

## TI-84 Tutorial

This document will help you become oriented with your TI-84 Graphing Calculator. Note that everything that follows should also work for the TI-83. Before using the calculator to solve particular mathematics problems, you should select the following defaults. You will rarely change these; if you run into problems during use of the calculator, make sure that these settings are as shown below.

For each of the following, set your screen to be the same as the one shown.

1) Press **MODE**.

```
NORMAL SCI ENG
FLOAT 0 1 2 3 4 5 6 7 8 9
RADIAN DEGREE
FUNC PAR PDL SEQ
CONNECTED DOT
SEQUENTIAL SIMUL
REAL a+bi re^θi
FULL HORIZ G-T
SET CLOCK 06/10/08 3:46PM
```

If you take courses in trigonometry or calculus, you will probably come back to this screen to change the 3<sup>rd</sup> and 4<sup>th</sup> rows.

2) Press **FORMAT** (2<sup>nd</sup> **ZOOM**).

```
RectGC PolarGC
CoordOn CoordOff
GridOff GridOn
AxesOn AxesOff
LabelOff LabelOn
ExprOn ExprOff
```

If your axes in the graphing window are not visible, make sure these are the settings.

3) Press **TBLSET** (2<sup>nd</sup> **WINDOW**).

```
TABLE SETUP
TblStart=0
ΔTbl=1
Indent: Auto [5]
Depend: [1] Ask
```

Having the independent variable on 'ask' will allow you to make your own table of inputs and outputs for specific equations.

4) Press **STAT PLOT** (2<sup>nd</sup> **Y=**).

```
STAT PLOTS
1:Plot1...Off
  [1] L1 L2
2:Plot2...Off
  [1] L1 L2
3:Plot3...Off
  [1] L1 L2
4↓PlotsOff
```

Unless you are interested in plotting sets of data, these need to be turned off.

5) Press **STAT**.

```
EDIT CALC TESTS
1:Edit...
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
```

Select option 5 and press enter. This will reset all columns in the statistics menu, in case you accidentally delete a column.

6) Press **ZOOM**.

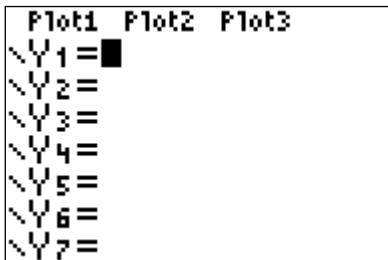
```
ZOOM MEMORY
1:ZBox
2:Zoom In
3:Zoom Out
4:ZDecimal
5:ZSquare
6:ZStandard
7↓ZTrig
```

Select option 6. This will reset the viewing window for graphing.

## Graphing Tutorial

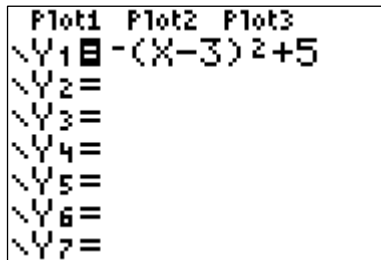
Now we are ready to explore the capabilities of your graphing utility. Complete the following walkthrough. After you finish this, you will be ready to try a few problems on your own.

1) Press **Y=**.



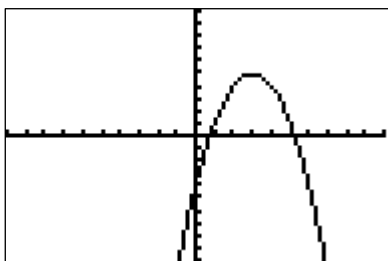
Clear any existing equations by highlighting the row and pressing **CLEAR**. Also make sure that the plots at the top are not highlighted.

2) Let's graph  $y = -(x - 3)^2 + 5$ .



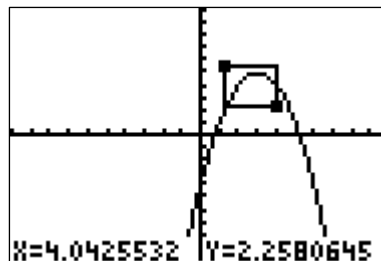
Enter this in the space for  $Y_1$ . Note the difference between the negative sign and the subtraction operation.

