

# **Calculator Basics**

**TI-83, TI-83<sup>+</sup>, TI-84**

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\* From <http://www.prenhall.com/divisions/esm/app/graphing/ti83/index.html>

## Getting Started

 turns On the calculator (located in the lower left corner ).

 turns OFF the calculator (located in the upper left corner).

The Home Screen is where you enter in and carry out most calculations. Press enter after entering the numbers/symbols.

1+2	3
$\sqrt{(4)}$	2
$5^2$	25


To darken or lighten screen, use  or  arrows.

**MODE** shown in the figure below helps you to change the display.

NORMAL	SCI	ENG
FIXED	0	1 2 3 4 5 6 7 8 9
RADIAN	DEGREE	
FUNC	PAR	POL SEQ
CONNECTED	DOT	
SEQUENTIAL	SIMUL	
REAL	a+bi	re^iθ
FULL	HORIZ	G-T
SET CLOCK	01/01/01	02:13

(The TI-83 does not show the “Set Clock” option)

 or [QUIT], will take you back to the home screen.

 is the exponent key.






Example:  $x^5 = x$   5        $3^4 = 3$   4 




Difference between *minus* and *negative* keys:




For negative numbers: choose  key (to the left of )

For minus or subtraction: choose  key right above the  key

Roots:

Square root: choose        Ex.  $\sqrt{16} =$   16  

Cube root: Rise to the 1/3 power. Ex.  $\sqrt[3]{8} = 2$   ( 1  3 ) .

$n^{\text{th}}$  roots: : Rise to the 1/n power. Ex.  $\sqrt[6]{64} = 2$   ( 1  6 ) .

Absolute value : Find  $|-2|$ .   NUM  abs( 2  ) .

## Graphing

Ex. Graph  $y = 2x + 5$

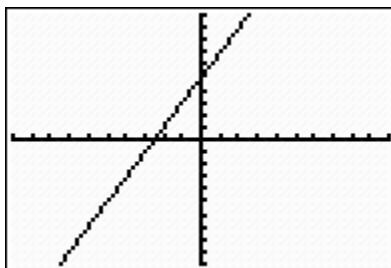
Go to  $\boxed{Y=}$  and type in the equation  $Y_1 = 2x + 5$ , and press  $\boxed{ZOOM}$   $\boxed{6}$  (ZStandard).

Press  $\boxed{\times, T, \theta, n}$  to type the variable  $x$ .

```

Plot1 Plot2 Plot3
\Y1  $\boxed{2X+5}$ 
\Y2 =
\Y3 =
\Y4 =
\Y5 =
\Y6 =
\Y7 =

```



$\boxed{WINDOW}$  tells us the portion of the coordinate system we are viewing when we look at our graph. You can change your window anytime you want to see more or less of your graph.

```

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

```

A window will be denoted by  $x: [-10, 10, 1]$  representing  $[x_{\min}, x_{\max}, x_{\text{scale}}]$ .  
The same thing we can do with  $y: [-10, 10, 1]$  representing  $[y_{\min}, y_{\max}, y_{\text{scale}}]$ .

Notes:

Press  $\boxed{(-)}$  to type a leading negative sign.

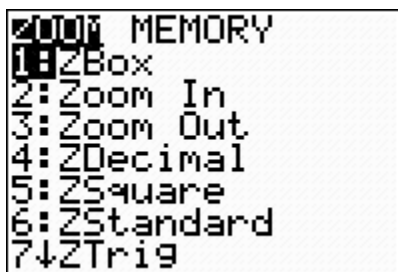
Press  $\boxed{-}$  to type a subtraction symbol.

Any character in an equation can be deleted. Highlight the character and press  $\boxed{DEL}$ .

A character can be inserted in an equation. Highlight the entry after which a character is to be inserted. Press  $\boxed{2nd}$   $\boxed{DEL}$ . The character is inserted in front of the highlighted character.

**Zoom:**

You can use ZOOM **ZOOM** if you want to change your window using preset scales.



Some common preset scales are:

**ZOOM** **6** selects ZStandard which sets the window to x: [-10, 10, 1], y: [-10, 10, 1]

**ZOOM** **4** selects ZDecimal which sets to x: [-4.7, 4.7, 1], y: [-3.1, 3.1, 1]. Each pixel represents 0.1 units. The tic marks on each axis are equally spaced.

