9-2

Study Guide

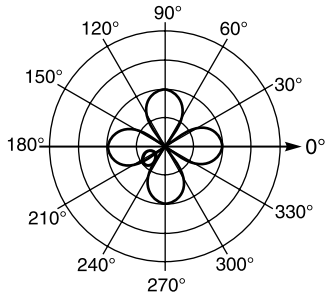
Graphs of Polar Equations

A **polar graph** is the set of all points whose coordinates (r, θ) satisfy a given polar equation. The position and shape of polar graphs can be altered by multiplying the function by a number or by adding to the function. You can also alter the graph by multiplying θ by a number or by adding to it.

Example 1 **Graph the polar equation $r = 2 \cos 2\theta$.**

Make a table of values. Graph the ordered pairs and connect them with a smooth curve.

θ	$2 \cos 2\theta$	(r, θ)
0°	2	(2, 0°)
30°	1	(1, 30°)
45°	0	(0, 45°)
60°	−1	(−1, 60°)
90°	−2	(−2, 90°)
120°	−1	(−1, 120°)
135°	0	(0, 135°)
150°	1	(1, 150°)
180°	2	(2, 180°)
210°	1	(1, 210°)
225°	0	(0, 225°)
240°	−1	(−1, 240°)
270°	−2	(−2, 270°)
300°	−1	(−1, 300°)
315°	0	(0, 315°)
330°	1	(1, 330°)

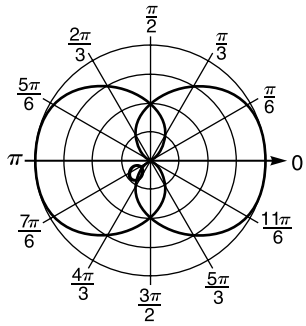


This type of curve is called a *rose*. Notice that the farthest points are 2 units from the pole and the rose has 4 petals.

Example 2 **Graph the system of polar equations. Solve the system using algebra and trigonometry, and compare the solutions to those on your graph.**

$r = 2 + 2 \cos \theta$

$r = 2 - 2 \cos \theta$



To solve the system of equations, substitute $2 + 2 \cos \theta$ for r in the second equation.

$$2 + 2 \cos \theta = 2 - 2 \cos \theta$$
$$\cos \theta = 0$$
$$\theta = \frac{\pi}{2} \text{ or } \theta = \frac{3\pi}{2}$$

Substituting each angle into either of the original equations gives $r = 2$. The solutions of the system are therefore $\left(2, \frac{\pi}{2}\right)$ and $\left(2, \frac{3\pi}{2}\right)$. Tracing on the curves shows that these solutions correspond with two of the intersection points on the graph. The curves also intersect at the pole.