Happy International Dance Day!

- Park your phones
- Grab your calculators

Quiz Thu.
(Tentative)
Test May 8th

Did you take the AP Survey????

Introduction to Polar Coordinates

If we list the position of an object based on its distance away and its angle, then we are using a **polar coordinate system.**

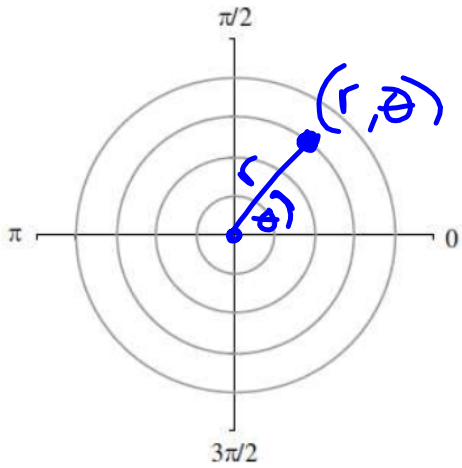
r = radius

θ

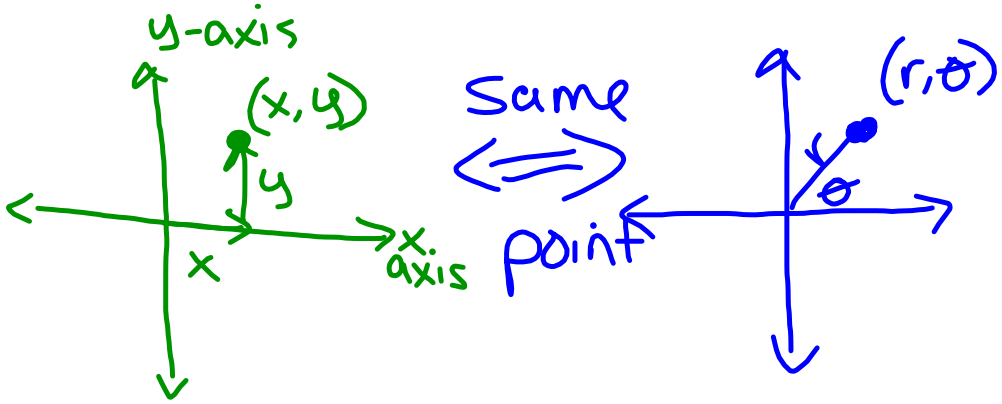
A fixed point O is called the **pole** (origin) and **the polar axis** is the horizontal ray to the right of the pole.

Coordinates will be given as (r, θ)

r = radius
θ = angles < degrees / radius



GPS systems and land surveying are just two examples of why we need polar coordinates.



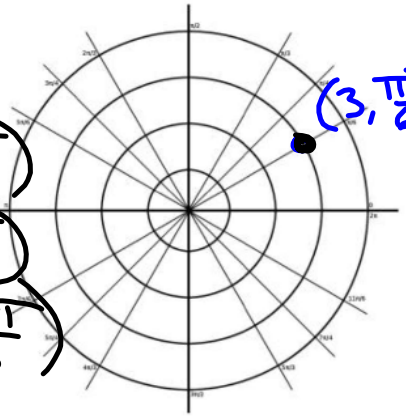
Plot the following points, then create three other polar representations for that point.

negative angle

(r, θ)

