

Plotting Piecewise Functions on a Graphing Calculator

Being able to visualize a piecewise function can greatly help in understanding the graph's behavior. However, the process of plotting piecewise functions by hand is not necessarily trivial. With a little work, we can use a graphing calculator to plot these functions and, at the same time, gain a visual guide to assist with plotting them by hand. We will explore graphing the following two piecewise functions on several different TI graphing calculator models.

$$f(x) = \begin{cases} 2x, & x < 0 \\ x + 3, & x \geq 0 \end{cases} \qquad g(x) = \begin{cases} \sqrt[3]{x}, & x \leq -1 \\ x^2 - 3x, & -1 < x < 4 \\ \sqrt{x-4}, & x \geq 4 \end{cases}$$

TI-82/83/83+/84+:

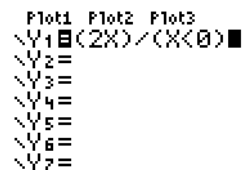
I will be using the TI-83+ for these examples, so my screens may look a little different than yours, but the steps are the same. Every piece of the piecewise functions will be entered separately as its own equation. That is, the first piece will be entered as Y_1 , the second piece as Y_2 , and so on.

Graphing $f(x)$:

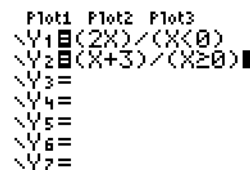
First, press the “Y=” key, located under the calculator's screen to the far left.



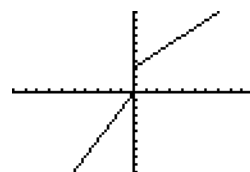
In parentheses, type the first piece, “2x”, in Y_1 . Press the divide key, and in parentheses again type the condition “ $x < 0$ ”. To find the “ $<$ ” symbol, press 2nd then the MATH key to display the TEST menu. The fifth item on the list should be “ $<$ ”. Your screen should now look like this:



Repeat this process for the second piece in Y_2 . The “ \geq ” symbol is the fourth item in the TEST menu. Your two functions should now look like this:



Press the GRAPH button (located under the screen to the far right) and watch your calculator draw the graph. You may have to restore your viewing window to the default settings by pressing the ZOOM button and then “6” for ZStandard (zoom standard).



Graphing g(x):

For Y₁, enter the first piece in the same manner as f(x) above. To find the cube root symbol, press the MATH button and scroll down to the fourth item. Press ENTER to select.

```

MATH NUM CPX PRB
1: Frac
2: Dec
3: 3
4: √[3]
5: √[ ]
6: fMin(
7: fMax(
    
```

For the second piece, the condition “-1 < x < 4” is not recognized by the calculator, so we need to enter it a little differently. “-1 < x < 4” is the same as “x > -1 and x < 4”. So, after the division sign and parentheses, enter “x > -1”, then go back to the TEST menu, right arrow key over to LOGIC, and select “and”. Finally, enter “x < 4” to finish Y₂.

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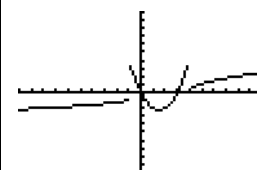
TEST LOGIC
1: and
2: or
3: xor
4: not(
    
```

Enter the third piece into Y₃ similar to the first piece. Y₁ through Y₃ should now look like this:

```

Plot1 Plot2 Plot3
√Y1(∛(X))/X≤-
1)
√Y2(X²-3X)/(X>-
1 and X<4)
√Y3(√(X-4))/X≥
4)
√Y4=
    
```

Press GRAPH and watch it work!



TI-85/86:

I will be using the TI-86 for these examples, so my screens may look a little different than yours, but the steps are the same. Every piece of the piecewise functions will be entered separately as its own equation. That is, the first piece will be entered as y1, the second piece as y2, and so on.

Graphing f(x):

First, press the GRAPH key then F1 to enter the “y(x)=” screen. In parentheses, type the first piece into y1. Press the divide key, and in parentheses type the condition “x < 0”. To find the “<” symbol, press 2nd then the “2” key to display the TEST menu. The F2 key corresponds to “<”. Your screen should now look like this:

```

Plot1 Plot2 Plot3
√y1(2 x)/(x<0)

```

x	y	INSF	DEL	SELECT
=	<	>	≤	≥

Repeat this process for the second piece into y2. The “≥” symbol is over F5 in the TEST menu. Your two functions should look like this:

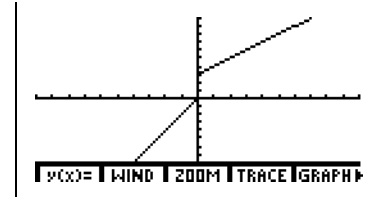
```

