SHARP®

MODEL

EL-9450

GRAPHING CALCULATOR

OPERATION MANUAL

Introduction

This graphing calculator can handle many types of mathematical formulas and expressions for you. It is powerful enough to process very complex formulas used in rocket science, but yet so compact that it fits in your coat pocket.

The main features of this calculator are:

- Equation editor display system,
- Slide Show feature to aid your math presentation,
- Enhanced graphing capability to visualize your project,
- Fraction calculation, and more.

We strongly recommend you read this manual thoroughly. If not, then browse through the very first chapter “Getting Started”, at least. Last, but not least, congratulations on purchasing the Graphing Calculator!

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Caring for Your Calculator

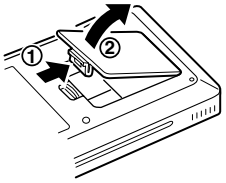
- Do not carry the calculator around in your back pocket, as it may break when you sit down. The display is made of glass and is particularly fragile.
- Keep the calculator away from extreme heat such as on a car dashboard or near a heater, and avoid exposing it to excessively humid or dusty environments.
- Since this product is not waterproof, do not use it or store it where fluids, for example water, can splash onto it. Raindrops, water spray, juice, coffee, steam, perspiration, etc. will also cause malfunction.
- Clean with a soft, dry cloth. Do not use solvents.
- Do not use a sharp pointed object or exert too much force when pressing keys.
- Avoid excessive physical stress.

Chapter 1
Getting Started

Before Use

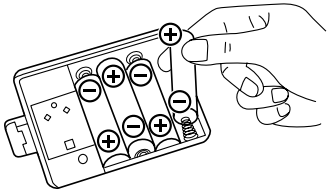
Inserting batteries - resetting the memory

1. Open the battery cover located on the back of the calculator. Pull down the notch, then lift the battery cover up to remove it.



2. Insert the batteries, as indicated. Make sure that the batteries are inserted in the correct directions.

   Do not remove the label since it contains backup battery for memory protection.



3. Place the battery cover back, and make sure that the notch is snapped on.

   The unit will automatically start its own initialization sequence. After a moment of “WAIT” message displayed on the screen, the following message will appear:

   PRESS [CL] TO CLEAR ALL DATA
   PRESS [ON] KEY TO CANCEL

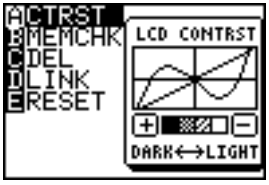
Note: If the above message does not appear, check the direction of the batteries and close the cover again. If this does not solve the problem, follow the instruction described in "Resetting the Calculator - 1. Using the RESET switch" on page 25.

4. Press [CL] to reset the calculator’s memory. The memory will be initialized. Press any key to set the calculator ready for normal calculation mode.

Adjusting display contrast

Since the display contrast may vary with the ambient temperature and/or remaining battery power, you may want to adjust the contrast accordingly. Here's how:

1. Press [2ndF], then [OPTION].



2. Adjust the contrast by using the [+] and [−] keys.
   [+]: increases the contrast
   [−]: decreases the contrast
3. When done, press [CL] to exit the mode.

Turning the calculator OFF

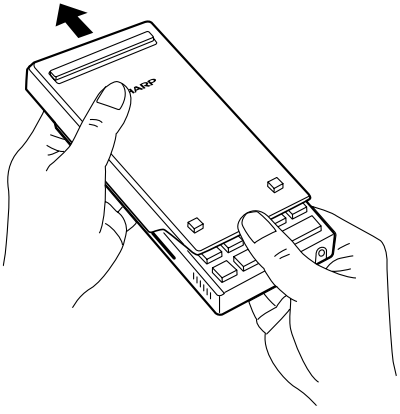
Press [2ndF] [OFF] to turn the calculator off.

Automatic power off function

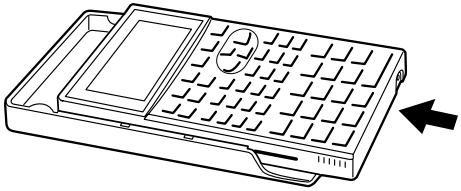
- The calculator is automatically turned off when there is no key operation for approximately 10 minutes (The power-off time depends on the conditions.)
- The calculator will not automatically power off while it is executing calculations ("■" flashes on the upper right corner of the display.)

Using the Hard Cover

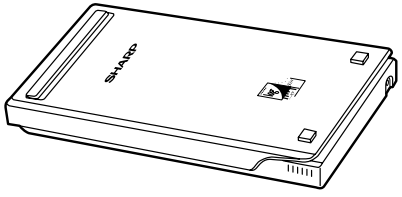
To open the cover:



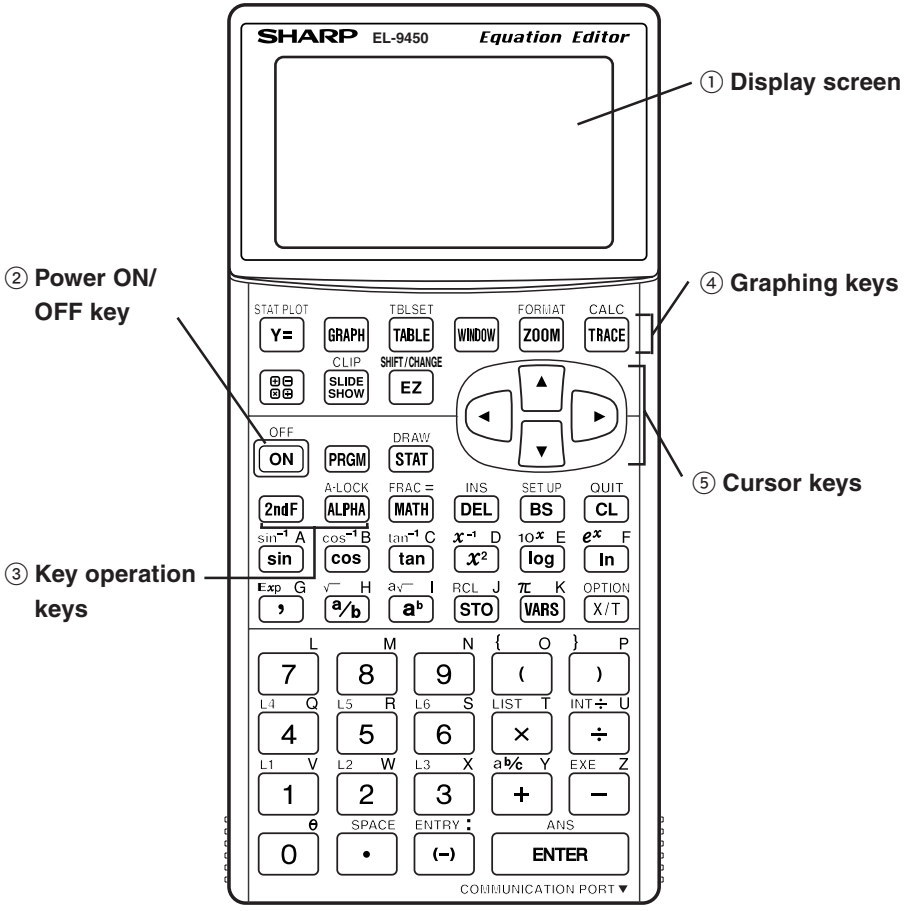
When in use:



When not in use:



Part Names and Functions



① **Display screen:**
Displays up to 96 pixels wide by 64 pixels tall of graphs and texts.

② **Power ON/OFF key:**
Turns calculator ON. To turn off the calculator, press [2ndF], then [OFF].

③ **Key operation keys:**
These keys are used to change the key functions.

[2ndF]: Changes the cursor to "2", and the next keystroke enters the function or mode printed above each key in yellow.

[ALPHA]: Changes the cursor to "A", and the next keystroke enters the alphabetical letter printed above each key in blue.

Note: Press [2ndF] [A-LOCK] to lock the specific keys in the alphabet entering mode. (ALPHA-LOCK)

④ **Graphing keys:**
These keys specify settings for the graphing-related mode.

[Y=]: Opens the formula input screen for drawing graphs.

[GRAPH]: Draws a graph based on the formulas programmed in the [Y=] window.

[TABLE]: Opens a Table based on the formulas programmed in [Y=].

[WINDOW]: Sets the display ranges for the graph screen.

[ZOOM]: Changes the display range of the graph screen.

[TRACE]: Places the cursor pointer on the graph for tracing, and displays the coordinates.

[STAT PLOT]: Sets the statistical plotting.

[TBLSET]: Opens the table setup screen.

[FORMAT]: Sets the operations of the graph screen.

[CALC]: Calculates specific values based on formulas programmed in [Y=]

⑤ **Cursor keys:**
Enables you to move the cursor (appears as _, ▮, etc. on the screen) in four directions. Use these keys also to select items in the menu.

- [⊞⊟ / ⊠⊞]: Returns calculator to calculation screen.
- [SLIDE SHOW]: Creates your own slide shows and displays the built-in slide show.
- [CLIP]: Obtains the screen for the slide show.
- [EZ]: Enters the rapid feature. (See page 83.)
- [SHIFT/CHANGE]: Enters the Shift or Change feature. (See page 96.)

Basic Operation keys

- [ENTER]: Used when executing calculations or specifying commands.
- [CL] / [QUIT]: Clear/Quit key
- [BS]: Backspace delete key
- [DEL]: Delete key
- [INS]: Toggle input mode between insert and overwrite (in **one-line edit mode**).
- [SETUP]: Allows you to set up the basic behavior of this calculator, such as to set answers in scientific or normal notation.

Menu and Function keys

- [PRGM]: Enter the programming menu.
- [STAT]: Enter the statistics menu.
- [DRAW]: Draws items on the graph. Use this key also to save or recall the graph/pixel data.
- [MATH]: Enter the Math menu with additional mathematical functions.
- [FRAC]: Enter the fraction menu.
- [OPTION]: Sets or resets the calculator settings, such as LCD contrast and memory usage.
- [LIST]: Accesses list features.
- [VARS]: Enter the menu for calculator specific variables.

Scientific Calculation keys

[sin] / [cos] / [tan] / [sin⁻¹] / [cos⁻¹] / [tan⁻¹]:
Trigonometric function keys

[x^2] / [log] / [ln] / [x^{-1}] / [10^x] / [e^x] / [a^b]:
Logarithm and exponential functions.

[$\frac{a}{b}$] / [$a\frac{b}{c}$]: Fraction calculation keys

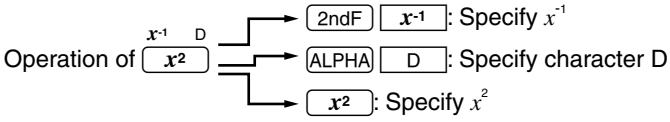
[int÷]: Integer division and remainder calculation keys

[$\sqrt{\ }$] / [$a\sqrt{\ }$]: Root calculation keys

Basic Key Operations

Since this calculator has more than one function assigned to each key, you will need to follow a few steps to get the function you need.

Example



- Press “as is” to get the function and number printed on each key.
- To access secondary function printed above each key in yellow, press [2ndF] first, then press the key. Press [CL] to cancel.
- To press the key printed above each key in blue, press [ALPHA] first, then press the key. When in Menu selection screen however, you do not have to press [ALPHA] to access the characters. Press [CL] to cancel.
- If you want enter alphabetical letters (blue) sequentially, use [2ndF] [A-LOCK]. Press [ALPHA] to return to the normal mode.
- In this manual, alphanumeric characters to be entered are indicated as they are (without using the key symbols). Use of the key symbol indicates that it is for selecting the menu specified by the character or number. The above example also indicates the key notation rules of this manual.

Quick Run-through: Fraction Calculation

Here are the major ingredients for 18 doughnuts:

$\frac{1}{4}$ cup warm water

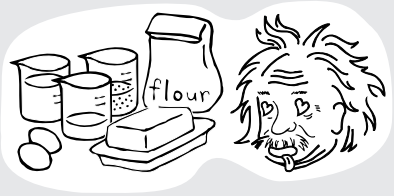
$\frac{3}{4}$ cup warm milk

$\frac{1}{3}$ cup sugar

4 cups all-purpose flour

2 eggs

3 tablespoons butter



Based on these values, solve the following problems using the calculator.

Question If you make 60 doughnuts according to the above recipe, how many cups of warm milk are required?

At first, you may calculate how many cups of warm milk are required for 1 doughnut =

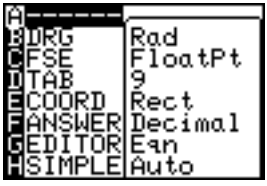
$\frac{3}{4} \div 18$

As for the ordinary calculation, the answer is 0.041666666. But how much is 0.041666666 of a cup of warm milk?

The answer has three modes, **Decimal** numbers, **Mixed** (numbers) and **Improp**(er numbers). If the **Mixed** or **Improp** answer mode is selected in the SETUP menu, you can obtain the answer in fractions.

Change answer mode from decimals to fractions

1. Press [2ndF] [SETUP].



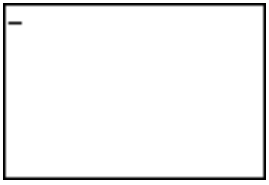
2. Select **F ANSWER** and press [2].

3. Press [CL].

Now the answer mode is set to the fraction answer mode (Mixed).

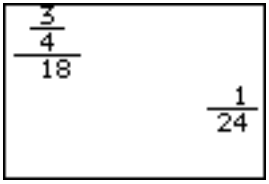
Set up the calculator before calculation

1. Press [⊞⊟/⊠⊞] to enter the calculation screen.
2. Press [CL] to clear the display.



Enter fractions

3. Press 3 [a b/c] 4 [▶].
4. Press [a b/c] 18 [▶].
5. Press [ENTER].



Now we have found $\frac{1}{24}$ of a cup of warm milk is required per one doughnut, how many cups are required for 60 doughnuts?

If you want to use the answer of the previous calculation, press [ANS] and you do not have to reenter the value.

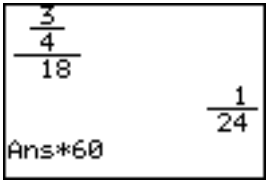
6. Press [2ndF] [ANS] [×], or directly [×] (multiplication).

"Ans" is displayed. ANS is a calculator specific variable which indicates the answer of calculations just before.

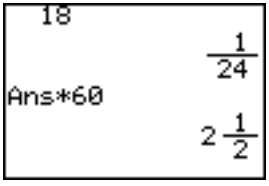
* When you enter + (addition), − (subtraction), × (multiplication), ÷ (division), it is not required to press [ANS].

Note: The multiplication sign and the division sign will appear on the screen as "∗" and "/", respectively.

7. Press 60.



8. Press [ENTER].

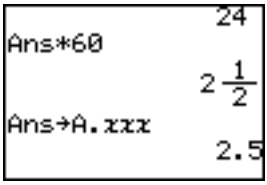


Answer: $2\frac{1}{2}$ cups of warm milk are required for making 60 doughnuts.

You can toggle between decimal values, mixed numbers, and improper fractions using fraction menu.

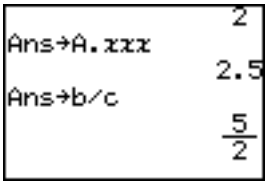
To a decimal value

1. Press 2ndF FRAC 4 ENTER.



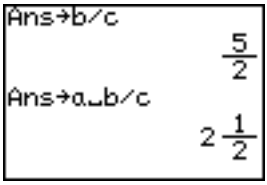
To an improper fraction

2. Press 2ndF FRAC 3 ENTER.



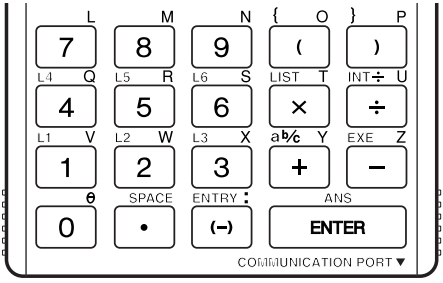
To a mixed number

3. Press 2ndF FRAC 2 ENTER.



Chapter 2
Operating the Graphing Calculator

Basic Key Operations



The standard calculation keys, located at the bottom four rows of the keyboard, enable you to access the basic functions of the calculator.

1. Entering numbers

Use the number keys ([0] ~ [9]), decimal point key ([·]), and negative number key ([(−)]) to enter numbers into the calculator. To clear the screen entry, press [CL].

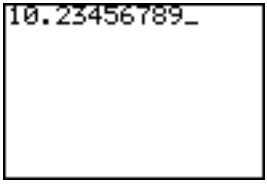
Number entry **Example**

Type 10.23456789 onto the Calculation screen.

1. Enter the Calculation screen, then clear the screen entry:
   [⊞] [CL]

2. Enter numbers with the number keys and decimal point key, as follows:

   10 [·] 23456789

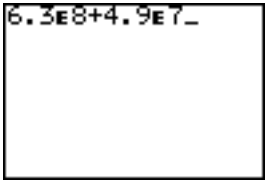


Note: [2ndF] [Exp] ([,]) can be used to enter a value in scientific notation.

Example

$6.3 \times 10^8 + 4.9 \times 10^7$

[⊞⊟ ⊠÷] [CL] 6.3 [2ndF] [Exp] 8 [+] 4.9 [2ndF] [Exp] 7



Entering a negative value

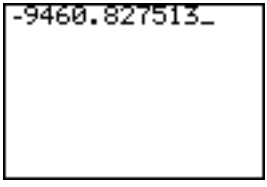
The negative number key [(–)] can be used to enter numbers, lists, and functions with negative values. Press [(–)] before entering the value.

Note: Do not use the [−] key to specify a negative value. Doing so will result in an error.

Example

Type -9460.827513 into the Calculation screen.

[⊞⊟ ⊠÷] [CL] [(–)] 9460.827513



2. Performing standard math calculations

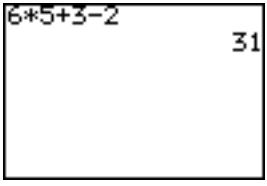
By utilizing the [+] [−] [×] and [÷] keys, you can perform the standard arithmetic calculations of addition, subtraction, multiplication, and division. Press [ENTER] to perform each calculation.

Perform an arithmetic calculation

Example

Obtain the answer to "6 × 5 + 3 − 2".

[⊞⊟ ⊠÷] [CL] 6 [×] 5 [+] 3 [−] 2 [ENTER]

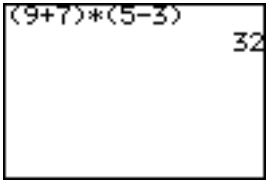


Using parentheses

With the (and) keys, parentheses (round brackets) can be added to group sections of expressions. Sections within the parentheses will be calculated first. Parentheses can also be used to close the passings of values in various functions, such as "round(1.2459,2)".

Example

Obtain the answer to "(9 + 7) × (5 – 3)".



[⊞⊟/⊠⊞] CL (9 + 7)
× (5 − 3) ENTER

Note: The multiplication sign "×", as the one in the above example, can be abbreviated if it proceeds a math function, a parenthesis "(", or a variable. Abbreviating "(1 + 2) × 3" to "(1 + 2) 3" will result in an error.

Cursor Basics

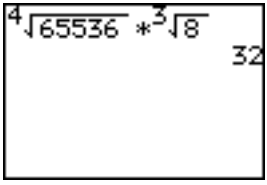
The cursor indicates where the next entry will be placed. The cursor may be placed automatically to different areas by various functions and tools, or can be moved around by using the ◄ ► ▲ ▼ keys. Use the cursor keys to select a menu item, select an item in a list, and trace along a graph.

Example

Enter "$\sqrt[4]{65536} \times \sqrt[3]{8}$" in the Calculation screen. Then press ENTER to calculate.

1. Press [⊞⊟/⊠⊞], then CL to clear the display.
2. Enter 4 for the root's depth, then press 2ndF [a√‾].
   The root figure is entered, with the cursor automatically placed below the figure.
   For detailed instructions of how to use the 2ndF key, refer to "Second Function Key" and "ALPHA Key" in this chapter.
3. Enter 65536.
   At this moment, the cursor is still placed under the root figure.
4. Press ► to move the cursor out of the area, then enter × at the cursor.
5. Press 2ndF [a√‾] again. Notice that the cursor is automatically placed so that you can specify the depth of this root figure. Type 3, ▼, and 8.

6. Press [ENTER] to obtain the answer.



Cursor appearance and input method

The cursor also displays information regarding the calculator's input method. See the following diagram.

Mode	Symbol	Remarks
Normal mode	_ ▒ ◂i	The appearance of the cursor pointer may vary according to the mode or position. The major shapes and the definitions are as follows: ◂i : Insert mode ▒ : Overwrite mode
When [ALPHA] is pressed	A ▒ ⋮	
When [2ndF] is pressed	2 ▒ ⋮	

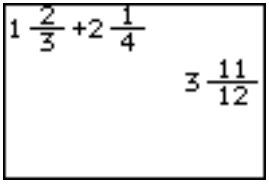
* ⋮, ⋮ and ⋮ appear at the insertion point within the functions such as a/b and $\sqrt[a]{\ }$.

Editing Entries

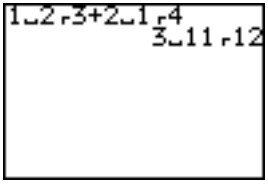
Editing modes

The calculator has the following two editing modes: **equation mode**, and **one-line mode**.
You can select one from the G EDITOR menu of the SETUP menu.

Equation editor



One-line editor



* See page 23 for details.

Cursor navigation

Use [◀] [▶] [▲] [▼] to move the cursor around, and use the [DEL] [BS] [CL] keys to edit entries.

- [DEL] key deletes an entry AT THE CURSOR.
- [BS] key erases one BEFORE THE CURSOR.
- Use [CL] to clear the entire entry line.

About the Insert mode

When the editing mode is set to **one-line**, insert mode needs to be manually specified. Press and release [2ndF], then [INS] to set the insert mode. Press [2ndF] [INS] again to return to the overwrite mode.

The [CL] key clears all screen entries in the Calculation screen, as well as clearing error messages. It also clears a single line equation in the [Y=] screen. For more information on the [Y=] key, refer to Chapters 4 of the manual.

Example

Type 3096, then change 3 to 4. When done, move the cursor to the very end of the numbers.

[⊞⊟/⊠⊞] [CL] 3 0 9 6 [◀] [◀] [◀] [◀] [DEL] 4 [▶] [▶] [▶]

Example

Type 4500000, then remove 500.

[⊞⊟/⊠⊞] [CL] 4 5 0 0 0 0 0 [◀] [◀] [◀] [BS] [BS] [BS]

Tips: You can jump the cursor to the beginning or the end of line by using the [2ndF] and [◀] [▶] keys. Likewise, if the cursor is at the very top of the stacked entry, press [2ndF] [▼] to jump the cursor all the way to the bottom. Press [2ndF] [▲] to jump the cursor to the top. To learn about how to use the [2ndF] key and its functions, refer to the section “Second Function Key” of this chapter.

Second Function Key

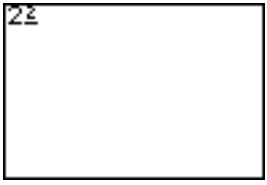
Use [2ndF] to call up the calculator's extended key functions, math functions and figures.

All functions associated with [2ndF] are color coded yellow, and are printed above each key.

Example

Enter "2π" on the screen.

1. Press [⊞⊟ ⊠⊞] [CL] to clear the screen, then enter "2" by pressing [2].
2. Press [2ndF]. When the key is released, the cursor on the screen changes, indicating that a second function is now ready to be called up.



3. Press [π]. The entry appears on the screen.

ALPHA Key

Use [ALPHA] to enter an alphabet character. All 26 alphabet characters from "A" up to "Z", "θ", "=", " : ", and space can be typed.

All functions associated with [ALPHA] are color coded blue, and are printed above each key.

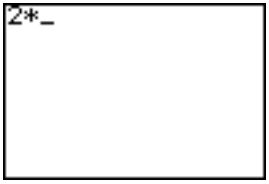
Note: Do not type out math figures (***sin***, ***log***, etc.), graph equation names (**Y1**, **Y2**, etc.), or list names (**L1**, **L2**, etc.), etc. with [ALPHA] keys. If "SIN" is entered from [ALPHA] mode, then each alphabet character — "S", "I" and "N" — will be entered as a variable. Call up the figure and equation names from within the second functions and various menus instead. If a colon (:) is used, data may continue to be entered in more than one term.

Entering one Alphabet character

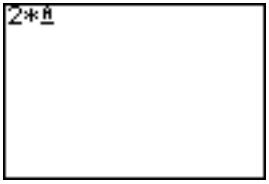
Example

Enter 2 × A on the screen.

1. Press [▦] [CL] to clear the screen. Enter "2 ×" by pressing 2 [×].



2. To enter "A", press [ALPHA]; the cursor pattern changes to "A" upon releasing the key.



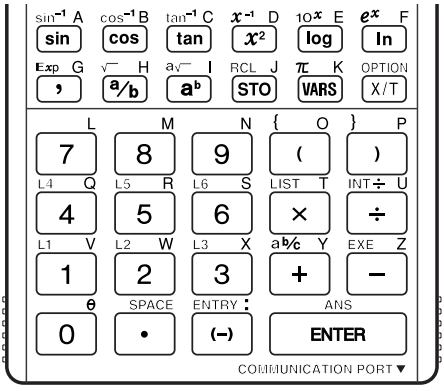
3. Press [A] to call "A" at the cursor.
   After the entry, the cursor pattern changes back to normal.

Entering 1 or More Alphabet characters

To type more than one alphabet character, use [2ndF] then [ALPHA] to apply the "ALPHA-LOCK". When done, press [ALPHA] to escape from the mode.

Note: Pressing [ALPHA] [▼] or [▲] allows you to jump to the next or previous page within the sub-menu.

Math Function Keys



Mathematical functions can be called up quickly with the Math Function keys.

Math Function keys:

sin	Enters a sine function at the cursor
sin⁻¹	Enters an arc sine function at the cursor
cos	Enters a cosine function at the cursor
cos⁻¹	Enters an arc cosine function at the cursor
tan	Enters a tangent function at the cursor
tan⁻¹	Enters an arc tangent function at the cursor
x^2	Enters "^{2}" at the cursor, to raise a number to the second power
x^{-1}	Enters "$^{-1}$" at the cursor, to raise a number to the negative first power
log	Enters a logarithm function at the cursor
10^x	Enters "10 to the xth power", then sets the cursor at the "x"
ln	Enters a natural logarithm function at the cursor
e^x	Enters "e-constant to the power of x", then sets the cursor at the "x"

[,] Enters " , " (a comma) at the cursor

[Exp] Enters a value in scientific notation

[a/b] Enters a fraction.

[√] Enters a "root" figure at the cursor

[a^b] Enters an exponent.

[a√] By itself enters a "root" figure; the cursor will be set at "a", the depth.

[STO] Stores a number or a formula into a variable

[RCL] Recalls an item stored in a variable

[VARS] Brings up the VARS menu.

[π] Input π (3.14...) figure.

[X/T] Input a variable (X for rectangular or T for parametric)

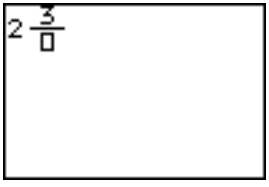
[int÷] Gives an answer as a quotient and a remainder

[ab/c] Enters a mixed number.

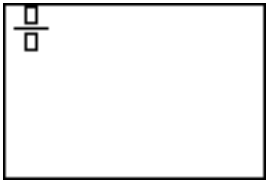
Note: If a number precedes [ab/c] [a/b] [a^b] and [a√], then the number will be set as the first entry of the figure. Else, the first entry is blank and the cursor flashes.

Examples

2 [2ndF] [ab/c] 3 [▼]
4 [▶]



[2ndF] [ab/c]
[◀] 2 [▶] 3 [▼] 4 [▶]



MATH, STAT, and PRGM Menu Keys

By using the MATH, STAT, and PRGM keys, you can access many menu items for complex calculation tasks. The appendix "List of Menu/Sub-menu Items" shows the contents of each sub-menu item.

Example

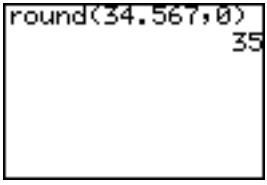
Round the following number beyond the decimal point: 34.567

1. Press [⊞⊟ / ⊠⊞] CL, then MATH. The MATH menu takes over the screen, as shown to the right. MATH menu items are displayed on the left side of the screen.

2. Use the ▲ and ▼ keys to move the cursor up and down the menu. As you scroll, you will see the corresponding sub-menu contents (shown on the right side of the screen) change.
3. Set the cursor at **B NUM**.

   Menu items can also be selected by using shortcut keys (**A** through **H**); in this example, simply press B to select **B NUM**. There is no need to use ALPHA for this operation.
4. Press a shortcut key 2 to select **2 round(**. The screen now goes back to the calculation screen, as follows:

   Another way of selecting the sub-menu item is to press ▶ (or ENTER) on the menu item **B NUM**. The cursor will be extended into the sub-menu on the right. Now, move the cursor on the sub-menu down to **2 round(**, then press ENTER.
5. Type 3 4 . 5 6 7 , 0), and press ENTER.



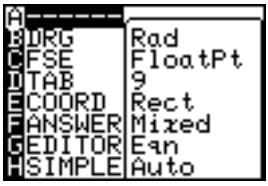
SETUP Menu

Use this menu to verify basic configurations, such as to define the calculator's editing preferences, and scientific and mathematical base units.

Checking the calculator's configuration

To check the current configuration of the calculator, press [2ndF], then [SETUP].

By entering menu items (**B DRG** through **H SIMPLE**), various setups can be changed. To exit the SETUP menu, press [CL].



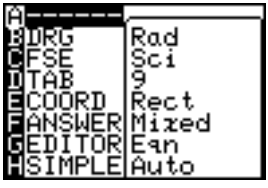
Example

Display the calculation result of "1000^2" in scientific notation.

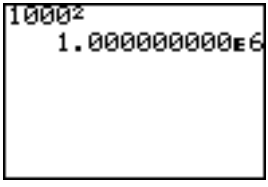
1. Press [2ndF], then [SETUP]. Within the SETUP menu, press [C], then [3] to select **3 Sci** under the **C FSE** menu.

Tips: Using the arrow keys, move the cursor down to the **C FSE** position, press [ENTER], and then move the cursor down to the **3 Sci** position. Press [ENTER] to select the sub-menu item.

2. The display goes back to the SETUP menu's initial screen.
3. Press [CL] to exit the SETUP menu.



4. Press [▦] [CL] to clear the Calculation screen, type 1 0 0 0 [x^2], then [ENTER].



SETUP Menu Items

DRG: For trigonometric calculations and coordinate conversions, various angle units can be selected:

- **Deg** Angle values to be set in degrees
- **Rad** Angle values to be set in radians (default)
- **Grad** Angle values to be set in grads

FSE: Various decimal formats can be set:

- **FloatPt** Answers are given in decimal form with a floating decimal point (default).
- **Fix** Answers are given in decimal form. The decimal point can be set in the TAB menu.
- **Sci** Answers are given in "scientific" notation. For example, "3500" is displayed as "3.500000000E3". The decimal point can be set in the TAB menu.
- **Eng** Answers are given in "engineering" notation with exponents set to be multiples of 3. "100000" will be displayed as "100.0000000E3", and "1000000" will be shown as "1.000000000E6". The decimal point can be set in the TAB menu.

Note: If the value of the mantissa does not fit within the range ±0.000000001 to ±9999999999, the display changes to scientific notation. The display mode can be changed according to the purpose of the calculation.

TAB: Sets the number of digits beyond the decimal point (0 through 9). The default is "9".

COORD: Sets the calculator to the rectangular or parametric graph coordinate system.

- **Rect** Rectangular coordinates (default)
- **Param** Parametric equation coordinates

ANSWER: Sets the answer preference to various number formats.

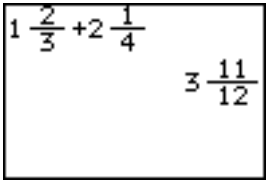
Decimal Answers will be given in decimal form (default)

Mixed Answers will be given in mixed fractions, whenever appropriate

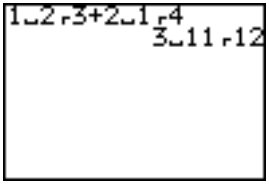
Improp Answers will be given in improper fractions, whenever appropriate

EDITOR: Sets the editing style to one of two available formats.