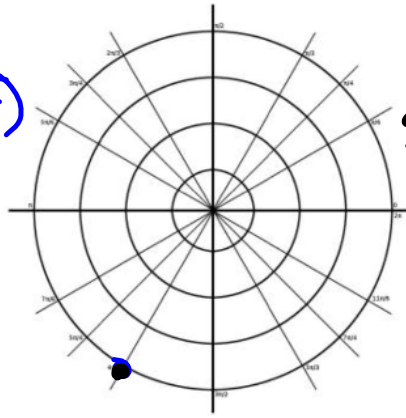
1. angle 1st
2. count "r" radius

$\left(3, \frac{\pi}{6}\right)$ $\theta = \frac{\pi}{6}$ $r = 3$



1. $(3, -\frac{11\pi}{6})$
2. $(-3, \frac{7\pi}{6})$
3. $(-3, -\frac{5\pi}{6})$

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



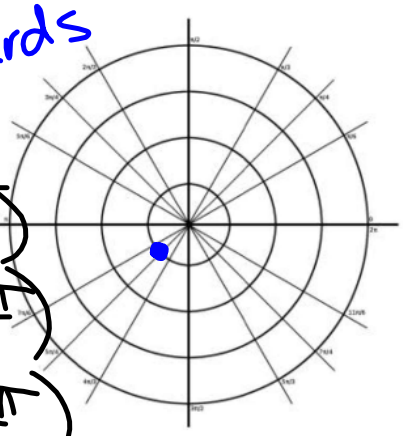
1. $(4, \frac{4\pi}{3})$
2. $(-4, \frac{\pi}{3})$
3. $(-4, -\frac{5\pi}{3})$

negative radius

$r = -1$

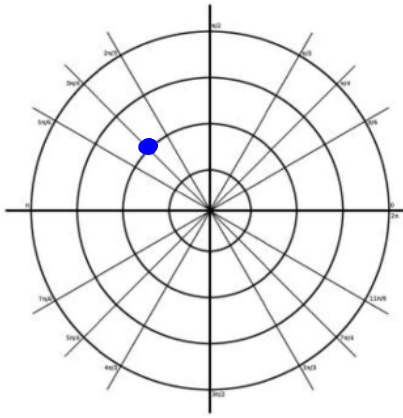
count backwards

$\left(-1, \frac{\pi}{4}\right)$



1. $(1, \frac{5\pi}{4})$
2. $(-1, -\frac{7\pi}{4})$
3. $(1, -\frac{3\pi}{4})$

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



1. $(2, \frac{3\pi}{4})$
2. $(2, -\frac{5\pi}{4})$
3. $(-2, -\frac{\pi}{4})$

Plot the following points, then create three other polar representations for that point.

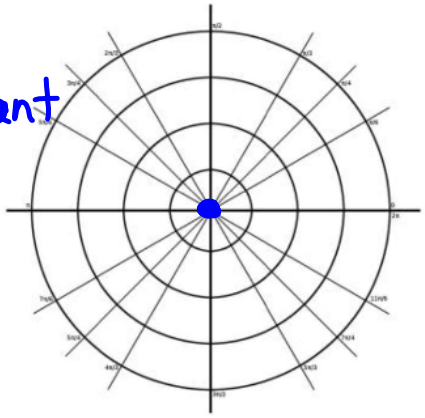
(r, θ)

$\left(0, \frac{\pi}{3}\right)$

angle is irrelevant

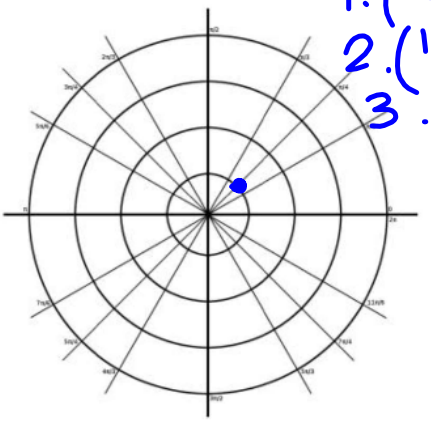
$r=0$

pole



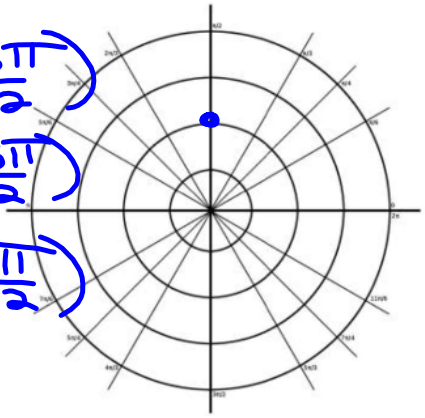
$\left(-1, \frac{5\pi}{4}\right)$

1. $\left(1, \frac{\pi}{4}\right)$
2. $\left(1, -\frac{7\pi}{4}\right)$
3. $\left(-1, -\frac{3\pi}{4}\right)$



