Graphing Circles

The standard equation of a circle of radius r that is centered at a point (h, k) is $(x - h)^2 + (y - k)^2 = r^2$. In order to put an equation in standard form so that you can graph in rectangular mode, it is necessary to solve the equation for y. You therefore need to use the process of completing the square.

Example

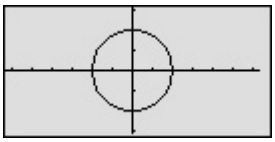
Graph the circles in rectangular mode. Solve the equation for y to put it in the standard form.

1. Graph $x^2 + y^2 = 4$.

2. Graph $x^2 - 2x + y^2 + 4y = 2$.

Before Starting There may be differences in the results of calculations and graph plotting depending on the setting. Return all settings to the default value and delete all data.

Set the zoom to the decimal window: [ZOOM] [A] ([ENTER] [ALPHA] [▼]) [7]

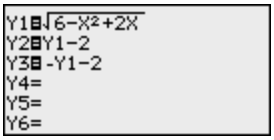
Step & Key Operation	*Display*	*Notes*
1-1 Solve the equation for y. Enter $y = \sqrt{4 - x^2}$ for Y1 (the top half). Enter $y = -\sqrt{4 - x^2}$ for Y2. [Y=] [2nd F] [$\sqrt{\ }$] [4] [—] [X/θ/T/n] [X^2] [ENTER] [(-)] [2nd F] [VARS] [A] [ENTER] [1]	Y1=√(4−X²) Y2=-Y1 Y3= Y4= Y5= Y6=	$y^2 = 4 - x^2$ $y = \pm\sqrt{4 - x^2}$
1-2 View the graph. [GRAPH]		This is a circle of radius r, centered at the origin.

2-1 Solve the equation for y, completing the square.

$x^2 - 2x + y^2 + 4y = 2$	Place all variable terms on the left and the constant term on the right-hand side of the equation.
$x^2 - 2x + y^2 + 4y + 4 = 2 + 4$	Complete the square on the y-term.
$x^2 - 2x + (y+2)^2 = 6$	Express the terms in y as a perfect square.
$(y+2)^2 = 6 - x^2 + 2x$	Leave only the term involving y on the left hand side.
$y+2 = \pm\sqrt{6-x^2+2x}$	Take the square root of both sides.
$y = \pm\sqrt{6-x^2+2x} - 2$	Solve for y.

Step & Key Operation	Display	Notes

2-2 Enter $y = \sqrt{6 - x^2 + 2x}$ for Y1, y = Y1 - 2 for Y2, and y = -Y1 -2 for Y3.



Y= CL 2nd F √ 6 — X/θ/T/n

X² + 2 X/θ/T/n ENTER CL

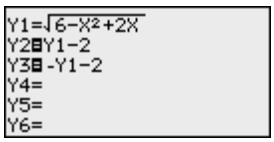
2nd F VARS A ENTER 1 —

2 ENTER

(-) 2nd F VARS ENTER 1 — 2

Notice that if you enter $y = \sqrt{6 - x^2 + 2x} - 2$ for Y1 and y = - Y1 for Y2, you will not get the graph of a circle because the "±" does not go with the "-2".

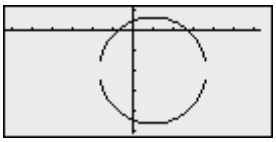
2-3 "Turn off" Y1 so that it will not graph.



▲ ▲ ◀ ENTER

Notice that "=" for Y1 is no longer darkened. You now have the top portion and the bottom portion of the circle in Y2 and Y3.

2-4 Adjust the screen so that the whole graph is shown. Shift 2 units downwards.



WINDOW ▼ (3 times) — 2 ENTER

— 2 ENTER GRAPH

-1.3 < Y < 3.1
↓
-5.1 < Y < 1.1

Graphing circles can be performed easily on the calculator display.