

*Super Size  
your TI-84 Plus  
Operating System  
to v2.53MP*

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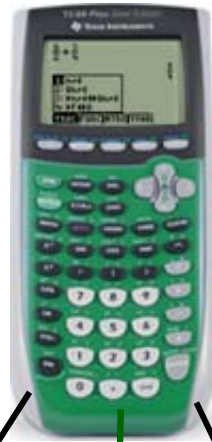
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***Join a Google Group on the TI-84 Plus***

Want more information? Stay connected at <http://groups.google.com/group/ti84plus/>

# TI-84 Plus OS Update 2.53MP

[education.ti.com/84](http://education.ti.com/84)



MathPrint Home Screen

1: n/d  
2: U n/d  
3: n/d d U n/d  
4: F F d D  
FRAC FUNC MTRN VVAR

MathPrint Home Screen

1: abs C  
2: Z C  
3: nDeriv C  
4: fnInt C  
5: to3BASEC  
FRAC FUNC MTRN VVAR

MathPrint Home Screen

ROW: 1 2 3 4 5 6  
COL: 1 2 3 4 5 6

MathPrint Home Screen

$\frac{d}{dx}(5X)|_{x=-1}$   
 $Y_1(\frac{2}{3})$

## MathPrint Home Screen

MathPrint Y=

Plot1 Plot2 Plot3  
Y1 Y2 Y3 Y4 Y5 Y6  
Y1 =  $2X^2 + 3X + \frac{1}{5}$   
Y2 =  $\frac{1}{2} \sin(\frac{\pi}{4} - \frac{2}{3})$   
Y3 =  
Y4 =  
Y5 =  
Y6 =

## MathPrint Y=

Scrolling History

Home Screen  
MathPrint and Classic

$\frac{d}{dx}(5X)|_{x=-1}$   
5  
8  
Y1(  
5  
8  
Y1(-8)

## Scrolling History Home Screen MathPrint and Classic

Update Mode Screen

NORMAL SCI ENG  
FLOAT 0 1 2 3 4 5 6 7 8 9  
RADIAN DEGREE  
FUNC PAR POL SEQ  
CONNECTED DOT  
SEQUENTIAL SIMUL  
REAL a+bi P<math>\theta</math>  
FULL HORIZ G-T  
NEXT

Update Mode Screen

MATHPRINT CLASSIC  
n/d U n/d  
ANSWERS: AUTO DEC FRAC  
GOTO FORMAT GRAPH: NO YES  
STAT DIAGNOSTICS: OFF ON  
SET CLOCK 01/22/10 5:42 AM

## Update Mode Screen

- MATHPRINT to CLASSIC Selection
- Fraction Type Selection n/d U n/d
- ANSWERS: AUTO DEC FRAC
- GOTO FORMAT GRAPH: NO YES
- ON OFF - Stats Diagnostics

Fraction Support in LIST & MATRIX

L1+L2  
 $(\frac{2}{4} \frac{1}{2} \frac{11}{15})$

L1	L2	L3	2
1/2	1/4	-----	
1/5	3/10		
2/15	2/5		

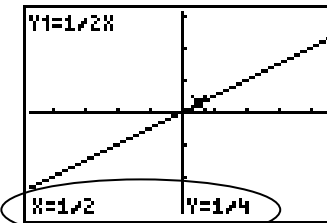
L2\*4 =

Fraction Support in LIST & MATRIX

MATRIX[A] 3 x 3  
[ [ 2/8 1/9 1/8 ]  
[ 2/5 1/5 2/5 ]  
[ 4/8 2/8 1/3 ] ]

3 \* 3 = 1/3

## Fraction Support in LIST & MATRIX



X	Y1
0	0
1	1/2
1/2	1/4
1/4	1/8
0	0

X=0

X	Y1	Y2
0	1/3	0
1/4	11/24	.2474
1/2	5/6	.47943
3/4	35/24	.68164
1	7/3	.84147
5/4	83/24	.94898
3/2	29/6	.99749

X	Y1
0	0
1	1/2
1/2	1/4
1/4	1/8
0	0

ΔTbl=

## ΔTbl Control from TABLE!

## MATH PROB

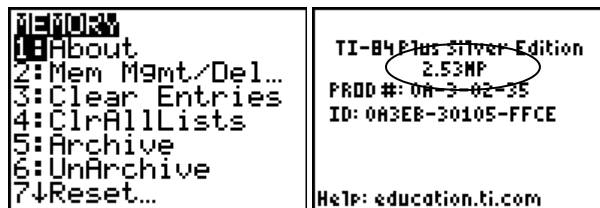
randIntNoRep(startnum,endum)  
Random ordering of integers in a range.

## MATH NUM

remainder(dividend, divisor)

## How To Check Your OS Version

1. Press **2nd Mem** on your handheld.
2. Select **1:About**.
3. Press **ENTER**.
4. We want TI-84 Plus 2.53MP.



## What You Need to Begin

- Computer with Internet access
- The latest version of TI-Connect™ software (v 1.6). Go to <http://education.ti.com/ticonnect/>
- TI Connectivity Cable (included with the TI-84 Plus Silver Edition). Some below are ancient. Available for purchase at <http://education.ti.com/ticonnect/>



Serial for Windows® or Mac® (gray)



Serial for Windows only (black)



USB for Windows® or Mac® (silver)



Standard Mini-A to Mini-B USB Cable for Windows® or Mac®

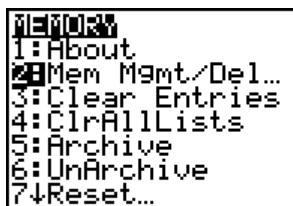
**Warning:** The cables are, from left to right, in order of oldest to most current. You will need to have TI-Connect™ Version 1.5 or later to use the Mini-A to Mini-B USB Cable. If you plug in the cable before installing the TI Connect™ software, Windows® may assign an incorrect driver for the cable. **INSTALL TI-CONNECT FIRST!!!**

- TI-84 Plus or TI-84Plus Silver Edition handheld with fresh batteries and memory archived. (You wouldn't undergo major surgery without being at the best you can be, would you?)

