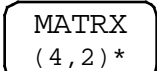


# TI-83 GRAPHING CALCULATOR AN INTRODUCTORY TUTORIAL

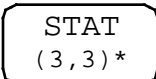
by  
Lamar Middleton  
Polk Community College  
1997

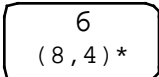
This introduction assumes that you have no experience with the calculator. If you have some experience, you may find that you wish to bypass some of the topics.

**LOCATING KEYS** - One of the challenges in your early work with the calculator will be locating keys. In this introduction, we will refer to the location of the keys by what we will term rows and columns. Look at the figure on the next page and at your TI-83 calculator. The calculator has ten rows of keys and, except for the rows which hold the arrow keys, there are 5 columns of keys for each row. We will refer to the location of keys by the row number followed by the column number. For example, if you locate the key on the 4th row and in the 2nd column, it has the letters "MATRX" on the face of the key. It also has "ANGLE B" on the body of the calculator above the key. In this introduction, we

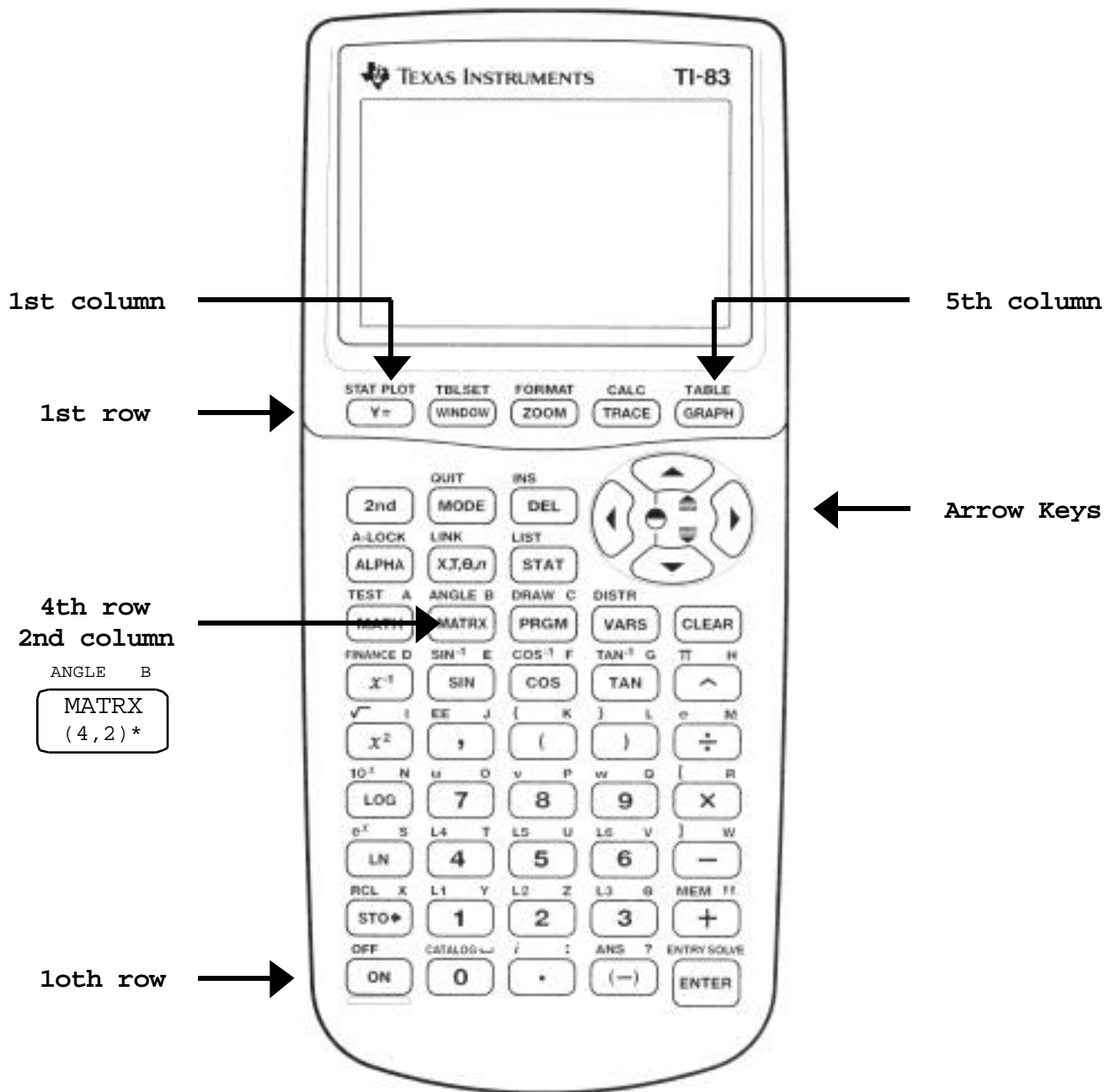
will use symbols such as  with the (4,2) included on the

