

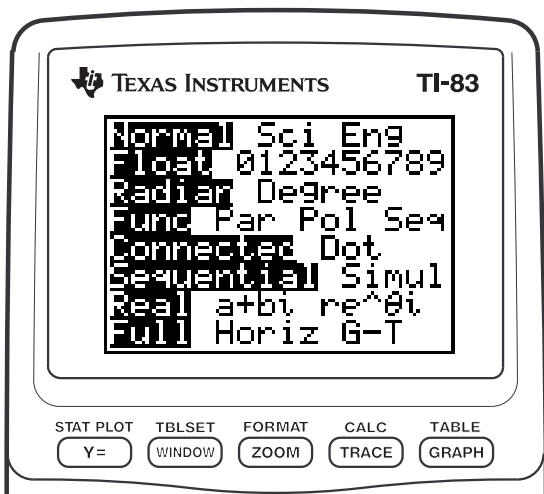
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# 1 Operating the TI-83

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# Turning On and Turning Off the TI-83

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## Turning On the Calculator

To turn on the TI-83, press **[ON]**.

- If you previously had turned off the calculator by pressing **[2nd] [OFF]**, the TI-83 displays the home screen as it was when you last used it and clears any error.
- If Automatic Power Down™ (APD™) had previously turned off the calculator, the TI-83 will return exactly as you left it, including the display, cursor, and any error.

To prolong the life of the batteries, APD turns off the TI-83 automatically after about five minutes without any activity.

## Turning Off the Calculator

To turn off the TI-83 manually, press **[2nd] [OFF]**.

- All settings and memory contents are retained by Constant Memory™.
- Any error condition is cleared.

## Batteries

The TI-83 uses four AAA alkaline batteries and has a user-replaceable backup lithium battery (CR1616 or CR1620). To replace batteries without losing any information stored in memory, follow the steps in Appendix B.

# Setting the Display Contrast

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## Adjusting the Display Contrast

You can adjust the display contrast to suit your viewing angle and lighting conditions. As you change the contrast setting, a number from **0** (lightest) to **9** (darkest) in the top-right corner indicates the current level. You may not be able to see the number if contrast is too light or too dark.

**Note:** The TI-83 has 40 contrast settings, so each number **0** through **9** represents four settings.

The TI-83 retains the contrast setting in memory when it is turned off.

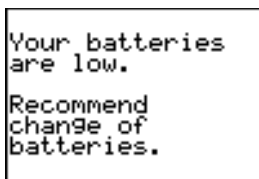
To adjust the contrast, follow these steps.

1. Press and release the  $\boxed{2nd}$  key.
2. Press and hold  $\boxed{\downarrow}$  or  $\boxed{\uparrow}$ , which are below and above the contrast symbol (yellow, half-shaded circle).
  - $\boxed{\downarrow}$  lightens the screen.
  - $\boxed{\uparrow}$  darkens the screen.

**Note:** If you adjust the contrast setting to **0**, the display may become completely blank. To restore the screen, press and release  $\boxed{2nd}$ , and then press and hold  $\boxed{\uparrow}$  until the display reappears.

## When to Replace Batteries

When the batteries are low, a low-battery message is displayed when you turn on the calculator.



```
Your batteries  
are low.  
  
Recommend  
change of  
batteries.
```

To replace the batteries without losing any information in memory, follow the steps in Appendix B.

Generally, the calculator will continue to operate for one or two weeks after the low-battery message is first displayed. After this period, the TI-83 will turn off automatically and the unit will not operate. Batteries must be replaced. All memory is retained.

**Note:** The operating period following the first low-battery message could be longer than two weeks if you use the calculator infrequently.

# The Display

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## Types of Displays

The TI-83 displays both text and graphs. Chapter 3 describes graphs. Chapter 9 describes how the TI-83 can display a horizontally or vertically split screen to show graphs and text simultaneously.

## Home Screen

The home screen is the primary screen of the TI-83. On this screen, enter instructions to execute and expressions to evaluate. The answers are displayed on the same screen.

## Displaying Entries and Answers

When text is displayed, the TI-83 screen can display a maximum of eight lines with a maximum of 16 characters per line. If all lines of the display are full, text scrolls off the top of the display. If an expression on the home screen, the Y= editor (Chapter 3), or the program editor (Chapter 16) is longer than one line, it wraps to the beginning of the next line. In numeric editors such as the window screen (Chapter 3), a long expression scrolls to the right and left.