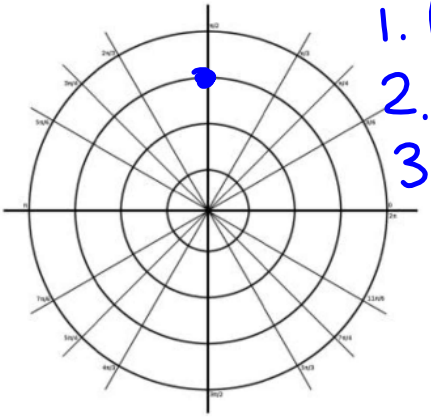
$\left(2, \frac{\pi}{2}\right)$

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



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

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



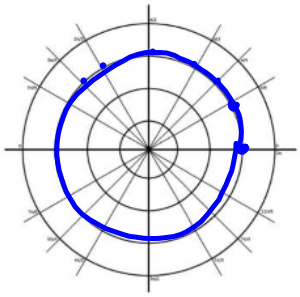
+ radius => on the line

- radius => across from the line

Basic Polar Graphs

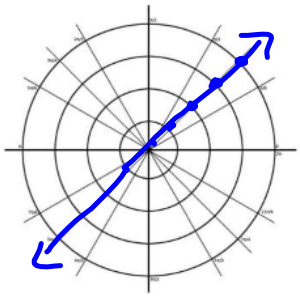
Graph r = 3

Circle, centered at the pole



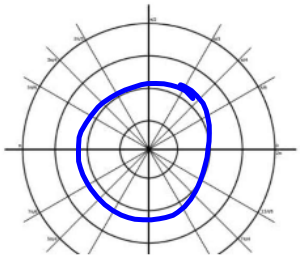
Graph $\theta = \frac{\pi}{4}$

Line, with angle $\frac{\pi}{4}$



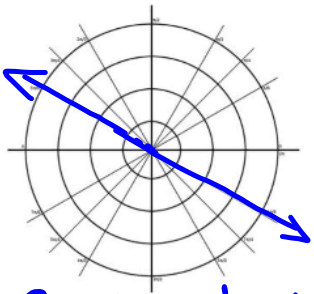
Graph r = 2

Circle



Graph $\theta = -\frac{\pi}{6}$ ~~$\frac{\pi}{6}$~~ $- \frac{7\pi}{6}$

Line



r = constant $\Rightarrow$ circle, centered at pole

θ = angle (deg. / radians) $\Rightarrow$ Line, through the pole

Special Polar Graphs: (r, θ)

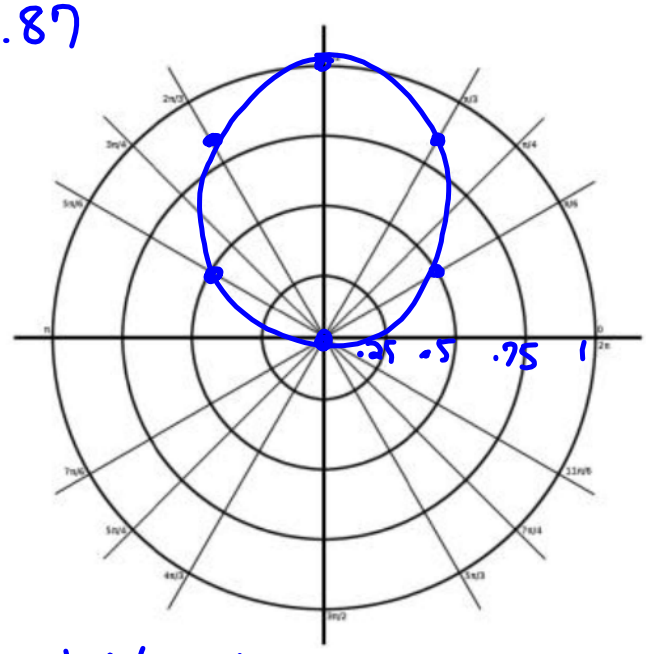
Graph: $r = sin\theta$

Mode:
- Polar
- Radians

θ	r
0	0
$\frac{\pi}{6}$	$\frac{1}{2}$
$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2} \approx .87$
$\frac{\pi}{2}$	1
$\frac{2\pi}{3}$	$\frac{\sqrt{3}}{2}$
$\frac{5\pi}{6}$	$\frac{1}{2}$
π	0
$\frac{7\pi}{6}$	$-\frac{1}{2}$
$\frac{4\pi}{3}$	$-\frac{\sqrt{3}}{2}$
$\frac{3\pi}{2}$	-1
$\frac{5\pi}{3}$	$-\frac{\sqrt{3}}{2}$
$\frac{11\pi}{6}$	$-\frac{1}{2}$
2π	0

