# A Polar Phenomenon (Part 1)

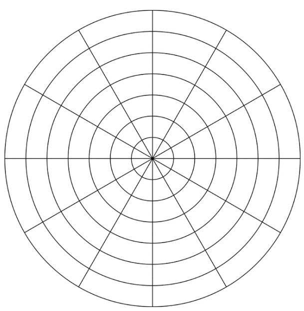
This year we have studied many types of functions by making connections between their graphs, equations, and tables. Now we're going to look at some polar curves and look for similar relationships.

1. Go to https://bit.ly/2MCZDOi. The folder "Part 1" should be open and the graph of $r = a\cos\theta$ should be turned on.
   a. What is the independent variable and what is the dependent variable in this equation?

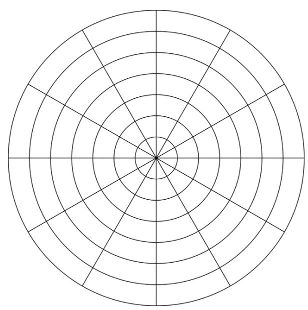
   b. Select the "play" button for slider *a* and watch. What do you notice?

2. Move slider *a* to graph the following:

$r = 5\cos\theta$



$r = -2\cos\theta$



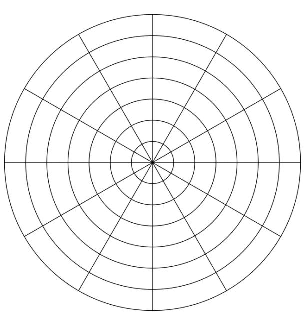
What similarities do you notice between the two graphs?

What differences do you notice? How do you think these are linked to the equation?

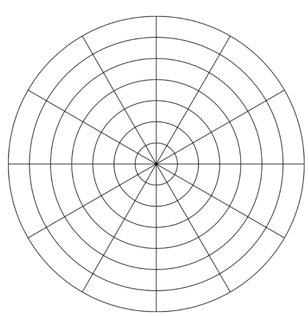
3. For each of the graphs above, give the ordered pair (in polar form) of the point that is *furthest* away from the pole/origin.

4. Turn off the graph of $r = a\cos\theta$, and turn on the graph of $r = a\sin\theta$. Move slider *a* to graph the following:

$r = 4\sin\theta$



$r = -3\sin\theta$



What do you think the *a* value represents?

How do circles that have sine in their equation differ from circles that have cosine in them? Why do you think this is?

5. For each of the graphs above, give the ordered pair (in polar form) of the point that is *furthest* away from the pole/origin.

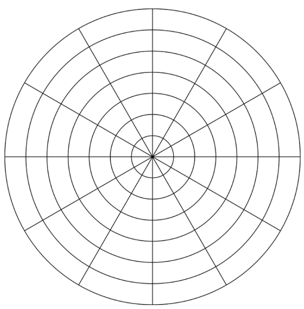
6. Close the folder for "part 1" and open the folder for "part 2". We will now be looking at the graphs of $r = a\cos(n\theta)$ and $r = a\sin(n\theta)$.

    a. With only the first equation turned on, press play on the *a* slider. What is changing?

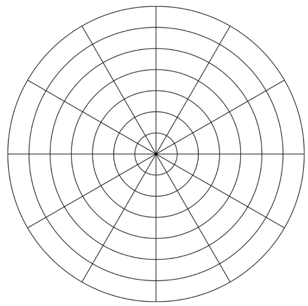
    b. Pause slider *a* and press play on the *n* slider. What is changing?

