Graphing Calculator

Using the TI-84 Plus in the Science Classroom (OS 2.55MP)

MATERIALS

calculator, graphing

T he graphing calculator is an extremely valuable and powerful tool in both math and science classes. You will be using it in many of your classes during your educational experience. This unit is intended to be a quick reference for many of the calculator skills you will be using in science lessons. Your teacher will walk you through the basic maneuvers and skills you are expected to know.

PURPOSE

In this activity, you will practice using the graphing calculator to analyze data.

Figure 1. Common TI graphing calculators
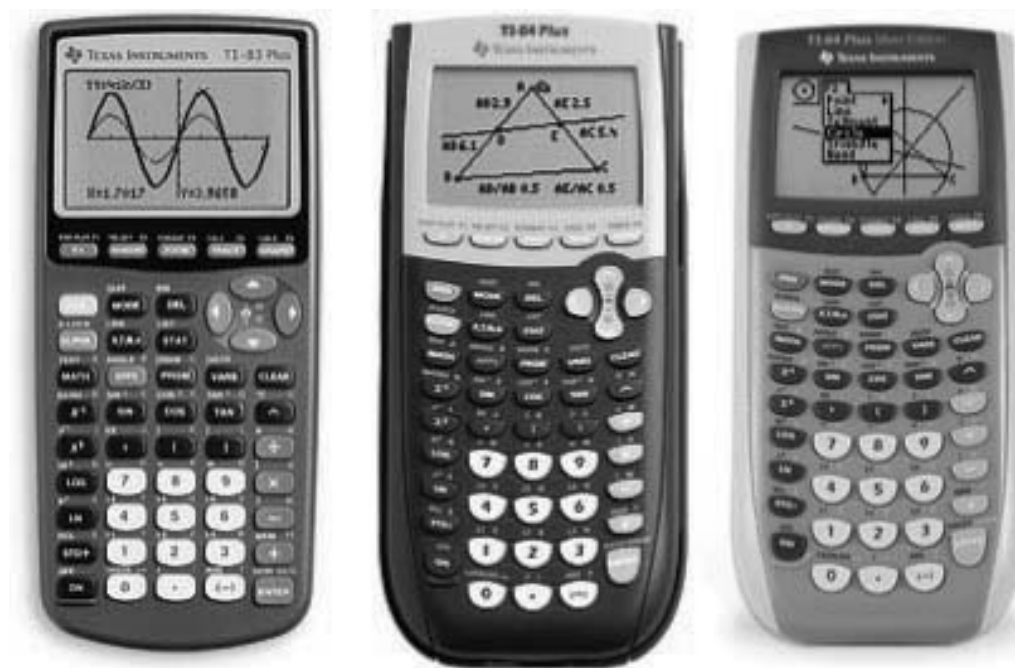
Your teacher will take you through the basic functions found on your graphing calculator. You should follow along and perform each of the steps on your own calculator. When you get home, go through the steps again on your own, using this guide.

Table 1. Layout and Important Keys	
Keys	**Function**
ENTER	Used to enter data and execute functions
2nd	Accesses the function above each of the keys (TI-83 Plus = yellow, TI-84 Plus = blue)
ALPHA	Accesses the green letters above the keys and allows for typing text
◄ ▲ ▼ ►	Operates like a mouse or computer arrows
APPS	Stores applications that drive data collection devices or other study aids
Y= WINDOW ZOOM TRACE	Graphing keys located across top that allow for graphing; also serve as function keys for some applications

ADJUSTING THE BRIGHTNESS OF THE SCREEN

Turn your calculator on. Use 2nd ▲ or 2nd ▼ to increase or decrease the darkness of the display on the screen. A number at the top right indicates your battery setting. If you are using rechargeable batteries, recharge the batteries when the setting level is at 6 or below. You will get a warning if your batteries are running low.

SETTING THE MODE

Select MODE to access the settings menu, as shown in Figure 2. Use the arrows ◄ ▲ ▼ ► to move around on the screen. We will move through each line of this menu to see which of these functions you will most likely use. Because many of the programs that drive the probes set the decimal at two or three decimal places, it is often necessary to reset this function back to FLOAT.


