



# **Getting Started with the TI-84 Plus CE *Python* Graphing Calculator**

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# What's New

## *What's New in TI-84 Plus CE Python v5.6.0*

### **TI-84 Plus CE Python**

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#### **CE Calculator File Updates**

- CE OS v5.6.0
  - Python App v5.5.0
  - Periodic Table App v5.5.0 (element updates)
  - Science Tools App v5.5.0 (constants update)
  - Polynomial Root Finder and Simultaneous Equation Solver v5.5.0 (minor fix)
  - Language Localization Apps v5.5.0 (minor additions)
- 

#### **Python Programming**

##### *TI-84 Plus CE Python*

- Supports Python programming using the Python App from the 84CE Bundle v5.6.0. Update to the latest at [education.ti.com/84ceupdate](https://education.ti.com/84ceupdate).
- Access the Python App from **[2nd]** **[apps]** or **[prgm]** when the Python App is loaded.

**Note:** What is your CE calculator experience for TI-Python?

- TI-84 Plus CE *Python* with 84CE Bundle v5.6.0 or higher
- 

#### **Software Information**

##### **TI Connect™ CE**

Connectivity support and \*.py <> PY AppVar conversion for the TI-84 Plus CE *Python*.

##### **TI-SmartView™ CE**

TI-84 Plus CE *Python* emulator supports Python App v5.5.0

Sample programs HELLO, GRAPH, and LINREGR are loaded upon install and reset.

Data Import Wizard converts appropriately formatted \*.csv files to calculator lists for the CE emulator. This feature is helpful when using ti\_system module and external data for Python programming.

- If decimal numbers are represented with the use of comma in the \*.csv file, the file will not convert using the Data Import Wizard. Please check your computer operating system number formatting and convert the \*.csv to use the decimal point representation. The CE calculator list and matrix editor use the number format as, for example, 12.34 and not 12,34.

**Note:** To run TI-Innovator™ Hub or TI-Innovator™ Rover programs, please send programs to the calculator using TI Connect™ CE. Please quit the Python App prior to a Emulator Explorer transfer to the computer and then to the calculator. TI-Innovator™ Hub and TI-Innovator™ Rover programs will not run from TI-SmartView™ CE.

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For more information about the new and updated functionality, go to [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate).

# Using Your TI-84 Plus CE *Python* Graphing Calculator

The TI-84 Plus CE *Python* graphing calculator comes with a USB cable, plenty of storage and operating memory. It also comes pre-loaded with software applications (Apps) to perform pre-algebra, algebra, calculus, biology, chemistry, and physics calculations.

## Key Features

- **High resolution, full-color backlit display**
  - Distinguish between multiple graphs and plots with color-coded equations, plots, and objects
  - Make graphs easier to read by adding grid lines
- **TI Rechargeable Battery**
  - Recharges using a USB cable, wall charger, or TI Charging Station CE
- **Familiar TI-84 Plus functionality**
  - Similar menu structure and navigation as the TI-84 Plus family with enhanced features
  - Built-in MathPrint™ functionality to input and view math symbols, formulas and stacked fractions
- **Import and use images**
  - Use TI Connect™ CE Software to send images (.gif, .jpg, .png, .tif, .bmp) from a computer to a calculator
  - Graph on top of images to connect concepts to the real world

The applications extend the functionality of your calculator, allowing you to perform specific math and science functions and to deepen your understanding of concepts. Pre-loaded applications include:

- |   |                                 |
|---|---------------------------------|
| • Cabri™ Jr   | • Probability Simulations       |
| • CellSheet™  | • Science Tools                 |
| • Conic Graphing  | • SmartPad for TI-SmartView™ CE |
| • Inequality Graphing                                     | • TI-Innovator™ Hub             |
| • Periodic Table  | • Transformation Graphing       |
| • Polynomial Root Finder and Simultaneous Equation Solver | • Vernier EasyData®             |
| • Python Programming for TI-84 Plus CE <i>Python</i>      |                                 |

**Note:** When Apps are not on your CE, please update to the latest at [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate).

Use this guide to learn more about these features and other essential tools of your TI-84 Plus CE *Python* graphing calculator.



# Using the Keyboard

This section covers basic graphing calculator settings and explains how to navigate the home screen and menus.

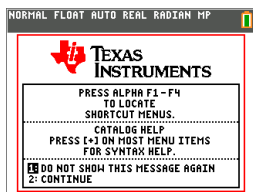
## *Turning the TI-84 Plus CE Python On and Off*

This section covers basic on and off features for your graphing calculator.

### Turning the Graphing Calculator On

Press **[on]**.

An information screen displays:



- Press **[1]** to continue to the home screen but not see this information screen the next time you press **[on]**.

-or-

- Press **[2]** to continue to the home screen.

**Note:** Any entry from this information screen will take you to the home screen (a blank screen).

The information screen shows the following for information purposes only. You must go to the home screen before you can complete the following.

- Press **[alpha] [f1] - [f4]** to locate shortcut menus.
- Press **[+]** on most menu items for Catalog Help.

**Note:** This message also displays when you reset RAM.

You may see a context-sensitive shortcut menu located at **[alpha] [f5]** for interactive features or actions such as interactive drawing features from the graph screen or TI-Basic program editing.

## Turning the Graphing Calculator Off

Press **[2nd]** **[off]**.

- The Constant Memory™ function retains settings and memory, and clears any error condition.
- If you turn off the TI-84 Plus CE *Python* and connect it to another graphing calculator or personal computer, any communication will “wake” it up.

## Automatic Power Down™ (APD™)

- To prolong battery-life, APD™ automatically turns the TI-84 Plus CE *Python* off after about three to four minutes of inactivity.
- If APD™ turns the graphing calculator off, it will return as you left it, including the display, cursor, and any error.

## Using the TI-84 Plus CE *Python* Keyboard

This section describes the functions of specific keys on the graphing calculator keyboard.

### TI-84 Plus CE *Python* Keyboard

- 1 Graph/Plot Setup Keys** allow access to interactive graphing features. When some graph screen features are active, you may see a shortcut menu in the **[alpha]** **[f5]** location for feature options.

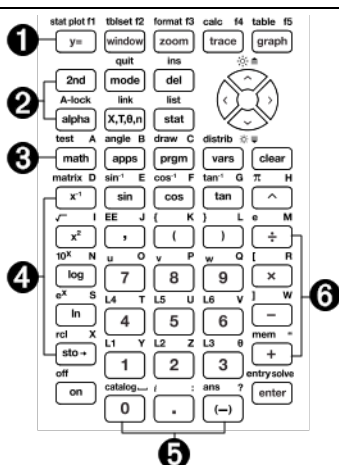
- 2 Editing Keys** allow you to edit expressions and values.

- 3 Math and Statistics Keys** display menus that access math, statistics, and other basic functions.

- 4 Scientific Keys** allow access to the capabilities of a standard scientific calculator—including trigonometric functions.

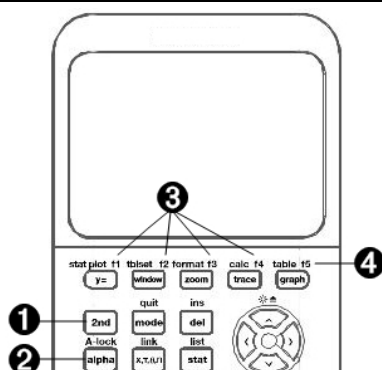
- 5 Number Keys** allow you to enter numbers.

- 6 Common Math Functions** allow you to divide, multiply, subtract, and add.



## Function Keys

- 1 **2nd** Access the second function printed to the left above each key.
- 2 **alpha** Access the third function printed to the right above each key.
- 3 **alpha** [f1] - [f4] Access shortcut menus for fraction templates, n/d, quick matrix entry, select **MATH** menus, and **VARS** menu functions.
- 4 **alpha** [f5] Context-sensitive shortcut menu for interactive features or actions such as interactive drawing features from the graph screen or TI-Basic program editing.



## Using the Function Keys

- |                               |  |
|-------------------------------|--|
| Primary Function              | The function appears on the key.<br><b>Ex:</b> to display the <b>MATH</b> menu, press <b>[math]</b> .  |
| Secondary Function            | The function appears above the key in the same color as the <b>2nd</b> key.<br>When you press the <b>2nd</b> key, the key name printed above the other key becomes active for the next keystroke.<br><b>Ex:</b> to display the <b>TEST</b> menu, press <b>2nd</b> and then <b>[test]</b> .<br>The flashing cursor becomes <b>■</b> when you press <b>2nd</b> . <b>■</b> may also appear in the status bar.   |
|                               |  |
| Tertiary (Alpha Key) Function | The function appears above the key in the same color as the <b>alpha</b> key.<br>The third function allows you to enter alphabetic characters and special symbols, and to access SOLVE and shortcut menus.<br><b>Ex:</b> to display the letter A, press <b>alpha</b> and then <b>[A]</b> . <ul style="list-style-type: none"> <li>• To enter several alphabetic characters in a row, press <b>2nd</b> <b>[A-lock]</b>. This locks the alpha key in the ON position so that you avoid having to repeatedly press <b>alpha</b>. Press <b>alpha</b> again to unlock it.</li> <li>• The flashing cursor becomes <b>■</b> when you press <b>alpha</b>. <b>■</b> may also appear in the status bar.</li> </ul> |
|                               |  |

## Setting the Display Brightness

This section covers how to set the display brightness and explains automatic dimming.

### Adjusting the Display Brightness

You can adjust the display brightness to suit your viewing angle and lighting conditions.

To adjust the brightness, follow these steps.

- ▶ Press **2nd** **▼** to darken the screen one level at a time.
- ▶ Press **2nd** **▲** to lighten the screen one level at a time.

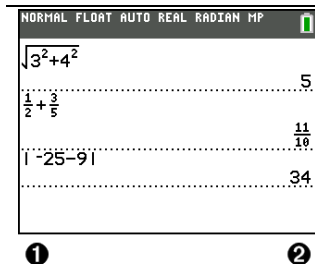
The TI-84 Plus CE *Python* retains the brightness setting in memory when it is turned off.

### Automatic Dimming

The TI-84 Plus CE *Python* automatically dims the screen brightness after 90 seconds of inactivity.

- ▶ Press **on** to return the screen to the preset brightness.
- ▶ Pressing **on** to adjust the brightness will not affect any of the current state of your calculator work.

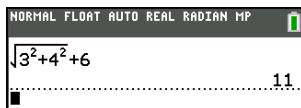
## Using the Home Screen



- 1 Expressions
- 2 Answers

Use the home screen to enter instructions and evaluate expressions. Answers appear on the same screen. Most calculations are stored in home screen history. Press  $\left[ \Delta \right]$  and  $\left[ \nabla \right]$  to scroll through the entry history and paste the entries or answers to the current entry line.

1. Enter a calculation.
2. Press  $\left[ 2\text{nd} \right]$   $\left[ \text{quit} \right]$  from any screen until you get back to the home screen.
3. Press  $\left[ 2\text{nd} \right]$   $\left[ \sqrt{\phantom{x}} \right]$   $3$   $\left[ x^2 \right]$   $\left[ + \right]$   $4$   $\left[ x^2 \right]$   $\left[ \rightarrow \right]$   $6$   $\left[ \text{enter} \right]$ .



**Note:** When you are in a MathPrint™ template, the cursor turns into a right arrow  $\rightarrow$  to indicate that you must press  $\left[ \rightarrow \right]$  to get out of the template before you continue entering the calculation.



### Displaying Entries and Answers

Mode settings control how the TI-84 Plus CE *Python* interprets expressions and displays answers. Press  $\left[ \text{mode} \right]$  to switch between classic entries and MathPrint™ mode. This guide focuses on MathPrint™ Mode, but may reference some classic entries.

### MathPrint™ Mode

- If an expression exceeds one line, it may scroll off the screen (on the home screen or the Y=screen). Press  $\left[ \rightarrow \right]$  to see the entire expression.

**Tip:** Press the cursor without pressing  $\left[ 2\text{nd} \right]$  to move the cursor along the line.

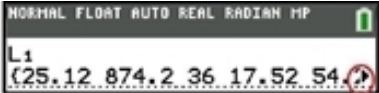
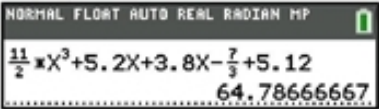
- An arrow appears to the left of an answer if it scrolls off the screen. Press  $\rightarrow$  and  $\leftarrow$  before you enter another expression to display the entire answer.

Classic Entries	MathPrint™
$1\frac{1}{2}$	$\frac{1}{2}$
$\sqrt{(5)}$	$\sqrt{5}$
$nDerive(x^2, x, 1)$	$\frac{d}{dx}(x^2) \mid x=1$

Some input areas in MathPrint™ mode only support classic entries.

Ex:  $\boxed{2nd} \boxed{[table]}$

### MathPrint™ (default)

	Entry Answer (Scrolls)
	Entry Answer

## Scrolling Through the Home Screen History

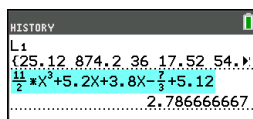
If all lines of the display are full, text scrolls off the top of the display.

You can scroll up through previous entries and answers on the home screen, even if you have cleared the screen. When you find an entry or answer that you want to use, you can select it and paste it (press [enter]) on the current entry line.

**Note:** List and matrix answers cannot be copied and pasted to the new entry line. However, you can copy the list or matrix command to the new entry line and execute the command again to display the answer.

- ▶ Press  $\uparrow$  or  $\downarrow$  to move the cursor to the entry or answer you want to copy and then press [enter].