face of the button to indicate the row number and column number of the key. In subsequent material, this row-column indicator will not be used.

Locate the  key in the 3rd row and third column and the

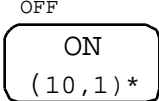
 key in the 8th row and 4th column.

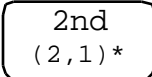
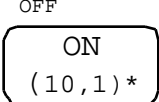
\* Indicates the key's row and column on the calculator keyboard.



\* Indicates the key's row and column on the calculator keyboard.

**ON/OFF** - Most of the calculator keys serve more than one purpose. The ON/OFF key, located in the 10th row and 1st column of the calculator, is used to both turn the calculator on and to turn the calculator off. Notice that "OFF" appears in gold print. This indicates that this is a 2nd function of the key and is accessed by first pressing the "2nd" key, located on the 2nd row, 1st column.

To turn the calculator on, press  .

To turn the calculator off, press  then  .

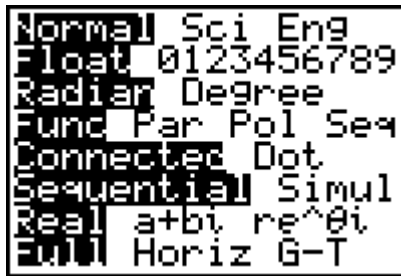
**ADD, SUBTRACT, MULTIPLY, DIVIDE** - The gray keys, located in the 7th-10th row, and the blue keys, located in the 5th column, can be used to perform basic operations. The "ENTER" key, in the 10,5 position, serves the same purpose as the "=" key on most scientific calculators. To calculate  $8 + 9$ , make sure that the calculator is turned on and press

    .

The calculator will display  $8+9$  on the left side of one line and the answer, 17, on the next line at the right side of the calculator screen.

Try this now with  $8 \times 9$  and  $8/9$ . You should get the answers 72 and, depending on your calculator's setting, .89, .8888888889, or some other form of a decimal point, followed by a number of 8's and then a 9. To control the number of decimal places displayed and several other calculator settings, we will need to change the MODE settings.

\* Indicates the key's row and column on the calculator keyboard.



QUIT

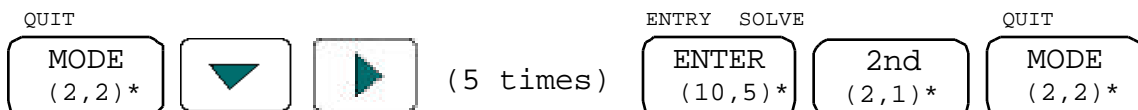
Press the MODE key, . You will see various settings

which will have meaning for you in your future work. We will set the number of decimal places for the calculator to display. Look on the second row where you see "Float 0123456789." Float indicates that the calculator will display an exact decimal representation when possible but will display as many decimal places as possible when there is no exact representation. Float is the default setting. (All entries on the left side of the screen are the defaults.) We will set the calculator to display 2 decimal places. Locate the arrow keys to the right of the 2nd and 3rd rows and press the down arrow to move the blinking cursor to the second row on the screen. Now press the right arrow key 3 times to move the blinking cursor over the "2." Press the ENTER key to indicate your choice. Now press the 2nd and QUIT (2nd function of the MODE key) to return to the home screen. Your key sequence should be:



If you now calculate  $8/9$ , your calculator will display .89 since it is set to display 2 decimal places.

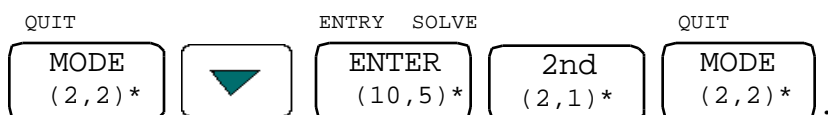
Set the calculator to display 4 decimal places. Press:



If you now calculate  $8/9$ , you should see .8889 displayed.

