

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**

```
Normal Sci Eng
Float 0123456789
Radian Degree
Func Par Pol Seq
Connected Dot
Sequential Simul
Real a+bi re^θi
Full Horiz G-T
```

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 $Y_1 = X + 1$

```
Plot1 Plot2 Plot3
\Y1=
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

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**.

```
WINDOW
Xmin=-10
Xmax=10
Xscl=1
Ymin=-10
Ymax=10
Yscl=1
Xres=1
```

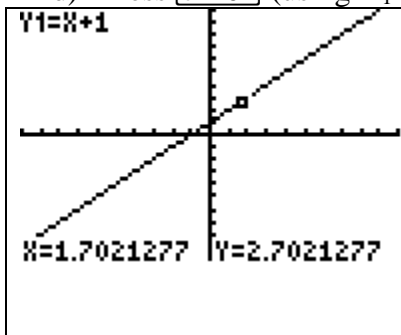
This defines the viewing window that will be used for the graph. In this case, the window goes from -10 to 10 for X and -10 to 10 for Y. **Xscl** and **Yscl** determine how often tick marks are placed on each axis. For this window, the tick marks will be placed 1 unit apart. **Xres** sets pixel resolution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

```
ZOOM MEMORY
1:ZBox
2:Zoom In
3:Zoom Out
4:ZDecimal
5:ZSquare
6:ZStandard
7↓ZTrig
```

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.

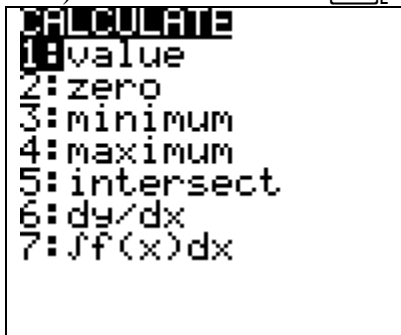
If two or more functions are graphed, the up or down arrow keys will move the cursor from one function to another.

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]**.

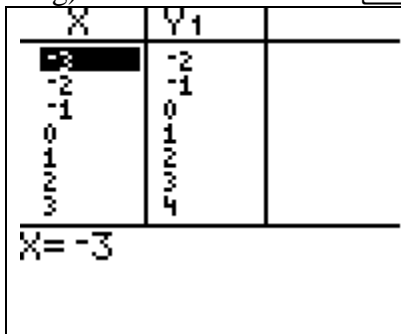


Value evaluates a function for a specified value of X. **Zero** finds the x-intercept of a function. **Minimum** finds the minimum value of a function within a specified interval. **Maximum** finds the maximum value of a function within a specified interval. **Intersect** finds the coordinates of a point 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]**

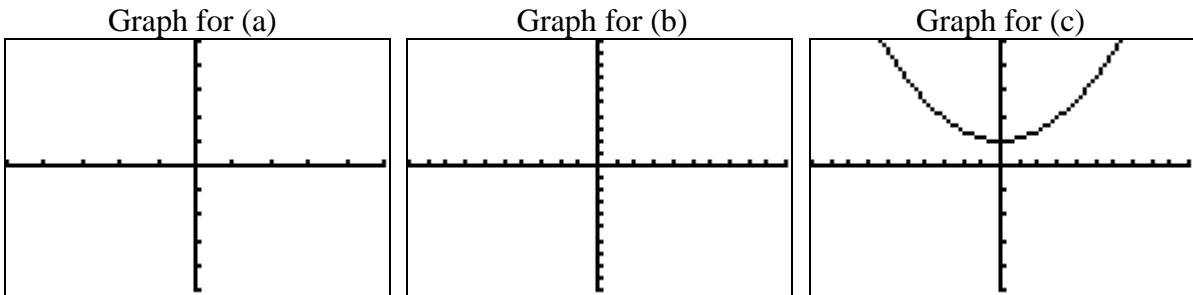


Along with the table feature in part g) above, the initial value for the independent variable can be specified using **TblStart** and ΔTbl defines the increment for the independent variable. When **Indpnt** and **Depend** are set to **Auto**, the values are displayed automatically in both the independent-variable 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 \square^{\wedge} 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.

