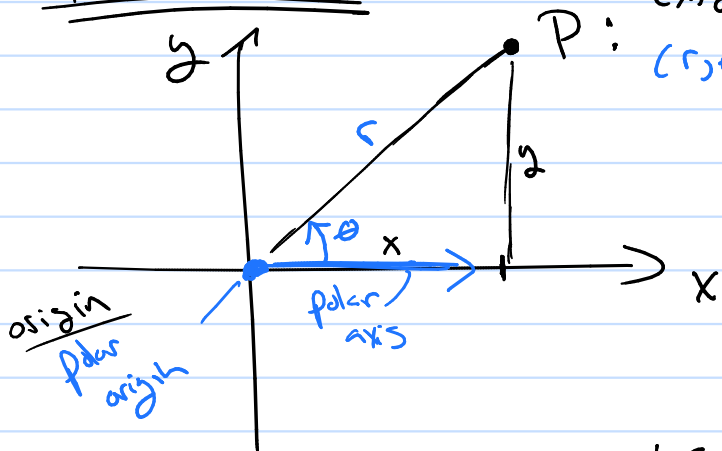


Math 112

Polar Coordinates

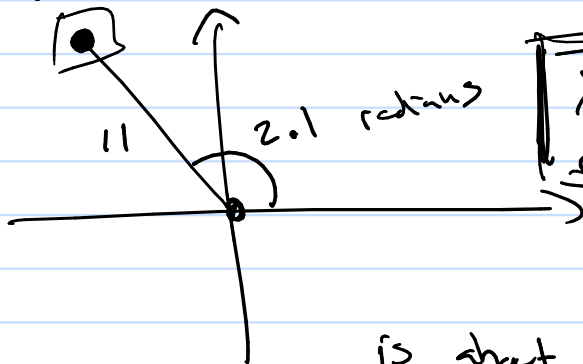


(x, y) in cartesian coord.
 (r, θ) in polar coord.

$x = r \cos \theta$ $y = r \sin \theta$	$\Leftrightarrow \cos \theta = \frac{x}{r}$ $\Leftrightarrow \sin \theta = \frac{y}{r}$
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We can use these equations to convert from (r, θ) coord. to (x, y) coord.

$(r, \theta) = (11, 2.1)$

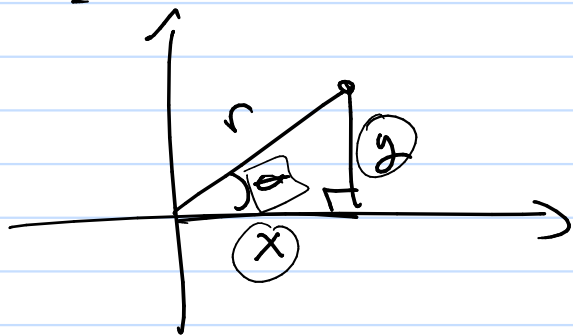


$x = r \cos \theta$ $y = r \sin \theta$	\Rightarrow
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$x = 11 \cos(2.1) \approx -5.6$
 $y = 11 \sin(2.1) \approx 9.5$

$(11, 2.1)$ in (r, θ) polar

is about $(-5.6, 9.5)$ in (x, y) cartesian

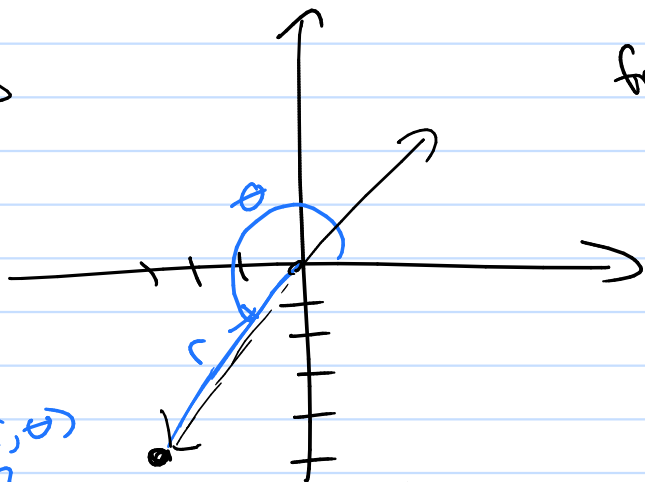


r 's = x 's and y 's

θ 's = x 's and y 's

$r^2 = x^2 + y^2$	and	$\tan \theta = \frac{y}{x}$
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Ex



