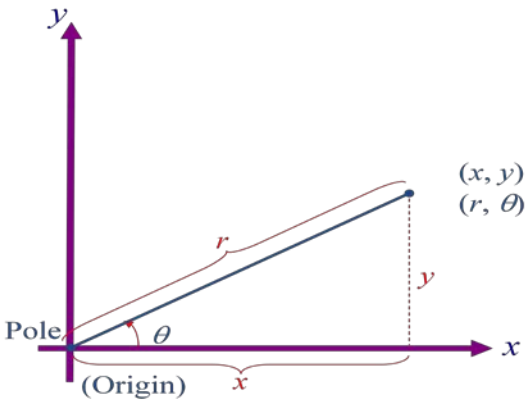
The relationship between rectangular and polar coordinates can be understood as follows.



The point (x, y) lies on a circle of radius r, so

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

Definitions of the trigonometric functions

$$\sin\theta = \frac{y}{r}$$
$$\cos\theta = \frac{x}{r}$$
$$\tan\theta = \frac{y}{x}$$

Coordinate Conversion

The polar coordinates (r, θ) are related to the rectangular coordinates (x, y) as follows.

Polar-to-Rectangular	Rectangular-to-Polar
$x = r\cos\theta$	$\tan\theta = \frac{y}{x}$
$y = r\sin\theta$	$r^2 = x^2 + y^2$

Example 1: Convert each point from polar to rectangular coordinates.

A) $\left(2, \frac{\pi}{6}\right)$ B) $\left(\sqrt{2}, \frac{\pi}{4}\right)$ C) $(4, -\frac{\pi}{3})$

Example 2: Convert each point to polar coordinates.

A) $(-1, 1)$ B) $(2, 2)$ C) $(-1, 0)$

Example 3: **Converting Rectangular Equations to Polar Form**

a) Describe the graph of the rectangular equation.

b) Find the corresponding polar equation.

A) $x^2 + y^2 = 16$ B) $y = 1$ C) $y = x$

Example 4: **Converting Polar Equations to Rectangular Form**

a) Describe the graph of the polar equation.

b) Find the corresponding rectangular equation.

A) $r = 1$ B) $\theta = \frac{\pi}{4}$ C) $r = \csc\theta$

Homework: pg 781-782 1-4, 19-28, 37-44, 65-69 odd, 85-97 odd