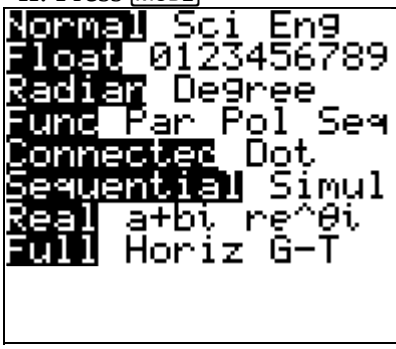
Graphing Calculator Guide for the TI-83/84 Plus

The following pages describe how to use the calculator to graph functions, use some of the matrix menu, use scientific notation, and other various keys.

I. Turn it on: Press [ON]

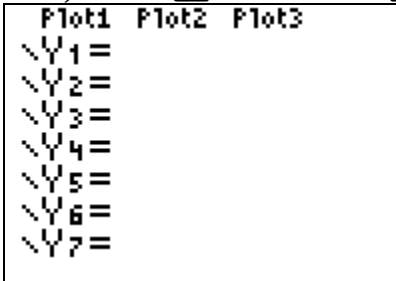
II. Press [MODE]



Listed are the mode settings for your calculator. The calculator will remain in these settings for the majority of use. **Float** will change the number of decimal places that the calculator will report in determining an answer. **Radian** mode interprets angle values as radians. **Degree** mode interprets angle values as degrees. **Connected** mode draws a line connecting each point calculated for the function, whereas **dot** mode plots only the calculated points.

III. Graphing Functions Note: The graphing keys are immediately below the screen.

a) Press [Y=]. Note: Press [X,T,Θ,n] [+] [1] to enter the function $Y_1 = X + 1$

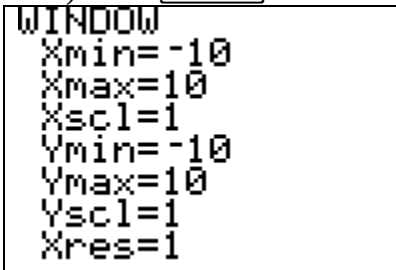


This feature is used to graph different types of functions: polynomial, rational, radical, exponential, logarithmic, etc.

Enter $Y_1 = X + 1$ as described above and hit the [GRAPH] key to see the function on the screen. More functions can be entered as needed with Y_2, etc.

Note: The X key ([X,T,Θ,n]) is in the 2nd row, 2nd column of the calculator.

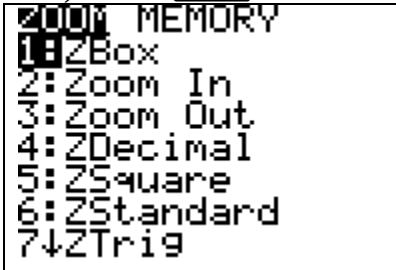
b) Press [WINDOW].



This defines the viewing window that will be used for the graph. In this case, the window goes from -10 to 10 for X and -10 to 10 for Y. **Xscl** and **Yscl** determine how often tick marks are placed on each axis. For this window, the tick marks will be placed 1 unit apart. **Xres** sets pixel resolution and will primarily be kept at 1.

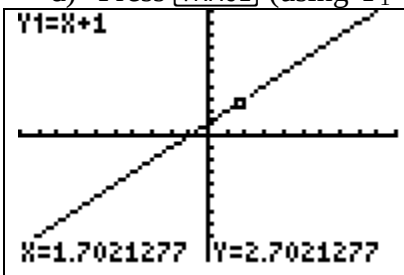
Note: This is known as a standard viewing window (**ZStandard**) as seen in part c) below.

c) Press [ZOOM].