The TI-84 Plus CE *Python* highlights the entry the cursor is on to help you select your desired choice.



The entry or answer that you copied is automatically pasted on the current input line at the cursor location.

**Note:** If the cursor is in a MathPrint™ expression, such as the denominator of a fraction, press [alpha]  $\uparrow$  to move the cursor out of the expression and then move the cursor to the entry or answer you want to copy to that location in the MathPrint™ template.

- ▶ Press [clear] or [del] to delete an entry/answer pair. After an entry/answer pair has been deleted, it cannot be displayed or recalled again.

## Returning to the Home Screen

To return to the home screen from any other screen, press [2nd] [quit] until you get back to home screen.

## Status Bar

The status bar displays on all screens and gives information about the selected calculator mode settings, any context help available for the item you currently have selected, and battery status.

The status bar may also show a busy indicator if the calculator is performing an operation,  $\alpha$  to indicate the calculator is in alpha status, and  $\mathbf{I}$  to indicate the secondary function is active.

Selected mode settings are displayed on the top line of the status bar when the cursor is in the active entry area. Mode settings do not display when the cursor is in the home screen history, since the mode may have been different for previous calculations.

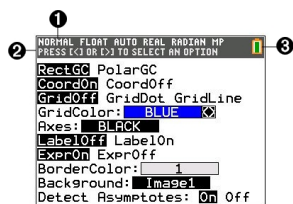
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**Tip:**

Context help, if available, is displayed on the second line. The battery status icon, busy indicator, alpha indicator, and second key indicator are on the right. When you scroll into the home screen history, the context help on the status bar displays HISTORY.

In the example below, the cursor is on the GridColor option. The context help for how to change the GridColor using the spinner menu is displayed on the second line of the status bar.

---



① Selected MODE settings.

② Context help for current cursor position or active feature.

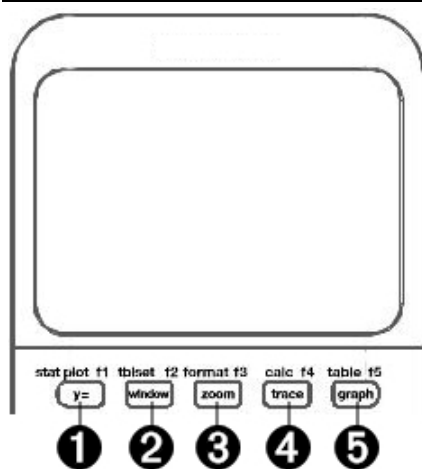
③ Battery icon.

This area of the status bar also displays the busy indicator, alpha indicator, and second key indicator, depending on the state of the graphing calculator.

---



## Using Shortcut Menus



- 1  $\alpha$  [f1]  
Opens FRAC menu.
- 2  $\alpha$  [f2]  
Opens FUNC menu.
- 3  $\alpha$  [f3]  
Opens MTRX menu.
- 4  $\alpha$  [f4]  
Opens YVAR menu.
- 5  $\alpha$  [f5]  
Opens special menus.

Shortcut menus allow quick access to the following:

- [f1] Templates to enter fractions, and to toggle between whole and mixed fractions, and fractions and decimals.
- [f2] Selected functions from the MATH MATH and MATH NUM menus as you would see them in a textbook, when in MathPrint™ mode. Functions include absolute value, numeric differentiation, numeric integration, summation, log base n, square root, permutations, combinations, and factorials.
- [f3] Quick MathPrint™ matrix entry, when available.
- [f4] Names of function variables from the VARS Y-VARS menu.

To open a shortcut menu, press  $\alpha$  plus the corresponding F-key: [f1] for FRAC, [f2] for FUNC, [f3] for MTRX, [f4] for YVAR, or [f5] for special menus within interactive graph activities, such as when using DRAW or Quick Plot and Fit Equation, and for TI-Basic program editing.

To select a menu item:

-either-

- Press the number corresponding to the item.

-or-

- Use the arrow keys to move the cursor to the appropriate line and then press [enter].

You can select all shortcut menu items except matrix templates using standard menus. For example, you can choose the summation template from several places:

FUNC shortcut menu

alpha

f2

NORMAL FLOAT AUTO REAL RADIAN MP

1:abs(

2:summation  $\Sigma$ (

3:nDeriv(

4:fnInt(

5:logBASE(

6:x<sup>f</sup>

7:nPr

8:nCr

9:!

1:|

2: $\Sigma$

3: $\frac{d}{dx}$

4: $\int$

5:log

6: $\square^{\square}$

7: $\square P$

8: $\square C$

9: $\square !$

FRAC

FUNC

MTRX

YVAR

2nd

catalog

NORMAL FLOAT AUTO REAL RADIAN MP

CATALOG

summation  $\Sigma$ (

tan(

tan<sup>-1</sup>(

Tangent(

tanh(

tanh<sup>-1</sup>(

tcdf(

Text(

TextColor(

The shortcut menus are available to use where input is allowed. If the calculator is in Classic mode, or if a screen is displayed that does not support MathPrint™ display, entries will be displayed in Classic mode. The MTRX menu is only available in MathPrint™ mode on the home screen and in the Y= editor.



**Note:** Shortcut menus may not be available if **alpha** plus f-key combinations are used while an application is running.

Display Cursors

The cursor may change to indicate what will happen when you press the next key or when you select the next menu item to be pasted as a character.

**Note:** The second cursor **II** and alpha cursor **A** may appear on the status bar, depending on the context.

Cursor	Appearance	Effect of Next Keystroke
Entry	Solid rectangle ■	This is the default cursor. Enter characters at this cursor; this overrides any existing character.
Insert	Underline —	Press <b>2nd</b> <b>ins</b> for this cursor. Enter characters in front of the cursor location.
Second	Reverse arrow II	This allows you to enter a 2nd character or complete a 2nd operation.
Alpha	Reverse A A	An alpha character is entered, <b>SOLVE</b> is executed, or shortcut menus are displayed.

Cursor	Appearance	Effect of Next Keystroke
Full	Checkerboard rectangle 	No entry; the maximum characters are entered at a prompt or memory is full. Also indicates the limit of the allowed MathPrint™ mode levels.
MathPrint™	Right arrow 	The cursor moves to either the next part of the template or out of the template. Press the right arrow to move out of all MathPrint™ templates before entering the remaining terms in an expression.

If you press **[alpha]** during an insertion, the cursor becomes an underlined **A (A)**. If you press **[2nd]** during an insertion, the underlined cursor becomes an underlined **↑ (↑)**.

**Note:** If you highlight a small character such as a colon or a comma and then press **[alpha]** or **[2nd]**, the cursor does not change because the cursor width is too narrow.

## Working with Menus

You can access TI-84 Plus CE *Python* commands using menus.

### Displaying a Menu

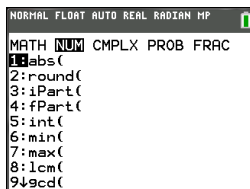
- When you press a key to display a menu, that menu temporarily replaces the screen where you are working.
- **Ex:** press  $\boxed{\text{math}}$  to display the **MATH** menu.
- After you select an item from a menu, the screen where you are working usually displays again.

**Note:** If a context help message is in the status bar when you press a menu that temporarily replaces the screen, that context help will remain in the status bar as a reminder that you are working within a context.

### Moving from One Menu to Another

Some keys access more than one menu. When you press such a key, the names of all accessible menus are displayed on the top line. When you highlight a menu name, the items in that menu are displayed. Press  $\boxed{\rightarrow}$  and  $\boxed{\leftarrow}$  to highlight each menu name.

**Note:** FRAC shortcut menu items are found in the FRAC menu, and are also found on the MATH NUM menu. FUNC shortcut menu items are also found on the MATH MATH menu.



### Scrolling a Menu

To scroll down the menu items, press  $\boxed{\downarrow}$ . To scroll up the menu items, press  $\boxed{\uparrow}$ .

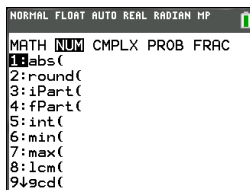
To page down 9 menu items at a time, press  $\boxed{\alpha}\boxed{\downarrow}$ . To page up 9 menu items at a time, press  $\boxed{\alpha}\boxed{\uparrow}$ .

To go to the last menu item directly from the first menu item, press  $\boxed{\uparrow}$ . To go to the first menu item directly from the last menu item, press  $\boxed{\downarrow}$ .

### Selecting an Item from a Menu

You can select an item from a menu in three ways.

- ▶ Press the number or letter of the item you want to select. The cursor can be anywhere on the menu, and the item you select does not need to be displayed on the screen.

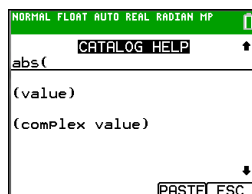


-or-

- ▶ Press  $\boxed{\downarrow}$  or  $\boxed{\uparrow}$  to move the cursor to the item you want, and then press  $\boxed{\text{enter}}$ .

-or-

- ▶ Within the Catalog listing of functionality, move the cursor to the item you want, and then press  $\boxed{+}$ . For most commands, the Catalog Help syntax editor displays the correct syntax. Enter the syntax using the displayed help, and then press  $\boxed{\alpha}$   $\boxed{f4}$  to paste. The Catalog Help pastes the complete command.
- ▶ Press  $\boxed{\alpha}$   $\boxed{f5}$  to escape without pasting the command.



### Notes:

- After you select an item from a menu, the TI-84 Plus CE *Python* typically displays the previous screen.
- If you do not see PASTE on the Catalog Help screen, press  $\boxed{2nd}$   $\boxed{quit}$  until you return to the home screen, then repeat your actions. If this happens, it may mean the screens were layered and the previous screen did not have an active cursor on an input line to accept the pasting of the function or command.

### Leaving a Menu without Making a Selection

You can leave a menu without making a selection in these two ways.

- Press  $\boxed{2nd}$   $\boxed{quit}$  to return to the home screen.

-or-

- Press  $\boxed{clear}$  to return to the previous screen.

### Using Menus

When you press a key or key combination to display a menu, one or more menu names appear on the top line of the screen.

- The menu name on the left side of the top line is highlighted. Up to nine items in that menu are displayed, beginning with item 1.
- A number or letter identifies each item's place in the menu. The order is 1 through 9, then 0, then A, B, C. Once number and letter options are exhausted, the item number or letter area will be blank. Select these items using the arrow keys.
- When the menu continues beyond the displayed items, a down arrow ( $\downarrow$ ) replaces the colon next to the last displayed item.
- When a menu item ends in an ellipsis (...), the item displays a secondary menu, editor, or wizard when you select it.
- Use Catalog Help for more syntax help when needed. Select a menu item and then press  $\boxed{+}$  to go to a syntax help editor (if the menu item is supported).

### Working with MATH Menus

To display the MATH menus, press  $\boxed{math}$ . Press  $\boxed{\leftarrow}$  or  $\boxed{\rightarrow}$  to display the menus for the NUM (Number), CMPLX (Complex), PROB (Probability) or FRAC (Fraction) commands.

- **Note:** Use Catalog Help for more syntax help when needed. Select a menu item and then press  $\boxed{+}$  to go to a syntax help editor (if the menu item is supported).

## MATH

To display the **MATH** menu, press  $\boxed{\text{math}}$ .

1: $\blacktriangleright$ Frac	Displays the answer as a fraction.
2: $\blacktriangleright$ Dec	Displays the answer as a decimal.
3: $\sqrt{\phantom{x}}$	Calculates the cube.
4: $\sqrt[3]{\phantom{x}}$	Calculates the cube root.
* 5: $\sqrt[x]{\phantom{x}}$	Calculates the $x^{\text{th}}$ root.
6: fMin(	Finds the minimum of a function.
7: fMax(	Finds the maximum of a function.
* 8: nDeriv(	Computes the numerical derivative of a function at a point.
* 9: fnInt	Computes the numerical integral of a function over an interval.
* 0: summation $\Sigma$ (	Computes the sum of an expression over an index.
* A: logBASE(	Computes the logarithm of a specified value determined from a specified base: logBASE(value, base).
B: piecewise(	Allows the entry of piecewise functions.
C: Numeric Solver...	Displays the equation solver.

\* FUNC shortcut menu  $\boxed{\alpha}$   $\boxed{\text{f2}}$

## NUM

To display the NUM menu, press  $\boxed{\text{math}}$   $\boxed{\blacktriangleright}$ .

* 1: abs(	Absolute value
2: round(	Round
3: iPart(	Integer part
4: fPart(	Fractional part
5: int(	Greatest integer

6: min(	Minimum value
7: max(	Maximum value
8: lcm(	Least common multiple
9: gcd(	Greatest common divisor
0: remainder(	Reports the remainder as a whole number from a division of two whole numbers where the divisor is not zero.
** A: $\blacktriangleright$ n/d $\blacktriangleleft\blacktriangleright$ Un/d	Converts an improper fraction to a mixed number or a mixed number to an improper fraction.
** B: $\blacktriangleright$ F $\blacktriangleleft\blacktriangleright$ D	Converts a decimal to a fraction or a fraction to a decimal.
** C: Un/d	Displays the mixed number template in MathPrint™ mode. Displays a small u between the whole number and fraction in Classic mode. Use n/d to complete the mixed number.
** D: n/d	Displays the fraction template in MathPrint™ mode. Displays a thick fraction bar between the numerator and the denominator in Classic mode. Also accessible by pressing $\boxed{\alpha}$ $\boxed{x, \tau, \theta, n}$ .

