

## 7.01 Polar Coordinates

Date: \_\_\_\_\_

**Opener: Plotting Polar Points in Desmos**

1. Go to [desmos.com/calculator](https://www.desmos.com/calculator)
2. Click the wrench (upper right) and choose the polar grid
3. Put the angle setting in degrees (shocking, right?!?)
4. Equation 1:  $r = 5$  from  $-6 \leq r \leq 6$ , scale of 1

*Suggestion:* Turn off the graph by clicking the colored circle to the left of Equation 1

5. Equation 2:  $a = 15$  from  $-360 \leq a \leq 360$ , scale of 15
6. Equation 3:  $(r \cos a, r \sin a)$
7. Equation 4:  $(x_1, y_1)$  *shift-underscore makes subscripts*
8. Equation 5:  $x_1 = 1$ , with a slider
9. Equation 6:  $y_1 = 1$ , with a slider

Use the sliders to move the points around.

Points (pun definitely intended!) to consider:

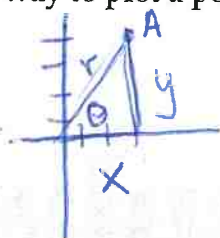
- What happens when  $r$  is negative?
- What happens when  $a$  is negative?

**There is more than one way to plot a point:**

Rectangular Graph:

$$A(3, 4)$$

$x, y$



Polar Graph:

$$(r, \theta)$$

$r = \text{radius}$

$\theta = \text{angle}$

i)  $+\theta$  is counterclockwise (CCW)

ii)  $-\theta$  is clockwise (CW)

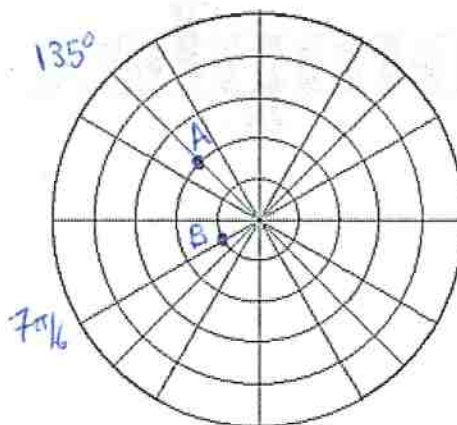
iii)  $+r$  is on the  $\theta$  angle

iv)  $-r$  is the opposite direction along the  $\theta$  line

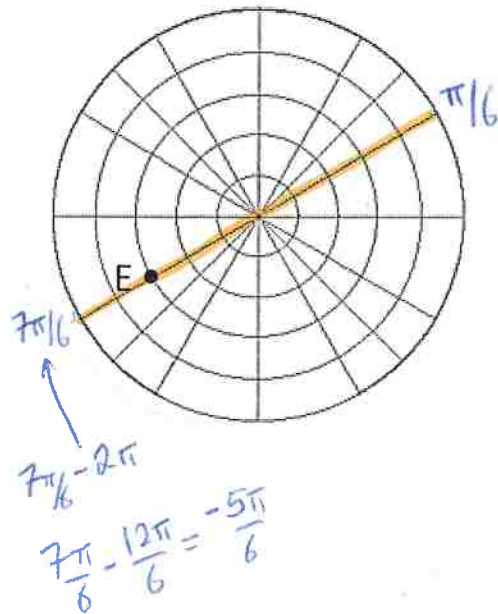
Example: Plot the Polar Points:  $(r, \theta)$

A  $(2, 135^\circ)$

B  $(1, \frac{7\pi}{6})$



Example: Name the location of E in 4 different ways with  $-2\pi \leq \theta \leq 2\pi$ .



$$(r, \theta)$$

$$E(3, \frac{7\pi}{6})$$

$$(3, -\frac{5\pi}{6})$$

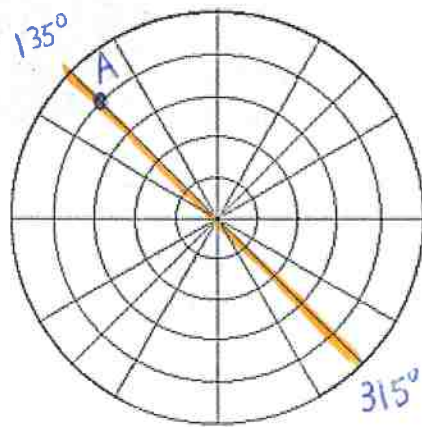
$$(-3, \frac{\pi}{6}) \left. \begin{array}{l} \frac{\pi}{6} - 2\pi \\ \frac{\pi}{6} - \frac{12\pi}{6} = -\frac{11\pi}{6} \end{array} \right\}$$

$$(-3, -\frac{11\pi}{6})$$

Example: Plot 3 points and determine different pairs of coordinates for them.