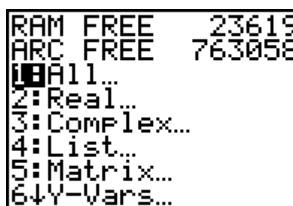
## How to Archive Your Calculator Memory

When you upgrade your OS, archived items on the receiving unit are not lost. Move items stored in Random Access Memory (RAM) into the Archived Memory as follows:

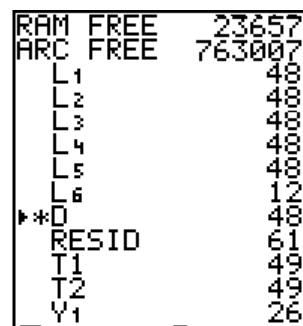
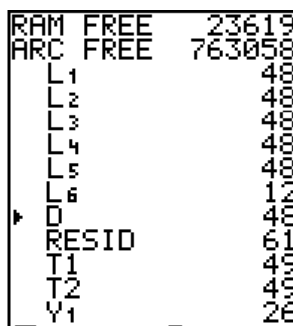
1. Press **2nd Mem** on your handheld.
2. Select **2:Mem Mgmt/Del...**
3. Select **1:All...**
4. Press **ENTER** next to anything that is not marked with a \* to move it into archived memory, where it will be safe.



You won't be able to use the item (lists, variables, programs, etc.) while they are archived. It is like a fire proof vault!

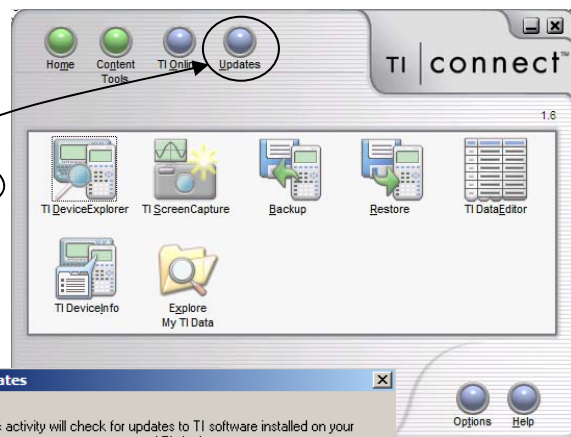


Press **ENTER** again from this screen to unarchive them and move them into RAM.



## Method 1 to Upgrade Your TI-84 OS: Let TI-Connect Do It

1. Run your Web browser and visit the TI Home Page <http://education.ti.com>
2. Start the TI Connect™ software (see above) that has already been installed on your machine.
3. Once TI Connect™ software has started, connect your handheld to the computer with the TI Connectivity Cable (See above the four types of cables.)
4. To download Apps you need the latest Operating System (OS) version for your handheld. Once you connect your handheld, click on **Updates** on TI Connect.

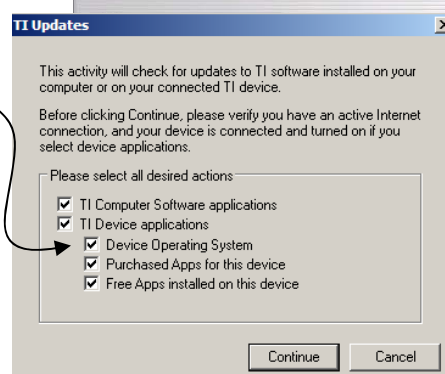


Make sure **Device Operating System** is checked.

If you need a newer OS version,  
TI Connect will upload the new OS on your machine.

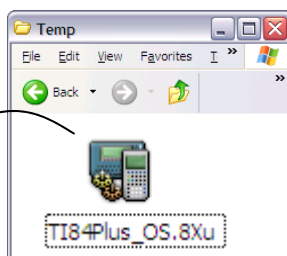
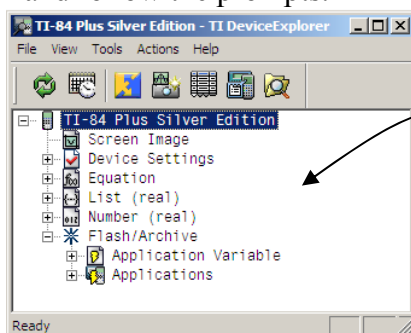
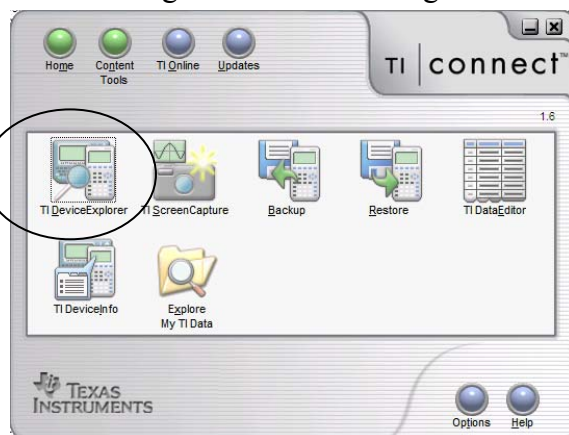


**BE SURE YOUR HANDHELD  
HAS FRESH BATTERIES!!!!**



## Method 2 to Upgrade Your TI-84 OS: Drag and Drop

- 1-3. Perform the first three steps of Method 1 above.
4. Go to <http://education.ti.com/84> and follow the prompts to get the latest 84 OS. Download it to your computer in a place you'll remember. Don't forget to download the guidebook. It has been updated too. Also download the App *Catalog Help v1.1*.
5. Once you connect your handheld, click on **TI Device Explorer** on TI Connect to open the Device Explorer window.
6. Drag the OS file into the Device Explorer window and follow the prompts.



**BE SURE YOUR HANDHELD  
HAS FRESH BATTERIES!!!!**

## Method 3 to Upgrade Your TI-84 OS: Get it From Another Upgraded Handheld

1. Make sure the calculators are **firmly** connected by inserting the ends of a unit-to-unit link cable into the appropriate port

2. On the receiving calculator, press  $\text{LINK}$   $\text{2nd}$   $\text{X, T, } \theta, n$

to access the **LINK** menu.