Eqn Formulas can be entered in a "display as written" approach (default setting).



Oneline Formulas will be displayed on one line.



Notes: Immediately after changing the EDITOR, the calculator will return to the calculation screen and the following data will be cleared.

- ENTRY memory
- Equations stored in the graph equation window ([Y=])

* Resetting to the default settings ([2ndF] [OPTION] [E] [1]) will also clear the above data.

Expression of up to 114 bytes can be entered in the **Equation edit mode**. If the expression exceed the screen width, it is horizontally extended.

Expression of up to 160 bytes can be entered in **one-line edit mode**. If the expression exceed the screen width, it goes to the next line.

SIMPLE: Sets the preference for handling reducible fractions.

Auto Fractions will automatically be reduced down (default)

Manual Fractions will not be reduced unless [2ndF] [FRAC] [1] (Simp) is used

Note: All the procedures in this manual are explained using the default settings unless otherwise specified.

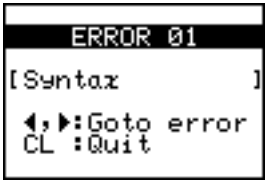
Error Messages

The calculator will display an error message when a given command is handled incorrectly, or when instructions cannot be handled correctly such that the task cannot be processed further. Various types of error messages are given to inform users about the types of situations to be remedied.

For example, performing the following key strokes:

[5] [×] [ENTER]

will result in an error, and the error message will be displayed.



In such a situation, you can go back to the expression to correct its syntax by pressing [◀] or [▶], or you can erase the entire line to start over by pressing [CL].

For a list of various error codes and messages, refer to the appendix.

Resetting the Calculator

Use the reset when a malfunction occurs, to delete all data, or to set all mode values to the default settings. The resetting can be done by either pressing the RESET switch located on the back of the unit, or by selecting the RESET in the OPTION menu.

Resetting the calculator's memory will erase all data stored by the user; proceed with caution.

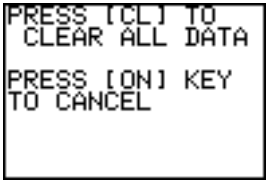
1. Using the RESET switch

1. Press the RESET switch on the back of the unit.

Note: Gently push the **RESET** switch with the tip of a ball-point pen or a similar object.

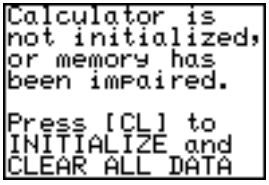
DO NOT use a tip of a pencil or mechanical pencil, a broken lead may cause a damage to the button mechanism.

2. After a moment of "WAIT" message displayed on the screen, the verification window will appear on the screen.



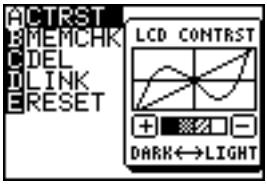
3. Press [CL] to clear all the stored data. Press [ON] to cancel resetting. After [CL] is pressed, the calculator's memory will be initialized.
   Press any key to display the calculation screen.

- The message on the right may occasionally appear. In this case, repeat the procedure from step 1 to prevent loss of data.



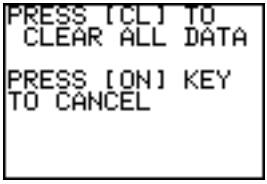
2. Selecting the RESET within the OPTION menu

1. Press [2ndF], then [OPTION]. The OPTION menu appears.



2. While in the OPTION menu, press [E] to select **E RESET**; the RESET sub-menu items should appear on the right side of the screen.

3. The first item **1 default** will initialize only the SETUP and FORMAT settings, while the second item **2 Allmem** will erase all memory contents and settings. To reset the memory, select **2 Allmem** by pressing [2]. The verification window will appear.
4. Press the [CL] key to clear all data stored on the calculator. Press any key to continue.



Chapter 3
Manual Calculations

In this chapter, we explore calculation features of this calculator, such as fraction to decimal conversion and the quotient-reminder key, trigonometric calculation, as well as basic arithmetic calculations.

1. Try it! 1

The speed of light is known to be 186,282 miles (approximately 300,000 kilometers) per second. That means light can go around the Earth 7 and a half times within a second!

Suppose you are standing at the equator. While the Earth rotates over the period of one day, you also rotate around the globe at a certain speed. Knowing the facts above, can you figure out how fast you are travelling, in miles per hour?

Since distance travelled = average speed × time taken, the following equation can be formed to find out the circumference of the Earth (x miles):

$$x \times 7.5 = 186282$$

Then,

$$x = 186282 \div 7.5$$

Since you know the Earth turns around once a day (which means, in 24 hours), divide the above "x" by 24 to get a value in miles per hour.

$$24 \times v = x$$

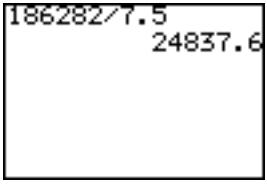
$$v = \frac{x}{24}$$

CONCEPT

1. Enter a math expression, then perform the calculation.
2. Save a number into a store, then recall the value later.

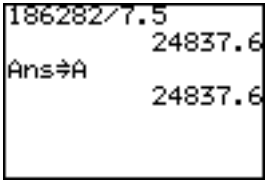
PROCEDURE

1. First, press [⊞⊟ ⊠⊞], then [CL] to clear any screen entries.
2. Type 186282 [÷] 7.5, then press [ENTER]. The circumference of the Earth is thus obtained.

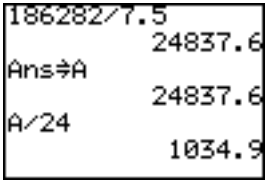


3. Store the answer in a variable. A variable is a symbol under which you can store a numerical value.

   We will use variable A to store the circumference of the Earth. Press [STO] to set the "store" mode. Press [ALPHA] **A**, then [ENTER] to store the answer. To call up the stored answer, press [ALPHA] **A** [ENTER] again.



4. Now, since the value you have stored under "A" is the distance you will be travelling in 24 hours, divide the number by 24. Press [ALPHA] **A** [÷] 24, then [ENTER].

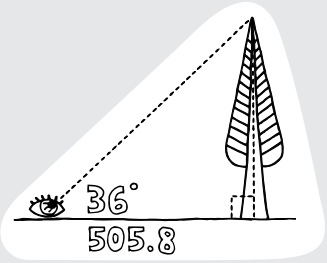


So, you are travelling at 1034.9 miles/hour.

Try it! 2

The Mendocino Tree, a coast redwood growing in Montgomery Woods State Reserve in California (USA), is known to be the tallest living tree in the world. You are to find out how tall the tree is by using the following factors:

- The distance from you to the bottom of the tree is exactly 505.8 feet, and the tree stands vertically.
- The angle of elevation between the top of the tree and the observer is 36 degrees.



If the base length of the right triangle is 505.8 feet, and the angle of elevation is 36 degrees, then the following expression can be derived:

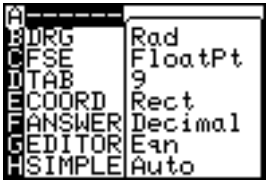
the height of the Mendocino tree (ft.) = 505.8 ft. × tan 36°

CONCEPT

1. Verify/change the calculator's angle unit.
2. Use the calculator's trigonometric function key to enter/perform the calculation.

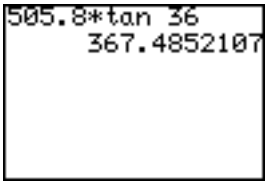
PROCEDURE

1. Since the angle of elevation is measured in degrees, the calculator's angle setting will need to be matched with that. Press [2ndF] [SETUP] to bring up the SETUP menu.

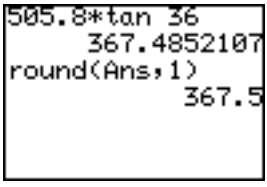


2. On the right side of the SETUP menu, the current setup will be displayed. Make sure that the top line is indicated as **Deg** (i.e., degrees). If not, then the angle system will need to be changed. Press [B] to select **B DRG**, then press [1] to select **1 Deg**.

3. Now, let's work on the actual calculation part. Press the [▦] key to enter the Calculation screen, and press [CL] to clear any screen entries.
4. Press 505.8 [×] [tan] 36. Press [ENTER] to execute the calculation.



5. Press [MATH] [B] [2] [2ndF] [ANS] [,] 1 [)] [ENTER] to round the answer to the appropriate degree of accuracy.



2. Arithmetic Keys

Performing addition, subtraction, multiplication and division

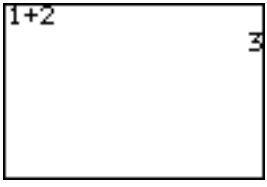
There are various keys for arithmetic calculations. Use the [+] [−] [×] [÷], [(−)], [(] and [)] keys to perform basic arithmetic calculations. Press [ENTER] to solve an equation.

[ENTER] Executes an expression.

Example

- Calculate 1 + 2.

[▦] [CL] 1 [+] 2 [ENTER]



A Note about expressions

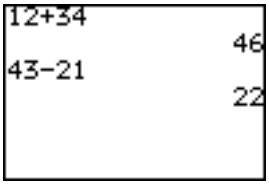
An expression is a mathematical statement that may use numbers and/or variables that represent numbers. This works just like a regular word sentence; one may ask "how are you?", and you may answer "okay." But what if an incomplete sentence is thrown, such as "how are"? You'll wonder, "how are... what?"; it just doesn't make sense. A math expression needs to be complete as well. $1 + 2$, $4x$, $2sinx + cosx$ form valid expressions, while "1 +" and "cos" do not. If an expression is not complete, the calculator will display an error message upon pressing the [ENTER] key.

[+] Enters an addition sign.

Example

• Calculate 12 + 34.

[⊞⊟/⊠⊞] [CL] 1 2 [+] 3 4 [ENTER]



[−] Enters a subtraction sign.

Example

• Subtract 21 from 43.

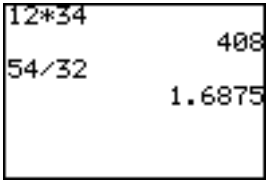
4 3 [−] 2 1 [ENTER]

[×] Enters a multiplication sign.

Example

• Multiply 12 by 34.

1 2 [×] 3 4 [ENTER]



[÷] Enters a division sign.

Example

• Divide 54 by 32.

5 4 [÷] 3 2 [ENTER]

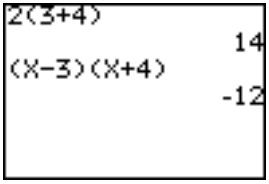
When to leave out the "×" sign

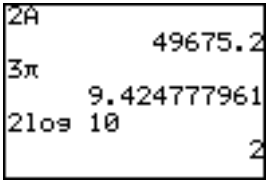
The multiplication sign can be left out when:

a. Placed in front of an open parenthesis.

b. Followed by a variable or a mathematical constant (π, e, etc.):

c. Followed by a scientific function, such as sin, log, etc.:





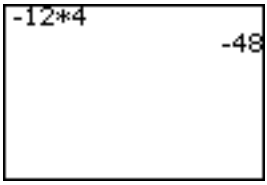
Entering a number with a negative value

(–) Sets a negative value.

Example

• Calculate -12 × 4.

(–) 1 2 × 4 ENTER



Note: Do not use the − key to enter a negative value; use the (–) key instead.

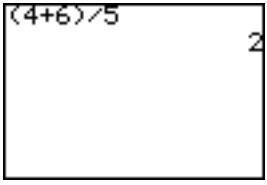
(Enters an open parenthesis. Use with ")" as a pair, or the calculation will result in an error.

) Enters a closing parenthesis; a parenthesis left open will result in an error.

Example

• Calculate (4 + 6) ÷ 5.

(4 + 6) ÷ 5 ENTER



Note: Functions, such as "round(", automatically include an open parentheses. Each of these functions needs to be closed with a closing parenthesis.

3. Calculations Using Various Function Keys

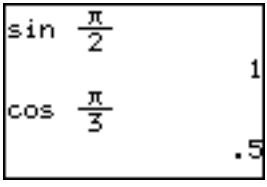
Note: The default angle unit of this calculator is radians. The example hereafter will therefore feature the radian angle system, unless otherwise specified. If you wish to change the angle system, you can change the unit to degrees or grads in the SETUP menu.

sin Enters a sine function to be used in a trigonometric calculation.

Example

• Calculate sine π/2.

sin 2ndF π $^{a}/_{b}$ 2 ENTER



cos Enters a cosine function to be used in a trigonometric calculation.

Example

• Calculate cosine π/3.

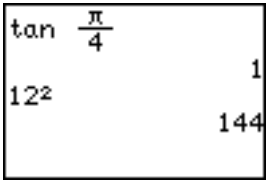
cos 2ndF π $\frac{a}{b}$ 3 ENTER

tan Enters a tangent function to be used in a trigonometric calculation.

Example

• Calculate tangent π/4.

tan 2ndF π $\frac{a}{b}$ 4 ENTER



x^2 Squares the preceding number.

Example

• Obtain the answer to 12^2.

12 x^2 ENTER

Note: When no base number is entered, the base number area will be left blank and just the exponent appear.

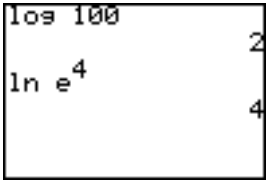
CL x^2 ◀ 1 2 ▶ ENTER

log Enters a "log" function for a logarithmic calculation

Example

• Calculate log 100.

log 1 0 0 ENTER



ln Enters a natural logarithm function.

Example

• Calculate ln e^4.

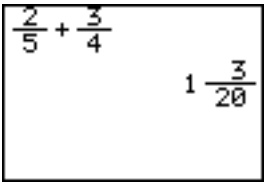
ln 2ndF e^x 4 ENTER.

, Enters a comma " , " at the cursor. A comma is required in some of the MATH functions. For more information, refer to the next section "Calculations Using MATH Menu Items" in this chapter.

[a b/c] Enters a fraction, setting the preceding number as its numerator.

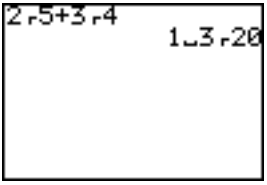
Example

Note: Before proceeding, go to the SETUP menu and make sure that the ANSWER mode is set to **Mixed**.



- Calculate $\frac{2}{5} + \frac{3}{4}$.

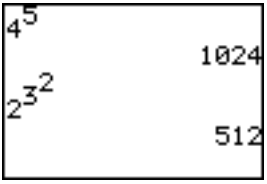
  2 [a b/c] 5 [▶] [+] [a b/c] 3 [▶] 4 [▶] [ENTER]



* If the calculator is set to **one-line mode**, then "⌐" will be entered instead. For example, "2⌐5" indicates "$\frac{2}{5}$".

[a^b] Enters an exponent, setting the preceding number as its base.

Example



- Raise 4 to the 5th power.

  4 [a^b] 5 [ENTER]

Note: When no base value is entered, "a^b" will be entered with both number areas left blank.

[CL] [a^b] [◀] 4 [▶] 5 [ENTER]

When calculating x to the power of m-th power of n, enter as follows;

- Calculate 2^{3^2}

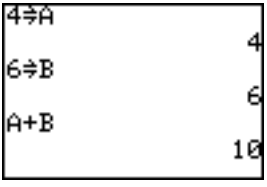
  2 [a^b] 3 [a^b] 2 [ENTER]

The above calculation is interpreted as $2^{3^2} = 2^9$.

If you wish to calculate $(2^3)^2 = 8^2$, press [(] 2 [a^b] 3 [▶] [)] [a^b] 2 [ENTER].

[STO] Stores a number in a variable.

Example



- Let A = 4, and B = 6.
  Calculate A + B.

  4 [STO] [ALPHA] A [ENTER]

  6 [STO] [ALPHA] B [ENTER]

  [ALPHA] A [+] [ALPHA] B [ENTER]

[VARS] Accesses the VARS menu. Refer to chapters 9 to learn how to use each item in this menu.

[X/T] Enters a variable "X" (rectangular) and "T" (parametric). Use this key when working with graph equations. Refer to Chapter 4 to learn how to use this feature.

Second functions

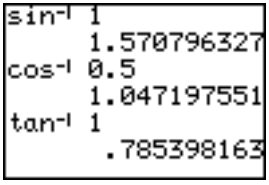
To access the second function of a key (printed above the keys in yellow), press and release [2ndF], then press the key you want to use.

[sin⁻¹] Enters an arc sine function to be used in a trigonometric expression.

Example

- Calculate arc sine 1.

[2ndF] [sin⁻¹] 1 [ENTER].



[cos⁻¹] Enters an arc cosine function to be used in a trigonometric expression.

Example

- Calculate arc cosine 0.5.

[2ndF] [cos⁻¹] 0.5 [ENTER].

[tan⁻¹] Enters an arc tangent function to be used in a trigonometric expression.

Example

- Calculate arc tangent 1.

[2ndF] [tan⁻¹] 1 [ENTER].

Note: Expressions with inverse trigonometric functions evaluate in the following ranges.

$\theta = \sin^{-1}x$, $\theta = \tan^{-1}x$

Deg: $0 \le |\theta| \le 90$

Rad: $0 \le |\theta| \le \frac{\pi}{2}$

Grad: $0 \le |\theta| \le 100$

$\theta = \cos^{-1}x$

Deg: $0 \le |\theta| \le 180$

Rad: $0 \le |\theta| \le \pi$

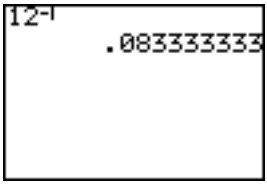
Grad: $0 \le |\theta| \le 200$

[x^{-1}] Enters "x^{-1}", and returns an inverse by raising a value to the power of negative one. The inverse of "5", for example, is "$\frac{1}{5}$".

Example

- Raise 12 to the power of negative one.

  1 2 [2ndF] [x^{-1}] [ENTER]



Note: When no base number is entered, "x^{-1}" will be entered, with "x" left blank.

[CL] [2ndF] [x^{-1}] [◀] 1 2 [ENTER]

[10^x] Enters a base of 10, setting the cursor at the exponent.

Example

- Calculate 5×10^5.

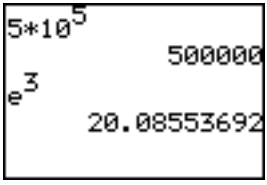
  [5] [×] [2ndF] [10^x] 5 [ENTER]

[e^x] Enters the Euler Number e (2.71…) to a power. The cursor will then be placed at the exponent.

Example

- Obtain a value of e^3.

  [2ndF] [e^x] 3 [ENTER].

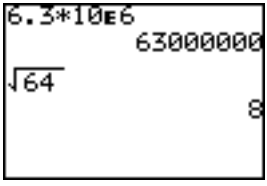


[Exp] Enters a value in scientific notation.

Example

- Enter a value 6.3×10^6.

  6.3 [×] 10 [2ndF] [Exp] 6 [ENTER].



[$\sqrt{\ }$] Enters a square root symbol.

Example

- Obtain the square root of 64.

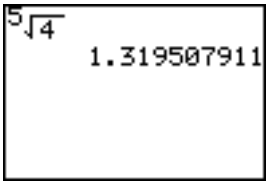
  [2ndF] [$\sqrt{\ }$] 6 4 [ENTER]

[a√‾] Enters "$\sqrt[a]{\ }$".

Example

• Bring 4 to the 5th root.

5 [2ndF] [a√‾] 4 [ENTER]



Note: When no depth of power is entered, "$\sqrt[a]{\ }$" is entered, with both number areas left blank.

[CL] [2ndF] [a√‾] 5 [▶] 4 [ENTER]

[RCL] Recalls a stored number.

Example

• Set C = 8.

8 [STO] [ALPHA] C [ENTER]

Recall the value of C.

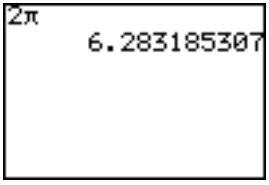
[2ndF] [RCL] [ALPHA] C [ENTER]

[π] Enters "pi". Pi is a mathematical constant, representing the ratio of the circumference of a circle to its diameter.

Example

• Enter "2π".

2 [2ndF] [π] [ENTER]



[OPTION] Opens option menu. (See page 154)

[{] [}] Enter braces to group numbers as a list.

[ANS] Recalls the previous answer. Use this key to incorporate the answer to the previous calculation into an expression.

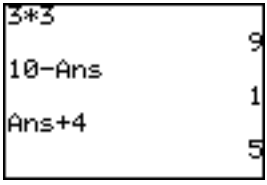
Example

- Perform 3×3.

  3 [×] 3 [ENTER]

  Subtract the value of the previous answer from "10".

  1 0 [−] [2ndF] [ANS] [ENTER]



Note: [ANS] can be considered as a variable; its value is automatically set when [ENTER] is pressed. If [ANS] is not empty, then pressing [+], [−], [×], or [÷] will recall "Ans" and places it at the beginning of an expression. If "1" was the previous answer, then pressing [+] 4 [ENTER] will result in "5".

[ENTRY] Recalls the previous entry. This is useful when you want to modify the previous entry, rather than re-entering the whole expression.

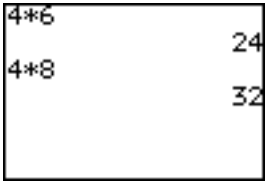
Example

- Calculate 4×6.

  4 [×] 6 [ENTER]

  Next, calculate 4×8.

  [2ndF] [ENTRY] [BS] 8 [ENTER]



Note: Executed expressions are stored in a temporary memory in the executed order. If the temporary memory is full, the oldest data is automatically deleted. Be aware that [ENTRY] may not function on these occasions.

A maximum of 160 bytes can be stored in the temporary memory. The capacity may vary when there are division codes between expressions.

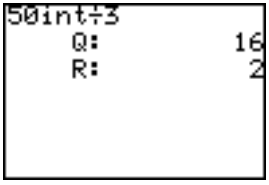
When switching from **equation edit mode** to **one-line edit mode** in the SETUP menu, all the numerical and graph equations stored in the temporary memory are cleared and cannot be recalled.

[int÷] Performs an integer division, and returns a quotient and a remainder.

Example

- Get a quotient and a remainder from 50 ÷ 3.

  50 [2ndF] [int÷] 3 [ENTER]



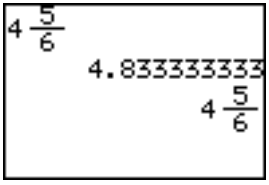
* Quotient value is set to Ans memory and remainder is not stored.

[a b/c] Enters a mixed number.

Example

- Enter $4\frac{5}{6}$

  4 [2ndF] [a b/c] 5 [▶] 6 [ENTER]



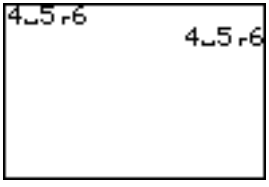
Note: If the answer is displayed in decimals, go to the SETUP menu and set the ANSWER mode to **Mixed**.

Note: When no value is entered prior to this key, the number areas will be left blank.

* If the calculator is set to **one-line mode**, [2ndF] [a b/c] enters "␣" (integer-fraction separator) only. Use [2ndF] [a b/c] in combination with [a/b] as follows.

- Enter $4\frac{5}{6}$ in **one-line mode**

  4 [2ndF] [a b/c] 5 [a/b] 6 [ENTER]



* Integer part of the mixed number must be a natural number. A variable can not be used. Equation or use of parenthesis, such as (1+2)␣2⌟3 or (5)␣2⌟3, causes a syntax error.

* While using the [a b/c] key, when a numerator or a denominator is negative, the calculator will display an error message.

[FRAC] Enters a fraction menu.

In the mixed or fraction calculation, you can select the automatic (default) or manual simplification of a fraction.

If you wish to use manual simplification, select the **Manual** at the **H SIMPLE** and **Mixed** or **Improp** at the **F ANSWER** in the SETUP menu.

To set the manual simplification.

1. Press [2ndF] [SETUP].
2. Press [H] [2].

   The answer of division will not simplify automatically. Use Simp feature of FRAC menu to simplify the fraction.

To set a fraction calculation mode

1. Press [2ndF] [SETUP].
2. For Mixed number mode, press [F] [2]; if Improper fraction mode is required, press [F] [3].

   Press [F] [2] to select the Mixed number mode in this example.
3. Press [CL].

1 Simp Simplifies a given fraction stored in the ANSWER memory.

Specifying no common factor

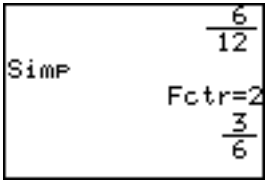
Simplify the fraction using the lowest common factor other than 1.

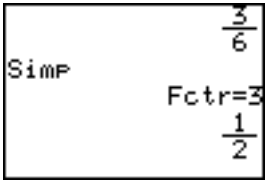
Example

1 [a b/c] 12 [▶] [+] 5 [a b/c] 12 [ENTER]

[2ndF] [FRAC] [1] [ENTER] (Simplified by 2, the lowest common factor of 12 and 6.)

[2ndF] [FRAC] [1] [ENTER] (Simplified by 3, the lowest common factor of 6 and 3.)





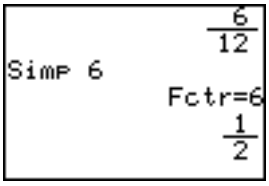
Specifying a common factor

Simplify the fraction using the specified common factor.

Example

1 [a⁄b] 12 [▶] [+] 5 [a⁄b] 12 [ENTER]

[2ndF] [FRAC] [1] 6 [ENTER] (Manually specify 6, the Greatest Common Factor of 12 and 6, to simplify the fraction.)



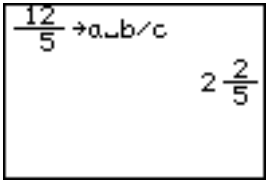
Note:
- If the wrong number is specified for a common factor, an error will occur.
- Calculation may take considerable amount of time if the factor is set to a large digit integer (6-digit or more, for example).

2 →a␣b/c Converts an improper fraction to a mixed number.

Example

- Change $\frac{12}{5}$ to a mixed number.

  12 [a⁄b] 5 [▶] [2ndF] [FRAC] [2] [ENTER]

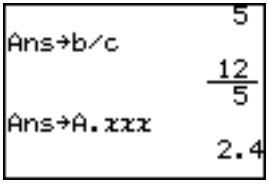


3 →b/c Converts a mixed number to an improper fraction.

Example

- Change $2\frac{2}{5}$ to an improper fraction.

  [2ndF] [FRAC] [3] [ENTER]



4 →A.xxx Converts a fraction to a decimal number.

Example

- Change $\frac{12}{5}$ to a decimal number.

  [2ndF] [FRAC] [4] [ENTER]

Note: The above three conversions will not affect the ANSWER settings in the SET UP menu.

If a decimal number is not rational, fraction conversion will not function but will display the answer in decimal format.

4. Calculations Using MATH Menu Items

The MATH menu contains functions used for more elaborate math concepts, such as logarithms, probability, and math unit conversions. The MATH menu items may be incorporated into your expressions.

A CALC The CALC sub-menu contains items to be used in calculations such as logarithmic and integral functions.

Note: The following examples show keystrokes with keyboard shortcuts. It is also possible to select a sub-menu item using the cursor keys.

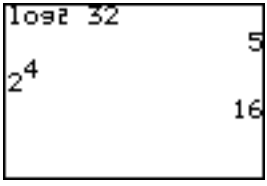
1 $\log_2$ **$\log_2$ *value***

Enters a base-2 logarithm ($\log_2$).

Example

- Calculate $\log_2 32$

MATH A 1 3 2 ENTER



2 2^x **2^{value}**

Raises 2 to a power. Sets the cursor to exponent.

Example

- Calculate 2^4

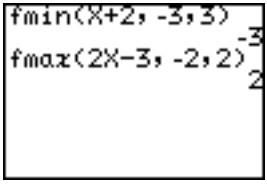
MATH A 2 4 ENTER

3 fmin(**fmin(*equation, lower limit of x, upper limit of x*)**

Returns the value of variable x when the equation Y has the minimum value within the specified range of x.

Example

MATH A 3 X/T + 2 , (–) 3 , 3) ENTER



4 fmax(**fmax(equation, *lower limit of x, upper limit of x*)**

Return the value of variable x when the equation Y has the maximum value within the specified range of x.

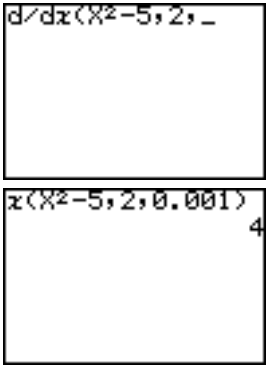
Example

MATH A 4 2 X/T – 3 , (–) 2 , 2) ENTER

5 d/dx(**d/dx(*equation, value of x [, tolerance]*)**
Returns derivative of equation Y at the specified X value using the tolerance (if not specified, default value is 1E–5).

Example

[MATH] [A] [5] [X/T]
[x^2] [−] 5 [,] 2
[,] 0 . 0 0 1 [)] [ENTER]

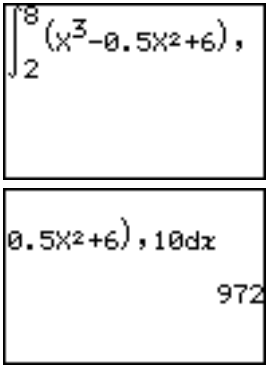


6 ∫ ∫ ***equation, lower limit, upper limit [, the number of divisions]*** **dx** (written as **one-line mode** syntax)
Calculates an integral value of equation Y from the lower limit to the upper limit using the specified number of divisions (if not specified, default value is 100). Use in conjunction with the **7 dx** sub-menu item.

Example

[MATH] [A] [6] 2 [▲]
8 [▶] [(] [X/T] [a^b]
3 [▶] [−] 0.5 [X/T]
[x^2] [+] [6] [)]
[,] 10 [MATH] [A]
[7] [ENTER]

- The above key strokes are to be performed under the Equation edit mode.



7 dx Enters a differential "***dx***" in an integration expression.

B NUM Use the NUM sub-menu items when converting between various number systems.

1 abs(**abs(*value*)**

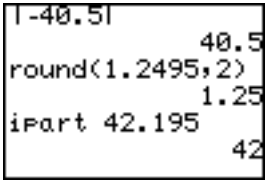
Returns an absolute value.

* A real number, a list, variable, or equation can be used as values.

Example

• Find an absolute value of "-40.5".

MATH B 1 (–)
4 0 . 5 ENTER



2 round(**round(*value [, digit number of decimals]*)**

Returns the rounded value of the term in parentheses. A rounding point can be specified.

* A real number, a list, variable, or equation can be used as values.

Example

• Round off 1.2459 to the nearest hundredth.

MATH B 2 1 . 2 4 5 9 , 2) ENTER

3 ipart **ipart *value***

Returns only the integer part of a decimal number.

* A real number, a list, variable, or equation can be used as values.

Example

• Discard the fraction part of 42.195.

MATH B 3 4 2 . 1 9 5 ENTER

4 fpart **fpart *value***

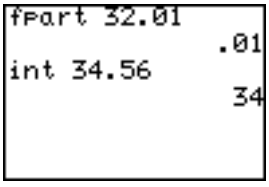
Returns only the fraction part of a decimal number.

* A real number, a list, variable, or equation can be used as values.

Example

• Discard the integer part of 32.01.

MATH B 4 3 2 . 0 1 ENTER



5 int **int *value***

Rounds down a decimal number to the closest integer.

Example

• Round down 34.56 to the nearest whole number.

MATH B 5 3 4 . 5 6 ENTER

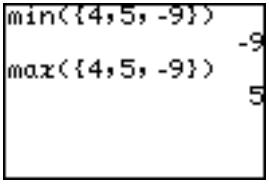
6 min(**min(*list*)**

Finds and returns the minimum value within a list of numbers. To define a list of more than two numbers, group the numbers with brackets (2ndF { and 2ndF }), with each element separated by a comma.

Example

• Find the smallest value among 4, 5, and -9.

MATH B 6 2ndF { 4 , 5 , (–) 9 2ndF }) ENTER



7 max(**max(*list*)**

Finds and returns the maximum value within a list of numbers.

Example

• Find the largest value among 4, 5, and -9.

