

Polar Coordinates

Graph the following points below:

$$A(3, 0)$$

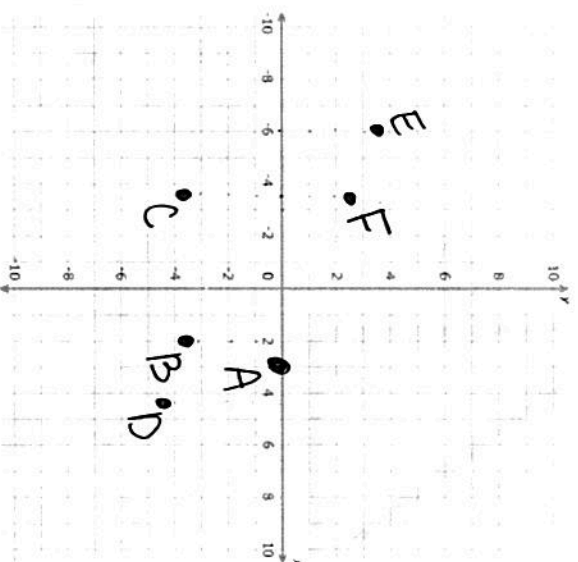
$$B(2, -2\sqrt{3})$$

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

$$D(3\sqrt{2}, -3\sqrt{2})$$

$$E\left(\frac{-7\sqrt{3}}{2}, 3.5\right)$$

$$F\left(-3.5, \frac{3\sqrt{3}}{2}\right)$$



This should be blank. This gets glued down!

Now graph the following polar points and determine any patterns you see. Polar points are written as (r, θ) , where r is the radius, and theta is the angle of rotation from the positive x-axis.

$(+)$ $r \rightarrow$ move towards x

$(-)$ $r \rightarrow$ move away

$A(3, 0)$ from x

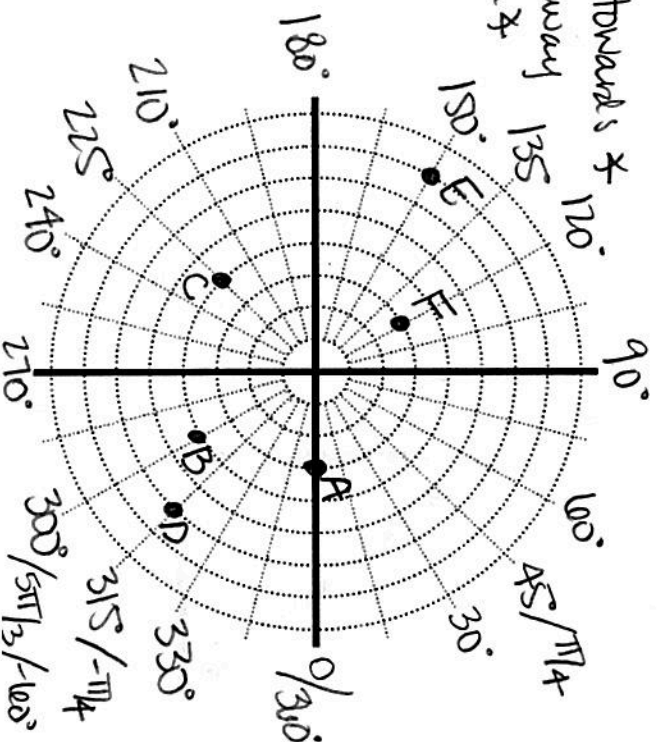
$$B\left(4, \frac{5\pi}{3}\right)$$

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

$$D\left(6, -\frac{\pi}{4}\right)$$

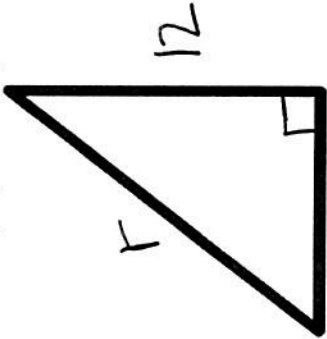
$$E(7, 150^\circ)$$

$$F(-3, -60^\circ)$$



Rectangular (x, y) → Polar (r, θ)

Ex 1) (5, 12)



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

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

$$\tan \theta = \frac{y}{x}$$

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

$$\theta = \tan^{-1}\left(\frac{12}{5}\right)$$

$$r = \sqrt{5^2 + 12^2}$$

$$r = 13$$

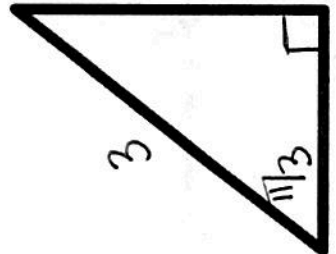
$$(13, \tan^{-1}\left(\frac{12}{5}\right))$$

Polar (r, θ) → Rectangular (x, y)

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

$$x = r \cos \theta$$

$$y = r \sin \theta$$



$$x = 3 \cos\left(\frac{\pi}{3}\right)$$

$$3\left(\frac{1}{2}\right) = \frac{3}{2}$$

$$y = 3 \sin\left(\frac{\pi}{3}\right)$$

$$3\left(\frac{\sqrt{3}}{2}\right) = \frac{3\sqrt{3}}{2}$$

$$\left(\frac{3}{2}, \frac{3\sqrt{3}}{2}\right)$$

Practice: Polar to Rectangular

Convert the following polar coordinates to rectangular form.

3. $\left(4, -\frac{\pi}{6}\right)$

$$x = 4 \cos\left(-\frac{\pi}{6}\right)$$

$$4\left(\frac{\sqrt{3}}{2}\right) = 2\sqrt{3}$$

$$x = 4 \cos\left(\frac{5\pi}{3}\right)$$

$$4\left(\frac{1}{2}\right) = 2$$

$$y = 4 \sin\left(-\frac{\pi}{6}\right)$$

$$4\left(-\frac{1}{2}\right) = -2$$

$$y = 4 \sin\left(\frac{5\pi}{3}\right)$$

$$4\left(-\frac{\sqrt{3}}{2}\right) = -2\sqrt{3}$$

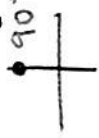
$$(2\sqrt{3}, -2)$$

$$(2, -2\sqrt{3})$$

Practice: Rectangular to Polar

Convert the following rectangular coordinates to polar form.

5. (0, 3)



$$r = \sqrt{0^2 + 3^2}$$

$$r = 3$$

$$\theta = \tan^{-1}\left(\frac{3}{0}\right)$$

und.

$$\theta = 90^\circ$$

$$(3, 90^\circ)$$

6. $(-\sqrt{3}, 1)$

$$r = \sqrt{(-\sqrt{3})^2 + 1^2}$$

$$r = 2$$

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

$$\theta = 150^\circ$$

$$(2, 150^\circ)$$