TI-84 Plus Graphing Calculator Instructions

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Getting to Know the

GRAPHING CALCULATOR

Button	**What Happens**
On	Calculator turns on
2nd On	Calculator turns off
+	Adds numbers
–	Subtracts numbers
×	Multiplies numbers
÷	Divides numbers
(–) vs. –	
(–)	is a negative sign used to signify a negative number – do not use in an expression as a minus sign
–	is the subtraction sign
ALPHA Y= **n/d**	enter fractions, enter numerator, **11**, use down or right arrow to go to denominator and enter it, **4**, then arrow to the right for $\frac{11}{4}$
Math **Frac**	converts decimals into simplified fractions
Math **Dec**	converts fractions into decimals
2nd Mode	**Quit** - takes you out of the current screen and back to the main screen
Clear	erases the current line of info
Del	deletes a single character – use the arrow key to move to a specific character to delete
2nd Del	**Insert** a character or characters – use your arrow to move to where you want to insert a character and press 2nd Del then enter what you want to insert
2nd Enter	displays the last item you entered in the calculator's main screen
2nd (–)	displays the value (**Answer**) the last time you pressed Enter
X,T,θ,n	the x variable

Exponents

X,T,θ,n x^2	x^2
7 x^2 Enter	7^2 49
((–) 5) x^2 Enter	$(-5)^2$ 25 not -25

always enter negative numbers in parentheses

X,T,θ,n Math **3:^{3}**	x^3
4 Math **3:^{3}**	4^3 64
X,T,θ,n ^ **6**	x^6
10 ^ **6**	10^6 1000000

Graphing

Y=	opens window to enter a function to graph – function must be solved for y
Y= 2 X,T,θ,n – 7	enters the function $y = 2x - 7$, press Graph to see the function graphed on a coordinate plane
Graph	opens window to see the graph of the function you entered in Y=
2nd Graph	**Table** - opens the x/y table of values for the function you entered in Y=
Zoom	allows you to zoom in and out on the coordinate plane– choose Z**Standard** when in doubt
◥	When graphing inequalities, move the cursor to the left of the **Y=** and press Enter until the symbol changes to greater than ◥ or less than ◣

Absolute Value Equations

To graph $y = |\, x - 3\,|$

1. Press Y=
2. Press MATH
3. Select **Num**
4. Select **Abs (**
5. Press ENTER
6. Type in **|x – 3|**
    a. Will look like **\Y₁ = |x – 3|**
7. Press GRAPH

To graph $y = \frac{1}{4}\,|x| - 7$

1. Press Y=
2. ALPHA Y= **n/d**
3. Type in $\frac{1}{4}$
4. Press MATH
5. Select **Num**
6. Select **Abs (**
7. Press ENTER
8. Type in **|x|– 7**
    a. Will look like **\Y₁ = $\frac{1}{4}$|x|– 7**
9. Press GRAPH

Inequalities

To graph $y \geq -3x + 4$ *greater than example*

1. Press Y =
2. Then press the arrow to move the cursor to the left on the \
3. Press ENTER until \ becomes ◥ for greater than (or ◣ for less than)
4. Press the arrow to move the cursor back to the right of =
5. Enter **– 3x + 4**
6. Press ENTER
    a. Will look like
    ◥ **Y₁ = – 3x + 4**
7. Press GRAPH

To graph $y < 2x^2 + 5x - 1$ *less than example*

1. Press Y =
2. Then press the arrow to move the cursor to the left on the \
3. Press ENTER until \ becomes ◣ for less than)
4. Press the arrow to move the cursor back to the right of =
5. Enter **$2x^2$ +5x –1**
6. Press ENTER
    a. Will look like
    ◣ **Y₁ = $2x^2$ +5x –1**
7. Press GRAPH

Piece-Wise Functions

This example shows all expressions and conditions as a single Y = entry

To graph $f(x)\begin{cases} x+2 \ if \ x<0 \\ 2x+5 \ if \ 0\le x\le 2 \\ -x+1 \ if \ x>2 \end{cases}$