\* FUNC shortcut menu  $\boxed{\alpha}$  [f2]

\*\* FRAC shortcut menu  $\boxed{\alpha}$  [f1]

## CMPLX

To display the CMPLX menu, press  $\boxed{\text{math}}$   $\boxed{\blacktriangleright}$   $\boxed{\blacktriangleright}$ .

1: conj(	Returns the complex conjugate.
2: real(	Returns the real part.
3: imag(	Returns the imaginary part.
4: angle(	Returns the polar angle.
5: abs(	Returns the magnitude (modulus).
6: $\blacktriangleright$ Rect	Displays the result in rectangular form.
7: $\blacktriangleright$ Polar	Displays the result in polar form.

## PROB

To display the PROB menu, press  $\boxed{\text{math}}$   $\boxed{\blacktriangleleft}$   $\boxed{\blacktriangleleft}$ .

1: rand	Random-number generator
* 2: nPr	Number of permutations
* 3: nCr	Number of combinations
* 4: !	Factorial
5: randInt(	Random-integer generator
6: randNorm(	Random # from Normal distribution
7: randBin(	Random # from Binomial distribution
8: randIntNoRep(	Random ordered list of integers in a range

\* FUNC shortcut menu  $\boxed{\alpha}$   $\boxed{f2}$

## FRAC

To display the FRAC menu, press  $\boxed{\text{math}}$   $\boxed{\blacktriangleleft}$ .

** 1: n/d	Displays the fraction template in MathPrint™ mode. Displays a thick fraction bar between the numerator and the denominator in Classic mode. Also accessible by pressing $\boxed{\alpha}$ $\boxed{X,T,\theta,n}$ .
** 2: Un/d	Displays the mixed number template in MathPrint™ mode. Displays a small u between the whole number and fraction in Classic mode. Use n/d to complete the mixed number.
** 3: $\blacktriangleright F \blacktriangleleft \blacktriangleright D$	Converts a decimal to a fraction or a fraction to a decimal.
** 4: $\blacktriangleright n/d \blacktriangleleft \blacktriangleright Un/d$	Converts an improper fraction to a mixed number or a mixed number to an improper fraction.

\*\* FRAC shortcut menu  $\boxed{\alpha}$   $\boxed{f1}$



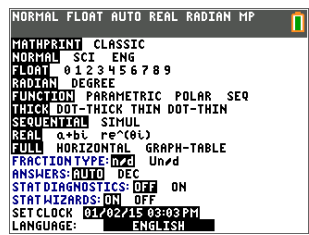
# Setting Up the Calculator Modes

Mode settings control how the calculator displays and interprets:

- Answers
- Elements of lists and matrices
- Graphs
- Language settings
- Numbers

## Setting Modes

To set calculator modes, press **[mode]**. The following menu appears on your screen:



**Note:** When you press **[mode]**, the cursor is on **NORMAL** by default. Press **[↑]** to switch between MathPrint™ and Classic modes.

**Note:** The Constant Memory™ feature retains mode settings when the unit is turned off.

## Changing Mode Settings

To change mode settings, follow these steps:

1. Press **[↓]** or **[↑]** to move the cursor to the line of the setting that you want to change.
2. Press **[→]** or **[←]** to move the cursor across the line to the desired setting.
3. Press **[enter]** to select a setting.

**Exception: LANGUAGE** Press **[→]** or **[←]** to select a loaded language. Press **[↓]** or **[↑]** to set the selected language.

**Note:** The second line of the status bar displays context help with a description of line modes.

Mode	Description
MATHPRINT CLASSIC	Controls whether inputs and outputs on the home screen and in the Y= editor are displayed as they are in textbooks
NORMAL SCI ENG	Numeric notation

Mode	Description
<b>FLOAT</b> 0 1 2 3 4 5 6 7 8 9	Number of decimal places in answers
<b>RADIAN</b> <b>DEGREE</b>	Unit of angle measure
<b>FUNCTION</b> <b>PARAMETRIC</b> <b>POLAR</b> <b>SEQ</b>	Type of graphing
<b>THICK</b> <b>DOT-THICK</b> <b>THIN</b> <b>DOT-THIN</b>	Resets all Y= line styles
<b>SEQUENTIAL</b> <b>SIMUL</b>	Whether to plot sequentially or simultaneously
<b>REAL</b> $a+bi$ $re^{i\theta}$	Real, rectangular complex, or polar complex
<b>FULL</b> <b>HORIZONTAL</b> <b>GRAPH-TABLE</b>	Full screen, two split-screen modes
<b>FRACTION</b> <b>TYPE:</b> $\frac{n}{d}$ $Un/d$	Displays results as simple fractions or mixed fractions
<b>ANSWERS:</b> <b>AUTO</b> <b>DEC</b>	Controls the format of the answers
<b>STAT</b> <b>DIAGNOSTICS:</b> <b>OFF</b> <b>ON</b>	Determines which information is displayed in a statistical regression calculation
<b>STAT</b> <b>WIZARDS:</b> <b>ON</b> <b>OFF</b>	Determines if syntax help prompts are provided for optional and required arguments for many statistical, regression and distribution commands and functions
<b>SET</b> <b>CLOCK</b>	Sets the time and date
<b>LANGUAGE:</b> <b>ENGLISH</b>	Sets the display language

## MATHPRINT™ CLASSIC

**MATHPRINT™** mode displays most inputs and outputs the way they are shown in

textbooks, such as  $\frac{1}{2} + \frac{3}{4}$  and  $\int_1^2 x^2 dx$ .

**CLASSIC** mode displays expressions and answers as if written on one line, such as  $1/2 + 3/4$ . (Fraction bars appear as thick lines. A division operation will appear as a thin slash mark.)

### Note:

- Some areas in **MATHPRINT™** mode display in classic (one line) formats.
- If you switch between these modes, most entries (except matrix calculations) will be preserved.

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## NORMAL SCI ENG

Answers are displayed in standard formats when the calculation or setting forces a decimal result on the calculator.

Notation for 12345.67	Decimal answer displays as:
<b>NORMAL</b> 12345.67 Retains the decimal notation up to limits of the calculator display and memory.	12345.67
<b>SCI</b> (Scientific) 1.234567 x 10 <sup>4</sup>  One digit to the left of the decimal with the appropriate power of 10 to the right of *E.	1.234567E4
<b>ENG</b> (Engineering) 12.34567 x 10 <sup>3</sup>  Up to three digits before the decimal and the power of 10 (to the right of E) is a multiple of three.	12.34567E3

### Note:

\* This E in the display stands for "x10" and the number entered after E becomes the power of 10.

The keypad contains  $\boxed{2\text{nd}} \boxed{[E]}$ , which displays as E on the calculator. The calculator notation, E, designates the "x10" part of the number without using extra parentheses. The calculator then follows the order of operations as expected when using SCI or ENG notation. This notation, E, is not typically accepted on homework and exams, and written results should use the standard notation, for example, the 1.234567 x 10<sup>4</sup>.

If you select **NORMAL** notation, but the answer cannot display in 10 digits (or the absolute value is less than .001), the TI-84 Plus CE *Python* expresses the answer in scientific notation.

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## FLOAT 0 1 2 3 4 5 6 7 8 9

**FLOAT** (floating) decimal mode displays up to 10 digits, plus the sign and decimal. **FLOAT** will display in the status bar.

Selecting **0123456789** specifies the number of digits (0 through 9) to display to the right of the decimal for decimal answers. **FIX#** will display in the status bar.

The decimal setting applies to **NORMAL**, **SCI**, and **ENG** notation modes.

The decimal setting applies to these numbers, with respect to the **ANSWER** mode setting:

- An answer displayed on the home screen
- Coordinates on a graph
- The **Tangent**( DRAW instruction equation of the line, x, and **dy/dx** values
- Results of calculated operations
- The regression equation stored after the execution of a regression model

## **RADIAN    DEGREE**

Angle modes control how the calculator interprets angle values in trigonometric functions and polar/rectangular conversions. The **RADIAN** or **DEGREE** setting will display in the status bar.

**RADIAN** mode interprets angle values as radians. Answers display in radians.

**DEGREE** mode interprets angle values as degrees. Answers display in degrees. Polar complex number arguments are always interpreted in radians.

## **FUNCTION    PARAMETRIC    POLAR    SEQ**

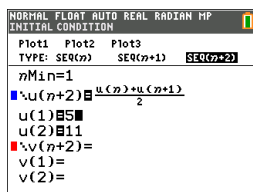
Graphing modes define the graphing parameters.

**FUNCTION** graphing mode plots functions, where Y is a function of X.

**PARAMETRIC** graphing mode plots relations, where X and Y are functions of T.

**POLAR** graphing mode plots functions, where r is a function of  $\theta$ .

**SEQUENCE** graphing mode plots sequences. Three sequences are available: u, v, and w, with an option of the independent variables of n, n+1, and n+2.



## **THICK    DOT-THICK    THIN    DOT-THIN**

Line Style:	Graphs as:
<b>THICK</b>	Thick line style (default). More pixels displayed around a plotted point (pixel). Equivalent to CONNECTED on earlier TI-84 Plus calculators.
<b>DOT-THICK</b>	Large dot plotting. (3x3 pixels). Equivalent to DOT on earlier TI-84 Plus calculators.

<b>THIN</b>	Thin line style (graphing per pixel). Use THIN for functions whose graph has an axis as an asymptote or for any plotting where a more detailed view of the graph is needed as compared to THICK.
<b>DOT-THIN</b>	DOT display is 1 pixel per dot graphed. Use DOT-THIN for functions whose graph has an axis as an asymptote or for any plotting where a more detailed view of the graph is needed as compared to DOT-THICK.

**Note:**

- You can change individual line styles in the Y= editor.
- Setting a line style plotting mode sets all Y= line styles to the selected style.

## SEQUENTIAL SIMUL

**SEQUENTIAL** graphing-order mode evaluates and plots one function completely before the next function is evaluated and plotted.

**SIMUL** (simultaneous) graphing-order mode evaluates and plots all selected functions for a single value of X and then evaluates and plots them for the next value of X.

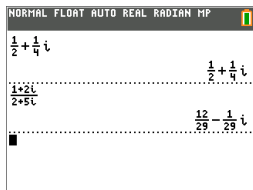
**Note:** Regardless of which graphing mode is selected, the calculator will sequentially graph all stat plots before it graphs any functions.

## REAL $a+bi$ $re^{(\theta i)}$

**REAL** mode does not display complex results unless complex numbers are entered as input.

Two complex modes display complex results.

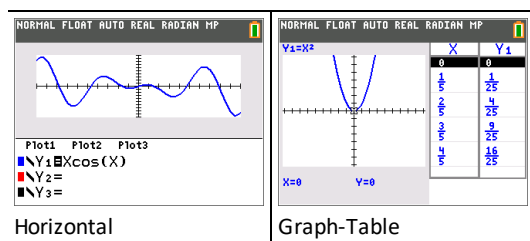
- **$a+bi$**  (rectangular complex mode) displays complex numbers in the form  $a+bi$ . The TI-84 Plus CE *Python* supports the n/d fraction template.
- **$re^{(\theta i)}$**  (polar complex mode) displays complex numbers in the form  $re^{(\theta i)}$ .



## FULL HORIZONTAL GRAPH-TABLE

**FULL** screen mode uses the entire screen to display a graph. Each split-screen mode displays two screens simultaneously.

- **HORIZONTAL** mode displays the current graph on the top half of the screen and most other calculator features on the bottom half.
- **GRAPH-TABLE** mode displays the current graph on the left half of the screen and plotted lists on the right half.



## FRACTION TYPE: $n/d$ $Un/d$

$n/d$  displays results as a simple fraction. Fractions may contain a maximum of six digits in the numerator; the value of the denominator may not exceed 9999.

$Un/d$  displays results as a mixed number, if applicable. **U**, **n**, and **d** must be all be integers. If **U** is a non-integer, the result may be converted  $U\ n/d$ . If **n** or **d** is a non-integer, a syntax error is displayed. The whole number, numerator, and denominator may each contain a maximum of three digits.

## ANSWERS: AUTO DEC

**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. If a decimal appears in the expression, the output will be a decimal number.

**DEC** displays answers as integers or decimal numbers.

**Note:** The **ANSWERS** mode setting also affects how values in sequences, lists, and tables are displayed. You can also convert values from decimal to fraction or fraction to decimal using  $\blacktriangleright$ FRAC,  $\blacktriangleright$ DEC, and  $\blacktriangleright$ F $\blacktriangleright$ D located in the **FRAC** shortcut menu or the **MATH** submenu.

## STAT DIAGNOSTICS: OFF ON

**OFF** displays a statistical regression calculation *without* the correlation coefficient ( $r$ ) or the coefficient of determination ( $r^2$ ).

**ON** displays a statistical regression calculation *with* the correlation coefficient ( $r$ ), and the coefficient of determination ( $r^2$ ), as appropriate.

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## STAT WIZARDS: ON OFF

**ON:** Selection of menu items in **MATH PROB**, **STAT**, **CALC**, **DISTR DISTR**, **DISTR DRAW** and **seq()** in **LIST OPS** displays a screen which provides syntax help (wizard) for the entry of required and optional arguments into the command or function. The function or command will paste the entered arguments to the Home Screen history or to most other locations where the cursor is available for input. Some calculations will compute directly from the wizard. If a command or function is accessed from [catalog] the command or function will paste without wizard support.

If no wizard is available, use Catalog Help for more syntax help when needed. To use Catalog Help, select a menu item and then press  $\boxed{+}$ .

**OFF:** The function or command will paste to the cursor location with no syntax help (wizard).

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## SET CLOCK

Use the clock to set the time and date, select the clock display format, and turn the clock on and off. The clock is turned on by default and is accessed from the mode screen.