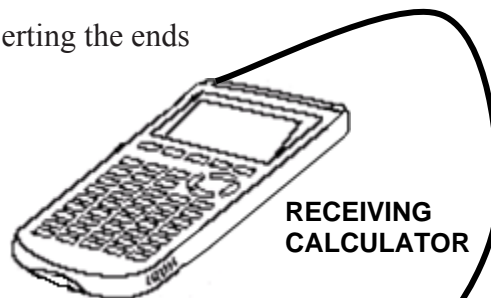
Press  $\text{RIGHT}$  to highlight the **RECEIVE** menu.

Press  $\text{ENTER}$  so that the calculator is on **Waiting...**

(The receiver must be on **Waiting** BEFORE the transfer.)

3. On the sending calculator, press  $\text{LINK}$   $\text{2nd}$   $\text{X, T, } \theta, n$  to access the **SEND** menu.

Select **G:SendOS**.



SENDING CALCULATOR

### Trouble Shooting:

1. If you receive an error, first check that the cables are firmly connected. Push in the cables tightly and then push in again. You don't want any data leaking out into the air!
2. If you still get an error, try it again with another cable. You could have trouble if the Input/Output port of the calculator is damaged.
3. If the receiving calculator does not have fresh batteries, it is unusable until new batteries have been replaced and the process is restarted.



BE SURE YOUR HANDHELD HAS FRESH BATTERIES!!!!

## Update the CatalogHelp APP to Version 1.1

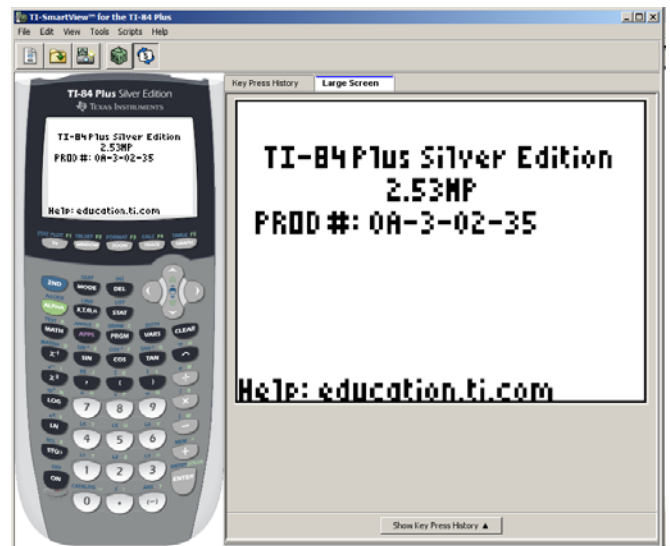
Please also update to Catalog Help v1.1 if you update to 2.53MP. You can use any of the above three methods. There is no functionality update to Catalog Help, but version 1.1 is needed to run on 2.53MP.

## Update TI-Smartview™ with the New OS

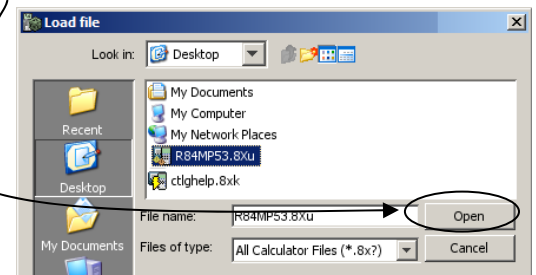
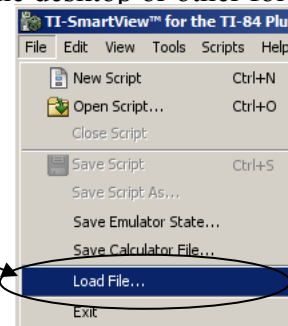
The TI-SmartView™ emulator software gives you a full functioning TI-84 Plus calculator on your computer.

To update TI-84 SmartView™ with the latest OS 2.53MP\*, your SmartView software needs to be version 3.1 or higher.

\*If you have a version of TI-84 SmartView™ below 3.0, you cannot download the Smartview software update from the TI Web Site. Instead, request your free upgrade by contacting TI Cares at 1-800-TI-CARES. You will need a photocopy of your Product Key.



1. If you haven't yet, go to <http://education.ti.com/84> and follow the prompts to get the latest 84 OS and download it to your computer in a place you'll remember, i.e., the desktop or other folder.
2. Open up TI-Smartview
3. Click on **File**.
4. Click on **Load File...**
5. The Load file dialog box displays.
6. In the Files of type: pull down menu, make sure **All Calculator Files (\*.8x?)** is selected.
7. Select the .8xu file you downloaded to your desktop.
8. Select **Open** to start loading the calculator OS to TI-SmartView.
9. If you use the Catalog Help APP, you will also want to load that file as well.

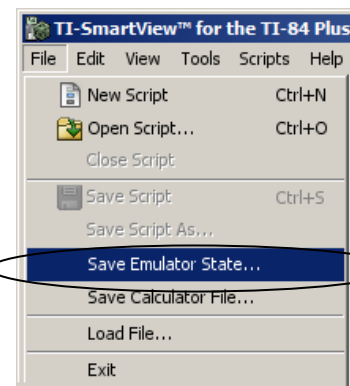


If your computer crashes while SmartView is open, it will revert back to OS v 2.43 when you restart it.



**Tip:** Click on **File > Save Emulator State** while you have TI-84 OS v 2.53MP running and give it a name, such as *MyState2010-03-07.84state*, and click **Save**. Now if you have a crash while Smartview is running and it reverts back to OS V 2.43, you can just reload the Emulator State:

1. Click **File > Load File**.
2. In the dialog box:
  - a. Navigate to the folder that contains the emulator state file.
  - b. Click the emulator state name to highlight it.
  - c. Click **Open**.



## Welcome to 2.53MP OS!

Notice the new message to access shortcut menus for access to new features and old favorites when you turn ON your calculator or reset!

Note: Most of the features in the new shortcut menus are available in the **MATH** MATH and **MATH** NUM menus.

PRESS ALPHA F1-F4  
TO LOCATE  
SHORTCUT MENUS.  
DO NOT SHOW AGAIN  
Z: CONTINUE

## The Mode Screen Has Two Pages

As before, the default settings for both Mode pages are all those on the left.