MATH B 7 2ndF { 4 , 5 , (–) 9 2ndF }) ENTER

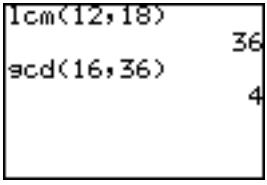
8 lcm(**lcm(*natural number, natural number*)**
Returns the least common multiple of two integers.

Example

• Find the least common multiple of 12 and 18.

[MATH] [B] [8] 1 2 [,] 1 8 [ )] [ENTER]

9 gcd(**gcd(*natural number, natural number*)**
Returns the greatest common divisor of two integers.



Example

• Find the greatest common divisor of 16 and 36.

[MATH] [B] [9] 1 6 [,] 3 6 [ )] [ENTER]

0 remain ***natural number*** **remain** ***natural number***
Returns the remainder of a division.

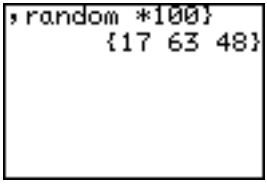
Example

• Obtain the remainder when 123 is divided by 5.

1 2 3 [MATH] [B] [0]
5 [ENTER]

C PROB Use the PROB sub-menu items for probability calculations.

1 random **random *[(number of trial)]***
Returns a random decimal number between 0 and 1.



Example

• Make a list with three random numbers.

Note: Set the "FSE" to "Fix" and "TAB" to "0" in the SETUP menu.

[2ndF] [{] [MATH] [C] [1] [×] 100 [,]
[MATH] [C] [1] [×] 100 [,] [MATH] [C]
[1] [×] 100 [2ndF] [}] [ENTER]

Note: The random functions (random) will generate different numbers every time when the display is redrawn. Therefore, the table values of the random functions will be different every time. When in case of random-based graphing calculations, the tracing values and other parameters of the graph will not match the graph's visual representation.

2 nPr Returns the total number of different arrangements (permutations) for selecting "r" items out of "n" items.

$${}_nP_r = \frac{n!}{(n-r)!}$$

Example

- How many different ways can 4 people out of 6 be seated in a car with four seats?

  6 [MATH] [C] [2] 4 [ENTER]

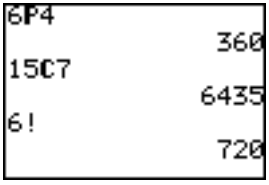
3 nCr Returns the total number of combinations for selecting "r" item out of "n" items.

$${}_nC_r = \frac{n!}{r!(n-r)!}$$

Example

- How many different groups of 7 students can be formed with 15 students?

  1 5 [MATH] [C] [3] 7 [ENTER]



4 ! Returns a factorial.

Example

- Calculate $6 \times 5 \times 4 \times 3 \times 2 \times 1$.

  6 [MATH] [C] [4] [ENTER]

D CONV CONV sub-menu items are to be used when converting a number in decimal form (degrees) to a number in sexagesimal form (degrees, minutes, seconds), or vice versa, and rectangular/polar coordinate conversion.

Sexagesimal and Degree System

The "base 60" sexagesimal system, as well as the minutes-second measurement system, was invented by the Sumerians, who lived in the Mesopotamia area around the fourth millennium B.C. The notion of a 360 degrees system to measure angles was introduced to the world by Hipparchus (555-514 B.C.) and Ptolemy (2nd cent. A.D.), about 5000 years later. We still use these ancient systems today, and this calculator supports both formats.

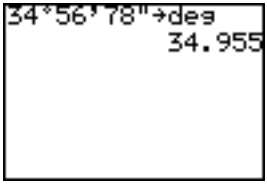
1 →deg ***value*** *(sexagesimal number)* **→deg**

Takes a number in sexagesimal form, and converts it into a decimal number. To enter a number in sexagesimal form, use items in the "ANGLE" sub-menu, described in the next subsection of this Chapter.

Example

- Convert 34° 56' 78" to degrees.

  3 4 [MATH] [E] [1] 5 6 [MATH] [2] 7 8 [MATH] [3] [MATH] [D] [1] [ENTER]



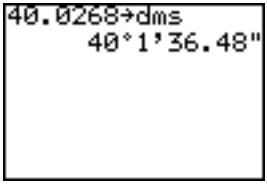
2 →dms ***value*** *(degrees)* **→dms**

Takes a number in decimal form (in degrees), and converts it into a sexagesimal number.

Example

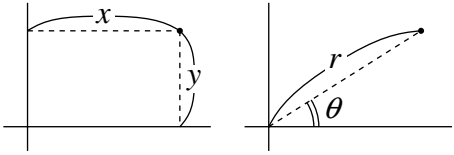
- Show 40.0268 degrees in degrees, minutes, and seconds.

  4 0 [.] 0268 [MATH] [D] [2] [ENTER]



Rectangular/ polar coordinate conversion

This calculator is equipped with rectangular coordinates and polar coordinates conversion capabilities.

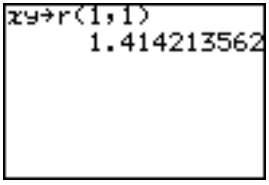


Rectangular to polar coordinate conversion functions

Conversion formulas: $r = (x^2 + y^2)^{1/2}$, $\theta = tan^{-1}(y/x)$

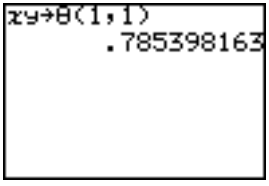
3 xy→r(**xy→r(*x coordinate, y coordinate*)**

Returns polar coordinate radius value from X-Y rectangular coordinates.



4 xy→θ(**xy→θ(*x coordinate, y coordinate*)**

Returns polar coordinate θ value from X-Y rectangular coordinates.
The following ranges are used to find θ.



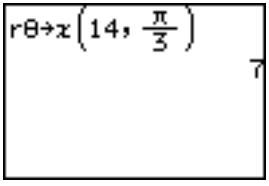
Degree mode: $0 \le |\theta| \le 180$
Radian mode: $0 \le |\theta| \le \pi$
Grad mode: $0 \le |\theta| \le 200$

Polar to rectangular coordinate conversion functions

Conversion formulas: $x = rcos\theta$, $y = rsin\theta$

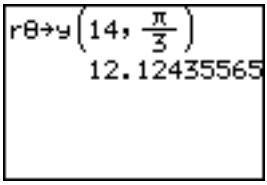
5 rθ→x(**rθ→x(*r coordinate, θ coordinate*)**

Returns rectangular coordinate X value from r-θ polar coordinates.



6 rθ→y(rθ→y(*r coordinate, θ coordinate*)

Returns rectangular coordinate Y value from r-θ polar coordinates.



E ANGLE Use the E ANGLE menu to enter a degree, radian and grad value without changing settings.

1 ° Inserts a degree, and sets the preceding value in degrees.

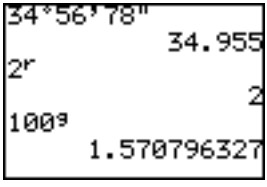
2 ’ Inserts a minute, and sets the preceding value in minutes.

3 ” Inserts a second, and sets the preceding value in seconds.

Example

- Enter 34° 56’ 78”.

3 4 [MATH] [E] [1]
5 6 [MATH] [2] ← “E ANGLE” remains selected; type the number to enter the symbols.
7 8 [MATH] [3]
[ENTER]



4 r Enters an “r”, to enter a number in radians.

Example

- Type 2 radian.

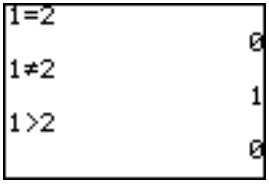
2 [MATH] [E] [4] [ENTER]

5 g Enters a “g” symbol, to enter a number in grads.

F INEQ Use the equality/inequality figures to compare two values. These sub-item tools return 1 (true) or 0 (false).

1 = Tests whether a preceding value and a following value are equal.

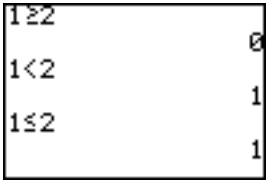
2 ≠ Tests whether a preceding value and a following value are not equal.



3 > Tests whether a preceding value is larger than a following value.

4 ≥ Tests whether a preceding value is larger than OR equal to a following value.

5 < Tests whether a preceding value is smaller than a following value.



6 ≤ Tests whether a preceding value is smaller than OR equal to a following value.

G LOGIC Use the **LOGIC** sub-menu items to perform logic calculation functions.
The following is the truth table of the combination of input A and B:

A	B	A and B	A or B	A xor B	A xnor B
1	1	1	1	0	1
1	0	0	1	1	0
0	1	0	1	1	0
0	0	0	0	0	1

A	notA
1	0
0	1

Executing a logic calculation Logic calculations convert decimals to binary numbers for logic calculations, and returns decimals for answers.

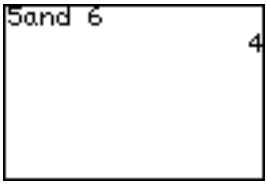
Value(s) or variable(s) can be used for logic calculations.

1 and ***value A*** **and** ***value B***

Enters an “AND” logic figure.

Example

5 AND 6



[⊞⊟/⊠÷] [CL] 5 [MATH] [G] [1] 6 [ENTER]

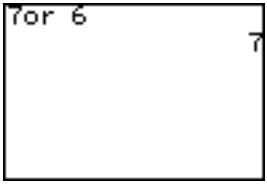
5 (decimals) is converted to 101(binary) and 6 to 110. AND will compare the two numbers digit by digit and returns the answer 100 (4).

2 or ***value A*** **or** ***value B***

Enters an “OR” logic figure.

Example

7 OR 6



[⊞⊟/⊠÷] [CL] 7 [MATH] [G] [2] 6 [ENTER]

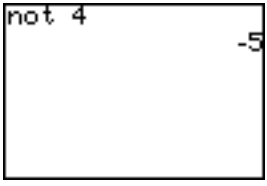
7 (decimals) is converted to 111(binary) and 6 to 110. OR will compare the two numbers digit by digit and returns the answer 111 (7).

3 not **not** ***value***

Enters a “NOT” logic figure.

Example

NOT 4



[⊞⊟/⊠÷] [CL] [MATH] [G] [3] 4 [ENTER]

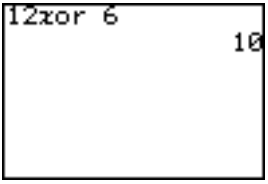
4 (decimals) is converted to 100(binary). NOT will calculate the given number digit by digit and returns the answer 1111111111111011 (-5).

4 xor ***value A* xor *value B***

Enters an Exclusive-OR (xor) logic figure.

Example

12 XOR 6



[⊞⊟/⊠⊞] [CL] 12 [MATH]
[G] [4] 6 [ENTER]

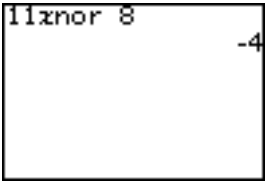
12 (decimals) is converted to 1100 (binary) and 6 to 0110. XOR will compare the two numbers digit by digit and returns the answer 1010 (10).

5 xnor ***value A* xnor *value B***

Enters an Exclusive-NOR (xnor) logic figure.

Example

11 XNOR 8



[⊞⊟/⊠⊞] [CL] 11 [MATH]
[G] [5] 8 [ENTER]

11 (decimals) is converted to 1011 (binary) and 8 to 1000. XNOR will compare the two numbers digit by digit and returns the answer 1111111111111100 (-4).

Chapter 4
Graphing Features

In this chapter, the graphing features of the calculator are described. It should be noted that the following examples assume that the angle mode is set Rad (radian), the default angle unit of the calculator. If set to degree or grad, some unexpected results will be obtained.

1. Try it!

There are two taxi cab companies in your city, Tomato Cab and Orange Cab, with different fare systems. The Tomato Cab charges $2.00 upon entering the taxi cab, and $1.80 for each mile the taxi travels. The Orange Cab, on the other hand, charges $3.50 plus $1.20 per mile. This means that taking the Tomato Cab will initially cost less than going with the Orange Cab, but will be more expensive as you travel longer distances.

Suppose you need to go to a place 3 miles away from where you are now. Which cab company should you take to save money?

Two math expressions can be derived from the above fare systems. If "y" represents the cost, while "x" represents the mileage, then:

$y = 2 + 1.8x$ ..... Tomato Cab's fare system

$y = 3.5 + 1.2x$ ..... Orange Cab's fare system

Use the calculator's graphing capabilities to figure out the approximate point where the Orange Cab gets ahead of the Tomato Cab, in terms of cost performance.

CONCEPT

1. By using two linear graphs, the approximate crossing point can be found.
2. The exact crossing point can be found with the TABLE function.

PROCEDURE

1. Setting to the rectangular coordinate graph mode.

   Press [2ndF] [SETUP] and check to make sure that **E COORD** is set to **Rect**.

2. Check the format as shown on the right.

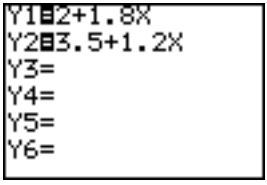
   Press [▦] [2ndF] [FORMAT].

3. Press [Y=] to enter the Graph Equation window. Six equation entry areas appear, from "Y1=" to "Y6=". Since we need only two equations in this exercise, let's use "Y1=" and "Y2=".
4. By default, the cursor should be placed on the right side of the "Y1=" equation, next to the equal sign. If this is not so, use the cursor keys to bring the cursor to the "Y1=" line, then press the [CL] key to clear any entries. The cursor will automatically be placed to the right of the equal sign.
5. Enter the first equation, "2 + 1.8X", to represent the Tomato Cab's fare system.

   2 [+] 1 . 8 [X/T]

   Use the [X/T] key to enter the "x", representing the distance in miles.
6. When the equation line is complete, press [ENTER]. The first equation is now stored, and the cursor automatically jumps to the second line, where the second equation can be entered.

7. At the second line, press [CL] to clear any entries, then enter "3.5 + 1.2X" to represent the Orange Cab's fare system. When done entering the equation, press [ENTER]. The two equations are now ready to graph.

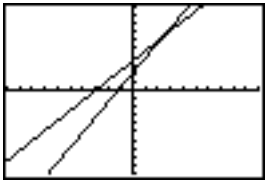


8. Press [GRAPH] to draw the graphs.
   To draw a graph, "=" must be highlighted. If not, move the cursor to "=" of the targeted equation and press [ENTER] to draw a graph, and press [ENTER] again not to draw a graph.

Graph Basics

The graph examples in this exercise are called X-Y graphs. An X-Y graph is quite useful for clearly displaying the relationship between two variables.

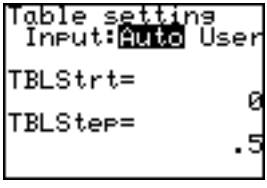
9. Let's take a look at the graph. The vertical axis represents the Y value, while X is represented by the horizontal axis. It appears that the two diagonal lines cross at the point where the X value is somewhere between 2 and 3, indicating that Orange Cab costs less than the other, after 3 miles of travelling.



10. Next, press [TABLE] to find the values per graph increment. When the travelling distance is 2 miles, the Tomato Cab charges 30 cents less overall than the Orange Cab, but it costs 30 cents more at 3 miles. To make the X increment smaller, press [2ndF] [TBLSET].

X	Y1	Y2
0	2	3.5
1	3.8	4.7
2	5.6	5.9
3	7.4	7.1
4	9.2	8.3
5	11	9.5
2		

11. When the Table setting window appears, move the cursor down to "TBLStep", type [.] [5], and press [ENTER]. Now the Y values will be sampled at every 0.5 mile.



12. Press [TABLE] to show the table again. It indicates that when the X value is 2.5, both Y1 and Y2 values are 6.5. It is now clear that if you are travelling 2.5 miles or more, the Orange Cab costs less.

2. Graph Modes

- This calculator has two graph modes, rectangular coordinate graph and parametric coordinate graph.
- To select the mode, press [2ndF] [SETUP] to enter the SETUP mode.

To set the rectangular coordinate graph mode. (default)

1. Press [2ndF] [SETUP] to display the SETUP screen.
2. Press [E] and [1].

   The graph mode is set to the rectangular coordinate system.

To set the parametric coordinate graph mode.

1. Press [2ndF] [SETUP].
2. Press [E] and [2].

   The graph mode is set to the parametric coordinate system.

3. Explanations of Various Graphing Keys

[Y=]: Displays the Graph Equation window. Up to 10 equations can be entered in rectangular coordinate graph mode, and UP to 12 equations can be entered in parametric coordinate graph mode. After the graph expression is entered, press [ENTER] to store the equation.

■: The expression can be represented as a graph.

= : The expression cannot be drawn as a graph.

- Move the cursor pointer to the "=" sign and press [ENTER] to change between to-draw and not-to-draw.

Note: To switch the window back to the calculation screen, simply press the [⊞⊟ ⊠⊞] key.

[GRAPH]: Draws a full-screen graph based on the equation(s) entered in the Graph Equation window. To cancel the graph drawing, press [ON].

Note: If no equations are entered in the Graph equation window, only the vertical (Y) and horizontal (X) axis will be displayed upon pressing the [GRAPH] key.

[TABLE]: Displays the graph values in a table. The default sample increment value of the graph's X axis is "1".

[ZOOM]: Displays the ZOOM menu. Within the ZOOM menu, various preferences can be set for the graph appearance on zooming in/out .
The menu items with each function and the sub-menu items are described below:

A ZOOM There are a myriad of tools under this menu item, by which the graph can be zoomed in/out in various styles. Press "A" within the ZOOM menu to select this menu item.

1 Auto According to the WINDOW setup, the graph will be zoomed in by adjusting the "Ymin" (the minimum Y value) and "Ymax" (the maximum Y value) according to the "Xmin" (the minimum X value) and "Xmax" (the maximum X value). When this item is selected, the graph will automatically be redrawn.

Note: The "Auto" sub-menu item is directly affected by how the WINDOW items are set up. Refer to the [WINDOW] key section in this chapter to learn how to set up the Xmin and Xmax items.

2 Box A box area can be specified with this sub-menu tool so that the area within the box will be displayed full screen.

To select a box area to zoom:

1. While the ZOOM menu item is selected within the ZOOM window, press [2] to select **2 Box**.
2. The graph appears on the screen. Use the cursor keys to position the cursor at a corner of the required box area. Press [ENTER] to mark the point as an anchor.
3. Once the initial anchor is set, move the cursor to a diagonal corner to define the box area. When the required area is squared off, press [ENTER].
   If a mistake is made, the anchor can be removed by pressing the [CL] key.
4. The graph will automatically be redrawn.

3 In A zoomed-in view of the graph will be displayed, sized according to the **B FACTOR** set up under the ZOOM menu. For example, if the vertical and horizontal zoom factors are set to "2", then the graph will be magnified two times. Refer to the **B FACTOR** segment of this section for more information.

4 Out The graph image will be zoomed out according to the **B FACTOR** setup under the ZOOM menu.

5 Default The graph will be displayed with default graph setting (Xmin = -10, Xmax = 10, Xscl = 1, Ymin = -10, Ymax = 10, Yscl = 1)

6 Square Set the same scale for X and Y axes. The Y-axis scale is adjusted to the current X-axis scale. The graph will be redrawn automatically.

7 Dec Sets the screen dot as 0.1 for both axes. The graph will then be redrawn automatically.

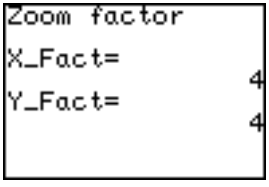
8 Int Sets the screen dot as 1.0 for both axes. The graph will then be redrawn automatically.

9 Stat Displays all points of statistical data set.

B FACTOR Use this menu to set the vertical and horizontal zooming factor. The factor set under this menu directly affects the zoom rate of the **3 In** and **4 Out** sub-menu tools under the ZOOM menu, as described above.

To set the zooming factor, do the following:

1. Within the **B FACTOR** menu, press ENTER to activate the setup tool.



2. When the "Zoom factor" window appears, the cursor is automatically placed at "X_Fact=". The default zoom factor is 4; enter the required value here.

3. Pressing [ENTER] after entering a value will switch the cursor position to "Y_Fact=". Enter the required zooming factor, and press [ENTER].
4. To go back to the ZOOM menu, press the [ZOOM] key.

C POWER

1 x^2 Use this zooming tool when the equation contains a form of "x^2".

2 x^{-1} Use this zooming tool when the equation contains a form of "x^{-1}".

3 $\sqrt{x}$ Use this zooming tool when the equation contains a form of "$\sqrt{x}$".

D EXP

1 10^x Use this tool when the equation contains a form of "10^x".

2 e^x Use this tool when the equation contains a form of "e^x".

3 log X Use this tool when the equation contains a form of "$log\ x$".

4 ln X Use this tool when the equation contains a form of "$In\ x$".

E TRIG

1 sin X Use this when the equation contains a sine function.

2 cos X Use this when the equation contains a cosine function.

3 tan X Use this when the equation contains a tangent function.

4 $\sin^{-1}$ X Use this when the equation contains an arc sine function.

5 $\cos^{-1}$ X Use this when the equation contains an arc cosine function.

6 $\tan^{-1}$ X Use this when the equation contains an arc tangent function.

F STO Under this menu item there is one tool that enables the storing of graph window settings.

1 StoWin By selecting this sub-menu item, the current graph window setup will be stored.

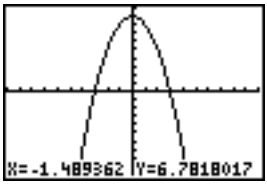
Note: The actual graph image will not be stored with this tool.

G RCL Under this menu item there are two tools that enable the recalling of the previous graph window setup:

1 RclWin On selecting this sub-menu item, the previously stored window setup will be recalled, and the graph will be redrawn accordingly. If no window setup has been stored previously, the default graph window setup will be used.

2 PreWin On selecting this sub-menu item, the window setup prior to the current zoom setup will be recalled, and the graph will be redrawn accordingly.

[TRACE]: Press this button to trace the graph drawn on the screen, to obtain the X-Y coordinates:



1. While the graph is displayed, press the [TRACE] key. The cursor appears, flashing on the graph line, with the present X-Y coordinates.
2. Trace the graph using the [◄] or [►] keys. The [◄] key decreases the value of x, while the [►] key increases it.
3. Pressing the [TRACE] key again will redraw the graph, with the cursor at the center of the screen. If the cursor is moved beyond the range of the screen, pressing the [TRACE] key will redraw the screen centered around the cursor.
4. When done, press the [CL] key to escape the tracing function.

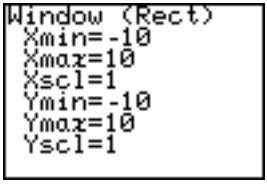
If more than one graph is displayed on the screen, use the [▲] or [▼] keys to switch the cursor from one graph to the other.

Note:
- If the [TRACE] key is not activated, the cursor will not be bound to the graph. Pressing the [◄], [►], [▲], or [▼] keys will position the free-moving flashing cursor on the graph display.
- Under the tracing mode in the parametric coordinate graph, the T value will also be displayed.

[WINDOW]: Displays the graph window setup.

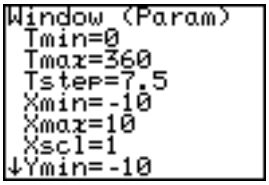
Rectangular coordinate system

Xmin/Xmax	Minimum and maximum values of x-axis, respectively
Xscale	Scale of x-axis
Ymin/Ymax	Minimum and maximum values of y-axis, respectively
Yscale	Scale of y-axis



Parametric coordinate system

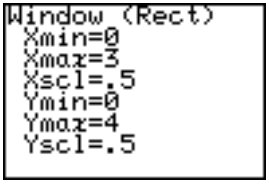
Tmin/Tmax	Minimum and maximum values for T, respectively
Tstep	Cursor pointer step value for tracing
Others	Same as rectangular coordinate system



Example

The setup values — the minimum/maximum X/Y values, and X/Y-axis scale — can be changed manually:

1. While the rectangular coordinate graph is displayed on the screen, press the [WINDOW] key. The following window appears, with the cursor set at "Xmin=".



2. The required X-minimum value can be entered here. This limits the left boundary of the graph window. For example, if "Xmin=" is set to "0", then the portion of the graph's Y-axis to the left will not be displayed.
3. Once the "Xmin=" value is entered ("0", for example), press [ENTER]. The left limit of the graph is now set, and the cursor moves to "Xmax=".
4. Now the right boundary of the graph can be set. Enter the required value here ("3", for example), and press [ENTER].

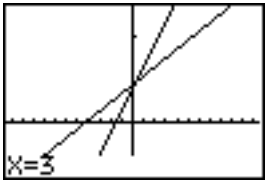
Note: The "Xmax=" value cannot be set equal to or smaller than the value of "Xmin". If so done, the calculator will display an error message upon attempting to redraw the graph, and the graph will not be displayed.

5. The next item "Xscl=" sets the frequency of the X-axis indices. The default value is "1". If, for example, the value is set to "0.5", then indices will be displayed on the X-axis at increments of 0.5. Enter the required "Xscl=" value ("0.5", for example), and press [ENTER].
6. The "Ymin=", "Ymax=", and "Yscl=" can be set, as was described for "Xmin=", "Xmax=", and "Xscl=" above.
7. When done, press the [GRAPH] key to draw the graph with the newly configured window setup.

CALC: Calculations can be performed on the entered graph equation(s). Press 2ndF CALC to access. The following 7 sub-menu tools are available:

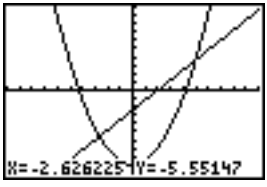
1 Value With this sub-menu tool, the Y value can be obtained by entering an X value. The flashing graph cursor will then be placed in that position on the graph. If more than one graph equation is set, use the ▲ or ▼ keys to switch to the equation you wish to work with.

Note: If the entered X value is incalculable, an error message will be displayed. Also, if the Y value exceeds the calculation range, then "----" will be displayed instead.



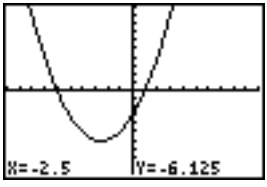
2 Intsct With this tool, the intersection(s) of two or more graphs can be found, where the flashing cursor will be placed. When the intersection is found, then the X-Y coordinates of the intersection will be displayed at the bottom of the screen. If there is more than one intersection, the next intersection(s) can be found by selecting the tool again.

Note: If there is only one graph equation entered there will be no other graph(s) to form an intersection, so selecting this tool will result in an error.



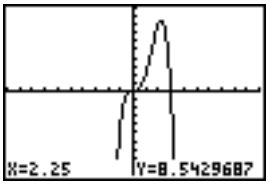
3 Minimum Finds the minimum of the given graph, and places the flashing cursor at that position.

Note: If the given graph has no minimum value, an error message will be displayed.



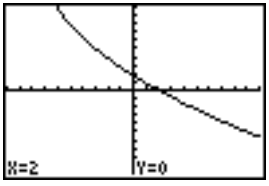
4 Maximum Finds the maximum of the given graph, and places the flashing cursor at that position.

Note: If the given graph has no maximum value, an error message will be displayed.



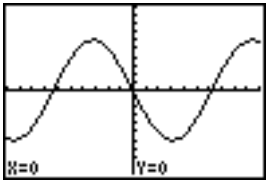
5 X_Incpt Finds an X-intercept (a crossing point of the graph on the X-axis) of the given graph, and places the flashing cursor at that position. If there is more than one X-intercept, the next X-intercept can be found by selecting the tool again.

Note: If the graph has no X-intercept, an error message will be displayed.



6 Y_Incpt Finds an Y-intercept of the given graph, and places the flashing cursor at that position.

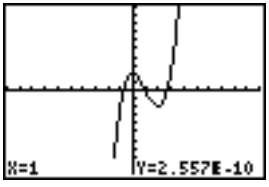
Note: If the graph has no Y-intercept, an error message will be displayed.



7 Inflec Calculates the inflection point of the given graph and moves the cursor to that point.

Example

1. Enter the graph equation $Y1 = x^3 - 3x^2 + 2$.
2. Press [2ndF] [CALC] [7].



Note:
- In the CALC functions of the parametric coordinate mode, only **Value** is valid.
- The visual result may be different when the ZOOM function is used.

4. The DRAW Function

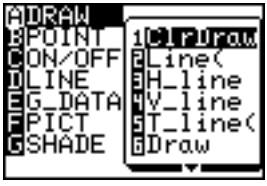
With the DRAW function, lines, circles, graphs, and pixel points can be added to the graph window. The DRAW menu also contains configuration tools for the ordinary graphs entered in the Graph Equation Entry window: line types, shading, and visibility status of each graph.

Press [2ndF] [DRAW] to enter the **DRAW** menu.

Note: When entering coordinates, the **DRAW** function assumes that rectangular coordinates will be entered. The exception to this is for **PxlON(**, **PxlOFF(**, **PxlCHG(**, and **PxlTST(**, all within the **B POINT** menu item.

A DRAW The tools in this menu add lines, circles, additional graphs and text on the graph screen.
The tools below can be accessed from the GRAPH window, or any other windows such as the Graph Equation Entry window and Calculation screen. Most of these tools, such as **Line(**, can be entered directly onto a graph from the cursor point.

1 ClrDraw Clears all items on the graph window EXCEPT for the graphs entered via the Graph Equation Entry window.



1. From the GRAPH window, press [2ndF] [DRAW] to enter the **DRAW** menu.
2. Press [A] to select **A DRAW**, then press [1] to select **1 ClrDraw.**

or

1. From the Calculation screen, press [2ndF] [DRAW] [A] [1].
   "ClrDraw" will appear.
2. Press [ENTER].
   All the items on the graph will be deleted and the message "Done" will appear.

2 Line(Draws a line according to the given X-Y coordinates of a start/end point.

Note: This tool can be used with any type of graph.

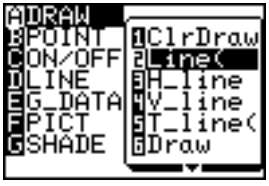
From the Calculation screen

Line(*x-coordinate of start point, y-coordinate of start point, x-coordinate of end point, y-coordinate of end point [,0]*)

Example

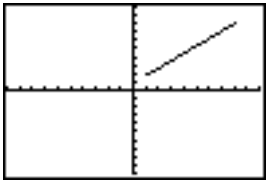
1. Select the DRAW menu. Select **A DRAW** in the menu, then select **2 Line(**.

   "Line(" will appear.



   Suppose you wish to draw a line, starting from an X-Y coordinate (1,2) to end at (8,8).

2. Enter "1,2,8,8" right after the "Line(" object, then close the expression with ( ).



3. Press ENTER.

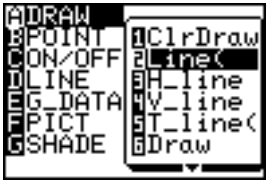
   The GRAPH window will appear with the specified line drawn on the graph.

Note: If you enter 0 for the 5th element of Line(function, (e.g. Line(1,2,8,8,0)) and press ENTER, you can clear the specified line.

From the GRAPH window

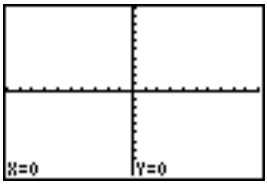
Line(

1. Press 2ndF DRAW to enter the **DRAW** menu.



2. Press [A] to select **A DRAW**, then press [2] to select **2 Line(**.

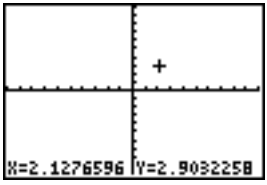
   The GRAPH window reappears, with the coordinate of the cursor showing at the bottom of the screen.



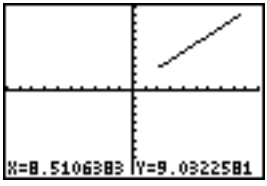
3. Move the flashing cursor on the screen to set the starting point of the line.

Note: The pixel increment can be set within the ZOOM menu. While **A ZOOM** is selected, choose **7 Dec** to set each pixel size to "0.1 × 0.1", or **8 Int** to set to "1 × 1".

4. When the starting point is set, press [ENTER] to anchor the location.



5. Move the cursor to indicate the end point of the line. When set, press [ENTER] to finalize the line drawing.



6. You may draw as many lines as you wish, by repeating the procedure from 4 to 5. When done drawing, press [CL] to exit the entry mode.

3 H_line Draws a horizontal line on the graph window.

From the Calculation screen

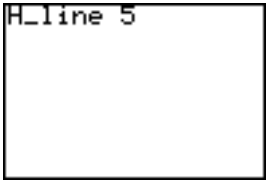
H_Line *y-value*

Draws a horizontal line (*y = value*) on the graph window.

