

## 6.4 Polar Coordinates

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Polar Coordinate System: points are described by distance and direction

Distance is measured from a fixed point called the **pole**.

Direction is relative to a fixed ray with endpoint at the pole - called the **polar axis**.



Polar Points:

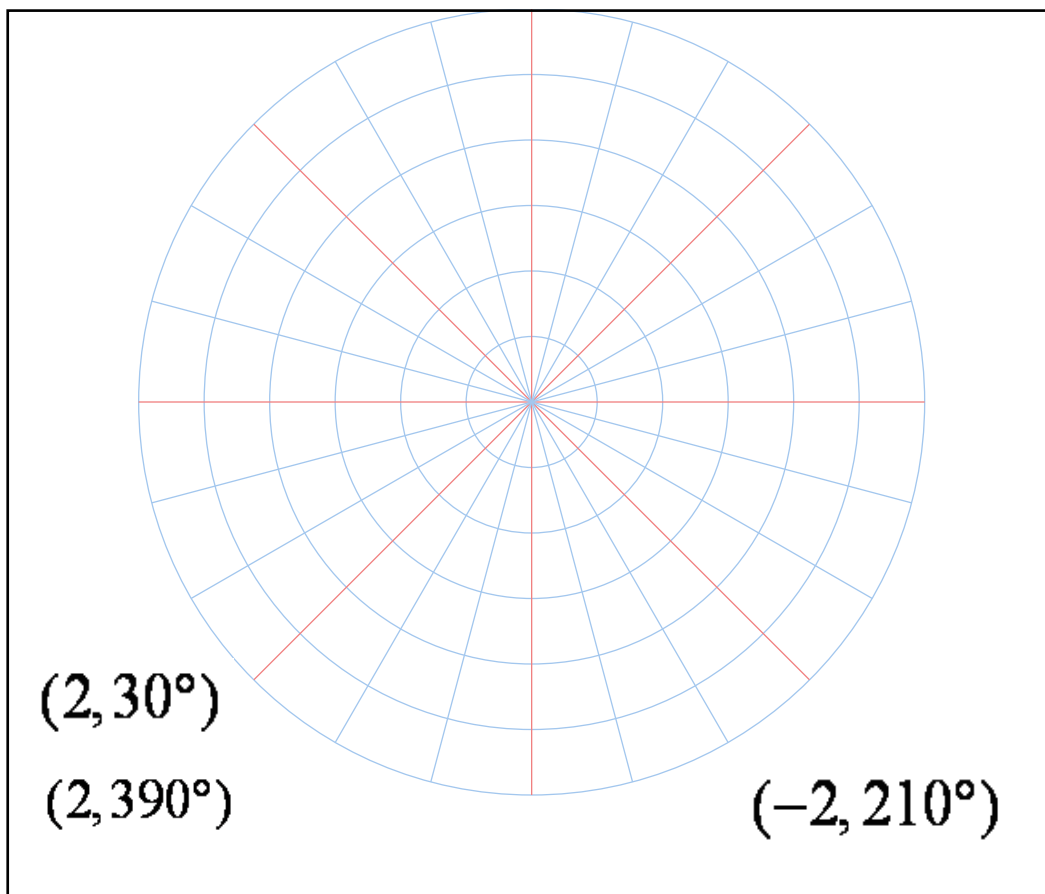
$(r, \theta)$

directed distance  
from the pole

directed angle  
measured from  
the polar axis

$(2, 30^\circ)$





Each point can be expressed in infinitely many ways.

Using a negative radius, move backwards.

To express in general using radians:

$$(r, \theta + 2n\pi)$$
$$(-r, \theta + (2n + 1)\pi)$$

## Conversions with points

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## Rectangular to Polar

$$(x, y) \rightarrow (r, \theta)$$

$$x^2 + y^2 = r^2 \quad \text{solve for } r$$

Do we know any equations relating  $x$ ,  $y$ , and  $r$ ??

Do we know any equations relating  $x$  and  $y$  that will help us find an angle??

$$\tan \theta = \frac{y}{x} \quad \text{solve for } \theta, \text{ refer to the ordered pair to get the correct quadrant}$$

Give the polar coordinates for:

(0, 1)

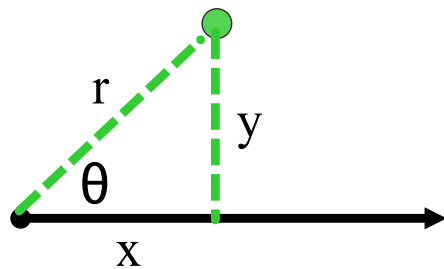
(2, 2)

## Conversion: Polar to Rectangular

#52- back

$$(r, \theta) \rightarrow (x, y)$$

this is the same idea as finding x and y components for initial velocity - just a different coordinate system



$$x = r \cos \theta$$

$$y = r \sin \theta$$

Give the rectangular coordinates for:

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

$$(2, 60^\circ)$$

## Conversions for Polar Equations

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to convert equations use:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

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

and other identities as needed

$$r = 5 \sec \theta$$

$$3x + 4y = 5$$

Converting from Rectangular to Polar:  $r = 4 \sec \theta$

Graphing Polar in your calculator:

## Finding Distance Using polar coordinates

Radar detects two airplanes at the same altitude. Their polar coordinates are  $(8\text{mil}, 110^\circ)$  and  $(5\text{mil}, 15^\circ)$ . How far apart are the airplanes?