CASIO

الحاسبة العلمية

fx-4100P

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CASIO

Scientific calculator
科學計算機
과학적 계산기

fx-4100P

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Introduction

Congratulations on your selection of the Casio fx-4100P scientific calculator. The fx-4100P is a truly sophisticated scientific tool made possible by state-of-the-art calculator engineering. Features include:

•12-digit dot matrix display for clear display of numbers, letters and symbols
•Formula memory for simplified repeat calculations
•Standard arithmetic operations, scientific functions, and statistical calculations

All of this makes the Casio fx-4100P a powerful tool that takes much of the work out of complex calculating chores.

CONTENTS

1/Meet the Scientific Calculator

The scientific calculator differs from the standard type in that it has many more keys and that each key has a number of different functions. In this section you will learn about how these keys and functions, as well as the general flow of basic operations for your scientific calculator. We recommend that you spend a few minutes reading through this section before continuing on to actual operation.

1. Reading the Key Function Indicators

As mentioned above, each key of the scientific calculator is capable of a variety of functions. For example, you would use a key such as the one illustrated below for the four functions: x^{-1}, $x!$, A and /A (what each of these markings means will be covered later in this manual).

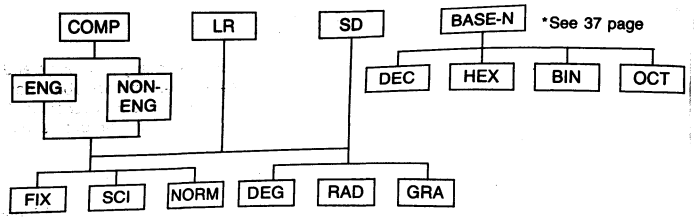
With this key, simply pressing it will perform the x^{-1} function, pressing it following the [SHIFT] key performs the $x!$ function, pressing it following the [ALPHA] key enters the variable A, while hexadecimal number /A is entered when the key is pressed in the BASE-N mode (page 3). Besides these three, some keys are marked with other functions that can only be performed in the SD (standard deviation) mode or LR (regression analysis) mode (see page 4 for modes).

All of this may sound a little hard to remember. To help you keep them straight, the function markings that appear above and below the keys have been color coded. Note the following:

Marking	Meaning
Orange	Press after [SHIFT].
Red	Press after [ALPHA].
Green	Press in BASE-N mode.
Blue	Press in SD or LR mode.

2. Understanding Modes

Before you start your calculations on a scientific calculator, you much first tell it how to handle the information you are about to input. The way that the calculator handles the information you give it depends on the ***mode*** that the calculated is in.
Once you put the calculator into a mode, you may be required to make one or more further choices. The following illustration shows all of the modes possible, and their relationship with each other.



COMP	Compute	OCT	Octal
LR	Regression analysis	FIX	Number of decimal places
SD	Standard deviation	SCI	Number of significant digits
ENG	Engineering	NORM	Normal
DEC	Decimal	DEG	Degrees
HEX	Hexadecimal	RAD	Radians
BIN	Binary	GRA	Grads

You can change the mode of the calculator by pressing the MODE key followed by a number. For your convenience, we have included a table of modes and the method you should use to specify them right under the calculator's display.

*The currently selected mode specifications are retained even when you switch the calculator off.

*After resetting the calculator (see page 14), the COMP, DEG and NORM modes are in effect.

■ Calculation Modes

MODE 0 — COMP mode
Use this mode for general calculations, including those that employ scientific functions. You should remember that no indicator appears on the display for the COMP mode.

MODE 1 — BASE-N mode
Use the BASE-N mode for binary/octal/decimal/hexadecimal conversions and calculations, as well as for logical (Boolean) operations. The symbol BASE-N is shown on the display while the calculator is in this mode.

MODE 2 — LR mode
Use the LR mode for regression calculations. The symbol LR is shown on the display while the calculator is in this mode.

MODE 3 — SD mode
Use the SD mode for standard deviation calculations. The symbol SD is shown on the display while the calculator is in this mode.

*Only one calculation mode can be in effect at any time — they cannot be used in combination.

