Chapter 0
Getting Started on the TI-83 or TI-84 Family of Graphing Calculators

0.1 Turn the Calculator ON / OFF, Locating the keys.

Turn your calculator on by using the [ON] key, located in the lower left hand corner of the calculator. To turn the calculator off press [2nd] [1] [OFF], located above the [ON] key.

To locate the correct keys think of your calculator as being divided into three sections:

1. The bottom six row of keys are your mathematical calculation and function keys.
2. Rows 7 - 9 are the menu and editing keys.
3. The very top row (under the screen) is where your graphing keys are located.

0.2 Adjusting the Screen Contrast

Depending on the room lighting you may want to adjust the screen contrast.

1. To darken the screen:

   Press and release the [2nd] key, then press and hold the up arrow [△] key.

2. To lighten the screen:

   Press and release the [2nd] key, then press and hold the down arrow [▽] key.

As the display contrast changes, a number appears in the upper right corner of the screen between 0 (lightest) and 9 (darkest).

If you adjust the setting to 0, the display may become completely blank. If this happens, increase the contrast and the display will reappear. When contrast needs to be set at 8 or 9 all the time, it is probably time to change the batteries.

0.3 MODE Default Settings

The calculator should be set to the default mode settings. Press [MODE] to see the settings.

Set your calculator to the settings as in Figure 0.1 or 0.2, using your arrow keys and pressing [ENTER] to activate your choice.

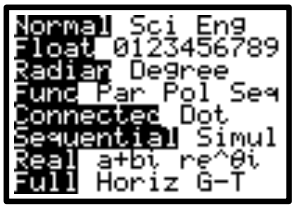

Figure 0.1 The TI-83 default mode screen

Figure 0.2 The TI-84 Plus default screen

Note: If your calculator is not new you may want to RESET MEMORY. This will completely erase all data and programs and reset the calculator to the default mode. Use this cautiously. Consult your owner's manual. Press [2nd] [MEM] (above +), then select **[7:Reset]** , then **[2:Defaults],** then **[2:Reset]**

[1]The [2nd] key selects the item to the above left of a key. The [ALPHA] key selects the item to the above right of a key. The items selected are color coded to the [2nd] and [ALPHA] keys.

0.4 The Home Screen

The Home Screen is your calculation and execution of instruction screen. To return to the Home Screen from any other screen, press [2nd] [QUIT] . The Home Screen is the primary screen of the TI-83 or TI-84. If there is something displayed on the Home Screen, press the [CLEAR] key.

0.5 Calculating

The bottom six rows of keys on the graphing calculator behave like those on any scientific calculator, except that your entry is seen on an eight-line computer screen. When you want the calculator to perform any calculation or instruction, press [ENTER] .

Note: The [2nd] key will access the commands to the above left of any key , which are color coded with [2nd] key.

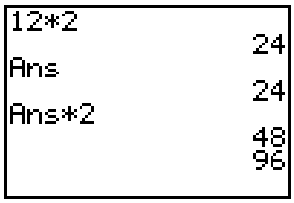

Figure 0.3
The asterisk , * , is used for Multiplication in place of the "times" sign to avoid confusion with the letter *x*.

Example 1

Find the value of 12×2 **.**

From the Home screen, do the following:

a. Type **12** [X] **2 ,** then press [ENTER] .The product 24 is displayed and *stored* as the answer. See Figure 0.3.

b. Press [2nd] [ANS] and [ENTER] ; 24 is again displayed.

Note: The result of your last calculation is always stored in memory. To recall your last calculation press [2nd] [ANS] .

c. Press the multiplication key [X] , then **2** and then [ENTER] . Pressing any operation key, $+, -, \times, \div, x^2, x^{-1}$ etc. , assumes that you want to operate on the stored answer. See Figure 0.3.

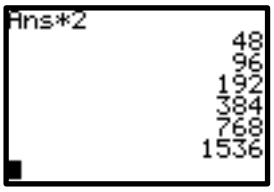

Figure 0.4

0.6 Iteration, Recalling a Process

Repeatedly press [ENTER] . Your screen should look like the bottom of Figures 0.3 and 0.4. This process is called iteration (repeating some process over and over again). The last operation (multiplying by 2) is repeated on the new answer.