$\frac{\pi}{6}$ $\frac{\pi}{6}$

$(\frac{1}{2}, \frac{\pi}{2})$



Window:

$\theta_{min} = 0$

$\theta_{max} = 2\pi \approx 6.28^R$

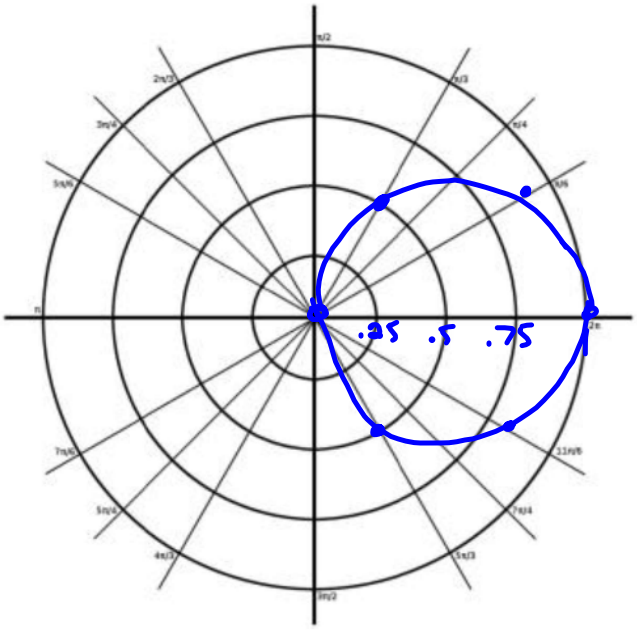
Tblsetup

$\Delta Tbl = \pi/6$

circle

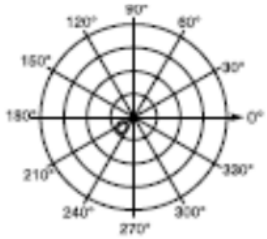
Graph $r = cos\theta$

θ	r
0	1
$\frac{\pi}{6}$	$\sqrt{3}/2$
$\frac{\pi}{3}$	$1/2$
$\frac{\pi}{2}$	0
$\frac{2\pi}{3}$	$-1/2$
$\frac{5\pi}{6}$	$-\sqrt{3}/2$
π	-1
$\frac{7\pi}{6}$	.
$\frac{4\pi}{3}$	.
$\frac{3\pi}{2}$	.
$\frac{5\pi}{3}$	.
$\frac{11\pi}{6}$	.
2π	.

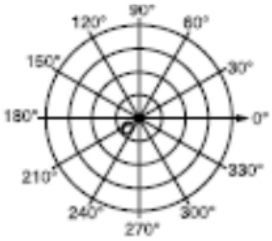


Graphing Polar Coordinates Practice **name**_____

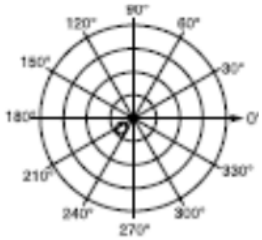
$(3,45°)$



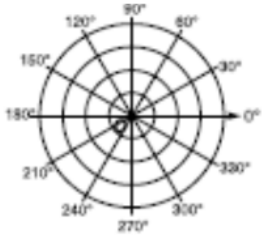
$(-2,60°)$



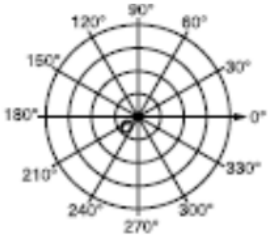
$(4,225°)$



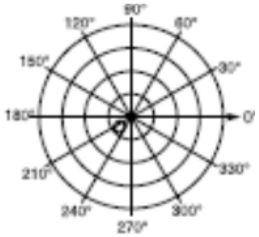
$(-3,315°)$



$(-2,-300°)$



$(4,150°)$



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

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

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

$\left(-2,\frac{5\pi}{6}\right)$

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

$\left(-3,\frac{7\pi}{6}\right)$

Graphing Polar Coordinates Practice name_____

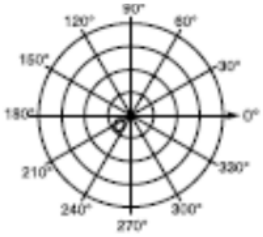
Graph each polar equation and describe its shape.

