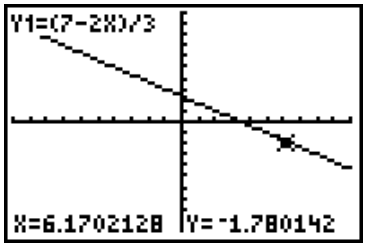
TI-83 Graphing Calculator Workshops
Session II: Graphs and Tables

1. Entering a function

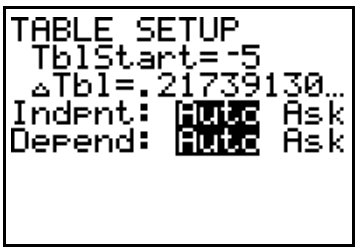
   - The equation must be solved for y, but it does not have to be simplified.
   - Example: $2x + 3y = 7$ can be rewritten as $y = \frac{7 - 2x}{3}$
   - To enter the equation into the calculator, press Y= [Y_1=] (7 – 2 X) ÷ 3. Note that parentheses are necessary around the numerator.
   - Press 2nd [QUIT] or ZOOM.

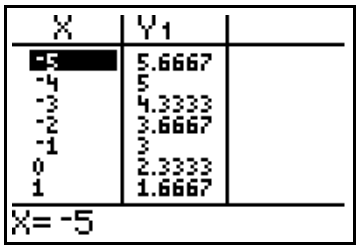
2. Using the built-in ZOOM options



   - ZOOM 6:ZStandard is the common starting WINDOW. The settings are Xmin= –10, Xmax=10,Xscl=1, Ymin= –10, Ymax=10, Yscl=1. Since this calculator WINDOW is not square, the graph will not look the same as it would on graph paper using the same units.
   - Press 6 to graph the equation entered above in the standard viewing WINDOW. Press TRACE and the cursor will appear on the graph. Use ◄ or ► to move to the right or left along the curve. Note that the coordinates of each point are displayed at the bottom of the WINDOW.
   - Press ZOOM [4:ZDecimal]; the graph will be redrawn on [–4.7, 4.7] x [–3.1, 3.1]. This WINDOW is a "square" or "friendly" WINDOW, i.e. the graph has the same shape as if it were drawn on graph paper with equal units on the x- and y-axes. Press TRACE and move the cursor left or right. You will see that the x-coordinate changes by exactly one-tenth unit each time.
   - Press ZOOM [6:ZStandard]. After the graph is drawn, press ZOOM [8:ZInteger], ENTER. The graph will be redrawn on –47, 47, 10, –31, 31, 10, another square WINDOW. When the cursor is moved, the x-coordinate changes by a whole unit.
   - Consult your Guidebook for other ZOOM options.

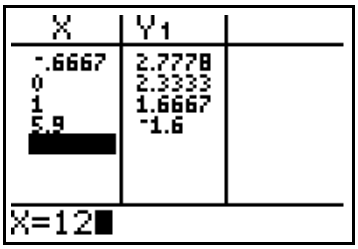
3. Using the TABLE feature





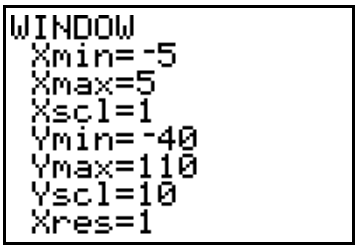
   - To draw a graph by hand, it is usually necessary to have a table of values. This can be generated by using the calculator's TABLE feature.
   - To choose how the TABLE is displayed, press [TBLSET].
   - To have the calculator automatically display the TABLE for you, type in the smallest desired value for x after [TblStart=]. Use ▼ to go down to [△Tbl=], and type desired increment for x. Use ▼ to go down to [Indpnt: Auto]. Press ENTER. Use ▼ to go down to [Depend: Auto]. Press ENTER. QUIT this screen or go to TABLE.
   - Press 2nd [TABLE] to view the TABLE of values. Use ▼ or ▲ to scroll to other values not displayed.
   - If you wish to choose the values of x yourself set up the the TABLE as shown at the right. The starting value and increment will be ignored. You will not be able to scroll off the screen, but you can delete some of the entries for x, or just type over them to get corresponding values for y.

