

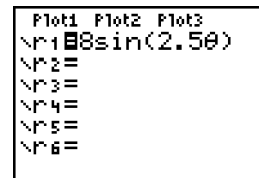
Chapter 5: Polar Graphing

Getting Started: Polar Rose

Getting Started is a fast-paced introduction. Read the chapter for details.

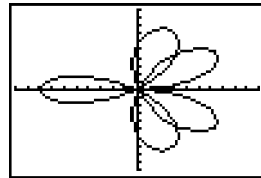
The polar equation $R=A\sin(B\theta)$ graphs a rose. Graph the rose for $A=8$ and $B=2.5$, and then explore the appearance of the rose for other values of A and B .

1. Press **MODE** to display the mode screen. Press **▼ ▼ ▼ ▶ ▶ ENTER** to select **Pol** graphing mode. Select the defaults (the options on the left) for the other mode settings.
2. Press **Y=** to display the polar **Y=** editor. Press **8** **SIN** **2.5** **[X,T,θ,n]** **]** **ENTER** to define r_1 .



```
Plot1 Plot2 Plot3
r1=8sin(2.5θ)
r2=
r3=
r4=
r5=
r6=
```

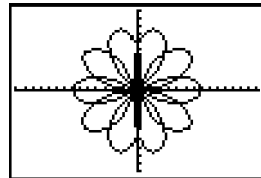
3. Press **ZOOM** **6** to select **6:ZStandard** and graph the equation in the standard viewing window. The graph shows only five petals of the rose, and the rose does not appear to be symmetrical. This is because the standard window sets $\theta_{\max}=2\pi$ and defines the window, rather than the pixels, as square.



4. Press **WINDOW** to display the window variables. Press **4** **2nd** **[π]** to increase the value of θ_{\max} to 4π .

```
WINDOW
 $\theta_{\min}=0$ 
 $\theta_{\max}=4\pi$ 
 $\theta_{\text{step}}=.1308996\dots$ 
 $X_{\min}=-10$ 
 $X_{\max}=10$ 
 $X_{\text{scl}}=1$ 
 $\downarrow Y_{\min}=-10$ 
```

5. Press **ZOOM** **5** to select **5:ZSquare** and plot the graph.



6. Repeat steps 2 through 5 with new values for the variables **A** and **B** in the polar equation $r_1=A\sin(B\theta)$. Observe how the new values affect the graph.

Defining and Displaying Polar Graphs

TI-83 Plus Graphing Mode Similarities

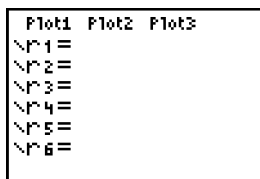
The steps for defining a polar graph are similar to the steps for defining a function graph. Chapter 5 assumes that you are familiar with Chapter 3: Function Graphing. Chapter 5 details aspects of polar graphing that differ from function graphing.

Setting Polar Graphing Mode

To display the mode screen, press $\boxed{\text{MODE}}$. To graph polar equations, you must select **PoI** graphing mode before you enter values for the window variables and before you enter polar equations.

Displaying the Polar Y= Editor

After selecting **PoI** graphing mode, press $\boxed{\text{Y=}}$ to display the polar **Y=** editor.



```
P1ot1 P1ot2 P1ot3
✓P1 =
✓P2 =
✓P3 =
✓P4 =
✓P5 =
✓P6 =
```

In this editor, you can enter and display up to six polar equations, r_1 through r_6 . Each is defined in terms of the independent variable θ .

Selecting Graph Styles

The icons to the left of r_1 through r_6 represent the graph style of each polar equation (Chapter 3). The default in **Pol** graphing mode is \backslash (line), which connects plotted points. Line, \equiv (thick), \rightarrow (path), \rightarrow (animate), and \cdot (dot) styles are available for polar graphing.

Defining and Editing Polar Equations

To define or edit a polar equation, follow the steps in Chapter 3 for defining a function or editing a function. The independent variable in a polar equation is θ . In **Pol** graphing mode, you can enter the polar variable θ in either of two ways.

- Press $\boxed{X,T,\theta,n}$.
- Press $\boxed{\text{ALPHA}} [\theta]$.

Selecting and Deselecting Polar Equations

The TI-83 Plus graphs only the selected polar equations. In the **Y=** editor, a polar equation is selected when the = sign is highlighted. You may select any or all of the equations.

To change the selection status, move the cursor onto the = sign, and then press **ENTER**.

Setting Window Variables

To display the window variable values, press **WINDOW**. These variables define the viewing window. The values below are defaults for **Pol** graphing in **Radian** angle mode.

