

Definitions: Polar Coordinates

The pole in the polar coordinate system is the same as the origin in the Cartesian coordinate system. The **polar axis** is shown in the same position as the positive x -axis in the Cartesian system.

A point in polar coordinates is written as an ordered pair (r, θ) , where

- ◆ θ is the measure of an angle in standard position whose terminal side contains the point.
- ◆ r (for “radius”) is the displacement (directed distance) from the pole to the point in the direction of the terminal ray of θ

Properties: Polar and Cartesian Coordinates

If a point with Cartesian coordinates (x, y) has polar coordinates (r, θ) , then

$$r^2 = x^2 + y^2$$

$$\frac{x}{r} = \cos \theta \quad \text{or equivalently} \quad x = r \cos \theta$$

$$\frac{y}{r} = \sin \theta \quad \text{or equivalently} \quad y = r \sin \theta$$

Read page 602 (paying special attention to Figure 13-2g and Figure 13-2h) before moving on.

Example 1

Plot the graph of the five-leaved rose $r = 6 \sin 5\theta$. Find numerically the first range of positive θ -values for which r is negative. Confirm your answer by plotting this part of the graph.

Example 2

Show algebraically that the graph of $r = 4 \cos \theta$ is a circle passing through the pole and $(4, 0)$.

Example 3

Show algebraically that the graph of $r = 5 \sec \theta$ is the line $x = 5$.