ZStandard is the most common zoom feature used. It is described above in part b). **ZBox** draws a box (using the arrow keys on the calculator) to define the viewing window, much like clicking and dragging a mouse with a computer. **Zoom In** magnifies the part of the graph that surrounds the cursor and **Zoom Out** does the opposite. **ZDecimal** sets the X and Y value of each pixel accurate to one decimal place. **ZSquare** squares up the window by making the vertical and horizontal distances equivalent ($\Delta X = \Delta Y$). **ZTrig** uses preset values appropriate for trig functions. Use the arrow keys to scroll down to **ZInteger**, **ZoomStat**, and **ZoomFit**, which may be appropriate with other applications.

d) Press [TRACE] (using $Y_1 = X + 1$ as stated in part a))

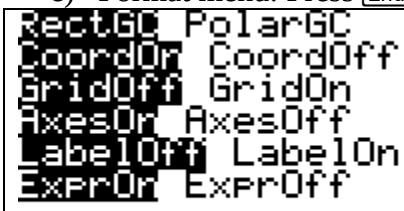


Use the left and right arrow keys to move the cursor from one plotted point to another along a function.

Note: If a ZDecimal window is used with trace, the x-values change by 0.1.

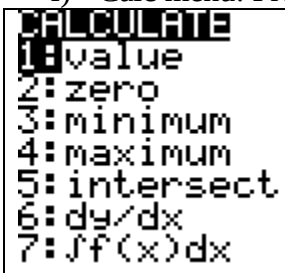
If two or more functions are graphed, the up or down arrow keys will move the cursor from one function to another.

e) Format menu: Press [2nd][FORMAT]. Note: Secondary keys are listed in square brackets.



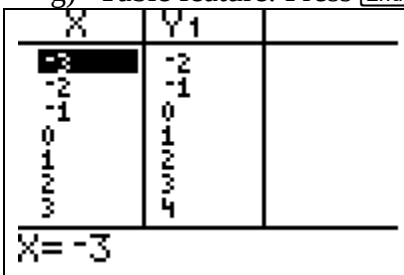
The calculator will primarily remain in these settings for the format menu. **RectGC** displays the cursor location as rectangular coordinates X and Y. **CoordOn** displays the cursor coordinates at the bottom of the graph. **GridOff** does not display grid points. **AxesOn** displays the axes. **LabelOff** does not display labels (X and Y) for the axes. **ExprOn** will display the Y= expression when the trace cursor is active.

f) Calc menu: Press [2nd][CALC].



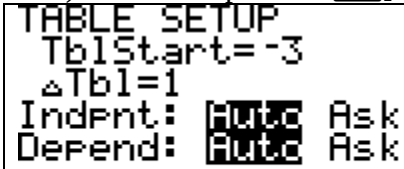
Value evaluates a function for a specified value of X. **Zero** finds the x-intercept of a function. **Minimum** finds the minimum value of a function within a specified interval. **Maximum** finds the maximum value of a function within a specified interval. **Intersect** finds the coordinates of a point at which two or more functions intersect.
Applications of these features will occur later.
Note: dy/dx and $\int f(x)dx$ are used in calculus courses.

g) Table feature: Press [2nd][TABLE]



The table feature shows the coordinates of the function that has been entered for Y_1. ($Y_1 = X + 1$ in this example.)

h) Table setup: Press [2nd][TBLSET]



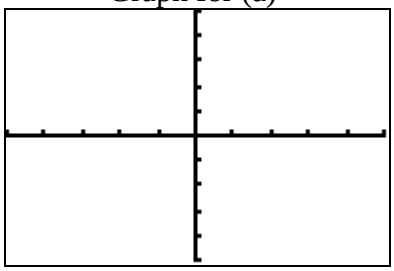
Along with the table feature in part g) above, the initial value for the independent variable can be specified using **TblStart** and Δ**Tbl** defines the increment for the independent variable. When **Indpnt** and **Depend** are set to **Auto**, the values are displayed automatically in both the independent-variable column and in all dependent-variable columns.

Example 1: Graph $Y = X^2 + 10$ and determine the viewing window that gives a complete graph.
Note: You can use the [^] key in the 4th row, 5th column to raise X to the 2nd power.