1. Press Y =
2. In the **Y_1 =**section press the arrow to move the cursor to the left on the \
3. Press ENTER until \ becomes ∴
4. Press the arrow to move the cursor back to the right of =
5. Each expression will be in parentheses along with its condition also in its own set of parentheses – all expression/condition pairs will be separated by **+**
6. Enter **(x + 2)(x**
7. Press 2nd MATH
8. Select $<$
9. Press ENTER
10. Type in **0)+(2x + 5)(0**
11. Press 2nd MATH
12. Select $\le$
13. Press ENTER
14. Type **x**
15. Press 2nd MATH
16. Select *Logic* then *and*
17. Press ENTER
18. Type **x**
19. Press 2nd MATH
20. Select $\le$
21. Press ENTER
22. Type in **2)+(-x + 1)(x**
23. Press 2nd MATH
24. Select $>$
25. Press ENTER
26. Type **2)**
    a. Will look like ∴**Y_1 =** (x + 2)(x $<$ 0)+(2x +5)(0≤x and x≤2)+(-x+1)(x $>$2)
27. Press GRAPH

Step Functions (Greatest Integer Functions)

To Graph $y = [\![2x-1]\!]$

1. Press Y =
2. In the **Y_1 =**section press the arrow to move the cursor to the left on the \
3. Press ENTER until \ becomes ∴
4. Press the arrow to move the cursor back to the right of =
5. Press MATH
6. Select **Num**
7. Select **int (**
8. Press ENTER
9. Type in **2x-1)**
    a. Will look like ∴**Y_1 = int(2x-1)**
10. Press GRAPH

To Graph $y = [\![4x]\!] + 2$

1. Press Y =
2. In the **Y_1 =**section press the arrow to move the cursor to the left on the \
3. Press ENTER until \ becomes ∴
4. Press the arrow to move the cursor back to the right of =
5. Press MATH
6. Select **Num**
7. Select **int (**
8. Press ENTER
9. Type in **4x)+2**
    a. Will look like ∴**Y_1 = int(4x)+2**
10. Press GRAPH

Regression Functions

Data needs to be plotted first to determine if it looks linear, quadratic or exponential.

Create a regression function for the following data.

X	1	4	5	8	11	15
Y	8	10	13	15	18	22

Enter Data

1. Press Stat
2. Choose **Edit** and **Edit**, press Enter
3. L1, L2 and L3 will appear in the window
4. Enter the input data (x) in the L1 column – enter one value, 1, then press Enter, enter the next value, 4, then Enter. Continue until all the input data is entered in L1 column
5. Press the **arrows** to move to the top of L2 column
6. Enter the output data (y) in the L2 column the same way you did the input data
7. After all of the input and output values are entered, you can use the arrows to scroll up and check each ordered pair – *each entry in L1 should have a corresponding entry in L2*

If data looks **Linear**

1. Press the Stat button
2. Use the arrow to select **Calc**
3. Use the arrow to select **LinReg (ax+b)** if you think the data forms a **linear** function
4. Press Enter, press Enter
5. Screen displays **a** and **b** values for **y = ax+b**
   a. **a** is the slope and **b** is the y-intercept
   b. In this example, we see
      LinReg
      y=ax+b
      a = 1.007731959
      b = 6.943298969
   c. So the equation of the linear function would be **y = 1.00x + 6.94**

If data looks **Quadratic**

1. Press the Stat button
2. Use the arrow to select **Calc**
3. Use the arrow to select **QuadReg** if you think the data forms a **quadratic** function
4. Press Enter, press Enter
5. Screen displays **a, b** and **c** values for **$y = ax^2+bx+c$**
   a. In this example, we see
      QuadReg
      $y= ax^2+bx+c$
      a = -.0031085541
      b = 1.058045669
      c = 6.8085095
   b. So the equation of the quadratic function would be
      $y = -.003x^2+1.058x+6.808$

If data looks **Exponential**

1. Press the Stat button
2. Use the arrow to select **Calc**
3. Use the arrow to select **ExpReg** if you think the data forms an **exponential** function
4. Press Enter, press Enter
5. Screen displays **a** and **b** values for **y = a*b^x**
   a. In this example, we see
      ExpReg
      y = a*b^x
      a = 8.007462683
      b = 1.074318267
   b. So the equation of the exponential function would be
      y = 8.007*1.074^x

Graph the function to get table values to plot the regression function and/or find a prediction value

1. Press Y = and enter the equation from above
2. Press 2ND Graph to get the table values to graph the regression function

To plot the data from L1 and L2

1. Press 2ND Y= (which is the **Stat Plot**)
2. Press Enter, press Enter to select **ON**
3. You will see the first type of graph selected which is scatter – keep that selected.
4. You will see the **X List** is the **L1** list we entered and the **Y List** is our **L2** list – if not, press 2ND 1 for **L1** and 2ND 2 for **L2**
5. Press Graph
6. You may have to Zoom **Zoom Out** or **In** to see the plotted data points and regression function