### Displaying the Clock Settings

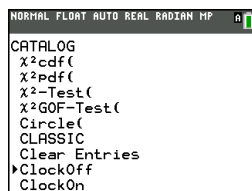
1. Press  $\boxed{\text{mode}}$ .
2. Press  $\boxed{\uparrow}$   $\boxed{\uparrow}$   $\boxed{\uparrow}$  to move the cursor to **SET CLOCK**.
3. Press  $\boxed{\text{enter}}$  to change clock settings.



**Note:** You may have to reset the clock if your battery power runs out. See [education.ti.com](http://education.ti.com) for future updates on the battery and battery preservation features.

### Turning the Clock On and Off

1. Press  $\boxed{2nd}$   $\boxed{\text{catalog}}$ .
2. Press  $\boxed{\downarrow}$  or  $\boxed{\uparrow}$  to scroll the **CATALOG** until the selection cursor points to **ClockOff** or **ClockOn**.
3. Press  $\boxed{\text{enter}}$   $\boxed{\text{enter}}$ .



## LANGUAGE

Press  $\blacktriangleright$  or  $\blacktriangleleft$  on the LANGUAGE spinner menu to select a loaded language. Press  $\blacktriangledown$  or  $\blacktriangleup$  to set the selected language.

### Note:

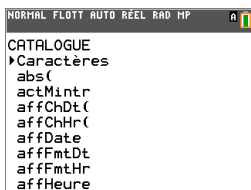
- The calculator will retain your language setting for most resets of the calculator.
- The **LANGUAGE** spinner menu will only display Language Apps loaded on the calculator. Check [education.ti.com](http://education.ti.com) for all available languages. Use TI Connect™ CE to load files to your calculator.

### Using the Special Character Set

After you select your desired language, a new item (**CHARACTER**) is added to the TI-84 Plus CE *Python* **CATALOG**. This item accesses special characters and accent marks used in the language that you chose for localization. You can use these special characters and accent marks for display messages and text strings that you want to store to a variable. You cannot, however, use them in variable names.

1. Press  $\boxed{2\text{nd}}$  [catalog] to display the **CATALOG**.

**Note:** **CHARACTER** is always the first item in the **CATALOG**.



2. Press [enter] to display the **CHARACTER** screen.

Accent marks appear in the menus at the bottom of the screen.



3. You can:
  - Select a special character:
    - a) Press  $\blacktriangleleft$ ,  $\blacktriangleright$ ,  $\blacktriangledown$ , or  $\blacktriangleup$  to move the box to the special character that you want to use in a message or text string.
    - b) Press [enter] to place the character on the edit line.
    - c) Press  $\blacktriangleleft$ ,  $\blacktriangleright$ ,  $\blacktriangledown$ , or  $\blacktriangleup$  to move the box to **Done**.
    - d) Press [enter] to paste the contents of the edit line to the previous screen.

-or-

- Add an accent mark to a character:
  - a) Press the function key ( $\boxed{f1}$ ,  $\boxed{f2}$ ,  $\boxed{f3}$ ,  $\boxed{f4}$ , or  $\boxed{f5}$ ) immediately above the accent mark to select it. The ALPHA uppercase mode is automatically turned on. To



change to lowercase, press  $\boxed{\text{alpha}}$ .

- b) Press the key associated with the alpha character that you want to accent, for example, [A] (above  $\boxed{\text{math}}$ ). The accented character is displayed in the edit line.
- c) Press  $\boxed{\leftarrow}$ ,  $\boxed{\rightarrow}$ ,  $\boxed{\downarrow}$ , or  $\boxed{\uparrow}$  to move the box to **Done**.
- d) Press [enter] to paste the contents of the edit line to the previous screen.

# Evaluating Expressions

An expression is a group of

- numbers,
- variables,
- functions and their arguments,
- or-
- a combination of these elements.

An expression evaluates to a single answer.

On the TI-84 Plus CE *Python*, you enter an expression in the same order as you would write it on paper. For example:  $\pi R^2$  is an expression.

## Order of Operations

The TI-84 Plus CE *Python* uses an order of operations system called Equation Operating System (EOS™), which

- defines the order in which functions in expressions are entered and evaluated
- and-
- allows you to enter numbers and functions in a simple, straightforward sequence.

EOS™ evaluates the functions in an expression in this order:

Order	Function
1	Functions that precede the argument, such as <b>sin(</b> or <b>log(</b>
2	Functions that are entered after the argument, such as 2, -1, !, °, r, and conversions
3	Powers and roots, such as 2 <sup>5</sup> or $\sqrt[5]{32}$
4	Permutations ( <b>nPr</b> ) and combinations ( <b>nCr</b> )
5	Multiplication, implied multiplication, and division
6	Addition and subtraction
7	Relational functions, such as > or
8	Logic operator <b>and</b>
9	Logic operators <b>or</b> and <b>xor</b>

**Note:** Within a priority level, EOS™ evaluates functions from left to right. Calculations within parentheses are evaluated first. A number in scientific or engineering notation, 2.34E6, is interpreted as  $(2.3 \times 10^6)$  with parentheses so the number remains the correct value during the EOS™ calculation.

## Implied Multiplication

The TI-84 Plus CE *Python* recognizes implied multiplication, so you do not need to press  $\boxed{\times}$  to express multiplication in all cases. For example, the TI-84 Plus CE interprets  $2\pi$ ,  $4\sin(46)$ ,  $5(1+2)$ , and  $(2*5)7$  as implied multiplication.

**Note:** TI-84 Plus CE *Python* implied multiplication rules differ from those of some other graphing calculators. For example:

Expression	TI-84 Plus CE <i>Python</i> evaluates as	Other Calculators may evaluate as
$1/2X$	$(1/2)X$	$1/(2X)$

## Parentheses

The TI-84 Plus CE *Python* completes all calculations inside a pair of parentheses first. For example, in the expression  $4(1+2)$ , EOS™ first evaluates the expression inside the parentheses,  $1+2$ , and then multiplies the answer, 3, by 4.

NORMAL FLOAT AUTO REAL RADIAN MP	
$4 \times 12$	48
$4(1+2)$	12

## Negation

To enter a negative number, use the negation key. Press  $\boxed{(-)}$  and then enter the number. On the TI-84 Plus CE *Python*, negation is in the third level in the EOS™ hierarchy. Functions in the first level, such as squaring, are evaluated before negation.

Example:  $-X^2$ , evaluates to a negative number (or 0). Use parentheses to square a negative number.

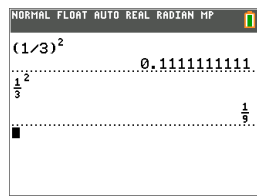
NORMAL FLOAT AUTO REAL RADIAN MP	
$-2^2$	-4
$(-2)^2$	4

NORMAL FLOAT AUTO REAL RADIAN MP	
$2 \rightarrow A$	2
$-A^2$	-4
$(-A)^2$	4

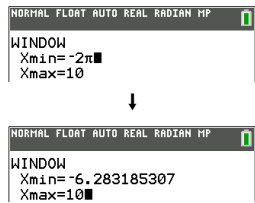
**Note:** Use the  $\boxed{-}$  key for subtraction and the  $\boxed{(-)}$  key for negation. If you press  $\boxed{-}$  to enter a negative number, as in  $9 \boxed{\times} \boxed{-} 7$ , or if you press  $\boxed{(-)}$  to indicate subtraction, as in  $9 \boxed{(-)} 7$ , an error occurs. If you press  $\boxed{\alpha} A \boxed{(-)} \boxed{\alpha} B$ , it is interpreted as implied multiplication  $(A)(-B)$ .

# Entering Expressions and Instructions

You can use an expression on the home screen to calculate an answer. In most places where a value is required, you can use an expression to enter a value.



Expressions evaluate to the (approximate) decimal display



## Entering an Expression

To create an expression, you enter numbers, variables, and functions using the keyboard and menus. An expression is evaluated when you press [enter], regardless of the cursor location. The entire expression is evaluated according to EOS™ rules, and the answer is displayed according to the mode setting for Answer.

Most TI-84 Plus CE *Python* functions and operations are symbols comprising several characters. You must enter the symbol from the keyboard or a menu; do not spell it out. For example:

- To calculate the log of 45, you must press **[log] 45**. Do not enter the letters **L**, **O**, and **G**. If you enter **LOG**, the TI-84 Plus CE *Python* interprets the entry as implied multiplication of the variables **L**, **O**, and **G**.
- When working with matrices, do not type the individual keys for **[ , A, and ]**. Use the NAMES menu in **[2nd] [matrix]** to paste the matrix name **[A]** to the cursor position.

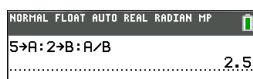
Calculate  $3.76 \div (-7.9 + \sqrt{5}) + 2 \log 45$ .

MathPrint™	Classic
<b>3</b> <b>[.]</b> <b>76</b> <b>[÷]</b> <b>(</b> <b>(-)</b> <b>7</b> <b>[.]</b> <b>9</b> <b>+</b> <b>[2nd]</b> <b>[√]</b> <b>5</b> <b>)</b> <b>+</b> <b>2</b> <b>[log]</b> <b>45</b> <b>)</b> <b>[enter]</b> <b>Note:</b> The <b>[ ]</b> is a notable keystroke difference as compared to Classic.	<b>3</b> <b>[.]</b> <b>76</b> <b>[÷]</b> <b>(</b> <b>(-)</b> <b>7</b> <b>[.]</b> <b>9</b> <b>+</b> <b>[2nd]</b> <b>[√]</b> <b>5</b> <b>)</b> <b>+</b> <b>2</b> <b>[log]</b> <b>45</b> <b>)</b> <b>[enter]</b>

**Note:** In MathPrint™ mode, press **[ ]** to get out of the MathPrint™ template and continue entering the expression.

## Multiple Entries on a Line

To enter two or more expressions or instructions on a line, separate them with colons (**[alpha]** **[ : ]**). All instructions are stored together in last entry **[2nd]** **[entry]** (above **[enter]**).

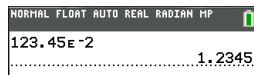


## Entering a Number in Scientific Notation

1. Enter the part of the number that precedes the exponent. This value can be an expression.
2. Press **[2nd]** **[EE]**. E is pasted to the cursor location.
3. Enter the exponent, which can be one or two digits.

### Notes:

- If the exponent is negative, press **[(-)]**, and then enter the exponent.
- E stands for "x10" and the calculator interprets the entire number as (123.45 x 10<sup>-2</sup>) as if it was entered with parentheses.



When you enter a number in scientific notation, the TI-84 Plus CE *Python* does not automatically display answers in scientific or engineering notation. The mode settings and the size of the number determine the display format.

## Functions

A function returns a value. For example, **log(** and **sin(** are functions. In general, the first letter of each function is lowercase. Most functions take at least one argument, as indicated by an open parenthesis following the name. For example, **sin(** requires one argument, **sin(value)**.

**Note:** To see the arguments of a function or command in the calculator, find the item in a menu or **[2nd]** **[catalog]** and press **+**. For most menu items, a Catalog Help screen will display and the syntax of the arguments will be displayed.

## Instructions

An instruction (command) initiates an action on the calculator. For example, **ClrDraw** is an instruction to the calculator to clear drawn elements from a graph. Instructions cannot be used in expressions. In general, the first letter of each instruction name is uppercase. Some instructions take more than one argument, as indicated by an open parenthesis at the end of the name. For example, on the TI-84 Plus CE *Python*, **Circle(** requires three arguments, and has two optional arguments:

**Circle**(*X,Y,radius[,color,linestyle]*)

## Interrupting a Calculation

To interrupt a calculation or graph in progress, which is indicated by the busy indicator in the status bar, press **[on]**.

When you interrupt a calculation, a menu is displayed.

- To return to the home screen, select **1:Quit**.
- To go to the location of the interruption, select **2:Goto**.

When you interrupt a graph, a partial graph is displayed.

- To return to the home screen, press **[clear]** or any non-graphing key.
- To restart graphing, press a graphing key or select a graphing instruction.