$\theta_{min}=0$	Smallest θ value to evaluate
$\theta_{max}=6.2831853\dots$	Largest θ value to evaluate (2π)
$\theta_{step}=.1308996\dots$	Increment between θ values ($\pi/24$)
$X_{min}=-10$	Smallest X value to be displayed
$X_{max}=10$	Largest X value to be displayed
$X_{scl}=1$	Spacing between the X tick marks
$Y_{min}=-10$	Smallest Y value to be displayed
$Y_{max}=10$	Largest Y value to be displayed
$Y_{scl}=1$	Spacing between the Y tick marks

Note: To ensure that sufficient points are plotted, you may want to change the θ window variables.

Setting the Graph Format

To display the current graph format settings, press $\boxed{2\text{nd}}$ $\boxed{[FORMAT]}$. Chapter 3 describes the format settings in detail. The other graphing modes share these format settings.

Displaying a Graph

When you press $\boxed{[GRAPH]}$, the TI-83 Plus plots the selected polar equations. It evaluates R for each value of θ (from θ_{min} to θ_{max} in intervals of θ_{step}) and then plots each point. The window variables define the viewing window.

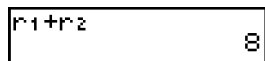
As the graph is plotted, X , Y , R , and θ are updated.

Smart Graph applies to polar graphs (Chapter 3).

Window Variables and Y-VARS Menus

You can perform these actions from the home screen or a program.

- Access functions by using the name of the equation as a variable.



A screenshot of a TI-83 Plus calculator screen. The screen displays a rectangular box containing the text 'r1+r2' on the left and the number '8' on the right, representing a variable assignment.

- Store polar equations.

"5θ"→r1	Done	Plot1 Plot2 Plot3 √r1 5θ √r2 =
---------	------	--------------------------------------

- Select or deselect polar equations.

FnOff 1	Done	Plot1 Plot2 Plot3 √r1 5θ √r2 =
---------	------	--------------------------------------

- Store values directly to window variables.

θ→θmin	θ
--------	---

Exploring Polar Graphs

Free-Moving Cursor

The free-moving cursor in **Pol** graphing works the same as in **Func** graphing. In **RectGC** format, moving the cursor updates the values of **X** and **Y**; if **CoordOn** format is selected, **X** and **Y** are displayed. In **PolarGC** format, **X**, **Y**, **R**, and θ are updated; if **CoordOn** format is selected, **R** and θ are displayed.

TRACE

To activate **TRACE**, press $\boxed{\text{TRACE}}$. When **TRACE** is active, you can move the trace cursor along the graph of the equation one θ **step** at a time. When you begin a trace, the trace cursor is on the first selected function at θ **min**. If **ExprOn** format is selected, then the equation is displayed.

In **RectGC** format, **TRACE** updates the values of **X**, **Y**, and θ ; if **CoordOn** format is selected, **X**, **Y**, and θ are displayed. In **PolarGC** format, **TRACE** updates **X**, **Y**, **R**, and θ ; if **CoordOn** format is selected, **R** and θ are displayed.

To move five plotted points at a time on a function, press $\boxed{2\text{nd}} \boxed{\leftarrow}$ or $\boxed{2\text{nd}} \boxed{\rightarrow}$. If you move the trace cursor beyond the top or bottom of the

screen, the coordinate values at the bottom of the screen continue to change appropriately.

Quick Zoom is available in **Pol** graphing mode; panning is not (Chapter 3).

Moving the Trace Cursor to Any Valid θ Value

To move the trace cursor to any valid θ value on the current function, enter the number. When you enter the first digit, a $\theta=$ prompt and the number you entered are displayed in the bottom-left corner of the screen. You can enter an expression at the $\theta=$ prompt. The value must be valid for the current viewing window. When you complete the entry, press **ENTER** to move the cursor.

ZOOM

ZOOM operations in **Pol** graphing work the same as in **Func** graphing. Only the **X** (**Xmin**, **Xmax**, and **Xscl**) and **Y** (**Ymin**, **Ymax**, and **Yscl**) window variables are affected.

The θ window variables (**θ min**, **θ max**, and **θ step**) are not affected, except when you select **ZStandard**. The **VARS ZOOM** secondary menu **ZT/Z θ** items **4:Z θ min**, **5:Z θ max**, and **6:Z θ step** are zoom memory variables for **Pol** graphing.

CALC

CALC operations in **Pol** graphing work the same as in **Func** graphing. The **CALCULATE** menu items available in **Pol** graphing are **1:value**, **2:dy/dx**, and **3:dr/dθ**.