

**Assignment**  
**Polar Graphs**

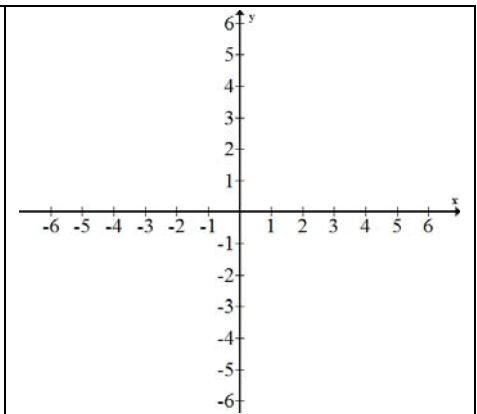
Name \_\_\_\_\_

**Objective:** You will graph several types of polar graphs, and explore to see how parameter changes alter the graphs.

Go to [www.desmos.com](http://www.desmos.com) and click on Start Graphing

**Assignment Details:**

- For each type of graph, graph all equations on the same grid using **different colors**.
- You may need to zoom out to be able to see complete graphs.
- Answer the questions about how changes in  $a$ ,  $b$ , or  $n$  affect the graph.

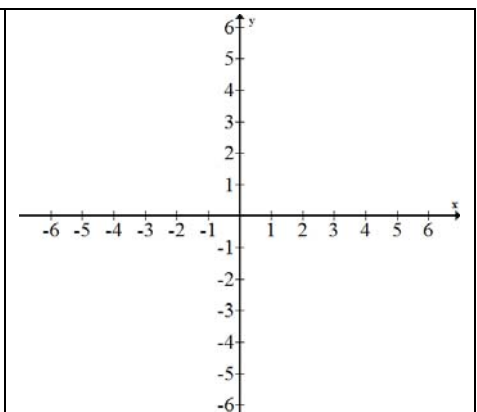
<p><b>Circle Exploration</b> Graph the following equations on the same grid.</p> <ol style="list-style-type: none"><li>1. <math>r(\theta) = 2 \cos(\theta)</math></li><li>2. <math>r(\theta) = 3 \cos(\theta)</math></li><li>3. <math>r(\theta) = -4 \cos(\theta)</math></li><li>4. <math>r(\theta) = -5 \cos(\theta)</math></li></ol>	
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**Circle Analysis**

1. In the equation  $y = a + b \cos(n\theta)$ , what is the value of  $a$  for each of the equations in *Circle Exploration* questions?  
What is the value of  $n$ ?

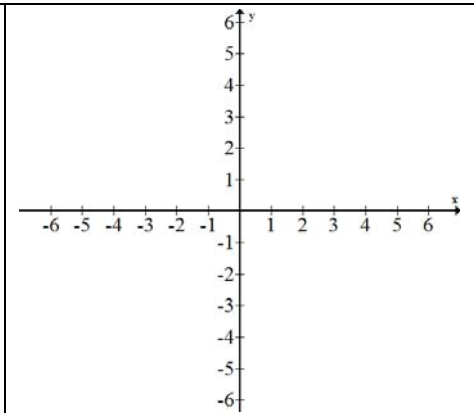
$a =$  \_\_\_\_\_       $n =$  \_\_\_\_\_

2. What effect does the absolute value of  $b$  have on the graph of the circle?
3. What effect does the positive or negative value of  $b$  have on the graph?

<p><b>Rose Curves Exploration</b> Graph the following equations on the same grid.</p> <ol style="list-style-type: none"><li>1. <math>r(\theta) = 4 \cos(\theta)</math></li><li>2. <math>r(\theta) = 4 \cos(2\theta)</math></li><li>3. <math>r(\theta) = 4 \cos(3\theta)</math></li><li>4. <math>r(\theta) = 4 \cos(4\theta)</math></li></ol>	
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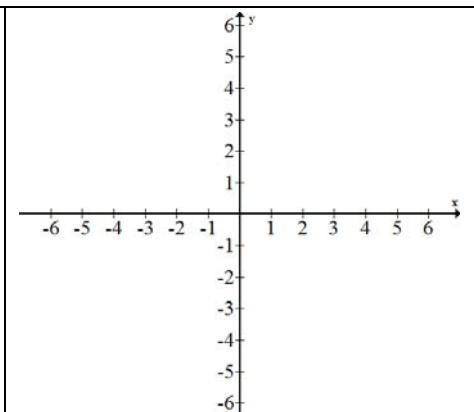
Graph the following equations on the same grid.

1.  $r(\theta) = 4 \cos(3\theta)$
2.  $r(\theta) = 5 \cos(3\theta)$
3.  $r(\theta) = 6 \cos(3\theta)$



Graph the following equations on the same grid.

1.  $r(\theta) = 5 \cos(3\theta)$
2.  $r(\theta) = -5 \cos(3\theta)$



**Rose Curve Analysis**

4. In the equation  $y = a + b \cos(n\theta)$ , what is the value of  $a$  for each of the equations in the *Rose Exploration*? What is the value of  $b$  in the first section of graphs?

