EXPLORATIONS

Activity 11

Exploring Polar Equations

Two of the basic forms of a polar curve are given by $r(\theta) = a + b\cos(n\theta)$ and $r(\theta) = a + b\sin(n\theta)$. By changing the values of a, b, and n different polar curves can be generated.

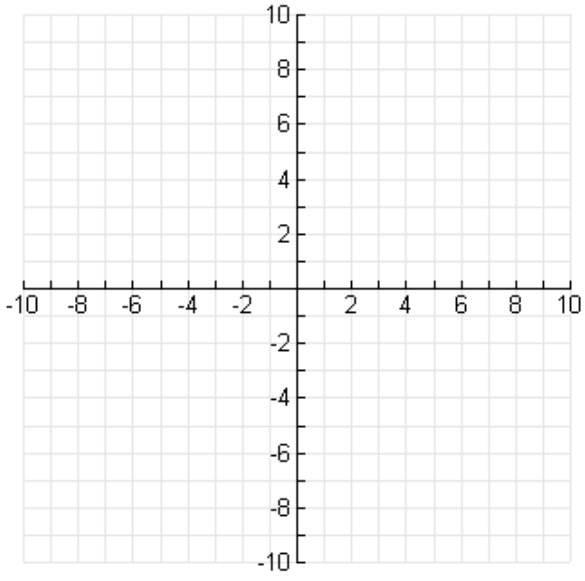
Circle Exploration

1. Open a new TI InterActive! document. Title this document **Exploring Polar Equations**. Add your name and the date to this document.

2. Select Mode settings and change the Graph Type to Polar and the Angle Format to Radian. Click on OK.

3. Select Graph to open a Graph window and define r1(θ): = 2 cos(θ).Click in the box to the left of $r1(\theta)$ to select the equation. Sketch the graph of r1(θ): = 2 cos(θ) on the provided grid.

   Note: *Use the Symbol Palette to access the θ.*



4. Define and select r2(θ): = 3 cos(θ). Sketch the graph of r2(θ): = 3 cos(θ) on the same grid.

5. Define and select r3(θ): = -4 cos(θ). Sketch the graph of r3(θ): = -4 cos(θ) on the same grid.

6. Define and select r4(θ): = −5 cos(θ). Sketch the graph of r4(θ): = −5 cos(θ) on the same grid.
7. Click on Save to Document  to paste the graphs into your TI InterActive! document.

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 3 through 6? What is the value of n?

   a = _____ n = _____

2. What effect does the absolute value of b have on the graph of the circle?

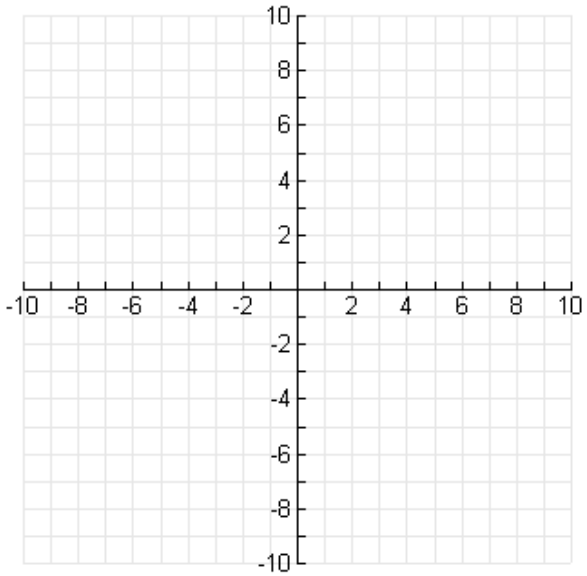
   _____

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

   _____

Rose Polar Curve Exploration

1. Select Graph  to open a new graphing window and define r1(θ): = 4 cos(θ). Click in the box to the left of r1(θ) to select the equation. Sketch the graph of r1(θ): = 4 cos(θ) on the provided grid.



2. Define and select r2(θ): = 4 cos(2θ). Sketch the graph of r2(θ): = 4 cos(2θ) on the same grid.
3. Define and select r3(θ): = 4 cos(3θ). Sketch the graph of r3(θ): = 4 cos(3θ) on the same grid.
4. Define and select r4(θ): = 4 cos(4θ). Sketch the graph of r4(θ): = 4 cos(4θ) on the same grid.
5. Click on Save to Document  to paste the graphs into your TI InterActive! document.

Rose Polar Curve Analysis

1. In the equation $y = a + b\cos(n\theta)$, what is the value of a for each of the equations in *Rose Polar Curves Exploration* questions 1 through 4? What is the value of b?

   a = _____ b = _____

2. How many rose leaves does each equation produce?

   A. r1(θ): = 4 cos(θ) leaves = _____

   B. r2(θ): = 4 cos(2θ) leaves = _____

   C. r3(θ): = 4 cos(3θ) leaves = _____

   D. r4(θ): = 4 cos(4θ) leaves = _____

3. How does the value of n determine the number of leaves?

   _____

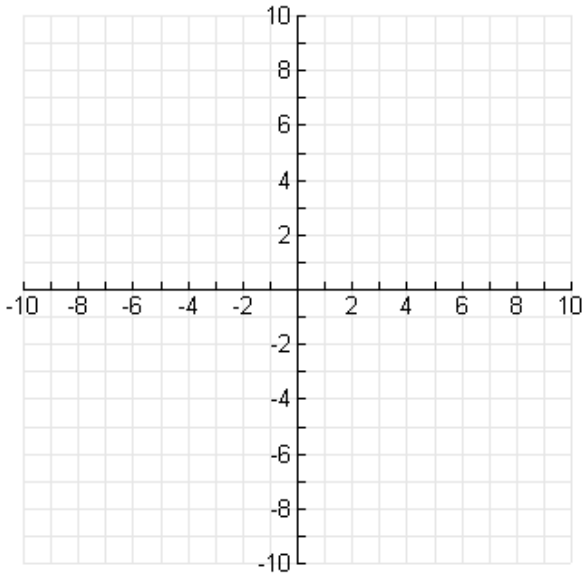
4. Select Graph  to open a new graph window. Define r1(θ): = 4 cos(3θ), r2(θ): = 5 cos(3θ) and r3(θ): = 6 cos(3θ). Click on Save to Document  to paste the graphs into your TI InterActive! document. What effect does the value of b have on the leaves of the rose?