Figure 2. Settings menu

USING THE CATALOG

The CATALOG lists all of the calculator's functions. You can access the CATALOG by pressing 2nd 0 . We will use the CATALOG to turn on statistical diagnostics. When you turn on diagnostics, the calculator will be able to determine a correlation of regression each time you attempt a line of best fit or curve fit. The closer the value of the r-value is to ±1.000, the better the data fit for the function being analyzed.

You will notice when you open the CATALOG it is locked into ALPHA mode, as indicated by the icon in the upper right corner of the screen. You can go to any letter in the alphabet by pressing the key that corresponds to that letter. Press "D," which is above the x^{-1} button. Arrow down to "DiagnosticOn" and select it by pressing ENTER. Execute it by pressing ENTER again. The word "Done" will now be displayed on the screen.

Figure 3. Turn on statistical diagnostics
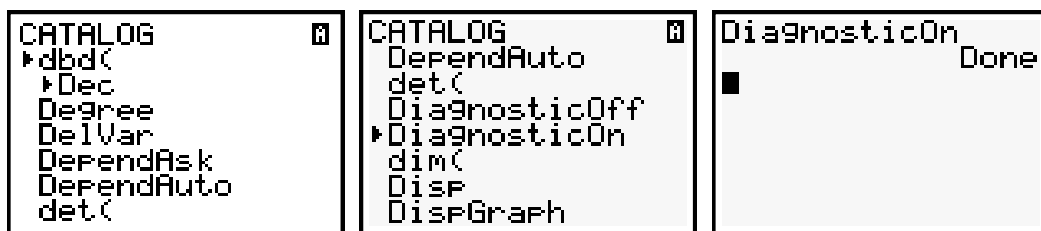
- Tip #1: If you are selecting a function from a menu of functions, pressing ENTER once selects the function. Pressing ENTER a second time executes the function.
- Tip #2: If you are having difficulty in navigation, read the entire screen.

Table 2. Frequently Used Operations	
Operation	**Function**
1:About	Tells you about your operating system. Because these calculators have a flash memory, it is possible to constantly update your operating system as new advances are released.
	To do this, you will need a TI-Graph Link™ cable and a software program called TI Connect™. You can download this program free from the TI website.
2:Mem Mgmt/Del	Allows you to delete programs or applications you may not be using
4:ClrAllLists	The easiest way to remove data from multiple lists
7:Reset	Reset all of your memory or your defaults

NUMBERS IN SCIENTIFIC NOTATION

The EE function is useful for scientific notation. This is activated by pressing
2nd , , with the , key located above the "7" button. It is very important that you
not use the × 10 ^ method of putting numbers into scientific notation. Operations
that are commutative will work regardless of how the number is entered, but
noncommutative operations will not be calculated properly.

Note how incorrectly entering a number in scientific notation affects the value of
the answer. The calculator interprets "2.5E−2" as a single number and divides the
numerator by that number. In the second (and incorrect) attempt, the calculator
interprets 2.5 as one factor and 10^{-2} as another factor, so the numerator is divided
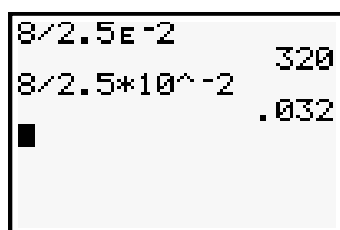by 2.5 and then multiplied by 10^{-2}.

Figure 4. Scientific notation

MANAGING MEMORY IN THE TI-83 PLUS AND TI-84 PLUS

Enter 2nd ▲ to display the menu screen shown in Figure 5. This menu allows you
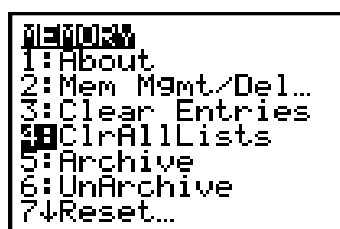to perform several important operations.

Figure 5. Memory menu

LINKING CALCULATORS AND TRANSFERRING PROGRAMS

To transfer a program, firmly press the link cord into both calculators. Press ⟦2nd⟧ ⟦X,T,Θ,*n*⟧ for the calculator receiving the information. Arrow right to RECEIVE and press ⟦ENTER⟧. The screen should look like the one shown in Figure 6.

