Section 1.4: Graphing Calculators and Computers

In this section we shall show some of the ways that calculators can help us in mathematics.

1. Calculator Warnings

Before we even consider how a calculator can be used to help in mathematics, there are a number of ground rules and warnings we need.

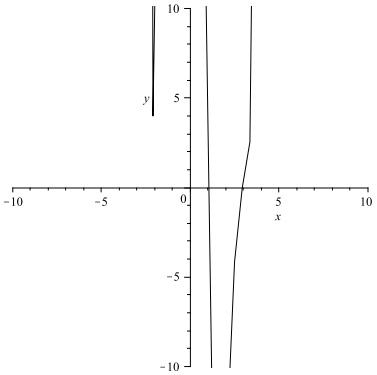
- (*i*) **What calculators are not for:**
  - (a) Simple calculations
  - (b) Basic graphs
  - (c) To do **anything** which you do not understand and could not already do yourself
- (*ii*) **What calculators are for**:
  - (a) An aid to your calculations (check answers, complicated computations)
  - (b) Graphing complicated functions
  - (c) Evaluating long tedious calculations through programing
  - (d) Solving problems which may not be solvable by hand
- (*iii*) **Warnings about calculator use**:
  - (a) Computers don't make mistakes - it is the people who program them
  - (b) Don't depend upon your calculator - you will **not** be allowed to use it on certain quizzes or midterms
  - (c) Calculators sometimes lie, so always be careful

2. Techniques for the TI 83

- (*i*) Sketching a graph:
  - Push the "y=" button on the top row far left
  - Type in the equation into the "Y1" row
  - Push the "GRAPH" button on the top row, far right

Example 2.1. Sketch a graph of $y = (x-1)(x+2)^2(x-3)^3$

Your graph should look like the following:

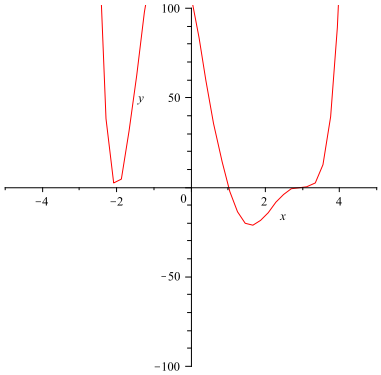


(*ii*) Viewing Windows - when you have sketched a graph, the standard viewing window may not be appropriate for viewing the graph missing important features like zeros or turning points. If this is the case, you can modify the window in the following way:

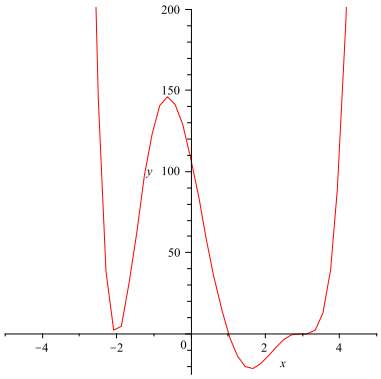
- Push the "WINDOW" button on the top row
- Type in appropriate values for "XMIN" (minimum x-coordinate), "XMAX" (maximum x-coordinate), "YMIN" (minimum y-coordinate) and "XMAX" (maximum y-coordinate). If one of the coordinates covers a much larger range, then
- If the window is still not appropriate, readjust

Example 2.2. Find an appropriate viewing window of $y = (x-1)(x+2)^2(x-3)^3$

From our previous graph, it is clear that the standard viewing window $-10 \leqslant x \leqslant 10$, $-10 \leqslant y \leqslant 10$ is appropriate. We know the zeros occur at $x = 1, -2, 3$ and it doe's not look like much occurs outside of this. Therefore, we change our x values to $-5 \leqslant x \leqslant 5$. The y values are more tricky, so we try $-50 \leqslant y \leqslant 50$:



This also does not appear to capture all of the graph, so we try $-25 \leqslant y \leqslant 200$ which seems more appropriate (though we could probably get a much better window):



(*iii*) Calculations - there are a number of different calculations a calculator will perform for you once you have a graph. All calculations by the calculator are roughly the same, so we illustrate with the process of finding a zero:

- Finding Zeros: Press "2nd"-"Trace" (which is the "CALC" button) and select "zero". This will take you back to the graph screen, but there will be a cursor on the screen.
- Move the cursor to the left of the zero you are trying to find and hit "ENTER".
- Move the cursor to the right of the zero you are trying to find and hit " "ENTER".
- Hit "ENTER" one more time and your calculator will find the zero and display its coordinates on the botton of the screen.

