

Unit 10 (Chapter 6): Parametric & Polar

6.4 Polar Coordinates

Target 10D: Understand the polar coordinate system by performing polar/rectangular coordinate conversions

Review of Prior Concepts

1. Find the magnitude of the vector  $\langle \sqrt{3}, 1 \rangle$ .

$$\begin{aligned} \text{magnitude} &= \sqrt{(\sqrt{3})^2 + (1)^2} \\ &= \sqrt{3+1} \\ &= \sqrt{4} \\ &= \boxed{2} \end{aligned}$$

2. Find the direction angle of the vector  $\langle \sqrt{3}, 1 \rangle$ .

$$\begin{aligned} \cos \theta &= \frac{\sqrt{3}}{2} && \text{or } \sin \theta = \frac{1}{2} \\ \theta &= \frac{\pi}{6} \end{aligned}$$

Polar Coordinates

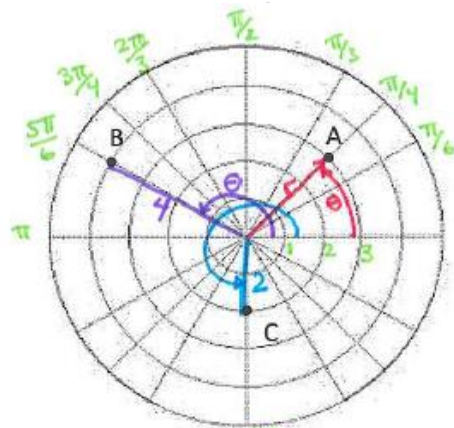
$(r, \theta)$

The polar coordinates of point A is  $(3, 45^\circ)$  or  $(3, \frac{\pi}{4})$ .

Example 1: Identify the coordinates of:

a) point B  $(4, 5\pi/6)$

b) point C  $(2, 3\pi/2)$

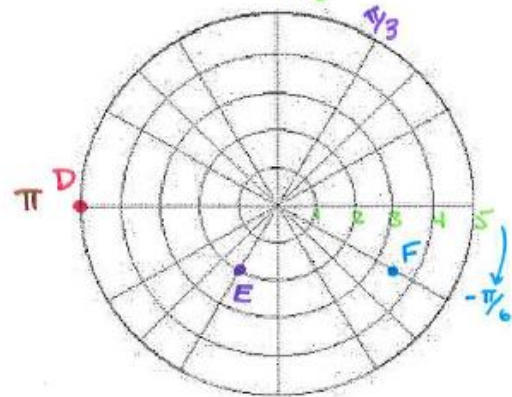


Example 2: Plot each of the given points:

a) D  $(5, \pi)$

b) E  $(-2, \frac{\pi}{3})$

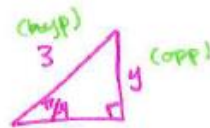
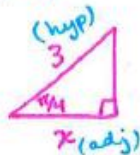
c) F  $(3.5, -\frac{\pi}{6})$



Example 3:

Determine the rectangular  $(x, y)$  coordinates of point A.

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



$$\cos \frac{\pi}{4} = \frac{x}{3}$$

$$\frac{\sqrt{2}}{2} = \frac{x}{3}$$

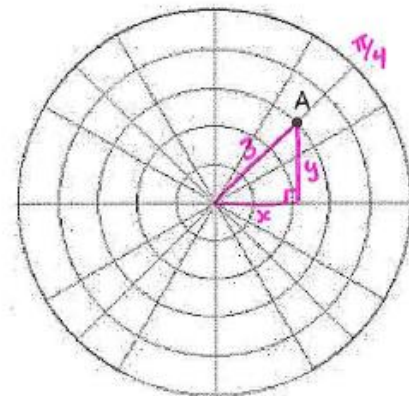
$$\frac{3\sqrt{2}}{2} = x$$

$$\sin \frac{\pi}{4} = \frac{y}{3}$$

$$\frac{\sqrt{2}}{2} = \frac{y}{3}$$

$$\frac{3\sqrt{2}}{2} = y$$

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



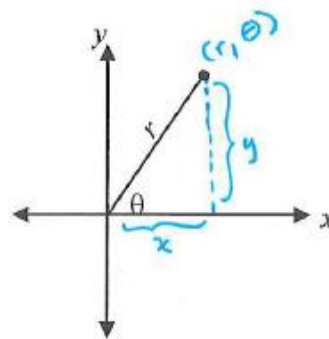
## Convert Polar Coordinates to Rectangular Coordinates

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

$$\cos \theta = \frac{x}{r} \quad \sin \theta = \frac{y}{r}$$

$$r \cos \theta = x \quad r \sin \theta = y$$

$$(x, y) = (r \cos \theta, r \sin \theta)$$



Example 4:

Convert  $(2, \frac{5\pi}{6})$  to rectangular coordinates.

$$(2 \cos \frac{5\pi}{6}, 2 \sin \frac{5\pi}{6})$$

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

$$\boxed{(-\sqrt{3}, 1)}$$

## Convert Rectangular Coordinates to Polar Coordinates

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

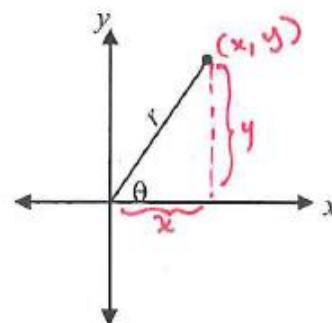
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$$x^2 + y^2 = r^2$$

\* then, solve for r

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

\* then, solve for  $\theta$



Example 5:

Convert  $(3\sqrt{2}, 3\sqrt{2})$  to polar coordinates.

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

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

$$18 + 18 = r^2$$

$$36 = r^2$$

$$6 = r$$

$$\tan \theta = \frac{3\sqrt{2}}{3\sqrt{2}}$$

$$\tan \theta = 1$$

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

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$$\frac{\sin \theta}{\cos \theta} = 1$$

$$= \frac{\frac{\sqrt{2}}{2}}{\frac{\sqrt{2}}{2}}$$

$$\boxed{(6, \frac{\pi}{4})}$$

**More Practice**

**Polar Coordinates**

[http://mathinsight.org/polar\\_coordinates](http://mathinsight.org/polar_coordinates)

<https://www.mathsisfun.com/polar-cartesian-coordinates.html>

[http://math.illinois.edu/~rasekh2/math231\(s2016\)/PolarEquations.pdf](http://math.illinois.edu/~rasekh2/math231(s2016)/PolarEquations.pdf)

<http://tutorial.math.lamar.edu/Classes/CalcII/PolarCoordinates.aspx>

[http://www.mathwords.com/p/polar\\_rectangular\\_conversion\\_formulas.htm](http://www.mathwords.com/p/polar_rectangular_conversion_formulas.htm)

<https://youtu.be/r0fv9V9GHdo>

<https://youtu.be/jexMSISDubM>

<https://youtu.be/2RQk9P-EVpQ>

<https://youtu.be/L4v98ZZft68>

**Homework Assignment**

p.492 #1-7odd,13,15,21,27,29