When an entry is executed on the home screen, the answer is displayed on the right side of the next line.

log(2)	— Entry
.3010299957	— Answer

The mode settings control the way the TI-83 interprets expressions and displays answers (page 1-9).

If an answer, such as a list or matrix, is too long to display entirely on one line, an ellipsis (...) is displayed to the right or left. Press  $\blacktriangleright$  and  $\blacktriangleleft$  to scroll the answer.

L1	— Entry
{25.12 874.2 36...}	— Answer

## Returning to the Home Screen

To return to the home screen from any other screen, press  $\boxed{2\text{nd}}$  [QUIT].

## Busy Indicator

When the TI-83 is calculating or graphing, a vertical moving line is displayed as a busy indicator in the top-right corner of the screen. When you pause a graph or a program, the busy indicator becomes a vertical moving dotted line.

---

## Display Cursors

In most cases, the appearance of the cursor indicates what will happen when you press the next key or select the next menu item to be pasted as a character.

<b>Cursor</b>	<b>Appearance</b>	<b>Effect of Next Keystroke</b>
Entry	Solid rectangle ■	A character is entered at the cursor; any existing character is overwritten
Insert	Underline —	A character is inserted in front of the cursor location
Second	Reverse arrow ↵	A 2nd character (yellow on the keyboard) is entered or a 2nd operation is executed
Alpha	Reverse A Ⓐ	An alpha character (green on the keyboard) is entered or SOLVE is executed
Full	Checkerboard rectangle ■	No entry; the maximum characters are entered at a prompt or memory is full

If you press ALPHA during an insertion, the cursor becomes an underlined A (**A**). If you press 2nd during an insertion, the underline cursor becomes an underlined ↑ (↑).

Graphs and editors sometimes display additional cursors, which are described in other chapters.

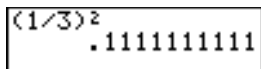
# Entering Expressions and Instructions

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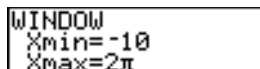
## What Is an Expression?

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-83, you enter an expression in the same order as you would write it on paper. For example,  $\pi R^2$  is an expression.

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.



(1/3)<sup>2</sup>  
.1111111111



WINDOW  
Xmin=-10  
Xmax=2π

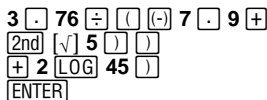
## Entering an Expression

To create an expression, you enter numbers, variables, and functions from the keyboard and menus. An expression is completed when you press **ENTER**, regardless of the cursor location. The entire expression is evaluated according to Equation Operating System (EOS™) rules (page 1-22), and the answer is displayed.

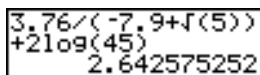
Most TI-83 functions and operations are symbols comprising several characters. You must enter the symbol from the keyboard or a menu; do not spell it out. For example, to calculate the log of 45, you must press **LOG** **45**. Do not enter the letters **L**, **O**, and **G**. If you enter **LOG**, the TI-83 interprets the entry as implied multiplication of the variables **L**, **O**, and **G**.

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



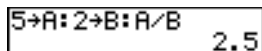
3 76 ÷ ( (-) 7 9 +  
2nd √ 5 ) )  
+ 2 LOG 45 )  
ENTER



3.76/(-7.9+√(5))  
+2log(45)  
2.642575252

## 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 (ENTRY; page 1-16).



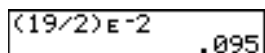
5→A:2→B:A/B  
2.5

---

## Entering a Number in Scientific Notation

To enter a number in scientific notation, follow these steps.

1. Enter the part of the number that precedes the exponent. This value can be an expression.
2. Press  $\boxed{2\text{nd}}$  [EE]. E is pasted to the cursor location.
3. If the exponent is negative, press  $\boxed{(-)}$ , and then enter the exponent, which can be one or two digits.



The image shows a TI-83 calculator display. The top line shows the expression  $(19/2)E-2$  and the bottom line shows the result  $.095$ .

When you enter a number in scientific notation, the TI-83 does not automatically display answers in scientific or engineering notation. The mode settings (page 1-9) and the size of the number determine the display format.