in polar? $(-3, -5)$ for (x, y) in cartesian

from (x, y) to (r, θ) use

$$r^2 = x^2 + y^2 \rightarrow r^2 = 34$$

$$\tan \theta = \frac{y}{x} \rightarrow \tan \theta = \frac{5}{3}$$

$$r = ?$$

$$\theta = ?$$

Given $r^2 = 34$ so $r = \sqrt{34}$ or $r = -\sqrt{34}$

$$\tan \theta = \frac{5}{3}$$

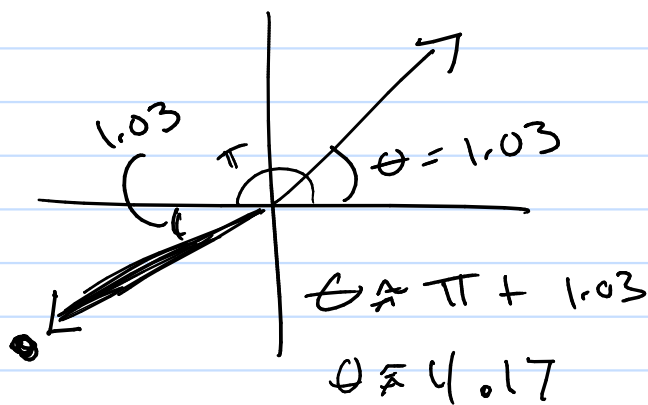
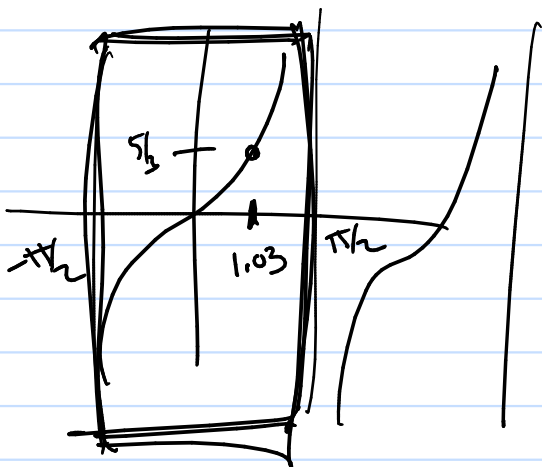
so $\theta = \arctan\left(\frac{5}{3}\right)$

octave: `atan(5/3)`

ans = 1.030376826524313

using

Octave



so $(-3, -5)$ in cartesian is

$(\sqrt{34}, \underline{4.17})$ in polar.

in degree?

$$4.17 \left(\frac{180^\circ}{\pi} \right) \approx 240^\circ$$

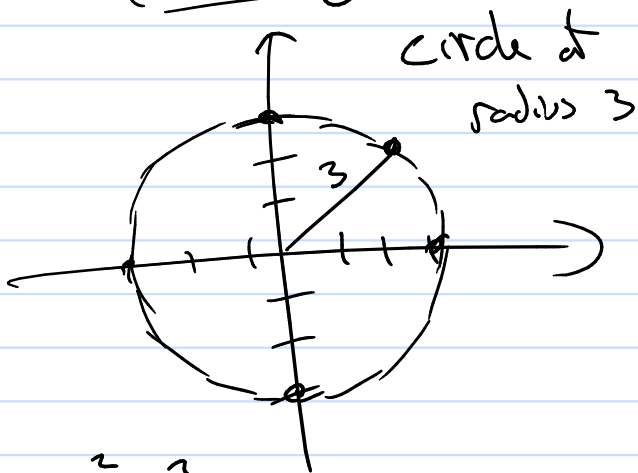
$(\sqrt{34}, 240^\circ)$

Conversions of equations?