### Second Screen:

**MATHPRINT CLASSIC** – Both Mathprint™ and Classic modes contain the same new functions, except **MathPrint™** mode provides additional matrix shortcuts from the F3 soft key and displays on the home screen and Y= editor most inputs and outputs the way they are shown in textbooks,

such as  $\frac{1}{2} + \frac{3}{4}$  and  $\sum_{k=1}^{100} kx^2$ .

**Classic** mode displays expressions and answers as if written on one line, such as  $1/2+3/4$  or  $\Sigma(KX^2,K,1,100)$ .

**Note:** If you switch between these modes, most entries typed on the home screen will be preserved; however matrix calculations will not be preserved unless you store them. Think of them as images drawn on the screen.

**n/d U n/d** - selection of fraction output as improper or mixed numbers.

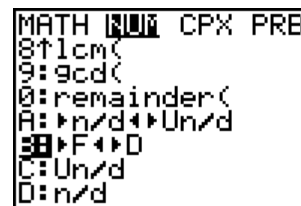
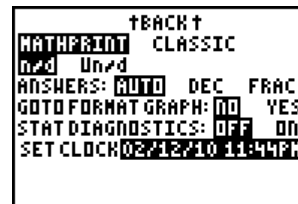
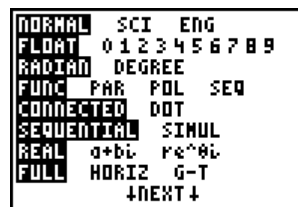
### ANSWERS

- **Auto** displays answers in a similar format as the input. For example, if a fraction is entered in an expression, the answer will be in fraction form, if possible.
- **Dec** displays answers as integers or decimal numbers.
- **Frac** displays answers as their fractional approximation, if possible.

The **Answers** mode setting also affects how values in sequences, lists, and tables are displayed.

*If **any** decimal point appears in the expression, then output is decimal. This is a quick way to force decimal output in **AUTO** mode.*

You can also convert values from decimal to fraction or fraction to decimal using the **FRAC** shortcut menu or the **MATH NUM** menu.



**GOTO FORMAT GRAPH:** Selecting YES jumps from the MODE screen to the FORMAT screen. This handy shortcut puts the FORMAT screen on the user's radar as a place to check to avoid calculator glitches, as well as helps support teachers who begin an activity making sure all is highlighted on the left on both screens. Pressing MODE will return to MODE from the FORMAT screen.

**STAT DIAGNOSTIC ON OFF** - Quickly select the existing option of displaying  $r$  and  $r^2$  when calculating statistical regressions. This is a shortcut to an existing feature (only found in the catalog under **DiagnosticOn** or **DiagnosticOff**) which is placed here for ease of use.

**SET CLOCK** was pushed to this screen so room could be made for the **↓NEXT↓** indicator on page 1.



## Helpful Tips

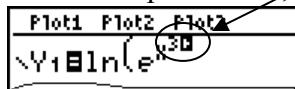


- When using scrolling history to select an item, press **ENTER** to be able to manipulate it. “You must pluck the fruit off the tree before taking a bite.”
- Make these commands your two new friends:
  - 2nd** **▶** takes you to the end of the line;
  - 2nd** **◀** takes you to the beginning of the line.
 These are handy when you may need to scroll horizontally.
- Use **ALPHA** **[F1]** to quickly access the fraction menu. (You can also can press **MATH** , press **▶** to the NUM menu, press **▲** to get **n/d** , etc. )
- In MathPrint™ mode, you get Super-Sized *math templates* of old functions as well as new ones where the screen real estate permits (namely, just the **Home Screen** and **Y= editor**):
 
 otherwise these are displayed as inline Classic equivalents in tight quarters (namely, the expression on the graph screen, WINDOW, TBLSET, TABLE, List entries, etc.)
- Using the **n/d** soft key in AUTO or FRAC mode with nondecimal numbers gives you different results than the **÷** hard key.

- n/d** soft key: **1** **ALPHA** **[F1]** **ENTER** **1** **2** will display  $\frac{1}{12}$  as a stacked fraction in template form where the screen real estate permits (namely, just the **Home Screen** and **Y= editor**); otherwise it is displayed as a “thick bar inline fraction”, i.e. as  $1/12$ , in tight quarters (WINDOW, TBLSET, TABLE, List entries, the expression on the graph screen, etc.)

- ÷** hard key: **1** **÷** **1** **2** will display  $1/12$ , the usual “thin bar inline fraction” which gives you the decimal approximation in any mode.  $\frac{1}{12} \approx .0833333333$

- Look at the screen as you type!  
In a math template arrows will appear as guideposts to steer you. Follow them.  
For example, if we want  $\sqrt{1 + \ln(e^{x^3+1})} + 1$ , once you are in the exponent are, press **▶**.  
You may feel the urge to press **▼** to move down. Resist the urge.



- Because of the unpredictability of the height of the expression on the entry line when using templates in MathPrint™ Mode, entries and answers will not wrap as in Classic Mode; however, if you watch the screen as you type, you can just break longer calculations into smaller ones.

MathPrint™

$$\begin{array}{l} 358.25+258.12 \\ \text{Ans}+589.35 \\ 1205.72 \end{array}$$

or

$$\begin{array}{l} 358.25+258.12+58 \\ 1205.72 \end{array}$$

Classic

$$\begin{array}{l} 358.25+258.12+58 \\ 9.35 \\ 1205.72 \end{array}$$

MathPrint™

Classic

You can also scroll horizontally in MathPrint™ Mode with the left and right arrow keys, but make sure the expression is on the entry line.  $358.25+258.12+58$

- Notice when you try to access the top row graphing keys **Y=** **WINDOW** **ZOOM** **TRACE** and you are in **ALPHA** LOCK (for example, wherever there are list names).

## Use Stacked Fractions, Scrolling History, and Zoom Features to Investigate Patterns!

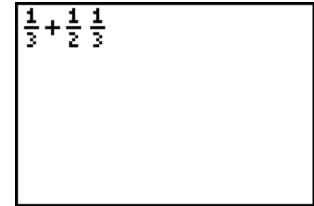
1. Press  $\boxed{1}$ .
2. Press  $\boxed{\text{ALPHA}} \boxed{[F1]}$  to get to the shortcut FRAC menu.