## Functions

A function returns a value. For example,  $\div$ ,  $-$ ,  $+$ ,  $\sqrt{\quad}$ , and **log**( are the functions in the example on page 1-6. In general, the first letter of each function is lowercase on the TI-83. Most functions take at least one argument, as indicated by an open parenthesis ( ) following the name. For example, **sin**( requires one argument, **sin**(*value*).

## Instructions

An instruction initiates an action. For example, **ClrDraw** is an instruction that clears any 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, **Circle**( requires three arguments, **Circle**(*X,Y,radius*).

## Interrupting a Calculation

To interrupt a calculation or graph in progress, which would be indicated by the busy indicator, press  $\boxed{\text{ON}}$ .

When you interrupt a calculation, the 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  $\boxed{\text{CLEAR}}$  or any nongraphing key.
- To restart graphing, press a graphing key or select a graphing instruction.

## TI-83 Edit Keys

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Keystrokes	Result
$\rightarrow$ or $\leftarrow$	Moves the cursor within an expression; these keys repeat.
$\uparrow$ or $\downarrow$	Moves the cursor from line to line within an expression that occupies more than one line; these keys repeat. On the top line of an expression on the home screen, $\uparrow$ moves the cursor to the beginning of the expression. On the bottom line of an expression on the home screen, $\downarrow$ moves the cursor to the end of the expression.
$2^{nd}$ $\leftarrow$	Moves the cursor to the beginning of an expression.
$2^{nd}$ $\rightarrow$	Moves the cursor to the end of an expression.
$\text{ENTER}$	Evaluates an expression or executes an instruction.
$\text{CLEAR}$	On a line with text on the home screen, clears the current line. On a blank line on the home screen, clears everything on the home screen. In an editor, clears the expression or value where the cursor is located; it does not store a zero.
$\text{DEL}$	Deletes a character at the cursor; this key repeats.
$2^{nd}$ [INS]	Changes the cursor to $\_ \_$ ; inserts characters in front of the underline cursor; to end insertion, press $2^{nd}$ [INS] or press $\leftarrow$ , $\uparrow$ , $\rightarrow$ , or $\downarrow$ .
$2^{nd}$	Changes the cursor to $\mathbb{I}$ ; the next keystroke performs a 2nd operation (an operation in yellow above a key and to the left); to cancel 2nd, press $2^{nd}$ again.
$\text{ALPHA}$	Changes the cursor to $\mathbb{A}$ ; the next keystroke pastes an alpha character (a character in green above a key and to the right) or executes SOLVE (Chapters 10 and 11); to cancel $\text{ALPHA}$ , press $\text{ALPHA}$ or press $\leftarrow$ , $\uparrow$ , $\rightarrow$ , or $\downarrow$ .
$2^{nd}$ [A-LOCK]	Changes the cursor to $\mathbb{A}$ ; sets alpha-lock; subsequent keystrokes (on an alpha key) paste alpha characters; to cancel alpha-lock, press $\text{ALPHA}$ ; name prompts set alpha-lock automatically.
$\text{X}, \text{T}, \theta, n$	Pastes an <b>X</b> in <b>Func</b> mode, a <b>T</b> in <b>Par</b> mode, a $\theta$ in <b>Pol</b> mode, or an <b>n</b> in <b>Seq</b> mode with one keystroke.

# Setting Modes

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## Checking Mode Settings

Mode settings control how the TI-83 displays and interprets numbers and graphs. Mode settings are retained by the Constant Memory feature when the TI-83 is turned off. All numbers, including elements of matrices and lists, are displayed according to the current mode settings.

To display the mode settings, press  $\boxed{\text{MODE}}$ . The current settings are highlighted. Defaults are highlighted below. The following pages describe the mode settings in detail.

Normal	Sci Eng	Numeric notation
Float	0123456789	Number of decimal places
Radian	Degree	Unit of angle measure
Func	Par Pol Seq	Type of graphing
Connected	Dot	Whether to connect graph points
Sequential	Simul	Whether to plot simultaneously
Real	$a+bi$ $re^{\theta i}$	Real, rectangular cplx, or polar cplx
Full	Horiz G-T	Full screen, two split-screen modes

## Changing Mode Settings

To change mode settings, follow these steps.

1. Press  $\boxed{\downarrow}$  or  $\boxed{\uparrow}$  to move the cursor to the line of the setting that you want to change.
2. Press  $\boxed{\rightarrow}$  or  $\boxed{\leftarrow}$  to move the cursor to the setting you want.
3. Press  $\boxed{\text{ENTER}}$ .