**ZOOM** **5** selects ZSquare which adjusts Xmin and Xmax so that the tic marks on the x axis are spaced the same as those on the y axis. This makes a circle appear as a circle (round) and not as an oval.

**ZOOM** **8** selects ZInteger which sets Xscl = 10 and Yscl = 10, and centers the graph at the cursor location. If you select **ZOOM** **6** and then **ZOOM** **8** **ENTER**, it sets the window to Xmin = -47, Xmax = 47, Ymin = -31, and Ymax = 31.

**ZOOM** **9** selects ZoomStat which defines the viewing window so that all data points are shown.

**ZOOM** **0** selects ZoomFit which adjusts Ymin and Ymax include the minimum and maximum y values for the selected functions.

## Evaluating a Function

The **TRACE** key will trace along a graphed function when you use the right and left cursor keys. **TRACE** gives you preset values that will depend on the window used, so it will not evaluate a function at all its  $x$ -values

Ex. Use the **TRACE** option with the function  $y = |x| + 2$ .

To plot  $y = |x| + 2$ , go to **Y=** and type in the equation using **ZOOM** **6**. The absolute value key is found in **MATH** **)** **NUM** and type **1**.

```

MATH NUM CPX PRB
1: 1/x
2: 1/Dec
3: 3
4: 3√
5: *√
6: fMin(
7: fMax(
  
```

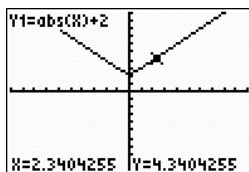
```

MATH NUM CPX PRB
1: abs(
2: round(
3: iPart(
4: fPart(
5: int(
6: min(
7: max(
  
```

```

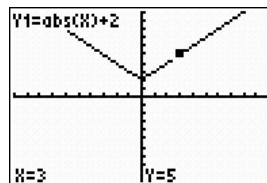
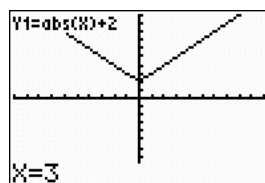
Plot1 Plot2 Plot3
Y1=abs(X)+2
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
  
```

Press **TRACE**, and use the cursor key to see some points on the graph. One of the points is shown.



To evaluate a graphed function for a specific value of  $x$ , simply type in the number (after you have pressed **TRACE**) and then press **ENTER**. You can keep entering numbers for  $x$  to obtain values for  $y$ .

Ex. Evaluate  $y = |x| + 2$  at  $x = 3$



The typed value of  $x$  must be between the  $X_{min}$  and  $X_{max}$  values entered in **WINDOW**. If you just use the **TRACE** key, you will not obtain the correct answer because  $x = 3$  is not a preset value for this window.

### Note:

You can also use the Value Option to evaluate a graphed function for a value of  $x$ .

To access the value option, by press **2nd** **TRACE** and type **1** or **ENTER**.

"x=" appears at the bottom of the screen.

Enter the desired value for  $x$ , and it will give you the  $y$  value. You can type any other value of  $x$ , and you will obtain the corresponding  $y$  value.

## Minimum and Maximum Values

These options are used to find relative the minimum and maximum of a function. To find these points, press **2nd** **TRACE**, and select **3** for minimum and **4** for maximum

```

CALCULATE
1:value
2:zero
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx
  
```

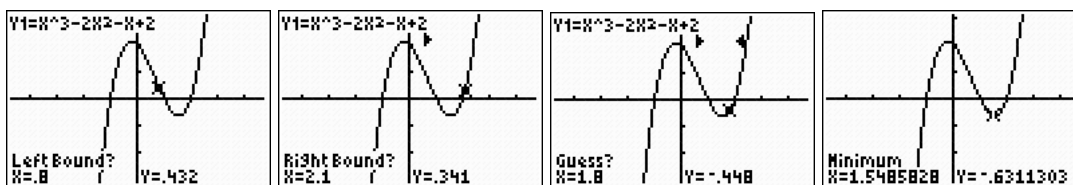
```


CALCULATE
1:value
2:zero
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx
  
```


Let's say we want to find the minimum and maximum value of the function

$$y = x^3 - 2x^2 - x - 2.$$

First we need to specify an interval containing the desired high or low point on the graph by setting the bounds of the function.