- When you press [2nd] [TABLE] you should get a blank TABLE. If not, press [DEL] repeatedly until all old entries are deleted. Type the desired value for x and press [ENTER]. Repeat as desired.



4. Customizing the WINDOW

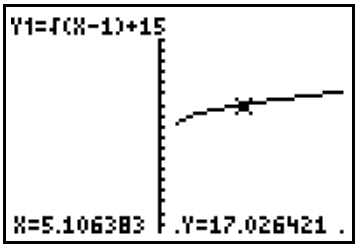
- To customize settings, press [WINDOW]. Any or all of the settings may be changed.
- If the Xscl or Yscl is too small, the tick marks will be too close together to be usable. They may even form a solid line beside the axis. When using large numbers, a reasonable scale is about one-tenth the number above it.
- If the scale is not important to you, the tick marks may be turned off by setting both Xscl and Yscl to 0.



- Pressing [ZOOM] [5:ZSquare] will create a "square" WINDOW based on the current WINDOW settings. The Ymin, Ymax, and Yscl will not be affected. The x values will be changed so that the ratio of the length of the x-axis to the length of the y-axis is approximately 3:2.

5. Options for finding a "missing" graph

- It may happen that no part of the graph shows up in the standard viewing WINDOW.
- Analyzing the equation itself may indicate which of the WINDOW settings need to be changed.
- Press [ZOOM] [3:Zoom Out] [ENTER] to enlarge the field of view. If a portion of the graph appears, you may have enough information to be able to make necessary changes in the WINDOW settings. You may need to repeat this step.
- Occasionally a graph is so close to an axis that it does not show up on the standard viewing WINDOW. If nothing shows up after zooming out several times, start over with the standard viewing screen, then press [ZOOM] [2:Zoom In] [ENTER] to reduce the field of view.
- Another possibility involves using [TRACE]. Example: $y = \sqrt{x-1}+15$ Start with the standard viewing WINDOW. Even though no graph is showing, you can still use [TRACE]. Begin moving the cursor to the right. You will see that there is no value for y until x gets to 1. (This function is only defined for $x \geq 1$.) If the calculator displays values for **both** x and y, you can press [ENTER], and the cursor will go vertically up or down to find the graph. The WINDOW will change, and the graph will be redrawn with the cursor in the center of the WINDOW. You may then wish to customize the WINDOW to create a more pleasing graph.

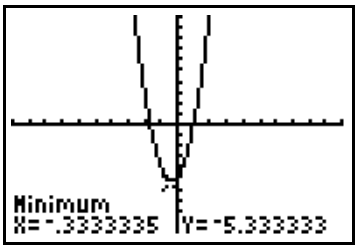


- The TI-83 has a nice feature which makes setting the WINDOW much easier. After typing in the equation, press [ZOOM] [0:ZoomFit]. This may not give you the WINDOW you desire, but it will show the important features of the graph and you will be able to modify the WINDOW as desired.

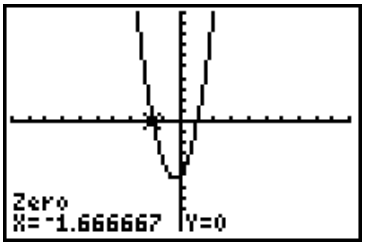
6. Analyzing graphs using [2nd] [CALC]

- Finding a maximum or minimum. Enter [$Y_1=3x^2+2x-5$] and graph using the standard viewing WINDOW. The function has a minimum value at its vertex. To find the vertex, press [2nd] [CALC] [3:minimum]. At the prompt [Left Bound?], move the cursor to

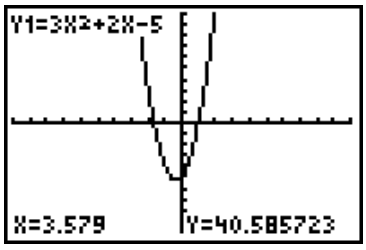
the left of the vertex and press [ENTER]. An arrow will appear at the top of the WINDOW. At the prompt [Right Bound?], move the cursor to the right of the vertex and press [ENTER]. Another arrow will appear at the top of the WINDOW. These arrows must be pointing at each other, and the vertex must be in the vertical column defined by the tips of the arrows. The calculator requires a [GUESS] in case there is more than one possible answer. Move the cursor near the vertex and press [ENTER].