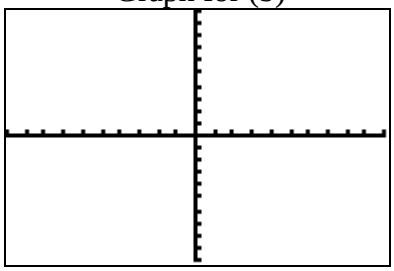
(a) [-5,5,1] by [-5,5,1]
(b) [-10,10,1] by [-10,10,1]
(c) [-10,10,1] by[-50,50,10]

Note: The windows above are given as [Xmin, Xmax, Xscl] by [Ymin, Ymax, Yscl]. Press [WINDOW] to enter the appropriate values for each window.

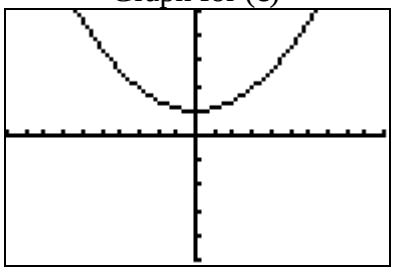
Graph for (a)



Graph for (b)



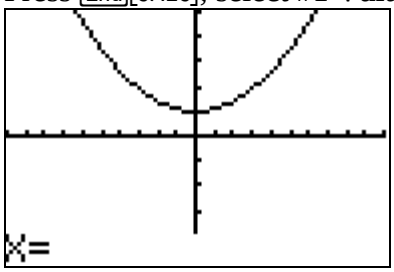
Graph for (c)



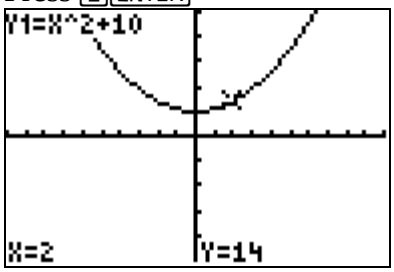
The graph for (c) gives a viewing window that shows a complete graph.

Determine the value of Y when X = 2 on the graph of $Y = X^2 + 10$.
Go into the calc menu:

Press [2nd][CALC], select #1 **Value**



Press [2] [ENTER]

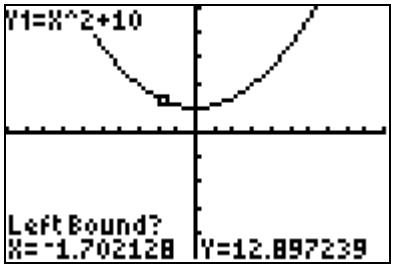


The value of Y is 14 when X = 2.

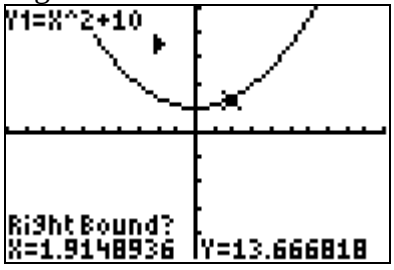
Find the minimum point on the graph of $Y = X^2 + 10$.
Go into the calc menu by pressing [2nd][CALC], select #3 **Minimum**:

Arrow over to the left of the minimum point using the arrow keys and press [ENTER] to set a left bound. Then arrow over to the right of the minimum point using the arrow keys and press [ENTER] to set a right bound:

Left Bound



Right Bound



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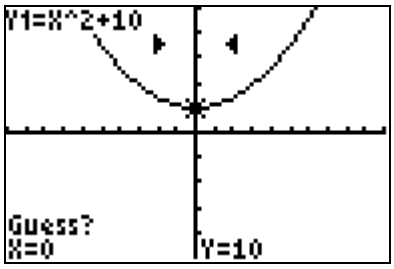
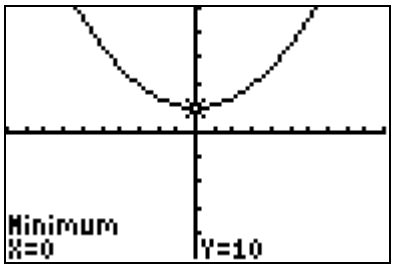
Arrow over close to the minimum for a guess and press [ENTER] to solve the problem.