When you are finished, be sure to *turn the Stat Plot off*

1. Press 2ND Y= (which is the **Stat Plot**)
2. Press Enter
3. Use arrow to select **OFF**
4. Press Enter
5. Press 2nd Mode to **Quit**

Matrices

Enter the matrix $\begin{bmatrix} 7 & 2 & -5 \\ -1 & 3 & 4 \end{bmatrix}$

1. Press 2nd x^{-1} (**Matrx**)
2. Use the arrow to move to **Edit**
3. Use the arrow to select the matrix you want to edit – you can choose **A** through **J** – select **1: [A]**
4. Press Enter
5. Enter the number of rows, **2**, press Enter
6. Enter the number of columns, **3**, press Enter
7. Enter each matrix entry by rows by pressing Enter after each entry
8. When finished press 2nd Mode (**Quit**)

View the Matrix

9. Press 2nd x^{-1} (**Matrx**)
10. Use the arrow to select the matrix you want to view, **1: [A]**
11. Press Enter
12. Matrix letter will appear on the screen
13. Press Enter to see the matrix entries

Add, Subtract and Multiply Matrices

$A = \begin{bmatrix} 5 & 2 \\ -6 & 4 \end{bmatrix}$ $B = \begin{bmatrix} 7 & 3 \\ 0 & 1 \end{bmatrix}$ $C = \begin{bmatrix} -9 & 6 \\ 8 & -2 \end{bmatrix}$

1. Enter the Matrices above
   - Press 2nd x^{-1} (**Matrx**)
   - Use the arrow to move to **Edit**
   - Use the arrow to select the matrix you want to edit
     - select **1: [A]** for the first matrix
     - select **2: [B]** for the second matrix
     - select **3: [C]** for the third matrix
   - follow the directions above for entering each matrix one at a time

Add A+C $\begin{bmatrix} 5 & 2 \\ -6 & 4 \end{bmatrix} + \begin{bmatrix} -9 & 6 \\ 8 & -2 \end{bmatrix}$

2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select the first matrix you want to add, **1: [A]**
4. Press Enter
5. Matrix letter **[A]** will appear on the screen
6. Press the **+** (plus) button
7. Press 2nd x^{-1} (**Matrx**)
8. Use the arrow to select the next matrix you want to add, **3: [C]**
9. Press Enter
10. Screen will look like **[A]+[C]**
11. Press Enter to see the result matrix

$$\begin{bmatrix} -4 & 8 \\ 2 & 2 \end{bmatrix}$$

Subtract C-B $\begin{bmatrix} -9 & 6 \\ 8 & -2 \end{bmatrix} - \begin{bmatrix} 7 & 3 \\ 0 & 1 \end{bmatrix}$

2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select the first matrix you want to subtract, **3: [C]**
4. Press Enter
5. Matrix letter **[C]** will appear on the screen
6. Press the $-$ (minus) button
7. Press 2nd x^{-1} (**Matrx**)
8. Use the arrow to select the next matrix in the expression, **2: [B]**
9. Press Enter
10. Screen will look like **[C]-[B]**
11. Press Enter to see the result matrix

$$\begin{bmatrix} -16 & 3 \\ 8 & -3 \end{bmatrix}$$

Multiply AB $\begin{bmatrix} 5 & 2 \\ -6 & 4 \end{bmatrix}\begin{bmatrix} 7 & 3 \\ 0 & 1 \end{bmatrix}$

2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select the first matrix you want to multiply, **1: [A]**
4. Press Enter
5. Matrix letter **[A]**will appear on the screen
6. Press the $\times$ (multiply) button
7. Press 2nd x^{-1} (**Matrx**)
8. Use the arrow to select the next matrix you want to multiply, **2: [B]**
9. Press Enter
10. Screen will look like **[A][B]**
11. Press Enter to see the result matrix

$$\begin{bmatrix} 35 & 17 \\ -42 & -14 \end{bmatrix}$$

Multiply by a Scalar $4C = 4\begin{bmatrix} -9 & 6 \\ 8 & -2 \end{bmatrix}$

2. Press **4**
3. Press 2nd x^{-1} (**Matrx**)
4. Use the arrow to select the matrix, **3: [C]**
5. Press Enter
6. Screen will look like **4[C]**
7. Press Enter to see the result matrix

$$\begin{bmatrix} -36 & 24 \\ 32 & -8 \end{bmatrix}$$

Determinants *(only square matrices)*

$\boldsymbol{A} = \begin{bmatrix} \mathbf{7} & \mathbf{2} & \mathbf{-5} \\ \mathbf{6} & \mathbf{0} & \mathbf{9} \\ \mathbf{-1} & \mathbf{3} & \mathbf{4} \end{bmatrix}$ **find *det(A)***