$a =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

5. How many rose leaves does each equation produce?

A.	$r(\theta) = 4 \cos(\theta)$	leaves =
B.	$r(\theta) = 4 \cos(2\theta)$	leaves =
C.	$r(\theta) = 4 \cos(3\theta)$	leaves =
D.	$r(\theta) = 4 \cos(4\theta)$	leaves =

E. Predict the number of leaves for  $r(\theta) = 4 \cos(5\theta)$ : \_\_\_\_\_ (check, if necessary)

6. How does the value of  $n$  determine the number of leaves?

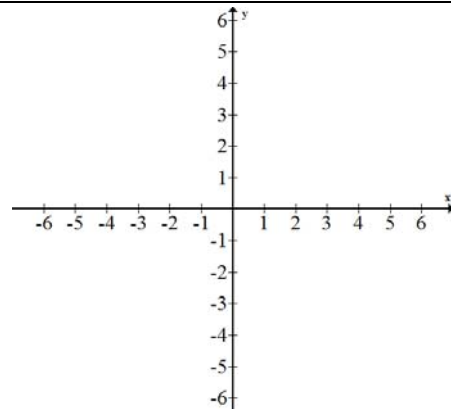
7. What effect does the value of  $b$  have on the leaves of the rose?

8. What effect does the positive or negative value of  $b$  have on the graph?

### Limaçon Curves Exploration

Graph the following equations on the same grid.

1.  $r(\theta) = 1 + 2 \cos(\theta)$
2.  $r(\theta) = 2 + 4 \cos(\theta)$
3.  $r(\theta) = 1 - 3 \cos(\theta)$
4.  $r(\theta) = 2 - 5 \cos(\theta)$



### Limaçon Curve Analysis

9. In the equation  $y = a + b \cos(n\theta)$ , what is the value of  $n$  for each of the equations in *Limaçon Curve Exploration*?

$n =$  \_\_\_\_\_

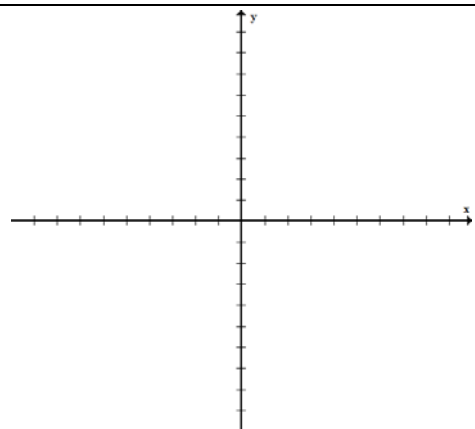
10. How does the absolute value of  $a$  compare to the absolute value of  $b$ ?
11. How do the absolute values of  $a$  and  $b$  affect the graph?
12. What effect does the positive or negative value of  $b$  have on the graph?

### Cardioid Exploration

Graph the following equations on the same grid.

1.  $r(\theta) = 2 + 2 \cos(\theta)$
2.  $r(\theta) = 3 + 3 \cos(\theta)$
3.  $r(\theta) = 4 + 4 \cos(\theta)$
4.  $r(\theta) = 5 + 5 \cos(\theta)$

- highlight  $r(\theta) = 3 + 3 \cos(\theta)$
- Now graph  $r(\theta) = 3 - 3 \cos(\theta)$



