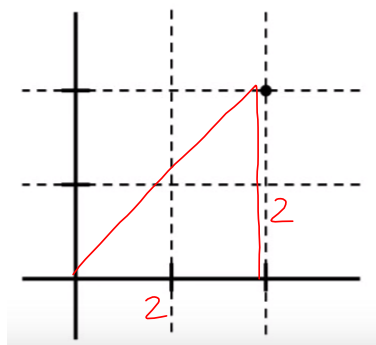


6.4 Polar Coordinates

Rectangular Coordinates:

$$(x, y)$$

$$(2, 2)$$



Polar Coordinates: (r, θ)

Find the polar coordinates of $(2, 2)$.

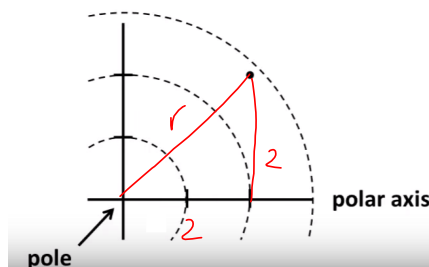
$$2^2 + 2^2 = r^2$$

$$8 = r^2$$

$$\boxed{2\sqrt{2} = r}$$

$$\tan^{-1}(2/2) = \tan^{-1}(1) = \theta \quad (2\sqrt{2}, \pi/4)$$

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

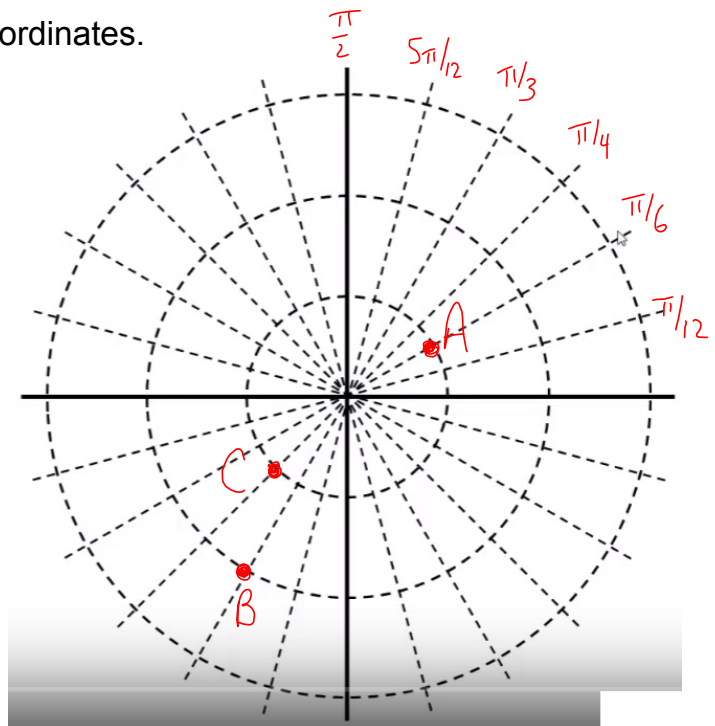


Plot the points with the given polar coordinates.

$$A\left(1, \frac{\pi}{6}\right)$$

$$B\left(2, \frac{4\pi}{3}\right)$$

$$C(-1, 45^\circ)$$



Note: Polar Coordinates are NOT unique.

Ex: Name three other points

equivalent to: $\left(2\sqrt{2}, \frac{\pi}{4}\right)$

$$\left(-2\sqrt{2}, \frac{5\pi}{4}\right)$$

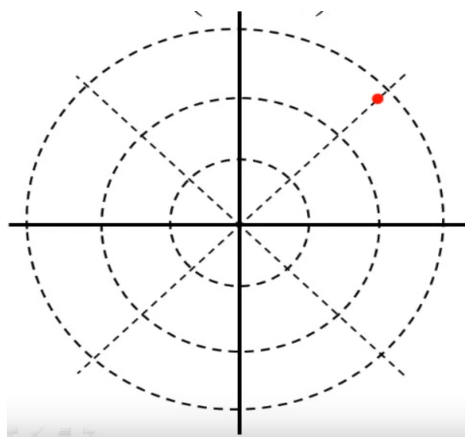
$$\left(2\sqrt{2}, \frac{9\pi}{4}\right)$$