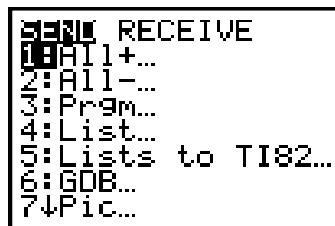*Figure 6. Set to receive data*
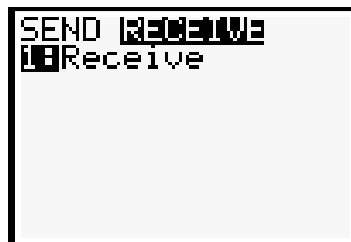
Press ⟦ENTER⟧. The receiving calculator should now display WAITING.

Now set up the transmitting calculator by pressing ⟦2nd⟧ ⟦X,T,Θ,*n*⟧. This window displays the various information or items available for transfer, as shown in Figure 7.

Figure 7. Transfer programs

Use the down arrow to select the desired information or item to be transferred, and press ⟦ENTER⟧ (or press the number that corresponds to the desired item). A new window appears displaying more specific items. Use the down arrow again to select the item to be transferred and press ⟦ENTER⟧. A square mark will appear next to the name, indicating it has been selected for transfer. Additional items may be selected using this same method.

When you have finished selecting your items, arrow right to TRANSMIT and press ⟦ENTER⟧. If a selected item is already present on the receiving calculator, a dialog box will appear allowing the user to overwrite that particular item.

ENTERING NUMBERS IN A LIST

Numbers to be analyzed or graphed are stored in the calculator's lists. The lists are handled by the statistical function. Press the ⬚STAT⬚ key and the screen shown in Figure 8 will appear.
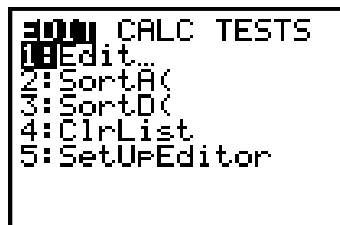

Figure 8. Enter a list of numbers

The operations you can perform from this menu are:

1. Edit – Enter or change numbers in the list
2. SortA(– Sort the numbers from smallest to largest
3. SortD(– Sort the numbers from largest to smallest
4. ClrList – Allows you to clear a specific list; however, you must enter an argument specifying which list(s) to clear. If you want to clear multiple lists, separate them by commas.
5. SetUpEditor – Reestablish lists that have been deleted or altered

MANAGING LISTS

From the STAT edit screen, press ENTER. You have multiple lists and may enter up to 999 data points in each list. You may also create additional lists; however, that is rarely needed for ordinary classroom work.

CLEARING LISTS

There are three major ways to clear lists:

1. Use the arrow key to move to the top of the list until the list title is highlighted by the cursor, as shown in Figure 9. Press CLEAR, then press ENTER. That specific list will be cleared.

Figure 9. Clear lists by name

2. Go to 2nd + to access the calculator's memory. Go to "4:ClrAllLists" and press ENTER ENTER, as shown in Figure 10.

Figure 10. Clear lists by memory

3. Go to STAT. Arrow down to "4:ClrList" and press ENTER. This method will only clear the list(s) that you tell it to clear. If you want to clear multiple lists, separate them by commas. For example, you can clear List 1 and List 2 by pressing 2nd 1 , 2nd 2, as shown in Figure 11. (Note: Parentheses are not required for this operation.)

Figure 11. Clear multiple lists

ENTERING DATA

The following sample data involves a simple density problem. Students in a Physical Science class poured a liquid into a graduated cylinder and measured the mass of several pre-determined volumes, as shown in Table 3. Enter the volume in L1, and enter the mass in L2.

Table 3. Sample Data	
Volume (mL)	Mass (g)
2	52.4
5	56.0
8	59.6
15	68.0
20	74.0

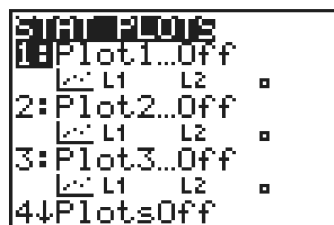## CLEARING Y= FUNCTIONS

Make sure that all equations from any previous user are removed from Y=. To do this press Y=, then position your cursor just to the right of the equals sign, and press CLEAR.

