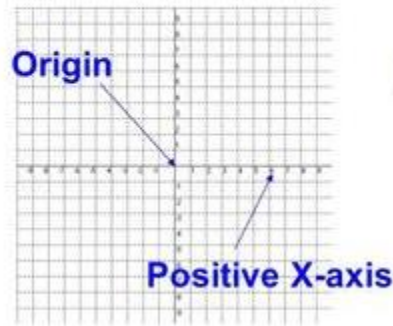
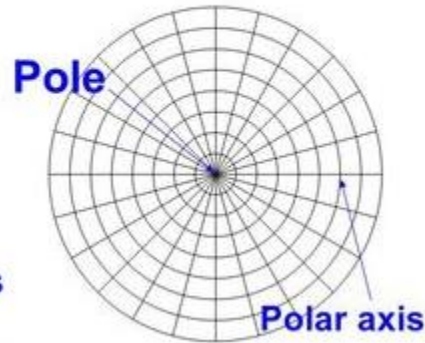


Notes—(8.1) Polar Coordinates/Equations

Rectangular Grid
(Cartesian Coordinates)



Polar Grid
(Polar Coordinates)



A **polar coordinate system** is a plane with a point O , the **pole**, and a ray from *standard position*, 0 , the **polar axis**. Each point P in the plane is assigned as **polar coordinates** as follows: r is the **directed distance** from O to P and θ is the **directed angle** whose initial side is on the polar axis and whose terminal side is on the line OP .

As in trigonometry, we measure θ as positive when moving counterclockwise and negative when moving clockwise. If $r > 0$, then P is on the terminal side of θ . If $r < 0$, then P is on the terminal side of $\theta + \pi$. We can use radian or degree measure for the angle θ .

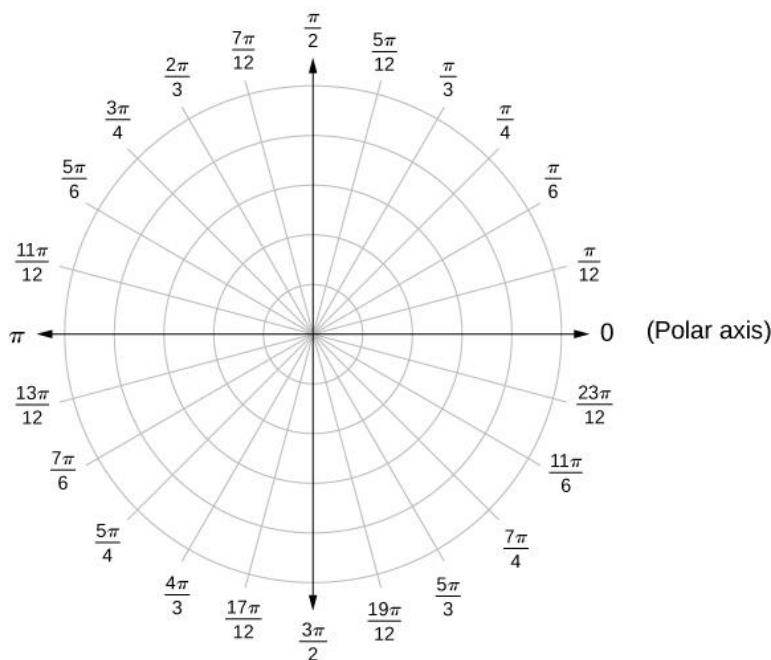
EXAMPLE 1 Plotting Points in the Polar Coordinate System

Plot the points with the given polar coordinates.

(a) $P(2, \pi/3)$

(b) $Q(-1, 3\pi/4)$

(c) $R(3, -45^\circ)$



Coordinate Conversion Equations

Let the point P have polar coordinates (r, θ) and rectangular coordinates (x, y) . Then

$$\begin{aligned}x &= r \cos \theta, & r^2 &= x^2 + y^2, \\y &= r \sin \theta, & \tan \theta &= \frac{y}{x}.\end{aligned}$$

EXAMPLE 2 Converting from Polar to Rectangular Coordinates

Find the rectangular coordinates of the points with the given polar coordinates.

(a) $P(3, 5\pi/6)$

(b) $Q(2, -200^\circ)$

EXAMPLE 3 Converting from Rectangular to Polar Coordinates

Find two polar coordinate pairs for the points with given rectangular coordinates.

(a) $P(-1, 1)$

(b) $Q(-3, 0)$

(c) $R(-4, -5)$

Converting from Polar Form to Rectangular Form

EXAMPLE 4 Convert each of the following to rectangular form and then graph.

a) $\theta = \frac{\pi}{4}$

b) $r = 5 \sec \theta$

c) $r = \cos \theta$

d) $r = 3$

EXAMPLE 5 Convert each of the following to rectangular form and identify the conic..

a) $r = \frac{4}{3-2 \cos \theta}$

b) $r = \frac{1}{1+\sin \theta}$

c) $r = \sin \theta - \cos \theta$

EXAMPLE 6 Convert each of the following to polar form.

a) $x^2 + y^2 = 5$

b) $(x - 2)^2 + y^2 = 4$

c) $(x + 4)^2 + (y - 1)^2 = 17$