3) Press **ZOOM** and select option 6.



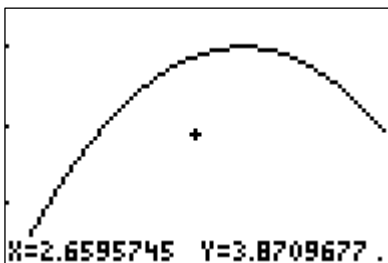
This is the graph of your equation in the standard viewing window.

4) Most of the **ZOOM** menu is obvious.



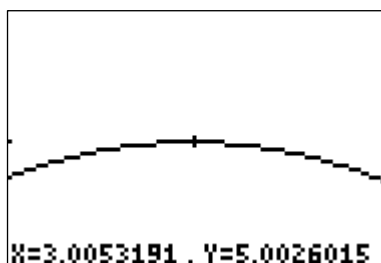
Let's say you want to look at the region near the top of this curve. In the **ZOOM** menu, select option 1. You will see a cursor flashing at the origin. Move it to a position to form a corner of your box and press enter. Now, using the arrow keys, drag out the appropriate box.

5) Press enter.



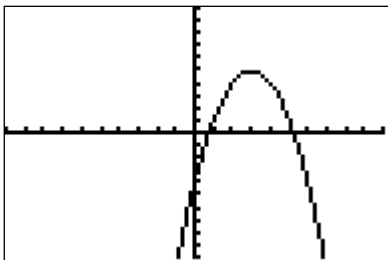
Your new screen is the box you dragged out.

6) Let's find the high point on the graph.



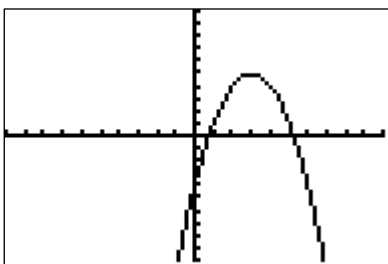
In the **ZOOM** menu, select option 2. Move the cursor to the high point, or maximum, and press enter. If you repeat this process, you will find a better estimate. It looks like the maximum occurs when  $x = 3, y = 5$ .

7) Now go back to the standard window.



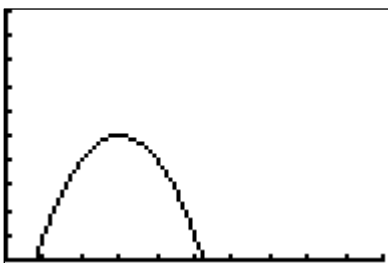
Press 6 in the **ZOOM** menu.

9) Now go back to the standard window.



Now we would like to gain a little more control over the size of our viewing window.

11) Set the **Xmin** and **Ymin** values to 0; graph.



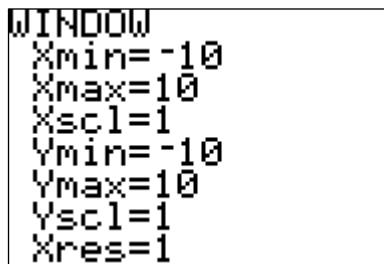
In many situations we are only interested in what occurs in the first quadrant of our graph.

8) Let's find the right-most  $x$ -intercept.



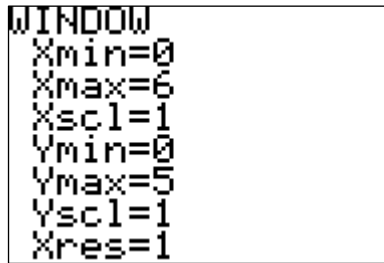
As we did with the maximum, we can **ZOOM IN** to this point to get an estimate. It appears that this  $x$ -intercept is approximately  $(5.27, 0)$ . If we continue to zoom in we find that  $(5.23, 0)$  is a better estimate. You can find the other one the same way.

10) Press **WINDOW**.



