

# CALCULATOR WORKSHOP BASICS

## TI-83, TI-83 Plus, TI-84 Plus

### INTRODUCTION:

The keyboard on the TI Calculator is organized in a certain pattern. We will explore some of the keys and their uses. Be very careful in the following examples! Press the keys in the *exact* order shown. Do NOT press any other keys or these exercises will not make sense. If you make a mistake and want to start over just press the CLEAR key to get a clean start. NOTE: The TI-83 and TI-84 are very similar calculators. Some of the colors of keys will differ.

### SCREEN DARKNESS/LIGHTNESS:

You may darken your screen by pressing the 2nd key followed by the "up" arrow ( $\Delta$ ) key. Or you may lighten your screen by pressing the 2nd key followed by the "down" arrow ( $\nabla$ ) key.

**USING THE 2ND KEY:** The 2ND key is blue or yellow. When you press it, it will allow you to access any of the blue or yellow commands written above each key.

**Example 1:** To get  $\sqrt{9}$  press:

**2ND**  **$x^2$**  **9** **ENTER**

You should get 3. Notice, there is no key with an = sign on it. Use the ENTER key for "equals." It takes two keys, 2ND and  $x^2$ , to get the  $\sqrt{\quad}$  symbol as indicated by the little blue or yellow  $\sqrt{\quad}$  above the  $x^2$ .

### EDITING:

Find the DEL key with INS written above. This key is used to delete or insert a symbol if you have put an incorrect symbol into the calculation or left something out.

Now look at the four arrow keys  
These are used to move the cursor around.



**Example 2:** (Replacing) Let's use the DEL and arrow keys to do some editing. First, press CLEAR to get a clear home screen. Assume we want to type in  $-2 + 3(5 - 2) + 9$ . To practice editing let's say you typed it in *wrong*. So now press these keys:

**(-)** **2** **+** **3** **(** **4** **-** **2** **)** **+** **9**

Note that the key with (-) is used to make a number negative. The key with a plain  $-$  on it is the subtraction key. Notice that we put in a 4 when we should have put in a 5. Use the left arrow ( $\leftarrow$ ) key to move the cursor so that it is on the 4. Press the following keys to get an answer of 16.

**5** **ENTER**

### HELPFUL HINT:

Notice the keys with the words MODE, STAT, PRGM, MATH, and VARS. Each has a menu of items that appear when you press these buttons. Go ahead and press one of them. When you are done and want to go back to the home screen, just press the CLEAR key. The keystrokes 2ND followed by QUIT will also get you back to the home screen.

### CALCULATING:

Your calculator can meet all your calculating needs! The trick is to know which keys to press to tell it what to do. Remember your calculator knows the following **Order of Operations**:

(1st) Take roots and raise to powers, (2nd) Do multiplication and division, and (3rd) Add and subtract, *in order* from left to right in each case. If you want the calculator to break this order of operations you *must* use the parentheses. Students make mistakes by using too few parentheses; they rarely make a mistake by using too many. Therefore, **WHEN IN DOUBT, USE PARENTHESES!**

**Example 6:** (Fractions) Calculate  $\frac{11-3}{4}$ .

Since the fraction bar implies that the numerator is grouped and the denominator is grouped. You must include parentheses for the numerator. Because there is only one number in the denominator, no parentheses are needed this time. Without parenthesis in the numerator, the calculator will not subtract the top first and then divide. It would *divide* the 3 by four and *then subtract* that answer from the 11. So you must press the following keys to get an answer of 2.

( ) 1 1 - 3 ) ÷ 4 ENTER

**Example 7:** (Fractions) Calculate  $\frac{3+5\pi}{4-6}$ .

The numerator and the denominator both contain more than one number, so both need parentheses. Look to find the  $\pi$  above the key with a ^ on it. The  $\pi$  key requires you to use the 2ND key. Press the following keys to get -9.353981634. This is an approximation, of course, because pi is an irrational number.

( ) 3 + 5 2ND ^ ) ÷ ( ) 4 - 6 )

**Example 8:** (Powers) Find  $3^4$ .

The key that tells the calculator to raise to a power is the key with ^ on it. Press the following keys to get an answer of 81. You can use this method for all exponents, even to find squares of numbers.

