

# Polar Curve Paths

Recognize and graph common polar equations.

HIGH SCHOOL • MA.912.T.4.3

**MA.912.T.4.3** "Graph equations in the polar coordinate plane with and without the use of graphing technology."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## CIRCLE PATTERNS

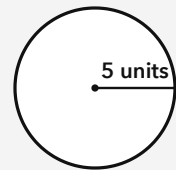
A constant equation  $r = a$  graphs a circle centered at the pole with radius  $|a|$ . The equation  $r = a \cos(\theta)$  graphs a circle with center  $(a/2, 0)$ , while  $r = a \sin(\theta)$  graphs a circle with center  $(0, a/2)$ . On the polar grids,  $O$  is the pole, radius labels count outward along the  $0$ -radian ray, and angle labels increase counterclockwise. Light rings and rays are reference guides; draw your curve over them.

## WORKED EXAMPLE

The printed circle models  $r = 5$ . State the graph represented by this equation.

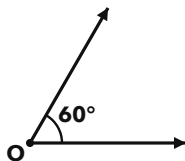
1. The value of  $r$  stays 5 for every angle.
2. Each point is 5 units from the pole.
3. Points the same distance from the pole form a circle.

**Answer:** A circle centered at the pole with radius 5 units.



## PRACTICE 4 problems

- 1** The ray shows  $\theta = 60$  degrees. A point has polar coordinates  $(4, \theta)$ . What are its rectangular coordinates?



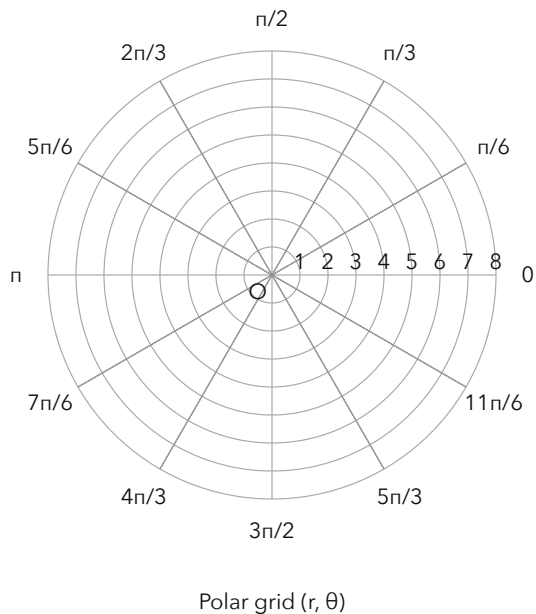
ANSWER \_\_\_\_\_

- 2** The ray shows  $\theta = 135$  degrees. A point has polar coordinates  $(2\sqrt{2}, \theta)$ . What are its rectangular coordinates?



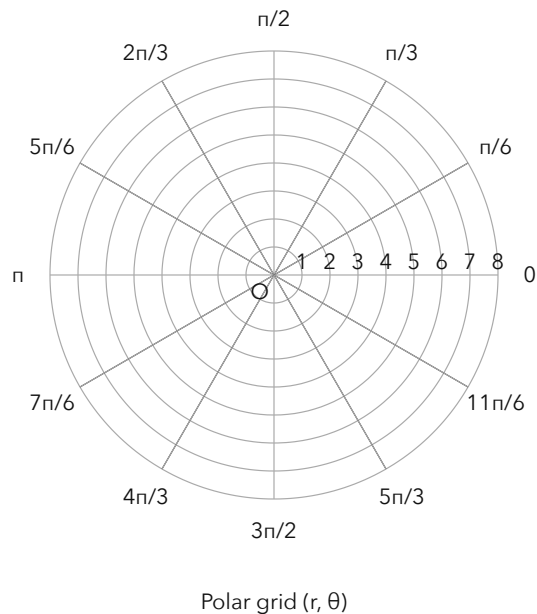
ANSWER \_\_\_\_\_

- 3** Graph  $r = 8\cos(\theta)$  on the polar grid.  
State the center and radius of the circle.



**ANSWER** \_\_\_\_\_  
\_\_\_\_\_

- 4** Graph  $r = -6\sin(\theta)$  on the polar grid.  
State the center and radius of the circle.