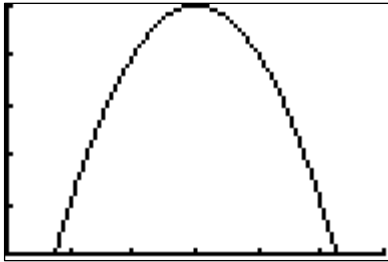
Note the standard viewing window coordinates.

12) There is a lot of wasted screen space.



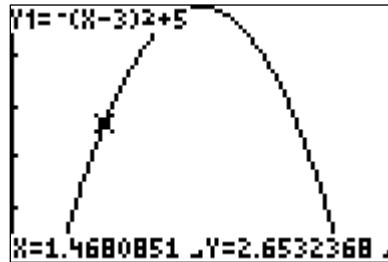
Go back to **WINDOW** and set **Xmax** to 6 and **Ymax** to 5.

13) Press **GRAPH**.



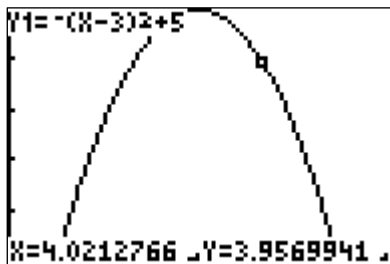
Note that the graph fills the screen. This graph is more visually appealing.

14) Press **TRACE**.



If you use the left/right arrows, you will see the cursor 'trace' along the curve to reveal more ordered pairs.

15) Let's find the value of  $y$  when  $x \approx 4$ .



Use the direction arrows to move as close as you can. You probably cannot land exactly on 4. However, you can get two estimates, one on each side of 4. Note that our  $y$ -value is also about 4. You can get a better estimate by **ZOOMing** in. What happens if, while in the graphing screen, you type 4 and hit enter? You get the exact value!

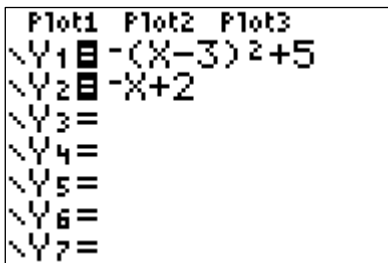
16) Press **TABLE**.

| X    | Y1     |  |
|------|--------|--|
| -5   | -59    |  |
| -1   | -11    |  |
| 0    | -4     |  |
| 4    | 4      |  |
| 1    | 1      |  |
| 6.25 | -5.563 |  |
| 80   | -724   |  |

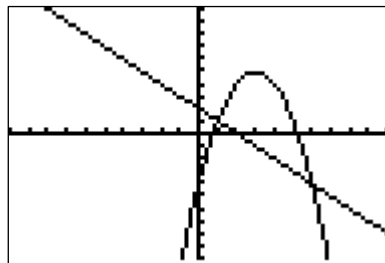
X=30

When you first learned how to graph, you made a 'table of values.' Your calculator can do this too. Try typing some specific values for  $x$ , and you will see the corresponding  $y$ -values show up in the  $Y_1$  column. Note that the value corresponding to  $x = 4$  is  $y = 4$ . If you are not able to enter values, go back and read #3 on page 1!

17) Press **Y=** and enter  $Y_2 = -x + 2$ .

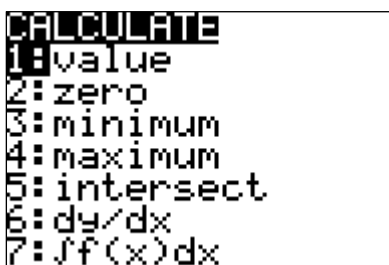


18) Press **GRAPH**.



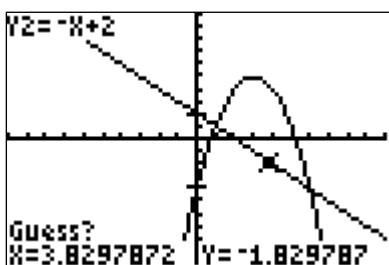
Now we have both the graph of a parabola and a line on the same viewing screen. What points look most interesting? Correct, where the two curves intersect. How can we find these? Correct, we can zoom in, but there is a more efficient approach.