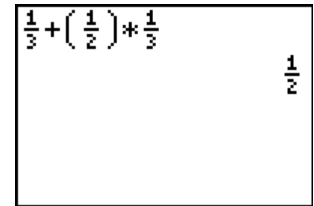
3. Press  $\boxed{\text{ENTER}}$  or  $\boxed{1}$  to select  $n/d$ .



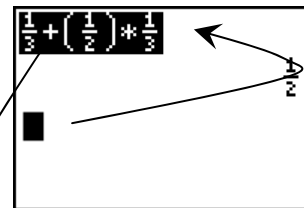
4. Press  $\boxed{3} \boxed{\rightarrow} \boxed{+} \boxed{1} \boxed{\text{ALPHA}} \boxed{[F1]} \boxed{\text{ENTER}} \boxed{2} \boxed{\rightarrow} \boxed{1} \boxed{\text{ALPHA}} \boxed{[F1]} \boxed{\text{ENTER}} \boxed{3} \boxed{\rightarrow}$



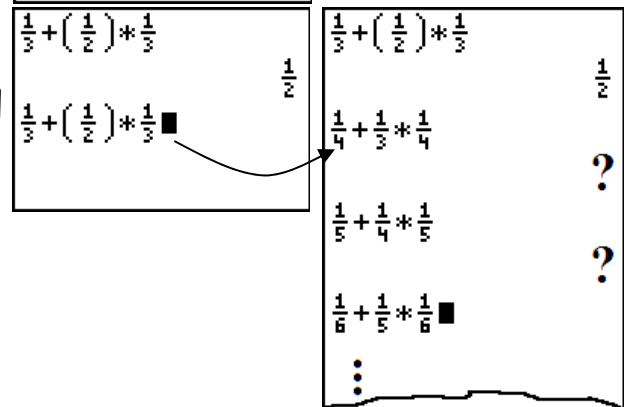
5. Press  $\boxed{\text{ENTER}}$  (to say “please”).



6. Press the  $\boxed{\uparrow}$  key twice to climb up the tree and highlight the expression. Press  $\boxed{\text{ENTER}}$  to “pluck the fruit off the tree.”



7. Press  $\boxed{2nd} \boxed{\leftarrow}$  to go to the beginning of the line. Change the expression to increase each denominator by 1. Press  $\boxed{\text{ENTER}}$ .



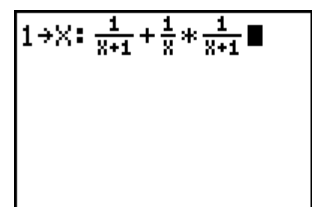
8. Repeat.

### Questions:

1. What pattern do you notice? Will it always work?
2. If you entered  $\frac{1}{100} + \frac{1}{99} * \frac{1}{100}$  what would you expect? Confirm your guess.

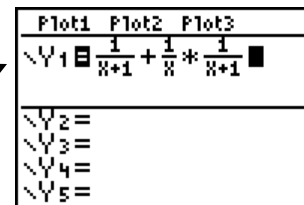
3. Explore  $\frac{1}{x+1} + \frac{1}{x} * \frac{1}{x+1}$  on the home screen for values of  $x$  of your choice.

Store a number in  $x$ :  $\boxed{1} \boxed{\text{STO}} \boxed{X,T,U,V} \boxed{\text{ALPHA}} \boxed{[ : ]}$ , then “climb the tree” by pressing the  $\boxed{\uparrow}$  key twice, press  $\boxed{\text{ENTER}}$  to pluck the fruit, and replace numbers with variable expressions.



- Replay, using  $\text{2nd}$   $\leftarrow$  to go to the beginning of the line and make  $x$  any nondecimal value you wish. What do you observe?
- Explore the graph of  $y = \frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$

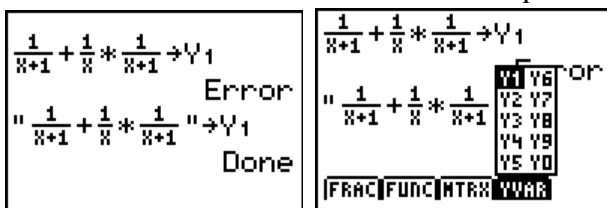
Replay, use the delete key so only you have  $\frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$  on the entry line, and press  $\text{ENTER}$ .



Press  $Y=$ , position your cursor in  $Y1$ , and press  $\text{2nd}$   $\text{ENTER}$  to “beam the expression up” into  $Y1$ .

**Alternate Approach:**

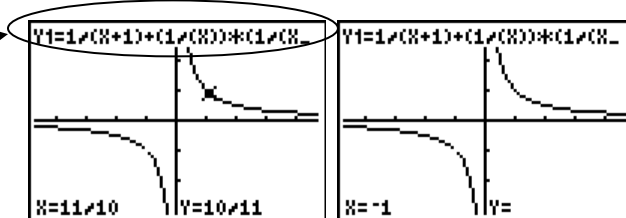
(You can also do this from the home screen but must use quotes. Use  $\text{ALPHA}$   $[F4]$   $\text{ENTER}$  to quickly get  $Y1$ .)



- Press  $\text{ZOOM}$  and scroll to see some neat options. Use  $\text{ZFract1/10}$ , press  $\text{TRACE}$ , and use the left and right arrow keys. Note:  $\text{ZFract1/10}$  sets the window variables so that you can trace in increments of  $\frac{1}{10}$ , if possible, and sets  $\Delta X$  and  $\Delta Y$  to  $\frac{1}{10}$ .



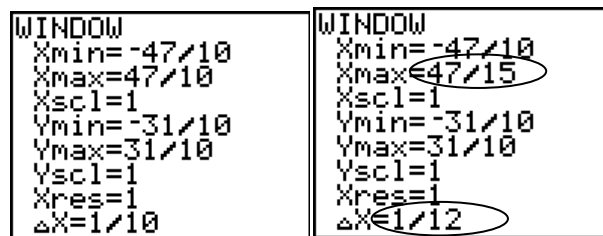
Notice the graph equation is in classic format. (Instead of a stacked fraction,  $n/d$  is shown as a thick bar inline fraction.) Compare the graph coordinate values as you trace.



What is happening when  $x = -1$ ?

Press  $\text{GRAPH}$  to liberate the cursor from the curve and observe the screen coordinates in this window.