Example 2

Interest compounded at 5% annually on an initial investment of $1000 can be represented by 1000*1.05, or A = P(1 + R) for the first year .
[Amount = (original investment)(1 + rate).]
Use iteration to determine the number of years for the amount of accumulated investment to be greater than $1300.

Press [CLEAR] to clear the Home Screen.

Type **1000** followed by [ENTER] . The number 1000 is now stored in memory.

Press [X] **1.05** [ENTER] . The number 1050 will now be displayed. See Figure 0.5. By repeatedly pressing [ENTER] , you can see the growth of your initial $1000 investment year by year and determine that 6 iterations (years) are necessary for you to exceed $1300. See Figures 0.5 and 0.6.

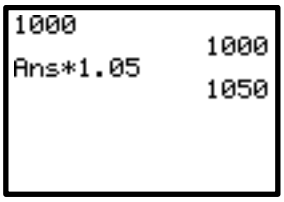

Figure 0.5

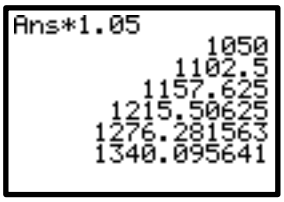

Figure 0.6
Between year 5 and 6 the amount is > 1300.

0.7 Converting Decimals and Fractions

The calculator can be used to convert decimals and fractions. Press **1** [÷] **4** [ENTER] . See Figure 0.7. The decimal answer for this expression, .25, is displayed. Press [MATH] . You are in the MATH menu . Menus give a list of additional command options. See Figures 0.8 or 0.9. Press [1] or [ENTER] to select the highlighted option. This option **[1: Frac]** will change the decimal answer back into a fraction.

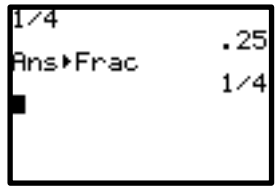

Figure 0.7

Note: When the denominator of a fraction has more than four digits the answer is displayed as a decimal and will not return to a fraction.

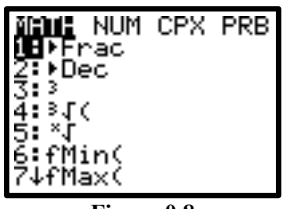

Figure 0.8
The TI-83/84 MATH menu

Figure 0.9
Down arrow to see the additional items

0.8 Selecting Items From a Menu

You can select an item from a menu by typing the number or by moving to that menu option with the down arrow key [▽] . You press [ENTER] to select your menu option. Press [MATH] [▽] . Select **[2: Dec]**. Press [ENTER] . This changes the fraction back to a decimal. See Figure 0.10.

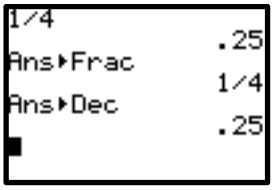

Figure 0.10

Example 3

Type in the following fraction problems, then use the MATH menu to change the answers back to fractional form.

a. $\frac{1}{2}+\frac{1}{3}$

Press [(] **1** [÷] **2** [)] [+] [(] **1** [÷] **3** [)] [ENTER] . Press [MATH] [1] [ENTER] . See Figure 0.11.

b. $3\frac{5}{9}+5\frac{3}{7}$

Press [(] **3** [+] **5** [÷] **9** [)] [+] [(] **5** [+] **3** [÷] **7** [)] [ENTER] . Press [MATH] [1] [ENTER] See Figure 0.11. The answer is 566/63 (not displayed). Press [CLEAR] .

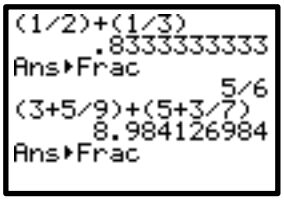

Figure 0.11

0.9 Raising a Number to a Power

To raise a number (called the base) to a power use the exponent key: [^] . For 3^2 press **3** [^] **2** [ENTER] or use a short -cut, press **3** [x^2] [ENTER] . This last method pastes the exponent to the upper right of 3. See Figure 0.12.