$r = 3$

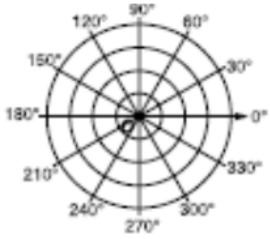
$\theta = \frac{11\pi}{6}$

$\theta = \frac{\pi}{6}$

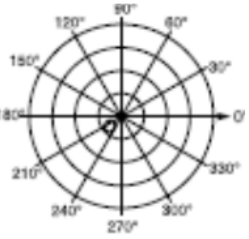
$\theta = 120°$



$r = 2$



$\theta = -150°$



For the following coordinate points: Graph the point and then rewrite them in three different ways

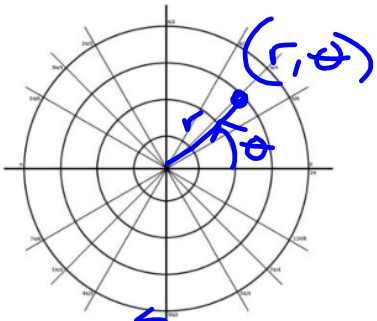
$\left(-2, \frac{5\pi}{6}\right)$

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

$\left(-3, \frac{7\pi}{6}\right)$

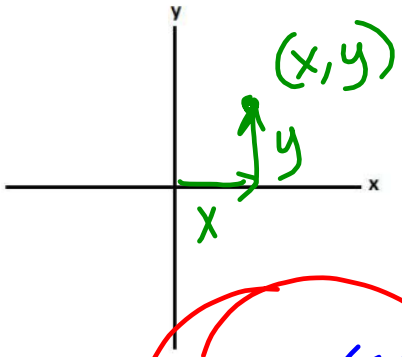
Polar Coordinates

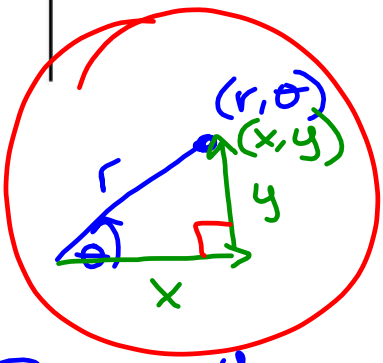
(r,θ)



Rectangular Coordinates

(x,y)





Conversion Formulas

Tan(θ) = $\frac{y}{x}$

x = $r \cdot \cos\theta$

y = $r \cdot \sin\theta$

$\sin\theta = \frac{y}{r}$

$\cos\theta = \frac{x}{r}$

Pythagorean Identity:

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

Circle

Polar (r, θ) ↑ Radians Degrees

Same point

Rectangular (x, y)

Quadrants are same

$x = r\cdot\cos\theta$

$y = r\cdot\sin\theta$

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

Convert the following polar coordinates to rectangular - Then graph both points:

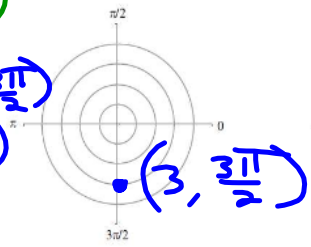
polar

$\left(3, \frac{3\pi}{2}\right)$ $(0,-3)$

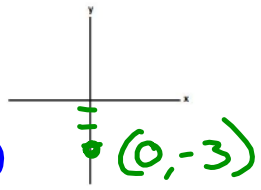
$x = 3\cos\left(\frac{3\pi}{2}\right)$ $y = 3\sin\left(\frac{3\pi}{2}\right)$

$= 3\cdot 0$ $= 3(-1)$

$x = 0$ $y = -3$



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



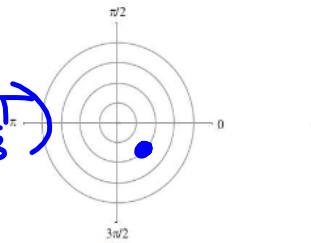
$(0,-3)$

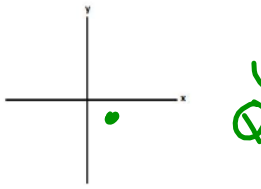
$\left(-2, \frac{2\pi}{3}\right)$ $(1,-\sqrt{3})$