19) Press **CALC** (**2<sup>nd</sup> TRACE**).



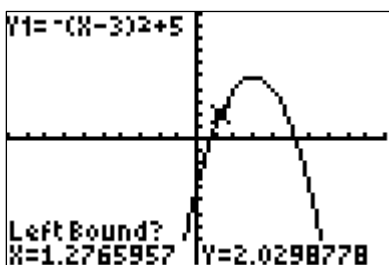
There are a number of options here. Zero can find  $x$ -intercepts and maximum can help us find the high point on the parabola we estimated earlier. However, this will be faster and give a better estimate than the zooming approach.

21) Guess?



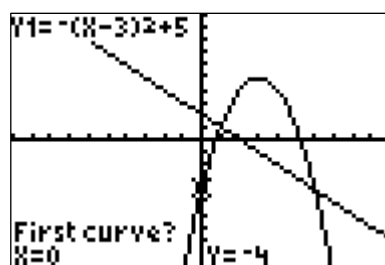
Now the calculator is asking you to guess? This may seem like an odd request, but there are two reasons for this. First, you need to tell the calculator which intersection you want to find (it can only find one at a time). Second, as with all technology, there must be a user directed input. The program that finds the intersection needs a “seed” value to start working.

23) Let’s find the maximum of the parabola again.



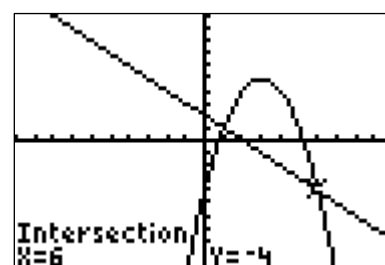
Remove the line from the graph. Now go back to the **CALC** menu (**2<sup>nd</sup> TRACE**). Select option 4 to find the maximum. You are prompted. This time you need to give the interval in which the calculator will look for the maximum; i.e., a left bound and a right bound, with the high point in between.

20) Select option 5 to find an intersection.



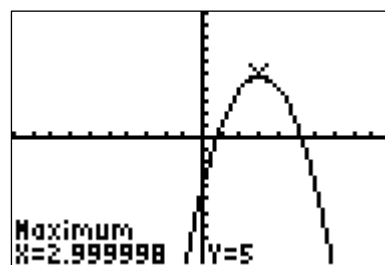
Note that the calculator is asking you to identify the curves of interest (since you can have up to ten curves showing). Just press enter for the ‘First curve?,’ and enter again when it asks for the ‘Second curve?.’

22) Let’s find the right-most intersection.



Move the cursor close to the right-most point of intersection and press enter. So these curves intersect at the point  $(6, -4)$ . Repeating this procedure will give  $(1, 1)$  as the second point of intersection.

24) Make your ‘guess’ close to the maximum.



So the maximum occurs at the point  $(3, 5)$ , as we approximated earlier. Note that the value for  $x$  is not quite 3. This is due to round-off error. This method is clearly faster than zooming in a bunch of times!

## Now it's your turn!

At this point, you should be feeling a bit more comfortable with the operation of your graphing calculator. On the other hand, you may be feeling a bit overwhelmed! So let's end the tutorial here and give you a chance to solve some problems on your own. You will surely learn more uses for the graphing calculator as you move through your mathematics courses, but this should give you a good start.

Use your calculator to solve the following problems. The answers are at the bottom of the page.