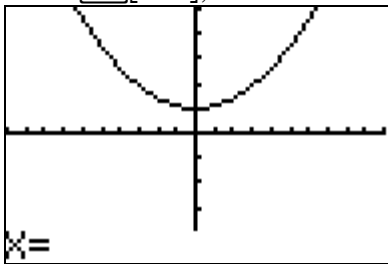


The graph for (c) gives a viewing window that shows a complete graph.

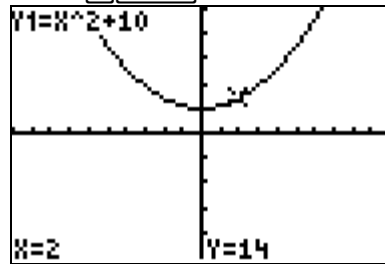
Determine the value of Y when X = 2 on the graph of $Y = X^2 + 10$.

Go into the calc menu:

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



Press **2**[ENTER]



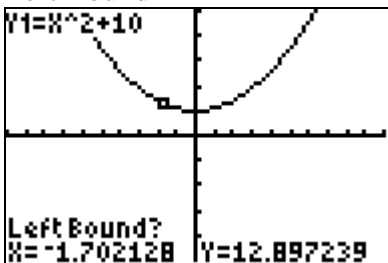
The value of Y is 14 when X = 2.

Find the minimum point on the graph of $Y = X^2 + 10$.

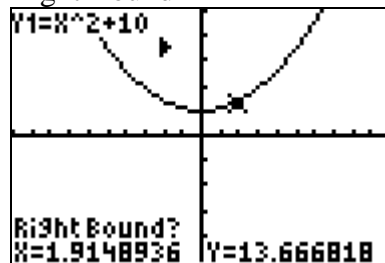
Go into the calc menu by pressing **2nd**[CALC], select #3 **Minimum**:

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

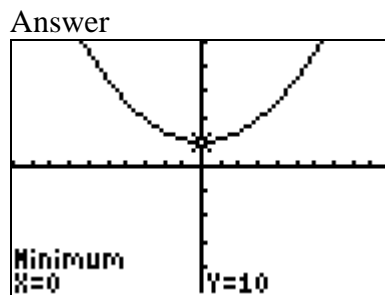
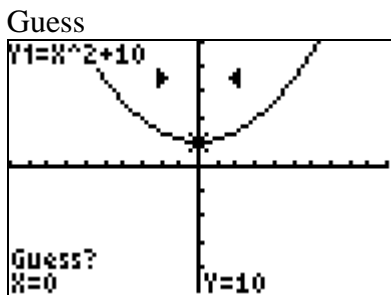


Right Bound



(Continued on the Next Page)

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

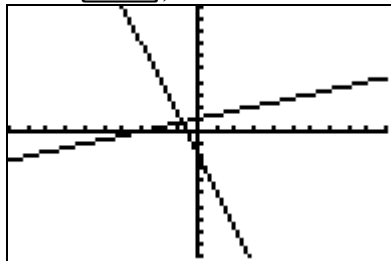


The minimum point is (0, 10).

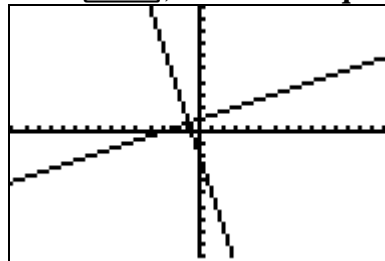
Example 2: The lines whose equations are $y = \frac{1}{3}x + 1$ and $y = -3x - 2$ are perpendicular because the product of their slopes, $\frac{1}{3}$ and -3 , is -1 .

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.
($\Delta X = \Delta Y$)

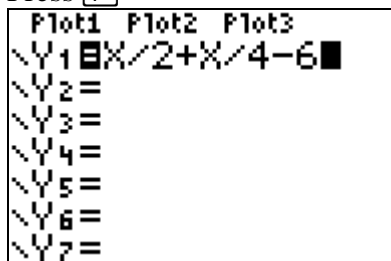
Example 3: Solve the equation for X using a graphing utility: $\frac{X}{2} + \frac{X}{4} = 6$

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:

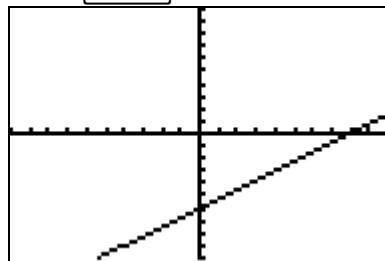
FIRST WAY: Set the equation equal to zero: $\frac{X}{2} + \frac{X}{4} - 6 = 0$ and use the calculator to graph

$Y_1 = X/2 + X/4 - 6$. Then find the x-intercepts (zeros) of the equation.

Press **[Y=]**

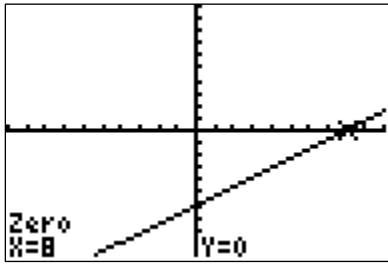


Press **[GRAPH]**



(Continued on the Next Page)

Press $\boxed{2nd}\boxed{[CALC]}$, select #2 **Zero**

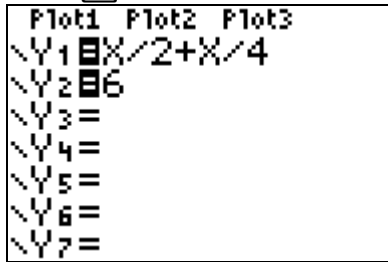


Set a left bound, right bound, and guess (similar to finding a minimum earlier in this guide) to find the solution.

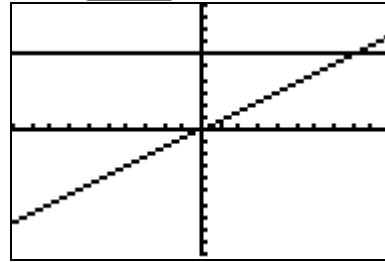
The solution to $\frac{X}{2} + \frac{X}{4} = 6$ is $X = 8$.