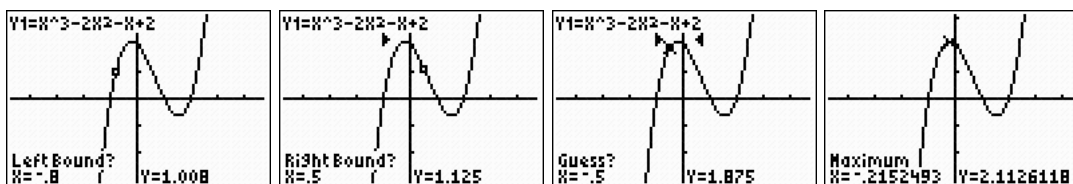
When question "Left Bound?" appears at the bottom of the screen. Use  to move the blinking cursor to the *left* of the relative minimum. Press **ENTER**. See screens above

The question "Right Bound?" appears at the bottom of the screen. Use  to move the blinking cursor to the right of the relative minimum. Press **ENTER**.

The arrows at the top of the screen indicate the boundaries between which the calculator will give the relative minimum. (The arrows must point toward each other.) The question "Guess?" appears at the bottom of the screen. Locate the cursor between the established boundaries. Press **ENTER**.

The coordinates of the minimum appear at the bottom of the screen.

To find the maximum of the function we select **4** and follow the steps above. In this case we need to use .



## Tables of Values

To create a table from a function, first, enter your equation into  $Y =$  then go to TABSET (Press **2nd** **WINDOW** to view the table set up)

```

Plot1 Plot2 Plot3
Y1 X^2-X-6
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =

```

```

TABLE SETUP
TblStart=0
ΔTbl=1
Indent: Auto Ask
Depend: Auto Ask

```

**TblStart** determines the first x value displayed in the table.

**ΔTbl** establishes the increment between successive x values.

**Indent Auto** displays a table with an automatically generated list of x values based on the established TblStart and ΔTbl.

**Depend Auto** displays a table with an automatically generated list of corresponding y values defined for equations defined in  $Y =$  . To see your table, press **2nd** **GRAPH**

X	Y1
0	-6
1	-6
2	-4
3	0
4	6
5	14
6	24

X=0

If you set your table to **Indent Ask**, you can enter any x value and get the corresponding y value.

(Note: *Indent* represents the x values, and *Depend* represents the y values.)

```

TABLE SETUP
TblStart=0
ΔTbl=1
Indent: Auto Ask
Depend: Auto Ask

```

X	Y1
-20	414
0	-6
30	50

X=30

## Graphing Scatter Plots

The process of graphing scatter plots consists of A) Entering Data, and B) graphing the scatter plot

### A) Entering Data

1. Press **STAT** to access the statistics mode.
2. Choose EDIT by pressing **1** or **ENTER**
3. Clear any previous data in columns L1, L2.

Use **↑** to select L1. Press **CLEAR** **ENTER**. Repeat for L2.

You can also use the clrlist option to clear lists. To do so, press **STAT** **4** .  
Next, specify which of the lists, L1 - L6, should be cleared.

```

2nd 2nd CALC TESTS
1:Edit...
2:SortA<
3:SortD<
4:ClrList
5:SetUpEditor
  
```

```

ClrList L1,L2
Done
  
```

L1	L2	L3	Z
1	1	---	
1	1	---	
---	---	---	
L2(5) =			

4. Enter x-coordinates of data points in L1 column; enter y-coordinates in L2.

### B) Graphing the scatter plot

1. To draw an scatter plot, press **2nd** **Y =** **1**, and set Plot1 menu as follows:

```

2nd 2nd Plot2 Plot3
Off Off
Type: [ ] [ ] [ ]
Xlist:L1
Ylist:L2
Mark: [ ] + .
  
```

This will turn ON the scatter plot Plot1.

2. Press **ZOOM** **9** to see scatter plot. You will have to adjust the window to see all your data.

3. To see your table of points, press **2nd** **GRAPH**.

**Important:** When you finish plotting scatter plots, you must turn OFF your scatter plot (see part B). Otherwise, you will not be able to see many of the graphs you write in the **Y =** screen.