1. Enter the Matrix above as matrix **[A]**
2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select **MATH**
4. Use the arrow to select **1: det(**
5. Press Enter
6. Press 2nd x^{-1} (**Matrx**)
7. Select the matrix for which you want to find the determinant, **1: [A]**
8. Press ENTER
9. Screen will look like **det([A]**
10. Press Enter to see the determinant, **-345**

Inverse *(only square matrices when det*$\neq \mathbf{0}$*)*

$\boldsymbol{B} = \begin{bmatrix} \mathbf{5} & \mathbf{8} & \mathbf{6} \\ \mathbf{3} & \mathbf{-2} & \mathbf{1} \\ \mathbf{1} & \mathbf{10} & \mathbf{4} \end{bmatrix}$ **find B^{-1}**

1. Enter the Matrix
2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select the matrix, **2: [B]**
4. Press Enter
5. Press x^{-1}
6. Screen will look like **[B]$^{-1}$**
7. Press Enter to see the result inverse matrix – you may need to use the arrows to see all the matrix entries if there are long decimals – press MATH and select Frac to turn entries into fractions, press Enter

$$\boldsymbol{B^{-1}} = \begin{bmatrix} \frac{-9}{7} & 2 & \frac{10}{7} \\ \frac{-11}{14} & 1 & \frac{13}{14} \\ \frac{16}{7} & -3 & \frac{-17}{7} \end{bmatrix}$$

RREF – Solving Systems of Equations

$$2x + 5y = -22$$
$$-3x + 6y = -48$$

1. Enter the Matrix $\begin{bmatrix} 2 & 5 & -22 \\ -3 & 6 & -48 \end{bmatrix}$
2. Press 2nd x^{-1} (**Matrx**)
3. Use the arrow to select **MATH**
4. Use the arrow to select **B: rref(**
5. Press Enter
6. Press 2nd x^{-1} (**Matrx**)
7. Select the matrix of the system you want to solve
8. Press ENTER
9. Screen will look like **rref([A]**
10. Press Enter to see the solution to the system $\begin{bmatrix} 1 & 0 & 4 \\ 0 & 1 & -6 \end{bmatrix}$ meaning **x = 4** and **y = $-$ 6**

System of Equations:
Finding the Solution of Two Equations

The solution of two equations is the intersection of the graphs of the two equations.

Ex: Find the intersection of the following lines

y = 2x-7
- x+3y=9

Rewrite - x+3y=9 into slope/intercept form:

y= $\frac{1}{3}$x +3

1. Press [Y =]
2. Next to \Y$_1$= type in the 1st equation **2x-7**
3. Next to \Y$_2$= type in the 2nd equation $\frac{\mathbf{1}}{\mathbf{3}}$**x +3**
4. Press [Graph]
5. Press [2nd] [Trace] (Calc)
6. Arrow down to **intersect**
7. Press [Enter]
8. **First curve?** appears on the screen
9. Press [Enter]
10. **Second curve?** appears on the screen
11. Press [Enter]
12. **Guess?** appears on the screen
13. Press [Enter]
14. The spider is on the intersection, and the value is displayed on the bottom of the screen,

Intersection
X=6 Y=5

The point (6, 5) is a solution for both equations and the system of equations.

*You may need to **Zoom Out** to see the lines intersect if you get an error when trying to find the intersection.*

Finding the Minimum or Maximum of a Curve

To find the min or max of $y = x^2 - 4x - 9$

1. Press Y =
2. Next to \Y$_1$= type in $\boldsymbol{x^2 - 4x - 9}$
3. Press Graph
4. Notice the parabola opens up so we will find the minimum
5. Press 2nd Trace (Calc)
6. Arrow down to **minimum**
7. Press Enter
8. **Left Bound?** appears on the screen
    a. Look at the parabola and choose the x value next to the left side of the curve - and type it, **– 2**
9. Press Enter
10. **Right Bound?** appears on the screen
    a. Look at the parabola and choose the x value next to the right side of the curve - and type it, **6**
11. Press Enter
12. **Guess?** appears on the screen
13. Press Enter
14. The value is displayed on the bottom of the screen