Example 4

Type the expression using the exponent keys:

$$3^4 \times 2^5 \div 6^2$$

Type as in Figure 0.12 , then press [ENTER] .

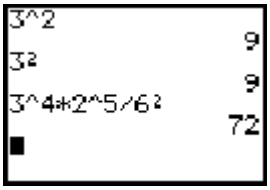

Figure 0.12

0.10 Order of Operations

The TI-83/84 uses algebraic order of operations: inside parentheses first, powers next, then multiply or divide from left to right and lastly add or subtract from left to right.

Example 5

a. Enter: $1 + 2(4 - 2)^2 + 6 \div 2$

Type as in Figure 0.13, then press ENTER .

The order of operations are performed algebraically in the following steps:

$1 + 2(4 - 2)^2 + 6 \div 2 =$	
$1 + 2(\mathbf{2})^2 + 6 \div 2 =$	inside parentheses
$1 + 2(\mathbf{4}) + 6 \div 2 =$	raise to power two
$1 + \mathbf{8} + 6 \div 2 =$	multiply
$1 + 8 + \mathbf{3} =$	divide
$\mathbf{9} + 3 =$	add
12	add

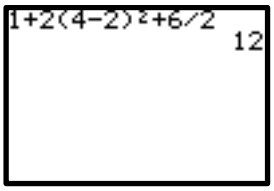

Figure.13

b. Enter: "One hundred fifths times two."

See Figure 0.14 for two methods. Figure 0.15 shows an incorrect use of parenthesis.

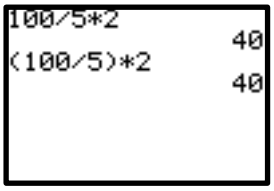

Figure 0.14

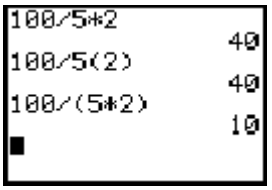

Figure 0.15

c. Enter "Sixteen raised to the one half power."

"Sixteen raised to the one-half power" is the same as "the square root of 16." Always enclose the fractional exponent in parentheses. See Figure 0.16.

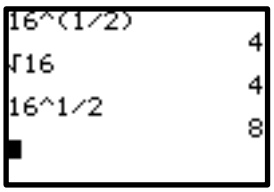

Figure 0.16

Note: 16^1/2 is ***not*** $\sqrt{16}$; fractional exponents must always be enclosed in parentheses. See Figure 0.16.

Troubleshooting: Parentheses in the denominator of a fraction are interpreted as a grouping. For the TI-83/84 parentheses are interpreted the same as the multiplication sign. See Figure 0.15. To avoid confusion always enclose fractions in parentheses. So (10/5)(2) or (10/5)*2 would be the preferred method for showing multiplication involving a fraction. This avoids any ambiguity.

0.11 Truth Tests

The graphing calculator can be used to determine whether an expression is true or false.

To use this feature, you must use the 2nd

TEST menu. Figure 0.17 shows the TEST menu. This is where the equal and inequality symbols are located.

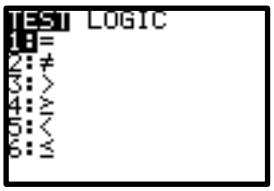

Figure 0.17

Example 6

a. Is $3 < 7$ **true or false?**

Press **3** [2nd] [TEST] [▽] . Select **[5:<]**, press **7** [ENTER] . See Figure 0.18.

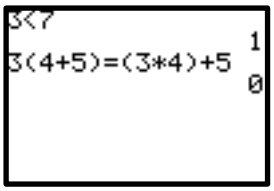

Figure 0.18

Note: When performing a TEST, remember that 1 means TRUE and 0 means FALSE.

b. Is $3(4+5) = (3 \times 4) + 5$ **true or false?**

This is a false statement, thus the answer is zero, See Figure 0.18.

