LESSON MAKER PRO

Polar Curve Detectives

Identify special polar equations and sketch their key features.

HIGH SCHOOL · MA.912.T.4.4

MA.912.T.4.4 "Identify and graph special polar equations, including circles, cardioids, limacons, rose curves and lemniscates."

NAME _____ DATE _____

RECOGNIZE THE PATTERN

A constant equation r = a makes a circle centered at the pole. Equations with sin or cos can make circles, cardioids, limaçons, or roses, while r^2 with sin(2θ) or cos(2θ) makes a lemniscate. For a rose r = a sin(nθ) or r = a cos(nθ), there are n petals when n is odd and 2n petals when n is even.

WORKED EXAMPLE

The circle shown is centered at the pole. Write one polar equation for the circle.

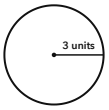


1. The graph is a circle centered at the pole.
2. Its radius is 11 units.
3. A constant r-value gives this circle.

Answer: r = 11

PRACTICE 6 problems

1 The circle shown is centered at the pole. Write one polar equation for it.



ANSWER _____

2 For r = 2cos(θ), identify the curve. Then give its center and radius in rectangular coordinates.

ANSWER _____

3 For r = 1 + cos(θ), identify the curve and state the direction it opens.

ANSWER _____

4 For r = 1 + 2cos(θ), identify the curve and state whether it has an inner loop.

ANSWER _____

5 For r = 3sin(2θ), state the number of petals and the length of each petal.

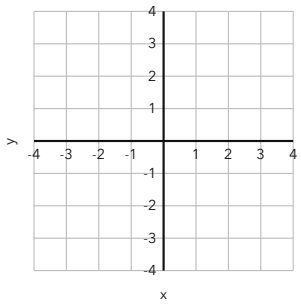
ANSWER _____

6 For r^2 = 9sin(2θ), identify the curve and state its orientation.

ANSWER _____

APPLY IT Show your work

1 A media club programs a laser design for a school festival. The beam follows r = 3sin(2θ). Sketch the design on the grid, then state how many bright petals it has and where their centers point.



ANSWER _____

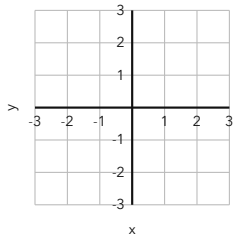
2 An underwater robotics team maps a sensor sweep with r = 2 - 2sin(θ). To plan the sweep, identify the curve, state its direction, and give its greatest distance from the pole.

WORK SPACE

ANSWER _____

CHALLENGE One step up

On the grid, sketch both r = 2cos(θ) and r = 2sin(θ). Explain how the two graphs are alike and how they are different by giving each circle's center and radius.



WORK SPACE AND ANSWER

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	The circle shown is centered at the pole. Write one polar equation for it.	**r = 3**
2	For r = 2cos(θ), identify the curve. Then give its center and radius in rectangular coordinates.	**Circle; center (1, 0), radius 1**
3	For r = 1 + cos(θ), identify the curve and state the direction it opens.	**Cardioid; opens right**
4	For r = 1 + 2cos(θ), identify the curve and state whether it has an inner loop.	**Limaçon; it has an inner loop**
5	For r = 3sin(2θ), state the number of petals and the length of each petal.	**4 petals; each petal has length 3**
6	For r^2 = 9sin(2θ), identify the curve and state its orientation.	**Lemniscate; its loops lie along the diagonal y = x**

PART 2 · APPLY IT

1. **A four-petal rose with petal length 3. The petal centers point at θ = π/4, 3π/4, 5π/4, and 7π/4.** Because n = 2 is even, r = 3sin(2θ) has 2n = 4 petals. The sine form places the petals on the diagonal directions.
2. **Cardioid; it opens downward; greatest distance from the pole is 4** The equal coefficients make a cardioid. Its largest r-value is 2 - 2(-1) = 4, which occurs at θ = 3π/2.

CHALLENGE

Both graphs are circles with radius 1 and both pass through the pole. r = 2cos(θ) has center (1, 0), while r = 2sin(θ) has center (0, 1).

Accept equivalent descriptions of direction, such as rightward or toward the positive x-axis. For sketches, accept accurate curves with the stated symmetry, centers, petal count, and maximum distances.