A Comparison of Function, Polar, Parametric, and Implicit Plots

by

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Textbook Correlation: Key Topic

- Function, Polar, Parametric, and Implicit Plots

NCTM Principles and Standards:

- Process Standard
    - Representation
    - Connections

Exercise 1.

Graph a circle with center point (0,0) and radius = 5 units.

Solution:

The circle can be graphed in various ways on the TI-89 (TI-92 Plus).

FUNCTION MODE
An equation of a circle with center point (0,0) and radius = 5 units in the Cartesian plane is
$x^2 + y^2 = 25$. To graph the circle in Function mode, the equation must be rewritten as
$y = \pm\sqrt{25 - x^2}$. Press the **MODE** key. Select **1:FUNCTION** for Graph. Enter both functions in the **Y=** editor, set the appropriate values for window variables, and graph as illustrated in the following screens below.
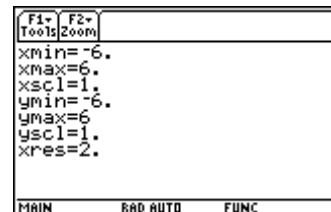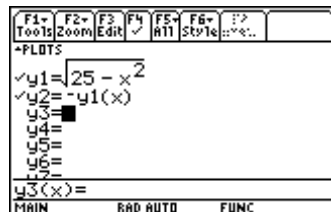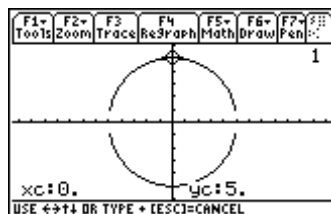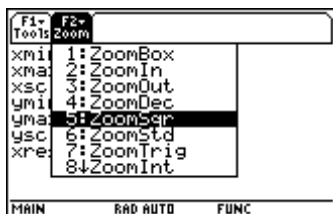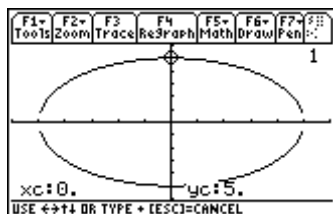
Notice that the cirle appears to be an ellipse in the first graph. Press **F2** and choose **5:ZoomSqr** to make the units on the x and y axes the same length.

POLAR MODE

A *polar curve* is the graph of an equation $r = f(\theta)$ where (r,θ) are standard polar coordinates of a point P. The relationship between the Cartesian coordinates (x, y) and polar coordinates (r,θ) of a point P are given by the equations $x = r \cdot \cos(\theta)$ and $y = r \cdot \sin(\theta)$.

An equation of a circle with center point $(0,0)$ and radius = 5 units in the polar plane is r =5 for any angle θ.

Press the **MODE** key. Select **3:POLAR** for Graph. Select **1:RADIAN** for Angle. Enter the equation in the **Y=** Editor.

Highlight the equation and select **6:Path** under **F6 Style**. Set the appropriate values for window variables. Note that the graph is completely traced out as θ varies from 0 to 2π.
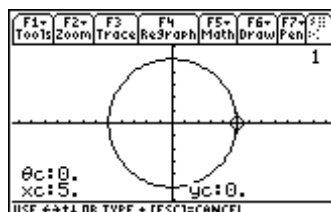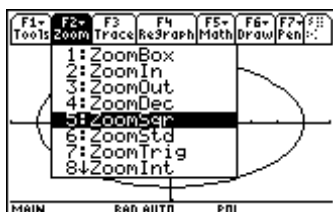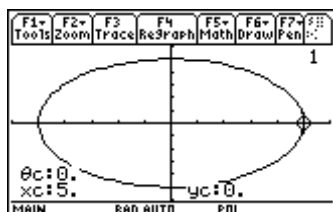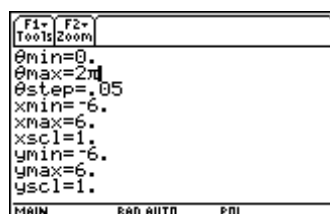

To enter θ in an equation such as $r = \sin 5\theta$ press **2nd** + **(CHAR)** and select **1:Greek and 9:θ**.
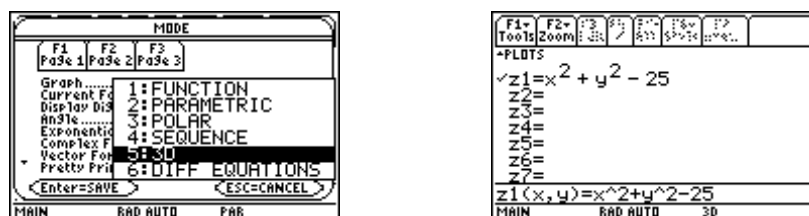
PARAMETRIC MODE

The relationship between a polar equation $r = f(\theta)$ and its parametric equation is $x = r \cdot \cos(\theta) = f(\theta)\cos(\theta)$ and $y = r \cdot \sin(\theta) = f(\theta)\sin(\theta)$. Parametric equations of a circle with center point (0,0) and radius = 5 units are x = 5 cos(t) and y = 5 sin(t). Note that t is used for the parameter instead of θ.