These are just some of the things your TI 83 can do - you should experiment to see for yourself.

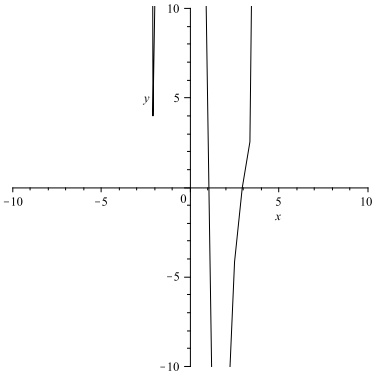
3. Techniques for the TI 89

(*i*) Sketching a graph:

- Push "2nd" button followed by the "F1" button (to get the "Y=" option) on the top row far left
- Type in the equation into the "Y1" row. If there is multiplication in your equation, make sure to use the multiplication button
- Push "2nd" button followed by the "F3" button (to get the "GRAPH" option) on the top row

Example 3.1. Sketch a graph of $y = (x-1)(x+2)^2(x-3)^3$

Your graph should look like the following:

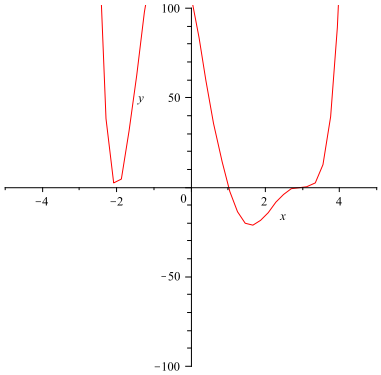


(*ii*) Viewing Windows - when you have sketched a graph, the standard viewing window may not be appropriate for viewing the graph missing important features like zeros or turning points. If this is the case, you can modify the window in the following way:

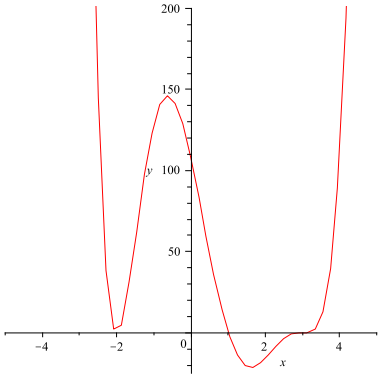
- Push "2nd" button followed by the "F2" button (to get the "WINDOW" option) on the top row
- Type in appropriate values for "XMIN" (minimum x-coordinate), "XMAX" (maximum x-coordinate), "YMIN" (minimum y-coordinate) and "XMAX" (maximum y-coordinate). If one of the coordinates covers a much larger range, then
- If the window is still not appropriate, readjust

Example 3.2. Find an appropriate viewing window of $y = (x-1)(x+2)^2(x-3)^3$

From our previous graph, it is clear that the standard viewing window $-10 \leqslant x \leqslant 10$, $-10 \leqslant y \leqslant 10$ is appropriate. We know the zeros occur at $x = 1, -2, 3$ and it doe's not look like much occurs outside of this. Therefore, we change our x values to $-5 \leqslant x \leqslant 5$. The y values are more tricky, so we try $-50 \leqslant y \leqslant 50$:



This also does not appear to capture all of the graph, so we try $-25 \leqslant y \leqslant 200$ which seems more appropriate (though we could probably get a much better window):



(*iii*) Calculations - there are a number of different calculations a calculator will perform for you once you have a graph. All calculations by the calculator are roughly the same, so we illustrate with the process of finding a zero:

- Finding Zeros: On the graphing screen, press “F5”, scroll down to “zero” and select by pressing enter.
- Move the cursor to the left of the zero you are trying to find and hit “ENTER”.
- Move the cursor to the right of the zero you are trying to find and hit ” “ENTER”.
- Your calculator will now find the zero and display its co-ordinates on the botton of the screen.

These are just some of the things your TI 89 can do - you should experiment to see for yourself.