### Cardioid Curve Analysis

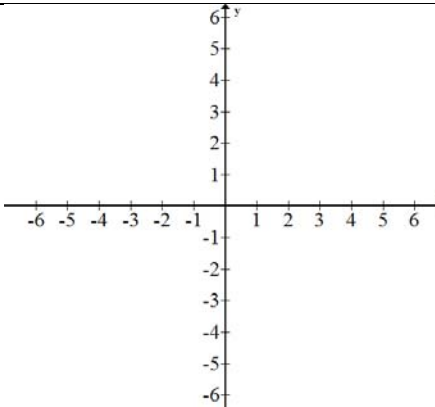
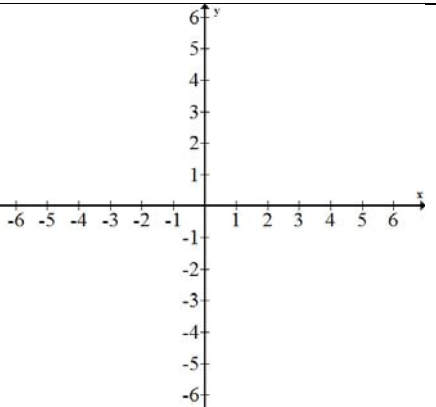
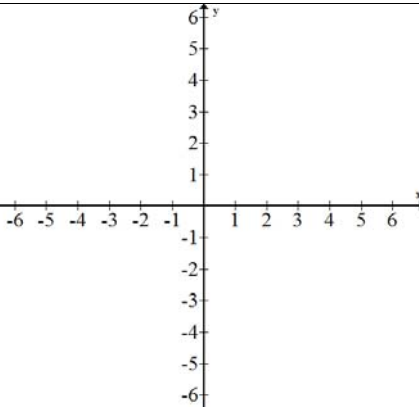
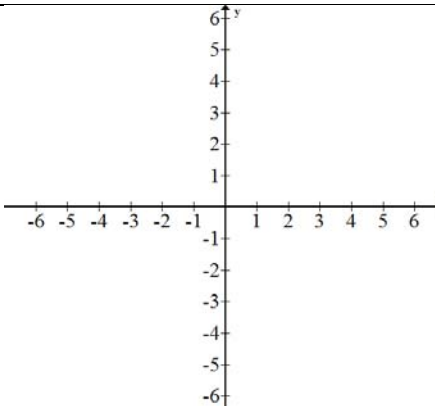
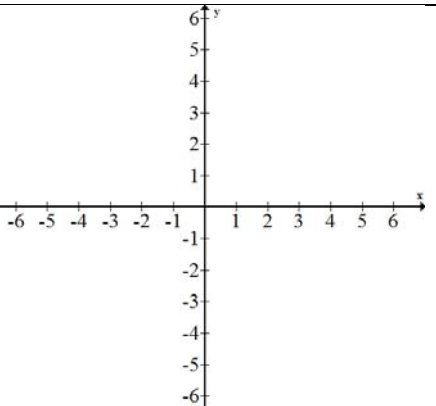
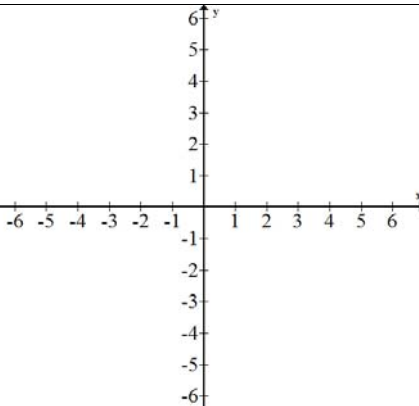
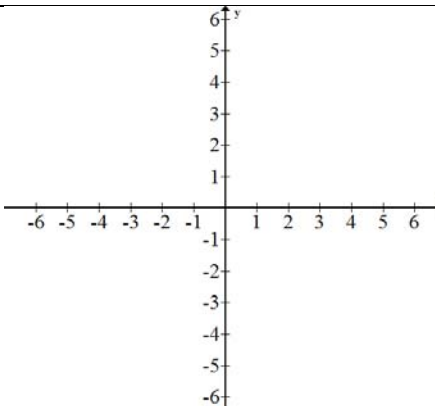
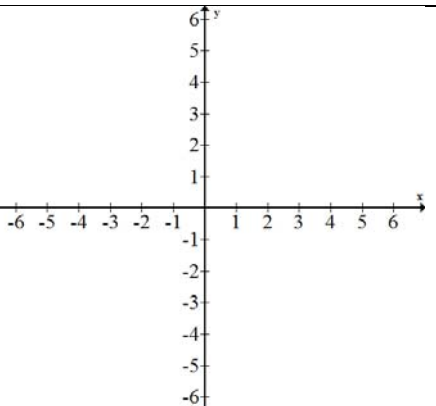
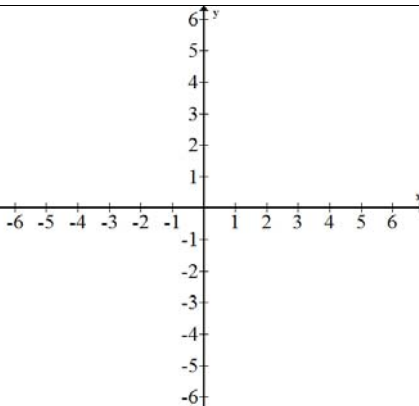
13. In the equation  $y = a + b \cos(n\theta)$ , what is the value of  $n$  for each of the equations in *Cardioid Curve Exploration*?

$n =$  \_\_\_\_\_

14. How does the absolute value of  $a$  compare to the absolute value of  $b$ ?
15. How do the absolute values of  $a$  and  $b$  affect the graph?
16. What effect does the positive or negative value of  $b$  have on the graph?

**Summary**

Consider the function  $r(\theta) = a + b\sin(n\theta)$ . Describe the graph produced and indicate whether the graph is a circle, rose, limaçon or cardioid. (Can you determine the shape without graphing? If necessary, use DESMOS to help with the graphs.)

17. $r(\theta) = 2 \sin(\theta)$	18. $r(\theta) = 4 \sin(\theta)$	19. $r(\theta) = 6 \sin(\theta)$
		
20. $r(\theta) = 2 \sin(2\theta)$	21. $r(\theta) = 2 \sin(3\theta)$	22. $r(\theta) = -3 \sin(4\theta)$
		
23. $r(\theta) = 1 + 2 \sin(\theta)$	24. $r(\theta) = 2 + 2 \sin(\theta)$	25. $r(\theta) = 2 - 5 \sin(\theta)$
		

26. How do the curves  $r(\theta) = a + b \cos(n\theta)$  and  $r(\theta) = a + b \sin(n\theta)$  compare?