Example

- Draw a horizontal line of $y = 5$.

1. Press [2ndF] [DRAW] [A] [3] and enter the value 5.



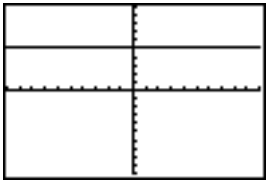
From the GRAPH window

H_Line

Example

- Draw a horizontal line manually.

1. Press [2ndF] [DRAW] [A] [3].
2. Use the cursor navigation keys ([▲] [▼] [◀] [▶]) to move the flashing cursor to the appropriate position.
3. Press [ENTER] to draw the line.



4 V_line Draws a vertical line on the graph window.

From the Calculation screen

V_Line *x-value*

Draws a vertical line (*x = value*) on the graph window.

Example

- Draw a horizontal line of $x = 3$.

1. Press [2ndF] [DRAW] [A] [4] and enter the value 3.

From the GRAPH window

V_Line

Example

- Draw a vertical line manually.

1. Press [2ndF] [DRAW] [A] [4].
2. Use the cursor navigation keys ([▲] [▼] [◄] [►]) to move the flashing cursor to the appropriate position.
3. Press [ENTER] to draw the line.

5 T_line(

Draws a tangental line at the specified point of a graph curve.

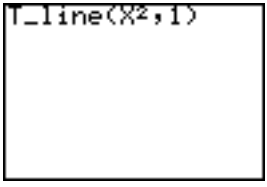
From the Calculation screen

T_line(*equation, x-value*)

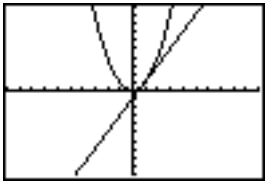
Example

- Draw the tangental line of $y = x^2$ at $x = 1$.

1. Select **T_Line(**.
2. Enter "x², 1)" on the line.



3. Press [ENTER].



Note: It is also possible to specify a function if stored in Y0 to Y9. (T_line(Y1, 1))

From the GRAPH window

T_line(

Example

- Draw a tangental line by manually specifying the point.

1. Select **T_Line(**.
2. Use [◄] [►] to move the flashing cursor on the targeted graph line.

   Use [▲] [▼] to select a graph to draw the tangental line.
3. When the point is set at the tangent point, press [ENTER].

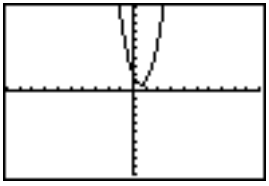
6 Draw **Draw *equation***

Draws an additional graph based on a given expression.

Example

- Draw the graph of $y = 3x^2-4x+2$.

1. Select **Draw**.
2. Enter "3x²–4x+2" on the line.
3. Press [ENTER].



Note: This tool can be used with rectangular coordinate graphs only.

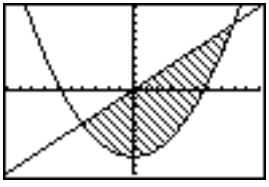
7 Shade(**Shade(*equation1, equation2 [, lower value, upper value]*)**

Draws two graphs, and shades the area between the two. If the x range is specified, it shades the area within the specified range.

Example

- Shade the area enclosed by $y = \frac{1}{4}x^2 - 8$ and $y = x$.

1. Select **Shade(**.
2. Enter "$\frac{1}{4}$x² – 8, x)" on the line.
3. Press [ENTER].

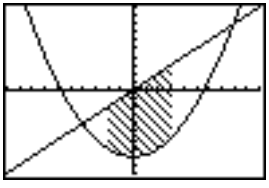


Example

- Shade the area enclosed by $y = \frac{1}{4}x^2 - 8$ and $y = x$ within the range of $-2 \le x \le 3$.

Before starting operation, Select **ClrDraw** to clear the graphs previously drawn.

1. Select **Shade(**.
2. Enter "$\frac{1}{4}$x² – 8, x, -2, 3)" on the line.
3. Press [ENTER].



Note: It is also possible to specify a function if stored in Y0 to Y9.

8 DrawInv

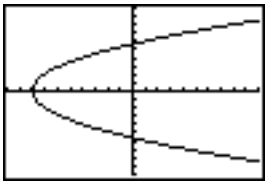
DrawInv *equation*

Draws an inverse of a given graph expression.

Example

• Draw the inverse graph of $y = \frac{1}{4}x^2 - 8$.

1. Select **DrawInv**.
2. Enter "$\frac{1}{4}x^2 - 8$" on the line.
3. Press ENTER.



Note: It is also possible to specify a function if stored in Y0 to Y9.

9 Circle(

Draw a circle on the graph screen.

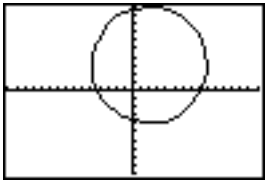
From the Calculation screen

Circle(*x-coordinate of center, y-coordinate of center, radius*)

Example

• Draw a circle with center at (2,3) and of radius 7.

1. Select **Circle(**.
2. Enter "2,3,7)" on the line.
3. Press ENTER.



Note: Before drawing a circle, press ZOOM A 6 to set the X-Y coordinates to square.

From the GRAPH window

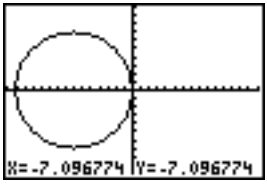
Circle(

Example

• Draw a circle manually.

1. Select **Circle(**.
2. Move the cursor to set the center point of the circle. Press ENTER to set the anchor.
3. Move the cursor to determine the radius length of the circle.
4. When done, press ENTER.

   The circle is drawn at the location.



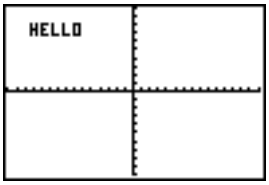
0 Text(**Text(*column, row,* "*strings*")**

Enters a text string at a given coordinate.

Example

• Draw "HELLO" on the graph at column 2, row 1.

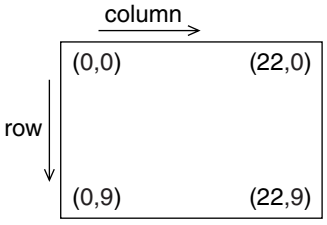
Text(2, 1, "HELLO")



Note: Use [MATH] [E] [3] to enter ""(double quotes).

Column and row definitions for text input

* Refer to the following diagram to specify the coordinates where you wish to start writing the text.



Note: Lines, points, and curves drawn by the Draw menu are handled as pictures. Therefore, they cannot be traced.

Graphs drawn by the Draw menu are automatically cleared if any screen settings are changed. To save the graph, use the **StoPict** menu.

B POINT Utilize these tools to manage point drawing and deletion on the graph.

There are two operation methods. One is to directly move the cursor pointer to the location on the graph screen where you wish to insert the point. The other is to call a relevant command on the Calculation screen and to directly input the coordinates to draw or delete the point. (X and Y coordinates should be separated by a comma.)

1 PntON(**PntON(*x-coordinate, y-coordinate*)**
Draws a point at a given coordinate. It takes the X-Y coordinate as an argument.

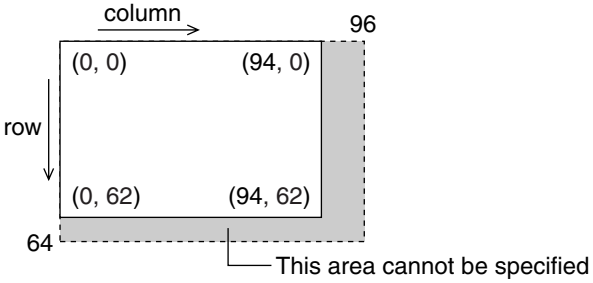
This tool can either be accessed from the GRAPH window or other windows. Entering from the GRAPH window enables a graphic entry, while entering from other windows enables text-based entry.

2 PntOFF(**PntOFF(*x-coordinate, y-coordinate*)**
Erases a pixel point. It takes the X-Y coordinate as an argument.

3 PntCHG(**PntCHG(*x-coordinate, y-coordinate*)**
Changes the status (i.e., visible/invisible) of a pixel at a given coordinate. Deletes the point when it is displayed and draws the point when it is not displayed.

4 PxlON(**PxlON(*column, row*)**
Draws a pixel point at a given screen location indicated by column and row.
The column and row definitions are as follows:

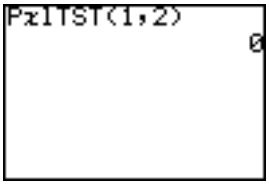
Column: 0 to 94,
Row: 0 to 64.



5 PxlOFF(**PxlOFF(*column, row*)**
Erases a pixel point at a given screen location indicated by column and row.

6 PxlCHG(**PxlCHG(*column, row*)**
Changes the status (i.e., visible/invisible) of a pixel at a given screen location indicated by column and row.

7 PxlTST(**PxlTST(*column, row*)**
Returns “1” if a pixel point is present at a given screen location indicated by column and row.
Returns "0" if no pixel point exists.



C ON/OFF Sets the visibility status of a given graph number (0-9).

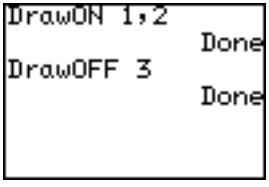
1 DrawON **DrawON [*equation number 1*, ...]** or **DrawON**
Sets the specified graphs visible. If no argument is given, then all graphs will be set visible.

2 DrawOFF **DrawOFF [*equation number 1*, ...]** or **DrawOFF**
Sets the specified graphs invisible. If no argument is given, then all graphs will be set invisible.

Example

- Set Y1 and Y2 to visible and Y3 to invisible.

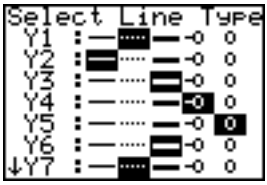
1. Press [2ndF] [DRAW] [C] [1].
2. Enter “1, 2” for equation numbers.
3. Press [ENTER].
4. Press [2ndF] [DRAW] [C] [2].
5. Enter 3 for equation number.
6. Press [ENTER].



D LINE Sets the line appearance of each graph. Each graph coordinate mode can retain a set of line appearance preferences. Solid line, dotted line, bold line, locus and dots can be selected.

1. Press [2ndF] [DRAW] [D] to select **D LINE**, then press [ENTER].
2. The next window enables you to select the line types of each graph in the set coordinate mode. (The rectangular coordinate mode is selected in this example.)

   Use the cursor keys to select the required line type, and press [ENTER].



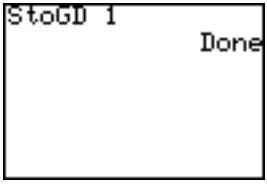
E G_DATA All graph data, including the graph equations and window settings, can be stored in 10 graph storage areas (1-9, and 0), which can be called up later.

1 StoGD **StoGD *number*** *(0-9)*
Saves the graph data.

Example

- Store the current graph data in location #1.

Note: The lines, graphs and pixels drawn with the **A DRAW** tools will not be saved here; use **StoPict** under **F PICT** instead.

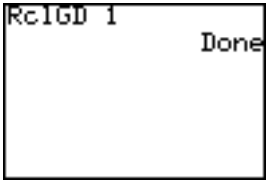


2 RclGD **RclGD *number*** *(0-9)*
Recalls the saved graph data.

Example

- Call back the previously stored graph data from location #1.

Note: Attempting to call back graph data from an empty location will result in an error.

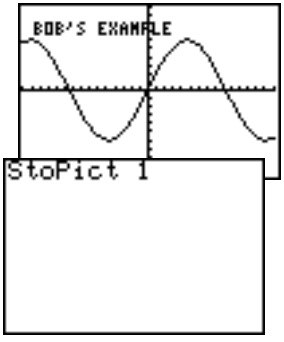


F PICT Stores and recalls the displayed pixel data for the graph window. The graph equations will not be saved or recalled with these tools.

1 StoPict **StoPict *number*** *(0-9)*
Saves the pixel data.

Example

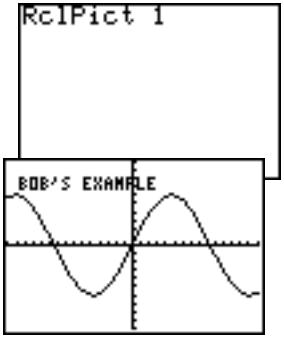
- Store the current graph, including the drawings, in location #1.



2 RclPict **RclPict *number*** *(0-9)*
Recalls the saved pixel data.

Example

- Call back the previously stored graph data from location #1.



G SHADE With these sub-menu tools, inequalities, intersections and compliments of multiple graphs can be visualized.

1 SET Sets up the shading area for each graph.

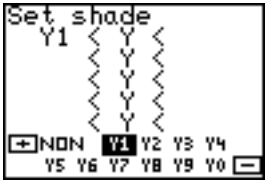
2 INITIAL Initializes the shading setup, and brings up the shading setup window.

Example

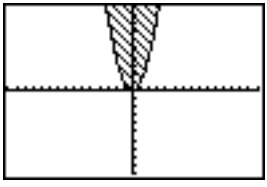
To access the DRAW menu, press [2ndF] [DRAW].

An inequation can be expressed with the calculator's graphing capability. Here's how:

1. Set up a simple graph within the Graph Equation window. Enter "X^2" for Y1, for example.
2. Press [2ndF], and [DRAW] to enter the DRAW menu, then press [G] to select **G SHADE**. The SHADE sub-menu appears.
3. Press [1] to select **1 SET**. The "Set shade" window appears.
4. Using the cursor keys, move the cursor pointer to the appropriate position.



5. Press [+] or [−] to set Y1 on the left side of "Y".
6. Press the [GRAPH] key. The graph will be redrawn.
7. Let's add another inequation, so that the area where the two inequality overlap can be shaded. Press the [Y=] key, and enter another simple graph equation such as "X + 4" for "Y2".



8. Now, return to the SHADE menu by pressing [2ndF] [DRAW], and [G]. Press [1] to select **"1 SET"**.
9. Within the "Set shade" window, add the second equation at the right of the topmost inequation. Use the [▶] or [◀] key to position the underscore cursor, then select "Y2" using [+] or [−] key.
10. Press the [GRAPH] to redraw the graph with the new shading appearance.

FORMAT: The graph appearance can be set and verified under this menu. Press 2ndF FORMAT to access.

A ------ Displays the current FORMAT settings. The default setting is:

OFF	(for the graph equation to be displayed on the graph)
OFF	(for displaying numeric derivatives on the graph)
Connect	(for drawing a graph with solid lines.)
Sequen	(for drawing the graphs in sequential order.)

B EXPRES This sets whether or not graph equations are displayed on the graph screen (in the trace mode, etc.). To display the equations on the graph, select **1 ON** by pressing 1 at this menu item.

C Y' The numeric derivative (dx/dy) can be displayed on the graph screen (in the trace mode, etc.). To activate this function, select **1 ON** by pressing 1 at this menu item.

D STYLE1

1 Connect To connect calculation points of a graph equation to create a graph. (Line indication.)

2 Dot Displays calculation points of a graph equation. (Dot indication.)

E STYLE2

1 Sequen To set to the sequential graphing mode. (Graphs are sequentially displayed one at a time.)

2 Simul To set to the simultaneous graphing mode. (Two or more graphs are displayed at the same time.)

5. Graphing Parametric Equations

A two-dimensional parametric equation assumes that both X and Y are represented by functions in a third variable T. When set in parametric graphing mode, the calculator automatically sets up the Graph Equation Entry screen to take one set of X and Y per each graph, with the equation's right side variable to be set as "T".

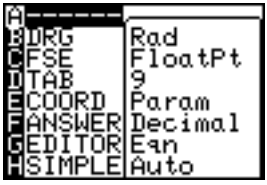
Example

- Draw a graph: $x(t) = 16\cos(t),\ y(t) = 9\sin(t)$.

1. Press [2ndF] [SETUP] to enter the SETUP menu.
2. Press [E] to select **E COORD**, then [2] to select **2 Param**.

   Be sure that the other settings are as shown on the right.

   To exit the SETUP menu, press [CL].

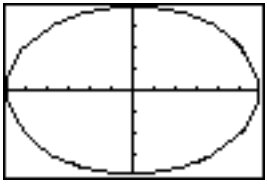


3. Press [Y=] to go to the Graph Equation Entry window.
4. Enter $16\cos(t)$ for **X1T=**. Press [ENTER] when done entering.
5. Enter $9\sin(t)$ for **Y1T=**. Press [ENTER] when done entering.

Note: The right side variable is automatically set to "T". When the [X/T] key is pressed within the Graph Equation Entry window, it will enter the variable "T".

6. Press [GRAPH] to draw the graph.
7. If the graph line extends beyond the screen, press [ZOOM] and select **A ZOOM** then **1 AUTO**.

   Use **3 IN** or **4 OUT** of the **A ZOOM** to adjust the drawing size.



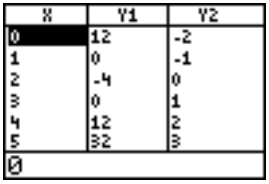
   You can also set the drawing size in the WINDOW menu by determining the maximum and minimum values of T, X and Y.

6. Tables

The calculator enables you to illustrate the changes using the equation and graph you have input. It also has tables for showing a list of X and Y values. Each column item can display up to 7 digits, including a sign and/or a decimal point.

There are two kinds of tables available corresponding to the coordinate system.

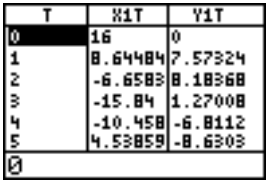
Rectangular coordinate system



X	Y1	Y2
0	12	-2
1	0	-1
2	-4	0
3	0	1
4	12	2
5	32	3

- The variable X is displayed in the left end column.
- The columns Y1 to Y2 are displayed on the first screen.
- Press [◀] [▶] to horizontally scroll the table. (The variable X is always displayed in the left end column.)
- The 10-digit value in the column where the cursor is currently located is displayed on the bottom line of the screen.
- Move the cursor using [◀] [▶] [▲] [▼].
- Non-input equation numbers and equations invalid for graphing will not be displayed in the above table.

Parametric coordinate system



T	X1T	Y1T
0	16	0
1	8.64484	7.57324
2	-6.6583	8.18368
3	-15.84	1.27008
4	-10.458	-6.8112
5	4.53859	-8.6303

- The variable T is displayed in the left end column.
- The columns X1T and Y1T are displayed on the first screen.
- Press [◀] [▶] to horizontally scroll the table.
- The 10-digit value in the column where the cursor is currently located is displayed on the bottom line of the screen.
- Move the cursor using [◀] [▶] [▲] [▼].
- Non-input equation numbers and equations invalid for graphing will not be displayed in the above table.

Setting a table

- Table setting allows you set how to input data for a table.
- Press [2ndF] [TBLSET] to enter the table setting screen.
- The cursor is initially located at **Auto**, showing the variable input method.

Auto: Automatically creates a table based on the graph equations and given TableStart and TableStep values.

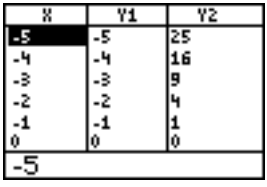
User: Displays a blank table. As you input values for variable columns, table values are automatically calculated by the equation. Thus, although TableStart and TableStep inputs can be made when selecting User, set values will be ignored.

- Press [◀] or [▶] to switch between **Auto** and **User**.
- TableStart is a start value of the variable in the table, and TableStep is a step value of the variable. Both are numeric values.

Example

Automatically create a table starting from -5 with a step of 1 in the X-Y coordinate after equations, based on "Y1 = X", "Y2 = X^2", and "Y3 = $-X^2 + 3$".

1. Press [2ndF] [TBLSET] and [▼] [(–)] 5 [ENTER] 1 [ENTER].
2. Press [TABLE].

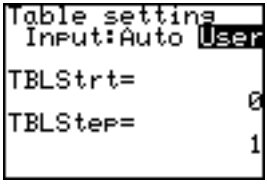


* If the cursor is on the top or bottom line of the table, [▲] or [▼] can still be used. The table contents will move to become visible in the display area.

Example

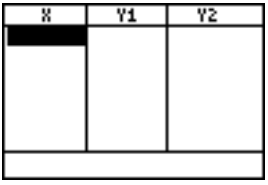
Create a table in the User mode under the above conditions.

1. Press [2ndF] [TBLSET] and [▶] [ENTER] [▼] 0 [ENTER] 1 [ENTER].

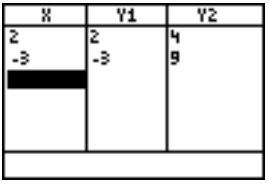


2. Press [TABLE].

   Blank table will appear.



3. Press 2 [ENTER] [(–)] 3 [ENTER] to enter X values.



* An automatically created table in the User mode cannot be scrolled vertically.

Note: While the table is in the User mode, a selected row can be deleted by pressing [DEL].

7. Other Convenient Graphing Features

The calculator is equipped with rapid graphing features that make graph equation entry and window and zoom settings easy. Press [EZ] to enter the rapid feature mode and you can easily enter an equation or set the settings by using the pre-installed equations or settings.

1. Rapid GRAPH

You can select a desired equation from the pre-installed list of equations to draw a graph.

- This feature is valid only in the rectangular coordinate system.

  If you press [EZ] in the other coordinate systems, an error will occur. The message "Rect-coordinate only available" will appear.
- 8 kinds and 50 types of equations listed below are pre-installed in the Rapid GRAPH feature.

	Main menus		Sub menus		Pre-installed Equations	
RAPID GRAPH	1	X^2	A)	$Y=AX^2$	1)	$Y=X^2$
					2)	$Y=3X^2$
					3)	$Y=(1/2)X^2$
					4)	$Y=-2\ X^2$
			B)	$Y=AX^2+B$	1)	$Y=X^2+1$
					2)	$Y=2X^2-1$
					3)	$Y=-X^2+1$
					4)	$Y=-2X^2-1$
			C)	$Y=A(X-H)^2+K$	1)	$Y=2(X-1)^2+2$
					2)	$Y=-2(X+1)^2+2$
					3)	$Y=(X+2)^2-1$
					4)	$Y=-(X+2)^2-1$
			D)	$Y=AX^2+BX+C$	1)	$Y=2X^2-3X-2$
					2)	$Y=-2X^2+3X+2$
	2	B^X	A)	$Y=B^X$	1)	$Y=2^X$
					2)	$Y=-2^X$
	3	LOG	A)	$Y=\log X$	1)	$Y=\log X$
			B)	$Y=A\log (X-H)+K$	1)	$Y=2\log (X+3)-1$
			C)	$Y=A\ln (X-H)+K$	1)	$Y=2\ln (X+3)-1$
	4	TRIG	A)	$Y=A\sin (BX-H)+K$	1)	$Y=2\sin (-2X+\pi)+2$
					2)	$Y=1/2\sin (X-\pi/2)$
					3)	$Y=-2\sin (-2X+\pi)$
					4)	$Y=-1/2\sin (X-\pi/2)$
			B)	$Y=A\cos (BX-H)+K$	1)	$Y=2\cos (-2X+\pi)+2$
					2)	$Y=1/2\cos (X-\pi/2)$
					3)	$Y=-2\cos (-2X+\pi)$
					4)	$Y=-1/2\cos (X-\pi/2)$
			C)	$Y=A\tan (BX-H)+K$	1)	$Y=2\tan (-2X+\pi)+2$
	5	X^3	A)	$Y=AX^3+BX^2+CX+D$	1)	$Y=X^3$
					2)	$Y=(1/2)X^3$
					3)	$Y=-X^3+2$
					4)	$Y=X^3-2X^2$
					5)	$Y=2X^3+X^2-3X$
			B)	$Y=A(X-H)^3+K$	1)	$Y=-2(X+1)^3-3$
	6	$\frac{1}{X}$	A)	$Y=A/X$	1)	$Y=1/X$
					2)	$Y=-1/X$
			B)	$Y=A/(X-H)+K$	1)	$Y=1/(X+2)$
					1)	$Y=1/(X-2)$
			C)	$Y=(AX+B)/(CX+D)$	1)	$Y=(2X-3)/(X-2)$
					1)	$Y=(-2X-3)/(-X-2)$
					1)	$Y=(-2X+1)/(X-1)$
			D)	$Y=A/(X-H)^2+K$	1)	$Y=2/(X-1)^2-3$
	7	$\sqrt{X}$	A)	$Y=A\sqrt{BX}$	1)	$Y=\sqrt{X}$
					1)	$Y=-\sqrt{X}$
			B)	$Y=A\sqrt{(BX-H)}$	1)	$Y=\sqrt{(2X-1)}$
			C)	$Y=A\sqrt{(BX-H)+K}$	1)	$Y=\sqrt{(X+3)+4}$
			D)	$Y=\sqrt[A]{BX}$	1)	$Y=\sqrt[3]{X}$
	8	$\lvert X\rvert$	A)	$Y=A\lvert X-H\rvert+K$	1)	$Y=\lvert X\rvert$
					2)	$Y=2\ \lvert X\rvert-1$
					3)	$Y=2\ \lvert X-1\rvert$

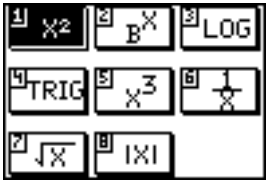
Example

Enter "Y = 2sin(-2X + π) + 2" for Y1 of the graph equation screen.

1. Press [Y=] to open the graph equation screen and place the cursor at Y1.

2. Press [EZ].

   The equation classification menu will appear.



3. Press [4] [ENTER] to select **4 TRIG**.

   You can move the cursor to the appropriate position using [▲] [▼] [◀] [▶] and press [ENTER] to select the equation classification menu.

   The equation classification sub-menu will appear.

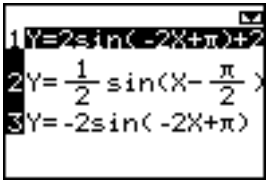
4. Move the cursor to A to select the sine graph and press [ENTER].

   The pre-installed equation menu will appear.

   Press [CL] to return to the initial Rapid GRAPH screen.

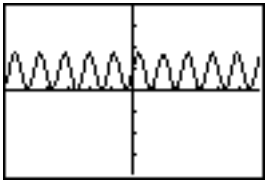
5. Select the appropriate equation ([1] for this case) and press [ENTER].

   The equation is displayed in one line. If the line is exceeded the display capacity, use [◀] or [▶] to display the hidden part and check the equation.



6. Press [GRAPH] to draw the selected graph.

   No graphing range is determined for the equation selected from the rapid graphing feature. the graph is drawn based on the current window settings.



7. Press [2ndF] [QUIT] to return to the calculation screen.

2. Rapid WINDOW

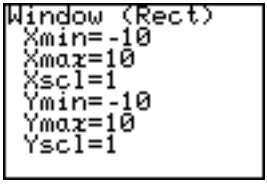
- This feature allows you to easily set the window settings by selecting from the pre-installed typical window settings.
- Regardless of the coordinate system, this function sets the X and Y values only.

Example

Set the X-Window to (-10 < X < 1, scl: 1) and Y-Window to (-10 < Y < 1, scl: 1).

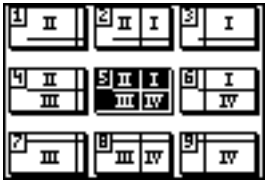
1. Press [WINDOW] to open the window screen.

   The default settings will appear. (The settings may vary according to your previous operations.)



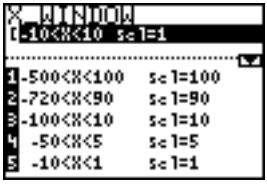
2. Press [EZ].

   A window setting main menu will appear, where Roman numerals indicate quadrants.



3. Select [7] [ENTER] to select the No. 7 window.

   You can move the cursor to the appropriate position using [▲] [▼] [◀] [▶] and press [ENTER] to select the desired window setting menu.



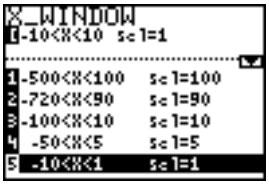
The X-Window selection screen will appear.

The settings displayed on the top line (followed by C:) indicates the current settings.

The [▼] mark on the upper right corner indicates that the other settings than displayed on the screen are pre-installed. Use [▲] [▼] to scroll the screen to show the other settings.

Press [CL] to return to the initial Rapid WINDOW.

4. Press [5] [ENTER] to select **-10 < X < 1 scl = 1**.

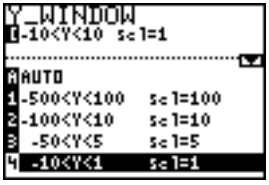


The Y-Window selection screen will appear.

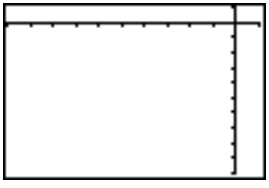
The settings displayed on the top line (followed by C:) indicates the current settings.

If you select **A AUTO**, the Y settings are set to the corresponding settings to X settings.

5. Press [4] [ENTER] to select **-10 < Y < 1 scl = 1**.



6. Press [ENTER] to draw the graph.



7. Press [2ndF] [QUIT] to return to the calculation screen.

Note: If you press [CL] during the settings and the X-Window settings are completed, the settings affect the subsequent operation. (It is not required to set both the X- and Y-Window settings at once.)

3. Rapid ZOOM

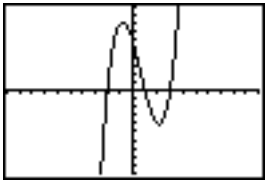
The Rapid ZOOM feature allows you to easily enlarge or reduce the graph size or change the graph locations while seeing the results.

Press [EZ] from the graph screen.

Example

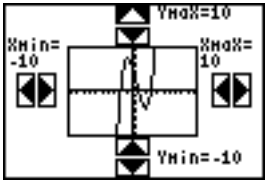
Display all the displacement points of the graph, which cannot be currently seen on the screen. The following examples are only references. They may differ from the actual display.

1. Press [GRAPH] to display the graph.



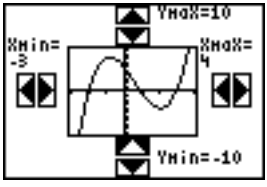
2. Press [EZ].

   A frame will appear at the center. The graph is displayed with its size reduced.



- ▲ / ▼ / ◀ / ▶ icon at the top/bottom/left/right of the screen each indicates that the value is increased each time when you press [ENTER].
- ▼ / ▲ / ▶ / ◀ icon at the top/bottom/left/right of the screen each indicates that the value is decreased each time when you press [ENTER].

3. Select (by inversing) the appropriate icon using [▲] [▼] [◀] [▶], and press [ENTER] appropriate times to change the maximum or minimum value of x or y coordinates.



4. Press [GRAPH] to view the full graph.

Chapter 5
SLIDE SHOW Feature

The SLIDE SHOW feature is especially incorporated to help students understand math concepts utilizing the calculator's graphing capabilities.

The SLIDE SHOW feature is designed to be used with SHARP's optional overhead projection system, which offers a hassle-free math presentation environment for the entire class.

The calculator is equipped with two types slide show functions:

- **Built-in Slide Show**

  Slide show programs for major equations are pre-installed under the **A B-IN** menu. You can select one from the sub-menus and execute the slide show.

- **Original Slide Show**

  You can create and register one original slide show program, that can be recalled from the **B ORG** menu.

Entering and exiting the Slide Show feature

1. Press [SLIDE SHOW].

   The Slide Show menu screen will appear.

A B-IN Selects and recalls a built-in slide show program.

B ORG Recalls your original slide show program.

C NEW Creates a new original slide show file by naming a file and capturing images.

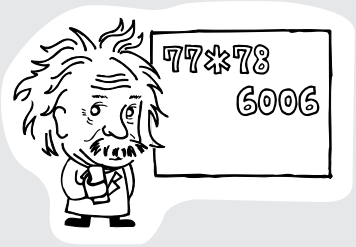
D EDIT Moves/deletes captured images or change the name of the original slide show file.

2. Press [⊞⊟ ⊠⊞] to exit the Slide Show feature.

1. Try it!

Make a SLIDE SHOW named “CNSCTV N” to tell how to use the calculator to find the two consecutive numbers whose product is 6006 under the following concept.