## Setting a Mode from a Program

You can set a mode from a program by entering the name of the mode as an instruction; for example, **Func** or **Float**. From a blank command line, select the mode setting from the mode screen; the instruction is pasted to the cursor location.

```
PROGRAM: TEST
:Func█
```

---

## Normal, Sci, Eng

Notation modes only affect the way an answer is displayed on the home screen. Numeric answers can be displayed with up to 10 digits and a two-digit exponent. You can enter a number in any format.

**Normal** notation mode is the usual way we express numbers, with digits to the left and right of the decimal, as in **12345.67**.

**Sci** (scientific) notation mode expresses numbers in two parts. The significant digits display with one digit to the left of the decimal. The appropriate power of 10 displays to the right of **E**, as in **1.234567E4**.

**Eng** (engineering) notation mode is similar to scientific notation. However, the number can have one, two, or three digits before the decimal; and the power-of-10 exponent is a multiple of three, as in **12.34567E3**.

**Note:** If you select **Normal** notation, but the answer cannot display in 10 digits (or the absolute value is less than .001), the TI-83 expresses the answer in scientific notation.

## Float, 0123456789

**Float** (floating) decimal mode displays up to 10 digits, plus the sign and decimal.

**0123456789** (fixed) decimal mode specifies the number of digits (**0** through **9**) to display to the right of the decimal. Place the cursor on the desired number of decimal digits, and then press **ENTER**.

The decimal setting applies to **Normal**, **Sci**, and **Eng** notation modes.

The decimal setting applies to these numbers:

- An answer displayed on the home screen
- Coordinates on a graph (Chapters 3, 4, 5, and 6)
- The **Tangent**( DRAW instruction equation of the line, **x**, and **dy/dx** values (Chapter 8)
- Results of CALCULATE operations (Chapters 3, 4, 5, and 6)
- The regression equation stored after the execution of a regression model (Chapter 12)

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## Radian, Degree

Angle modes control how the TI-83 interprets angle values in trigonometric functions and polar/rectangular conversions.

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

**Degree** mode interprets angle values as degrees. Answers display in degrees.

## Func, Par, Pol, Seq

Graphing modes define the graphing parameters. Chapters 3, 4, 5, and 6 describe these modes in detail.

**Func** (function) graphing mode plots functions, where **Y** is a function of **X** (Chapter 3).

**Par** (parametric) graphing mode plots relations, where **X** and **Y** are functions of **T** (Chapter 4).

**Pol** (polar) graphing mode plots functions, where  $r$  is a function of  $\theta$  (Chapter 5).

**Seq** (sequence) graphing mode plots sequences (Chapter 6).

## Connected, Dot

**Connected** plotting mode draws a line connecting each point calculated for the selected functions.

**Dot** plotting mode plots only the calculated points of the selected functions.

---

**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 TI-83 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  $a+bi$ .
- **$re^{\theta i}$**  (polar complex mode) displays complex numbers in the form  $re^{\theta i}$ .

**Full, Horiz, G-T** **Full** screen mode uses the entire screen to display a graph or edit screen.

Each split-screen mode displays two screens simultaneously.

- **Horiz** (horizontal) mode displays the current graph on the top half of the screen; it displays the home screen or an editor on the bottom half (Chapter 9).
- **G-T** (graph-table) mode displays the current graph on the left half of the screen; it displays the table screen on the right half (Chapter 9).

# Using TI-83 Variable Names

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## Variables and Defined Items

On the TI-83 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-83 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	<b>A, B, . . . , Z, <math>\theta</math></b>
Complex numbers	<b>A, B, . . . , Z, <math>\theta</math></b>
Matrices	[A], [B], [C], . . . , [J]
Lists	<b>L1, L2, L3, L4, L5, L6</b> , and user-defined names
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>
Stat plots	<b>Plot1, Plot2, Plot3</b>
Graph databases	<b>GDB1, GDB2, . . . , GDB9, GDB0</b>
Graph pictures	<b>Pic1, Pic2, . . . , Pic9, Pic0</b>
Strings	<b>Str1, Str2, . . . , Str9, Str0</b>
System variables	<b>Xmin, Xmax</b> , and others

## Notes about Variables

- You can create as many list names as memory will allow (Chapter 11).
- Programs have user-defined names and share memory with variables (Chapter 16).
- From the home screen or from a program, you can store to matrices (Chapter 10), lists (Chapter 11), strings (Chapter 15), system variables such as **Xmax** (Chapter 1), **TblStart** (Chapter 7), and all Y= functions (Chapters 3, 4, 5, and 6).
- From an editor, you can store to matrices, lists, and Y= functions (Chapter 3).
- 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 graph databases and pictures (Chapter 8).