\* Indicates the key's row and column on the calculator keyboard.

Now set the MODE to the default, Float, by pressing

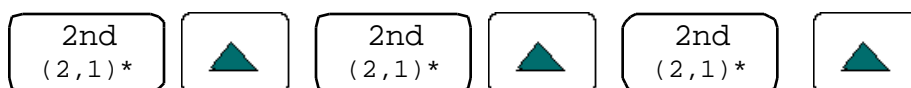


The division  $8/9$  should now display .888888889.

**CLEAR** - To clear entries on the calculator screen press CLEAR (4,5)\*.

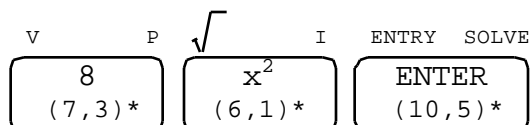
If the CLEAR key is pressed while typing screen entries and before pressing the ENTER key, only the current line is cleared. If the CLEAR key is pressed after pressing the ENTER key, the entire screen is cleared.

**SCREEN CONTRAST** - With the screen cleared, perform the calculations  $5+6$  and  $5*6$ . The darkness of the characters on the screen can be changed by adjusting the screen contrast. Press the 2nd key, followed by pressing the up arrow. Repeat this process 3 times. The key sequence will be:



You should see the screen darken. You may also notice that a number appears in the upper right corner of the screen. Press the 2nd key followed by the down arrow in succession 3 times. You will notice the screen lighten and the number in the upper right corner may decrease. When the number becomes a 7, 8 or 9 in order to have the screen dark enough, you must consider changing the batteries. (You can press the 2nd key, then press and hold down the up or down arrow to make rapid changes of the screen contrast.)

**SQUARE ROOTS AND SQUARING** - The key in the 6th row and 1st column has three functions. Its primary function is to square a number or expression. Its second function is to evaluate a square root and it also is used as an ALPHA key as will be explained later. We will calculate the square of 8,  $8^2=64$ . Press:



You should see the desired result. Note that it is entered on the calculator just as you would write it with pencil and paper.

\* Indicates the key's row and column on the calculator keyboard.

We will now calculate the square root of 64,  $\sqrt{64}=8$ . Press:

$\sqrt{\phantom{x}}$  I L6 V L4 T  
 2nd (2,1)\*  $x^2$  (6,1)\* 6 (8,4)\* 4 (8,2)\* . Notice that the calculator

has inserted a left parenthesis for you. Now press:

} L ENTRY SOLVE  
 ) (6,4)\* ENTER (10,5)\* . You should see the desired result.

**STORE** - A third function of the  $x^2$  key is as a storage location. Notice that the I on the  $x^2$  key is green. It is accessed by first pressing the ALPHA key in the 3rd row and 1st column. We will store the number 9 in I. Press:

W Q RCL X A-LOCK  $\sqrt{\phantom{x}}$  I ENTRY SOLVE  
 9 (7,4)\* STO (9,1)\* ALPHA (3,1)\*  $x^2$  (6,1)\* ENTER (10,5)\* .

To recall this number we press:

A-LOCK  $\sqrt{\phantom{x}}$  I ENTRY  
 ALPHA (3,1)\*  $x^2$  (6,1)\* ENTER (10,5)\* .

We can use this number in calculations. For example 2I should be  $2(9)=18$ . Press:

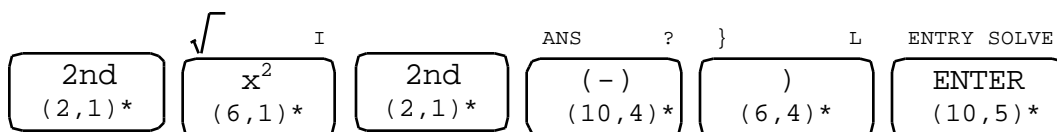
L2 Z A-LOCK  $\sqrt{\phantom{x}}$  I ENTRY SOLVE  
 2 (9,3)\* ALPHA (3,1)\*  $x^2$  (6,1)\* ENTER (10,5)\* .

Your calculator should display 2I with the result, 18, on the right side of the screen. Now calculate  $I + 5 = 9 + 5 = 14$ . Press:

A-LOCK  $\sqrt{\phantom{x}}$  I MEM !! L5 U ENTRY SOLVE  
 ALPHA (3,1)\*  $x^2$  (6,1)\* + (9,5)\* 5 (8,3)\* ENTER (10,5)\* .