## Intersections

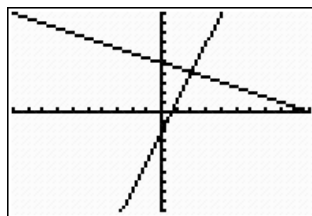
The Intersect option is used to determine a point of intersection of two graphs.


First enter one equation in  $Y_1$ , and the other in  $Y_2$ . Then press **GRAPH**. You can also press **ZOOM** **6** to graph in the standard window.

```

Plot1 Plot2 Plot3
Y1=3X-2
Y2=-(1/2)X+5
Y3=
Y4=
Y5=
Y6=
Y7=

```



Press **2nd** **TRACE**, and Press **5**. (The intersect option can also be obtained by using the  to select option 5 and pressing **ENTER**.)

```

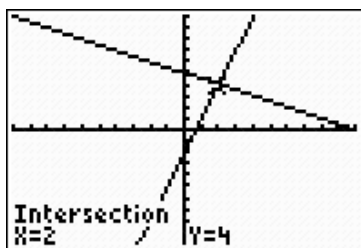
CALCULATE
1:value
2:zero
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx

```

The cursor appears on the first graph indicated by the equation in the upper left-hand corner of the screen. The question "First curve?" appears at the bottom of the screen. Press **ENTER** to select the curve. Remember that a line is considered a curve.

Then, the question "Second curve?" appears at the bottom of the screen, and the cursor jumps to the other curve (or line). Press **ENTER** to select the curve.


The question "Guess?" appears at the bottom of the screen. Move the blinking cursor close to the desired point of intersection and press **ENTER**. The coordinates of the point of intersection appear at the bottom of the screen. Here, the point of intersection is (2, 4).



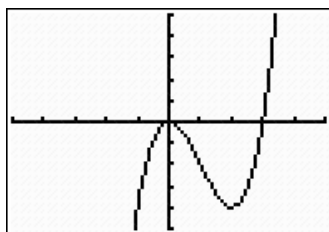
## Zeros (Roots)

The Zero option is used to determine the x-intercepts of a graph.



Enter your equation in  $Y_1$ , and press **GRAPH** in any appropriate window.

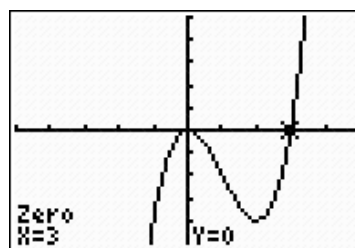
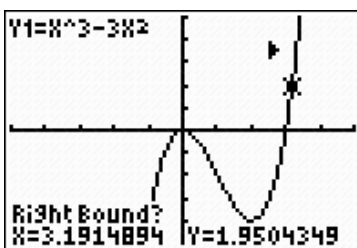
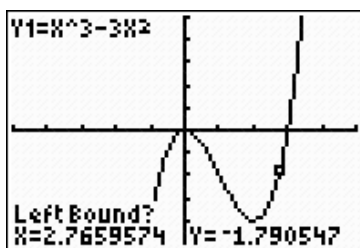
Press **2nd** **TRACE**, and Press **2** to obtain the Zero option (The zero option can also be obtained by using the  to select option 2 and pressing **ENTER**.)

```
Plot1 Plot2 Plot3
\Y1=X^3-3X^2
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```



```
2nd F1 F2 F3 F4 F5 F6 F7
1:value
2:zero
3:minimum
4:maximum
5:intersect
6:dy/dx
7:∫f(x)dx
```

Since a function may have more than one x intercept, specify an interval containing the desired x intercept. Let's say that we want to find the x-intercept to the right. When the question "Left Bound?" appears at the bottom of the screen, after you press **ENTER**, use the  to move the blinking cursor to the *left* of the x intercept, and press **ENTER**. See first graph below. When the question "Right Bound?" appears at the bottom of the screen, use the  to move the blinking cursor to the *right* of the x intercept, and press **ENTER**. See the second graph below.



The arrows at the top of the screen indicate the boundaries between which the calculator will give the zero. (The arrows must point toward each other and the x intercept must lie between them.) When the question "Guess?" appears at the bottom of the screen, locate the cursor between the established boundaries, and press **ENTER**. The x-intercept will show. See the last graph above. To find the other zero, repeat the steps.

## Graphing Scatter Plots and Regression Equations

The process of finding the regression equation consists of A) Entering Data, B) Finding the regression equation, C) graphing the scatter plot, and D) Plotting the regression equation.

### A) Entering Data

1. Press **STAT** to access the statistics mode.
2. Choose EDIT by pressing **1** or **ENTER**.
3. Clear any previous data in columns L1, L2.

Use **↑** to select L1. Press **CLEAR** **ENTER**. Repeat for L2.

You can also use the clrstest option to clear lists. To do so, press **STAT** **4** . Next, specify which of the lists, L1 - L6, should be cleared.