Plot1 Plot2 Plot3
√y1(2 x)/(x<0)
√y2(x+3)/(x≥0)

```

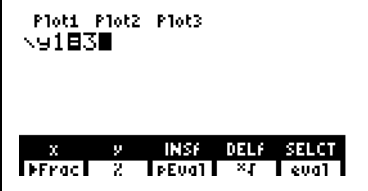
x	y	INSF	DEL	SELECT
=	<	>	≤	≥

If you are still in the TEST menu like I was, press EXIT twice and then F5 to draw the graph. You may have to restore your viewing window to the default settings by pressing F3 for ZOOM then F4 for ZSTD (zoom standard).



Graphing $g(x)$:

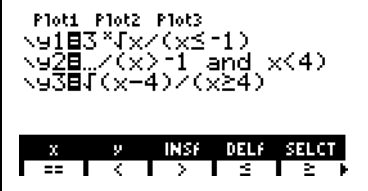
For y_1 , enter the first piece in the same manner as $f(x)$ above. Entering the cube root symbol requires a couple of steps, since the TI-85/86 does not contain a built-in cube root command. First type 3, then press 2nd → MATH (above the multiplication key) → F5 → MORE → F4. Then, type “x” for the radicand.



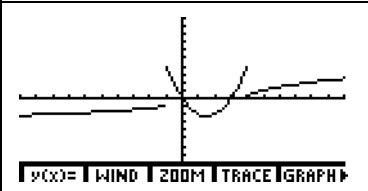
For the second piece, the condition “ $-1 < x < 4$ ” is not recognized by the calculator, so we need to enter it a little differently. “ $-1 < x < 4$ ” is the same as “ $x > -1$ and $x < 4$ ”. So, after the division sign and parentheses, enter “ $x > -1$ ”, then press 2nd → BASE (above the “1” key) → F4 → F1 to select “and”. Finally, enter “ $x < 4$ ” to finish y_2 .



Enter the third piece similar to the first piece; y_1 through y_3 should now look like this:



Press EXIT twice and then F5 to graph your function and watch it work!

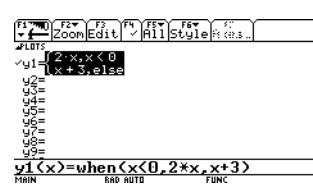


TI-89/Voyage 200:

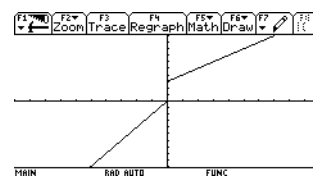
I will be using the Voyage 200 for these examples, so my screens may look a little different than yours, but the steps are the same. Graphing a piecewise function on these calculators is very different than graphing it on a TI-84 or 86. We cannot use the same methods that we used before - the calculator will not recognize them. Instead, we need to use the “when()” command. The syntax of this command is **when(condition, true result, false result)**.

Graphing $f(x)$:

Start the “Y=” editor by pressing $\blacklozenge \rightarrow$ F1 (or W). Enter this command into y1 (without quotes): “when($x < 0, 2x, x + 3$)”. In English, this command says, “when x is less than zero, return $2x$. If x is not less than zero, then return $x + 3$.”