Guess



Answer

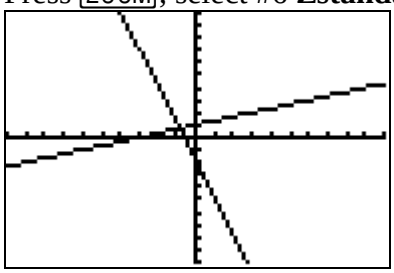


The minimum point is (0, 10).

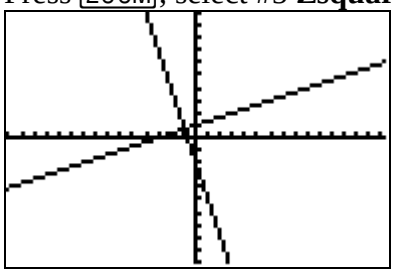
Example 2: The lines whose equations are $y = \frac{1}{3}x + 1$ and $y = -3x - 2$ are perpendicular because the product of their slopes, $\frac{1}{3}$ and -3, is -1.

Use a graphing utility to graph the equations $Y_1 = X/3 + 1$ and $Y_2 = -3X - 2$ in a [-10,10,1] by [-10,10,1] viewing window. Do the lines appear to be perpendicular?

Press [ZOOM], select #6 **Zstandard**



Press [ZOOM], select #5 **Zsquare**



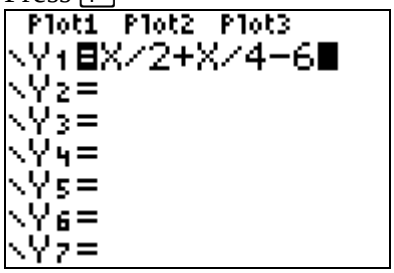
The lines do not appear to be perpendicular in Zstandard. They do appear perpendicular in a Zsquare window because the distances vertically and horizontally are equivalent.
($\Delta X = \Delta Y$)

Example 3: Solve the equation for X using a graphing utility: $\frac{X}{2} + \frac{X}{4} = 6$

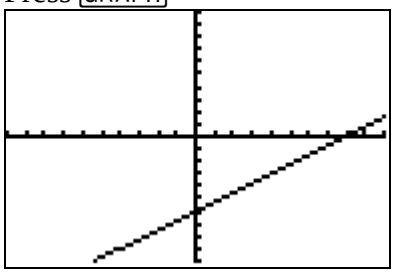
Put the calculator back into a standard viewing window by pressing [ZOOM], select #6 **Zstandard**.
Note: There are two ways to solve this problem as discussed below:

FIRST WAY: Set the equation equal to zero: $\frac{X}{2} + \frac{X}{4} - 6 = 0$ and use the calculator to graph $Y_1 = X/2 + X/4 - 6$. Then find the x-intercepts (zeros) of the equation.

Press [Y=]



Press [GRAPH]



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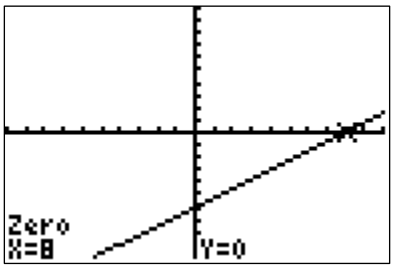
Press [2nd][CALC], select #2 **Zero**

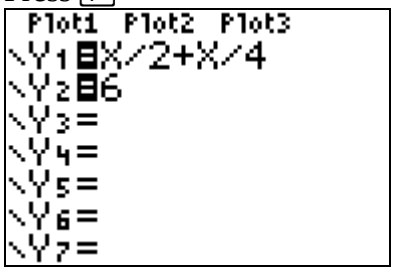


Set a left bound, right bound, and guess (similar to finding a minimum earlier in this guide) to find the solution.