```

300) CALC TESTS
1:Edit
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
  
```

```

ClrList L1,L2
Done
  
```

4. Enter x-coordinates of data points in L1 column; enter y-coordinates in L2.

### B) Finding the regression equation

To find the regression equation, press **STAT** **→** **CALC** and then type of you want (linear **4**, Quadratic **5**, cubic **6**, exponential **0**, power **▲** etc.) and **ENTER**.

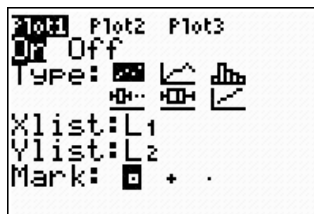
If you do not see  $r$  and  $r^2$  in the linear regression, do the following:

Press **2nd** **0** [CATALOG] and scroll down to Diagnostic On, and press **ENTER**. You will see the word 'Done' in your screen. Now you repeat step B, and you should see  $r$  and  $r^2$ .

continue

### C) Graphing the scatter plot

2. To draw an scatter plot, press **2nd** **Y =** **1**, and set Plot1 menu as follows:



This will turn ON the scatter plot Plot1.

2. Press **ZOOM** **9** to see scatter plot. You will have to adjust the window to see all your data.

3. To see your table of points, press **2nd** **GRAPH**.

### D) Plotting the regression equation

To plot data, press **Y =** and clear any previous equations. The equation can be transferred to **Y =** without typing the equation as follows. Press **Y =** **VAR** **5** and use **→** to select EQ You will see the scatter plot and the graph.

#### **Important:**

When you finish plotting scatter plots, you must turn OFF your scatter plot (see part C).

Otherwise, you will not be able to see many of the graphs you write in the **Y =** screen.

## Solving Systems of Equations by using Matrices

**Example:** Use a matrix to solve the following system of equations.

$$\begin{cases} 3x - 4y + 2z = 18 \\ x + 5y - 3z = -15 \\ 5x + 2y + 3z = 20 \end{cases}$$

Go to MATRIX ( <b>2nd</b> <b>X<sup>-1</sup></b> ) and then EDIT.	
Define [A] to be a 3X4 matrix. Use the cursor and the ENTER key to move through the spaces.	
Now enter the coefficients and constants from the system by entering the value and pressing ENTER.	
Return to the home screen ( <b>2nd</b> <b>MODE</b> ) and access the MATRIX MATH menu and scroll down to item B.	
Hit ENTER to return to the home screen.	
Enter matrix [A] by pressing <b>2nd</b> <b>X<sup>-1</sup></b> 1 and close the parentheses.	
Press ENTER and read the solution as x=2, y=-1, z=4.	

## Determinants of Matrices

**Example:** Find the determinant  $\begin{vmatrix} 7 & 2 & 3 \\ 3 & 4 & 5 \\ 5 & 6 & 7 \end{vmatrix}$ .

Go to MATRIX ( <b>2nd</b> <b>X<sup>-1</sup></b> ) and then EDIT.	
Define [A] to be a 3X3 matrix. Use the cursor and the ENTER key to move through the spaces.	
Now enter the coefficients and constants from the system by entering the value and pressing ENTER.	
Return to the home screen ( <b>2nd</b> <b>MODE</b> ) and access the MATRIX MATH menu and select 1: det(	
Hit ENTER to return to the home screen.	
Enter matrix [A] by pressing <b>2nd</b> <b>X<sup>-1</sup></b> 1 and close the parentheses.	
Press ENTER and read the solution -12	