# Storing Variable Values

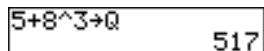
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## Storing Values in a Variable

Values are stored to and recalled from memory using variable names. When an expression containing the name of a variable is evaluated, the value of the variable at that time is used.

To store a value to a variable from the home screen or a program using the  $\boxed{\text{STO}}\blacktriangleright$  key, begin on a blank line and follow these steps.

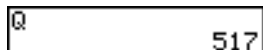
1. Enter the value you want to store. The value can be an expression.
2. Press  $\boxed{\text{STO}}\blacktriangleright$ .  $\rightarrow$  is copied to the cursor location.
3. Press  $\boxed{\text{ALPHA}}$  and then the letter of the variable to which you want to store the value.
4. Press  $\boxed{\text{ENTER}}$ . If you entered an expression, it is evaluated. The value is stored to the variable.



5+8^3+0 517

## Displaying a Variable Value

To display the value of a variable, enter the name on a blank line on the home screen, and then press  $\boxed{\text{ENTER}}$ .



Q 517

## Recalling Variable Values

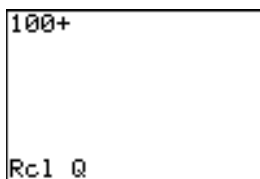
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### Using Recall (RCL)

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

1. Press **2nd** [**RCL**]. **Rcl** and the edit cursor are displayed on the bottom line of the screen.
2. Enter the name of the variable in any of five ways.
  - Press **ALPHA** and then the letter of the variable.
  - Press **2nd** [**LIST**], and then select the name of the list, or press **2nd** [**LN**].
  - Press **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 **PRGM** **▾**, and then select the name of the program (in the program editor only).

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



100+  
Rcl 0

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



100+517■

**Note:** You can edit the characters pasted to the expression without affecting the value in memory.

# ENTRY (Last Entry) Storage Area

---

## Using ENTRY (Last Entry)

When you press **ENTER** on the home screen to evaluate an expression or execute an instruction, the expression or instruction is placed in a storage area called ENTRY (last entry). When you turn off the TI-83, ENTRY is retained in memory.

To recall ENTRY, press **2nd** **ENTRY**. The last entry is pasted to the current cursor location, where you can edit and execute it. On the home screen or in an editor, the current line is cleared and the last entry is pasted to the line.

Because the TI-83 updates ENTRY only when you press **ENTER**, you can recall the previous entry even if you have begun to enter the next expression.

---

5 <b>+</b> 7	5+7	12
<b>ENTER</b>		
<b>2nd</b> <b>ENTRY</b>	5+7	

---

## Accessing a Previous Entry

The TI-83 retains as many previous entries as possible in ENTRY, up to a capacity of 128 bytes. To scroll those entries, press **2nd** **ENTRY** repeatedly. If a single entry is more than 128 bytes, it is retained for ENTRY, but it cannot be placed in the ENTRY storage area.

---

1 <b>STO</b> <b>ALPHA</b> A	1→A	1
<b>ENTER</b>		
2 <b>STO</b> <b>ALPHA</b> B	2→B	2
<b>ENTER</b>		
<b>2nd</b> <b>ENTRY</b>	2→B	

---

If you press **2nd** **ENTRY** after displaying the oldest stored entry, the newest stored entry is displayed again, then the next-newest entry, and so on.

---

	1→A	
	2→B	1
		2
<b>2nd</b> <b>ENTRY</b>	1→A	

---

---

## Reexecuting the Previous Entry

After you have pasted the last entry to the home screen and edited it (if you chose to edit it), you can execute the entry. To execute the last entry, press  $\boxed{\text{ENTER}}$ .

To reexecute the displayed entry, press  $\boxed{\text{ENTER}}$  again. Each reexecution displays an answer on the right side of the next line; the entry itself is not redisplayed.