3 ^ 4 ENTER

**Example 9:** (Squares) Calculate  $7.3^2$  using the  $x^2$  button and then using the ^ key. Press the following keys to get an answer of 53.29.

7 . 3  $x^2$  ENTER

OR

7 . 3 2ND ^ 2 ENTER

**Example 10:** (Roots) Find  $\sqrt[3]{7}$ .

Your calculator knows that a *square root* is the same as an exponent of  $\frac{1}{2}$ ; a *cube root* is the same as an exponent of  $\frac{1}{3}$ , a *fourth root* is the same as an exponent of  $\frac{1}{4}$ , and so forth. It is necessary to put parentheses around the fraction in the exponent position. We will use the fact that  $\sqrt[3]{7} = 7^{\frac{1}{3}}$ . Press the following keys to get an answer of 1.912931183.

**7** **^** **(** **1** **÷** **3** **)** **ENTER**

**Example 11:** (Square Roots) Find  $\sqrt{4^2 - 2(5)}$ .

It is important to note that the  $\sqrt{\quad}$  is a symbol of inclusion that will require parenthesis so that the calculator knows how much you are placing under the square root symbol. Thus if there is an expression inside the  $\sqrt{\quad}$  you *must* put **parentheses** around it. On most calculators, you will automatically get the left parenthesis, (, when you press the  $\sqrt{\quad}$ . Press the following keys to get answer of 2.449489743.

**2ND** **x<sup>2</sup>** **4** **x<sup>2</sup>** **-** **2** **\*** **5** **)** **ENTER**

**ANS KEY:**

Every time you perform a calculation, you press the ENTER key. Your calculator automatically stores each answer to a calculation as ANS. As soon as you do another calculation the previous answer is replaced. This is a powerful capability which will save you many hours of keystrokes!

**Example 14:** (Using ANS) Let's say that you want to first calculate  $\sqrt[3]{2+3(6)}$  and then you wish to find  $\frac{2}{\sqrt[3]{2+3(6)}}$ . First press the following buttons to calculate the denominator. When you press ENTER, the answer 2.714417617 will be stored at the ANS key.

**(** **2** **+** **3** **×** **6** **)** **^** **(** **1** **÷** **3**

To find  $\frac{2}{\sqrt[3]{2+3(6)}}$ , we will use the ANS key instead of retyping the whole denominator again.

**2** **÷** **2nd** **(-)** **ENTER**

The final result is 0.7368062997.

**PRACTICE PROBLEMS**

- |                            |                               |   |
|----------------------------|-------------------------------|---|
| (1) $2 - 6(3 + 2.3)$       | (2) $\frac{3}{7}(3.2 - 1.02)$ | (3) $\frac{3 + 2\pi}{6 - 2(-0.2)}$          |
| (4) $\sqrt{4 + 3(12 - 5)}$ | (5) $\frac{4}{3}\pi 5^3$      | (6) $\frac{7 + \sqrt{7^2 - 4(2)(3)}}{2(2)}$ |

## ANSWERS TO PRACTICE PROBLEMS

- (1) -29.8                      (2) 0.9342857143                      (3) 1.450497704  
(4) 5                              (5) 523.5987756                      (6) 3

## CALCULATOR WORKSHOP GRAPHING TI-83, TI-83 Plus, TI-84 Plus

The top row of keys deals with the graphing capability of your calculator:

**Y=**    **WINDOW**    **ZOOM**    **TRACE**    **GRAPH**

### WINDOW:

If you press the WINDOW key, you will be able to change the following viewing window settings used for a graph.

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

Xmin is the smallest  $x$ -coordinate possible in the window.

Xmax is the largest  $x$ -coordinate possible in the window.

Xscl is the scale used for the tic marks on the  $x$ -axis.

Ymin is the smallest  $y$ -coordinate possible in the window.

Ymax is the largest  $y$ -coordinate possible in the window.

Yscl is the scale used for the tic marks on the  $y$ -axis.

Xres sets the resolution for your screen, ignore it.

To change the values of the viewing window just use the arrow keys to move the cursor over the value(s) under you want to change and key in the values you want to use. To return to the home screen press the following keys.

**2nd**    **MODE**

### GRAPHING:

In order to graph a function it must be solved for  $y$ , that is, it must be in the form  $y =$  an expression. To see the graphing input screen press the following key.

**Y=**

On the screen you should see the following. You may have expressions already entered after some of the  $y =$ . If so, move your cursor to each line and press the CLEAR key.