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 $\boxed{Y=}$

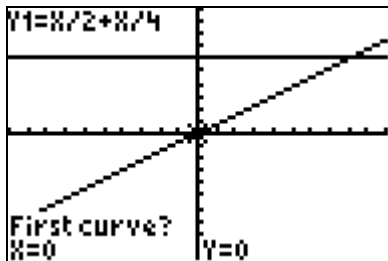


Press \boxed{GRAPH}

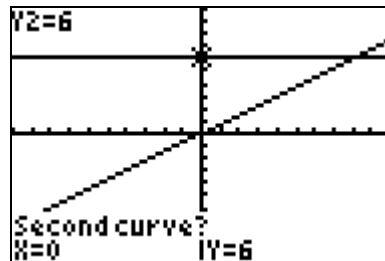


To find the solution, press $\boxed{2nd}\boxed{[CALC]}$ and select #5 **Intersect**. Since we only have two functions graphed, the calculator will go to Y_1 as the first curve (press \boxed{ENTER}), Y_2 as the second curve (press \boxed{ENTER}), and arrow close to the intersection point for a guess (press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

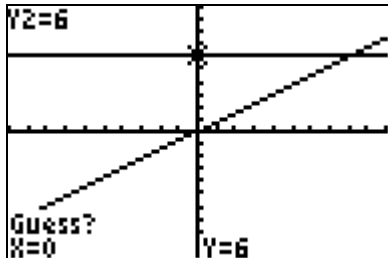
First Curve?



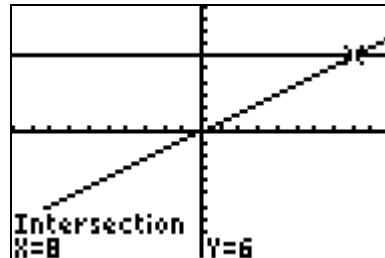
Second Curve?



Guess?



Answer

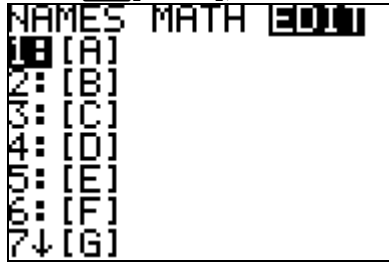


The solution to $\frac{X}{2} + \frac{X}{4} = 6$ is $X = 8$.

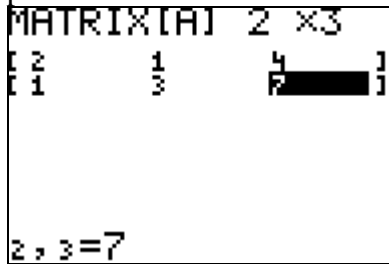
IV. Matrices (can be used to solve a system of linear equations)

Example: Solve the system of equations: $2x + y = 4$
 $x + 3y = 7$

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



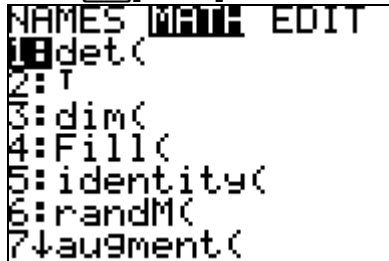
Enter the size of the matrix: **2x3** for our example (2 rows by 3 columns). Then enter your values in the augmented matrix. Press **[ENTER]** after each value or use the arrow keys to go from one position to the next in the matrix.



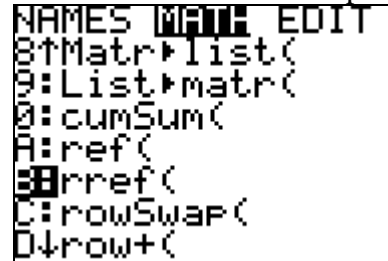
Press **[2nd][QUIT]** when finished to go back to the home screen.

To find the solution to the system:

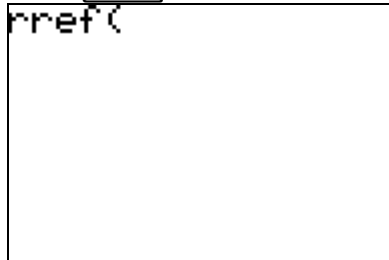
Press **[2nd][MATRIX]** and arrow to MATH



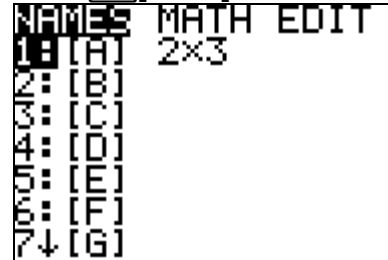
Press the down arrow to option B: **rref()**



Press **[ENTER]**



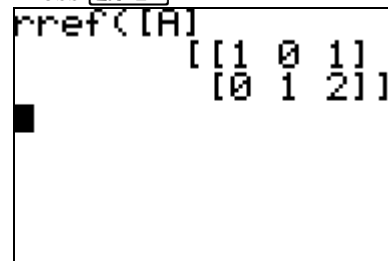
Press **[2nd][MATRIX]** and choose the matrix name



Press **[ENTER]**



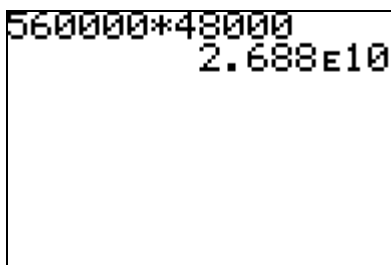
Press **[ENTER]**



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

V. Scientific Notation

Example: Multiply the following on the home screen: $560,000 \cdot 48,000$



560000*48000
2.688E10

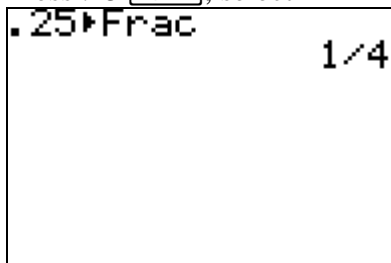