$$\left(2\sqrt{2}, -\frac{7\pi}{4}\right)$$

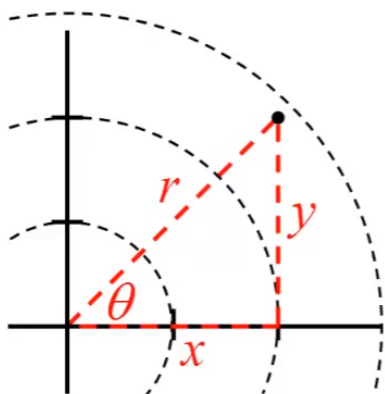
$$(r, \theta)$$

$$(r, \theta \pm 2\pi)$$

$$(-r, \theta \pm \pi n)$$



Coordinate Conversion:



Polar to Rectangular:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

Rectangular to Polar:

$$r = \sqrt{x^2 + y^2}$$

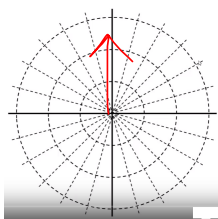
$$\theta = \tan^{-1}\left(\frac{y}{x}\right)$$

Find the rectangular coordinate using the given polar coordinate.

$$a.) \left(4, \frac{\pi}{2} \right)$$

$$\left(4 \cos \frac{\pi}{2}, 4 \sin \frac{\pi}{2} \right)$$

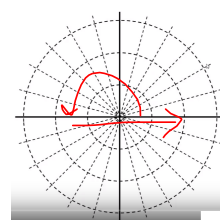
$$(0, 4)$$



$$b.) (-3, \pi)$$

$$(-3 \cos \pi, -3 \sin \pi)$$

$$(3, 0)$$



$$c.) \left(16, \frac{5\pi}{6} \right)$$

$$\left(16 \cos \frac{5\pi}{6}, 16 \sin \frac{5\pi}{6} \right)$$

$$(-8\sqrt{3}, 8)$$

$$d.) (-2, 40^\circ)$$

$$(-2 \cos 40, -2 \sin 40)$$

$$(-1.53, -1.29)$$

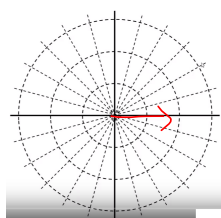
Find two different polar coordinates using the given rectangular coordinate.

a.) $(1, 0)$

$$(1, 0)$$

$$(1, 2\pi)$$

$$(-1, \pi)$$

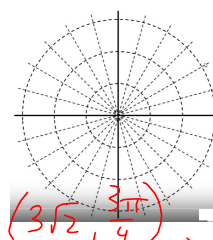


b.) $(-3, 3)$

$$r = \sqrt{(-3)^2 + 3^2}$$

$$r = \sqrt{18} = 3\sqrt{2}$$

$$\tan^{-1}\left(\frac{3}{-3}\right) = \tan^{-1}(-1) = \frac{3\pi}{4}$$



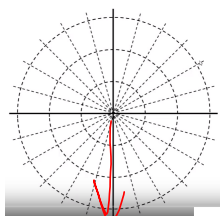
$$(3\sqrt{2}, \frac{3\pi}{4})$$

$$(-3\sqrt{2}, \frac{7\pi}{4})$$

c.) $(0, -4)$

$$(4, \frac{3\pi}{2})$$

$$(-4, \frac{\pi}{2})$$



d.) $(3, 4)$

$$r = 5$$

$$\tan^{-1}\left(\frac{4}{3}\right) = \theta = 53.13^\circ$$

$$(5, 53.13^\circ) \quad (-5, 233.13^\circ)$$