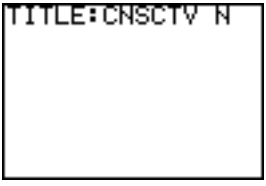
- Consecutive numbers are only one apart and can be considered to be roughly the same number.
- The nearest squares to 6006 to one significant figure are $70 \times 70 = 4900$ and $80 \times 80 = 6400$
- The latter is actually nearer to 6006 so the numbers sought are nearer to 80 than 70.
- The only last-digit combinations leading to their products having 6 in the units column are 2×3 and 7×8.



Find the answer using the calculator.

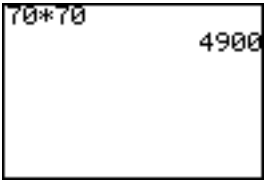
Create a new SLIDE SHOW

1. Press [SLIDE SHOW] to enter the SLIDE SHOW menu.
2. Press [C] [ENTER] to select **C NEW**.
3. Name your project (type “CNSCTV N” for example), and press [ENTER].



Capture images

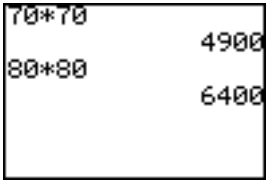
4. Enter [⊞⊟ ⊠⊞] [CL] 70 [×] 70 and press [ENTER].



5. Press [2ndF] [CLIP].

   The message “STORE SCREEN: 01” will appear. The image will be stored on page 1 of the SLIDE SHOW “CNSCTV N”, and the screen will automatically return to the previous screen.

6. Enter 80 [×] 80 and press [ENTER].

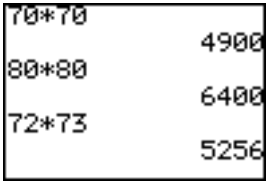


7. Press [2ndF] [CLIP].

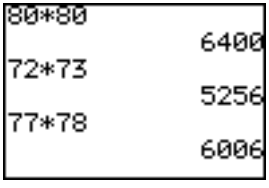
   The image will be stored on page 2 of the SLIDE SHOW.

   Each time you press [2ndF] [CLIP], the screen image will be captured and stored in the SLIDE SHOW.

8. Enter 72 [×] 73 and press [ENTER].



9. Press [2ndF] [CLIP].
10. Enter 77 [×] 78 and press [ENTER].
11. Press [2ndF] [CLIP].



Note:
- Images cannot be captured while drawing.
- If the cursor flashes at the upper right corner of the screen, the calculator is busy processing tasks. The SLIDE SHOW feature cannot capture images during this period.
- A captured image cannot be recaptured.

Playing back the original SLIDE SHOW

1. Press [SLIDE SHOW] to go to the SLIDE SHOW menu.

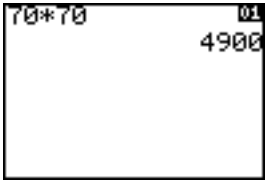
   Press [B] to select **B ORG**.

   The saved SLIDE SHOW name will be shown.

2. Press [ENTER].

   The first page of the SLIDE SHOW will appear.

   The number appearing at the upper right of the screen is the slide number.



3. Use the [▼] key or [ENTER] to display the next image; press the [▲] key to show the previous image.

Using the optional PC-link kit (see page 156)

By utilizing the optional PC-link kit, the original SLIDE SHOW file can be sent directly to your PC. The file can then be opened and be printed out to keep track of the math activities in the class.

2. Built-in Slide Show

The built-in slide show programs are designed to let you (or your students) understand the relationships between equations and graphs.

- The calculator has eight built-in slide show programs based on the major equations, such as $Y = X^2$, $Y = AX + B$, $Y = \sqrt{x}$ and $Y = \sin X$.
- The built-in slide shows are read-only and cannot be revised or deleted.

  Please note that the screen images of the built-in slide show may differ from the actual screen.

Executing the built-in Slide Show (Y = AX + B)

1. Press [SLIDE SHOW].
2. Move the cursor to select **A B-IN** using [▲] / [▼] and press [ENTER].

3. Move the cursor to select **2 Y = AX + B** and press [ENTER].

   The graph and X-Y table of Y1 = 2X + 1 are displayed on the first screen.

   The two-digit number on the upper right corner of the display shows the current screen number.

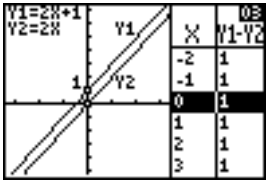
4. Press [▼] to proceed to the next screen.

   The graph and X-Y table of Y2 = 2X are displayed.

   The coordinate (1, 2) is marked and the corresponding row of the X-Y table is highlighted.

5. Press [▼] again.

   The above two graphs are displayed simultaneously, and the Y value column of the table is changed to show the Y1 - Y2 values, where you can find the relationship between Y1 and Y2 is totally constant (Y1 -Y2 = 1).



6. Press [▼] to proceed the slide show.

Note: If you wish to display the previous screen, press [▲].

[▲] is not effective on the first screen and [▼] is not effective on the last screen.

The number of screens are different among the built-in slide shows.

For example, as the slide show “Y = AX + B” is consist of 8 screens, [▼] is not effective on the 8th screen.

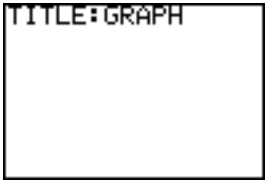
7. Press [2ndF] [QUIT] to exit the Slide Show feature and return to the calculation screen.

3. Creating an Original Slide Show

You can create and registered one self-made slide show in the calculator.

To create an original slide show

1. Press [SLIDE SHOW] [C] (C NEW) and press [ENTER].
2. Input the appropriate title and press [ENTER]. (Up to 8 characters can be used for the title.)



3. Operate the calculator to display the screen you wish to store.
4. Press [2ndF] [CLIP] to capture the target screen.

   Each time you press [2ndF] [CLIP], the screen image will be captured and registered in the current slide show.

Note: If an original Slide Show has been already stored, the delete confirmation display appears after selecting **C NEW**.

Press [ENTER] to delete the previous Slide Show file.

Press [2ndF] [QUIT] to cancel.

4. Viewing the Original Slide Show

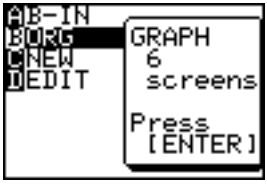
To view the original slide show which was created previously, follow these steps.

1. Press [SLIDE SHOW] [B] (B ORG).

   The saved slide show name will be displayed.
2. Press [ENTER].

   The first screen of the slide show will appear.

   Navigate the slide show by using [▲] / [▼].



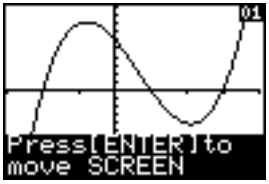
5. Editing the Original Slide Show

The registered slide show data can be sorted and deleted, and the title can be renamed in the edit mode.

1. Changing the order of the screens (MOVE)

This sub-menu tool moves the selected screen image to change the playback order.

1. Press [SLIDE SHOW] [D] [1].
2. Press [▲] or [▼] to call up the screen you wish to move and press [ENTER].
3. Press [▲] or [▼] to select the place you wish to move to and press [ENTER].
4. Press [2ndF] [QUIT] to exit the MOVE mode.



2. Deleting the registered screen (DEL)

This sub-menu tool deletes the selected image captured in the slide show.

To delete a screen

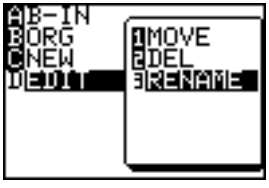
1. Press [SLIDE SHOW] [D] [2].
2. Press [▲] or [▼] to select the screen you wish to delete and press [ENTER].
3. Press [2ndF] [QUIT] to exit the DEL mode.

3. Renaming the registered title (RENAME)

This sub-menu tool lets you rename the slide show title.

To change the title

1. Press [SLIDE SHOW] [D] [3].
2. Input the new title.
3. Press [ENTER].
4. Press [2ndF] [QUIT] to exit.



Chapter 6
SHIFT/CHANGE Features

The calculator is equipped with SHIFT and CHANGE features.

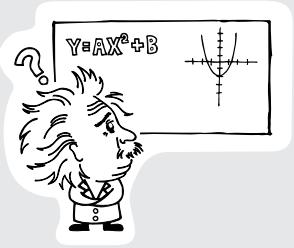
SHIFT Feature: Automatically shifts the graph without changing its shape.

CHANGE Feature: Automatically changes the graph shape without changing its location.

- Eight major graphs are built into the calculator for the SHIFT feature and six graphs for the CHANGE feature.
- The graph and the corresponding equation can be displayed on the same screen in order to easily view the relationship between graph and equation.
- The calculator can temporarily store the graph locus that is shifted or changed its shape.
- All the built-in SHIFT/CHANGE features are in the rectangular coordinate system regardless of the current coordinate system.

1. Try it!

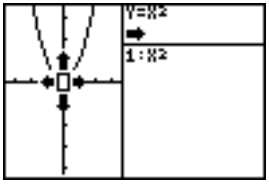
Check the relationship between the graph and the coefficients of the quadratic function $Y = AX^2 + B$.



1. Press 2ndF SHIFT/CHANGE.

Entering the SHIFT feature and select the function.

2. Press [A] [1] to select **1 Y = X²** in the SHIFT feature.



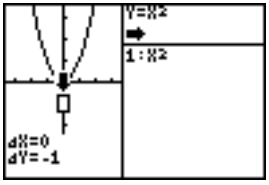
The graph of Y = X² will appear on the left window.

The corresponding function will be displayed on upper half of the right window. The lower half displays the registered functions during operation.

The cursor ✥ will appear on the vertex of the graph (SHIFT standby mode). The four arrows of the cursor indicates that the graph can be shifted to the four directions.

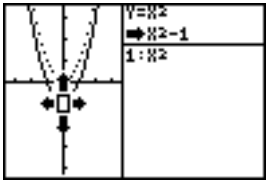
Shift the graph downward.

3. Press [▼].



The cursor will change to ↓ to confirm the graph will be shifted downward in the next step.

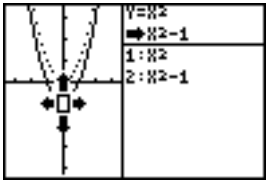
4. Press [ENTER].



The new graph shifted downward by 1 will be displayed in a solid line and the previous graph will change into a dotted line. The new function corresponding to the graph "Y = X² ⇒ X² – 1" will appear on the right window (upper half).

Register the function.

5. Press [ENTER].



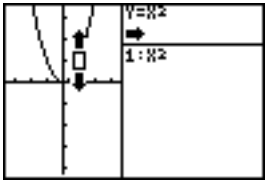
The new function will be registered and appear on the lower half of the right window.

Press [▲] [▼] [▶] [◀] to continue to shift the graph.

Entering the CHANGE feature and select the function.

6. Press [2ndF] [SHIFT/CHANGE] [B].

7. Press [1] to select **1 Y = X²** in the CHANGE feature.



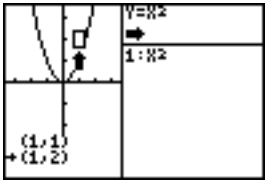
The graph of $Y = X^2$ will appear on the left window.

The corresponding function will be displayed on upper half of the right window. The lower half shows the registered function during operation.

The cursor ⇕ will appear on the graph (CHANGE standby mode). The two arrows of the cursor indicates that the graph shape can be changed narrower or wider.

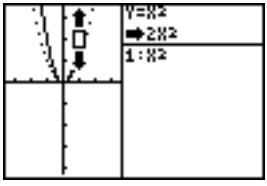
Make the graph narrower.

8. Press [▲].



The cursor will change to ⇕ to confirm the graph shape will be changed narrower, after you press [ENTER].

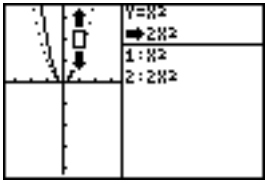
9. Press [ENTER].



The narrower graph will be displayed in a solid line and the previous graph will change into a dotted line. The new function corresponding to the graph "$Y = X^2 \Rightarrow 2X^2$" will appear on the right window (upper half).

Register the function.

10. Press [ENTER].



The new function will be registered and appear on the lower half of the right window.

Press [▲] [▼] to continue to change the graph shape.

2. SHIFT Feature

The graph can be shifted in the specified increments within the specified range described in the following table.

No.	Equation	Shift step	Shift range
1	$Y=X^2$	X : 1 Y : 1	X=–3 to 3 Y=–2 to 3
2	$Y=\sqrt{x}$	X : 1 Y : 1	X=–2 to 4 Y= –2 to 3
3	Y=1/X	X : 1 Y : 1	X=–4 to 2 Y=–3 to 2
4	$Y=e^x$	X : 1 Y : 1	X=–3 to 3 Y=–3 to 2
5	Y=ln X	X : 1 Y : 1	X=–4 to 2 Y=–2 to 3
6	Y=sinX (DEG)	X : 90 Y : 1	X=–270 to 270 Y=–2 to 3
	Y=sinX (RAD)	X : π/2 Y : 1	X=–3π/2 to 3π/2 Y=–2 to 3
	Y=sinX (GRAD)	X : 100 Y : 1	X=–300 to 300 Y=–2 to 3
7	Y=tanX (DEG)	X : 45 Y : 1	X=–135 to 135 Y=–2 to 3
	Y=tanX (RAD)	X : π/4 Y : 1	X=–3π/4 to 3π/4 Y=–2 to 3
	Y=tanX (GRAD)	X : 50 Y : 1	X=–150 to 150 Y=–2 to 3
8	Y= | X |	X : 1 Y : 1	X=–3 to 3 Y=–2 to 3

Example

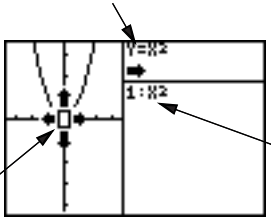
Shift the graph of $Y = X^2$ using the SHIFT feature.

Set the shift mode to "$Y = X^2$".

1. Press [2ndF] [SHIFT/CHANGE] [A].
2. Press [1].

   The first screen of the shift feature shown below will appear.

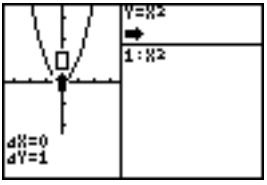
The equation of the graph before shift (Solid line graph)



Registered equation
(The first equation, "Y = X²", is automatically registered.)

The directions the graph can be shifted (When all the four arrows are shown, the graph can be shifted for four directions.)

3. Press [▲].

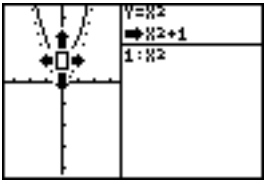


The graph "Y = X²" is shifted by 1 (Y = 1) upward.

The cursor icon will change to " " indicating that the graph will be shifted upward from the start point (0, 0) in the next step.

The ΔX and ΔY values at the bottom of the graph indicates the amount of shift amount in the X and Y directions.

4. Press [ENTER].

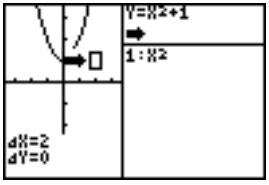


The line type of the original graph (Y = X²) is changed to the dotted line (....) and the shifted graph is drawn in the solid line (—).

The upper right portion of the screen shows how the equation is changed according to the graph shift. In this case, it says "Y = X²" is changed to "Y = X² + 1".

The cursor position is also shifted in the same direction and the cursor icon will be changed to the four arrow type, indicating that shift feature is now in the standby mode.

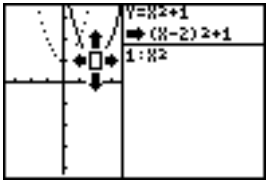
5. Press [▶] [▶] to shift the graph to the right in two increments (for the + X direction).



   The upper right portion of the screen will change as shown on the right, and only the "Y = X^2 + 1" graph is shown on the screen.

   This means that the graph can be shifted based on the newly shifted equation "Y = X^2 + 1".

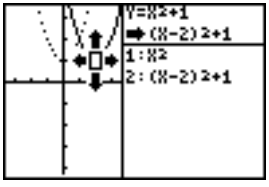
6. Press [ENTER].



   The graph is shifted to the right by 2 increments and the equation is changed from "Y = X^2 + 1" to "Y = $(X - 2)^2$ + 1".

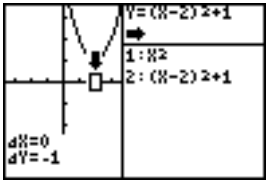
   (The graph for "Y = X^2 + 1" is changed to the dotted line.)

7. Press [ENTER] to register the equation (graph) "Y= $(X - 2)^2$ + 1".

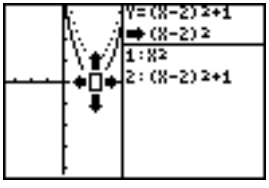


   The registered equation "$(X - 2)^2$ + 1" is added to under "Y = X^2" on the bottom half right screen. (Up to ten equations, 1 to 9, and 0, including the base equation (Y = X^2) can be registered.)

8. Press [▼] to further shift the graph downward by 1 increment.

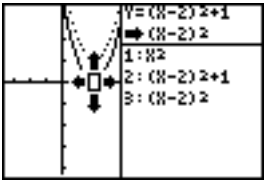


9. Press [ENTER].



   The graph will be shifted downward and the graph for "Y = $(X - 2)^2$ + 1" is changed to the dotted line.

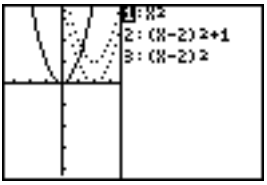
10. Press [ENTER] to register the equation (graph) of "Y = $(X - 2)^2$".



- As described above the SHIFT feature can show how the equation changes according to the graph shift.

Draw graphs from the registered equations

11. Press [ALPHA] [▶] to enter the graph regeneration screen.

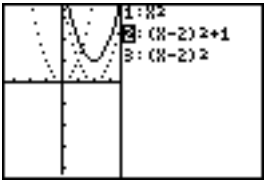


The screen shown to the right will appear and all registered equations are displayed on the right portion of the screen.

Initially, the cursor is located at **1: X^2** and the corresponding graph is displayed in a solid line. Other graphs are displayed by dotted lines.

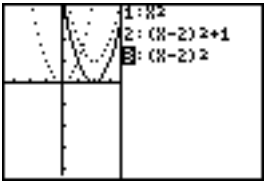
Note: This operation clears equations that have not been registered in the previous operations.

12. Press [▼] to move the cursor to **2: $(X - 2)^2 + 1$**.



The corresponding graph "Y = $(X - 2)^2 + 1$" is changed to the solid line and other graphs are displayed by dotted lines.

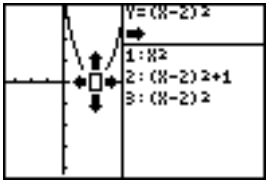
13. Press [▼] to move the cursor to **3: $(X - 2)^2$**.



The corresponding graph "Y = $(X - 2)^2$" is changed to the solid line and other graphs are displayed by dotted lines,

View changes in equations and graphs, accordingly.

14. Press [ALPHA] [◀] to return to the shift screen shown on the right.



Note: In the above example, since the graph for "$Y = (X - 2)^2$" has been selected (3: $(X - 2)^2$), that equation becomes a base equation immediately after returning to the graph shift screen. (Therefore, if the equation "$Y = (X - 2)^2 + 1$" has been selected (2: $(X - 2)^2 + 1$), that equation becomes a base equation.)

To return to the previous screen from the SHIFT feature :

- Press [CL] to return to the initial screen when a desired equation has been selected by pressing [2ndF] [SHIFT/CHANGE] [A] and [1] ~ [8].
- Press [2ndF] [QUIT] to return to the calculation screen.
- Note that above key operations clear the shifted or registered equations/graphs.
  (The built-in equations are not cleared.)

3. CHANGE Feature

The CHANGE feature shows the relationship between the graph and equation by changing the shape of the graph.

Using this function, you may view changes such as "$Y = 2X^2$" and "$Y = 3X^2$" based on "$Y = X^2$". Selection of the screen and equation are done using procedures similar to those used in the SHIFT feature.

The following shows the built-in equations, change steps, and movable range applicable to the change feature. (Including the trigonometric functions for different angles)

No.	Equation	Change step	Range for change
1	$Y=X^2$	X : 1 Y : 1	Y=–2 to 3
2	$Y=\sqrt{x}$	X : 1 Y : 1	Y=–2 to 3
3	$Y=\lvert X \rvert$	X : 1 Y : 1	Y=–2 to 3
4	$Y=e^x$	X : 1 Y : 2.718	Y=–2 to 3
5	Y=sinX (DEG)	X : 90 Y : 1	Y=–2 to 3
	Y=sinX (RAD)	X : 1.57 Y : 1	Y=–2 to 3
	Y=sinX (GRAD)	X : 100 Y : 1	Y=–2 to 3
6	Y=tanX (DEG)	X : 45 Y : 1	Y=–2 to 3
	Y=tanX (RAD)	X : 0.785 Y : 1	Y=–2 to 3
	Y=tanX (GRAD)	X : 50 Y : 1	Y=–2 to 3

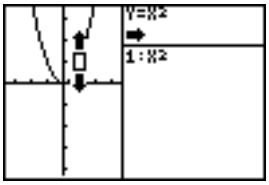
Example

Change the graph "Y = X^2" using the CHANGE feature.

Set the change mode to "Y = X^2".

1. Press [2ndF] [SHIFT/CHANGE] [B] [1].

   The screen shown to the right will appear.

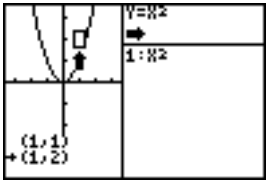
   

   The cursor icon " ⇕ " will appear.

   This indicates the directions in which the graph can be changed (upward and downward only). The same rule is applied to other equations.

2. Press [▲].

   The cursor frame " □ " shifts upward and an arrow will appear toward the cursor.

   Numeric values displayed on the bottom of the screen show how the x-y coordinate will be changed according to the graph change.

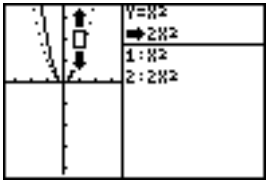
   (The right example shows that you wish to change the graph of "Y = X^2" passing the coordinate (1, 1) to the graph passing (1, 2).)

3. Press [ENTER].

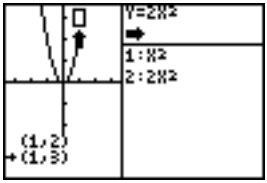
   The new graph is displayed by a solid line and the cursor moves the location to the targeted coordinate (1, 2).

   The right above portion of the screen indicates that the equation has changed from "Y = X^2" to "Y = $2X^2$"

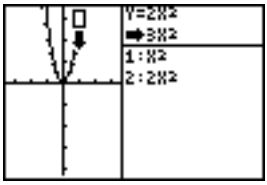
4. Press [ENTER] to register the equation "Y = $2X^2$".

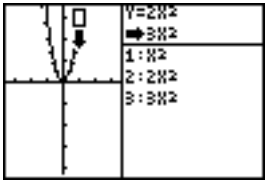
5. Press [▲].
   The graph for "Y = 2X²" is changed as shown on the right.



6. Press [ENTER].
   In the same manner as described in the SHIFT feature, the previous graph is displayed by the dotted line and the newly changed graph is displayed by the solid line.

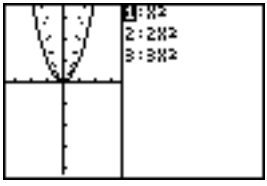


7. Press [ENTER] to register the equation "Y = 3X²".

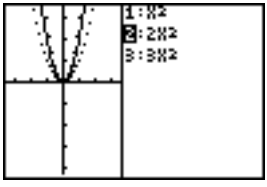


Draw graphs from the registered equations

8. Press [ALPHA] [▶] to enter the graph regeneration screen.
9. Press [▲] [▼] to move the cursor.
   Basic operations are the same as those described in the SHIFT feature. Refer to the page 102 for details.



To return to the change screen from the graph regeneration screen:
Press [ALPHA] [◀].



To return to the previous screen from the CHANGE feature :

- Press [CL] to return to the initial screen when a desired equation has been selected by pressing [2ndF] [SHIFT/CHANGE] [B] and [1] ~ [6].
- Press [2ndF] [QUIT] to return to the calculation screen.
- Note that above key operations clear the changed or registered equations/graphs.
  (The built-in equations are not cleared.)

Chapter 7
List Features

The list features can be used in equations and calculations.

1. Try it!

By analyzing years of data, we found that it takes the driver of a car approximately 0.75 seconds to react to a situation before actually applying the brakes. Once the brake pedal is depressed, it takes additional time for the car to come to a complete stop. Here is the equation used to compute total stopping distance on dry, level concrete:

The reaction time distance (in feet) = 1.1 times the speed (in miles per hour);
The braking distance = 0.06 times the speed squared;

$y = (1.1 \times v) + (0.06 \times v^2)$,

where y represents the total stopping distance (in feet), and v represents the speed (miles/hour)

Calculate the total stopping distances at the speeds of 30, 40, 50, 60, 70, 80 miles per hour.

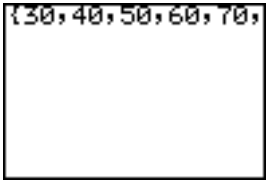
CONCEPT

1. You can calculate all answers individually, but if you use list, you can obtain the results with one calculation.

PROCEDURE

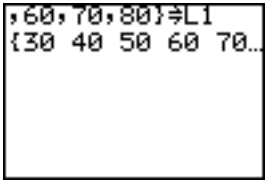
Enter each speed value in the list

2. Press [⊞⊟ ⊠⊞] [CL] to enter the calculation screen.
3. Press [2ndF] [{] 30 [,] 40 [,] 50 [,] 60 [,] 70 [,] 80 [2ndF] [}]
   The calculator displays the set of data.



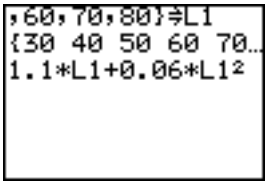
Store the list in L1

4. Press STO 2ndF L1.
5. Press ENTER to store the list in L1.



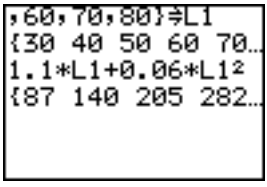
Enter the equation using L1

6. Press 1.1 × 2ndF L1 + 0.06 × 2ndF L1 x^2
7. Press ENTER.



8. List {87, 140, 205, 282, 371, 472} will appear.

   "..." shows that results extend beyond the display to the right. Use ◀, ▶ to scroll left or right, respectively.



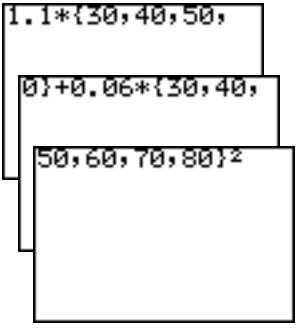
So the solutions are:

Car speed	Stopping distance
30 miles/hour	87 feet
40 miles/hour	140 feet
50 miles/hour	205 feet
60 miles/hour	282 feet
70 miles/hour	371 feet
80 miles/hour	472 feet

Note:

- You can also perform the above calculation using the direct list input method (using braces).

  1.1 × {30, 40, 50, 60, 70, 80} + 0.06 × {30, 40, 50, 60, 70, 80} x^2 and press ENTER.



2. Creating a list

A list is a series of values enclosed by braces, and is treated as a single value in calculations or equations.

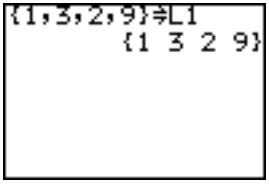
The calculator has 6 storage areas for lists from L1 to L6.

You can edit or access lists by pressing [2ndF] [L1] to [L6] (numeric keys from 1 to 6).

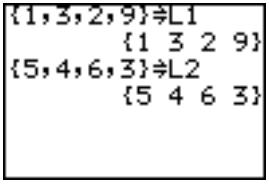
Using [2ndF] [LIST] **(L_DATA)** menus, you can store up to 10 sets (L_DATA 0 to L_DATA 9) of lists (L1 to L6) in a memory and recall any of the stored sets as required.

Store a series of data 1, 3, 2, and 9 in the list L1, and 5, 4, 6, 3 in L2

1. Press [▦] [CL] to enter the calculation screen.
2. Press [2ndF] [{] 1 [,] 3 [,] 2 [,] 9 [2ndF] [}]
3. Press [STO] [2ndF] [L1].
4. Press [ENTER] to store the list in L1.



5. Press [2ndF] [{] 5 [,] 4 [,] 6 [,] 3 [2ndF] [}] [STO] [2ndF] [L2] [ENTER] for L2.



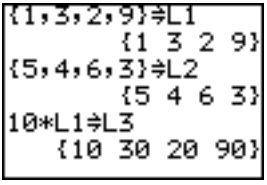
Tips: To view a specific list, press [2ndF] [L1] to [L6], then [ENTER] at the calculation screen.

3. Normal List Operations

- Lists can contain real numbers.
- Lists can be used as values (or variables) in calculations or equations.
- Calculations between lists are also possible. (Both lists must contain the same number of elements.)
- The following examples use the values in L1 and L2 that were stored in the previous section.

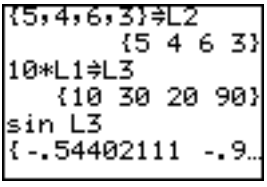
Calculate 10 × L1 and store the results in L3

1. Press 10 [×] [2ndF] [L1] [STO] [2ndF] [L3] [ENTER].



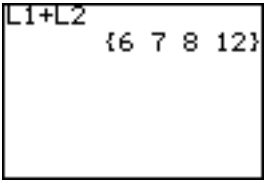
Calculate the sine of L3

2. Press [sin] [2ndF] [L3] [ENTER]. "..." shows that results extend beyond the display to the right. Use [◀], [▶] to scroll left or right, respectively.



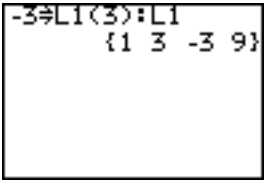
Calculate L1 + L2

3. Press [2ndF] [L1] [+] [2ndF] [L2] [ENTER].



Change the 3rd element of L1 to –3

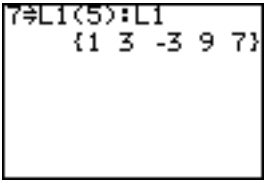
4. Press [(–)] 3 [STO] [2ndF] [L1] [(] 3 [)] [ALPHA] [:] [2ndF] [L1] [ENTER].



Append the new value 7 to L1 as the 5th element

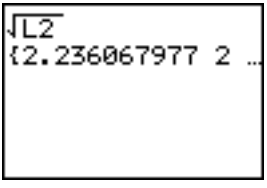
5. Press 7 [STO] [2ndF] [L1] [(] 5 [)] [ALPHA] [:] [2ndF] [L1] [ENTER].

Note: Separated by a colon (:), two or more commands can be entered in one line.



Calculate the root of L2

6. Press [2ndF] [√‾] [2ndF] [L2] [ENTER].



4. Special List Operations

This calculator has three list calculation menus: OPE, MATH and L_DATA.

Press [2ndF] [LIST] to access list calculation menus.

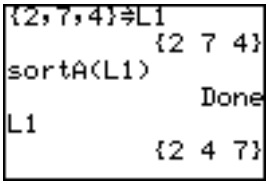
Calculations using the OPE menu functions

1 sortA(**sortA(*list name*)**

Sorts lists in ascending order.

Example

- Store list {2, 7, 4} in L1, and sort L1 in ascending order.

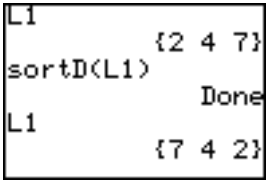


2 sortD(**sortD(*list name*)**

Sorts lists in descending order.

Example

- Sort the above list L1 in descending order.

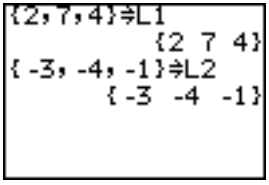


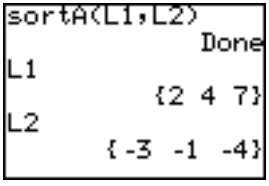
Note: **sortA(*list name 1, subordinate list name 1*,...)**

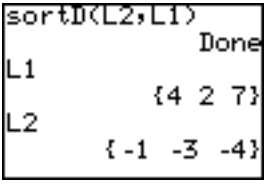
If two or more lists are entered separated by commas, a sort is performed on the first list as a key, and the following lists are sorted in the order corresponding to the elements in first list (key list).