0.12 Deep Recall and Editing

Press [CLEAR] . To recover your last entry press [2nd] [ENTRY] . To evaluate, press [ENTER] . To edit an expression, use the left and right arrows to position the cursor for editing and press delete [DEL] or insert [2nd] [INS] .

Example 7

Change the expression in Example 6 part (b) to $3(4+5) = (3 \times 4) + (3 \times 5)$

First recall the expression. Press [2nd] [ENTRY] . Use [◁] to place the cursor on the last 5; press [2nd] [INS] type [(] **3** [X] , then [▷] to place the parenthesis after the 5, press [)] . Press [ENTER] . See Figure 0.19. Now the expression is evaluated as true (i.e. the number 1 appears). The parentheses are optional. See Figure 0.20

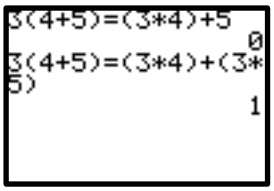

Figure 0.19

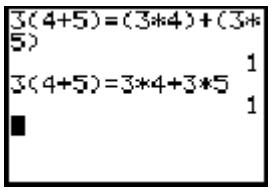

Figure 0.20

Note: Also try pressing [2nd] [ENTRY] , [2nd] [ENTRY] several times and you will see some of the old expressions that you typed. This is called ***deep recall*** and it is used to retrieve expressions that have been typed many steps earlier. It is equivalent to scrolling up the page.

0.13 Storing Values to Variables

Recall Example 2 where we were finding the amount of money A, accumulated after one year using the formula $A = P(1 + R)^x$, where the principle P = \$1000 and the rate R = 5%, and x=1. The calculator allows you to store values to alphabetical letters A through Z. You access the letters by first pressing the [ALPHA] key and you store number values to letters by using the store [STO] key.

> Note: Alphabetical letters are located to the above right of keys and are color coded to match the [ALPHA] key.

Example 8

Find A if $P = 1000$, $R = .05$ using
$A = P(1 + R)^1 = P(1 + R)$.

1. To store 1000 to P , press **1000** [STO] [ALPHA] [P] [ENTER] .
2. To store .05 to R , press **.05** [STO] [ALPHA] [R] [ENTER] See Figure 0.21.
3. Type the expression ***P(1 + R)****;* remember to press [ALPHA] before typing the letter. Press [ENTER] to evaluate.

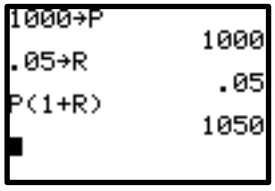

Figure 0.21

The expression has been evaluated using the stored values to P and R. These values will remain the same until you store a new value to R and P . See Figure 0. 21.

> **Trouble Shooting**: If your calculator is new or if the memory has been cleared, the initial stored value to all letters is zero.

A special note about x and y

Since the variables ***x*** and ***y*** are used in plotting graphs, their values are constantly updated when you TRACE on a graph. Therefore the values of x and y may change if you have used the graphing feature.

There are two ways to access the ***x*** variable, since it is usually the variable of choice in algebra. Press [ALPHA] [X] or use the handy [X,T,Θ,n] key. See Figure 0.22.

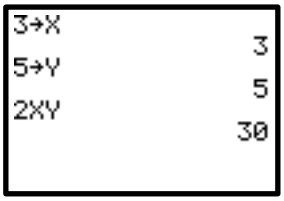

Figure 0.22

0.14 Subtraction and "Negative of"

In algebra the minus sign is used two different ways:

1. as the operation sign between two numbers to mean "subtract", as in $5-3$, or
2. in front of a number to mean "the opposite of or negative of", as in **-7**.

The calculator has two different keys for minus.

Press **5** [-] **3** [ENTER] for subtraction.

For -7 find the negative key [(-)] located to the left of ENTER . Press [(-)] **7** [ENTER] .

See Figure. 0.23.