   _____

5. Select Graph  to open a new graph window. Define r1(θ): = 5 cos(3θ) and r2(θ): = -5 cos(3θ). Click on Save to Document  to paste the graphs into your TI InterActive! document What effect does the positive or negative value of b have on the graph?

   _____

Limaçon Curve Exploration



1. Select Graph  to open a new graphing window and define r1(θ): = 1 + 2 cos(θ). Click in the box to the left of *r*1(θ) to select the equation. Sketch the graph of r1(θ): = 1 + 2 cos(θ) on the provided grid.
2. Define and select r2(θ): = 2 + 4 cos(θ). Sketch the graph of r2(θ): = 2 + 4 cos(θ) on the same grid.
3. Define and select r3(θ): = 1 − 3 cos(θ). Sketch the graph of r3(θ): = 1 − 3 cos(θ) on the same grid.
4. Define and select r4(θ): = 2 − 5 cos(θ). Sketch the graph of r4(θ): = 2 − 5 cos(θ) on the same grid.
5. Click on Save to Document  to paste the graphs into your TI InterActive! document.

Limaçon Curve Analysis

1. In the equation $y = a + b\cos(n\theta)$, what is the value of n for each of the equations in *Limaçon Curve Exploration* questions 1 through 4?

   n = _____

2. How does the absolute value of a compare to the absolute value of b?

   _____

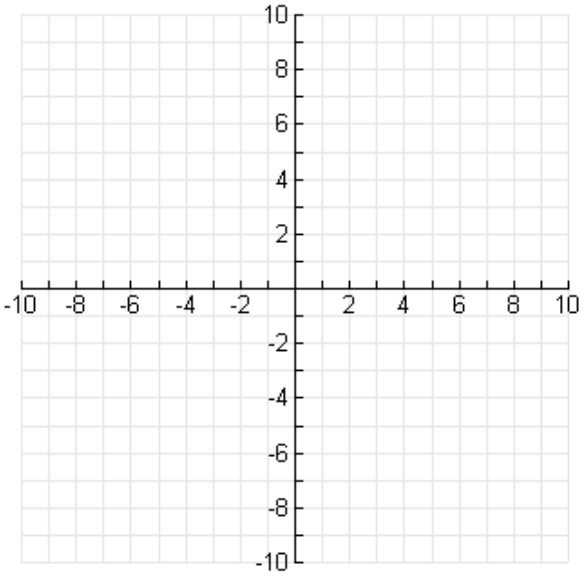
3. How do the absolute values of a and b effect the graph?

   _____

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

   _____

Cardiod Curve Exploration



1. Select Graph to open a new graphing window and define r1(θ): = 2 + 2 cos(θ). Click in the box to the left of *r*1(θ) to select the equation. Sketch the graph of r1(θ): = 2 + 2 cos(θ) on the provided grid.

2. Define and select r2(θ): = 3 + 3 cos(θ). Sketch the graph of r2(θ): = 3 + 3 cos(θ) on the same grid.

3. Define and select r3(θ): = 4 + 4 cos(θ). Sketch the graph of r3(θ): = 4 + 4 cos(θ) on the same grid.

4. Define and select r4(θ): = 5 + 5 cos(θ). Sketch the graph of r4(θ): = 5 + 5 cos(θ) on the same grid.

5. Click on Save to Document to paste the graphs into your TI InterActive! document.

Cardiod Curve Analysis

1. In the equation $y = a + b\cos(n\theta)$, what is the value of n for each of the equations in *Cardiod Curve Exploration* questions 1 through 4?

   n = _____

2. How does the absolute value of a compare to the absolute value of b?

   _____

3. How do the absolute values of a and b affect the graph?

   _____

4. Select Graph to open a new graph window. Define r1(θ): = 3 + 3 cos(θ) and r2(θ): = 3 − 3 cos(θ). Click on Save to Document to paste the graphs into your TI InterActive! document. What effect does the positive or negative value of b have on the graph?

   _____

5. Save this document as **cardiod.tii**. Print a copy of this document.

Additional Exercises

In a math box, define a: = 0, b = 2, n: = 1. Select Polar Graph and define r1(θ): = a + b * sin(n * θ). Describe the graph produced and indicate whether the graph is a circle, rose, limaçon or cardiod. Change the values to those given in each problem.

1. a: = 0, b: = 2, n: = 1

_____

_____

2. a: = 0, b: = 4, n: = 1

_____

_____

3. a: = 0, b: = -6, n: = 1

_____

_____

4. a: = 0, b: =2, n: = 2

_____

_____

5. a: = 0, b:= 2, n: = 3

_____

_____

6. a:= 0, b: = -3, n: = 4

_____

_____

7. a:= 1, b: = 2, n: = 1

_____

_____

8. a: = 2, b: =2, n: = 1

9. a: = 3, b: = -4, n: = 1

10. a: = 2, b: = -5, n: = 1

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

12. Generalize how the values of *a*, *b*, and *n* produce the different curves.