Example

- Store lists {2, 7, 4} and {-3, -4, -1} in L1 and L2 respectively, and sort L1 and L2 in ascending order using list L1 as a key list.

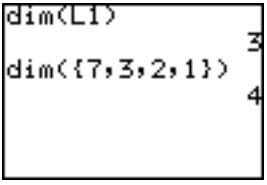






3 dim(**dim(*list*)**

Returns the number of items (dimension) in the list.

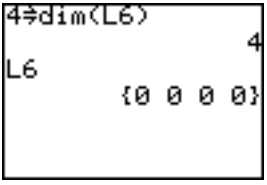


Example

- Display the dimension of list L1.

natural number ⇒ dim(*list name*)

Set the number of items (dimension) of specified list to the specified number.



Example

- Set the dimension of list L6 to 4.

  All the elements are initially 0.
  This operation overwrites the existing list dimensions.
  The existing values within the new dimensions remain as they are.

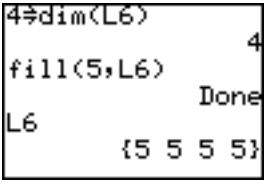
4 fill(**fill(*value*, *list*)**

Enter the specified value for all the items in the specified list.

* The dimension of the list must be set beforehand.

Example

- Set the dimension of list L6 to 4 and substitute 5 for all the items of list L6.



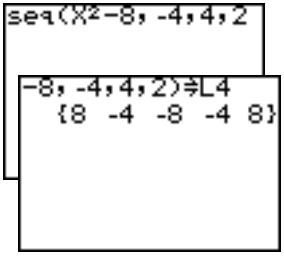
5 seq(**seq(*equation, start value, end value[, increments]*)** ⇒ target list name

Makes a list using the specified equation, range (start value and end value) and increments.

Example

- Fill the list using the equation $y = x^2 - 8$, where x increases from -4 to 4 by increments of 2.

* If increment is omitted, the default value 1 is used.



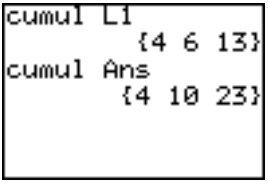
6 cumul **cumul *list***

Sequentially cumulates each item in the list.

$l_i = l_1 + l_2 + ... + l_i$, where l_i is the i-th item of the list.

Example

- Set the list L1 to {4, 2, 7}, and obtain the cumulated list L1.
- Cumulate the above result.



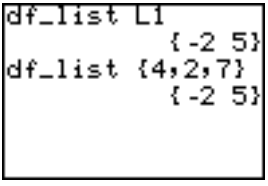
7 df_list **df_list *list***

Returns a new list using the difference between adjacent items in the list.

$l_i = l_{i+1} - l_i$, where l_i is the i-th item of the list.

Example

- Set the list L1 to {4, 2, 7}, and calculate the difference between adjacent items.

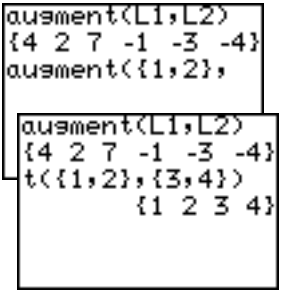


8 aug…(**augment(*list 1*, *list 2*)**

Returns a list appending the specified lists.

Example

- Obtain the list appending L1 ({4, 2, 7}) and L2 ({-1, -3, -4}).



Calculations using MATH Menus

During the following explanations, the values of lists, L1 and L2 will be assumed to be:

L1 = {2, 8, -4}

L2 = {-3, -4, -1}

1 min(**min(*list*)**

Returns the minimum value in the list.

Example

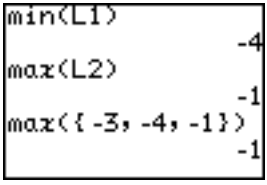
- Calculate the minimum value of the list L1.

2 max(**max(*list*)**

Returns the maximum value in the list.

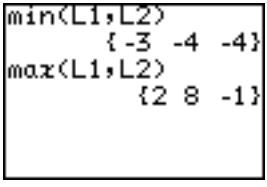
Example

- Calculate the maximum value of the specified list L2.



Note: **min(*list 1, list 2*)**
max(*list 1, list 2*)

If two lists are specified in parenthesis separated by a comma, then a list consisting of minimum (or maximum) values is returned.

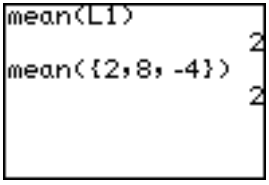


3 mean(**mean(*list [, frequency list]*)**

Returns the mean value of items in the specified list.

Example

- Calculate the mean value of list L1.

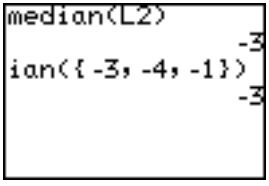


4 median(**median(*list [, frequency list]*)**

Returns the median value of items in the specified list.

Example

- Calculate the median value of the list L2.



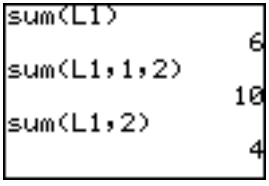
5 sum(**sum(*list [, start number, end number]*)**

Returns the sum of items in the specified list.

Example

- Calculated the sum of the list items of L1.

* You can specify the range of items in the list to sum.
`sum(L1,1,2)` means sum the 1st to 2nd items of the list L1.
`sum(L1,2)` means sum all items from the second to the last of the list L1.



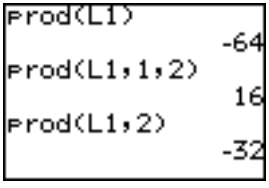
6 prod(**prod(*list [, start number, end number]*)**

Returns the multiplication of items in the specified list.

Example

- Calculate the multiplication of items in the list L1.

* You can specify the range of items in the list to multiply.
`prod(L1,1,2)` means multiply the 1st to 2nd items of the list L1.
`prod(L1,2)` means multiplication of all items from the second to the last of the list L1.

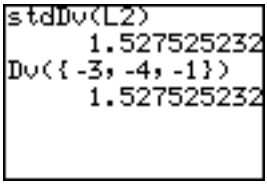


7 stdDv(**stdDv(*list [, frequency list]*)**

Returns the standard deviation of the specified list items.

Example

- Calculate the standard deviation using the list items of list L2.

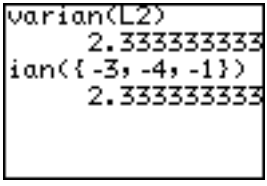


8 varian(**varian(*list [, frequency list]*)**

Returns the variance of the specified list items.

Example

- Calculate the variance using the list items of list L2.



Standard deviation and variance

Standard deviation: $s = \sqrt{\text{Variance}}$

Variance = $\sqrt{\dfrac{\sum_{k=1}^{n}(l_k - m)^2}{n-1}}$

where n = number of list items
l_k = list item value
m = mean value of the list

5. Drawing multiple graphs using the list function

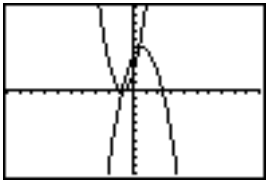
Using list items as coordinates, you can simultaneously draw multiple graphs.

1. Press [Y=].
2. Enter the equation;
   Y1 = {3, -2}x^2 + {5, 3}x + {2, 4}

3. Press [GRAPH].

   Two graphs are drawn as shown on the right.

   In this case, the first one represents the equation $y = 3x^2 + 5x + 2$ and the second $y = -2x^2 + 3x + 4$.



You can also use L1 to L6 to enter the equation;

1. Set the lists L1 to L3 as follows;

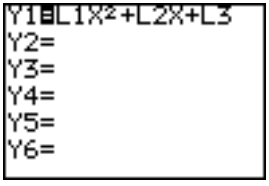
   {3, -2} ⇒ L1,

   {5, 3} ⇒ L2,

   {2, 4} ⇒ L3, and then

2. Enter the equation as follows.

   $Y1 = L1x^2 + L2x + L3$



6. Using L_DATA functions

The calculator can store up to 10 list groups in memory (L_DATA 0 to L_DATA 9). You may store or recall any one of these list groups. Each list group can contain up to 6 lists.

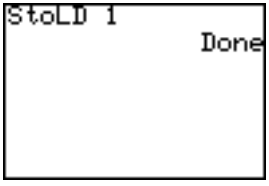
1 StoLD **StoLD *natural number*** *(0-9)*

Stores the current group of lists (L1 to L6) in L_DATA 0 to 9.

Example

1. Press [2ndF] [LIST] and select [C] [1].
2. Enter the preferred number from 0 to 9 and press [ENTER].

   "Done" will appear and the current lists will be stored in L_DATA #.



2 RclLD **RclLD *natural number*** *(0-9)*

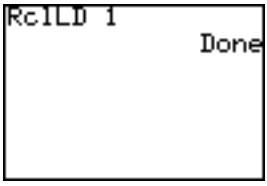
Recall the stored group of lists for use.

Any current list data (not stored in L_DATA) is overwritten.

Example

1. Press [2ndF] [LIST] and select [C] [2].
2. Enter the number to recall and press [ENTER].

   "Done" will appear and the current lists will be overwritten by the recalled list group.



7. Using List Table to Enter or Edit Lists

You can use List Table in the STAT menu to easily access the contents of the lists.

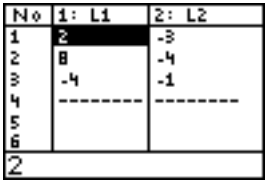
Though the STAT menu was originally designed for Statistics function calculations, the List Table is very useful for entering or editing list items.

How to enter the list

1. Press [STAT] [A] [ENTER].

   The list table will appear.

   The first column indicates the order number of each list, and the 2nd column corresponds to the list L1, the 3rd to the L2, and so on.



2. Move the cursor to the target cell and enter the appropriate value.

   The value will appear on the bottom line.

3. Press [ENTER].

   The value will enter the cell and the cursor move down to the next cell.

* "--------" indicates the end of the list. When you enter the value, "--------" goes down to the next cell.

How to edit the list

1. Press [STAT] and select **A EDIT**, then press [ENTER].
2. Use the cursor keys to move the cursor to the target cell.
3. Enter the new value and press [ENTER].
   The new value will be stored in the target cell.

* The display on the bottom line relates to the cell where the cursor pointer is located.

  Though any number can be entered in a cell, the bottom line of the screen can display up to a maximum of 10 digits excluding exponents, and the cell can display up to a maximum of 8 digits including exponents.

Chapter 8
Statistics & Regression Calculations

The following statistical and regression features are available:

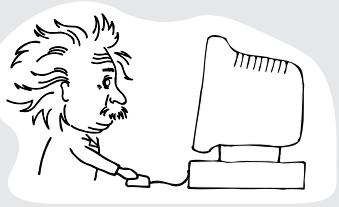
- Statistical calculations such as means and standard deviations
- Graphing statistical data
- Plotting regression curves
- Obtaining coefficients from regressions

1. Try it!

The following table shows the access counts (per hour) of a certain web site from Sunday midnight to Monday midnight.

Hours	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sunday	98	72	55	3	6	24	15	30	59	72	55	43	21	10	150	151	135	108	204	253	232	251	75	30
Monday	32	8	12	2	4	19	32	72	95	91	123	201	184	108	95	72	45	38	75	111	153	90	84	35

Let's input these data into the calculator (List function) and plot a histogram.



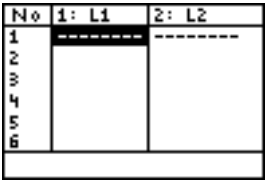
Opening the list table to enter data

1. Press [STAT].
   The Stat menu will appear.

2. Select **A EDIT** and press [ENTER].
   The List table will appear. Initially, all elements are blank and the cursor pointer is located at L1-1 (top left).

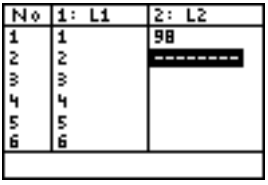
Entering hours (index value)

3. Input 1 for hour.
4. 1 will be displayed at the bottom line of the display.
5. Press [ENTER] to input the index value.
6. Continue the procedure to input 2 to 24.



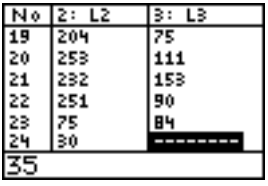
Entering the data for Sunday

7. Press [▶] to move the cursor to the top line of L2.
8. Input 98 for hour 01.
   98 will be displayed at the bottom line of the display.
9. Press [ENTER] to input the data.
   98 will appear in position L2-1 and the cursor will move to the second row.
10. Input 72 for hour 02 and press [ENTER]. Continue the procedure to the end of the data.



Entering the data for Monday

11. Press [▶] to move the cursor to the top line of L3.
12. Input 32 for hour 01 and press [ENTER].
13. Continue the procedure to the end of the data.



If you enter the wrong data

1. Press [◀], [▶], [▲], or [▼] to move the cursor pointer to the target cell. To jump the cursor at the beginning or the end of the list, use the [2ndF] key in tandem with a cursor key.
2. Input the correct number and press [ENTER].

Graphing the statistical data (Histogram)

Now we can plot the data to make histograms, broken line graphs and other statistical graphs.

1. Press [2ndF] [STAT PLOT].
2. Select **A PLOT1** and press [ENTER].
   The following screen will appear.

Setting the graph drawing "on"

3. The first line shows if the graph drawing is on or off. Initially, the graph drawing is off. With the cursor pointer at the "on" position, press [ENTER] to set the graph drawing on.

Selecting whether 1-variable plotting or 2-variable plotting

4. Press [▼] to move the cursor to the next line (DATA).
5. Select X for 1-variable plotting and press [ENTER].

Select the list number used for graphing

Determining ListX and Freq Frequency relates to the number of times access occurred (L2) at the ListX stage. You can refer that the Access of ListX (L1) hour occurred Freq (L2) number of times.

6. Press [▼] to move the cursor to the next line (ListX).
7. The default list name for ListX is L1. If another list name is set, press [2ndF] [L1] to enter L1.
8. L1 is set to be used for x-axis items.

Setting the frequency

9. Press [▼] to move the cursor to the next line (Freq).
10. Press [2ndF] [L2] to enter L2.

Selecting the graph

11. Press [▼] to move the cursor to the next line (GRAPH).
12. The graph format defaults to histogram, so if that is what is required, this does not need to be changed.

Making a graph

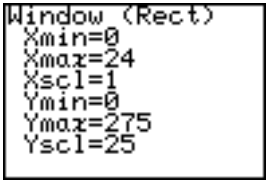
13. Press [ZOOM], and then select **A ZOOM**.
14. Press [▶] to move the cursor right and then press [▼] several times.
    9 Stat will appear.

15. Select **9 Stat** and press [ENTER].
    You can directly press [9] at step 14 to select **9 Stat**.
    The histogram will appear on the display.

    When you draw the graph using the automatic statistics zoom function (**9 Stat**), the division number is automatically set to $\frac{X_{max} - X_{min}}{X_{scl}}$ (default value: 10). If you wish to show the graph hour by hour, change the value in the [WINDOW] menu.

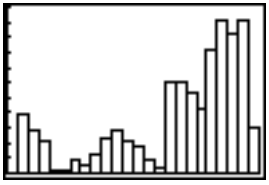
Set the WINDOW settings

1. Press [WINDOW].
   Window (Rect) setting menu will appear.



2. Enter the values as shown in the diagram to the right.
   Ymax is determined by the maximum access number (253 at 20:00 on Sunday).

3. Press [GRAPH].
   You can compare up to 3 statistical data by setting PLOT2/PLOT3 to on.



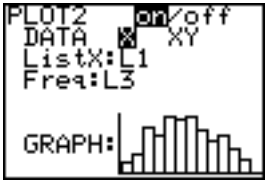
Compare the access rates on Sunday and Monday

Set the statistical plotting of PLOT1 (Sunday data) to a broken line

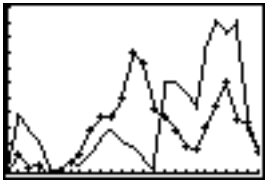
1. Press [2ndF] [STAT PLOT] [A] [ENTER] and move the cursor to GRAPH.
2. Press [2ndF] [STAT PLOT] again.
3. Press [B] and [1] (broken line with dots).
4. Press [GRAPH].
   The histogram is now changed to a broken line graph.

5. Press [2ndF] [QUIT] to clear the screen.
6. Press [2ndF] [STAT PLOT] and select **B PLOT2**.
7. Set as follows.
   PLOT: on, DATA: X, ListX: L1, and Freq: L3.

8. Move the cursor to GRAPH and press [2ndF] [STAT PLOT].



9. Press [B] [2] (broken line with cross points).
10. Press [GRAPH].
    Now you can compare the difference in web site access counts between Sunday and Monday.
    Press [2ndF] [QUIT].



2. Statistics Features

1. STAT menus

Press the [STAT] key to access the statistical calculation menus. The menus are as follows:

A EDIT	Provides the entry or edit mode and displays a list table.
B OPE	Calculation menu for operations such as ascending or descending sort.
C CALC	Obtains statistical values.
D REG	Calculates regression curves.

Data Entry

Use a list table to enter the statistical data (press [STAT] to access). Up to 999 elements can be used for each list, though the amount of data able to be entered will vary according to the memory usage.

Calculating statistic values (CALC menu)

Use the CALC menu under the STAT menu to obtain statistic values.
Press [STAT] [C] to access the CALC menu.

2. Statistical evaluations available under the C CALC menu

1_Stats 1-variable (x) statistical a calculations

- $\bar{x}$ Mean of sample (x)
- sx Standard deviation of sample (x)

$$sx = \sqrt{\frac{\Sigma x^2 - n\bar{x}^2}{n-1}}$$

- σx Population standard deviation of sample (x)

$$\sigma x = \sqrt{\frac{\Sigma x^2 - n\bar{x}^2}{n}}$$

- Σx Sum of sample (x)
- Σx^2 Sum of squares of sample (x)
- n Sample number
- xmin Smallest value of sample (x)
- Q1 First quartile of sample (x)
- Med Median of sample (x)
- Q3 Third quartile of sample (x)
- xmax Largest value of sample (x)

2_Stats 2-variable (x, y) statistical calculations

The following values are added to the 1-variable statistic calculations

- $\bar{y}$ Mean of sample (y)
- sy Standard deviation of sample (y)
- σy Population standard deviation of sample (y)
- Σy Sum of sample (y)
- Σy^2 Sum of squares of sample (y)
- Σxy Sum of product of sample (x, y)
- ymin Smallest value of sample (y)
- ymax Largest value of sample (y)

The web site access counts example on page 120 will be used again to demonstrate the calculation of statistical values.

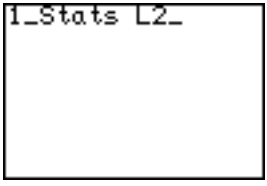
Hours	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sunday	98	72	55	3	6	24	15	30	59	72	55	43	21	10	150	151	135	108	204	253	232	251	75	30
Monday	32	8	12	2	4	19	32	72	95	91	123	201	184	108	95	72	45	38	75	111	153	90	84	35

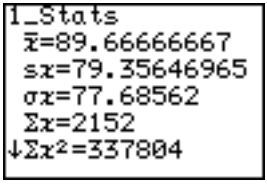
* If you did not previously enter the above values in the list table, press [STAT] and select **A EDIT** to display the list entry mode and enter the values.

Calculating one-variable statistics using web site access counts for Sunday (L2) and Monday (L3).

Statistical calculations using the Sunday data (L2)

1. Press [⊞⊟ ⊠⊞] [CL] and [STAT] to display the statistics menu.
2. Press [C] and then [1].
   1_Stats will be displayed on the top line of the screen followed by the cursor.
3. Press [2ndF] [L2] to enter L2 and press [ENTER].
   All the statistical values will be displayed on the screen.

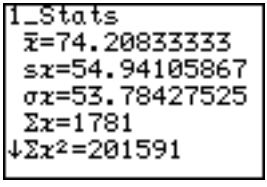




4. Press [▼] or [▲] to scroll the screen.

Statistical calculations using the Monday data (L3)

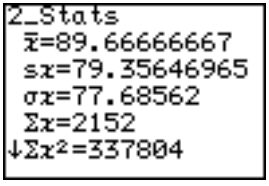
5. Press [STAT] to display the statistics menu.
6. Press [C] and then [1].
   1_Stats will be displayed on the bottom line of the screen followed by the cursor.
7. Press [2ndF] [L3] to enter L3 and press [ENTER].



Calculating the previous two-variable statistical values can be performed in a single operation. Use a " , " (comma) to separate the two variables.

1. Press [⊞⊟⊠⊞] [CL] and [STAT] to display the statistics menu.
2. Press [C] and then [2].
   2_Stats will be displayed on the top line of the screen followed by the cursor.

3. Press [2ndF] [L2] [,] [2ndF] [L3] to enter L2 and L3, and press [ENTER].
   All the statistical values will be displayed on the screen.



4. Press [▼] or [▲] to scroll the screen.

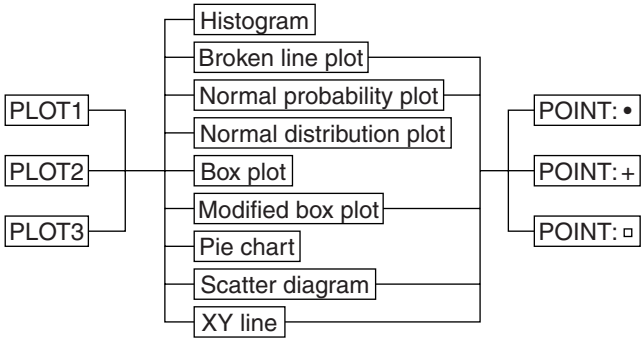
3. Graphing the statistical data

Press [2ndF] [STAT PLOT] to access the statistical graphing mode.

The calculator can plot statistical data on up to 3 types of graph (PLOT1 to PLOT3) to check the state of distribution.

The graph types can be selected from histogram, broken line plot, normal probability plot, normal distribution plot, box plot, modified box plot, pie chart, scatter diagram and XY line. Broken line plot, normal probability plot, modified box plot, scatter diagram and XY line can use 3 different types of points.

Statistical graph types overview (chart)

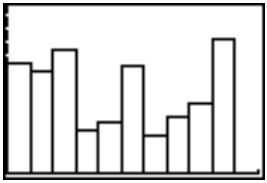


1. Graph Types

Histogram (HIST)

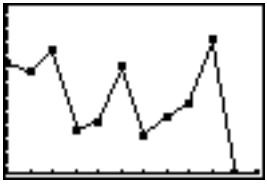
A bar graph of sample (x)
The width of the bars is set by the Xscl*.
The Y-axis shows the frequency.

* The Xscl can be changed to between 1 and 64. Use the Window Setting Menu to change the Xscl. (See page 62.)



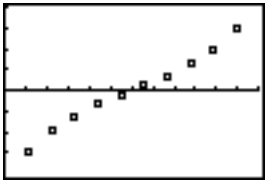
Broken line plot (B.L.)

A broken line graph for the frequency distribution of sample (x)
Three types of points can be selected.
The broken line is displayed by connecting the upper left points of the bars of the histogram, as the upper left point of each bar represents each class value in the histogram.
The calculator can draw both a histogram and a broken line plot at the same time.



Normal probability plot (N.P.)

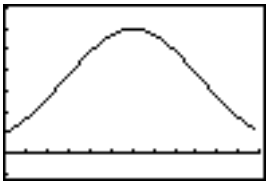
Plots the variance of the standardized normal distribution with the statistical data (x) on the X axis or Y axis.
If the points plot almost linearly, it indicates that the data is of normal distribution.
The distance between the dots is set by the Xscl.



- The Xscl can be changed between 1 and 64. Use the Window Setting Menu to change the figure. (See page 62)
- You cannot set the frequency in the Normal probability plot. The statistical data must be created using only one list without splitting into the data and frequency.

Normal distribution plot (N.D.)

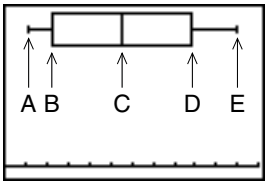
A normal distribution curve of sample(x)
The x-axis is in the range of Xmin to Xmax.



Box plot (Box)

A box plot graph of sample (x)

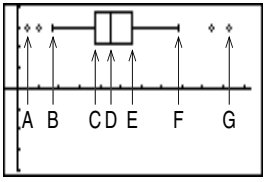
A. The minimum value (xmin) of the sample (x)
B. The first quartile (Q1)
C. Median (Med) of the sample (x)
D. The third quartile (Q3)
E. The maximum value (xmax) of the sample (x)



Modified box plot (MBox)

A modified box plot graph of sample (x)

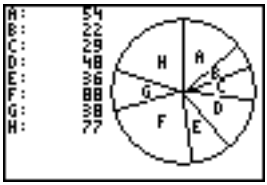
A. The minimum value (xmin) of the sample (x)
B. The tip of extension which is defined by (Q3 – Q1) x 1.5
C. The first quartile (Q1)
D. Median (Med) of the sample (x)
E. The third quartile (Q3)
F. The tip of extension which is defined by (Q3 – Q1) x 1.5
G. The maximum value (xmax) of the sample (x)

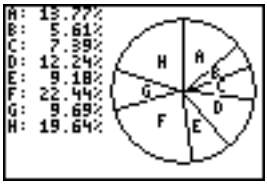


- Statistical data on the outside of the extension are indicated by points, selectable from three types of points.
- The length of the extension from the box is determined by Q1 and Q3.

Pie chart (PIE)

Pie graph of sample (x)





- Maximum number of division is 8.
- Calculation range: $0 \leq x < 10^{100}$
- Data can be displayed in two modes:
  - Value display: 7 digits
  - Percentage display: Fixed decimal (2 digits decimal)

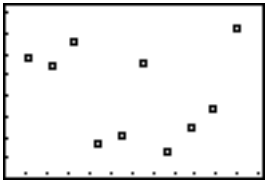
* Pie graphs are drawn in the same order as on the specifying list.

* Pie graphs cannot be displayed simultaneously with other graphs and X/Y axis, though lines or dots can be drawn. The coordinates of the free-moving cursor depend on the Window settings.

- The values are stored in variables A to H.
- As all the displayed values are rounded down in the percentage display mode, the total percentage may not be 100.

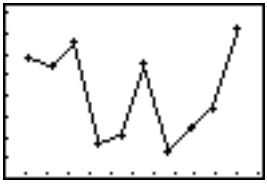
Scatter diagram (S.D.)

A two-dimensional plot graph using two samples (x, y)
Two sets of statistical data are required for the scatter diagram.



- Three types of points are selectable from three types of points.
- Two statistical data lists can be set to either x- or y-axis according to your requirements.

XY Line (XYLINE)



- Displays a graph that connects each point of the scatter diagram.
- Each point is connected in the sequence (rows) of the statistical data.

2. Specifying statistical graph and graph functions

- Up to three graphs can be plotted per sample data.

Specifying type of statistics graphing

1. Press [2ndF] [STAT PLOT].
2. Select from **A PLOT1**, **B PLOT2** or **C PLOT3** and press [ENTER] to set the statistical graphing specifications.

   Press [2ndF] [QUIT] before step #3.

- You may just press [A] to [C] to select.
- You can overlap 3 plotting graphs (from PLOT1 to PLOT3) on a single screen. Choose on or off at the top line to determine whether each graph is displayed or not.

Limit settings (x value)

3. Press [2ndF] [STAT PLOT] [D] **(D LIMIT)** to specify the graphing range.
   The **D LIMIT** menu is used to set the upper and lower limit lines of sample (x) of the statistical graph.

Displaying the upper and lower limit lines

4. Press [1] **(1 SET)**.
5. Enter the appropriate value for Lower limit and press [ENTER].
6. Enter the appropriate value for Upper limit and press [ENTER].

Displaying the mean value line of sample (x)

7. Press [2ndF] [STAT PLOT] [D] **(D LIMIT)** and press [2] **(2 LimON)** [ENTER] to display a line that indicates the mean value of sample (x), as well as the upper and lower limit lines.
8. Press [2ndF] [STAT PLOT] [D] [3] **(3 LimOFF)** and [ENTER] not to display the lines.

- Upper and lower limit values are displayed using short broken lines.
- The default value of the upper/lower limit is 1.

* The mean value line is indicated by a long broken line.

3. Statistical plotting on/off function

• You can set the statistical plotting of PLOT 1 to 3 at once.

1. Press [2ndF] [STAT PLOT].
2. Press [E].
3. • To set the all plotting ON: Press [1] (**1 PlotON**).
   • To set the all plotting OFF: Press [2] (**2 PlotOFF**).
   * You can control the plotting of **PLOT1** to **PLOT3** separately by pressing [1] ~ [3] after **PlotON** (or **PlotOFF**).
4. Press [ENTER] to set.

4. Trace function of statistical graphs

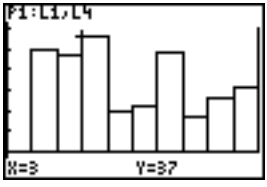
• The trace feature is available in statistical graphing and can be used to trace the curves of graphs with the cursor.

Tracing the graph

1. Press [TRACE].
2. Use [◄] or [►] to move the cursor pointer to trace the graph curve.

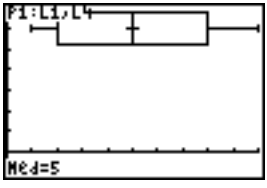
Histogram

How tracing is done



• After pressing [TRACE], the cursor pointer will appear on the top left corner of the first bar.
• If you press [◄] or [►], the cursor pointer sequentially jumps between top left corners of the bars.
• X and Y values are displayed at the bottom line of the screen.
• Use [▲] or [▼] to change between graphs to trace.

Box plots and modified box plots



• After pressing [TRACE], the cursor pointer will appear on the Med value of sample (x).
• If you press [◄] or [►], the cursor pointer sequentially jumps among specific values, such as Q1, Q3, min, max.
• The value of cursor pointer position is displayed at the bottom line of the screen.

Note: The trace feature is not available in the Pie chart.

4. Data list operations

Descending sort, ascending sort, changing the list order and deleting the lists can be done in the Operation menu.

Press [STAT] **B OPE** to access the data list operations.

1 sortA(**sortA(*list*)**

Sorts the list in ascending order.
This function is the same as the sortA(menu item in List functions.
See page 111 for details.

2 sortD(**sortD(*list*)**

Sorts the list in descending order.
This function is the same as the sortD(menu item in List functions.
See page 111 for details.

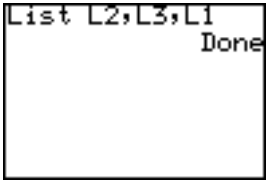
3 SetList **SetList *list name 1 [, list name 2 ...]***

Changes the list order as specified.

Example

To change the order of lists in order of L2, L3, L1.

Press [ENTER] to execute.
Each list must be separated by a " , " (comma).



- If only a single list name is specified, the specified list moves to the left end of the table.
- After changing the list order, execute **SetList** with no argument. The list names are redefined according to the changing order.

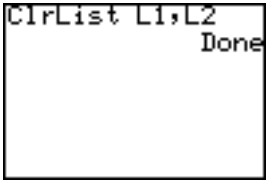
4 ClrList **ClrList *list name 1 [, list name 2 ...]***

Deletes all the data from the specified list(s).

Example

To delete the data of L1 and L2.

Press [ENTER] to execute.
Each list must be separated by a " , " (comma).