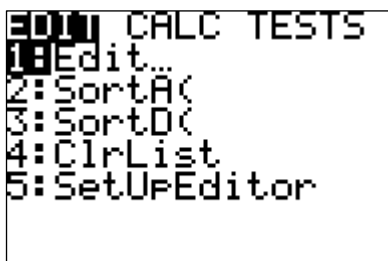
1. Graph  $y = \sqrt{2x+1}$  in the standard viewing window. Use your graph to estimate the value of  $y$  that corresponds to  $x = 3$ . (Note that the square root symbol is the 2<sup>nd</sup> function of the  $x^2$  key.)
2. Graph  $y = x^2 - 13$  in the standard viewing window. Does it look like the whole graph is visible? How can you fix this? Now that you have a better graph, what is the lowest point on the graph?
3. Graph  $y = -0.25x + 5$  in the standard viewing window. Find the  $x$ - and  $y$ -intercepts of this graph. Note that you will need a better viewing window to find the  $x$ -intercept.
4. Graph  $y = x^2$  and  $y = -(x+1)^2 + 7$  in the standard viewing window. Note that these curves intersect each other twice. Find both.
5. Graph  $y = (x-27)^2 + 56$  in the standard viewing window. What happened? Where is the graph? If we knew a couple points on the graph, this would give us some insight as to what values we should use for our viewing window. Go to the **TABLE**. Enter some values for  $x$ , say  $x = -10, 0, 10, 20, 30, 40, 50$ . Do you see a pattern? What happens between 20 and 40? So what would be reasonable viewing **WINDOW**?

- ANSWERS:**
1.  $y \approx 2.6457513$
  2. In **WINDOW**, make the **Ymin** -15. Minimum at  $(0, -13)$
  3.  $x$ -int  $(20, 0)$ ,  $y$ -int  $(0, 5)$
  4.  $(-2.302776, 5.3027756)$ ,  $(1.3027756, 1.6972244)$
  5. **Xmin** = -10, **Xmax** = 50, **Ymin** = 25, **Ymax** = 1500

## Scatter Diagrams and Regression

In several of your courses, you may be interested in entering sets of data. Your calculator is capable of performing statistical operations. It can also find the equations of 'best fit' for a particular set of data, perhaps a line or a parabola. Completing the following walkthrough will help to familiarize you with the data entering procedure.

- 1) Press **STAT**.



- 2) Select **Edit** in this menu.

| L1       | L2    | L3    | 1 |
|----------|-------|-------|---|
| ████████ | ----- | ----- |   |
| L1(1) =  |       |       |   |

If you have data already visible, say in the L1 column, move your cursor up to highlight L1 and press **CLEAR**. Do not press **DEL**, as this will delete the L1 column. If you do this, go back and read #5 on page 1!

- 3) Enter some data.

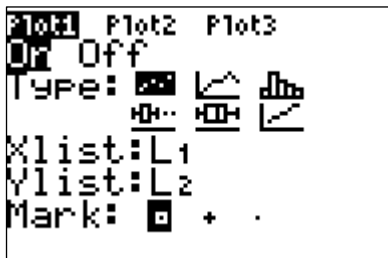
| L1      | L2       | L3    | 2 |
|---------|----------|-------|---|
| -1      | 1        | ----- |   |
| 0       | 2        |       |   |
| 2       | 3        |       |   |
| 4       | 5        |       |   |
| 5       | 7        |       |   |
| -----   | ████████ |       |   |
| L2(6) = |          |       |   |

Enter the ordered pairs (-1, 1), (0, 2), (2, 3), (4, 5), and (5, 7). Note that L1 corresponds to  $x$ -values and L2 corresponds to  $y$ -values.

- 4) Press **STAT PLOT** ( $2^{\text{nd}}$  **Y=**).

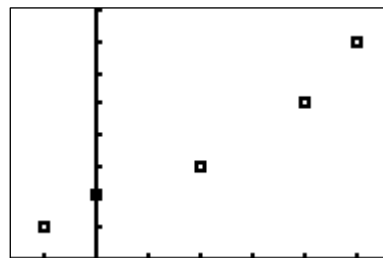


- 5) Press (1) and select **ON** in this menu.



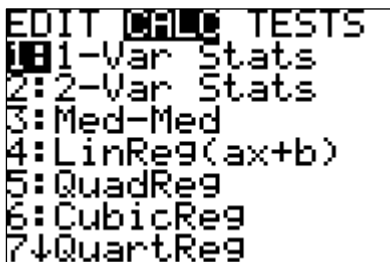
There are several features on this screen. For now, just make sure the plot is turned on and that L1 and L2 are shown for Xlist and Ylist, respectively.

- 6) Press **ZOOM** and select menu option 9.