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

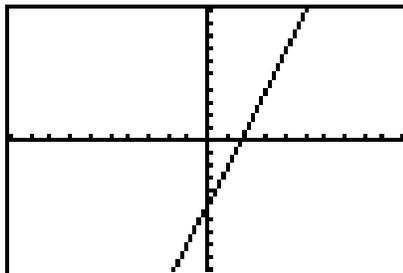
**Example 1:** Graph  $y = 3x - 5$ .

To graph  $y = 3x - 5$  press the following keys: **Y=** **3** **X,T,θ,n** **-** **5** **GRAPH**

Be sure your WINDOW is set at the following standard settings.

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

Your graph should look like the following:



Now press **TRACE**. Notice that  $x = 0$  and  $y = -5$  are at the bottom of the screen. The cursor is positioned at the point  $(0, -5)$  on the graph. Now use the right arrow key to move the cursor along the graph to the right. Each time you press the arrow key the  $x$  and  $y$  values at the bottom of the screen change. In each case the calculator is telling you the coordinates of the point on the graph where the cursor is located.

To leave the graphing window press **2nd** **MODE**

To erase the graph and return to the home screen press **Y=** **CLEAR** **2nd** **MODE**

**Example 2** Graph  $y = x^2 + 12$  by pressing the following keys:

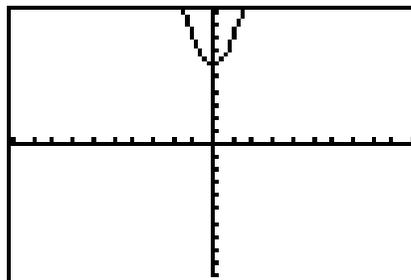
**Y=** **X,T,θ,n** **x<sup>2</sup>** **+** **1** **2** **GRAPH**

**Notice your screen is blank!!** This has happened because your viewing window is too small to see any part of the graph of this function. We need to change the viewing window so that it will include more of the coordinate plane.

Press **WINDOW** and reset your viewing window to the following:

```
WINDOW
Xmin=-20
Xmax=20
Xscl=1
Ymin=-20
Ymax=20
Yscl=1
Xres=1
```

Your graph should look like:



You can see that the graph lies at the top center of the screen. If you want to, you can change the window again to eliminate the part that seems unnecessary. Try the following settings: -10, 10, 1, -10, 20, 2. Take some time to change the WINDOW in some different ways so that you can see how this changes your ability to see the graph. To return your WINDOW to the standard setting of -10, 10, 1, -10, 10, 1 press **ZOOM** **6**.

**USING THE TABLE FEATURE:**

You should still have  $y = x^2 + 12$  in your  $Y_1 =$  . Press **2ND** **WINDOW** to access the table features. On your screen you should see:

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

Your settings may be different. If any are different, move your cursor over each setting and change it to show what is given here. To highlight AUTO, position your cursor and press the ENTER key.

Now press **2nd** **GRAPH** to see the following table of values.

X	Y <sub>1</sub>
0	12
1	13
2	16
3	21
4	28
5	37
6	48

X=0

You may use your cursor keys to move up and down in the table and make it scroll to display more values. The calculator is calculating values for the equation you have entered in  $Y_1$ ,  $y = x^2 + 12$ .

**Example 3: (TABLE ASK Feature)**

Press **Y=** **CLEAR** to clear out your old equation. Next enter the equation  $y = \frac{9}{5}x + 32$  into  $Y_1$  by pressing the following keys:

**(** **9** **÷** **5** **)** **X,T,θ,n** **+** **32**

Then press **2nd** **WINDOW** and change your table settings to:

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

And then press **2nd** **GRAPH** to go back to look at the table. Since the independent variable setting is set to ASK, rather than AUTO, the calculator is waiting for you to enter the x values you want, rather than automatically filling in the table for you. The equation you

are using,  $y = \frac{9}{5}x + 32$ , converts temperatures in degrees Celsius to temperatures in degrees

Fahrenheit. Tell the calculator to calculate the  $y$ -value when  $x$  is 0 by pressing 0 and ENTER. You will see the  $y$ -value of 32 show up in the display. Enter 25 and 100 next to get their corresponding  $y$ -values.