$x = -2\cos\left(\frac{2\pi}{3}\right)$ $y = -2\sin\left(\frac{2\pi}{3}\right)$

$x = -2\cdot\left(-\frac{1}{2}\right)$ $y = -2\cdot\frac{\sqrt{3}}{2}$

$x = 1$ $y = -\sqrt{3} \approx -1.7$





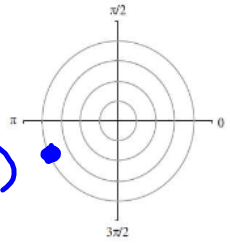
II

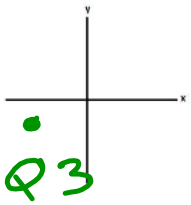
Q4

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

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

$x = -2\sqrt{3}$ $y = -2$





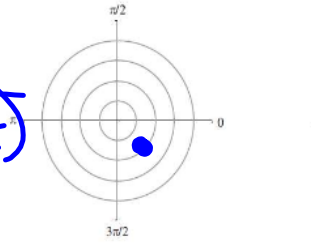
Q3

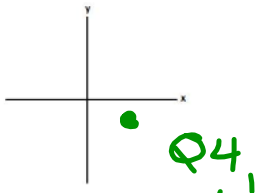
$\left(2, -\frac{\pi}{4}\right)$ $\frac{7\pi}{4}$

$x = 2\cos\left(\frac{7\pi}{4}\right)$ $y = 2\sin\left(\frac{7\pi}{4}\right)$

$x = \sqrt{2}$ $y = -\sqrt{2}$

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



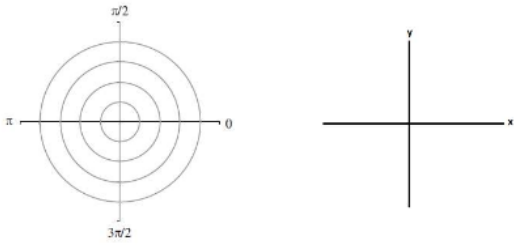


Q4

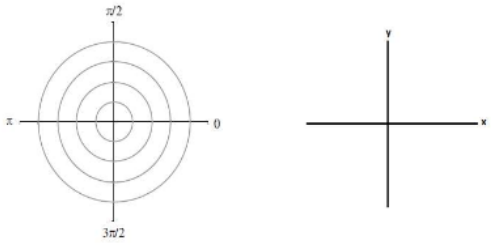
II

Try to convert these polar points into rectangular without using the formulas:

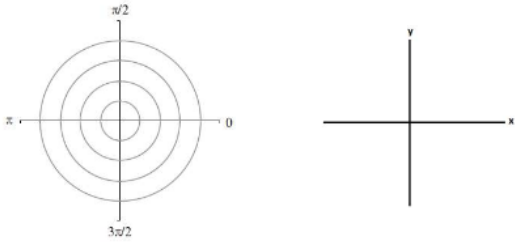
Convert $(3, \frac{\pi}{2})$ to rectangular



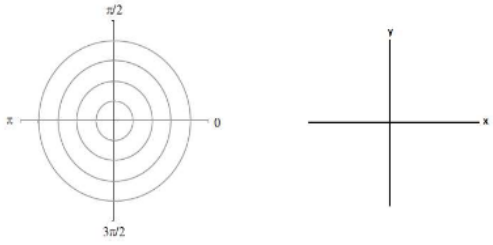
Convert $(-2, \frac{\pi}{2})$ to rectangular



Convert $(-4, 2\pi)$ to rectangular



Convert $(2, \pi)$ to rectangular



Practice: Find the rectangular coordinates of each point with the given polar coordinates.

1. (6,120°)
2. (-4,45°)
3. $\left(3, \frac{7\pi}{6}\right)$

4. $\left(-2, \frac{5\pi}{6}\right)$
5. $\left(-5, \frac{4\pi}{3}\right)$
6. $\left(3, \frac{\pi}{2}\right)$