7. Change the *a* and *n* sliders to graph the following:

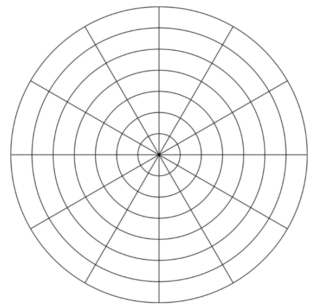
$r = 5\cos(3\theta)$



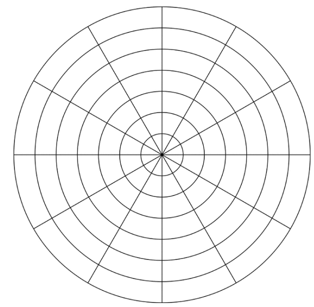
$r = -4\cos(5\theta)$



$r = 5\cos(2\theta)$



$r = 3\cos(4\theta)$

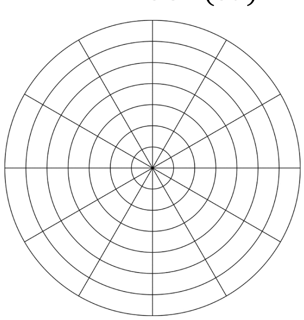


8. How can you tell from the equation how many petals there will be?

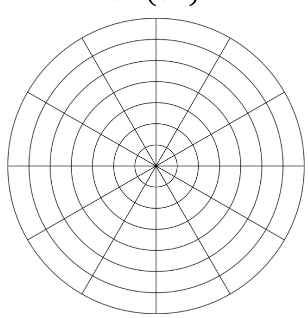
9. Evaluate each of the four equations at $\theta = 0$. What do you notice? What does this tell you about where the first petal will be located?

10. Turn off the graph of $r = a\cos(n\theta)$ and turn on the graph of $r = a\sin(n\theta)$. Change the *a* and *n* sliders to graph the following:

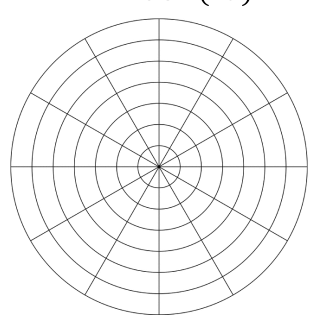
$r = 5\sin(3\theta)$



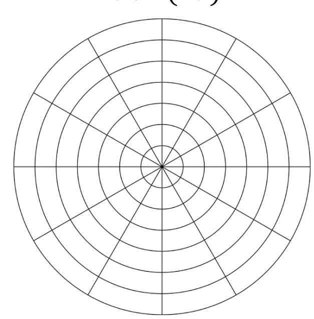
$r = 3\sin(5\theta)$



$r = 5\sin(2\theta)$



$r = 3\sin(4\theta)$



11. What similarities and differences do you notice between equations with cosine in them versus equations with sine in them? (Shape, symmetry, location of petals, etc.)

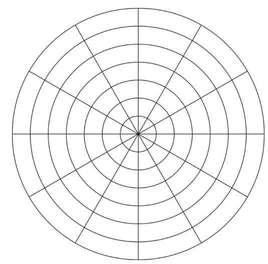
12. For each of the four graphs, how could you determine the angle made between the petals?

# Lesson 8.3 – Polar Graphs: Circles and Roses

QuickNotes

## Check Your Understanding

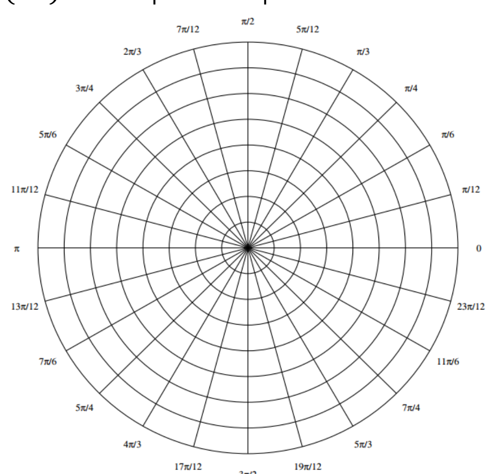
1. Sketch the graph of $r = -6\cos\theta$ without a calculator or Desmos.



2. Consider the equation $r = 7\sin(3\theta)$.
   a. What things can you tell about its graph just by looking at the equation?

   b. Fill out a table of values for $r = 7\sin(3\theta)$. Then plot the points and sketch the graph.

| $\theta$ | $r$ |
|---|---|
| $0$ | |
| $\pi/6$ | |
| $\pi/2$ | |
| $5\pi/6$ | |




3. Consider the graph of $r = 5\cos(4\theta)$. Determine the following:

Number of petals: ______ Symmetry: ____________ Angle between petals: ______

Length of each petal: ______ First petal at $\theta =$_______ Range: ____ $\leq r \leq$ _____