■ Engineering Mode

MODE • — ENG mode
Use the ENG mode in combination with the calculation modes to perform engineering symbol calculations. The symbol ENG is shown on the display while the calculator is in this mode. Repeat this operation to leave the engineering mode. See page 36 for details on the ENG mode.

■ Angle Modes

MODE 4 — DEG mode
Use this mode to calculate in degrees. The symbol D is shown on the display while the calculator is in this mode.

MODE 5 — RAD mode
Use this mode to calculate in radians. The symbol R is shown on the display while the calculator is in this mode.

MODE 6 — GRA mode
Use this mode to calculate in grads (100 grads = $\pi/2$rad = 90°). The symbol G is shown on the display while the calculator is in this mode.

*The angle modes are used in combination with calculation modes (except for BASE-N).

■ Display Modes

MODE 7 — FIX mode
Use the FIX mode to specify the number of decimal places for the fractional part of a value. The symbol FIX is shown on the display while the calculator is in this mode.

MODE 8 — SCI mode
Use the SCI mode to specify the number of significant digits for a value. The symbol SCI is shown on the display while the calculator is in this mode.

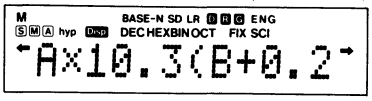
MODE 9 — NORM mode
Use the NORMAL mode to cancel specifications made in the FIX and SCI modes. No symbol is shown on the display while the calculator is in this mode. This operation also changes the range of the exponent display (see page 5).

*The display modes are used in combination with calculation modes (except for BASE-N).

3. Reading the Display

■ Symbols and Indicators

When you look at the display of the calculator, you can see various symbols and indicators. These tell you the status and mode of the calculator.



M: Displayed when there is something stored in the independent memory.
BASE-N: Displayed while the calculator is in the BASE-N mode.
SD: Displayed while the calculator is in the SD mode.
LR: Displayed while the calculator is in the LR mode.
D: Displayed while degrees are specified as the angle unit.
R: Displayed while radians are specified as the angle unit.
G: Displayed while grads are specified as the angle unit.
ENG: Displayed while the calculator is in the ENG mode.
S: Appears when you press the SHIFT key.
M: Appears when you press the MODE key.
A: Appears when you press the ALPHA key.
hyp: Appears when you press the hyp key.
Disp: Displayed which an intermediate calculation result is being shown.
DEC: Displayed while decimal input is specified for the BASE-N mode.
HEX: Displayed while hexadecimal input is specified for the BASE-N mode.
BIN: Displayed while binary input is specified for the BASE-N mode.
OCT: Displayed while octal input is specified for the BASE-N mode.
FIX: Displayed while the number of decimal places is specified.
SCI: Displayed while the number of significant digits is specified.
◀ ▶: Indicate that a display exceeds 12 characters. ◀ indicates that the display is continued off of the left side of the screen while ▶ indicates that it continues off of the right.

■ Exponential Displays

The display can show calculation results only up to 10 digits long. When an intermediate value or a final result is longer, the calculator automatically switches over to exponential notation. Values greater than 9,999,999,999 are always displayed exponentially, while the lower limit is selectable. Note the following:

Type	Lower limit	Upper limit
A (Norm 1)	0.01 (10^{-2})	9,999,999,999 (10^{10})
B (Norm 2)	0.000000001 (10^{-9})	9,999,999,999 (10^{10})

Values less than the lower limits or greater than the upper limit shown above are displayed using exponential format.

Use the following procedure to switch between the Type A lower limit and the Type B lower limit:

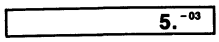
① Check the display to see if the FIX or SCI symbols are shown, indicating that the number of significant digits or the number of decimal places have been specified. If either of the symbols is shown, press MODE 9 to cancel the specification.

② Perform the following calculation:

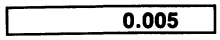
1 ÷ 200 EXE

③ Look at the display to see what the current lower limit is.

If the display reads:
$5.^{-03}$, the current setting is Type A



If the display reads:
0.005, the current setting is Type B

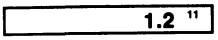


④ Press MODE 9 to switch between the Type A and Type B lower limits.