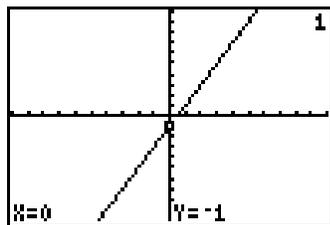
Your table should look like the following:

The values in the  $X$ -column are temperatures in degrees Celsius and the values in the  $Y_1$ -column are the corresponding temperatures in degrees Fahrenheit;  $25^\circ\text{C}$  is  $77^\circ\text{F}$ .

### **FINDING THE X-INTERCEPTS OF A GRAPH:**

The  $x$ -intercept(s) of a graph are the point(s) where the graph crosses the  $x$ -axis. This (these) point(s) give the value of  $x$  where  $y$  is equal to zero and is (are) also known as the *root* or *zero* of an equation. Graph  $y = 2x - 1$ . Set the WINDOW to standard settings, ZOOM, 6.

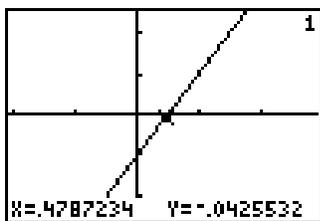
Now press **TRACE**.



Note that a blinking box appears near the  $y$ -axis, and at the bottom of the screen you should see  $X = 0$   $Y = -1$ . You can move the cursor by using the left and right arrow keys. Remember that  $y$  is equal to zero on the  $x$ -axis. So use the right arrow to move the cursor as close as possible to the  $x$ -axis. Watch the  $Y$  number at the bottom of the screen. When it jumps from a negative number to a positive number you have jumped across the  $x$ -axis.

Let's assume that we want to find this  $x$ -intercept correct to two decimal places. Move the cursor so it is at a position where the  $y$ -value is as close to zero as possible and press

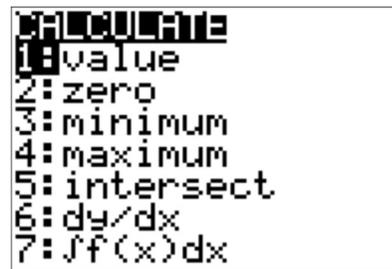
**ZOOM** **2** **ENTER** to zoom in closer.



Your screen should change so that it is now displaying a smaller part of the graph, but with much more detail. Press **TRACE** again, and position your cursor so that the displayed value of  $y$  is as close to zero as possible, and press **ZOOM** **2** **ENTER** again. You should now see even more detail in your graph.

You must ZOOM and TRACE as many times as it takes so that the  $x$ -coordinates on the screen stay constant to **three** decimal places as you move the cursor back and forth over the  $x$ -axis. The  $y$ -coordinate will change from positive to negative or visa versa as you trace across the  $x$ -axis. When the third decimal place on the  $x$ -coordinate remains the same above and below the  $x$ -axis you have the desired accuracy. Round to the second decimal place. You should get the  $x$ -intercept to be 0.50.

**Optional:** Another approach to finding the  $x$ -intercept of a graph uses the CALC menu. Enter the equation  $y = 5x + 7$  in  $Y_1$  and set the window to standard settings ZOOM, 6. Then press  $\boxed{2ND}$   $\boxed{TRACE}$ . This opens up a new menu of options as shown to the right, the second option listed is zero, so press  $\boxed{2}$ .



The screen will jump back to the graph and at the bottom of the screen you should see displayed: **Left Bound?** and a set of  $x$  and  $y$  coordinates. (See the graphs at the bottom of this page.) Looking at the graph, we can see that the  $x$ -intercept is between  $x = -2$  and  $x = -1$ . The calculator wants you to enter a value of  $x$  that is *left of* the actual  $x$ -intercept. So position your cursor until the  $x$  value displayed is to the left of the actual  $x$ -intercept and press  $\boxed{ENTER}$ . The calculator then asks for: **RightBound?** Again, use your right cursor key to move the displayed  $x$  value is *right of* the actual  $x$ -intercept and press  $\boxed{ENTER}$  a second time. Last, the calculator asks for: **Guess?** Move your cursor close to the actual  $x$ -intercept and press  $\boxed{ENTER}$  for a third and final time. The calculator should display: Zero X=-1.4 Y=0. This means for the equation  $y = 5x + 7$ ,  $y = 0$  when  $x = -1.4$ .