SETTING UP STAT PLOTS

Go to ⌑2nd⌑ ⌑Y=⌑ to get to STAT PLOTS, as shown in Figure 12.

Figure 12. Set up stat plots

Press ⌑ENTER⌑ to get to Plot1, and press ⌑ENTER⌑ to turn on Plot1. Use the down arrow to move down one row. Select the first choice, a scatter plot, and press ⌑ENTER⌑. Be sure that the "Xlist" is L1 and the "Ylist" is L2. Arrow down to the last row and choose a point style ("Mark"), as shown in Figure 13.
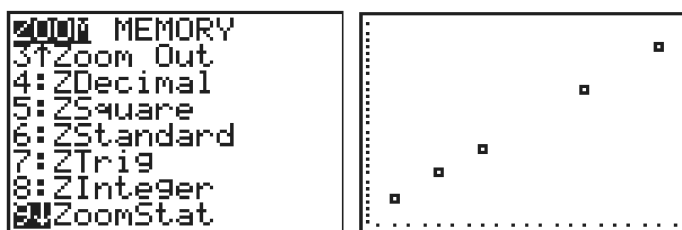
Figure 13. Options for stat plot
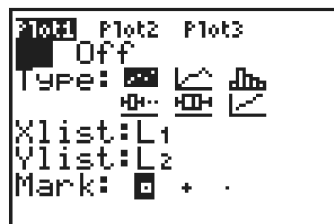
GRAPHING STATISTICAL DATA

Statistical data are most easily graphed by using the "ZoomStat" function. Press ⌑ZOOM⌑ and arrow down to "9:ZoomStat" (or simply press ⌑ZOOM⌑ ⌑9⌑). Your graph should now be shown on the screen, as in Figure 14.

Figure 14. Graph statistical data

- Tip #3: If you think you should be seeing a graph but you are not, try using ⌑ZOOM⌑ ⌑9⌑ to reset your window to the range that includes your data.

LINEAR REGRESSION

If the data in your graph looks as though it might be linear, you should run a linear regression to find out the function. A linear regression is simply a mathematical "line of best fit." To perform a linear regression on your data, press STAT and right arrow over to CALC. Arrow down to "4:LinReg(ax+b)". You should see the screen shown in Figure 15.

```
EDIT CALC TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
```

Figure 15. Select linear regression

Press ENTER to get to the screen shown on the left in Figure 16. Be sure the "Xlist" should be L1 and the "Ylist" should be L2. Arrow down to "Calculate" and press ENTER to see the second screen.

```
LinReg(ax+b)
Xlist:L₁
Ylist:L₂
FreqList:
Store RegEQ:
Calculate
```

```
LinReg
y=ax+b
a=1.2
b=50
r²=1
r=1
```

Figure 16. Linear regression options

This will give a linear equation in the form of $y = ax + b$. In this case, the complete function is exactly equal to $y = 1.2x + 50$.

The correlation coefficient or correlation of regression is given by r, which in this case is 1. This value would indicate that this is a very nice linear function. In a real-life laboratory situation, the correlation coefficient would not usually be 1 but rather more like 0.999 or 0.998. Again, the closer the correlation coefficient is to ± 1.000, the more likely the data fit the function chosen.

PASTING A FUNCTION

It is possible to run the regression and paste the equation into Y= in one step. Follow the screens shown to perform this set of operations.

Select STAT and arrow right over to CALC. Arrow down to "4:LinReg(ax+b)" and press ENTER (Figure 17), then arrow down to "Store RegEQ", press the VARS key, and arrow right to Y-VARS (Figure 18).