$0 \boxed{\text{STO}} \boxed{\text{ALPHA}} \boxed{N}$	$0 \rightarrow N$	
$\boxed{\text{ENTER}}$		$0$
$\boxed{\text{ALPHA}} \boxed{N} \boxed{+} \boxed{1} \boxed{\text{STO}} \boxed{\text{ALPHA}} \boxed{N}$	$N+1 \rightarrow N:N^2$	
$\boxed{\text{ALPHA}} \boxed{:} \boxed{\text{ALPHA}} \boxed{N} \boxed{x^2} \boxed{\text{ENTER}}$		$1$
$\boxed{\text{ENTER}}$		$4$
$\boxed{\text{ENTER}}$		$9$

## Multiple Entry Values on a Line

To store to ENTRY two or more expressions or instructions, separate each expression or instruction with a colon, then press  $\boxed{\text{ENTER}}$ . All expressions and instructions separated by colons are stored in ENTRY.

When you press  $\boxed{2\text{nd}} \boxed{\text{ENTRY}}$ , all the expressions and instructions separated by colons are pasted to the current cursor location. You can edit any of the entries, and then execute all of them when you press  $\boxed{\text{ENTER}}$ .

---

For the equation  $A=\pi r^2$ , use trial and error to find the radius of a circle that covers 200 square centimeters. Use 8 as your first guess.

$8 \boxed{\text{STO}} \boxed{\text{ALPHA}} \boxed{R} \boxed{\text{ALPHA}}$	$8 \rightarrow R: \pi R^2$
$\boxed{:} \boxed{2\text{nd}} \boxed{\pi} \boxed{\text{ALPHA}} \boxed{R} \boxed{x^2} \boxed{\text{ENTER}}$	$201.0619298$
$\boxed{2\text{nd}} \boxed{\text{ENTRY}}$	$8 \rightarrow R: \pi R^2$
	$201.0619298$
$\boxed{2\text{nd}} \boxed{\leftarrow} \boxed{7} \boxed{2\text{nd}} \boxed{\text{INS}} \boxed{\cdot} \boxed{95}$	$8 \rightarrow R: \pi R^2$
$\boxed{\text{ENTER}}$	$7.95 \rightarrow R: \pi R^2$
	$198.5565097$

Continue until the answer is as accurate as you want.

---

## Clearing ENTRY

**Clear Entries** (Chapter 18) clears all data that the TI-83 is holding in the ENTRY storage area.

## Ans (Last Answer) Storage Area

---

### Using Ans in an Expression

When an expression is evaluated successfully from the home screen or from a program, the TI-83 stores the answer to a storage area called **Ans** (last answer). **Ans** may be a real or complex number, a list, a matrix, or a string. When you turn off the TI-83, the value in **Ans** is retained in memory.

You can use the variable **Ans** to represent the last answer in most places. Press  $\boxed{2\text{nd}} \boxed{[\text{ANS}]}$  to copy the variable name **Ans** to the cursor location. When the expression is evaluated, the TI-83 uses the value of **Ans** in the calculation.

---

Calculate the area of a garden plot 1.7 meters by 4.2 meters. Then calculate the yield per square meter if the plot produces a total of 147 tomatoes.

$1 \boxed{.}$   $7 \boxed{*}$   $4 \boxed{.}$   $2$   
 $\boxed{\text{ENTER}}$   
 $147 \boxed{\div}$   $\boxed{2\text{nd}} \boxed{[\text{ANS}]}$   
 $\boxed{\text{ENTER}}$

1.7*4.2	7.14
147/Ans	20.58823529

### Continuing an Expression

You can use **Ans** as the first entry in the next expression without entering the value again or pressing  $\boxed{2\text{nd}} \boxed{[\text{ANS}]}$ . On a blank line on the home screen, enter the function. The TI-83 pastes the variable name **Ans** to the screen, then the function.

$5 \boxed{\div}$   $2$   
 $\boxed{\text{ENTER}}$   
 $\boxed{\times}$   $9 \boxed{.}$   $9$   
 $\boxed{\text{ENTER}}$

5/2	2.5
Ans*9.9	24.75

### Storing Answers

To store an answer, store **Ans** to a variable before you evaluate another expression.

---

Calculate the area of a circle of radius 5 meters. Next, calculate the volume of a cylinder of radius 5 meters and height 3.3 meters, and then store the result in the variable V.