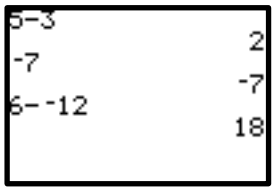

Figure 0.23

Note: The negative sign is actually a little bit shorter and slightly raised compared to the subtraction symbol. See Figure 0.23.

Example 9

Evaluate the following. Type each problem and then press [ENTER] :

a. $6-^{-}12$

b. -3×-9

c. $(-5)^2$ (use the $[x^2]$ key for power 2)

d. -5^2

See Figures 0.23 and 0.24.

Note that the values for Example 9c and 9d above are different. See Figure 0.24. Order of operations in 9d says: "Square five first, then take its opposite."

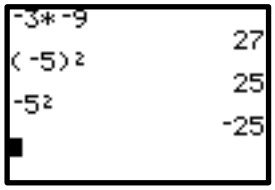

Figure 0.24

Note: To square a negative number you must put it in parentheses.

Trouble Shooting: The most common calculator error is using the subtraction symbol instead of the negative symbol. See Figure 0.25 and 0.26.

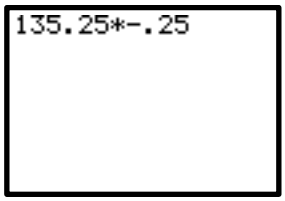

Figure 0.25

Figure 0.26

0.15 The Error Message

Incorrectly using the subtraction sign produces an error message. When you type the expression as in Figure 0.25 and press [ENTER] , the message **ERR:SYNTAX** appears. See Figure 0.26. Choose **[2:Goto]** to position the cursor to the place where the error occurred. See Figure 0.27. Choose **[1:Quit]** to begin a new line on the Home Screen.

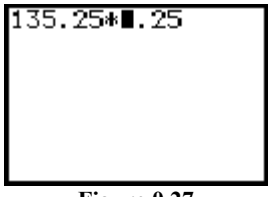

Figure 0.27

0.16 Absolute Value

The absolute value of a number is the value of the number without regard to the sign. It is also interpreted as the distance from zero on the number line. The absolute value of +3 is 3 and the absolute value of –3 is 3. In mathematical symbols we write: $|3| = 3$ and $|-3| = 3$, because each number is three units from zero, regardless of the direction.

Example 10

Find the value of the following expressions by hand. Verify each answer by typing the expression into the calculator.

a. $|-6|$

b. $|-5+1|$

c. $|6-15| - \sqrt{81}$

To begin we must find the absolute value symbol. It is hidden under a menu. Press

MATH ▷ to **<NUM>**, select **[1:abs( ].**

See Figure 0.28. Type each of the above expressions. See Figure 0.29.

Figure 0.28

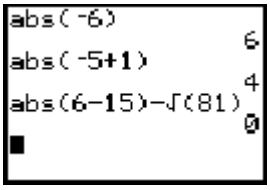

Figure 0.29

Note: If you cannot find a command, use the catalogue feature. Press 2nd CATALOG. Use the down arrow key to find the command, then press ENTER. See Figure 0.30.

Figure 0.30

0.17 Multiple Parentheses

You may encounter a problem that is written using multiple grouping symbols such as parentheses ( ), brackets [ ] or braces { }. Parentheses are the only grouping symbols for calculations, since the calculator is programmed to follow algebraic order of operations and braces are used to enclose lists.

Example 11

Simplify each expression by hand, then verify on the calculator.

a. $\left[5-\left(\frac{6+12}{3}\right)\right]+2(5-17)$

b. $3\{5-[6-2(4-9)]+6(-2)\}$

Type each expression as in Figure 0.31.

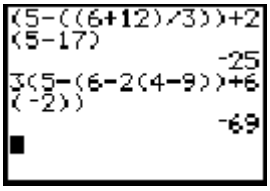

Figure 0.31

Note: The numerator or denominator of a fraction is always placed in parentheses when more than one term is present.