- Press  $\text{WINDOW}$ . Scroll to notice  $\Delta X$  has now joined the party!  $\text{ZFract1/10}$  uses thick bar inline fractions for  $Xmin$ ,  $Xmax$ ,  $Ymin$ ,  $Ymax$ , and  $\Delta X$ .



Want  $\text{ZFract1/12}$  instead?

You can make it (or others) yourself. Change  $\Delta X$  to  $1/12$ .

(This adjusts  $Xmin$  or  $Xmax$  since  $\Delta x = \frac{Xmax - Xmin}{94}$ .) Press  $\text{GRAPH}$  and  $\text{TRACE}$ .

Notice it converts coordinates when possible. There is no longer a hole showing at  $x = -1$ . Why not? Make the adjustment  $Xmin = -47/12$  to center the window.

$$Xmax = 47/12$$

Now press  $\text{GRAPH}$  and  $\text{TRACE}$ . Voila! There's the hole.

- Build the motivation to get a common denominator and show  $\frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$  is algebraically  $\frac{1}{x}$ .

## Use the $\Delta Tbl$ Shortcut

Find how long it takes for \$200 compounded quarterly at 6 percent APR to grow to \$475.  
Report your answer correct to the nearest 0.1 year.

Advantages: This is a quick way to find approximate solutions, since you often use the table to help build the graphing window anyway. It also provides an avenue for multiple perspectives.

1. Enter the expression in Y1 and press  $\boxed{2nd}$   $\boxed{WINDOW}$  to match the screen shown to the right.

Plot1	Plot2	Plot3
$\sqrt{Y1}$	$\sqrt{Y2}$	$\sqrt{Y3}$
$200(1 + \frac{.06}{4})^{4X}$		

TABLE SETUP	
TblStart=	0
$\Delta Tbl$ =	1
IndPnt:	Auto Ask
Depend:	Auto Ask

2. Scroll the table to find when the amount is closest to \$475.

X	Y1	
0	200	
1	212.27	
2	225.3	
3	239.12	
4	253.8	
5	269.37	
6	285.9	

Press + for  $\Delta Tbl$

3. Position your cursor on the input whose output is closest to \$475. In this case, we highlight 14.

X	Y1	
11	385.07	
12	408.7	
13	433.77	
14	460.39	
15	488.64	
16	518.63	
17	550.45	

X=14

4. Press  $\boxed{+}$  and change  $\Delta Tbl$  to 0.1. Press  $\boxed{ENTER}$ . It will take about 14.5 years to reach \$475.

X	Y1	
11	385.07	
12	408.7	
13	433.77	
14	460.39	
15	488.64	
16	518.63	
17	550.45	

$\Delta Tbl=.1$

X	Y1	
14	460.39	
14.1	463.14	
14.2	465.91	
14.3	468.69	
14.4	471.49	
14.5	474.31	
14.6	477.14	

X=14.5

To approximate the answer to 0.01 years, we need only repeat the last two steps, setting  $\Delta Tbl$  to 0.01.

It will take about 14.52 years to reach \$475.

Support the answer with a graphical and analytical solution, or use the equation solver in the  $\boxed{MATH}$  MATH menu.

X	Y1	
14	460.39	
14.1	463.14	
14.2	465.91	
14.3	468.69	
14.4	471.49	
14.5	474.31	
14.6	477.14	

X=14.5

X	Y1	
14	460.39	
14.1	463.14	
14.2	465.91	
14.3	468.69	
14.4	471.49	
14.5	474.31	
14.6	477.14	

$\Delta Tbl=.01$

X	Y1	
14.48	473.74	
14.49	474.03	
14.5	474.31	
14.51	474.59	
14.52	474.87	
14.53	475.16	
14.54	475.44	

X=14.52

Another example: Consider using the table to explore the behavior of  $y = \frac{x^2 - 4}{x - 2}$  near  $x = 2$ .

## Use $\log_b x$ to Build Conceptual Understanding of the Logarithm

- Compare the expressions on the screen to the right.  
Notice the usual order of operations are followed.  
Unveil  $\log_2(4)^3 = (\log_2(4))^3 = (\log_2 2^2)^3 = (2)^3 = 8$   
and  $\log_2(4^3) = \log_2(2^2)^3 = \log_2(2^6) = 6$

$\log_2(4)^3$	8
$\log_2(4^3)$	6

Explore with a table and a graph.

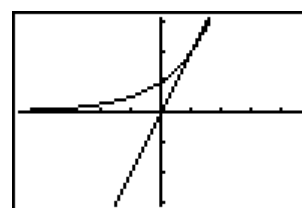
What is simplified form of each?

Plot1	Plot2	Plot3
$Y_1 = \log_2(4)^x$		
$Y_2 = \log_2(4^x)$		
$Y_3 =$		
$Y_4 =$		
$Y_5 =$		

Do they look more familiar now?  
Superimpose graphs of  $y = 2^x$  and  $y = 2x$  over each.  
Facilitate a class discussion on inverse properties.

X	Y1	Y2
0	1	0
1	2	2
2	4	4
3	8	6
4	16	8
5	32	10
6	64	12

Press + for  $\Delta|b|$



- Consider the function  $y = \log_x 10$ .

Enter the expression in Y1.

Plot1	Plot2	Plot3
$Y_1 = \log_x(10)$		

Press  $\text{2nd}$   $\text{WINDOW}$  to match the screen shown to the right,  
where **IndEnt** is set to Ask.

TABLE SETUP		
TblStart=	0	
$\Delta$ Tbl=	1	
IndEnt:	Auto	Ask
Depend:	Auto	Ask

Explore with a table, where  $x$  is a power of 10.

X	Y1	
10	1	
100	1/2	
1000	1/3	
10000	1/4	
1*10	-1	

X=

Explore with a graph after, say, ZoomQuadrant1.



Simplify the function  $y = \log_x 10$  so that  $x$  is not the logarithmic base.  
Compare tables and graph the result in the same window.

**Answer:**  $y = \frac{1}{\log x}$

- Perform a similar investigation with the function  $y = \log_x e$ ,  
exploring in a table values of  $x$  which are powers of  $e$ .  
What is another way to write this function, where  $x$  is not the logarithmic base?