$\boxed{2\text{nd}} \boxed{[\pi]}$   $5 \boxed{x^2}$   
 $\boxed{\text{ENTER}}$   
 $\boxed{\times}$   $3 \boxed{.}$   $3$   
 $\boxed{\text{ENTER}}$   
 $\boxed{\text{STO}}$   $\boxed{\text{ALPHA}}$   $V$   
 $\boxed{\text{ENTER}}$

$\pi 5^2$	78.53981634
Ans*3.3	259.1813939
Ans→V	259.1813939

## Using a TI-83 Menu



You can access most TI-83 operations 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 seven items in that menu are displayed, beginning with item **1**, which also is highlighted.
- A number or letter identifies each menu item's place in the menu. The order is **1** through **9**, then **0**, then **A**, **B**, **C**, and so on. The LIST NAMES, PRGM EXEC, and PRGM EDIT menus only label items **1** through **9** and **0**.
- When the menu continues beyond the displayed items, a down arrow (↓) replaces the colon next to the last displayed item.
- When a menu item ends in an ellipsis, the item displays a secondary menu or editor when you select it.



To display any other menu listed on the top line, press  or  until that menu name is highlighted. The cursor location within the initial menu is irrelevant. The menu is displayed with the cursor on the first item.

**Note:** The Menu Map in Appendix A shows each menu, each operation under each menu, and the key or key combination you press to display each menu.

## Scrolling a Menu

To scroll down the menu items, press . To scroll up the menu items, press .

To page down six menu items at a time, press  . To page up six menu items at a time, press  . The green arrows on the calculator, between  and , are the page-down and page-up symbols.

To wrap to the last menu item directly from the first menu item, press . To wrap to the first menu item directly from the last menu item, press .

---

## Selecting an Item from a Menu

You can select an item from a menu in either of two 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 need not be displayed on the screen.
- Press  $\downarrow$  or  $\uparrow$  to move the cursor to the item you want, and then press  $\text{ENTER}$ .

After you select an item from a menu, the TI-83 typically displays the previous screen.

**Note:** On the LIST NAMES, PRGM EXEC, and PRGM EDIT menus, only items **1** through **9** and **0** are labeled in such a way that you can select them by pressing the appropriate number key. To move the cursor to the first item beginning with any alpha character or  $\theta$ , press the key combination for that alpha character or  $\theta$ . If no items begin with that character, then the cursor moves beyond it to the next item.

---

Calculate  $\sqrt[3]{27}$ .

$\text{MATH}$   $\downarrow$   $\downarrow$   $\downarrow$   $\text{ENTER}$        $\sqrt[3]{(27)}$   
 $27$   $\downarrow$   $\text{ENTER}$        $3$

---

## Leaving a Menu without Making a Selection

You can leave a menu without making a selection in any of four ways.

- Press  $2^{\text{nd}}$  [QUIT] to return to the home screen.
- Press [CLEAR] to return to the previous screen.
- Press a key or key combination for a different menu, such as  $\text{MATH}$  or  $2^{\text{nd}}$  [LIST].
- Press a key or key combination for a different screen, such as  $\text{Y=}$  or  $2^{\text{nd}}$  [TABLE].

# VARS and VARS Y-VARS Menus

---

## VARS Menu

You can enter the names of functions and system variables in an expression or store to them directly.

To display the VARS menu, press  $\boxed{\text{VARS}}$ . All VARS menu items display secondary menus, which show the names of the system variables. **1:Window**, **2:Zoom**, and **5:Statistics** each access more than one secondary menu.

---

### VARS Y-VARS

1: Window...	XY, T/ $\theta$ , and U/V/W variables
2: Zoom...	ZX/ZY, ZT/Z $\theta$ , and ZU variables
3: GDB...	Graph database variables
4: Picture...	Picture variables
5: Statistics...	XY, $\Sigma$ , EQ, TEST, and PTS variables
6: Table...	TABLE variables
7: String...	String variables

---

## Selecting a Variable from the VARS Menu or VARS Y-VARS Menu

To display the VARS Y-VARS menu, press  $\boxed{\text{VARS}} \boxed{\blacktriangleright}$ . **1:Function**, **2:Parametric**, and **3:Polar** display secondary menus of the Y= function variables.

---

### VARS Y-VARS

1: Function...	<i>Yn</i> functions
2: Parametric...	<i>XnT</i> , <i>YnT</i> functions
3: Polar...	<i>rn</i> functions
4: On/Off...	Lets you select/deselect functions

---

**Note:** The sequence variables (**u**, **v**, **w**) are located on the keyboard as the second functions of  $\boxed{7}$ ,  $\boxed{8}$ , and  $\boxed{9}$ .