### TI-84 Plus CE *Python* Edit Keys

Keystrokes	Result
<b>[▶]</b> or <b>[◀]</b>	<ul style="list-style-type: none"><li>• Moves the cursor within an expression; these keys repeat if held down on the keypad.</li></ul>
<b>[▲]</b> or <b>[▼]</b>	<ul style="list-style-type: none"><li>• Moves the cursor from line to line within an expression that occupies more than one line; these keys repeat if held down on the keypad.</li><li>• Moves the cursor from term to term within an expression in MathPrint™ mode; these keys repeat if held down on the keypad.</li><li>• On the home screen, scrolls through the history of entries and answers.</li></ul>
<b>[2nd]</b> <b>[◀]</b>	<ul style="list-style-type: none"><li>• Moves the cursor to the beginning of an expression.</li></ul>
<b>[2nd]</b> <b>[▶]</b>	<ul style="list-style-type: none"><li>• Moves the cursor to the end of an expression.</li></ul>
<b>[alpha]</b> <b>[▲]</b>	<ul style="list-style-type: none"><li>• Moves the cursor out of a MathPrint™ expression and up into history on the home screen.</li><li>• Moves the cursor from a MathPrint™ expression to the previous Y-var in the Y=editor.</li></ul>
<b>[alpha]</b> <b>[▼]</b>	<ul style="list-style-type: none"><li>• Moves the cursor from a MathPrint™ expression to the next Y-var in the Y=editor.</li></ul>
<b>[ENTRY]</b> <b>[L2]</b> <b>[ALPHA]</b> <b>[L2]</b> <b>[TRACE]</b>	<ul style="list-style-type: none"><li>• Evaluates an expression or executes an instruction.</li></ul>
<b>[clear]</b>	<ul style="list-style-type: none"><li>• Clears the current line on a line with text on the home screen.</li><li>• Clears everything on the home screen on a blank line on the home screen. This does not clear the history of your entries and answers.</li><li>• Press <b>[▲]</b> to see the history.</li><li>• Use Clear Entries* followed by <b>[clear]</b> if you wish to delete all home screen entries.</li></ul>

Keystrokes	Result
	<p>*Clear Entries is found in [catalog].</p> <ul style="list-style-type: none"> <li>Clears the expression or value where the cursor is located in an editor; it does not store a zero.</li> </ul>
[del]	<ul style="list-style-type: none"> <li>Deletes a character at the cursor; this key repeats if held down on the keypad.</li> </ul>
[2nd] [del]	<ul style="list-style-type: none"> <li>Changes the cursor to an underline (<u>  </u>); inserts characters in front of the underline cursor; to end insertion, press [2nd] [ins] or press [←], [↑], [→], or [↓].</li> </ul>
[2nd]	<ul style="list-style-type: none"> <li>Changes the cursor or status bar indicator to <b>1</b>; the next keystroke performs a <b>2nd</b> function (displayed above a key and to the left); to cancel <b>2nd</b>, press [2nd] again.</li> </ul>
[alpha]	<ul style="list-style-type: none"> <li>Changes the cursor or status bar indicator to <b>1</b>; the next keystroke performs a third function of that key (displayed above a key and to the right) or accesses a shortcut menu. To cancel [alpha], press [alpha] or press [←], [↑], [→], or [↓].</li> </ul>
[2nd] [A-lock]	<ul style="list-style-type: none"> <li>Changes the cursor to <b>1</b>; sets alpha-lock; subsequent keystrokes access the third functions of the keys pressed; to cancel alpha-lock, press [alpha]. If you are prompted to enter a name such as for a group or a program, alpha-lock is set automatically.</li> </ul> <p><b>Note:</b> The TI-84 Plus CE <i>Python</i> does not automatically set alpha-lock for entries that require list names.</p>
[X,T,θ,n]	<ul style="list-style-type: none"> <li>Pastes an X in <b>Function</b> mode, a T in <b>Parametric</b> mode, a θ in <b>Polar</b> mode, or an n in <b>Seq</b> mode with one keystroke.</li> </ul>
[alpha] [X,T,θ,n]	<ul style="list-style-type: none"> <li>Pastes the n/d template at the cursor position.</li> </ul>

## Working with Graphs

This section covers how to change color options on a graph, how to draw points on a graph, and how to insert an image as a background on a graph.

### Using Color on the TI-84 Plus CE Python

The TI-84 Plus CE *Python* graphing calculator has many color options and a high resolution display that allows more information to be shown on the screen. The TI-84 Plus CE *Python* uses color in the following ways:

- Y= editor for line color.
- DRAW commands for line color, such as vertical lines, circles, and text on the graph screen.
- The graph format screen for grid, axes, or border color, and applying a background image or color.
- Statistical Plots.

Color options for various features are accessed via a spinner menu. With the cursor on a color selection for a feature, use the  $\leftarrow$  or  $\rightarrow$  to change the color. When the cursor is on any spinner menu, the context help in the status bar frequently displays the hint: PRESS [ $\leftarrow$ ] OR [ $\rightarrow$ ] TO SELECT AN OPTION.

**Note:** Take care to choose appropriate color combinations for the graph areas so that all features are visible.

### Resetting Color Options to Default

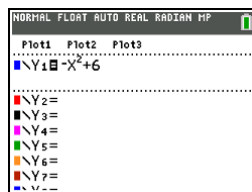
- With the cursor on a function in [Y=], press  $\boxed{\text{clear}}$   $\boxed{\text{clear}}$  to return to the default color and line style for that function.
- You can reset the calculator to its default settings, including color settings, by pressing  $\boxed{2\text{nd}}$   $\boxed{[\text{mem}]} \mathbf{7} \mathbf{2} \mathbf{2}$ .

### Using Color on the Graph Screen

The examples below show how to set up the graph of a function. Here, the mode is set to FUNCTION and the default settings are assumed.

Enter an equation in the Y= editor.

1. Press  $\boxed{Y=}$ .
2. Press  $\boxed{(-)}$   $\boxed{X,T,\theta,n}$   $\boxed{x^2}$   $\boxed{+}$   $\boxed{6}$ .

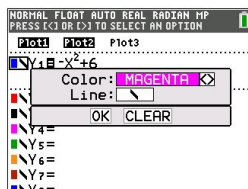


To set the line color in the Y= editor:



1. Press  $\leftarrow$  to highlight the color and line style indicator.
2. Press [enter].

The spinner dialog displays. Notice the second line in the status bar, which displays hints.



3. Press  $\rightarrow$   $\rightarrow$   $\rightarrow$  to place the cursor box on the color and line style at the left of the screen and press [enter].
4. Press  $\rightarrow$   $\rightarrow$   $\rightarrow$  to select MAGENTA.
5. Press  $\downarrow$ .

**Note:** The thick line style is the default. It can be changed by pressing  $\leftarrow$  or  $\rightarrow$ .

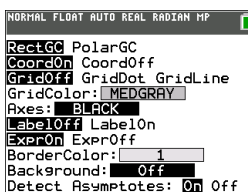
6. Press  $\downarrow$  to highlight OK and then press [enter].

To set a Background Image:

1. Press  $2^{nd}$  [format].

Set GridColor, Axes, and BorderColor as desired.

2. Press  $\uparrow$  or  $\downarrow$  as necessary to highlight Background.



The spinner menu becomes active.

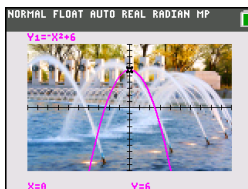
3. Press  $\leftarrow$  or  $\rightarrow$  to select the desired Background Image or color.

**Note:** Your Image Vars may be different than the one displayed.

**Note:** To create Background Image Vars, use the free TI Connect™ CE software to convert and send images to your TI-84 Plus CE *Python* graphing calculator.

4. Press  $\text{trace}$  to see the graph and trace points.

**Note:** You can manipulate the graph to “fit” an object in the Background Image Var. You can also use QuickPlot and Fit Equation to fit an equation to a shape. (See **QuickPlot**.)



## Using QuickPlot and Fit Equation

QuickPlot and Fit Equation allows you to drop points on a graph screen and model a curve to those points using regression functions. You can select color and line style, draw points on a graph, and choose an equation to fit the drawn points. You can then store the results of the plot and equation.

QuickPlot and Fit Equation is an option in the **[stat]** CALC menu.

Prior to starting the QuickPlot and Fit Equation interactive feature on the graph area, be sure to set your Background Image Var and other graph settings from the FORMAT screen. Also set your WINDOW or ZOOM settings.

Drop points on the screen. Points can be saved to lists.



Calculate the regression equation, draw the curve, and store the function.

## Working With Images

The TI-84 Plus CE *Python* uses both pictures and background images. They are both stored in Flash archive, but they are used in different ways.

### Using Pictures and Backgrounds

- Image Vars (Image1 - Image9, and Image0) are variables stored in archive memory. An Image Var is used as a Background Image in the graph area. Several images are pre-loaded on the TI-84 Plus CE *Python*. You can also convert images to TI-84 Plus CE *Python* Image Vars in the TI Connect™ CE software and load them to the calculator. You cannot create images on the calculator.

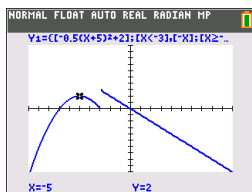
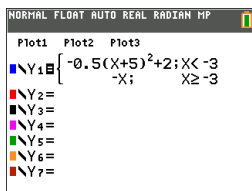
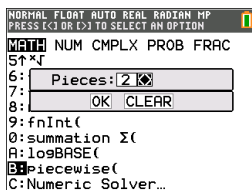
**Note:** TI Connect™ CE software is available as a free download from [education.ti.com/go/download](http://education.ti.com/go/download).

- Pic Vars (Pic1 - Pic 9, and Pic0) are also variables stored in archive memory. Pic Vars can be created by drawing in the graphing area, and the changes saved and recalled to the graphing area. Saving a Pic Var will not include the Background Image behind your graphing area.
- Both Image Vars and Pic Vars are stored and run in Flash archive, not in RAM. They are both accessible in the VARS menu.
- Image Vars and Pic Vars can only be shared with another TI-84 Plus CE *Python* or TI-84 C graphing calculator.
- TI-84 Plus Pic Vars cannot be shared between the TI-84 Plus and the TI-84 Plus CE *Python* graphing calculators.
- If you perform a RAM reset on the TI-84 Plus CE *Python*, the Image Vars and Pic Vars remain in Archive memory for use.

## Using Piecewise Function Graphing

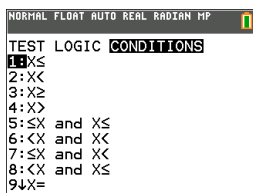
### How to enter a piecewise function

1. Press **[math]**.
2. Press **[↑]** or **[↓]** to scroll to **B:piecewise(**.
3. Press **[enter]**.
4. Press **[4]** or **[↓]** to select the number of pieces (1-5) for the function.
5. Press **[↓]** **[enter]** to select **OK**.
6. Enter functions in the **y=** editor.
7. Press **[zoom]** **6:ZStandard** to set the standard window and graph.



### Conditions Menu **[2nd]** **[test]**

The CONDITIONS menu, **[2nd]** **[test]** **[4]** pastes several characters at once in the condition part of the piecewise template for quicker entry.



**Note:** The piecewise conditions are entered using the relations found in **[2nd]** **[test]** (above **[math]**). These relations are typically used for True(1)/False(0) testing in programming on the calculator.

### Special Information when using intervals in the condition part of the piecewise template:

Textbook format for an interval, such as  $-2 \leq X \leq 5$ , is allowed only when entered directly in the condition part of the piecewise template in the calculator. Do not use this format in other locations in the calculator for the same interval interpretation.

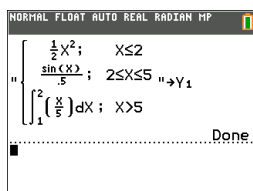
Note that if an interval form is selected from the CONDITIONS menu, the interval form will paste in the correct logical format for an interval as, for example,  $-2 < X$  and  $X < 5$ . This is the correct format for all features in the calculator to give the expected logical test result True(1)/False(0) and will also give the correct X interval in piecewise graphing.

#### Note:

- Overlapping intervals: The graph is plotted from left (Xmin) to right (Xmax). For each value of X from left to right, the calculator looks for the first valid expression to calculate the Y value. Overlapping intervals are allowed and will be graphed according to the first valid expression that can be computed for an X value.

#### Tips

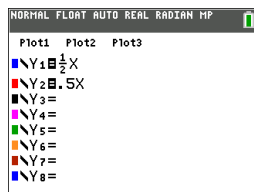
- Once a piecewise template is selected with a certain number of pieces, you will not be able to add or delete a piece. You may select a larger number of pieces and enter zeros (False) to have placeholder rows. This is helpful when creating drawings using functions on the graph screen.
- The piecewise function uses one MathPrint™ level out of a maximum of four. You may see the checkerboard cursor (⊞) when you enter a function in the template, but that function is allowed if entered outside of a piecewise template. To keep the maximum number of MathPrint™ levels desired, enter the function in another YVar, such as Y3, and then use Y3 in the piecewise template.
- You can enter a function from the Home Screen. You can use this method to enter a "tall" function with many pieces. For example, "2X"→Y1:



- You can edit or view a function from  $\boxed{Y=}$  on the home screen if needed and store the function back to  $\boxed{Y=}$ . Remember the format, "2X"→Y1.
  - Quote:  $\boxed{\alpha}$   $\boxed{[ ]}$
  - Recall the YVar:  $\boxed{2nd}$   $\boxed{[rci]}$   $\boxed{\alpha}$   $\boxed{[f4]}$  (select a YVar) and  $\boxed{[enter]}$
  - Close quote and store:  $\boxed{\alpha}$   $\boxed{[ ]}$   $\boxed{sto\rightarrow}$
  - Select the YVar:  $\boxed{\alpha}$   $\boxed{[f4]}$  and  $\boxed{[enter]}$

## Working with Tables

When a function is entered in the Y= editor, you can view a table of values by pressing **2nd** [table].



NORMAL FLOAT AUTO REAL RADIAN MP					
PRESS $\blacktriangleleft$ TO EDIT FUNCTION					
X	Y1	Y2			
0	0	0			
1	$\frac{1}{2}$	0.5			
2	1	1			
3	$\frac{3}{2}$	1.5			
4	2	2			
5	$\frac{5}{2}$	2.5			
6	3	3			

Y1 =  $\frac{1}{2}X$

**Note:** The table setup, **2nd** [table], determines how table values are displayed. Check the table setup values if the table results are not in expected format of fraction. Using a mix of decimal and fractions will not retain fractions.

## Working with Matrices

You can enter matrices using the matrix editor on your graphing calculator. For example, you can perform the following operations on matrices:

- Addition
- Division
- Elementary Row Operations
- Inverses
- Multiplication
- Subtraction

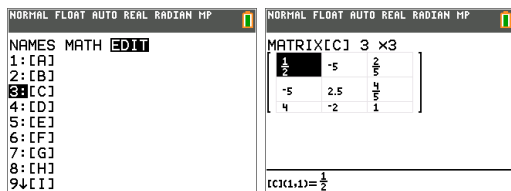
### Using the Matrix Editor

1. Press **[2nd]** **[matrix]**.
2. Press **[↓]** to navigate to the EDIT submenu.
3. Select from one of 10 allowed matrix variable names [A] – [J].
4. Enter the dimension of the matrix, then enter values in each matrix cell.

