the polar axis is similar to the x-axis of the rectangular system. The ordered pair (r, θ) is used to define the Polar Coordinates of point P. The directed distance from the pole to point P is called r and the measure of the angle from the polar axis to point P is θ. The coordinates of the pole are (0,θ) for any real value of θ measured in degrees or radians. Both r and θ can be positive or negative.



Observe the following definitions:

(r, θ) – Polar Coordinates
Point O – pole (origin)
$\overrightarrow{OA}$ -- polar axis
r – distance from the pole to point P
θ – is the angle formed by the polar axis and the ray from the pole to point P
(x, y) – Rectangular Coordinates

When r is positive, the polar distance is measured from point O along the terminal side of angle θ (counterclockwise).
When r is negative, the polar distance is measured from point O along a ray opposite of the terminal side of angle θ (clockwise).



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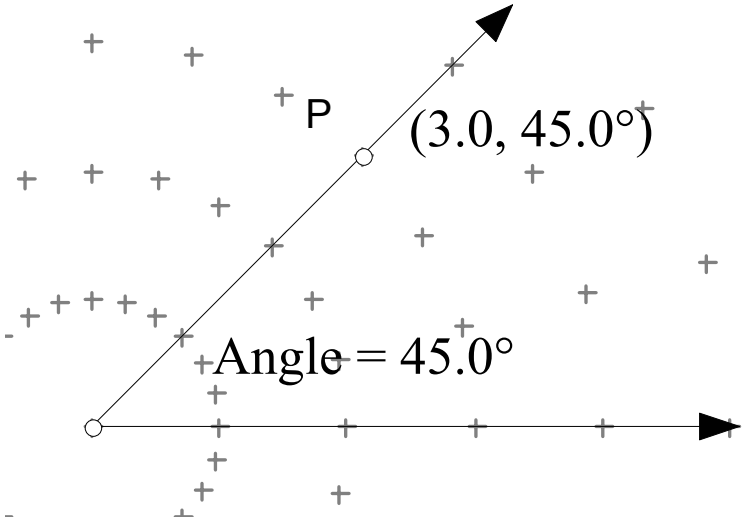
Example 1:

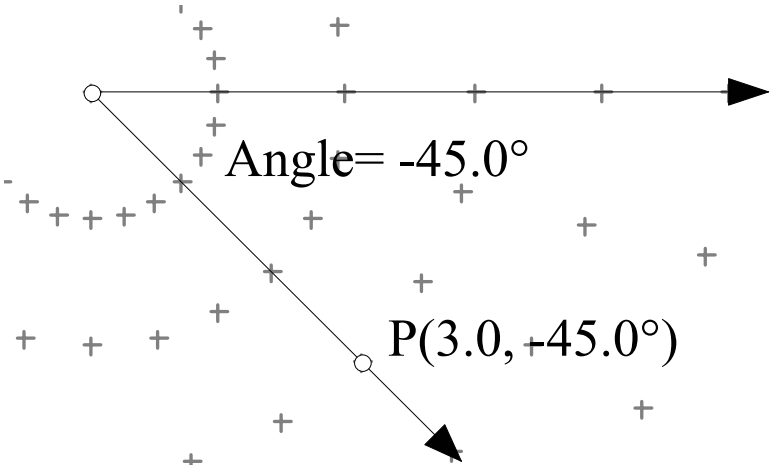
Graph each point on the rθ-plane:

$$U\left(3,\frac{\pi}{4}\right),\ \ \mathrm{V}\left(3,\frac{9\pi}{4}\right),\ \ \mathrm{W}\left(3,\frac{-\pi}{4}\right),\ \ \mathrm{X}\left(-3,\frac{\pi}{4}\right) \text{ and } \mathrm{Y}\left(-3,\frac{-\pi}{4}\right)$$

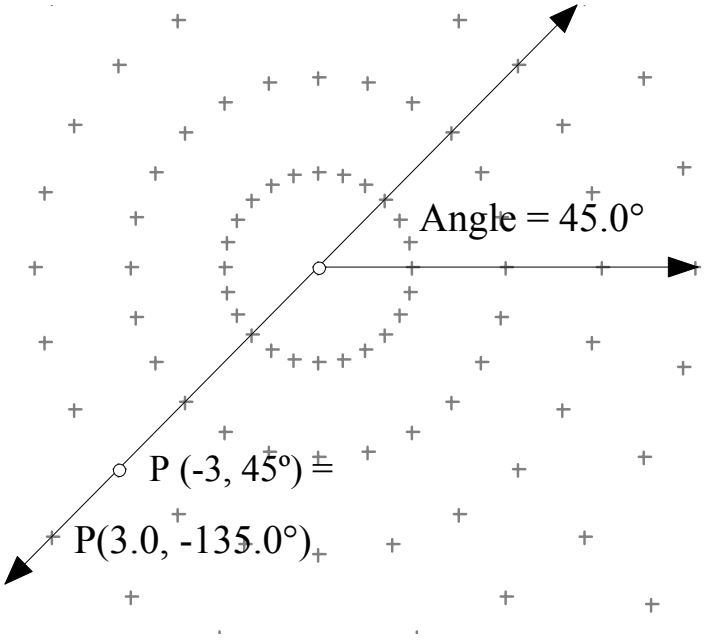
U and V:



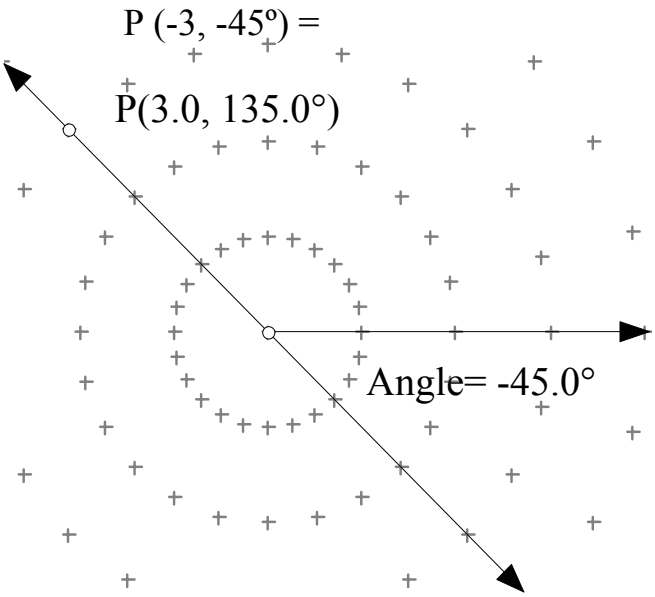
W:



X:



Y:



Notice that points can be represented more than one way in polar form!

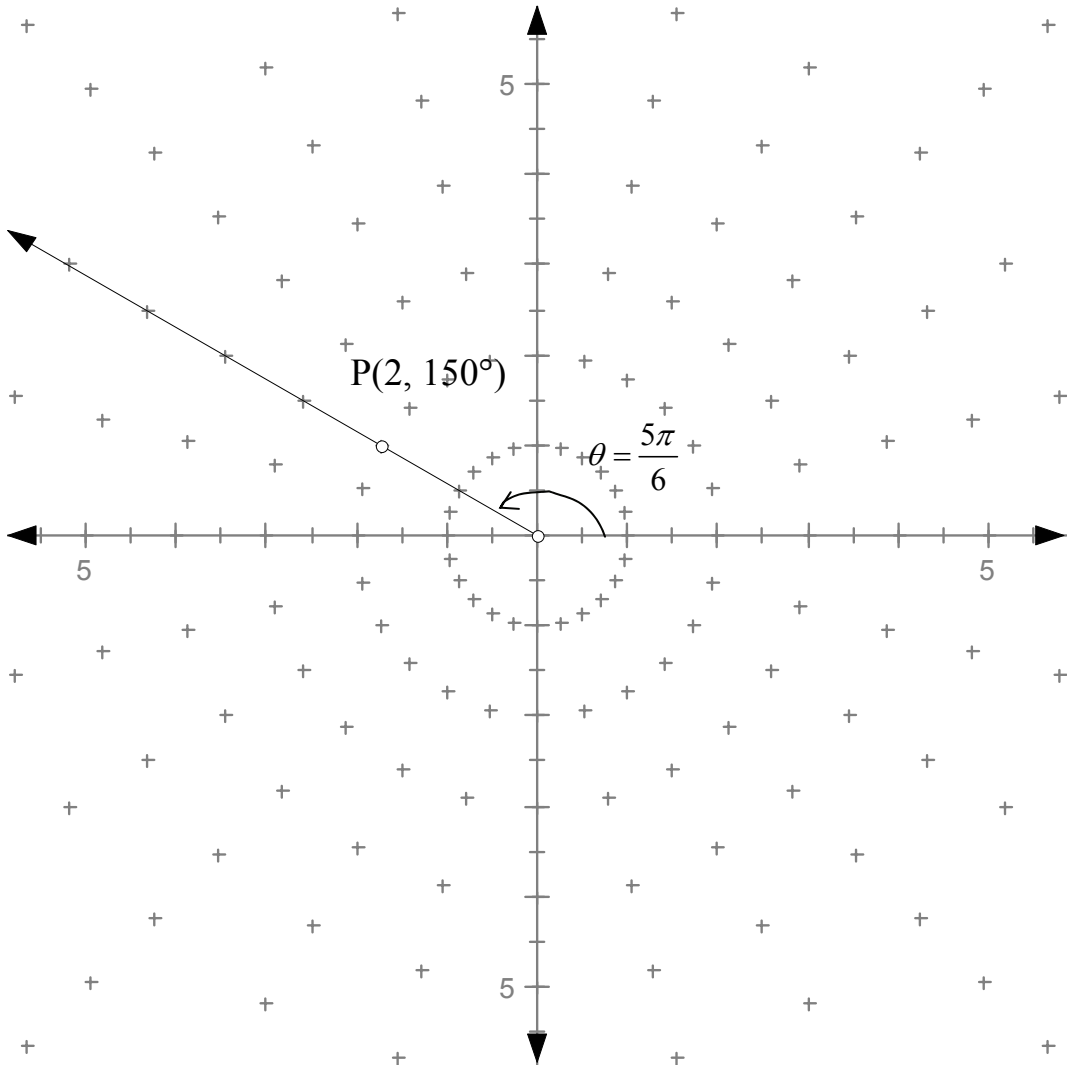
In general, the following can be used to plot points on the polar coordinate system:

(r, θ)

- $(r, \theta+2k\pi) \rightarrow$ k is any integer
- $(-r, \theta+\pi+2k\pi) \rightarrow$ k is any integer

Example 2:

Plot the point $P\left(2,\frac{5\pi}{6}\right)$ and find four other pairs of polar coordinates to represent the same point.



Other Representations:

$$P\left(-2,\frac{11\pi}{6}\right) = P\left(-2,\frac{23\pi}{6}\right) = P\left(2,\frac{17\pi}{6}\right) = P\left(2,\frac{-7\pi}{6}\right)$$