The solution is 2.688×10^{10} or 26,880,000,000.

Note: To type a number in scientific notation like 2.688×10^{10} : Press 2.688 $\boxed{2\text{nd}}\boxed{EE}10$.

VI. Various Keys

- $\boxed{2\text{nd}}\boxed{\text{CATALOG}}$: List of operations for the calculator are stored here in alphabetical order. This can be helpful when an operation is difficult to locate.
- $\boxed{\text{MATH}}$: Various submenus with mathematical operations including \triangleright **FRAC** which changes decimals to fractions.

Press .25 $\boxed{\text{MATH}}$, select #1 \triangleright **FRAC**, $\boxed{\text{ENTER}}$



.25*Frac
1/4

- $\boxed{\text{PRGM}}$: Can create/store different programs here.
- $\boxed{\text{STAT}}$: Used to find mean, median, standard deviation, regression lines, etc.
- $\boxed{\wedge}$: Used for exponents.
- $\boxed{\text{DEL}}$ versus $\boxed{\text{CLEAR}}$: The $\boxed{\text{DEL}}$ key will delete a single character and the $\boxed{\text{CLEAR}}$ key will delete the whole expression.
- $\boxed{2\text{nd}}\boxed{\text{INS}}$: Allows the possibility of inserting a key without retyping the whole expression.
- $\boxed{2\text{nd}}\boxed{\blacktriangle}$: Will darken the screen (when batteries get low).
- $\boxed{2\text{nd}}\boxed{\blacktriangledown}$: Will lighten the screen (when the screen is too dark).
- $\boxed{2\text{nd}}\boxed{\text{ENTRY}}$: Will recall what you just entered on the home screen. This allows you to edit the line using the arrow keys, delete key ($\boxed{\text{DEL}}$), and insert key ($\boxed{2\text{nd}}\boxed{\text{INS}}$). $\boxed{2\text{nd}}\boxed{\text{ENTRY}}$ can also be repeated several times in succession to edit other previous lines.
- $\boxed{2\text{nd}}\boxed{\text{QUIT}}$: Will take you back to the home screen.
- $\boxed{2\text{nd}}\boxed{\text{ANS}}$: Will recall the previous answer.

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

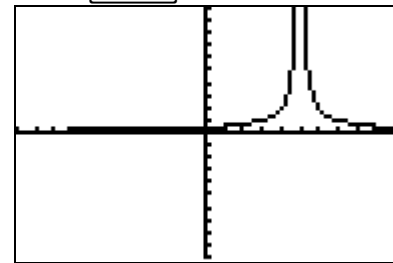
a) Graph $Y_1 = \frac{2}{|x-5|}$

Press $[Y=][2][\div][\text{MATH}]$, arrow to NUM, select #1 abs($[X,T,\theta,n]-[5][\]$)

