Graphing Calculator Activity
TI-83 Plus
A Study of the Rose Curve in Polar Coordinates

Introduction

Graphing complex equations in polar coordinates can be tedious and time consuming. The graphing calculator enables us to quickly generate curves in polar coordinates. By graphing a selection of formulas for related curves, we can easily discover how variations in the equation effect the appearance of the curve. In this activity, we'll be investigating the rose curve.

Preparation

Begin by letting the calculator know that you want to work in polar coordinates.

1. Press [MODE].
2. Using the down arrow button [▼], move the curser down three lines to the line that reads Func Par Pol Seq.
3. Using the right arrow button [▶], move the cursor across until it highlights Pol.
4. Your screen should look like Figure 1:

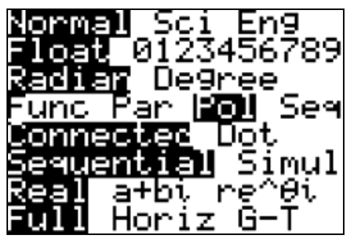


Figure 1

5. Press [ENTER].

Your calculator is now set to work in polar coordinates.

Creating a Polar Graph

Let's start by creating a graph of the function $r = 2\cos 3\theta$.

1. Press [Y=].
2. The cursor will be flashing next to the expression \r1=.
3. Type: 2[COS]3[X,T,Θ,n]
4. Press [ZOOM]6

Your graph will look like Figure 2.

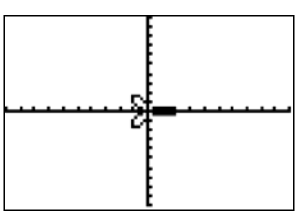


Figure 2

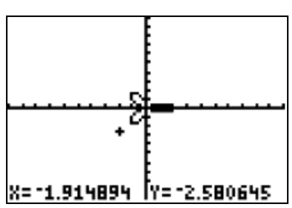


Figure 3

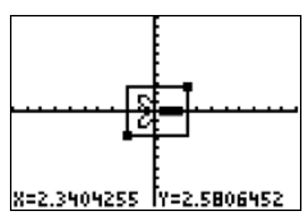


Figure 4

We can make this graph easier to see by using the zoom box function.

1. Press [ZOOM] 1
2. There will now be a small cursor visible on the graph. Use the left [◄] and down [▼] arrow buttons until the cursor is slightly below and to the left of the curve as shown in Figure 3.
3. Press [ENTER] to select this cursor position as the lower left corner of your graph.
4. Now use the up [▲] and right [►] arrow buttons to move the cursor to a spot just to the right and above the curve. The curve will be enclosed in a box as shown in Figure 4.
5. Press [ENTER]

Your graphing calculator will now redraw the curve. Your screen should look like Figure 5.

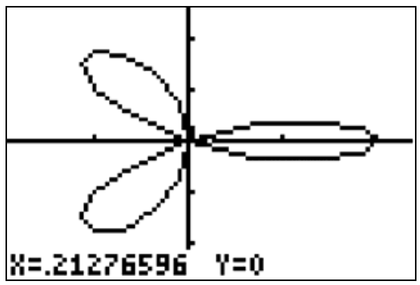


Figure 5: $r = 2\cos 3\theta$

Analyzing the Graph

We can use the calculator to determine how long the petals are.

1. Press [2nd] CALC.
2. Press 1.
3. $\theta =$ will appear in the screen followed by a flashing cursor.

Since one of the petals lies directly on the x-axis, we can find the length of that petal by choosing the value $\theta = 0$.

4. Press 0 then [ENTER].
5. The x-y coordinates of the point where $\theta = 0$ will appear on the screen and a blinking cursor will mark the location of that point as shown in Figure 6.

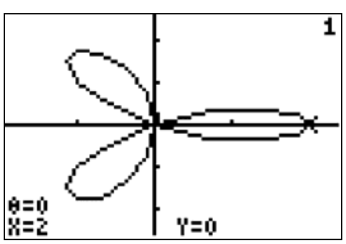
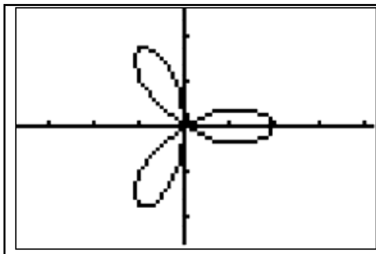


Figure 6

This is telling us that at the point where $\theta = 0$, y = 0 and x = 2. In other words, the petal is 2 units long.

It doesn't appear that the three petals are the same length. This is because the axes are not set to the same scale. We can fix this by pressing [ZOOM] 5. The new, square graph is shown in Figure 7.



Now, the three petals appear to be the same length. In fact, this is true of all rose graphs, so it is only necessary for us to find the length of one petal in order to describe the graph.

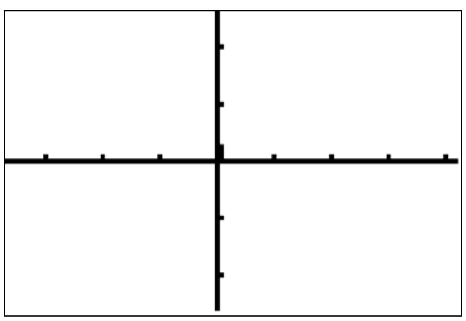
We also describe rose graphs by counting the number of petals, in this case, 3.

Figure 7

Variations on a Rose

We created this rose by graphing the equation $r = 2\cos 3\theta$. We can think of rose curves in the general form $r = a\cos b\theta$. Let's explore the impact of changing the values for *a* and *b*.