**Note:** Once in the editor, use the arrow keys to navigate between cells.

#### Example:

Matrix [C] as a 3x3 matrix is now in memory.



### Performing a Calculation with a Matrix

1. Press **[2nd]** **[quit]** to go to the Home Screen.
2. Press **[2nd]** **[matrix]** use the MATH submenu to select a matrix command.
3. Use the NAMES submenu to paste the matrix name.

**Note:** A matrix name, such as [C], is a special character and can ONLY be pasted for a calculation from the **[2nd]** **[matrix]** NAMES menu and not typed from the calculator keypad.

#### Example:

To find the determinant of [C] as entered above:

- ▶ Use the **[2nd]** **[matrix]** MATH menu to paste the
  - 1: det( command
  - and-

- **2nd** **[matrix]** NAMES 3: [C]

as matrix variables to the Home Screen.

```
NORMAL FLOAT AUTO REAL RADIAN MP
NAMES MATH EDIT
1:det(
2:
3:dim(
4:Fill(
5:identity(
6:randM(
7:augment(
8:Matr→list(
9↓List→matr(
```

```
NORMAL FLOAT AUTO REAL RADIAN MP
NAMES MATH EDIT
1:[A]
2:[B]
3[C] 3×3
4:[D]
5:[E]
6:[F]
7:[G]
8:[H]
9↓[I]
```

```
NORMAL FLOAT AUTO REAL RADIAN MP
det([C])
.....-38.95
```

**Note:** Remember that you cannot type in a matrix name from the calculator keypad. Use the **2nd** **[matrix]** NAMES menu to paste a matrix name.

# Working with Probability and Statistics

This section covers probability and statistics functions and instructions (commands).

- Probability features deal with random numbers, which are generated by algorithms on the calculator.
- Statistics features allow you to create lists of data, then plot or analyze that data.

## Working with Probability

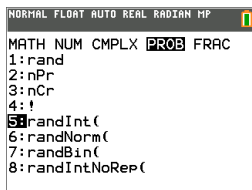
You can find probability features in the **math** PROB submenu.

Many probability features have Stat Wizards to help you enter the syntax.

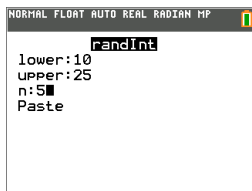
### Example:

To generate a set of five random integers between 10 and 25 (inclusive):

1. Press **math**, then press **▸** until you highlight **PROB**.
2. Press **▾** until you highlight **5: randint(**, then [enter].

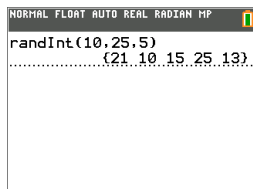


3. Enter the lower integer, then [enter].
4. Enter the upper integer, then [enter].
5. Enter the number of integers (**n**), then [enter].



6. Press [enter] to Paste.
7. Press [enter] again to see the random set of integers.





### Note:

- With each rand execution, the TI-84 Plus CE *Python* generates the same random-number sequence for a given seed value. The TI-84 Plus CE *Python* factory-set seed value for rand is 0. To generate a different random-number sequence, store any nonzero seed value to rand. To restore the factory-set seed value, store 0 to rand, or reset the defaults by going to [2nd] [mem] 7:Reset... 2:Defaults....
- The seed value also affects randInt(), randNorm(), and randBin() instructions.

## Working with Statistics

You can find statistics commands in the [stat] menu. You can create lists of data, then plot or analyze that data using the statistics commands.

You can use the following statistics functions:

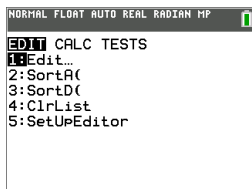
Description	Keys
Best fit equations (regressions)	[stat] ► ► ▼
Define and store up to three stat plot definitions	[2nd] [stat plot]
Distributions	[2nd] [distr]
List-based statistical analysis	[2nd] [list] ► ►
Logistic and sine regression analysis	[stat] ► ► ▼
One- and two-variable analysis	[stat] ► ► 1 and [stat] ► ► 2
Statistical tests	[stat] ► ► ►

## Inferential Statistics

You can perform 16 hypothesis tests and confidence intervals and 15 distribution functions. You can display hypothesis test results graphically or numerically.

### To enter lists of data:

- Press [stat].
- Select **1: Edit** in the **EDIT** submenu, then [enter].



3. Enter your data into list columns.

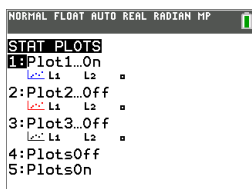
**Note:** Once in the list editor, use the arrow keys to enter the data in the lists. L1 – L6 are built-in list names. Custom list names can be created by scrolling to a blank list name and pressing [enter].

L1	L2	L3	L4	L5	L6
1					
1.5					
1.75					

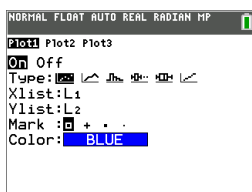
L1(1) =  $\frac{1}{2}$

**To plot this data:**

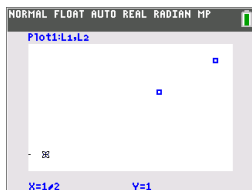
4. Press **2nd** [stat plot].
5. Press **1: Plot1** (to set up a scatter plot for L1 and L2), then [enter].



6. Press **◀** to highlight **On**.



7. Press **zoom** to automatically set up a graphing window for your data.
8. Press **9: ZoomStat** to see the graph.
9. Press **trace** and arrow keys to trace on the plot.



You can plot your statistics data in these ways:

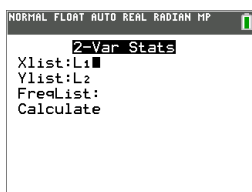
- Scatter plot
- xyLine
- Histogram
- Regular or Modified box-and-whisker plot
- Normal probability plot

### To find the two variable statistics for L1 and L2:

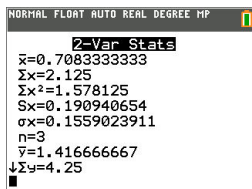
1. Press **[stat]**.
2. Press **[>]** to highlight **CALC**.
3. Press **[v]** until you highlight **2:2-Var Stats**, then [enter].



4. Press **[v]** until you highlight **Calculate**, then [enter].



- The screen will display the variable statistics.



**Note:** Most common probability and statistics commands will have a wizard to prompt for syntax (values). The built-in Catalog Help is also available by pressing the  $\boxed{+}$  key on most menu items. This opens an editor to help you fill in the syntax (values) needed in a calculation.

# Working with Variables

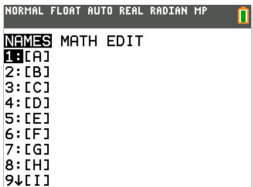
You can enter and use several types of data, including real and complex numbers, matrices, lists, functions, stat plots, graph databases, graph pictures, and strings.

## Using Variable Names

### Variables and Defined Items

You can enter and use several types of data, including real and complex numbers, matrices, lists, functions, stat plots, graph databases, graph pictures, and strings.

The TI-84 Plus CE *Python* uses assigned names for variables and other items saved in memory. For lists, you also can create your own five-character names.

Variable Type	Names
Real numbers (including fractions)	<b>A, B, ... , Z, <math>\theta</math></b>
Complex numbers	<b>A, B, ... , Z, <math>\theta</math></b>
Matrices	<b>[A], [B], [C], ... , [J]</b> To enter a matrix name: Press <b>[2nd]</b> <b>[matrix]</b> . The Matrix Names menu appears. Press the number on the keypad that corresponds with the desired Matrix Name. Ex: Press 1 for [A] as shown below. 
Lists*	<b>L1, L2, L3, L4, L5, L6, and user-defined names</b>
Functions	<b>Y1, Y2, ... , Y9, Y0</b>
Parametric equations	<b>X1T and Y1T, ... , X6T and Y6T</b>
Polar functions	<b>r1, r2, r3, r4, r5, r6</b>
Sequence functions	<b>u, v, w</b>

Variable Type	Names
Stat plots	<b>Plot1, Plot2, Plot3</b>
Graphical databases	<b>GDB1, GDB2, ... , GDB9, GDB0</b> Save current equations from Y= and Window settings to re-use.
Background images	<b>Image1, Image2, ... , Image9, Image0</b>
Pictures	<b>Pic1, Pic2, ... , Pic9, Pic0</b>
Strings	<b>Str1, Str2, ... , Str9, Str0</b>
Apps	Applications
AppVars	Application variables
Groups	Grouped variables Save a group of allowed calculator files for sharing or to re-use when setting up a classroom.
System variables	<b>Xmin, Xmax</b> , and others

\* Once a list contains a complex number, it is designated as a complex list. To change a list to Real numbers, delete the list and enter the Real values.

### Notes about Variables

- You can create as many list names as memory will allow.
- From the home screen or from a program, you can store to matrices, lists, strings, and system variables such as **Xmax**, **TblStart**, and all **Y=** functions.
- From an editor, you can store to matrices, lists, and **Y=** functions.
- From the home screen, a program, or an editor, you can store a value to a matrix element or a list element.
- You can use **DRAW STO** menu items to store and recall Pic Vars.
- Although most variables can be archived, system variables including **r**, **T**, **X**, **Y**, and **θ** cannot be archived.

**Note:** In TI-Basic programming, it is best practice to avoid using these system variables to avoid unexpected changes in the variable value due to calculations and graphing when executing a program.

- **Apps** are independent applications, which are stored in Flash archive. **AppVars** is a variable holder used to store variables created by independent applications. You cannot edit or change variables in **AppVars** unless you do so through the application that created them.

## Storing Variable Values

Values are stored to and recalled from memory using variable names. When you evaluate an expression that contains a variable name, the graphing calculator substitutes the value currently stored in that variable.

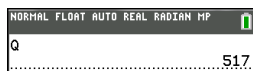
To store a value to a variable from the home screen or a program using the **[sto→]** key, begin on a blank line and follow these steps.

1. Enter the value you want to store. The value can be an expression.
2. Press **[sto→]**.  
→ is copied to the cursor location.
3. Press **[alpha]** and then the letter of the variable to which you want to store the value.
4. Press **[enter]**. The graphing calculator evaluates the expression and stores the value to the variable.



## Displaying a Variable Value

To display the value of a variable, enter the variable name on a blank line on the home screen, and then press **[enter]**.



## Archiving Variables (Archive, Unarchive)

You can store variables in the TI-84 Plus CE *Python* user data archive, a protected area of memory separate from RAM. The user data archive lets you:

- Store data, programs, applications or any other variables to a safe location where they cannot be edited or deleted inadvertently.
- Create additional free RAM by archiving variables.

By archiving variables that you do not need to edit frequently, you can free up RAM for applications that may require additional memory.

The graphing calculator places an asterisk (\*) to the left of archived variables in most menus as well as in **[2nd] [mem] 2:Mem Management**. You cannot edit or execute archived variables in CE OS Version 5.2 or earlier. In CE OS Version 5.3 and later, you can execute programs if they are stored in an archive. If needed, you can use the Archive/UnArchive commands to manage the memory location.

**Example:**

If you archive a list named **L1**, you will see that it exists in memory. However, if you select and paste the name **L1** to the home screen, it will not appear on the home screen. You must unarchive it in order to see its contents and edit it.

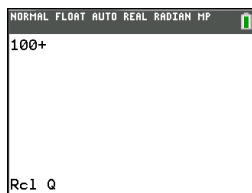
**Note:** Image Vars are run and stored in archive, but when an Image Vars displays in **VARS 4:Picture & Background**, the BACKGROUND menu does not display the asterisk \*.

## Recalling Variable Values

To recall and copy variable contents to the current cursor location, follow these steps. To leave **Rcl**, press **clear**.

1. Press **[2nd]** **[rc]**. **Rcl** and the edit cursor are displayed on the bottom line of the screen.
2. Enter the name of the variable in one of the following ways:
  - Press **[alpha]** and then the letter of the variable.
  - Press **[2nd]** **[list]**, and then select the name of the list, or press **[2nd]** **[L1]** or **[L2]**, and so forth.
  - Press **[2nd]** **[matrix]**, and then select the name of the matrix.
  - Press **[vars]** to display the **VARS** menu or **[vars]** **[▶]** to display the **VARS Y-VARS** menu; then select the type and then the name of the variable or function.
  - Press **[alpha]** **[f4]** to display the YVAR shortcut menu, then select the name of the function.

The variable name you selected is displayed on the bottom line and the cursor disappears.



3. Press **[enter]**. The variable contents are inserted where the cursor was located before you began these steps.



### Notes:

- You can edit the characters pasted to the expression without affecting the value in memory.
- You can use **Rcl** in the Y= editor to paste a current function to a new YVar to avoid retyping long expressions.



# Solving Equations

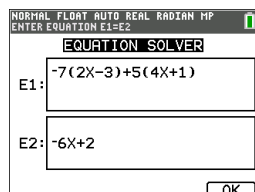
Press **[math]** **[ $\Delta$ ]** to access **C:Numeric Solver....**

## Numeric Solver

1. Enter an equation as **expression 1=expression 2 (E1=E2)**.

You may enter more than one variable, but you will have to select one variable to solve. The other variables used will take on the value stored in the calculator.