0.18 Verifying Solutions with Substitution, Tables and Graphs

We can use the store [STO] feature to verify solutions to equations and to check that expressions are equivalent

Example 12

Is 4 a solution to $3(4x-1)-6=47-2x$ **?**

Method 1: Using Substitution
If 4 is a solution to the equation then when 4 is substituted into the left side of the equation it will have the same value as the right side. Verify this by storing 4 to *x* and then enter the left side of the equation. Press **4** [STO] [X,T,Θ,n] [ALPHA] [:] **3(4*x*-1) – 6.** [ENTER] . See Figure 0.32. Enter the right side of the equation: **47 - 2*x*** [ENTER] . Both sides yield equivalent values, so x = 4 is a solution. See Figure 0.32.

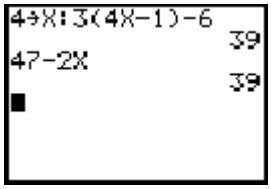

Figure 0.32

> Note: The colon key [:] , located above the decimal key, allows you to concatenate or write multiple commands on the same line.

Method 2: Using a Table of values
Constructing a table of values for the left and the right side of the equation shows that when *x*=4, both sides share the same value. Store each side of the expression on the [Y=] screen. Press [Y=] and clear all entries. In Y_1 type **3(4x-1) - 6** [ENTER] , and in and Y_2 type **47-2x** [ENTER] . See Figure 0.33. To display the table values, press [2nd] [TBLSET] (above the WINDOW key). Your cursor is at the prompt **TblStart=**. Press **0** [ENTER] **.** See Figure 0.34. The prompt [△Tbl] is set to 1, and will increment your table by one unit. You can change it, but it is not necessary. To view the table, press [2nd] [TABLE] (above GRAPH). Use the [▽] [△] arrows to scroll through the *x* values of the table. Notice that the values in the Y_1 and Y_2 columns are the same only for *x* = 4. See Figure 0.35. This shows that 4 is the solution.

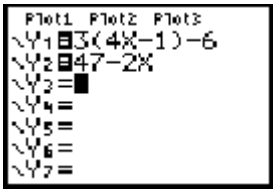

Figure 0.33

Figure 0.34

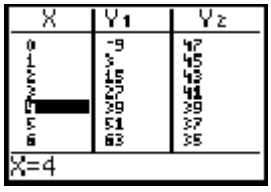

Figure 0.35

Method 3: Using a Graph

If we plot all the values from the table and those values in-between, we can generate the graph of the left side and the right side of the equation.

Press [ZOOM] , select **[6:ZStandard].** See Figure 0.36. This will set your standard viewing window from –10 to 10 along both the *x*-axis and *y*-axis. Press [GRAPH] . See Figure 0.37.

We see only one graph when we anticipate two. We need to adjust our *y*-axis values so that we can see the intersection point at (4,39) as indicated on the table of values.

Press [WINDOW] [▽] to **Ymax=**, enter **50.** See Figure 0.38 . Press [GRAPH] . See Figure 0.39. Now both graphs are displayed. The intersection point is the solution to the equation.

Press [2nd] [CALC] (above TRACE). Select **[1:value]** . See Figure 0.40. At the prompt type **4** [ENTER] . The y value of 39 is displayed for Y_1. See Figure 0.41. Press [▽] , now the y value for Y_2 is displayed and it is the same value of 39. See Figures 0.42. This shows that the intersection point is (4,39) and that x=4 is the solution to the equation.