```

Plot1 Plot2 Plot3
\Y1=2/abs(X-5)
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
    
```

Press $[\text{GRAPH}]$



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

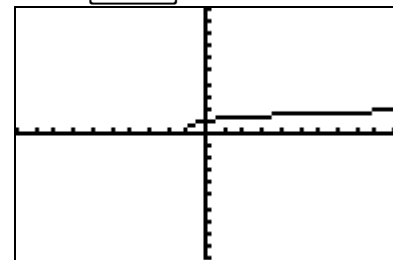
Press $[Y=][4][\text{MATH}]$, select #5 $\sqrt[4]{\ } , ([X,T,\theta,n]+[1][\])$ for Y_1

Press $[Y=]([X,T,\theta,n]+[1][\])^{([1][\div][4][\])}$ for Y_2

```

Plot1 Plot2 Plot3
\Y1=4*sqrt(X+1)
\Y2=(X+1)^(1/4)
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
    
```

Press $[\text{GRAPH}]$



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

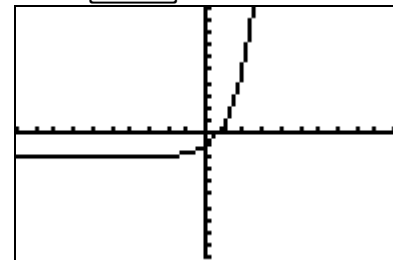
c) Graph $Y_1 = e^x - 2$

Press $[Y=][2\text{nd}][e^x][X,T,\theta,n]-[2][\]$

```

Plot1 Plot2 Plot3
\Y1=e^(X)-2
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
    
```

Press $[\text{GRAPH}]$



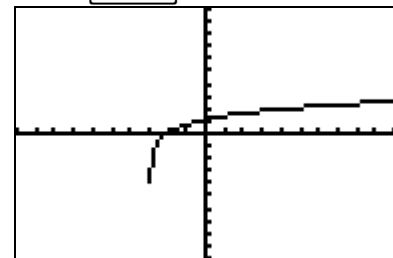
d) Graph $Y_1 = \ln(X+3)$

Press $[Y=][\text{LN}][X,T,\theta,n]+[3][\]$

```

Plot1 Plot2 Plot3
\Y1=ln(X+3)
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
    
```

Press $[\text{GRAPH}]$



VIII. Turn it OFF: Press $[2\text{nd}][\text{OFF}]$

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