$$-360^\circ \leq \theta \leq 360^\circ$$

$$135 - 360 \rightarrow \theta = -225^\circ \rightarrow 135^\circ$$



$$\theta = 315 - 360$$

$$\theta = -45^\circ$$

$$A(4, 135^\circ)$$

$$(4, -225^\circ)$$

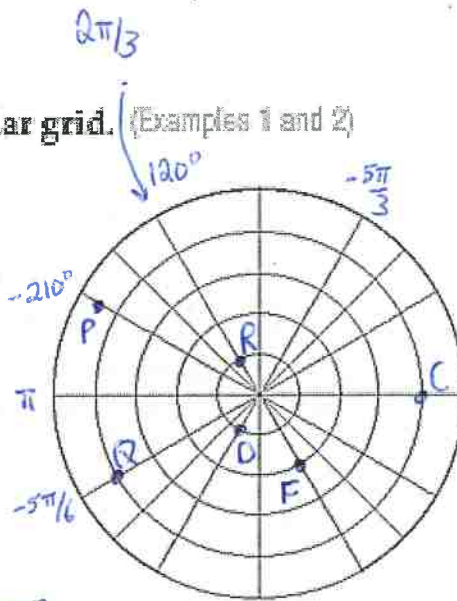
$$(-4, 315^\circ)$$

$$(-4, -45^\circ)$$

7.01 Practice:

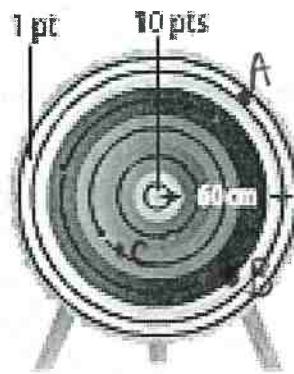
Graph each point on a polar grid. (Examples 1 and 2)

1. R(1, 120°)
3. F(-2,  $\frac{2\pi}{3}$ )
5. Q(4,  $-\frac{5\pi}{6}$ )
7. D(-1,  $-\frac{5\pi}{3}$ ) *same as  $\theta = \pi/3$*
9. C(-4,  $\pi$ )
11. P(4.5, -210°)



*same as  $\theta = -210 + 360$   
 $\theta = 150^\circ$*

13. ARCHERY The target in competitive target archery consists of 10 evenly spaced concentric circles with score values from 1 to 10 points from the outer circle to the center. Suppose an archer using a target with a 60-centimeter radius shoots arrows at  $(57, 45^\circ)$ ,  $(41, 315^\circ)$ , and  $(15, 240^\circ)$ . (Examples 1 and 2)

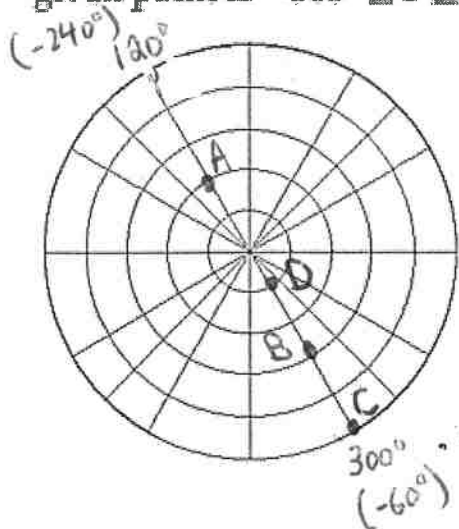


0-6	→	10 pts
6-12	→	9 pts
12-18	→	8 pts
18-24	→	7 pts
24-30	→	6 pts
30-36	→	5 pts
36-42	→	4 pts
42-48	→	3 pts
48-54	→	2 pts
54-60	→	1 pts

a. Plot the points where the archer's arrows hit the target on a polar grid.

b. How many points did the archer earn?  $1 \text{ pt} + 4 \text{ pts} + 8 \text{ pts} = 13 \text{ pts}$

Find three different pairs of polar coordinates that name the given point if  $-360^\circ \leq \theta \leq 360^\circ$  or  $-2\pi \leq \theta \leq 2\pi$ . (Example 3)



15. A(-2, 300°), (-2, -60°), (2, 120°), (2, -240°)
17. B(-3,  $\frac{2\pi}{3}$ ), (-3,  $-\frac{4\pi}{3}$ ), (3,  $\frac{5\pi}{3}$ ), (3,  $-\frac{\pi}{3}$ )
19. C(-5,  $-\frac{4\pi}{3}$ ), (-5,  $\frac{2\pi}{3}$ ), (5,  $\frac{5\pi}{3}$ ), (5,  $\frac{\pi}{3}$ )
21. D(-1, -240°), (-1, 120°), (1, -60°), (1, 300°)