## Scroll Through the History to Build the Sum of a Sequence

1. Using the scrolling history we can successively build up the series below.

- a. Create these expressions on your home screen. Use **n/d** once.  
No need to use the parentheses keys at all.

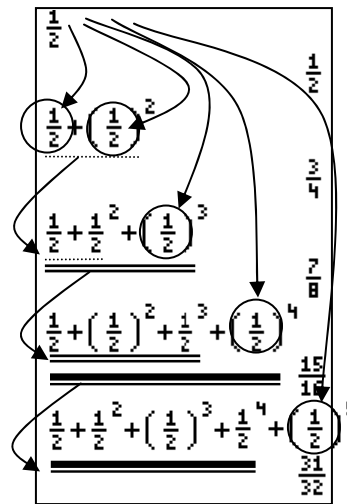
$$\frac{1}{2}$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^4 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^4 + \left(\frac{1}{2}\right)^5 =$$



- b. Can you predict the next one?

Now use sigma notation  $\sum_{k=1}^n \left(\frac{1}{2}\right)^k$  using the **ALPHA** [F2] shortcut to make four more.

What pattern do you see with the total sums?

- c. Is the sum getting bigger or smaller? Is the number we are adding each time getting bigger or smaller? Is the sum approaching a number? Explain your answer.

2. Pose new questions and make conjectures:

- a. Suppose your first number for finding sums as in the previous problem was  $\frac{1}{3}$  instead of  $\frac{1}{2}$ .

Use the same pattern as the one used above and investigate the sums in the same manner.

- b. Try the same investigation with  $\frac{1}{4}$ .

- c. What is the pattern if you use  $\frac{1}{5}$ ?

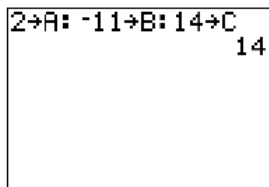
- d. Does a pattern hold for  $\frac{2}{5}$ ?

- e. What happens if you use  $\frac{3}{2}$ ?

## An Old Favorite Cleans Up Well: The Quadratic Formula\*

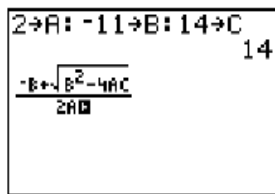
Begin with the equation  $2x^2 - 11x + 14 = 0$ .

1. Press **2** **[STO]** **[ALPHA]** **A** to store the coefficient of the  $x^2$  term.
2. Press **[ALPHA]** **[:]**. The colon allows you to enter more than one instruction on a line.
3. Press **(-)** **11** **[STO]** **[ALPHA]** **B** to store the coefficient of the X term. Press **[ALPHA]** **[:]** to enter a new instruction on the same line. Press **14** **[STO]** **[ALPHA]** **C** to store the constant.
4. Press **[ENTER]** to store the values to the variables A, B, and C.
5. The last value you stored is shown on the right side of the display. The cursor moves to the next line, ready for your next entry.

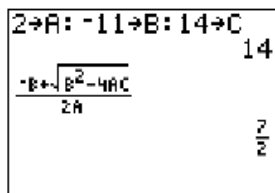


6. Press **[ALPHA]** **[F1]** **1** **[ALPHA]** **B** **[+]** **[2nd]** **[√]** **[ALPHA]** **B** **[x<sup>2</sup>]** **-** **4** **[ALPHA]** **A** **[ALPHA]** **C** **[>]** **[>]** **2** **[ALPHA]** **A** to enter the expression for one of the solutions for the quadratic formula,

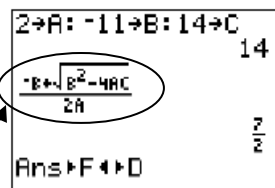
$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



7. Press **[ENTER]** to find one solution for the equation  $2x^2 - 11x + 14 = 0$ .  
The answer is shown on the right side of the display. The cursor moves to the next line, ready for you to enter the next expression.



8. Convert to a decimal if desired.
9. To find the other solution, press the UP arrow to highlight the expression, press **ENTER**, edit as appropriate, and press **ENTER**.

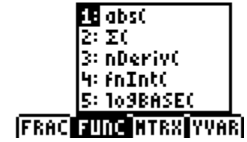
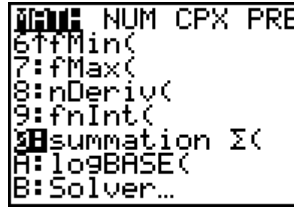


\*The above is taken from the updated TI-84 Plus / TI-84 Silver Edition guidebook, available online at <http://education.ti.com/84> for download.

## Summary of New Functionality

From the **MATH** MATH menu or **ALPHA** [F2]:

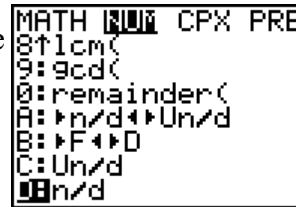
- **Summation**  $\Sigma$  (*expression, start, end*) displays the MathPrint™ summation entry template  $\sum_{start}^{end} (expression)$  and returns the sum of elements of *list* from *start* to *end*, where *start*  $\leq$  *end*.
- **logBASE**(*value, base*) displays the template  $\log_{base}(value)$  and returns  $\log_{base} value$ .



From the **MATH** NUM menu or **ALPHA** [F1]:

- **remainder**(*dividend, divisor*) reports the remainder as a whole number from a division of two whole numbers where the divisor is not zero.

remainder(125, 2)  
1

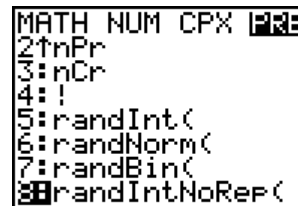


- Converts the results from a fraction to mixed number (**Un/d**) or from a mixed number to a fraction (**n/d**), if applicable.
- Converts an answer from a fraction to a decimal or from a decimal to a fraction.
- **Un/d** displays results as a mixed number, if applicable.  $\frac{a}{b}c$ . The unit, numerator and denominator are limited to three digit integers.
- **n/d** displays results as a simple fraction, if possible.  $\frac{a}{b}$ . The numerator and denominator are limited to five digit integers. Complex arithmetic is not supported using **n/d**.