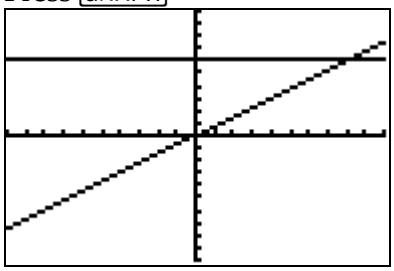
The solution to $\frac{X}{2}+\frac{X}{4}=6$ **is X = 8.**

SECOND WAY: Graph each side of the equation by letting $Y_1 = X/2 + X/4$ and $Y_2 = 6$. The solution is the first coordinate of the point(s) of intersection. Find the point of intersection as follows:

Press [Y=]

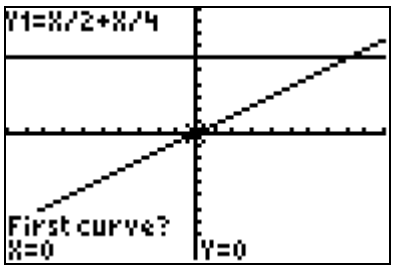


Press [GRAPH]

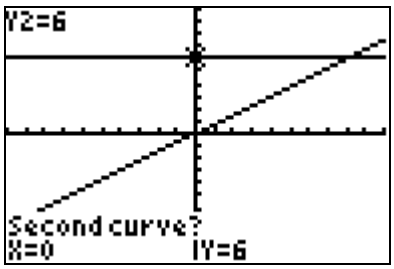


To find the solution, press [2nd][CALC] and select #5 **Intersect**. Since we only have two functions graphed, the calculator will go to Y_1 as the first curve (press [ENTER]), Y_2 as the second curve (press [ENTER]), and arrow close to the intersection point for a guess (press [ENTER]).
See the illustration below:

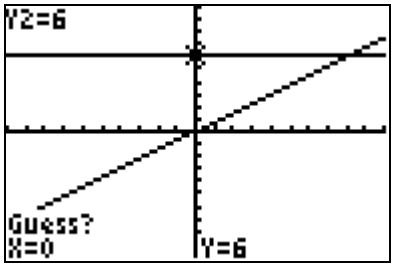
First Curve?



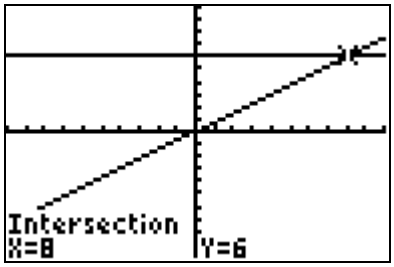
Second Curve?



Guess?



Answer



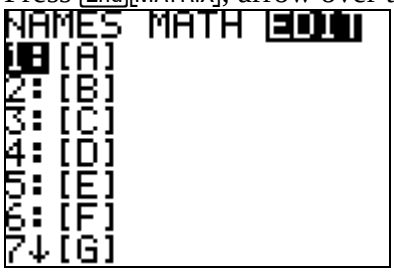
The solution to $\frac{X}{2}+\frac{X}{4}=6$ **is X = 8.**

IV. Matrices (can be used to solve a system of linear equations)

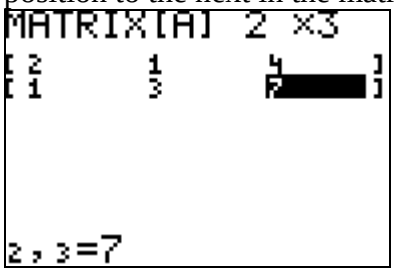
Example: Solve the system of equations: $2x + y = 4$

$x + 3y = 7$

Press [2nd][MATRIX], arrow over to EDIT and press [ENTER].



Enter the size of the matrix: **2x3** for our example (2 rows by 3 columns). Then enter your values in the augmented matrix. Press [ENTER] after each value or use the arrow keys to go from one position to the next in the matrix.

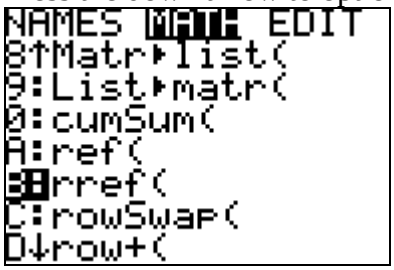


Press [2nd][QUIT] when finished to go back to the home screen.