5. Regression Calculations

Accessing the regression menu

1. Press STAT D (**D REG**).
   The Regression menu is displayed.

01 MedMed **Med_Med** ***(list name for x, list name for y [, frequency list] [, equation name to store])***
Finds the regression line using the median-median method. (linear regression)

Formula: $y = ax + b$
Parameters: a, b

02 ax+b **Rg_ax+b** ***(list name for x, list name for y [, frequency list] [, equation name to store])***
Finds the regression line. (linear regression)

Formula: $y = ax + b$
Parameters: a, b, r, r^2

03 a+bx **Rg_a+bx** ***(list name for x, list name for y [, frequency list] [, equation name to store])***
Finds the regression line. (linear regression)

Formula: $y = a + bx$
Parameters: a, b, r, r^2

04 x^2 **Rg_x^2** ***(list name for x, list name for y [, frequency list] [, equation name to store])***
Finds the regression line using the second degree polynomial. (quadratic regression)

Formula: $y = ax^2 + bx + c$
Parameters: a, b, c, R^2

05 ln **Rg_ln** ***(list name for x, list name for y [, frequency list] [, equation name to store])***
Finds the regression curve using the natural logarithm. (natural logarithm regression)

Formula: $y = a + b \ln x$
Parameters: a, b, r, r^2

06 log **Rg_log** ***(list name for x, list name for y [, frequency list] [, equation name to store])***

Finds the regression curve using the common logarithm. (common logarithm regression)

Formula: $y = a + b \log x$
Parameters: a, b, r, r^2

07 ab^x **Rg_ab^x** ***(list name for x, list name for y [, frequency list] [, equation name to store])***

Finds the regression curve using the exponential function. (exponential regression)

Formula: $y = ab^x$
Parameters: a, b, r, r^2

08 ae^{bx} **Rg_ae^{bx}** ***(list name for x, list name for y [, frequency list] [, equation name to store])***

Finds the regression curve using the Euler exponential function. (Euler exponential regression)

Formula: y = ae^bx
Parameters: a, b, r, r^2

09 x^{-1} **Rg_x^{-1}** ***(list name for x, list name for y [, frequency list] [, equation name to store])***

Finds the regression curve using the reciprocal function. (reciprocal regression)

Formula: $y = a + bx^{-1}$
Parameters: a, b, r, r^2

10 ax^b **Rg_ax^b** ***(list name for x, list name for y [, frequency list] [, equation name to store])***

Finds the regression curve using the power function. (power regression)

Formula: $y = ax^b$
Parameters: a, b, r, r^2

11 x' ***value*** or ***list*** **x'**

Finds the estimated value of x for a given value of y by applying the function determined by the regression.

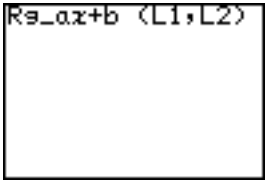
Example

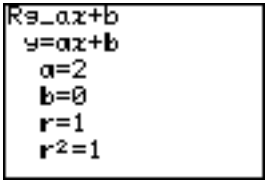
When the following is entered as statistical data:

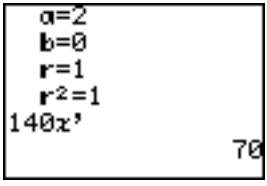
x	10	20	30	40	50
y	20	40	60	80	100

Find estimated value of x given $y = 140$.

1. Enter the above data into L1 (x) and L2 (y) and execute regression menu 02, **ax+b** (L1, L2).
2. Press [⊞⊟/⊠⊞] 140 [STAT] [D] [1] [1] [ENTER].







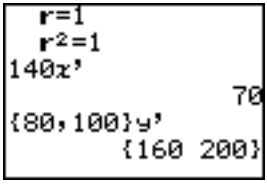
12 y' ***value*** or ***list*** **y'**

Find the estimated value of y for a given value of x by applying the function determined by the regression formula.

Example

Using above data, find the estimated value for y given $x = 80, 100$.

1. Press [⊞⊟/⊠⊞] [2ndF] [{] 80 [,] 100 [2ndF] [}] [STAT] [D] [1] [2] [ENTER].



- **11 x'** and **12 y'** will be valid after executing a regression calculation excluding 2nd degree polynomial regressions.

Note: When selecting a regression equation from 02 to 10 and calling to screen, “Rg” is automatically added to the equation to indicate a regression equation. For example “Rg_ax+b” will be displayed when selecting “02 ax+b”.

Using the regression functions

The following table shows the relationship between the time and temperature of water, when heating a beaker filled with water.

Time (min)	2	3	4	5	6	7	8	9	10	10.5	11	11.5	12	12.5
Temperature (°C)	38.4	46.4	54.4	62.5	69.6	76.1	82.4	88.6	93.4	94.9	96.5	98.2	99.1	100

Enter a data in a list table

1. Press [STAT] [A] [ENTER].
2. Enter the time into list 1 (L1).
3. Enter the temperature into list 2 (L2).

Plotting the data

1. Press [2ndF] [STAT PLOT] [A] [ENTER].
2. Press [ENTER] to turn on the plotting.
3. Press [▼] and [▶] to select XY of DATA menu and press [ENTER].
   Freq will change to ListY and set L2 to ListY.

Selecting the graph type

1. Press [▼] to move the cursor to GRAPH.
2. Press [2ndF] [STAT PLOT] [G] and [2] **(2 Scattr+)** to set the graph type to scatter and point type to “+”.
3. Press [ZOOM] [A] [9] **(9 Stat)** to plot the scatter diagram for this data.

- Selecting [A] [9] in the ZOOM mode allows for quick graphing in an optimum range since window setting values of the graph plotting screen are automatically set using the list data.

Drawing a regression curve using quadratic regression

1. Press [⊞⊟ / ⊠⊞] [CL] [STAT] [D] [0] [4] **(04 x^2)**.
2. Press [(] [2ndF] [L1] [,] [2ndF] [L2] [,] [VARS] [A] [ENTER] [A] [1] [)].
   If you enter Y1 as the last variable, the obtained formula will automatically be set to the formula Y1.
3. Press [ENTER].
   The regression formula and parameters will be displayed on the screen.
4. Press [GRAPH].
   The calculator will draw the scatter diagram using the determined parameter values.
5. If there is a large difference between the regression curve and plotted dots, change the regression curve and repeat the above procedures.

About the residual list

- There are residuals between regression curves and actual values.
- The residual list stores these residuals automatically.
- The **resid** list can be found in **B REGEQN** of the STAT VARS menu ([VARS] [H] [ENTER] [B] [8]).
- Use the following key operation to recall the residual list from the calculation screen.
  [⊞⊟ / ⊠⊞] [CL] [VARS] [H] [ENTER] [B] [8]
- Press [ENTER] to display the residual list on-screen.
- To show the residual list in the form of a graph, first store as a list, then follow the graphing operation.

* **resid** cannot be graphed when specified independently.

Chapter 9
Programming Features

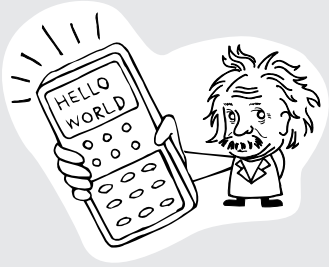
The calculator has programming features that enable automatic processing of a series of calculations any number of times.

Almost all the calculation and graphing language can be used in programs as well as the control flow statements such as If, Gosub Return and Goto (with Label).

While programming, editing mode is set to **one-line mode**, regardless of the SETUP settings.

1. Try it!

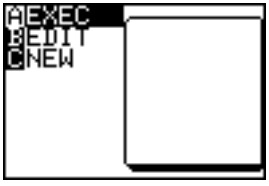
Display a message “HELLO WORLD” on the display.



Creating a new program

1. Press PRGM.
   The program menu screen will appear.

A EXEC	Executes the selected program
B EDIT	Opens a stored program file.
C NEW	Creates a new program file

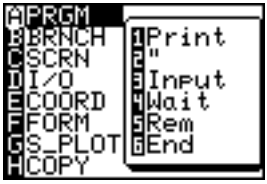


2. Press C ENTER.
   A new program window will open.
3. Input the program name (HELLO) on the top line of the screen.
   Up to 8 characters can be used for the title.

4. Press [ENTER].
5. The cursor will move to the program input field just under the title.

Starting programming

6. Press [PRGM].



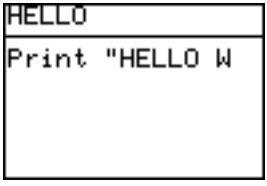
The program menu will open.

The commands and other statements are pre-installed in the calculator.

Do not directly type in commands using the Alphabetical mode, select each command from the program menu.

Entering a command

7. Select [A] [1].
8. Press [PRGM].
9. Select [A] [2].



The characters following a double quotation mark can be manipulated as text. No double quotation mark is required to close the text.

Entering the alphabetical input lock mode

10. Press [2ndF] [A-LOCK] to enter the alphabetic lock mode.
11. Type HELLO WORLD.

Up to 160 alphanumeric characters can be input per line. (Strings of up to 158 characters maximum can be entered per line excluding commands in this case, because each command is regarded as a single character.)

When a line exceeds the width of the screen, the display will shift to the left.

Store the program line by line

12. Press [ENTER].

The cursor will move to the next line and the data input will be stored.

Store the program line by pressing [ENTER], [▲] or [▼].

13. Press [2ndF] [QUIT] to exit the program edit screen.

Execute the program

14. Press [PRGM] [A].
    A list of stored programs will appear.
15. Press [0] [1] to execute the program 01 "HELLO".

2. Programming Hints

Editing the program

Press [PRGM] [B] and then the appropriate numbers to open the stored program.

Adding commands, strings or command lines to the program

Press [2ndF] [INS] to enter the insert type mode.
Press [ENTER] to go to the next line. Be sure to press [2ndF] [INS] again to turn off the insert type mode and return to type over mode.

Press [ENTER] twice to insert a blank line.

Entering alphabetical characters (uppercase only)

Press [ALPHA] to enter characters. Press [2ndF] [A-LOCK] to use a ALPHA-LOCK mode to input a series of alphabetical characters.

Inputting commands

In general, only a single command can be input per line.

Storing a program line by line

After pressing [ENTER], [▼] or [▲], the line will be stored in memory. Otherwise, it is not stored. Be sure to store the all lines by pressing [ENTER] ([▲] or [▼]) before quitting editing (pressing [2ndF] [QUIT]).

Blank line

Blank lines are ignored during execution. You can include blank lines to gain better readability.

Deleting a line

Move the cursor to the line you wish to delete and press [CL].

Deleting command or strings

Move the cursor to on or after the letter you wish to delete and press [DEL] or [BS], respectively.

Deleting an entire program	Press [2ndF] [OPTION] and use **C DEL**. (See Chapter 10 OPTION Menu, page 155).
Copying a line to another location	Press [PRGM] [H] in the program edit mode. (See page 148 for details)
Changing the program name	Press [▲] to move the cursor to the program name field. Enter the new name and press [ENTER] or [▼].
Re-executing the program	Pressing [ENTER] again after execution of the program completes.
Break the execution process	Press [ON] or [2ndF] [QUIT] to break the execution process.

3. Variables

- Single letters (uppercase letter from A to Z and θ) can be used as variables.
- Defined once in one program, a variable is set as a global variable across all other stored programs unless redefined.

  Hence results calculated in one program can be used by another.
- Only numerical values can be set as variables.
- Strings cannot be set as variables.

Setting a variable

Use [STO] to input a specific value or the value of formula into the variable. Do not use = (comparison operands) to set the values into variable.

5 → A	The variable A is set to 5.
MA + B → C	The variable C is set to the value of formula MA + B.

4. Operands

- Almost all the calculation operands can be used in a program.
- Input an operand directly from the keys (+, −, ×, ÷, sin, cos, log and others) or using MATH, STAT, LIST and other menus.

Comparison operands

- The calculator has 6 comparison operands.
- Press [MATH] [F] and select an appropriate comparison operand.

=	Equal	≠	Not equal
>	Greater than	≥	Greater than or equal
<	Less than	≤	Less than or equal

5. Programming commands

- Print, Input, Wait, Rem, End and other commands can be used in a program.
  Data input/output, graph settings and others can be controlled from a program.
- Press [PRGM] in the program edit mode to input the command.

A PRGM menu [PRGM] [A]

1 Print **Print** ***variable***
Print ***"character strings ["]***
Displays the value of the variable on the screen.

The display format may vary according to the SET UP menu settings.

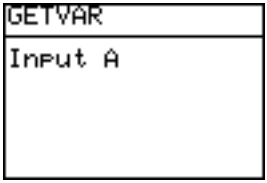
Character strings displayed by the print command will break at the edge of the screen.

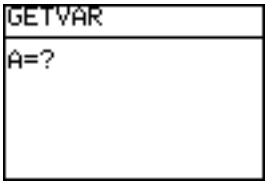
2 " ***command " strings***
Characters enclosed by double-quote marks are considered to be strings.

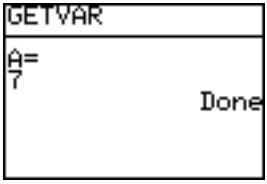
The closing double-quote can be omitted when it would appear at the end of a line.

3 Input **Input *variable***

Enables the user to input a value (list, etc.) for the specified variable during execution. A message “variable = ?” will appear on the screen while the calculator waits for data input.







4 Wait **Wait [*natural number* (1 to 255)]**

Interrupts execution for the (natural number) of seconds. If no value is specified, interruption continues until any key is pressed.

- A symbol will flash at the upper right corner of the screen during the wait.
- This command can be used for displaying intermediate results or other information.

5 Rem **Rem *comments***

Comments start with Rem and extend to the end of the line.

These lines are ignored at execution.

Comments should be entered as notes for future reference, though it should be noted that they do occupy some memory space.

6 End **End**

Indicates the end of a program.

End is not necessary at the last line of the program.

B BRNCH menu PRGM B

See 6. Flow control tools on page 147.

C SCRN menu PRGM C

C SCRN menu commands are used to display or clear the screen.

1 ClrT **ClrT**
Clears the program text screen without affecting the plotted graph.

2 ClrG **ClrG**
Clears the graph screen without affecting the specified graph.

After the graph screen is cleared, the specified graph statement is drawn.

3 DispT **DispT**
Displays the program text screen.

4 DispG **DispG**
Displays the graph screen.

D I/O menu PRGM D

This menu is used to send or receive data from externally connected devices.

1 Get **Get *variable***
Receives data from externally connected devices.

2 Send **Send *variable***
Sends data to externally connected devices.

E COORD menu (PRGM) [E]

E COORD menu commands are used to set the settings used in graphing.

1 Rect **Rect**
Sets the graph coordinates as X and Y coordinates.

2 Param **Param**
Sets the graph coordinates as parametric coordinates.

F FORM menu (PRGM) [F]

F FORM menu commands are used to set the graph format.

1 ExprON **ExprON**
Sets the graph equation to be displayed on the graph screen.

2 ExprOFF **ExprOFF**
Sets the graph equation to not be displayed on the graph screen.

3 Y' ON **Y'ON**
Sets the value of the derived function (Y') to be displayed on the graph screen.

4 Y' OFF **Y'OFF**
Sets the value of the derived function (Y') to not be displayed on the graph screen.

5 Connect **Connect**
Draws a graph with connected lines.

6 Dot **Dot**
Draws a graph with dots.

7 Sequen **Sequen**
Draws the graphs in sequential order.

8 Simul **Simul**
Draws the graphs simultaneously.

G S_PLOT menu PRGM G

S_PLOT menu commands are used for statistics plotting.

1 Plt 1(Sets the statistical graph settings for plot 1.

2 Plt 2(Sets the statistical graph settings for plot 2.

3 Plt 3(Sets the statistical graph settings for plot 3.

The above menu commands have the same usage as the following:

Plt1(*graph type, X list name [, Y list name, frequency list]*)
* Press 2ndF STAT PLOT to specify a graph type.

4 PlotON **PlotON *[number]***
Sets drawing of the specified statistical graph to on.

If no number is specified, this command turns on all of the statistical graphs.

5 PlotOFF **PlotOFF *[number]***
Sets drawing of the specified statistical graph to off.

If no number is specified, this command turns off all of the statistical graphs.

6. Flow control tools

The calculator has the common flow control tools such as Goto - Label loop structures with If-statement clauses for enhancing a program's efficiency. It also has the capability for subroutines.

To access the flow control tools, use the PRGM **B BRNCH** menu.

1 Label **Label *label name***
Specifies a branch destination for Goto or Gosub.

The same Label name cannot be used in two places within the same program.

Up to 10 characters can be used for a Label name.

Up to 50 Labels can be used in a single program.

2 Goto **Goto *label name***
To shift the program execution to a label.

3 If **If *conditional statements* Goto *label name***
Only the **Goto** command can be used in combination with **If** clause.

4 Gosub **Gosub *label name***
5 Return **.....**
End

[Rem *start of the subroutine* *(label name)*]
Label *label name*
Statements
Return
Subroutine structures can be used for programming.

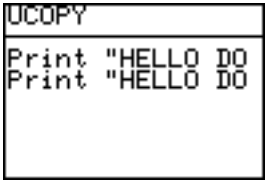
- The Gosub label name must be the same as the Label starting the subroutine.
- A Return statement is necessary at the end of the subroutine.
  When the Return statement is executed, the calculator executes the next line after the Gosub statement.
- Up to 10 subroutines can be nested.

7. Other menus convenient for programming

H COPY menu [PRGM] [H]

You can copy and paste line by line using the COPY menu commands.

1. Move the cursor to the line that you wish to copy.
2. Press [PRGM] [H].
3. Select **1 StoLine** and press [ENTER].
   The selected line will be stored in the memory.
4. Move the cursor to the line where you wish to paste the stored line.
5. Press [PRGM] [H], select **2 RclLine** and press [ENTER].
   The stored line will be inserted at the targeted position.



- Please note that only a single line can be stored in the memory.

VARS menu

- Functions that control the graph screen can be selected from the VARS menu.
- Press [VARS] to display the VARS menu (shown to the right).

A EQVARS Specifies the graph equation (Y1 to Y9, and Y0, X1T•Y1T to X6T•Y6T).

B WINDOW Specifies the functions that set the graph display screen size (Xmin, Ymax, Tstep, etc.).

C STOWIN Specifies the stored zoom (window) setting value (Zm_Xmin, Zm_Ymax, etc.).

D L_DATA Specifies list data (L_Data1 to L_Data9, and L_Data0).

E G_DATA Specifies the graph data (G_Data1 to G_Data9, and G_Data0).

F PICTUR Specifies picture data (Pict1 to Pict9, and Pict0).

G TABLE Specifies table setting values (Table Start, Table Step, Table List).

H STAT Specifies statistics, functions ($\bar{x}$, Σx, $\bar{y}$ …), regression expressions, points and statistical verification functions.

- The commands and functions in the VARS menu can be displayed on the screen. Current setting data can also be reset.
- The results of arithmetic functions can also be displayed.
- The ZOOM command is selected directly from the ZOOM menu.

  Names of some ZOOM commands change when inserted into programs. These are [A ZOOM], [C POWER], [D EXP] and [E TRIG] of the ZOOM menu.

  "Zm_" is automatically added to each of these functions when inserted into programs.

Example

Zm_Auto, Zm_x^2, Zm_sin, etc.

- Always enter the argument for functions requiring an argument at the end of the command, such as the CALC function ([2ndF] [CALC]). An error will be returned for commands not accompanied by an argument.

Example

Value 5

Example

Set Xmin = -3, Xmax = 10, Xscl = 1, Ymin = -5, Ymax = 5, Yscl = 1 in the WINDOW screen.

Use [STO] to input the settings.

Expression	Operational sequence
-3 ⇒ Xmin	[(–)] 3 [STO] [VARS] [B] [ENTER] [A] [1] [ENTER]
10 ⇒ Xmax	10 [STO] [VARS] [ENTER] [2] [ENTER]
1 ⇒ Xscl	1 [STO] [VARS] [ENTER] [3] [ENTER]
-5 ⇒ Ymin	[(–)] 5 [STO] [VARS] [ENTER] [4] [ENTER]
5 ⇒ Ymax	5 [STO] [VARS] [ENTER] [5] [ENTER]
1 ⇒ Yscl	1 [STO] [VARS] [ENTER] [6] [ENTER]

* Operation to input a function equation (for example, $x^2 + 2$) to the graphic equation "Y1" is also made using [STO] in the same manner as described above.

"$X^2 + 2$" ⇒ Y1: [PRGM] [A] [2] [X/T] [x^2] [+] 2 [PRGM] [A] [2] [STO] [VARS] [A] [ENTER] [A] [1]

Note: Function equations cannot be assigned in the graphic equations, such as Y1, if the EDITOR mode under SET UP is set to **Equation**. Switch the EDITOR to **one-line mode** prior to assigning such graphic equations.

Example

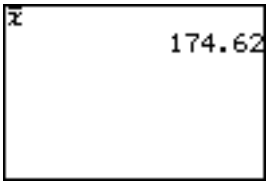
The following data are included in list L1.

L1: 165, 182.5, 173.8, 166.5, 185.3

A one-variable calculation was executed based on this data.

After returning to the calculation screen, average values can be viewed by using the following procedure.

- Press [VARS] [H] [ENTER] [A] [0] [2] to display "$\bar{x}$" on the screen.
- Press [ENTER] to obtain the average value of X as determined in the previous calculation.



- In this way, the contents of an immediately preceding statistical calculation can be stored as statistical values.
- These contents remain valid until the next statistical calculation is executed, even if the power is turned off.
- The same is true even for regression calculations and verification calculations.

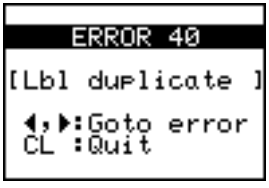
8. Debugging

After programming, it is required to debug the program.

1. Press [PRGM] [A] and select the program to debug.

   If any bugs are present, error messages will appear.

   The following example indicates that the same label name has been used two or more times.



2. Press [◀] or [▶] to display the line where the error exists and correct the mistake.

When an infinite loop occurs

Execution can be interrupted by pressing [ON].

Use this command if the program enters an infinite loop. Press [◀] or [▶] to display the program source with the cursor on the line where interrupted.

* Refer to Appendix “Error Codes and Error Messages” on page 167.

9. Sample programs

CONVERT

```
* Convert temperatures from Celsius to Fahrenheit.
```

Selects conversion mode

```
Label START
Print "1. C TO F
Print "2. F TO C
Input S
If S = 1 Goto CTOF
If S = 2 Goto FTOC
Goto START
```

Celsius to Fahrenheit

```
Label CTOF
Input C
(9/5) * C + 32 ⇒ F
Print "F
Print F
End
```

Fahrenheit to Celsius

```
Label FTOC
Input F
(5/9) * (F – 32) ⇒ C
Print "C
Print C
End
```

HIST

```
* Creates a histogram based on the entered data.

10 ⇒ dim(L1)
Gosub INSCORE
Gosub AVGSCORE
Plt1(Hist, L1)
Zm_Stat
Wait
End
```

Sequentially input the data in list L1.

```
Label INSCORE
1 ⇒ I
Print "ENTER SCORE
Input A
A ⇒ L1(1)
2 ⇒ I
Label LOOP
Print "ENTER NEXT
Input A
A ⇒ L1(I)
I + 1 ⇒ I
If I ≤ 10 Goto LOOP
Return
```

Calculate the median of List L1.

```
Label AVGSCORE
Print "AVERAGE IS
Median(L1) ⇒ M
Print M
Wait 3
Return
```

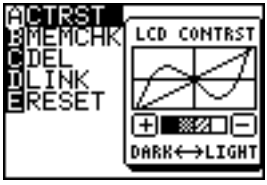
Chapter 10
OPTION Menu

The calculator is equipped with OPTION menu for adjusting the display contrast, checking memory usage, deleting stored data, transferring data, and resetting the calculator's memory.

Accessing the OPTION Menu

Press [2ndF] [OPTION].

The OPTION Menu will appear.



A: Adjusts the display contrast

B: Checks the memory usage

C: Deletes files

D: Link command to use with another calculator or PC.

E: Resets the calculator

1. Adjusting the screen contrast

1. Press [2ndF] [OPTION].

   The screen contrast setting window will appear.

2. Press [+] to darken or [−] to lighten the screen.

2. Checking the memory usage

The memory usage window enables you to check how much memory you have used. If the memory is nearly full, delete files or reset the calculator to operate safely.

1. Press [2ndF] [OPTION].
2. Press [B].

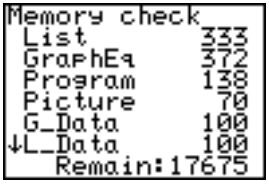
   The memory check window will appear. The remaining number of bytes of user memory will be shown on the display.

   The user memory is used to store data for graph equations, graph screens, lists and so on.

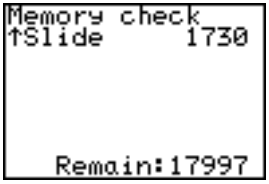
3. If you want check the details, press [ENTER].

   The detailed memory usage window will appear.

   The total remaining memory will appear on the bottom line of the screen.



4. Press [▼] to scroll the window.



List: The amount of memory (bytes) used by lists

GraphEq: The amount of memory (bytes) used by graph equations

Program: The amount of memory (bytes) used by program files

Picture: The amount of memory (bytes) used by graph pictures

G_Data: The amount of memory (bytes) used by stored graph data

L_Data: The amount of memory (bytes) used by stored list data

Slide: The amount of memory (bytes) used by slide shows the user has created

3. Deleting files

Press [2ndF] [OPTION] [C] to enter the delete menu.

The sub-menu items are the same as those of the Memory Check menu (List, Graph Eqn, Program, Picture, G_Data, L_Data and slide).

Deletions can be executed entry by entry.

To delete the list "L3"

1. Press [2ndF] [OPTION] [C] [1].

   The list deletion window will appear with the cursor pointer at the top (L1).

2. Move the cursor pointer to **L3** using [▲] / [▼].

3. Press [ENTER].

   L3 will disappear and the **L3** line will become empty.

- Press [2ndF] [QUIT] to cancel the delete option.
- Above procedures and displays are only an example. Displayed items may vary according to data input and use.

* Press [2ndF] [OPTION] [C] [8] to delete the memories previously entered.

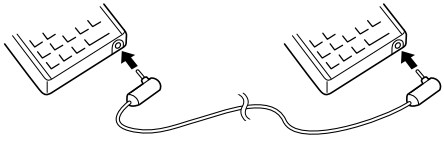
4. Linking to another EL-9450 or PC

Using the optional CE-450L or CE-LK1P, the EL-9450 can be linked to another EL-9450 or PC, respectively.

To transfer data, press [2ndF] [OPTION] [D] to open the Link option window. Press [1] to send data and press [2] to receive data.

Transmission between EL-9450's

1. Connect the calculators securely using the optional CE-450L communication cable.

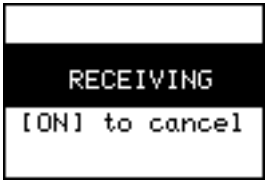


- Make sure the communication cable is firmly inserted into the ports of both calculators.

* Use the CE-450L only for linking two EL-9450's. The EL-9450 can only be linked to another EL-9450.

2. Press [2ndF] [OPTION] [D] on both calculators.
3. Press [2] on the receiving machine.

   The receive mode screen will appear on the display.



4. Press [1] on the sending machine.
5. The send menu will appear on the display. Specify the data to send from the following categories.

A SELECT Displays the menu window to send the data specified as follows:

1 ALL Displays a list of all the stored files category by category.

2 List Displays a list of all the stored list files.

3 GraphEq Displays a list of all the stored graph equations.

4 Program Displays a list of all the stored program files.

5 G_Data Displays a list of all the stored graph data files.

6 L_Data Displays a list of all the stored list data files.

7 Picture Displays a list of all the stored picture files.

8 Slide Displays a list of all the user-made slide show data.

9 A - Z, θ Displays a list of variables A to Z and θ.

B BACKUP Send all the data stored in the calculator memory.

6. Select the item to send using [▲] / [▼] and pressing [ENTER]. A "✱" will be placed by the selected item.
7. Press [2ndF] [EXE] to send.
8. Transmission begins and a busy message will appear on the displays of the both calculators.

- An data in the same memory locations in the receiver will be automatically overwritten.
- Up to 10 files can be selected to send at once.

Example

If you wish to send the list **L1**, and **L2** and graph equation **Y2** to the other calculator.

1. Prepare the receiving calculator by pressing [2ndF] [OPTION] [D] [2].
2. Press [2ndF] [OPTION] [D] [1] on the sending calculator.

   The send menu will appear.

3. Press [1].

   A list of all the data stored will be are displayed and the cursor positioned on the top line.

   - You can also select **2 List** for "L1" and "L2", and **3 Graph Eqn** for "Y2", for example, and send the data category by category.

4. Move the cursor to L1 and press [ENTER].

   A "✱" mark will flash to the left of "L1", indicating that the item has been selected to be sent.

   Press [ENTER] again to deselect.

5. Select the other files you wish to send in the same manner.
6. Press [2ndF] [EXE] to start transmission.

Transmission between the EL-9450 and PC

- The optional kit CE-LK1P (cable and Windows software) is required for calculator to data communication with PC.
- Refer to the CE-LK1P operation manual for details.
- During communications between calculator and PC, no operation of the calculator is required. Just connect the cable and press the power on key, and the entire operation can be controlled from the PC.

5. Reset function

If a problem occurs after replacing batteries, or the calculator does not function correctly, use the RESET option.

1. Press [2ndF] [OPTION] [E].
2. Press [1] to return the calculator's SETUP and FORMAT settings to the default value, or [2] to delete all the stored data.

   See "Resetting the Calculator" on page 25 for details.

Appendix

1. Replacing Batteries

The calculator uses two different kinds of batteries: manganese (AAA) for unit operation, and lithium (CR2032) for memory backup.

Compatible battery types

Type (use)	Model	Quantity
Manganese battery (for unit operation)	AAA	4
Lithium battery (for memory backup)	CR2032	1

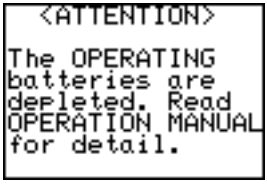
* To prevent loss of stored data, **DO NOT remove both the unit operation and memory backup batteries at the same time**.

Precautions for handling batteries

- Fluid from a leaking battery accidentally entering an eye could result in serious injury. Should this occur, wash with clean water and immediately consult a doctor.
- Should fluid from a leaking battery come into contact with your skin or clothes, immediately wash with clean water.
- If the product is not to be used for some time, to avoid damage to the unit from leaking batteries, remove them and store in a safe place.
- Do not leave exhausted batteries inside the product.
- Do not fit partially used batteries, and be sure not to mix different batteries types.
- Keep batteries out of the reach of children.
- Do not allow batteries to become completely exhausted; doing so may cause the batteries to leak, and may damage the calculator's hardware.
- Do not throw batteries into a fire or water, as this may cause them to explode.

Procedures for replacing unit operation batteries

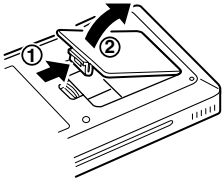
When battery power becomes low, a message will show indicating that a new set of batteries are needed.



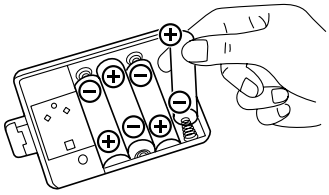
1. Turn off the calculator's power ([2ndF] [OFF]).

2. Turn over the calculator.

   Locate the battery compartment cover, and open the cover as illustrated.



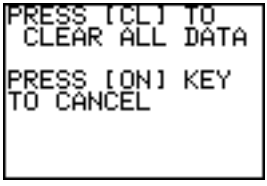
3. Replace all four AAA batteries as illustrated.



4. Replace the battery compartment cover.

   The following message will appear.

   If the message does not appear, repeat the procedures from step 2.



5. Press [ON].

   Do not press [CL]. This will clear all the data.

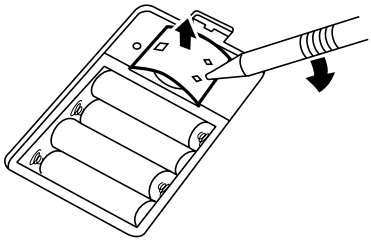
Replacing the memory backup battery

Once every 5 years, the lithium battery will need to be replaced.

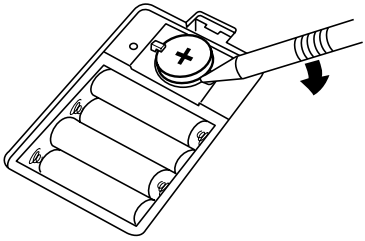
The lithium battery is used to maintain the memory of the calculator.

Note: Do not remove the lithium battery while the unit operation batteries are removed; otherwise all the calculator's stored memory will be lost.

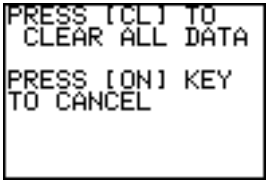
1. Perform procedures 1 and 2, as shown above. Do not remove the unit operation batteries.
2. Remove the the memory backup battery cover, as shown.



3. Use a pen to lift the lithium battery out of the battery compartment.
4. Insert the new battery with the PLUS (+) side facing up.
5. Replace the lithium battery cover.