From the **MATH** PRB menu:

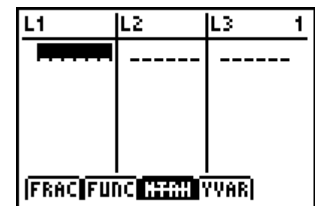
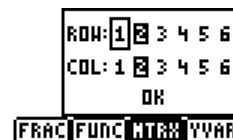
- **RandIntNoRep**(*startnum, endnum*) gives a random reordering of an interval of integers.

randIntNoRep(1, 5)  
(1 3 2 5 4)  
randIntNoRep(1, 5)  
(4 5 1 2 3)  
randIntNoRep(1, 5)  
(3 2 5 1 4)



Other Menu Shortcuts:

- **MTRX** Shortcut through **ALPHA** [F3] may be crossed out when it can't fit in one line, i.e., outside of Home Screen or Y= Editor or when in Classic Mode.
- **YVAR** Shortcut through **ALPHA** [F4] is tied to graphing mode.

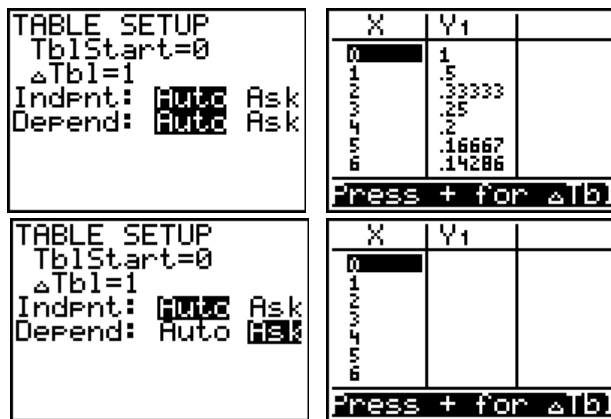


<p>Function Mode</p>	<p>Parametric Mode</p>	<p>Polar Mode</p>	<p>Sequence Mode Note: <b>u, v, w,</b> and <b>n</b> are already on the keypad.</p>
----------------------	------------------------	-------------------	--



Shortcuts continued:

- Scroll through the history of calculations on the home screen in MathPrint™ or Classic mode. Quickly recall an input/output by simply highlighting it and pressing enter. (Lists and matrices as output will not paste from the history)
- Use the  $\Delta$ Tbl Shortcut when IndFmt is set to Auto.



- Jumping to Format screen from second page of Mode screen facilitates classroom housekeeping.
- Stat Diagnostics display controls are easily accessible.



### Compatibility with Programs

- Programs created with OS 2.43 and earlier should run correctly but may give unexpected results when you run them using OS 2.53MP. You should test programs created with earlier OS versions to make sure you get the desired results. In particular, some programmers write strings without closing quotation marks or expressions without closing parentheses. Break this habit now to avoid unexpected results.
- Programs can run in Classic or MathPrint™ mode.
- Shortcut menus are available wherever the MATH menu can be accessed.
- MathPrint™ templates are not available for programs. All input and output is in Classic format.
- You can use fractions in programs, but you should test the program to make sure that you get the desired results.
- The spacing of the display may be slightly different in MathPrint™ mode than in Classic mode. (In MathPrint™ Mode, the entire screen prints pixel by pixel. In Classic Mode, the screen prints line by line.) You may notice that programs run slightly slower in MathPrint Mode. If you prefer the spacing in Classic mode, set the mode using a command in your program.
- If a program dumps output to the Home Screen, it is not possible to access it by arrowing up through the scrolling history. (Recall you could not access it with  $\boxed{2nd}$  [ENTRY] either.)

## Compatibility with Apps Released Before 2/15/2010

APPS developed prior to OS V 2.53MP will still run on the TI-84 Plus family in a classic format entry. For example, Transformation Graphing and Inequality Graphing Y= will be in classic format. The new features of MathPrint (templates and fraction math) will not be enabled since the APPS were developed for previous OS versions.

TI-Navigator will not accept the new MathPrint or fraction entry features as was true for new features that appeared in the 2.43 OS.



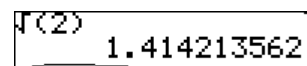
Remember, any version of Catalog Help prior to 1.1 is not compatible with 2.53MP.

## Carpe Deim!

Effective use of technology requires understanding what the machine is doing. Otherwise it is easy to be misled.

This is a finite decimal machine. Always has been. Always will be. It tries to behave, however, as if it is not.

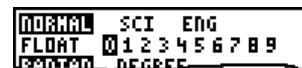
For example, ask *any* programmable device to compute  $\sqrt{2}$ .



```
√(2)
1.414213562
```

That's a nice approximation, but we know there is a lot more after that, in fact, 1.414213562373095048801688724209698078569671875376948073176679737990732478...

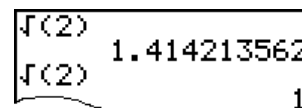
If you change the Mode to "Fixed 0", you may get unexpected results.



```
NORMAL SCI ENG
FLOAT 0 1 2 3 4 5 6 7 8 9
FIXED 0 DEGREE
```

Why did it do this?

Because you asked it to display it that way. ☺



```
√(2)
1.414213562
√(2)
1
```

Now with TI-84 Plus OS Update 2.53MP, the  $\frac{\blacktriangleright}{\blacktriangleleft}$ Frac command is more powerful than ever, displaying any result as a fraction, if possible, where the numerator and denominator can be up to five digits. Wow!

So, if you change the Mode to "FRAC", and compute some anomalous irrational numbers (and these are not easy to find!), you may get unexpected results.



```
MATHPRINT CLASSIC
Dnd Unnd
ANSWERS: AUTO DEC FRAC
```

Why did it do this?

Because you asked it to display it that way. ☺



```
5√3
70226
8109
```

The fraction command will approximate the output, if possible, as a fraction.

Moral: In a technological age, users must understand what they are asking the machine to do.

If a student chooses to do the above, you have a wonderful teaching moment on your hands.

This is a classic example of "Garbage In-Garbage Out" (GIGO), i.e, when the user blames the machine for not "doing the right thing" when given imperfect input.

They will have to learn this lesson sooner or later, and the sooner the better.

*Carpe Diem!*