Tex expressions with x, y 's \rightarrow find expressions with only r, θ 's

Tex expressions with r, θ 's \rightarrow find expressions with only x, y 's

Tex $x^2 + y^2 = 9$



$$x^2 + y^2 = 9$$

$$(r \cos \theta)^2 + (r \sin \theta)^2 = 9$$

$$r^2(\cos^2 \theta + \sin^2 \theta) = 9$$

creative use of all the trig identities and

$$x = r \cos \theta \leftarrow$$

$$y = r \sin \theta$$

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

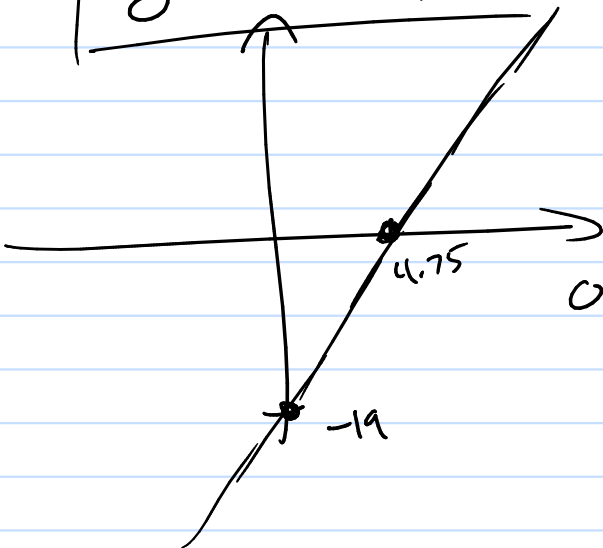
$$\tan \theta = y/x$$

$$x^2 + y^2 = 9$$

$$\rightarrow r^2 = 9$$

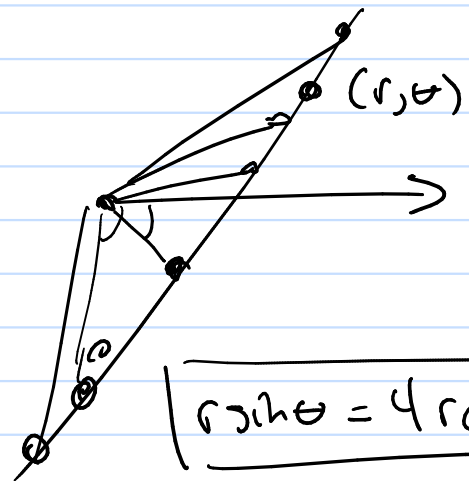
$$r = 3 \quad \checkmark$$

$y = 4x - 19$



$$0 = 4x - 19$$

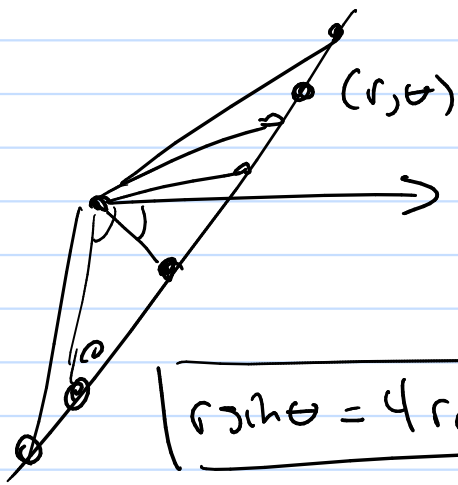
$$x = \frac{19}{4} = 4.75$$



$$r \sin \theta = 4r \cos \theta - 19$$

$$r \sin \theta - 4r \cos \theta = -19$$

$$r(\sin \theta - 4 \cos \theta) = -19$$



$$r \sin \theta = 4r \cos \theta - 19$$

$$r \sin \theta - 4r \cos \theta = -19$$

$$r (\sin \theta - 4 \cos \theta) = -19$$

$$r = \frac{-19}{\sin \theta - 4 \cos \theta}$$

$$r = \frac{19}{4 \cos \theta - \sin \theta}$$