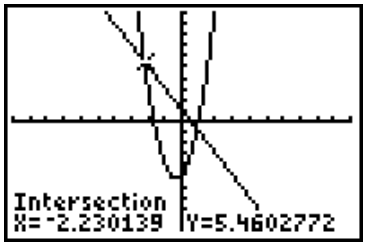
- Any values calculated on the graphing screen are automatically stored as the appropriate variable. [2nd] [QUIT] to return to the home screen. Press [X] [ENTER] and you will see the x-coordinate of the vertex we just found. Pressing [MATH] 1:▷Frac will tell the calculator to change the decimal to a fraction. If the calculated number is a rational number AND IF the calculator hasn't lost too much information in rounding, the decimal will be changed to a fraction.
- The coordinates of the vertex in this example look suspiciously like $\left(-\frac{1}{3}, -\frac{16}{3}\right)$, even the calculator may not be able to convert these decimals to fractions. You can prove that the fractions are the exact coordinates of the vertex by substituting them into the function.
- A similar procedure using [2nd] [CALC] [4:maximum] can be employed to find the maximum value of a function in a given interval.
- The x-intercepts can be found using [2nd] [CALC] [2:zero]. You must supply bounds and a guess as above. One x-intercept is $\left(-\frac{5}{3}, 0\right)$. This means that one solution to the equation $3x^2 + 2x - 5 = 0$ is $x = -\frac{5}{3}$. Repeating this process shows that the other x-intercept is (1, 0); the other solution to the equation $3x^2 + 2x - 5 = 0$ is $x = 1$.



- While the graph is displayed, the value of y at a point can be found by pressing [2nd] [CALC] [1:value]. At the bottom of the WINDOW type the desired value for x. Press [ENTER] to see the corresponding value of y. The value chosen for x must be between Xmin and Xmax.



- One way to solve a system of two equations is to find the intersection of their graphs. Type in [Y_2=–2x+1] and graph both equations on the standard viewing WINDOW. Press [2nd] [CALC] [5:intersect]. You will need to identify the two equations and the desired point of intersection. (This is easier if only two equations are graphed at a time.) Use [▼] or [▲] to move from one graph to the other. Press [ENTER] to select the first curve. The cursor will automatically jump to the other curve. Press [ENTER] again. Use [◄] or [►] to select the desired point of intersection. Press [ENTER].
- INTERSECT may be used to find the zero of a function by letting y_1 = the function and $y_2 = 0$.

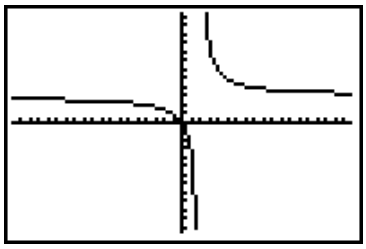


7. Changing the mode.

   - Press [MODE] to display the current MODE settings.
   - The most common settings are the first ones in each row.
   - To change from [Connected MODE] to [Dot MODE], use the arrow keys to go down and to the right so that the blinking cursor is on [Dot], and press [ENTER].
   - To return to the home screen, press [2nd] and then [QUIT].

8. Graphing a rational function

   - $y = \frac{3x}{x-2}$: Enter the function as Y_1 and graph on the standard viewing window.
     You will notice a vertical line at about x = 2. But this makes no sense since we can tell by looking at the function that it is not defined for x = 2. The calculator starts at the left side of the window and tries to draw continuously until it gets to the right side unless you tell it otherwise. If you keep in mind that the vertical line cannot be a part of the graph, then it is not a problem.
   - Change to [Dot MODE] and regraph the function. Now you will see that the vertical line is gone, but now there are spaces between some of the dots. This is not too bad if you understand what is happening where the dots are located.
   - Change back to [Connected MODE]. Redraw the graph using [4:ZDecimal]. This viewing window may not show as much of the graph as you would like. Redraw the graph using [3:Zoom Out]. Repeat as necessary to get a satisfactory graph. This method does not always get rid of the vertical line, but it is worth a try!



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Judy Ahrens
Pellissippi State Technical Community College
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