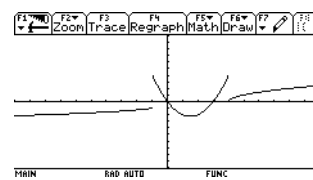
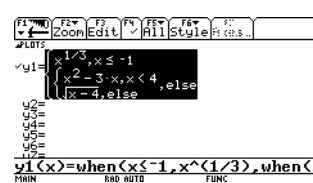


Graph your equation and watch it draw! You may have to restore your viewing window to the default settings by pressing F2 for Zoom then “6” for ZoomStd (zoom standard).



Graphing $g(x)$:

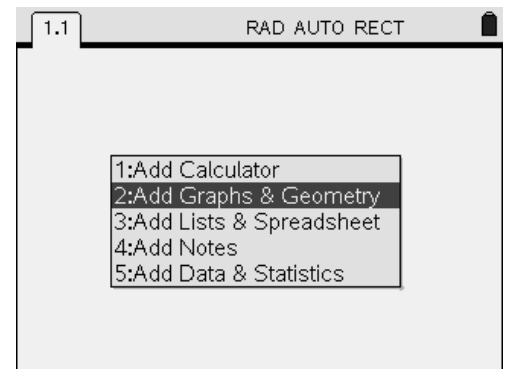
The “when()” command for this function will be slightly different. Enter this command: “when($x \leq -1, x ^ (1/3), \text{when}(x < 4, x ^ 2 - 3x, \sqrt{x - 4})$)”. The first two pieces of the first “when()” command takes care of the first piece of $g(x)$, whereas the second “when()” command takes care of the last two pieces of $g(x)$. As you can see, the greater the number of pieces in a piecewise function, the more complex the “when()” commands become. (Note: If the first piece doesn't graph, make sure the “Complex Format” setting under the “MODE” button is set to “REAL”.)



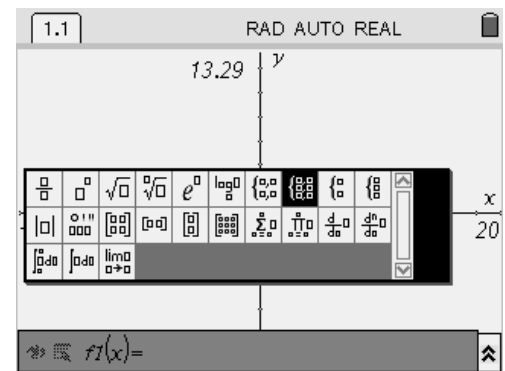
TI-Nspire™:

Graphing $f(x)$:

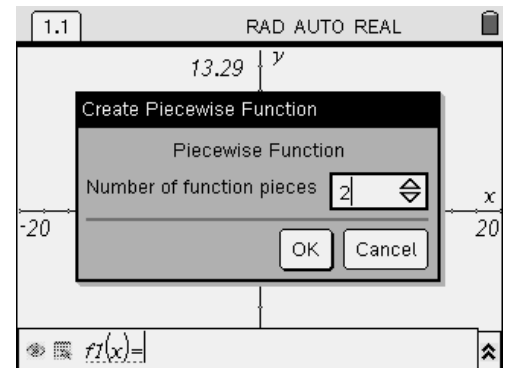
Either use a current Graphs page, or start a new page, problem, or document and choose “Add Graphs & Geometry”.



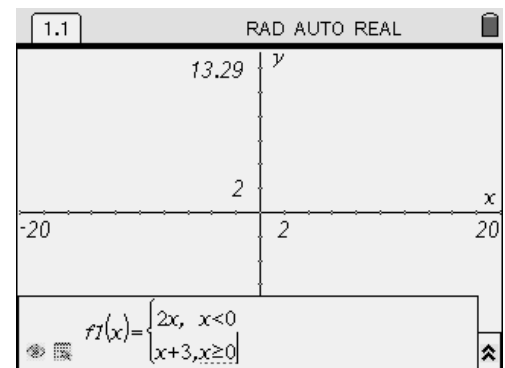
In the function bar at the bottom, press ctrl then matrix for the Clickpad, or matrix for the Touchpad. Select the icon that looks like a left brace with a 3x2 matrix beside it.



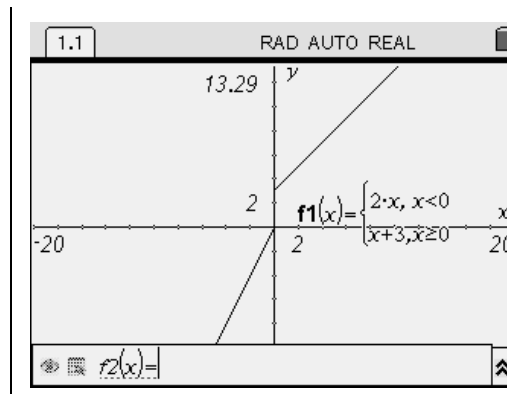
Enter “2” for the number of pieces.



Fill in the piecewise function. An easy way to get the “ \geq ” sign is to press ctrl and then “ $>$ ” (Clickpad), or ctrl then “ $=$ ” (Touchpad).



Press ENTER to display the graph.



Graphing $g(x)$:

Very similar to $f(x)$, just enter “3” for the number of pieces instead of “2”. Also, the TI-Nspire™ understands the condition “ $-1 < x < 4$ ”, so it can be entered in this way instead of using the “and” logic operator that the other calculators needed. (Note: the cube root symbol can be obtained by pressing ctrl and then “^”.)