To select a variable from the VARS or VARS Y-VARS menu, follow these steps.

1. Display the VARS or VARS Y-VARS menu.
  - Press  $\boxed{\text{VARS}}$  to display the VARS menu.
  - Press  $\boxed{\text{VARS}} \boxed{\blacktriangleright}$  to display the VARS Y-VARS menu.
2. Select the type of variable, such as **2:Zoom** from the VARS menu or **3:Polar** from the VARS Y-VARS menu. A secondary menu is displayed.
3. If you selected **1:Window**, **2:Zoom**, or **5:Statistics** from the VARS menu, you can press  $\boxed{\blacktriangleleft}$  or  $\boxed{\blacktriangleright}$  to display other secondary menus.
4. Select a variable name from the menu. It is pasted to the cursor location.

# Equation Operating System (EOS™)

---

## Order of Evaluation

The Equation Operating System (EOS™) defines the order in which functions in expressions are entered and evaluated on the TI-83. EOS lets you enter numbers and functions in a simple, straightforward sequence.

EOS evaluates the functions in an expression in this order:

1	Single-argument functions that precede the argument, such as $\sqrt{}$ , <b>sin()</b> , or <b>log()</b>
2	Functions that are entered after the argument, such as $2^{-1}$ , $!$ , $^{\circ}$ , $^{\circ}$ , $^{\circ}$ , and conversions
3	Powers and roots, such as $2^5$ or $5^{\sqrt{32}}$
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 $\leq$
8	Logic operator <b>and</b>
9	Logic operators <b>or</b> and <b>xor</b>

Within a priority level, EOS evaluates functions from left to right.

Calculations within parentheses are evaluated first. Multiargument functions, such as **nDeriv(A<sup>2</sup>,A,6)**, are evaluated as they are encountered.

---

## Implied Multiplication

The TI-83 recognizes implied multiplication, so you need not press  $\times$  to express multiplication in all cases. For example, the TI-83 interprets  $2\pi$ ,  $4\sin(46)$ ,  $5(1+2)$ , and  $(2*5)7$  as implied multiplication.

**Note:** TI-83 implied multiplication rules differ from those of the TI-82. For example, the TI-83 evaluates  $1/2X$  as  $(1/2)*X$ , while the TI-82 evaluates  $1/2X$  as  $1/(2*X)$  (Chapter 2).

## Parentheses

All calculations inside a pair of parentheses are completed first. For example, in the expression  $4(1+2)$ , EOS first evaluates the portion inside the parentheses,  $1+2$ , and then multiplies the answer,  $3$ , by  $4$ .

$4*1+2$	6
$4(1+2)$	12

You can omit the close parenthesis ( ) at the end of an expression. All open parenthetical elements are closed automatically at the end of an expression. This is also true for open parenthetical elements that precede the store or display-conversion instructions.

**Note:** An open parenthesis following a list name, matrix name, or Y= function name does not indicate implied multiplication. It specifies elements in the list (Chapter 11) or matrix (Chapter 10) and specifies a value for which to solve the Y= function.

## Negation

To enter a negative number, use the negation key. Press  $\ominus$  and then enter the number. On the TI-83, negation is in the third level in the EOS hierarchy. Functions in the first level, such as squaring, are evaluated before negation.

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

$-2^2$	-4
$(-2)^2$	4

$2\rightarrow A$	2
$-A^2$	-4
$(-A)^2$	4

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

# Error Conditions

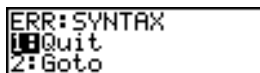
---

## Diagnosing an Error

The TI-83 detects errors while performing these tasks.

- Evaluating an expression
- Executing an instruction
- Plotting a graph
- Storing a value

When the TI-83 detects an error, it returns an error message as a menu title, such as ERR:SYNTAX or ERR:DOMAIN. Appendix B describes each error type and possible reasons for the error.



- If you select **1:Quit** (or press  $\boxed{2\text{nd}}$  [QUIT] or  $\boxed{\text{CLEAR}}$ ), then the home screen is displayed.
- If you select **2:Goto**, then the previous screen is displayed 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 **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 (**ERR: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. If you cannot recognize the error, refer to Appendix B.
4. Correct the expression.