**ANSWER** - The answer to the most recent calculation is automatically stored in the calculator and can be recalled in two ways. Calculate  $5+2$  by pressing the 5, +, 2 and ENTER keys. The result, 7, is stored by the calculator in a location called "Ans." Now press the + key followed by the 9 and ENTER keys. Your calculator displays "Ans+9" on the left with "16" on the right. This feature will work if you first press any of the operation keys (add, subtract, multiply, divide), the STORE or  $x^2$  keys, or several others.

The value in Ans is now 16. If we wish to find the square root of Ans, we must first enter the square root symbol and then recall Ans. Ans is the second function of the (-) key, located in the 10th row and 4th column. Press:

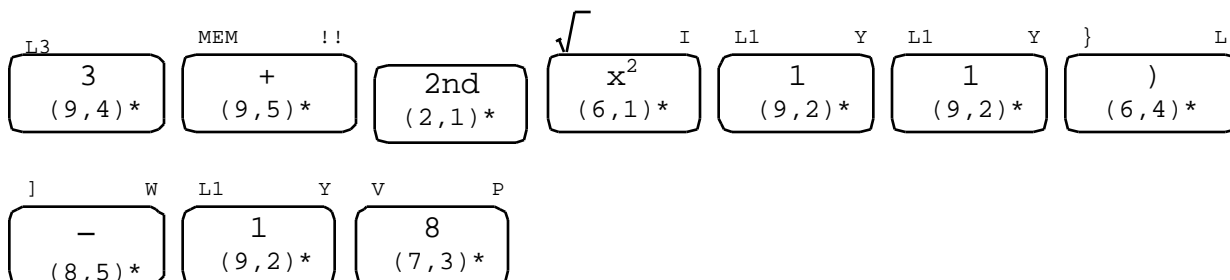


The result should be 4.

(NOTE: The calculator inserts a left parenthesis for the square root and we typed in the right parenthesis. In this situation, and in many others, the right parenthesis is not required. In some situations it is required. It is generally best to include it until you become expert on when the right parenthesis is required and when it is not.)

**EDITING** - We will all make typing mistakes when entering expressions and the calculator has features which allow us to correct our mistakes instead of having to re-enter the entire expression. The exact procedure which we will use to correct mistakes is dependent on whether we have pressed the ENTER key prior to detecting the mistake.

- A. ENTER not pressed.** Assume that we had intended to enter  $3 + \sqrt{10} - 18$ , but mistakenly typed  $3 + \sqrt{11} - 18$  without pressing the ENTER key. Type  $3 + \sqrt{11} - 18$  by pressing:



We now wish to change the second 1 in 11 to a 0. Press the left arrow key, located on the right side in the 2nd and 3rd rows, 5 times. The blinking cursor should be above the 1. Press the 0 key followed by the ENTER key. The result, -11.83772234, should be displayed. (NOTE: If your calculator is not set to the "Float" mode, you may display fewer digits in the result.)

\* Indicates the key's row and column on the calculator keyboard.

- B. ENTER pressed.** Assume that we really wanted to enter  $3+\sqrt{16}-18$  but now have  $3+\sqrt{10}-18$  and have pressed ENTER. We can recall the expression by using the 2nd ENTRY feature. ENTRY is the second function of the ENTER key. Press:

ENTRY    SOLVE

2nd (2,1)*	ENTER (10,5)*
---------------	------------------

.

The expression which we wish to change is on the screen with the blinking cursor at its end. Press the left arrow key 5 times to move the cursor over the 0 in 10, type a 6 and press the ENTER key. Your result should now be -11.

- C. INSERT & DELETE.** Type  $3+\sqrt{126}-18$  but do not press ENTER. If we wish to change the 126 to 16, we may now press the left arrow key 6 times until the cursor is over the unwanted 2 and press the DELETE key followed by the ENTER key. The DELETE key is in the 2nd row, 3rd column.

INS                  ENTRY    SOLVE

DEL (2,3)*	ENTER (10,5)*
---------------	------------------

. Your result should again be -11.