Press the **MODE** key. Select **2:PARAMETRIC** for Graph. Enter both functions in the **Y=** editor, set the appropriate values for window variables, and graph as illustrated in the following screens below.
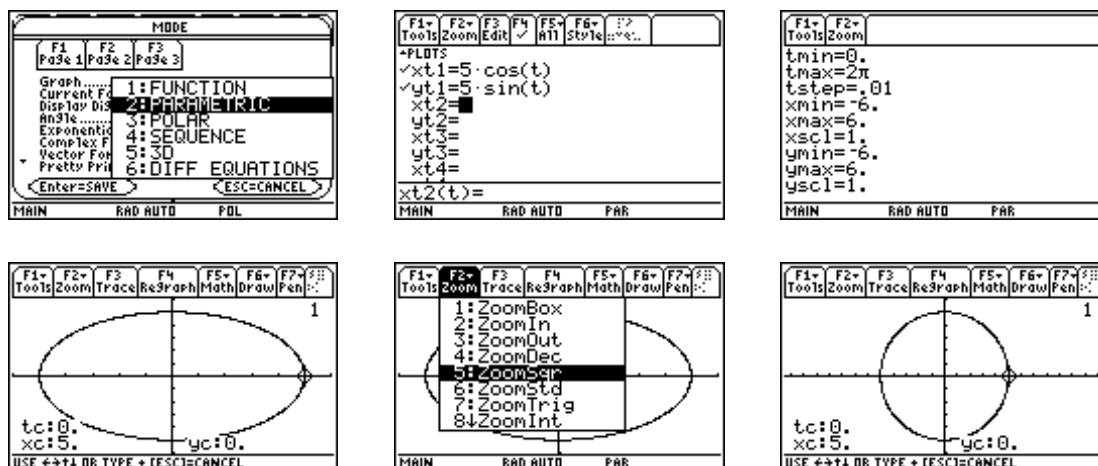
IMPLICIT PLOT

As stated in the *TI-89 Guidebook* (1998, Texas Instruments Incorporated), an implicit plot is used primarily as a way to graph 2D implicit forms that cannot be graphed in function graphing mode. To graph the circle as an implicit plot in 3D mode rearrange the equation as an equation set to zero, $x^2 + y^2 - 25 = 0$. Press the **MODE** key and select **3D** for Graph. Enter the non zero side of the equation in the **Y=** editor.

Press **F1 Tools** and select **9:Format**. Select **IMPCIT PLOT** for Style.

F1▾ F2▾ F3 F4 F5 F6▾ F7
Tools Zoom 3k 7 All Style axes

2:Save Copy As
3:New...
4:Cut
5:Copy
6:Paste
7:Delete   ←
8:Clear Functions
9:Format...   ◆

z1(x,y)=x^2+y^2-25
TYPE OR USE ←→↑↓ + [ENTER] OR [ESC]

F1▾ F2▾ F3 F4 F5▾ F6▾ F7▾
Tools Zoom Trace ReGraph Math Draw Pen

GRAPH FORMATS

Coordinates RECT→
Axes............ AXES→
Labels......... ON→
Style.......... IMPLICIT PLOT→
<Enter=SAVE> <ESC=CANCEL>

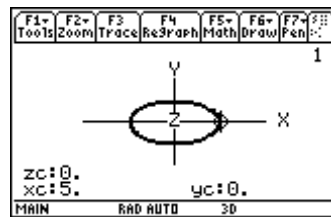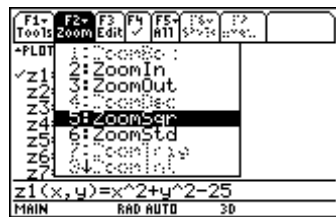MAIN   ◼◼◼ RAD AUTO   3D
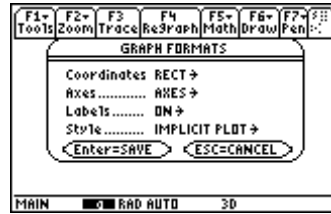
Set appropriate values for the Window variables.

F1▾ F2▾
Tools Zoom

eyeθ=-90.
eyeφ=0.
eyeψ=0.
xmin=-10.
xmax=10.
xgrid=14.
ymin=-10.
ymax=10.
ygrid▾14.

MAIN   RAD AUTO   3D

F1▾ F2▾
Tools Zoom

xmin▲-10.
xmax=10.
xgrid=14.
ymin=-10.
ymax=10.
ygrid=14.
zmin=0.
zmax=10.
ncontour=5.

MAIN   RAD AUTO   3D
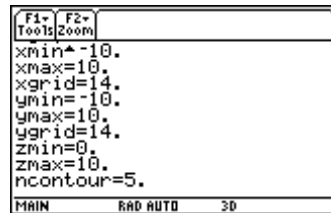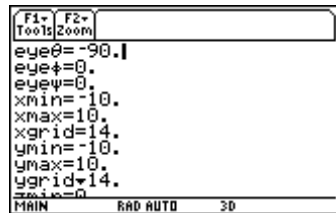
Press **F2 ZOOM** and select **5:ZoomSqr**.

Warning: This process is <u>Very Slow</u>.

F1▾ F2▾ F3 F4 F5▾ F6▾ F7
Tools Zoom Edit ✓ All Style axes

PLOT   1:ZoomBox
✓z1   2:ZoomIn
z2   3:ZoomOut
z3   4:ZoomDec
z4   5:ZoomSqr
z5   6:ZoomStd
z6   7:ZoomTrig
z7

z1(x,y)=x^2+y^2-25
MAIN   RAD AUTO   3D

F1▾ F2▾ F3 F4 F5▾ F6▾ F7▾
Tools Zoom Trace ReGraph Math Draw Pen
                                         1

zc:0.
xc:5.   yc:0.
MAIN   RAD AUTO   3D

Some curves are more easily represented in one or another of the forms illustrated above and cannot easily be represented in all of the forms as the circle in these exercises.