    Minimum
    X=2.0000021 Y= –13

The vertex is (2, -13) and –13 is the minimum value of the quadratic

To find the min or max of $y = -2x^2 - 10x + 15$

1. Press Y =
2. Next to \Y$_1$= type in $\boldsymbol{-2x^2 - 10x + 15}$
3. Press Graph
4. Notice the parabola opens down so we will find the maximum
5. Press 2nd Trace (Calc)
6. Arrow down to **maximum**
7. Press Enter
8. **Left Bound?** appears on the screen
    a. Look at the parabola and choose the x value next to the left side of the curve - and type it, **– 7**
9. Press Enter
10. **Right Bound?** appears on the screen
    a. Look at the parabola and choose the x value next to the right side of the curve - and type it, **2**
11. Press Enter
12. **Guess?** appears on the screen
13. Press Enter
14. The value is displayed on the bottom of the screen

    Maximum
    X=–2.499998 Y=27.5

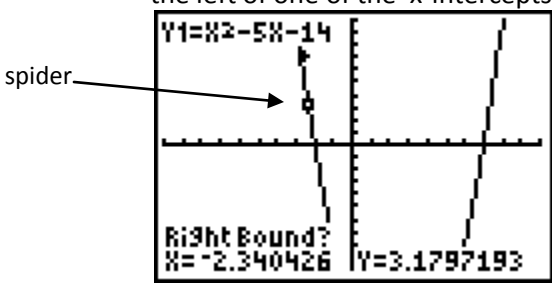
The vertex is (-2.5, 27.5) and 27.5 is the minimum value of the quadratic

Finding the Zeros of an Equation

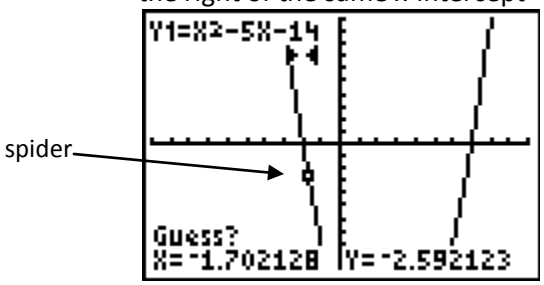
Zeros of an equation are where the equation crosses the x-axis. They are the solutions to the variable in the equation when the equation is set equal to zero.

To find the zeros of $y = x^2 - 5x - 14$

1. Press Y =
2. Next to \Y$_1$= type in $\boldsymbol{x^2 - 5x - 14}$
3. Press Graph
4. Press 2nd Trace (Calc)
5. Arrow down to **zero**
6. Press Enter
7. **Left Bound?** appears on the screen
   a. You can choose the left bound by using the left or right arrow buttons to move the spider on the line to the left of one of the x-intercepts



   b. Or you can type in the left bound value – look for the value on the x-axis to the left of the intercept point and type it, **– 3**
8. Press Enter
9. **Right Bound?** appears on the screen
   a. You can choose the right bound by using the left or right arrow buttons to move the spider on the line to the right of the same x-intercept



   b. Or you can type in the right bound value – look for the value on the x-axis to the right of the same intercept point and type it, **– 1**
10. Press Enter
11. **Guess?** appears on the screen
12. Press Enter
13. The spider is on the zero, the x-intercept, and the value is displayed on the bottom of the screen

    Zero
    X=-2 Y=0

You repeat #4-13 to find another zero if the graph intersects the x-axis in a second location.

14. Press 2nd Trace (Calc)
15. Arrow down to **zero**
16. Press Enter
17. **Left Bound?** appears on the screen
    c. You can choose the left bound by using the left or right arrow buttons to move the spider on the line to the left of one of the x-intercepts
    d. Or you can type in the left bound value – look for the value on the x-axis to the left of the intercept point and type it, **6**
18. Press Enter
19. **Right Bound?** appears on the screen
    e. You can choose the right bound by using the left or right arrow buttons to move the spider on the line to the right of the same x-intercept
    f. Or you can type in the right bound value – look for the value on the x-axis to the right of the same intercept point and type it, **8**
20. Press Enter
21. **Guess?** appears on the screen
22. Press Enter
23. The spider is on the zero, the x-intercept, and the value is displayed on the bottom of the screen

    Zero
    X=7 Y=0
24. Press Enter to clear the Zero value

The two zeros, or solutions for *x*, of the equation $\boldsymbol{y = x^2 - 5x - 14}$ are *x* = – 2 and *x* = 7