ENTRY    SOLVE

Press 

2nd (2,1)*	ENTER (10,5)*
---------------	------------------

 to bring the expression back on the

screen and let us assume that we want to change the expression to  $3+\sqrt{169}-18$ . Press the left arrow 4 times to move the cursor over the right parenthesis. We want to insert a character. INSERT is a second function of the DELETE key so press:

INS

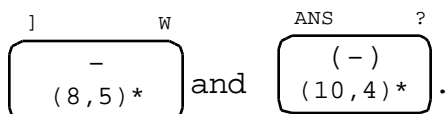
2nd (2,1)*	DEL (2,3)*
---------------	---------------

.

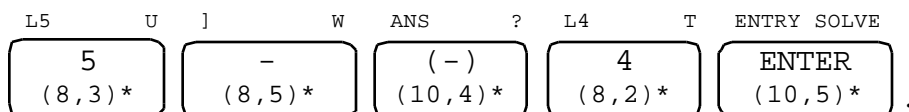
Now type the 9 and press ENTER. Your result should be -2. Notice that the 9 was inserted in front of the cursor.



**THE NEGATIVE SIGN** - The TI-83 has two keys which appear to contain a negative or subtraction sign. They are:

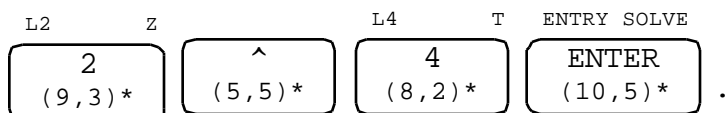


The first key listed above, -, is the subtraction key. The second key listed, (-), is used to indicate a negative number. The negative sign will appear higher on the calculator screen and is shorter than the subtraction sign. We will calculate  $5 - (-4)$  without the use of parentheses to illustrate this. Press:



Notice on the calculator screen the difference in the subtraction sign and the negative sign. Notice also that the result of the calculation is 9.

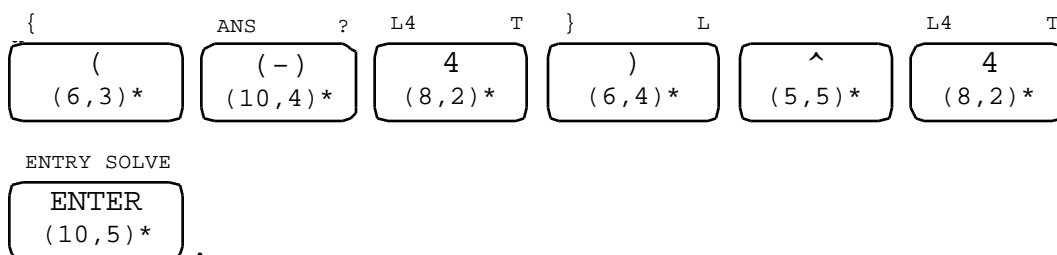
**EXPONENTS** - We have used the  $x^2$  key to square a number, i.e. to raise a number to the second power. If we wanted  $x^4$ , we could use the carat key located in the 5th row, 5th column. We will calculate  $2^4$ . Press:



You should see 16 as the result of the calculation.

**ORDER OF OPERATIONS** - The order of operations used by the calculator is the same as the usual rules for order of operations. Just as in writing mathematical expressions with pencil and paper, parentheses may be used to ensure that calculations are performed in the desired manner.

If we calculate  $(-4)^4$  the result should be 256. Press:



\* Indicates the key's row and column on the calculator keyboard.

Without the parentheses, our expression becomes  $-4^4$  which, according to order of operations is the negative of  $4^4$  or  $-256$ . Press:

ANS	?	L4	T	L4	T	ENTRY SOLVE
(-)		4		^		ENTER
(10,4)*		(8,2)*		(5,5)*		(10,5)*

**PRACTICE CALCULATIONS** - Some typical calculations are illustrated below. We use the \* symbol for multiplication and / for division. This is the way these operation symbols appear on your calculator screen.

$-8*6+42$  is entered

ANS	?	V	P	[	R	L6	V	MEM	!!
(-)		8		X		6		+	
(10,4)*		(7,3)*		(7,5)*		(8,4)*		(9,5)*	

L4	T	L2	Z	ENTRY SOLVE
4		2		ENTER
(8,2)*		(9,3)*		(10,5)*

. The result should be -6.

