

Student Workbook

Polar Coordinates: Graphs

Name: _____

Date: _____

Period: _____

Learning Target: I can identify and classify polar curves (circles, cardioids, limaçons, rose curves) and test them for symmetry.

Vocabulary

Term	Meaning
Cardioid	$r = a \pm a \cos\theta$ (or $\sin\theta$) — a heart-shaped curve where $a = b$.
Limaçon	$r = a \pm b \cos\theta$ (or $\sin\theta$), $a \neq b$ — may have an inner loop, be dimpled, or convex.
Rose Curve	$r = a \cos(n\theta)$ or $a \sin(n\theta)$ — a flower-shaped curve with petals.

Key Concept: Basic Polar Curve Types

QUICK IDENTIFICATION	
Equation Form	Curve
$r = a$	Circle centered at origin, radius a
$r = 2a \cos\theta$ or $2a \sin\theta$	Circle through the origin
$r = a \pm a \cos\theta/\sin\theta$	Cardioid
$r = a \cos(n\theta)/\sin(n\theta)$	Rose curve

Key Concept: Classifying Limaçons

$r = a \pm b \cos\theta$ (or $\sin\theta$) — **COMPARE a/b** $a/b < 1$: inner loop $a/b = 1$: cardioid $1 < a/b < 2$: dimpled
 $a/b \geq 2$: convex (smooth)

EXAMPLE 1
Classify $r = 2 + 4\cos\theta$.

$a=2, b=4, a/b = \rule{1cm}{0.4pt} \rightarrow \rule{1cm}{0.4pt}$

Key Concept: Rose Curve Petals

$r = a \cos(n\theta)$ or $a \sin(n\theta)$ If n is ODD: n petals. If n is EVEN: $2n$ petals.

EXAMPLE 2

Find the number of petals for $r = 3\cos(2\theta)$.

$n=2$ (even) $\rightarrow$ _____ petals

COMMON MISTAKE

For rose curves, an EVEN n gives $2n$ petals, NOT n petals! This is the most commonly missed rule in this chapter.

Key Concept: Symmetry Tests

THREE TESTS Polar axis: replace θ with $-\theta$. Line $\theta=\pi/2$: replace θ with $\pi-\theta$. Pole: replace r with $-r$.

EXAMPLE 3

Test $r = 4\cos\theta$ for symmetry about the polar axis.

$r = 4\cos(-\theta) =$ _____ (since cosine is an even function) $\rightarrow$ symmetric

Guided Practice — Part A: Identify the Curve

A1 $r = 6$

A2 $r = 4 + 4\sin\theta$

Guided Practice — Part B: Classify the Limaçon

B1 $r = 3 + 5\cos\theta$

B2 $r = 6 + 2\sin\theta$

Guided Practice — Part C: Rose Curve Petals

C1 $r = 5\cos(3\theta)$

C2 $r = 2\sin(4\theta)$

Guided Practice — Part D: Symmetry Tests

D1 Test $r = 3\sin\theta$ for symmetry about the line $\theta = \pi/2$.

D2 Test $r = 2 + 2\cos\theta$ for symmetry about the polar axis.

BEFORE YOU MOVE ON

Check with a partner: for rose curves, did you double the petal count when n is even?