

Polar Point Paths

Locate, convert, and interpret points in the polar plane.

HIGH SCHOOL • MA.912.T.4.1

MA.912.T.4.1 "Define and plot polar coordinates. Convert between polar coordinates and rectangular coordinates with and without the use of technology."

NAME _____

DATE _____

FROM TURNS TO COORDINATES

A polar coordinate (r, θ) names a point by its distance r from the origin and its angle θ , measured counterclockwise from the positive x -axis. Convert polar to rectangular with $x = r \cos(\theta)$ and $y = r \sin(\theta)$. Convert rectangular to polar with $r = \sqrt{x^2 + y^2}$, then choose the angle from the point's quadrant. A negative r places the point on the ray opposite θ .

WORKED EXAMPLE

Convert the rectangular coordinate $(5, 12)$ to polar form, where $0 \leq \theta < 2\pi$.

1. $r = \sqrt{5^2 + 12^2} = \sqrt{169} = 13$.
2. The point is in Quadrant I, so $\theta = \arctan(12/5)$.
3. Write the coordinate as (r, θ) .

Answer: $(13, \arctan(12/5))$

PRACTICE 6 problems

- 1** Plot the polar coordinate $(4, \pi/2)$. What rectangular coordinates name the point?

ANSWER _____

- 2** Convert the rectangular coordinate $(-\sqrt{3}, 3)$ to polar form, where $0 \leq \theta < 2\pi$.

ANSWER _____

- 3** Convert the rectangular coordinate $(\sqrt{2}, -\sqrt{2})$ to polar form, where $0 \leq \theta < 2\pi$.

ANSWER _____

- 4** Convert the polar coordinate $(6, \pi)$ to rectangular form.

ANSWER _____

- 5** A point is plotted at the polar coordinate $(-2, \pi/6)$. Write its rectangular coordinates.

ANSWER _____

- 6** Convert the rectangular coordinate $(0, -7)$ to polar form, where $0 \leq \theta < 2\pi$.

ANSWER _____

APPLY IT Show your work

- 1** At a robotics meet, a robot begins at the origin. Its position is $(8, 3\pi/4)$, where distance is measured in meters. Write its rectangular coordinates. What do the signs of the coordinates tell you about its location?

WORK SPACE

ANSWER _____

- 2** For a game map, a treasure marker is 9 units west and $9\sqrt{3}$ units south of the starting point. Its rectangular coordinate is $(-9, -9\sqrt{3})$. Write its polar coordinate, where $0 \leq \theta < 2\pi$.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

The point P has polar coordinate $(-11, \pi/3)$. Give two equivalent polar coordinates for P, one with a positive radius and one with a negative radius, where each angle is between 0 and 2π . Explain why the coordinates name the same point.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Plot the polar coordinate $(4, \pi/2)$. What rectangular coordinates name the point?	$(0, 4)$
2	Convert the rectangular coordinate $(-\sqrt{3}, 3)$ to polar form, where $0 \leq \theta < 2\pi$.	$(2\sqrt{3}, 2\pi/3)$
3	Convert the rectangular coordinate $(\sqrt{2}, -\sqrt{2})$ to polar form, where $0 \leq \theta < 2\pi$.	$(2, 7\pi/4)$
4	Convert the polar coordinate $(6, \pi)$ to rectangular form.	$(-6, 0)$
5	A point is plotted at the polar coordinate $(-2, \pi/6)$. Write its rectangular coordinates.	$(-\sqrt{3}, -1)$
6	Convert the rectangular coordinate $(0, -7)$ to polar form, where $0 \leq \theta < 2\pi$.	$(7, 3\pi/2)$

PART 2 • APPLY IT

- $(-4\sqrt{2}, 4\sqrt{2})$; the robot is west and north of the origin.** Use $x = 8 \cos(3\pi/4)$ and $y = 8 \sin(3\pi/4)$. The negative x-value and positive y-value place the robot northwest of the origin.
- $(18, 4\pi/3)$** Find $r = \sqrt{(-9)^2 + (-9\sqrt{3})^2} = 18$. The point is in Quadrant III with reference angle $\pi/3$, so $\theta = 4\pi/3$.

CHALLENGE

Positive radius: $(11, 4\pi/3)$. Negative radius: $(-11, \pi/3)$. A negative radius moves 11 units in the direction opposite $\pi/3$, which is the same direction as $4\pi/3$.

Accept exact radical forms and equivalent polar angles only when they meet the stated angle interval. For rectangular coordinates, accept coordinate pairs with equivalent simplified values.