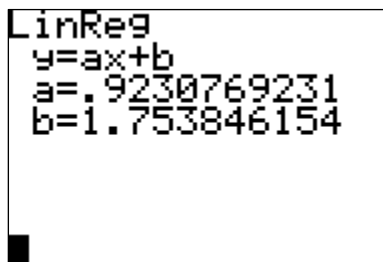
This graphs your scatter diagram in a window that shows all of your data well.

7) Let's find a line that fits this data well.



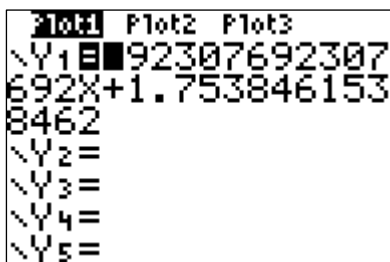
Press **STAT** and highlight the **CALC** column. When you scroll downward, you will see several choices. Number 5 does quadratic regression, finding the best fitting parabola for a set of data. We are going to use number 4.

8) Select 4 and press enter.



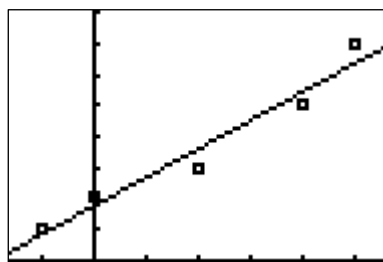
The linear equation that 'best fits' the data is given by  $y = 0.9230769231x + 1.753846154$ .

9) Enter your equation in  $Y_1$ .



There is an alternative to manually typing this equation. After selecting linear regression and before pressing enter, press **VAR**, select **Y-VARS**, select (1), select (1) again, and then enter. This will tell the calculator to automatically send the regression equation to  $Y_1$ . Note that this gives more decimal places, as shown above.

10) Graph it.



Now you can see how well the line fits the data. You can now use this line to interpolate and extrapolate.

### Now it's your turn!

1. Enter the data (0, 10.6), (10, 15.9), (20, 20.0), (30, 23.8), (40, 29.8), (50, 34.0). Note that you will need to **CLEAR** the previously entered data from the L1 and L2 columns (move the cursor up to L1 and press **CLEAR**, not **DEL**. Do the same for L2.) Find the equation of the line of 'best fit.'
2. Enter the data (1990, 1.9), (1992, 2.5), (1994, 3.7), (1996, 6.1), (1998, 9.6), (2000, 17.8), (2001, 23.3). Does it look like a line would fit this data very well? It sort of looks like half of a parabola would fit. Find the equation of the parabola of 'best fit.' Make sure you graph it with the data to verify that it does in fact fit well.

- ANSWERS:**
1.  $y = 0.4642857143x + 10.74285714$
  2.  $y = 0.247203179x^2 - 984.7896218x + 980784.6616$



## A Final Note

Most of the problems and errors you run across in the use of the graphing calculator will be easily rectified by making appropriate use of the order of operations, correct syntax, and by following the advice of error screens on the calculator itself. Your instructor or tutor will also be of great help in quickly sorting out any difficulties you are having. However, every semester someone will have something strange happen on a calculator (usually during an exam!) that we can't figure out how to fix.

There is a quick way to get your calculator back to the default settings with which it was originally shipped. Note that this will delete everything...data, programs, you name it.

Press **MEM** (**2<sup>nd</sup>** +). The following screen appears:

```
MEMORY
1:About
2:Mem Mgmt/Del...
3:Clear Entries
4:ClrAllLists
5:Archive
6:UnArchive
7↓Reset...
```

Press 7 to Reset the calculator. In the next menu select the first option **1: All RAM**: You will be asked if you are sure...select 2 to reset. Now go back through this and do the same for **2: Defaults**.

```
RAM ARCHIVE ALL
1:All RAM...
2:Defaults...
```

This should rectify any problems you are having.

One last thing....nothing in this document will replace the batteries in your calculator! Make sure you come prepared to class, especially exams. When your batteries are dying, your calculator will give a warning. Do not ignore this and try to push it to the distance.....they will die during problem number 3 on your next exam!