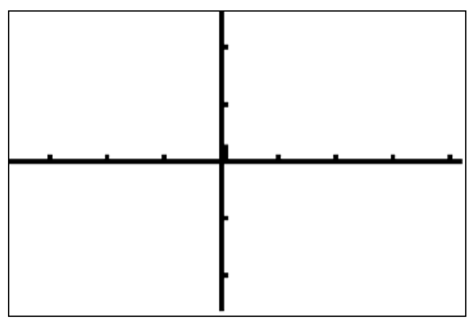
1. Press [Y=].
2. The last equation will still be visible and the cursor will be flashing over the number 2.
3. Change the 2 to a 1 by pushing 1.
4. Press [ZOOM] 5.
5. Draw your graph below.
6. Determine the length of the petals by pressing [2nd] CALC 1 and entering the value 0 for θ .
7. Press [ENTER].
8. Record the petal length and number of petals in the space provided below the graph.
9. Repeat these steps with the function $r = 3\cos 3\theta$.



$r = 1\cos 3\theta$

Petal Length = __________ units

Number of petals = __________



$r = 3\cos 3\theta$

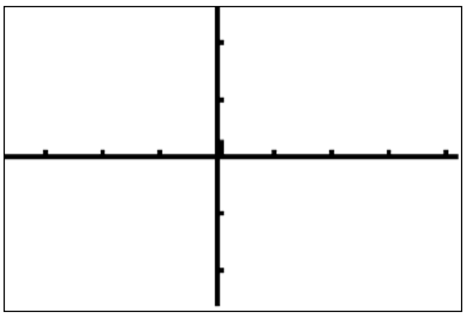
Petal Length = ___________ units

Number of petals = ____________

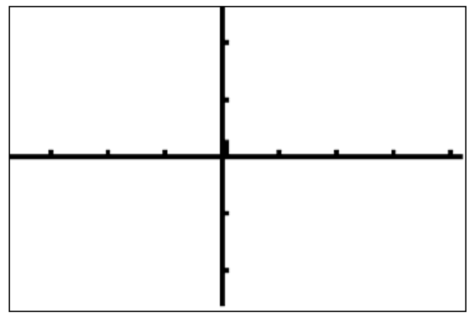
What relationship do you observe between the value *a* and the petal length?

Let's look at the impact of changing the value of *b*.

1. Press [Y=].
2. Enter the equation $2\cos(5\theta)$
3. Press [ZOOM] 5.
4. Draw your graph below.
5. Determine the length of the petals by pressing [2nd] CALC 1 and entering the value 0 for θ .
6. Press [ENTER].
7. Record the petal length and number of petals in the space provided below the graph.
8. Repeat these steps with the function $r = 2\cos 7\theta$.



$r = 2\cos 5\theta$



$r = 2\cos 7\theta$

Petal Length = ___________ units

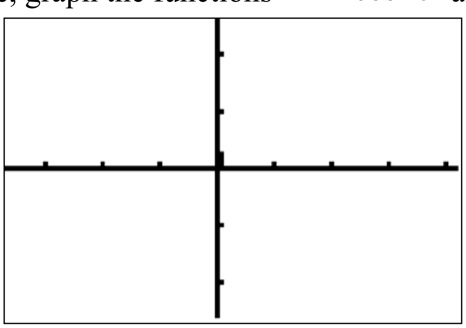
Number of petals = ___________

Petal Length = ____________ units

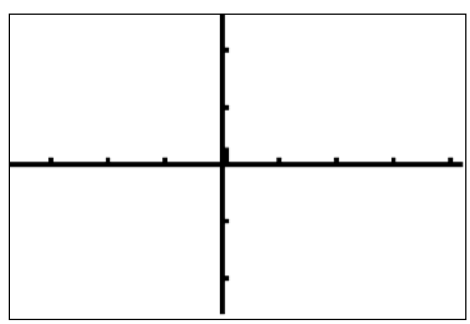
Number of petals = _____________

What do you observe about the relationship between the value of *b* and the number of petals?

Let's consider two more variations on the value for *b*. Following the same procedure you used above, graph the functions $r = 2\cos 2\theta$ and $r = 2\cos 4\theta$.



$r = 2\cos 2\theta$



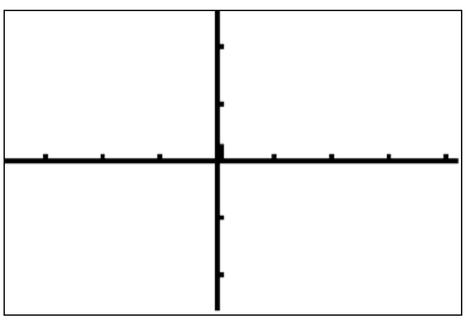
$r = 2\cos 4\theta$.

Number of petals = _______________ Number of petals = ______________

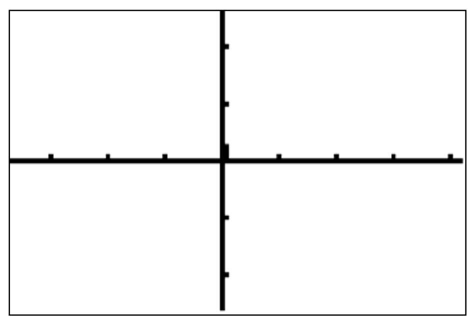
How would you change your conclusions about the effect of the value *b* on the rose graph?

How would you predict the number of petals?

Let's look at one more way we can change the rose graph. We'll use some of the same values for *a* and *b* that we've already employed, but with one significant change. Graph the equations $r = 2\sin(3\theta)$ and $r = 2\sin(4\theta)$. Draw your graphs below.



$r = 2\sin(3\theta)$



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

What happens to the rose when we change the cosine function to a sine function?

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