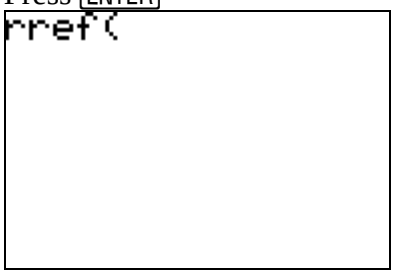
To find the solution to the system:

Press [2nd][MATRIX] and arrow to MATH

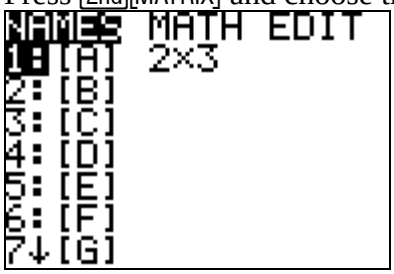
Press the down arrow to option B: **rref(**



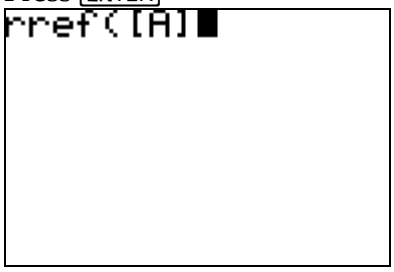
Press [ENTER]



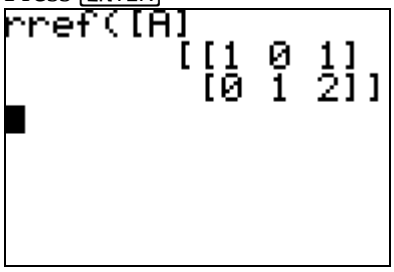
Press [2nd][MATRIX] and choose the matrix name



Press [ENTER]



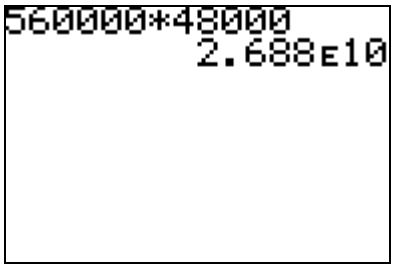
Press [ENTER]



The solution to the system of equations is x = 1 and y = 2.

V. Scientific Notation

Example: Multiply the following on the home screen: 560,000 · 48,000



The solution is 2.688×10^{10} or 26,880,000,000.

Note: To type a number in scientific notation like 2.688×10^{10}: Press 2.688 [2nd][EE]10.

VI. Various Keys

a) [2nd][CATALOG]: List of operations for the calculator are stored here in alphabetical order. This can be helpful when an operation is difficult to locate.

b) [MATH]: Various submenus with mathematical operations including ▷ **FRAC** which changes decimals to fractions.

Press .25 [MATH], select #1 ▷ **FRAC**, [ENTER]

c) [PRGM]: Can create/store different programs here.

d) [STAT]: Used to find mean, median, standard deviation, regression lines, etc.

e) [^]: Used for exponents.

f) [DEL] versus [CLEAR]: The [DEL] key will delete a single character and the [CLEAR] key will delete the whole expression.

g) [2nd][INS]: Allows the possibility of inserting a key without retyping the whole expression.

h) [2nd][▲]: Will darken the screen (when batteries get low).

i) [2nd][▼]: Will lighten the screen (when the screen is too dark).

j) [2nd][ENTRY]: Will recall what you just entered on the home screen. This allows you to edit the line using the arrow keys, delete key ([DEL]), and insert key ([2nd][INS]). [2nd][ENTRY] can also be repeated several times in succession to edit other previous lines.

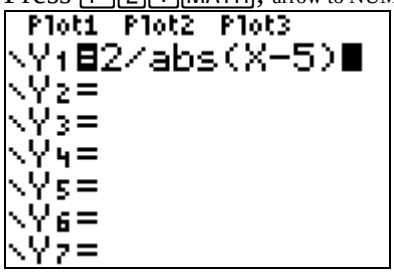
k) [2nd][QUIT]: Will take you back to the home screen.