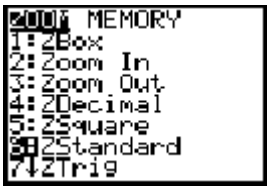

Figure 0.36

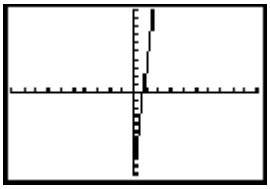
Figure 0.37

Figure 0.38

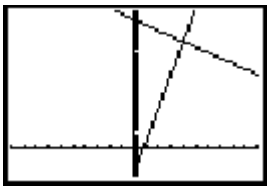
Figure 0.39

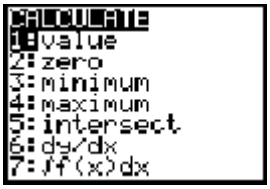

Figure 0.40

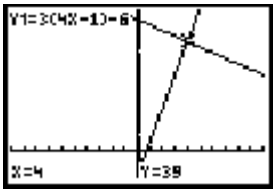

Figure 0.41

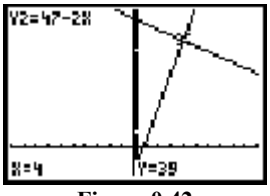

Figure 0.42

Method 4: solve algebraically

In Example 12 we asked: Is 4 a solution to $3(4x-1)-6=47-2x$? Solving analytically using algebra produces:

$$\begin{aligned} 3(4x-1)-6 &= 47-2x \\ 12x-3-6 &= 47-2x \\ 12x-9 &= 47-2x \\ 14x-9 &= 47 \\ 14x &= 56 \\ x &= \frac{56}{14} \\ x &= 4 \end{aligned}$$

When you solve an equation algebraically you should verify your answer using substitution, tables or graphs.

0.19 Linking Graphing Calculators

This course comes with TI-GRAPH LINK data files which can be downloaded by your instructor or by yourself from the website www.wiley.com/college/kimeclark

You may need to need purchase a special cable to link the computer to the calculator. TI Connectivity cables work with TI Connect software or TI-GRAPH LINK software to enable connections between TI calculators and a computer. For more information go to: http://education.ti.com/us/product/accessory/connectivity/features/cables.html

Programs can be transferred from one graphing calculator to another. You will need the cable that came with your calculator to link calculators together.

Note: A list of all Graph Link data files appears in the **Preface** of this manual.

0.19.1 Receiving Data

1. Attach the cable to both calculators. Be sure to push the cable **all** the way in.
2. Press [2nd] [LINK] [▷] to **<RECEIVE>**.

   Press [ENTER] . See Figure 0.43.
3. The receiving calculator must say ***Waiting...***

0.19.2 Sending data:

1. Press [2nd] [LINK] . See Figure 0.44
2. [▽] to the programs or lists to be sent.

   Press [ENTER] to select. A small square indicates the selection has been made.
3. [▷] to <TRANSMIT> press [ENTER] . See Figures 0.44 and 0.45.
4. Wait for the message: ***Done,*** on the receiving calculator.

Troubleshooting: If an asterisk (*) appears in front of a program, it has been archived. To un-archive press [2nd] [MEM] , select **[2:Mem Mgmt]** [▽] , select **[7:Progrm]** . [▽] to all programs beginning with an asterisk (*), then press [ENTER] . The programs are now un-archived and ready to execute. See Figures 0.47-0.50

Figure 0.43

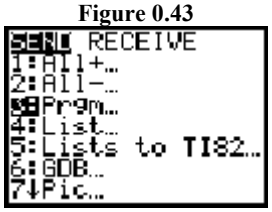

Figure 0.44

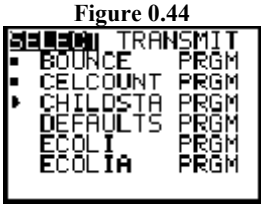

Figure 0.45

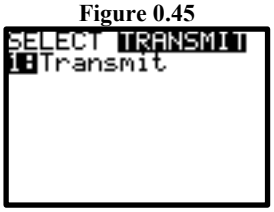

Figure 0.46

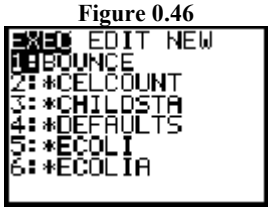

Figure 0.47

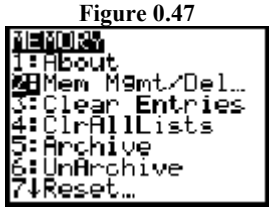

Figure 0.48

Figure 0.49

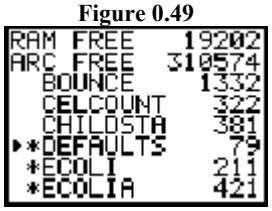

Figure 0.50