6. Replace the battery compartment cover. The following message will appear.



7. Press [ON].

Do not press [CL]. This will clear all the data.

2. Troubleshooting Guide

Refer to the list of possible symptoms, and solutions may be found here.

The calculator's power won't turn on!

- The operation batteries may not be installed, may be exhausted, or may be inserted incorrectly. Check the operation batteries in the battery compartment.
- Place the battery cover securely or the calculator will not turn on.

The saved calculator configurations are not retained!

- Both the lithium battery and the operation batteries may need to be replaced.

The power seems to be on, but the characters and numbers cannot be seen clearly on the display!

- The screen contrast may need to be adjusted.

  Press [2ndF] [OPTION], then press [A] to enter **A CTRST**; the screen contrast can be adjusted by using the [+] or the [−] key.

The calculator won't take the minus (-) sign; calculation results in a syntax error!

- To set a negative value, use the [(−)] key instead of the [−] key.

The calculation results are very different from what is usually expected!

- The angle unit and other configurations may be incorrectly set. Check the configuration under the [2ndF] [SETUP].

The graph cannot be seen!

- Check the zoom configuration. Try selecting the automatic zoom tool, by pressing [ZOOM], then [A] [1].
- The graph line may be set differently; check the line configuration under [2ndF] [DRAW] menu.
- The calculator may not be set to display graphs. Check the **"="** sign in **Y=** screen.

The screen images cannot be stored (SLIDE SHOW)

- The available memory may be too small to store the screen image. Select **"B MEMCHK"** under [2ndF] [OPTION] menu. Select and delete unnecessary items under **"C DEL"**.

The calculator is not responding; the software appears to have crashed!

- Press [ON]. If this does not work, then press [2ndF], then [ON] to tell the running application to quit.

  If everything fails, then the calculator's memory may need to be reset. Resetting the calculator's memory will clear all the stored information, such as programs, lists, and variables.

  To reset the unit's memory, press the RESET switch on the back of the unit to open the verification window. To prevent data loss, try [ON] first. If it does not work, repeat the reset operation and press [CL] when prompted. (See page 25.)

3. Specifications

Model	EL-9450
Product name	Graphing Calculator
Display	96 x 64 dot matrix liquid crystal display Number of digits: mantissa 10 digits, exponents 2 digits (standard screen); 7 digit display (including negatives, decimals) for table screen, etc. Display method: Numerical value, calculation equation input (direct algebraic logic input / one-line input method), fraction display method specification.
Calculation method	D.A.L. (Direct Algebraic Logic)
Calculation features	Manual calculation (arithmetic, parentheses calculation, memory calculation, function calculation, integral calculation, coordinate conversion), boolean operation, statistic calculation, regression calculation, etc.
Input method	Manual key entry
Graphic features	Built-in slide show, shift/change, rapid graph Rectangular/parametric coordinate graph Graph range specification, graph window mode automatic specification, graph plotting, trace, calculation function, zoom, picture input, paint, graph database register, etc.
Statistic features	1-/2-variable statistical data input/calculation, register, edit and frequency input, regression calculation function, etc.
List features	Direct data entry/edit to list, calculation function for various lists, etc.
Slide Show features	Screen image capture, play function **The maximum number of pages to be captured:** Approx. 110 pages (pages equivalent to the $Y = X^2$ graph screen)
Program features	Condition statement command, subroutine, graph, various function commands

Option menu	Screen contrast adjustment, memory usage check, data delete, data link (between EL-9450 and PC or another EL-9450)
Memory size	32 KB (user area: Equation edit mode…approx. 17.9 KB, One-line edit mode…approx. 20 KB)
Power supply	Operation: 6 V DC⎓ AAA manganese battery (R03) × 4 Memory backup: 3 V DC⎓ Lithium battery (CR2032) × 1
Automatic power-off	Approx. 10 minutes
Operating temperature range	0 °C to 40 °C (32 °F to 104 °F)
Power consumption	0.13 W
Battery life	Operation battery set: approx. 200 hours (with 5 minutes of continual use and 55 minutes in the display state for every hour at a temperature of approx. 20°C/68°F) Memory backup: approx. 5 years (at a temperature of approx. 20°C/68°F, and when the operation batteries are replaced frequently)
Note:	The life span may differ according to battery brand, type, usage, and ambient temperature.
External dimensions	76 mm (W) × 163 mm (D) × 19.5 mm (H) 3” (W) × 6-13/32” (D) × 25/32” (H) (without the hard cover)
Weight	175 g (0.39 lb) (with batteries, without the hard cover)
Accessories	4 AAA manganese batteries (included), 1 lithium battery (installed), operation manual

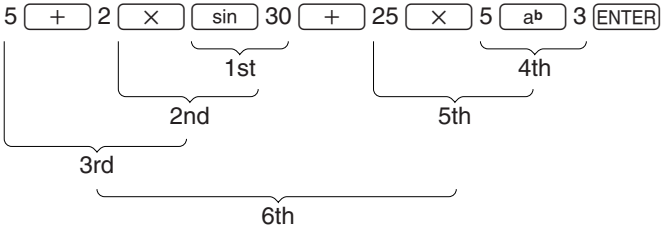
4. Precedence of Calculations

When solving a mathematical expression, this calculator internally looks for the following figures and methods (sorted in the order of evaluation):

1) Fractions (1/4, a/b, ␣, etc.)
2) Single calculation functions where the numerical value occurs before the function (X^2, X^{-1}, !, " ° ", " ^{r} ", and " ^{g} ")
3) Exponential functions (a^b, $\sqrt[a]{\ }$, etc)
4) Multiplications between a value and a stored variable/constant, with "×" abbreviated (2π, 2A, etc.)
5) Single calculation functions where the numerical value occurs after the function (sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, log, 10^x, ln, e^x, $\sqrt{\ }$, abs, int, ipart, fpart, (–), not, etc.)
6) Multiplications between a number and a function in #5 (3cos20, etc. "cos20" is evaluated first)
7) Permutations and combinations (nPr, nCr)
8) ×, ÷
9) +, –
10) and
11) or, xor, xnor
12) Equalities and inequalities (<, ≤, >, ≥, ≠, =, →deg, →dms, etc.)

Example

The key operation and calculation precedence



- If parentheses are used, parenthesized calculations have precedence over any other calculations.

5. Error Codes and Error Messages

Error Code	Error Message	Description
01	Syntax	Syntax error found in equation/program
02	Calculate	Calculation-related error found (division by 0, calculation beyond range, etc.)
03	Nesting	Cannot nest more than 14 numerical values, or 32 functions during execution.
04	Invalid	Invalid value error
05	Dimension	Inconsistency in the dimension of list for STAT calculation. During graph plotting, STATPLOT is ON although there is no data.
07	Invalid DIM	Size of list exceeds calculation range.
08	Argument	Inconsistency found in argument of the structured function.
09	Data Type	Invalid data type used in calculation.
11	No define	Undefined list used in calculation.
12	Domain	Argument definition outside of domain.
13	Increment	Increment error found.
17	Stat Med	Med-Med law (statistic) error found.
20	No Argument	Argument missing.
21	Not pair ∫ dx	∫ and dx are not used in a pair.
23	Not pair ( )	Parentheses are not used in a pair.
24	Not pair { }	Braces are not used in a pair.
25	Line over	Line is over the capacity.
26	Not delete	Unable to delete a selected item.
27	Buffer over	Input/equation exceeds buffer capability.
30	Editor type	Invalid editor type found.*
33	Graph Type	Graph type setting incorrect.
36	No solution	No solution found.
37	No title	No title entered.
38	Too many obj	More than 30 objects selected.
40	Lbl duplicate	Labels with identical name found in program.
41	Lbl undefined	Goto/Gosub encountered with no defined label.
42	Lbl over	More than 50 labels found in program.
43	Gosub stack	Nesting of more than 10 subroutines found.

Error Code	Error Message	Description
44	Line too long	Line contains more than 160 characters.
45	Can't return	Return used without jumping from subroutine.
46	Storage full	Cannot create more than 99 files.
47	Coord type	Invalid coordinate system for command.
70	I/O device	Communication error found among devices.
71	Wrong Mode	Wrong communication mode set.
90	Memory over	Memory is full; cannot store data as requested.
99	System error	System error found; user memory space is insecure.
	Low battery	Operation interrupted due to low battery power.
	BREAK!!	Operation break specified.

* The following operations may cause Editor type error. Correct the Editor type to continue.
  - Recall the Graph data (G_DATA) stored in a different EDITOR mode than currently in use.
  - Receive the Graph equation (Y1 and others) entered in a different EDITOR mode than currently in use.

6. Calculation Range

1. Arithmetic calculation

The results for dividend, multiplicand and operand are:

$-1 \times 10^{100} < x \leq -1 \times 10^{-99}$, $1 \times 10^{-99} < x \leq 1 \times 10^{100}$ or $x = 0$
(valid within the range of display capability)

Note: Calculation results and input values less than 1×10^{-99} are considered equal to 0.

2. Function calculation

Calculation accuracy

In principle, calculation errors are ±1 of the last digit. (In case of exponential display, the calculation errors are ±1 of the last digit of the mantissa display.)

However, a calculation error increases in continuous calculations due to accumulation of each calculation error. (This is the same for a^b, $\sqrt[a]{b}$, n!, e^x, ln, etc. where continuous calculations are performed internally.)

Additionally, a calculation error will accumulate and become larger in the vicinity of inflection points and singular points of functions.

Function	Calculation range	Notes
sin x cos x tan x	DEG : $\lvert x\rvert < 1 \times 10^{10}$ RAD : $\lvert x\rvert < \frac{\pi}{180} \times 10^{10}$ GRAD : $\lvert x\rvert < \frac{10}{9} \times 10^{10}$ However, the following are excluded for tan x DEG : $\lvert x\rvert = 90\ (2n - 1)$ RAD : $\lvert x\rvert = \frac{\pi}{2}\ (2n - 1)$ GRAD : $\lvert x\rvert = 100\ (2n - 1)$	"n" is an integer
$\sin^{-1} x$ $\cos^{-1} x$	$-1 \leq x \leq 1$	
$\tan^{-1} x$	$\lvert x\rvert < 1 \times 10^{100}$	
ln x log x	$1 \times 10^{-99} \leq x < 1 \times 10^{100}$	$\ln x = \log_e x$
e^x	$-1 \times 10^{100} < x \leq 230.2585092$	$e \fallingdotseq 2.71828...$
10^x	$-1 \times 10^{100} < x < 100$	
x^{-1}	$\lvert x\rvert < 1 \times 10^{100}$	$x \neq 0$

Function	Calculation range	Notes
x^2	$\|x\| < 1 \times 10^{50}$	
$\sqrt{x}$	$0 \le x < 1 \times 10^{100}$	
n!	$-0.5 \le n \le 69.5$	n is an integer or integer + 0.5
a^b (^)	When a > 0: $-1 \times 10^{100} < b \log a < 100$ When a = 0: $0 < b < 1 \times 10^{100}$ When a < 0: b is an integer, or $\frac{1}{b}$ is an odd number ($b \neq 0$) However, $-1 \times 10^{100} < b \log \|a\| < 100$	$a^b = 10^{b \cdot \log a}$
$\sqrt[a]{b}$	When b > 0: $-1 \times 10^{100} < \frac{1}{a} \log b < 100$, $a \neq 0$ When b = 0: $0 < a < 1 \times 10^{100}$ When b < 0: a is an odd number, or $\frac{1}{a}$ is an integer ($a \neq 0$) However, $-1 \times 10^{100} < \frac{1}{a} \log \|b\| < 100$	$\sqrt[a]{b} = 10^{\frac{1}{a} \log b}$
nPr nCr	$0 \le r \le n \le 69$	n and r are positive integers
→dms →deg	$\|x\| < 1 \times 10^{100}$	
xy → r xy → θ	$\|x\| < 1 \times 10^{100}$, $\|y\| < 1 \times 10^{100}$ $\sqrt{x^2 + y^2} < 1 \times 10^{100}$ $\left\|\frac{y}{x}\right\| < 1 \times 10^{100}$	$r = \sqrt{x^2 + y^2}$ $\theta = \tan^{-1} \frac{y}{x}$
rθ → x rθ → y	$\|r\| < 1 \times 10^{100}$	x = r cosθ y = r sinθ The range of θ is the same as x of sin x and cos x

Function	Calculation range	Notes
Statistic calculations	$\lvert x\rvert < 1 \times 10^{50}$ $\lvert y\rvert < 1 \times 10^{50}$ $\lvert \Sigma x\rvert < 1 \times 10^{100}$ $\Sigma x^2 < 1 \times 10^{100}$ $\lvert \Sigma y\rvert < 1 \times 10^{100}$ $\Sigma y^2 < 1 \times 10^{100}$ $\lvert \Sigma xy\rvert < 1 \times 10^{100}$ $\lvert n\rvert < 1 \times 10^{100}$	
$\overline{x}$	$n \neq 0$	Same for $\overline{y}$, sy and σy
sx	$n > 1$ $\lvert \Sigma x\rvert < 1 \times 10^{50}$ $0 \leq \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1} < 1 \times 10^{100}$	
σx	$n > 0$ $\lvert \Sigma x\rvert < 1 \times 10^{50}$ $0 \leq \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n} < 1 \times 10^{100}$	
r	$n > 0$ $\lvert \Sigma x\rvert < 1 \times 10^{50}$ $\lvert \Sigma y\rvert < 1 \times 10^{50}$ $0 < (\Sigma x^2 - \frac{(\Sigma x)^2}{n})(\Sigma y^2 - \frac{(\Sigma y)^2}{n}) < 1 \times 10^{100}$ $\lvert \Sigma xy - \frac{\Sigma x \Sigma y}{n}\rvert < 1 \times 10^{100}$ $\left\lvert \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{n}}{\sqrt{(\Sigma x^2 - \frac{(\Sigma x)^2}{n})(\Sigma y^2 - \frac{(\Sigma y)^2}{n})}} \right\rvert < 1 \times 10^{100}$	

Function	Calculation range	Notes
b	$n > 0$ $\lvert\Sigma x\rvert < 1 \times 10^{50}$ $\lvert(\Sigma x)\ (\Sigma y)\rvert < 1 \times 10^{100}$ $0 < \lvert\Sigma x^2 - \frac{(\Sigma x)^2}{n}\rvert < 1 \times 10^{100}$ $\lvert\Sigma xy - \frac{\Sigma x \Sigma y}{n}\rvert < 1 \times 10^{100}$ $\left\lvert \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{n}}{(\Sigma x^2 - \frac{(\Sigma x)^2}{n})} \right\rvert < 1 \times 10^{100}$	Regression calculations excluding 2nd degree polynomials.
a	$\lvert b\bar{x}\rvert < 1 \times 10^{100}$ $\lvert\bar{y} - b\bar{x}\rvert < 1 \times 10^{100}$	Same as above. Same as b for other.
y'	$\lvert bx\rvert < 1 \times 10^{100}$ $\lvert a + bx\rvert < 1 \times 10^{100}$	
x'	$\lvert y - a\rvert < 1 \times 10^{100}$ $\lvert\frac{y - a}{b}\rvert < 1 \times 10^{100}$	
int÷ remain	$0 \leq x < 10^{10}$ $0 \leq x < 10^{10}$	
→ a b/c → b/c	$\lvert x\rvert < 10^{10}$	A number with 10 or less decimal places, or the 10^{10}-th or above decimal places are 0.
List	Error is returned when the number of elements exceeds 1000.	This is the same when the result of a list function specifies 1000 or more elements.

7. List of Menu/Sub-menu Items

Square brackets indicate that the value or variable is optional.

1. MATH menus

Functions Commands	Syntax	Keystrokes	Page
MATH CALC			
$\log_2$	$\log_2$ *value*	A 1	42
2^X	2 *value*	A 2	42
fmin(	fmin(*equation, lower limit of x, upper limit of x*)	A 3	42
fmax(	fmax(*equation, lower limit of x, upper limit of x*)	A 4	42
d/dx(	d/dx(*equation, value of x [, tolerance]*)	A 5	43
$\int$	$\int$ *equation, lower limit, upper limit [, the number of divisions]* dx	A 6	43
dx	$\int$ *equation, lower limit, upper limit [, the number of divisions]* dx	A 7	43
MATH NUM			
abs(	abs(*value*)	B 1	44
round(	round(*value [, digit number of decimals]*)	B 2	44
ipart	ipart *value*	B 3	44
fpart	fpart *value*	B 4	45
int	int *value*	B 5	45
min(	min(*value A, value B*) or min(*list*)	B 6	45
max(	max(*value A, value B*) or max(*list*)	B 7	45
lcm(	lcm(*natural number, natural number*)	B 8	46
gcd(	gcd(*natural number, natural number*)	B 9	46
remain	*natural number* remain *natural number*	B 0	46
MATH PROB			
random	random *[(number of trial)]*	C 1	46
nPr	*value A* nPr *value B*	C 2	47
nCr	*value A* nCr *value B*	C 3	47
!	*value* !	C 4	47
MATH CONV			
→deg	*value* →deg	D 1	48
→dms	*value* →dms	D 2	48

Functions Commands	Syntax	Keystrokes	Page
xy→r(	xy→r(*x-coordinate, y-coordinate*)	D 3	49
xy→θ(	xy→θ(*x-coordinate, y-coordinate*)	D 4	49
rθ→x(	rθ→x(*r-coordinate, θ-coordinate*)	D 5	49
rθ→y(	rθ→y(*r-coordinate, θ-coordinate*)	D 6	50
MATH ANGLE			
°	*value* ° [*value* ' *value* "]	E 1	50
'	*value* ° *value* ' [*value* "]	E 2	50
"	*value* ° *value* ' *value* " Print "*character strings*["]	E 3	50
r	*value* r	E 4	50
g	*value* g	E 5	50
MATH INEQ			
=	*value A* = *value B*	F 1	51
≠	*value A* ≠ *value B*	F 2	51
>	*value A* > *value B*	F 3	51
≥	*value A* ≥ *value B*	F 4	51
<	*value A* < *value B*	F 5	51
≤	*value A* ≤ *value B*	F 6	51
MATH LOGIC			
and	*value A* and *value B*	G 1	52
or	*value A* or *value B*	G 2	52
not	not *value*	G 3	52
xor	*value A* xor *value B*	G 4	53
xnor	*value A* xnor *value B*	G 5	53

2. LIST menus

Functions Commands	Syntax	Keystrokes	Page
2ndF LIST OPE			
sortA(	sortA(*list name [, subordinate list name1, ... , subordinate list name n]*)	A 1	111
sortD(	sortD(*list name [, subordinate list name1, ... , subordinate list name n]*)	A 2	111
dim(	dim(*list*)	A 3	112
fill(	fill(*value, list*)	A 4	112

Functions Commands	Syntax	Keystrokes	Page
seq(	seq(*equation, start value, end value [, increment]*)	A 5	113
cumul	cumul *list*	A 6	113
df_list	df_list *list*	A 7	113
aug…(	augment(*list 1, list 2*)	A 8	114
2ndF LIST MATH			
min(	min(*value A, value B*) or min(*list*)	B 1	114
max(	max(*value A, value B*) or max(*list*)	B 2	114
mean(	mean(*list [, frequency list]*)	B 3	115
median(	median(*list [, frequency list]*)	B 4	115
sum(	sum(*list [, start number, end number]*)	B 5	115
prod(	prod(*list [, start number, end number]*)	B 6	115
stdDv(	stdDv(*list [, frequency list]*)	B 7	116
varian(	varian(*list [, frequency list]*)	B 8	116
2ndF LIST L_DATA			
StoLD	StoLD *natural number*	C 1	117
RclLD	RclLD *natural number*	C 2	118

3. STAT menus

Functions Commands	Syntax	Keystrokes	Page
STAT EDIT/OPE			
EDIT	No arguments	A ENTER	124
sortA(	sortA(*list [, subordinate list 1, ... , subordinate list n]*)	B 1	133
sortD(	sortD(*list [, subordinate list 1, ... , subordinate list n]*)	B 2	133
SetList	SetList *[list name 1, list name 2, list name 3, ...]*	B 3	133
ClrList	ClrList *list name1 [, list name 2, ...]*	B 4	133
STAT CALC			
1_Stats	1_Stats *[x list name [, frequency list]]*	C 1	125
2_Stats	2_Stats *[x list name, y list name [, frequency list]]*	C 2	125

* "list" in the above table means a list or a list name.

Functions Commands	Syntax	Keystrokes	Page
STAT REG			
MedMed	Med_Med (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 1	134
ax+b	Rg_ax+b (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 2	134
a+bx	Rg_a+bx (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 3	134
x^2	Rg_x^2 (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 4	134
ln	Rg_ln *(list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 5	134
log	Rg_log (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 6	135
ab^x	Rg_ab^x (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 7	135
ae^{bx}	Rg_ae^{bx} (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 8	135
x^{-1}	Rg_x^{-1} (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 0 9	135
ax^b	Rg_ax^b (*list name for x, list name for y [, frequency list] [, equation name to store]*)	D 1 0	135
x'	*value or list* x'	D 1 1	136
y'	*value or list* y'	D 1 2	136

4. STAT PLOT menus

Functions Commands	Syntax	Keystrokes	Page
2ndF STAT PLOT PLOT1/PLOT2/PLOT3/LIMIT/ON/OFF			
PLOT1	No arguments	A ENTER	131
PLOT2	No arguments	B ENTER	131
PLOT3	No arguments	C ENTER	131
SET	No arguments	D 1	131
LimON	No arguments	D 2	131
LimOFF	No arguments	D 3	131
PlotON	PlotON [number]	E 1	132
PlotOFF	PlotOFF [number]	E 2	132

Functions Commands	Syntax	Keystrokes	Page
2ndF STAT PLOT **(in STAT PLOT mode) HIST/B.L./N.P./N.D./BOX/PIE/S.D./XYLINE**			
Hist	No arguments	A 1	128
Broken •	No arguments	B 1	128
Broken +	No arguments	B 2	128
Broken □	No arguments	B 3	128
Norm •_X	No arguments	C 1	128
Norm+_X	No arguments	C 2	128
Norm □_X	No arguments	C 3	128
Norm •_Y	No arguments	C 4	128
Norm+_Y	No arguments	C 5	128
Norm □_Y	No arguments	C 6	128
NormDis	No arguments	D 1	129
Box	No arguments	E 1	129
MBox •	No arguments	E 2	129
MBox+	No arguments	E 3	129
MBox □	No arguments	E 4	129
Pie	No arguments	F 1	130
Pie%	No arguments	F 2	130
Scattr •	No arguments	G 1	130
Scattr+	No arguments	G 2	130
Scattr □	No arguments	G 3	130
xyLine•	No arguments	H 1	130
xyLine+	No arguments	H 2	130
xyLine □	No arguments	H 3	130

5. DRAW menus

Functions Commands	Syntax	Keystrokes	Page
2ndF DRAW **DRAW**			
ClrDraw	No arguments	A 1	66
Line(	Line(*x-coordinate of start point, y-coordinate of start point, x-coordinate of end point, y-coordinate of end point [,0]*)	A 2	67
H_line	H_line *y-value*	A 3	69

Functions Commands	Syntax	Keystrokes	Page
V_line	V_line *x-value*	A 4	69
T_line(	T_line(*equation, x-value*)	A 5	70
Draw	Draw *equation*	A 6	71
Shade(	Shade(*equation 1, equation 2 [, begin, end]*)	A 7	71
DrawInv	DrawInv *equation*	A 8	72
Circle(	Circle(*x-coordinate of center, y-coordinate of center, radius*)	A 9	72
Text(	Text(*column, row, "character strings"*)	A 0	73
2ndF DRAW POINT			
PntON(	PntON(*x-coordinate, y-coordinate)*	B 1	74
PntOFF(	PntOFF(*x-coordinate, y-coordinate)*	B 2	74
PntCHG(	PntCHG(*x-coordinate, y-coordinate*)	B 3	74
PxlON(	PxlON(*column, row*)	B 4	74
PxlOFF(	PxlOFF(*column, row*)	B 5	74
PxlCHG(	PxlCHG(*column, row*)	B 6	74
PxlTST(	PxlTST(*column, row*)	B 7	75
2ndF DRAW ON/OFF/LINE/G_DATA/PICT/SHADE			
DrawON	DrawON [*equation number 1, equation number 2, …*]	C 1	75
DrawOFF	DrawOFF [*equation number 1, equation number 2, …*]	C 2	75
LINE	No arguments	D ENTER	76
StoGD	StoGD *number*	E 1	76
RclGD	RclGD *number*	E 2	76
StoPict	StoPict *number*	F 1	77
RclPict	RclPict *number*	F 2	77
SET	No arguments	G 1	78
INITIAL	No arguments	G 2	78

6. ZOOM menus

Functions Commands	Syntax	Keystrokes	Page
ZOOM ZOOM			
Auto	No arguments	A 1	58
Box	No arguments	A 2	58
In	No arguments	A 3	59

Functions Commands	Syntax	Keystrokes	Page
Out	No arguments	A 4	59
Default	No arguments	A 5	59
Square	No arguments	A 6	59
Dec	No arguments	A 7	59
Int	No arguments	A 8	59
Stat	No arguments	A 9	59
ZOOM FACTOR/POWER			
FACTOR	No arguments	B ENTER	59
x^2	No arguments	C 1	60
x^{-1}	No arguments	C 2	60
$\sqrt{x}$	No arguments	C 3	60
ZOOM EXP			
10^x	No arguments	D 1	60
e^x	No arguments	D 2	60
log x	No arguments	D 3	60
ln x	No arguments	D 4	60
ZOOM TRIG			
sin x	No arguments	E 1	60
cos x	No arguments	E 2	60
tan x	No arguments	E 3	60
$\sin^{-1}$ x	No arguments	E 4	60
$\cos^{-1}$ x	No arguments	E 5	60
$\tan^{-1}$ x	No arguments	E 6	61
ZOOM STO/RCL			
StoWin	No arguments	F 1	61
RclWin	No arguments	G 1	61
PreWin	No arguments	G 2	61

7. CALC menus

Functions Commands	Syntax	Keystrokes	Page
2ndF CALC CALC			
Value	Value *x*	A 1	64

Functions Commands	Syntax	Keystrokes	Page
Intsct	No arguments	A 2	64
Minimum	No arguments	A 3	64
Maximum	No arguments	A 4	65
X_Incpt	No arguments	A 5	65
Y_Incpt	No arguments	A 6	65
Inflec	No arguments	A 7	65

8. SLIDE SHOW menus

Functions Commands	Syntax	Keystrokes	Page
SLIDE SHOW **B-IN**			
$Y = x^2$	No arguments	A 1	92
Y = AX + B	No arguments	A 2	92
$Y = \sqrt{x}$	No arguments	A 3	92
Y = 1 / x	No arguments	A 4	92
Y = sin x	No arguments	A 5	92
Y = tan x	No arguments	A 6	92
$Y = \cos^{-1} x$	No arguments	A 7	92
Y = ln x	No arguments	A 8	92
SLIDE SHOW **ORG/NEW/EDIT**			
ORG	No arguments	B ENTER	94
NEW	No arguments	C ENTER	94
MOVE	No arguments	D 1	95
DEL	No arguments	D 2	95
RENAME	No arguments	D 3	95

9. SHIFT/CHANGE menus

Functions Commands	Syntax	Keystrokes	Page
2ndF SHIFT/CHANGE **SHIFT**			
$Y = x^2$	No arguments	A 1	99
$Y = \sqrt{x}$	No arguments	A 2	99
Y = 1 / x	No arguments	A 3	99
$Y = e^x$	No arguments	A 4	99

Functions Commands	Syntax	Keystrokes	Page
Y = ln x	No arguments	A 5	99
Y = sin x	No arguments	A 6	99
Y = tan x	No arguments	A 7	99
Y = |x|	No arguments	A 8	99
2ndF SHIFT/CHANGE CHANGE			
$Y = x^2$	No arguments	B 1	104
$Y = \sqrt{x}$	No arguments	B 2	104
Y = |x|	No arguments	B 3	104
$Y = e^x$	No arguments	B 4	104
Y = sin x	No arguments	B 5	104
Y = tan x	No arguments	B 6	104

10. FRAC menus

Functions Commands	Syntax	Keystrokes	Page
2ndF FRAC FRAC			
Simp	Simp *[number]*	1	40
→a␣b/c	*value* →a␣b/c	2	41
→b/c	*value* →b/c	3	41
→A.xxx	*value* →A.xxx	4	41

11. PRGM menus

Functions Commands	Syntax	Keystrokes	Page
PRGM			
EXEC	No arguments	A	139
EDIT	No arguments	B	139
NEW	No arguments	C ENTER	139
PRGM (in the Prgramming mode) PRGM			
Print	Print *variable* Print "*character strings* ["]	A 1	143
"	"*characters* ["]	A 2	143
Input	Input *variable*	A 3	144
Wait	Wait [*natural number*]	A 4	144

Functions Commands	Syntax	Keystrokes	Page
Rem	Rem *comments*	A 5	144
End	No arguments	A 6	144
PRGM (in the Prgramming mode) BRNCH			
Label	Label *label name*	B 1	147
Goto	Goto *label name*	B 2	147
If	If *conditional statements* GOTO *label name*	B 3	148
Gosub	Gosub *label name*	B 4	148
Return	No arguments	B 5	148
PRGM (in the Prgramming mode) SCRN			
ClrT	No arguments	C 1	145
ClrG	No arguments	C 2	145
DispT	No arguments	C 3	145
DispG	No arguments	C 4	145
PRGM (in the Prgramming mode) I/O			
Get	Get *variable*	D 1	145
Send	Send *variable*	D 2	145
PRGM (in the Prgramming mode) COORD			
Rect	No arguments	E 1	146
Param	No arguments	E 2	146
PRGM (in the Prgramming mode) FORM			
ExprON	No arguments	F 1	146
ExprOFF	No arguments	F 2	146
Y'ON	No arguments	F 3	146
Y'OFF	No arguments	F 4	146
Connect	No arguments	F 5	146
Dot	No arguments	F 6	146
Sequen	No arguments	F 7	146
Simul	No arguments	F 8	146
PRGM (in the Prgramming mode) S_PLOT			
Plt1(	Plt1(*graph type, X list name [, Y list name, frequency list]*)	G 1	147
Plt2(	Plt2(*graph type, X list name [, Y list name, frequency list]*)	G 2	147
Plt3(	Plt3(*graph type, X list name [, Y list name, frequency list]*)	G 3	147

Functions Commands	Syntax	Keystrokes	Page
PlotON	PlotON [*number*]	G 4	147
PlotOFF	PlotOFF [*number*]	G 5	147
PRGM (in the Prgramming mode) COPY			
StoLine	No arguments	H 1	148
RclLine	No arguments	H 2	148

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In Europe:

This equipment complies with the requirements of Directive 89/336/EEC as amended by 93/68/EEC.

Dieses Gerät entspricht den Anforderungen der EG-Richtlinie 89/336/EWG mit Änderung 93/68/EWG.

Ce matériel répond aux exigences contenues dans la directive 89/336/CEE modifiée par la directive 93/68/CEE.

Dit apparaat voldoet aan de eisen van de richtlijn 89/336/EEG, gewijzigd door 93/68/EEG.

Dette udstyr overholder kravene i direktiv nr. 89/336/EEC med tillæg nr. 93/68/EEC.

Quest'apparecchio è conforme ai requisiti della direttiva 89/336/EEC come emendata dalla direttiva 93/68/EEC.

Η εγκατάσταση αυτή ανταποκρίνεται στις απαιτήσεις των οδηγιών της Ευρωπαϊκής Ενωσης 89/336/ΕΟΚ, όπως ο κανονισμός αυτός συμπληρώθηκε από την οδηγία 93/68/ΕΟΚ.

Este equipamento obedece às exigências da directiva 89/336/CEE na sua versão corrigida pela directiva 93/68/CEE.

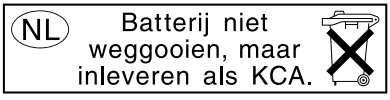
Este aparato satisface las exigencias de la Directiva 89/336/CEE, modificada por medio de la 93/68/CEE.

Denna utrustning uppfyller kraven enligt riktlinjen 89/336/EEC så som kompletteras av 93/68/EEC.

Dette produktet oppfyller betingelsene i direktivet 89/336/EEC i endringen 93/68/EEC.

Tämä laite täyttää direktiivin 89/336/EEC vaatimukset, jota on muutettu direktiivillä 93/68/EEC.

NOTE: FOR NETHERLANDS ONLY



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