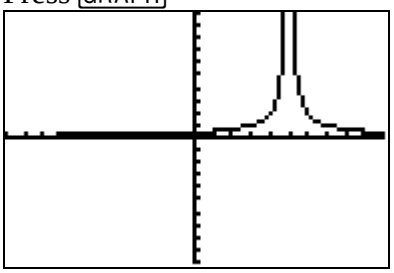
l) [2nd][ANS]: Will recall the previous answer.

VII. Graphing Various Functions (in a standard viewing window)

a) Graph $Y_1 = \dfrac{2}{|x-5|}$

Press [Y=][2][÷][MATH], arrow to NUM, select #1 abs(, [X,T,Θ,n][−][5][)] Press [GRAPH]

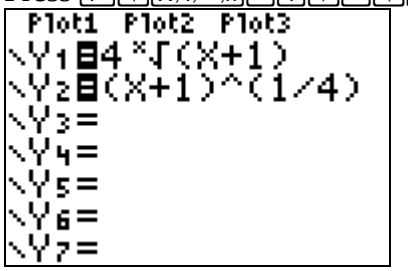


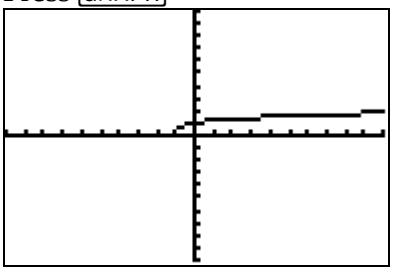


b) Graph $Y_1 = \sqrt[4]{X+1}$ Note: This can also be graphed as $Y_2 = (X+1)^{\frac{1}{4}}$

Press [Y=][4][MATH], select #5 $\sqrt[x]{}$,[(][X,T,Θ,n][+][1][)] for Y_1

Press [Y=][(][X,T,Θ,n][+][1][)][^][(][1][÷][4][)] for Y_2 Press [GRAPH]

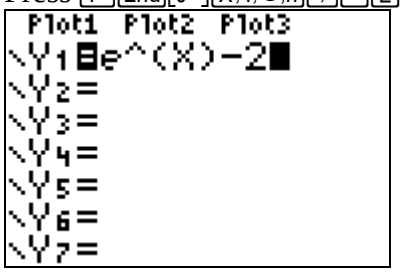


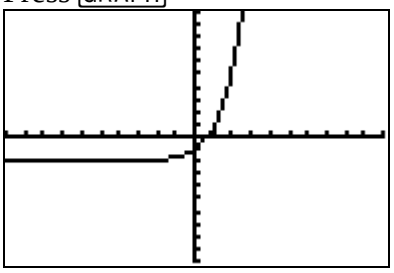


Notice the graphs are the same for Y_1 and Y_2. Hit [Y=], arrow to Y_2, [CLEAR] to delete the 2nd function before graphing the next equation.

c) Graph $Y_1 = e^X - 2$

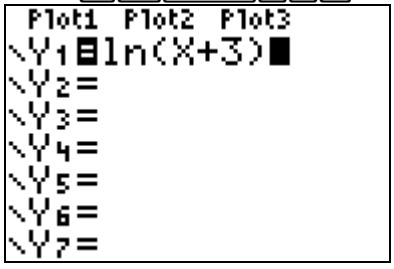
Press [Y=][2nd][e^x][X,T,Θ,n][)][−][2] Press [GRAPH]

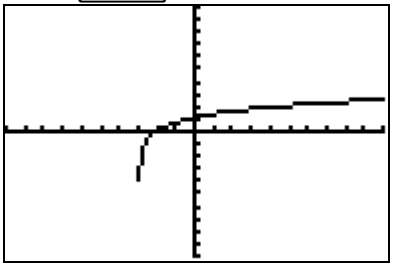




d) Graph $Y_1 = \ln(X+3)$

Press [Y=][LN][X,T,Θ,n][+][3][)] Press [GRAPH]





VIII. Turn it OFF: Press [2nd][OFF]

Note: Some excerpts from this guide were taken from the TI-83 Plus Calculator Guide ©1999