$(12.3 - 8.6)^3$  will require parentheses to enter properly. Press:

{	L1	Y	L2	Z	i	:	L3	]	W
(		1		2		.		3	
(6,3)*		(9,2)*		(9,3)*		(10,3)*		(9,4)*	
								-	
								(8,5)*	

V	P	i	:	L6	V	}	L		L3
8		.		6		)		^	
(7,3)*		(10,3)*		(8,4)*		(6,4)*		(5,5)*	
									3
									(9,4)*

ENTRY SOLVE
ENTER
(10,5)*

. The result should be 50.653.

Calculate  $48/2^3$ . Since order of operations will require that  $2^3$  will be calculated first, your result should be  $48/8 = 6$ .

To calculate  $\frac{4.2}{12.7-3.4}$ , we must enter into the calculator the expression  $4.2/(12.7-3.4)$ . The parentheses are necessary and the result should be displayed as .4516129032. NOTE: If your calculator's decimal setting (set in MODE) is not Float you may have fewer digits displayed.

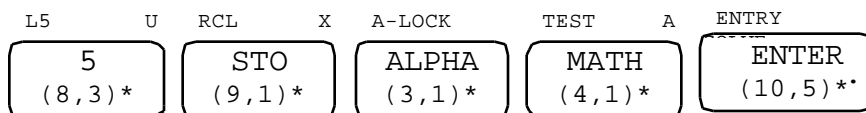
If we had not entered the parentheses in the previous example, i.e. if we had entered  $4.2/12.7-3.4$  into the calculator, 4.2 would have been divided by 12.7 and then 3.4 would be subtracted from the result. The calculator would have displayed -3.069291339.

\* Indicates the key's row and column on the calculator keyboard.

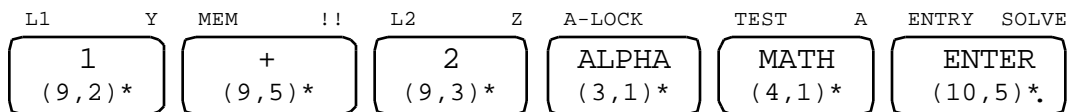
To calculate  $12.2 + \frac{18-25}{4^2}$ , you would enter  $12.2+(18-25)/4^2$ . The result should be 11.7625.

**IMPLIED MULTIPLICATION** - In mathematical expressions, if we write  $2A$  we mean to multiply 2 times the variable  $A$ . If we write  $2(A-5)$  we mean to multiply 2 times the quantity  $A-5$ . The TI-83 uses the same convention. The calculator will multiply 2 times the number stored in location  $A$ .

Store the number 5 in location  $A$ . Recall that the alphabetic storage locations are accessed by first pressing the ALPHA key then the key with the green alphabetic character. Press:



Now calculate  $1 + 2A$  by pressing:



Since the value of  $A$  is 5,  $1 + 2A = 1 + 2(5) = 11$ .

Enter  $3/(2A)$  into your calculator, ensuring that you include the parentheses. After pressing ENTER, your result should be  $3/(2A) = 3/10 = .3$ .

Now enter  $3/2A$  into your calculator without the parentheses. After pressing ENTER, your result should be 7.5. The calculator, following order of operations explicitly, divided 3 by 2 and then multiplied the result by 5.

**The TI-83 handles implied multiplication differently than does the TI-82 or TI-85.**

\* Indicates the key's row and column on the calculator keyboard.

Either of these other calculators performs the implied multiplication first and would have considered  $3/(2A)$  and  $3/2A$  as the same.

**RECALLING PREVIOUSLY ENTERED EXPRESSIONS** - We learned earlier how, by using the 2nd ENTRY keys that we could recall the last expression entered. It is also possible to recall other previously entered expressions.

With 5 stored in location A, enter (pressing the ENTER key after each expression) the expressions  $5A+1$ ,  $3A-7$ ,  $A^2+3$  and  $1-7A$ . Your results should be 26, 8, 28 and -34, respectively. If we wish to recall the expression  $5A+1$  we can press the keys

ENTRY   SOLVE

2nd (2,1)*	ENTER (10,5)*
---------------	------------------

 in succession 4 times. Notice that the first

time the 2 keys are pressed that  $1-7A$  is "pasted" on the screen. The next time,  $1-7A$  is replaced by  $A^2+3$ . The third time  $3A-7$  appears and  $5A+1$  appears after we have pressed the keys 4 times. If we now press the ENTER key, the result, 26, will appear.

\* Indicates the key's row and column on the calculator keyboard.