**ANSWER** \_\_\_\_\_  
\_\_\_\_\_

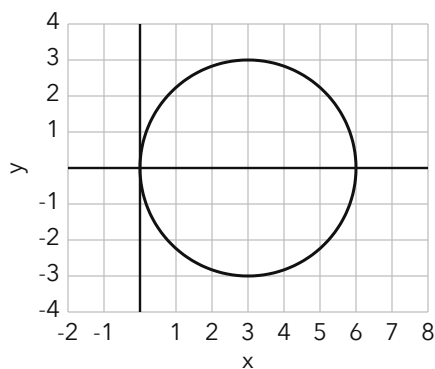
## APPLY IT Show your work

- 1** A game map uses the pole as the arena center. A safe-zone border stays 8 units from the center in every direction. Write a polar equation for the border and identify its graph.

WORK SPACE

**ANSWER** \_\_\_\_\_

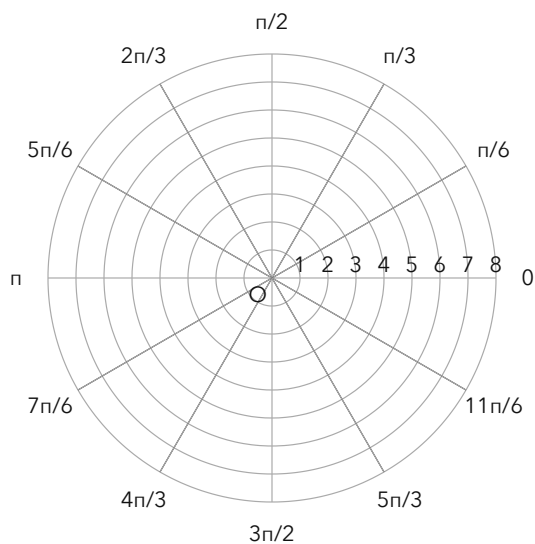
- 2** At a concert, a microphone pickup boundary is shown on the coordinate grid. Write its polar equation.



**ANSWER** \_\_\_\_\_

## CHALLENGE One step up

Graph  $r = 4\cos(\theta) + 4\sin(\theta)$  by hand on the polar grid. State the center and radius, then explain how you found them. Use polar graphing technology to check your curve and describe any correction needed.



Polar grid ( $r, \theta$ )

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WORK SPACE AND ANSWER

## PART 1 • PRACTICE

| # | PROBLEM                                                                                                                           | ANSWER                                          |
|---|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| 1 | The ray shows $\theta = 60$ degrees. A point has polar coordinates $(4, \theta)$ . What are its rectangular coordinates?          | <b><math>(2, 2\sqrt{3})</math></b>              |
| 2 | The ray shows $\theta = 135$ degrees. A point has polar coordinates $(2\sqrt{2}, \theta)$ . What are its rectangular coordinates? | <b><math>(-2, 2)</math></b>                     |
| 3 | Graph $r = 8\cos(\theta)$ on the polar grid. State the center and radius of the circle.                                           | <b>Center: <math>(4, 0)</math>. Radius: 4.</b>  |
| 4 | Graph $r = -6\sin(\theta)$ on the polar grid. State the center and radius of the circle.                                          | <b>Center: <math>(0, -3)</math>. Radius: 3.</b> |

## PART 2 • APPLY IT

- $r = 8$ ; a circle centered at the pole with radius 8 units.** A constant  $r$  value means every border point is the same distance from the pole. The border is therefore a circle of radius 8.
- $r = 6\cos(\theta)$**  The boundary is a circle through the pole with center  $(3, 0)$  and radius 3. A circle of this form has equation  $r = 6\cos(\theta)$ .

## CHALLENGE

**Center:  $(2, 2)$ . Radius:  $2\sqrt{2}$ . Multiply by  $r$  to get  $x^2 + y^2 = 4x + 4y$ . Completing the square gives  $(x - 2)^2 + (y - 2)^2 = 8$ . Technology check: the plotted curve should be the same circle through the pole. Accept an accurate description of agreement or of a correction to the hand-drawn graph.**

Accept equivalent coordinate forms, including rectangular-coordinate work that leads to the same circle. For the challenge, accept a correct completed-square equation and center-radius description.