2. Press OK.



3. Place the cursor on the variable to solve. For this example, the variable is X.

The current value of X stored in the calculator is displayed (X=0).

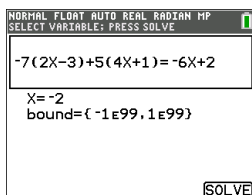
You should enter a value close to your estimate of the solution. If needed, you can look at the intersection of the graph of both sides of your equation or use the table of values to know more about your problem. Here, X=0 is a reasonable starting point for the calculator computation.

Bound – {-1E99, 1E99} represents the calculator version of the Real Number line: {-1x10<sup>99</sup>, 1x10<sup>99</sup>}. You can change this interval if you know about where the solution lies given your study of a graph or table. For most textbook problems, you probably will not have to change this line.

4. Press the [SOLVE] (**[graph]**) shortcut key.
5. Check your solution. The calculator checks the solution it generated.

## Interpreting the Numeric Solver Screen

Always read the context help line for tips.



The solution will be marked with a small square.

(Advanced) Bounds gives the interval where the solution is found. Here, {-1E99, 1E99} is {-1x10<sup>99</sup>, 1x10<sup>99</sup>} which has the calculator looking for the solution within a very large interval of numbers. You can adjust this interval if you do not get all the solutions to your equation by limiting the values to a smaller interval. Here, there is only one solution,

$X = -2$ .

**E1-E2=0** (**expression 1 = expression 2**) is finding the difference of the left hand side of your equation, **E1** with  $X = -2$  and the right hand side of your equation, **E2** with  $X = -2$ . The difference is zero. The equation balances.  $X = -2$  is the solution. (Advanced: When **E1=E2** is not zero, but is a small value, the calculator algorithm likely gave a result close to the exact answer but within some tolerance of the calculator arithmetic.)

# Managing Calculator Files

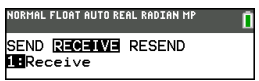
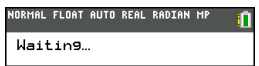
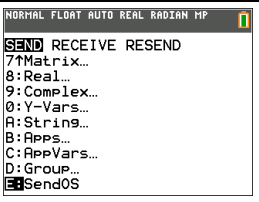
This section explains how to transfer the OS from calculator to calculator and describes compatibility between graphing calculators.

## Transferring the OS from calculator to calculator

You can transfer the operating system from one calculator to another using a USB unit-to-unit cable.

Connect the two calculators by firmly inserting the USB cable ends into the calculators. The USB port is located on the front-right side of the calculator.

**Note:** You cannot transfer the OS or files using the TI Charging Station CE (see the Accessories section). The TI Charging Station CE only charges the TI-84 Plus CE *Python* graphing calculators.

Receiving calculator: [2nd] [link] [▢] [enter]	 The image shows the TI-84 Plus CE screen with the menu: NORMAL FLOAT AUTO REAL RADIAN MP, SEND RECEIVE RESEND, and 1:Receive.
When you press [enter], the graphing calculator displays the message <b>Waiting...</b>	 The image shows the TI-84 Plus CE screen with the menu: NORMAL FLOAT AUTO REAL RADIAN MP, and Waiting...
Sending calculator: [2nd] [link] [▲] [▲] [enter]	 The image shows the TI-84 Plus CE screen with the menu: NORMAL FLOAT AUTO REAL RADIAN MP, SEND RECEIVE RESEND, 7:Matrix..., 8:Real..., 9:Complex..., 0:Y-Vars..., A:String..., B:Apps..., C:AppVars..., D:Group..., and E:SendOS.

**Note:** The RESEND menu in [2nd] [link] retains the last set of files sent from the sending calculator.

## Compatibility with Graphing Calculators

**Note:** Not all TI-84 Plus CE *Python* graphing calculator files are compatible with other TI-84 Plus Family graphing calculator files because of the higher resolution of the color screen. In general, numeric files (not limited to lists, variables, matrices, and functions) are shared between these graphing calculators but Apps are not shared between these graphing calculators even if they have the same title. When not compatible, the computer file extensions for the TI-84 Plus CE *Python* are different from a similar variable from the TI-84 Plus/TI-84 Plus Silver Edition graphing calculators.

<b>File Type</b>	<b>Link from TI-84 to TI-84 Plus CE <i>Python</i></b>	<b>Link from TI-84 Plus CE <i>Python</i> to TI-84</b>	<b>84P computer file type</b>	<b>TI-84 Plus CE <i>Python</i> computer file type</b>
Operating System	No	No	8xu	8eu
Apps	No	No	8xk	8ek
AppVar <sup>1</sup>	Yes	Yes	8xv	8xv
Programs - TI Basic <sup>1, 2</sup>	Yes	Yes	8xp	8xp
Assembly Programs <sup>1</sup>	Yes	No	8xp	8xp
Pictures	No	No	8xi	8ci
Background Images	N/A	No	N/A	8ca
Group Files	Yes	Yes	8xg	8xg
User Zoom	Yes	Yes	8xz	8xz
String	Yes	Yes	8xs	8xs
Table	Yes	Yes	8xt	8xt
Function file	Yes	Yes	8xy	8xy
GDB <sup>3</sup>	Yes	Yes	8xd	8xd
List	Yes	Yes	8xl	8xl
Matrix	Yes	Yes	8xm	8xm
Number	Yes	Yes	8xn	8xn
Complex	Yes	Yes	8xc	8xc
Window Setup	Yes	Yes	8xw	8xw
Backup	No	No	8xb	—

<sup>1</sup> App Vars and Programs should be reviewed for use after the transfer between the TI-84 Plus family graphing calculators. Some App Vars may not setup an App as expected. Some Programs will need to be modified due to the difference in screen resolution and new commands.

<sup>2</sup> Programs created using commands available only in the latest OS version will not transfer to graphing calculators with an earlier OS version.




<sup>3</sup> You may receive a version error if you used DOT-THIN line style. Change the line style to avoid the error.

# Using Press-to-Test

Use Press-to-Test to manage exams using TI graphing calculators in your classroom.

The teacher will tell you when to set your calculator in exam mode.

## Setting Up Test Mode

1. Turn the calculator OFF.
2. Press and hold down the ,  and  keys, and then release.
3. The RESET OPTIONS screen displays.
4. To change the default settings, move the cursor over the desired setting and press [enter].


By default:

- ANGLE is set to DEGREE
  - STAT DIAGNOSTICS is set to ON
  - DISABLE logBASE and DISABLE  $\Sigma()$  are set to YES
5. Press **OK** to first validate any loaded TI Apps and then set up the exam mode. When validation and test mode setup is complete, the confirmation screen will display.



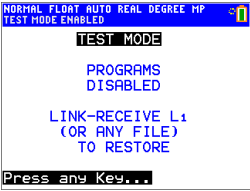
6. Press any key to place the calculator in test mode.

### Note:

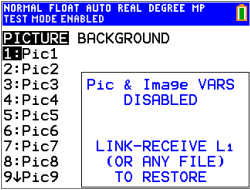
- The status bar is blue when in TEST MODE and TEST MODE ENABLED.
  - Pic & Image Vars are disabled.
  - All variables stored in RAM and in archived memory are deleted.
7. On the exam calculator, press  to verify that applications are disabled. The following screen displays:



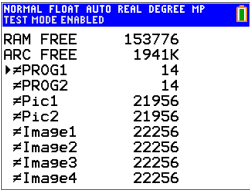
8. On the exam calculator, press **[prgm]** to verify that programs have been disabled. The following screen displays:



9. On the exam calculator, Pic and Image Vars are shown as disabled. The following screen displays:



10. In memory management (**[2nd]** **[mem]**, **2:Mem Management/Delete...**), disabled files will display with the not equal sign.



## Bringing a Calculator Out of Test Mode

You can re-enable all disabled calculator files by using one of the following methods:

- Link two TI-84 Plus CE *Python* graphing calculators using a unit-to-unit USB cable and then transfer a file by using **[2nd] [link]**, **SEND RECEIVE**.
- Use TI Connect CE **Actions > Quit Exam Mode on Connected CE Calculators** to quit the exam mode on any connected CE calculator. You may also send a calculator file to the connected CE calculator to quit from exam mode.
- Use TI Connect CE to send a calculator file to the calculator.
- Use the TI TestGuard™ App re-enable feature.

To clear a calculator of files created during an exam:

1. Turn off the calculator while in test mode.
2. "Re-Press-to-Test" - press and hold down the **[▶]**, **[◀]**, and **[on]** keys, and then release.
3. Select **OK** when you see the Reset Verification Screen. The calculator is now "clean."

---

**Tip:** To preserve battery life, take your calculator out of Press-to-Test mode after the exam.

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## Using Applications (Apps)

These applications are preloaded on your TI-84Plus CE *Python*. You can view the Applications Guidebook at [education.ti.com/eguides](http://education.ti.com/eguides).

Update your CE with the latest OS and all TI Apps at [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate).

Press **[apps]** to see the complete list of applications.

### ***Cabri™ Jr. App***

Construct, analyze, and transform mathematical models and geometric diagrams on your TI graphing calculator. You can:

- Perform analytic, transformational, and Euclidean geometric functions
- Build geometric constructions interactively with points, a set of points for locus, lines, polygons, circles, and other basic geometric objects
- Alter geometric objects on the fly to see patterns, make conjectures, and draw conclusions

### ***CellSheet™ App***

Combines spreadsheet functionality with the power of a graphing calculator.

Create cell formulas and use built-in functions.

Cells can contain:

- Integers
- Real numbers
- Formulas
- Variables
- Text and numeric strings
- Functions

Each spreadsheet contains 999 rows and 26 columns. The amount of data you can enter is limited only by the available RAM.

- Store (x,y) coordinate pairs to lists for viewing and optimizing functions for linear programming.

### ***Conic Graphing App***

Presents equations in function, parametric, or polar form and provides a simple way to graph the four conic shapes:

- Ellipse
- Circle
- Parabola
- Hyperbola

Enter the required parameters to graph, trace, or solve for the conic's characteristic.



## ***Inequality Graphing App***

Gives you new features for graphing equations and inequalities and evaluating the relationship between them. You can:

- Enter inequalities using relation symbols
- Graph inequalities and shade the union and intersection regions
- Enter inequalities (vertical lines only) in an X=editor
- Trace points of interest (such as intersections) between relations
- Store (x,y) coordinate pairs to lists for viewing and optimizing functions for linear programming.

## ***Periodic Table App***

Provides a graphical representation of the elements of the Periodic Table. This application allows you to:

- Observe and explore the Periodic Table of the Elements
- Find property data and useful information about the known elements
- Sort the elements by atomic number, alphabetically by name, or alphabetically by symbol
- Identify groups of elements by region (noble gasses, halogens, etc.) and block (p-, d-, s- and f-)
- Export property data to lists for further analysis
- Graph the major properties (atomic radii, electronegativities, etc.) against atomic number to illustrate the periodic nature of the elements

## ***Polynomial Root Finder and Simultaneous Equation Editor App***

This application:

- Calculates the roots (zeros) of polynomials of degree 1 through 10 with a convenient, easy-to-use interface.
- Allows you to store solutions into lists, load a list into the application for polynomial coefficients, and store the polynomial to a Y-Var to graph after quitting the App.
- Finds solutions to systems of linear equations.
- Allows you to load matrices containing the coefficients of linear systems, and identify whether a given system has a unique solution, an infinite number of solutions, or no solution.

## ***Probability Simulation App***

Explore probability theory with interactive animation that simulates the rolling of dice and tossing of coins, and generates random numbers on your calculator. Options include:

- Bar Graph - Trace on probabilities or frequencies
- Table of trials data
- Settings for specifying numbers of trials
- Ways to collect data

- Weighting

In addition, students can export data for further exploration.

## ***Python App for the TI-84 Plus CE Python***

TI-Python is based on CircuitPython, a variant of Python 3 for teaching coding. It was developed by Adafruit and adapted for use by TI.

The interpreter of your Python program is executed within this TI-Python environment, separate and different from the CE OS calculations. Calculations may also vary from other versions of Python due to number type storage in the Python version.

The Python App offers the following to support your Python programming on your calculator.

- File Manager to list the Python programs (Python AppVars) stored in RAM on your calculator.
- Editor to create new programs in your calculator and edit existing Python programs.
- Shell to display output of your Python program or to run Python commands at the Shell prompt. This environment is also referred to as an interpreter or console.

At this time, the Python modules available to import are math and random. Please use TI-Basic for programming TI-Innovator™ and/or TI-Innovator™ Rover. Use the latest CE Bundle to update your calculator at [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate).

## ***What is your Python experience?***

### ***TI-84 Plus CE Python***

- TI-84 Plus CE *Python* with OS v5.6.0 or higher
- Python App v5.5.0 or higher
  - Run Python App on your calculator to check if you need to update at [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate)
- Access the Python App from **[2nd]** **[apps]** or **[prgm]** when the Python App is loaded.

## ***Science Tools App***

Science Tools allows you to perform unit conversions on your calculator. App elements include:

- Significant Figures Calculator
- Constants and Conversions
- Data and Graph Wizard
- Vector Calculator

## SmartPad™ CE App

### Connecting a Calculator as a Remote Key Pad

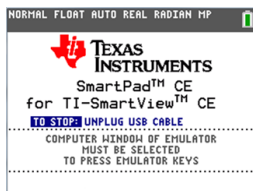
The SmartPad™ CE App allows you to connect a calculator as a remote key pad.