Figure 17. Select linear regression

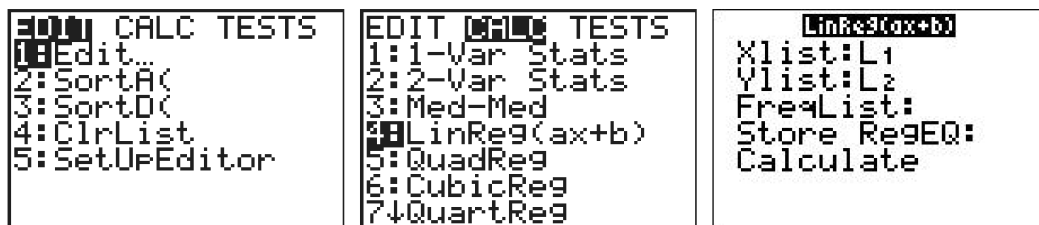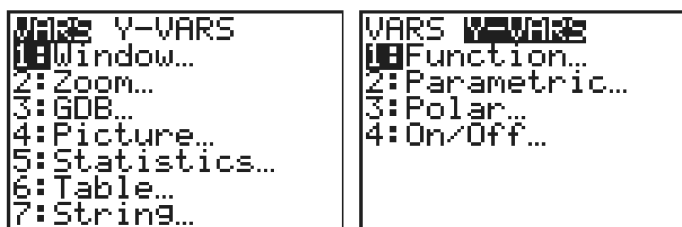*Figure 18. Select Y-VARS*

Now press ENTER ENTER ENTER ENTER. The regression data and the equation will be pasted into Y= at the same time, as shown on the screens of Figure 19. View your graph by pressing ZOOM 9.

Figure 19. Paste a function

TRACING ON THE GRAPH

Press the ⌶TRACE⌶ key. In the upper left corner you should see a "P1:L1,L2" (on the TI-84 Plus you will see "P1", for PLOT1, in the upper right corner). This means that you are in a statistical plot of your data. Use the left and right arrows to move from data point to data point. The x and y values are shown at the bottom of the screen.

Now press the up arrow. Notice that the designation in the upper left corner has changed, and you should have your regression equation on the screen (the regression equation is not shown on the TI-84 Plus). Your cursor is now on the regression line so that you may interpolate values. Again, the x and y values are shown at the bottom of the screen.

CALCULATING A VALUE

We would like to be able to use this equation for further analysis.

SOLVING FOR VALUES OF Y GIVEN X

Let us say that we would like to know the total mass when there is 17 mL of liquid in the graduated cylinder. Press [2nd] [TRACE] to get to CALCULATE. Select "1:value" and press [ENTER], at which point you will see a prompt at the bottom of your graph that reads "X=". Type in "17" and press [ENTER]. The mass of the cylinder and liquid (the value of y) will be displayed at the bottom, as shown in Figure 20.

Figure 20. Calculate a value of y given x
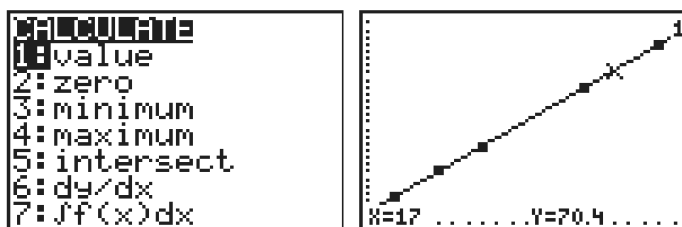
If after entering the value of x and pressing [ENTER] you receive an error message, it is likely that the number for which you are solving is outside the range of x-values on the graph. To correct this, press [WINDOW] and adjust the "Xmin" and "Xmax" so that the value of x falls within this range.

SOLVING FOR VALUES OF X GIVEN Y

Let us say we would like to know the volume of liquid in the graduated cylinder (the value of x) if the total mass (the value of y) is 62.5 g. Press [Y=] and arrow down to the space just to the right of "Y2=" and enter "62.5." Now press [2nd] [TRACE] to get to CALCULATE. Arrow down to "5:intersect" and press [ENTER]. You will see a graph of the line y = 62.5, which will intersect your "best fit line" at the desired x-value.

The bottom left of the screen will read "First curve?" Press [ENTER], then the display will read "Second curve?" Press [ENTER] followed by "Guess?" and again press [ENTER]. This will calculate the intersection of the two graphs. Both the x and y values are now displayed at the bottom of the screen.