#### To use the TI-84 Plus CE *Python* as a remote keypad for TI-SmartView™ CE:

1. SmartPad™ CE App for TI-84 Plus CE *Python* comes pre-loaded on the calculator. If not on your TI-84 Plus CE *Python*, SmartPad CE App is also available to load to your calculator at [education.ti.com/go/download](http://education.ti.com/go/download).
2. Connect your TI-84 Plus CE *Python* to your computer using the USB Computer cable which came with your calculator.
3. Launch TI-SmartView™ CE.

**Note:** Click on the TI-SmartView™ CE emulator keypad to make sure it is in focus.

4. Run SmartPad™ CE App on your TI-84 Plus CE *Python*.
5. Press **[apps]** and select SmartPad™ CE from the Apps menu.
6. Read the information on the splash screen.



7. Press keys on the calculator key pad which remotely press the emulator key pad.

#### To stop the App:

- Disconnect the USB cable from the calculator to stop the App and remote key pad feature.

**Tip:** Reconnect the USB cable and run the App again if the remote key pad connectivity is no longer responding.

#### Note:

- The TI-84 Plus CE *Python* running the SmartPad™ CE App will not display calculations or graphs. The calculator becomes a remote USB key pad for the emulator only.
- The TI-84 Plus CE *Python* will remain a remote key pad when the TI-SmartView™ CE emulator keypad is in focus. Click on the TI-SmartView emulator prior to pressing keys on the calculator.
- The TI SilverLink cable is not supported in TI-SmartView™ CE.

## ***TI-Innovator™ Hub App***

The TI-Innovator™ Hub App runs automatically in CE OS v5.5 and higher when the App is loaded on the calculator. The TI-Basic program editor is enhanced with a HUB submenu to help you with spelling and syntax of commands for TI-Innovator™ Hub programming. Save time by using the submenu to paste full TI-Innovator™ commands rather than typing alpha characters from the keypad as you write your programs.

**Note:** You can get CE OS v5.5.0 or higher and the TI-Innovator™ Hub App at [education.ti.com/84ceupdate](http://education.ti.com/84ceupdate).

## ***Transformation Graphing App***

Transformation Graphing lets you observe the effects of changing coefficient values without leaving the graph screen. Transformation Graphing affects only function graphing mode. X is the independent variable and Y is the dependent variable. It is not available in parametric, polar, or sequence graphing modes.

Transformation Graphing allows you to manipulate up to four coefficients on the graph: A, B, C, and D. All other coefficients act like constants using the value in memory. You can step through the transformation of a function or animate the transformation using play styles, play/pause, play, and fast play.

## ***Vernier EasyData™ App***

Use EasyData™ App from Vernier Software & Technology to explore your world. The EasyData™ App auto-launches data collection when used with Vernier EasyTemp™ sensor, and loads built-in experiments for every supported Vernier sensor.

## Using Accessories

This section covers how to use:

- TI computer software
- TI Charging Station CE
- TI rechargeable batteries

### ***Using TI Desktop Software***

Use TI desktop software to exchange information between your graphing calculator and your computer, or to display a TI graphing calculator for your entire classroom.

#### **Using TI-SmartView™ CE Emulator Software**

The TI-SmartView™ CE emulator software allows you to display a TI graphing calculator for your entire classroom. With TI-SmartView™ CE emulator software, you can:

- View the history of your key press entries.
- Capture and save screen shots to use in other documents as you investigate a math or science concept.
- Use the View3™ pane to show three additional screens simultaneously.
- Use the SmartPad CE App running on a connected CE calculator as a remote keypad to press keys on your CE emulator in view.
- Update to v 5.6.0 or higher to use the TI-84 Plus CE *Python* emulator for class demonstrations of Python programming using the Python App. Demonstrate the complete Python experience of File Manager, Editor, and Run Python programs (as Python AppVars). Convert \*.py programs from your computer to Python AppVars by sending to the CE emulator using Emulator Explorer. See TI-SmartView CE guide for more information.

**Note:** The Python experience is the emulation of the Python experience as on the TI-84 Plus CE *Python* with Python App.

The TI-SmartView™ CE emulator software includes two workspaces:

- **Calculator Emulator:** allows you to perform calculations and view answers as you would on a physical calculator
- **Emulator Explorer:** allows you to manage emulator content

#### **Using TI Connect™ CE**

The TI Connect™ CE software makes exchanging information between your graphing calculator and your computer quick and easy.

The TI Connect™ CE software includes three workspaces:

- **Calculator Explorer:** allows you to manage emulator content

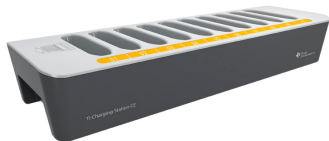
- Convert \*.py programs from your computer to Python AppVars by sending to the CE calculator using Calculator Explorer. See TI-Connect CE guide for more information at [education.ti.com/eguide](http://education.ti.com/eguide)
- **Screen Capture:** allows you to manage screen captures
- **Program Editor:** allows you to work with TI-Basic programs

## Using the TI Charging Station CE

The TI Charging Station CE has 10 slots, and each slot can accommodate a TI-84 Plus CE *Python* graphing calculator. Place a TI-84 Plus CE *Python* graphing calculator in one of these slots to charge the TI Rechargeable Battery.

**Note:** It is not necessary to fill all the slots in the charging station to charge batteries.

**Note:** In order to ensure proper charging, please do not have any cable, unit-unit or unit-computer, connected to the USB port.



## Preparing Charging Stations for Use

The TI Charging Station CE is shipped with the following components in each package:

- A TI Charging Station CE
  - An AC adapter
  - A regional power cord adapter
1. Insert the small end of the power adapter cord into the charging station's power jack.
  2. Plug the other end of the adapter into a power outlet.
- An indentation on each side of the TI Charging Station CE enables you to lift it. Always use two hands to lift and move the charging station.
  - Place the charging station on a flat, stable surface. You can also use a wheeled cart if you need to move the charging station between classrooms. When deciding on a location, consider its proximity to a power source such as a power strip or wall outlet.

## Inserting Graphing Calculators into the TI Charging Station CE

The slots in the TI Charging Station CE are designed to accommodate a graphing calculator without a slide case attached. The calculator will not fit in the slots with the slide case attached.

The front of the calculator must face the front of the charging station. You may damage the TI-84 Plus CE *Python* graphing calculator if you try to force it into the charging station facing the wrong direction. When looking at the TI logo on the charging station, insert calculators into the slot with the keypad facing left.



1. Remove the slide case from the graphing calculator.
2. Align the grooves on the sides of the graphing calculator with the guides in the charging station slots. Ensure the calculator is facing the proper direction.
3. Gently push the graphing calculator into the slot. You will feel a slight resistance; continue pushing down until the graphing calculator is seated.

When the TI-84 Plus CE *Python* EZ Spot graphing calculator is properly seated in a slot, the LED light on the side of the calculator turns amber to indicate it is charging.

### **Charging Batteries**

The TI-84 Plus CE *Python* graphing calculator uses a Li-Ion TI Rechargeable Battery.

The charging process starts automatically when a graphing calculator is placed in a slot on a powered charging station. You can charge a classroom set of graphing calculators overnight.

### **Determining Battery Status**

The LED light on each connected EZ Spot graphing calculator in the charging station provides basic information about the status of the rechargeable battery.

- When the light is amber, the battery is charging.
- When the light is green, the battery is fully charged.

### **Troubleshooting**

If the recharge fails:

- Make sure the graphing calculator is seated properly in the slot. Batteries are not charged if the connector on the graphing calculator and the connector in the slot are not aligned.

- Check the connector on the graphing calculator to ensure that it is clean. If there is build-up on the graphing calculator's connector, you can remove it with a clean, dry cloth or a pencil eraser. Never use wet cloths or solutions of any kind.

### Storing Charging Stations

Store the TI Charging Station CE on a flat surface such as a table or a wheeled cart. You cannot damage the charging station by leaving it plugged in for extended periods of time. Also, you cannot damage the batteries by leaving them in the charging station beyond the time needed to fully charge them.

### Using, Replacing, and Charging Batteries

The TI-84 Plus CE *Python* graphing calculator comes with a:

- TI rechargeable battery
- USB computer cable for transferring files and charging the battery

**Note:** Charge the battery for at least four hours to ensure optimum performance.

### Battery Status

The battery status icon on the upper right of the screen gives information on battery life.



The battery icons indicate the level of battery power remaining, and indicate if the battery is charging.



Battery is 75% to 100% charged.



Battery is 50% to 75% charged.



Battery is 25% to 50% charged.



Battery is 5% to 25% charged.

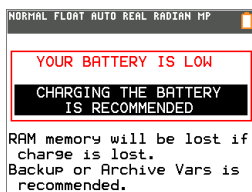


Battery is charging.

### Warning:

- RAM memory will be lost if the battery charge is lost. You should back up or archive your variables if your battery power gets low.
- Displays this message when you turn on the unit.





## Deep Sleep Mode

To maximize battery life, this graphing calculator is shipped in Deep Sleep mode. To wake the handheld from this mode, press **[on]** for at least 4 seconds or apply USB (computer or wall adapter) or TI Charging Station CE power. After waking the handheld, you can turn it on anytime by pressing **[on]**. To maximize battery life during extended storage periods, the Deep Sleep mode is enabled automatically after a period of being in the off state.

## Recharging the TI Rechargeable Battery

You should make sure the TI-84 Plus CE *Python* battery is charged for classroom use and before exams.

Use one of the following options to charge the battery in the TI-84 Plus CE *Python* graphing calculator:

- Connect the graphing calculator to a computer using a USB computer cable.
- or-
- Connect to a wall outlet using a TI wall adapter (may be sold separately).
- or-
- Place the graphing calculator in a TI Charging Station CE.

The amount of time required to fully charge the battery may vary, but charging takes approximately four hours. It is not necessary to remove the TI Rechargeable Battery from the graphing calculator to recharge it. The graphing calculator operates normally while it is attached to a charging source.

To recharge a graphing calculator from a computer, a TI USB driver must be installed. To download TI Connect™ CE or TI-SmartView™ CE software that includes a driver, go to: [education.ti.com/go/download](http://education.ti.com/go/download).

## Replacing TI Rechargeable Batteries

Take these precautions when replacing rechargeable batteries:

- Use only the charger recommended for the battery, or the one that was provided with the original equipment.
- Remove the graphing calculator from the charger or alternating current adapter when not in use or being charged.
- **Do not** use the battery in other devices because:

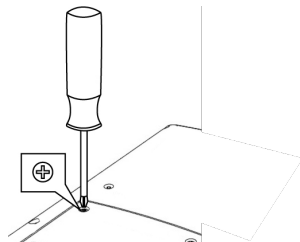
- This may result in personal injury or damage to equipment or property.
- There is a risk of explosion if a battery is replaced by the wrong type.

### Replacing the Battery

Use only the TI Rechargeable Battery to replace the TI-84 Plus CE *Python* battery.

To replace the battery, follow these steps.

1. Use a small screwdriver to release the panel from the back of the handheld.
2. Remove the panel.
3. Remove the old battery.
4. Drop in a new battery.
5. Replace the back panel and fasten the screws with a screwdriver.



### Disposing of Used Batteries Safely and Properly

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

When the TI Rechargeable Battery is fully charged, the graphing calculator draws power in the following order:

1. From a connected external power source, such as:
  - A computer connected through a USB computer cable
  - or-
  - A TI wall adapter (may be sold separately)
2. From the TI Rechargeable Battery

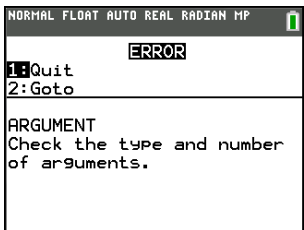
# Diagnosing and Correcting Error Conditions

The TI-84 Plus CE *Python* detects errors while performing these tasks:

- Evaluating an expression
  - Executing an instruction
  - Plotting a graph
  - Storing a value
1. Determine the error. The error screens give helpful hints about what may have happened, but the errors are not always fully explained.
  2. Correct the expression.

## Diagnosing an Error

When the TI-84 Plus CE *Python* detects an error, it returns an error message with a short description.



1:Quit	Displays the home screen
2:Goto	Displays the previous screen with the cursor at or near the error location

**Note:** If a syntax error occurs in the contents of a Y= function during program execution, then the **2:Goto** option returns to the Y= editor, not to the program.

## Correcting an Error

To correct an error, follow these steps.

1. Note the error type (`ERROR:error type`).
2. Select **2:Goto** (if it is available).The previous screen is displayed with the cursor at or near the error location.
3. Determine the error. The error screens give helpful hints about what may have happened, but the errors are not always fully explained.
4. Correct the expression.

## General Information

### **Online Help**

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

Select your country for more product information.

### **Contact TI Support**

[education.ti.com/ti-cares](http://education.ti.com/ti-cares)

Select your country for technical and other support resources.

### **Service and Warranty Information**

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

Select your country for information about the length and terms of the warranty or about product service.

Limited Warranty. This warranty does not affect your statutory rights.

### **Precautions for Rechargeable Batteries**

Take these precautions when replacing rechargeable batteries:

- Use only the charger recommended for the cell or battery, or the one that was provided with the original equipment.
- Remove the cell or battery from the charger or alternating current adapter when not in use or being charged.
- Use of the battery in other devices may result in personal injury or damage to equipment or property.
- Do not mix brands (or types within brands) of batteries. There is a risk of explosion if a battery is replaced by the wrong type.

### **Disposing of Batteries**

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries according to local regulations.

### **Korean Class A warning statement**

#### **Class A**

급기기(업무용방송통신기자재)

#### **Notification**

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