*Note that the lower limit is not changed if you press MODE 9 while the number of significant digits (SCI displayed) and/or the number of decimal places (FIX displayed) are specified. The first time you press MODE 9, you clear the FIX and SCI specifications, and so you must press MODE 9 again to change the lower limit.

•Notes on Exponential Notation

A value that is expressed exponentially takes up much less space. To convert a positive value from exponential notation, look at the exponent for the number 10 in the exponential notation. Then move the decimal place of the value to the right, the same number of places, adding zeros as needed. For example:



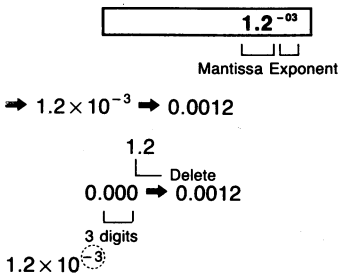
Mantissa Exponent

➡ 1.2×10^{11} ➡ 120,000,000,000

1.2
└ Delete
00000000000 ➡ 120000000000
└ 11 digits

1.2×10^{11}

Negative values are handled the same way, except that you move the decimal place to the left instead of the right. For example:



You can find further information on the use of exponential notation on pages 10 and 30.

•Hexadecimal and Sexagesimal Display Formats

The format used for the display of hexadecimal and sexagesimal values differs from the normal display because such values require letters and special symbols. Note the following:

•Hexadecimal

ABCDEF12

Indicates the hexadecimal value ABCDEF12.

•Sexagesimal

12°34'56.78"

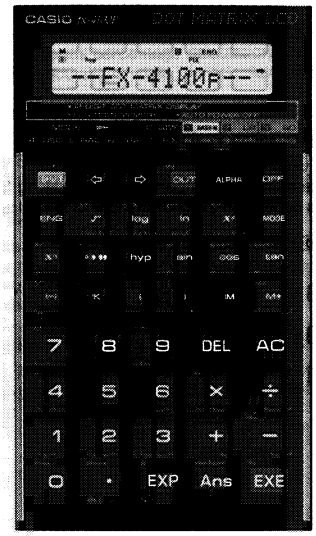
Indicates the sexagesimal value 12 degrees (hours), 34 minutes, 56.78 seconds.

2/Before Using Your Calculator

Note the following safety precautions before using your calculator.

- Avoid damage to precision components by guarding your calculator against exposure to temperature extremes, high humidity, dust, sudden temperature changes, and strong impact. Low temperatures can slow down the display speed or even cause the display to fail completely. This is generally temporary, and normal operations should return at warmer temperatures.
- When the calculator is performing internal calculations, the display will clear and key operation will be impossible. Before entering data, check the display to confirm that the calculator is ready for further input.
- Never attempt your own maintenance or try to take the calculator apart.
- Never incinerate old batteries.
- Never use thinner, benzine or other volatile agents for cleaning. Clean the exterior of the calculator with a soft cloth that has been dampened with a solution of water and a mild neutral detergent.

3/General Guide



[SHIFT] Shift key

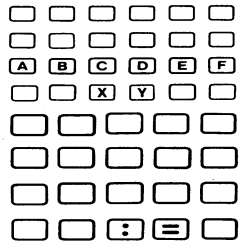
Changes the function of a key to the function marked in orange above the key. When you press [SHIFT] the [S] symbol appears on the display. Pressing [SHIFT] again while [S] is displayed cancels the shift and causes [S] to disappear from the display

[MODE] Mode key

Press this key followed by [EXP], [•], or [0] through [9] to set the mode of the calculator. See page 3 for details on the modes available.

[ALPHA] Alpha key

Changes the function of a key to input the letter or symbol marked in red above the key. When you press [ALPHA] the [A] symbol appears on the display. Pressing [ALPHA] again while [A] is displayed cancels the ALPHA function and causes [A] to disappear from the display.

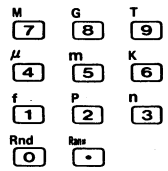


Rnd [0] ~ T [9], Ran# [•] BLOCK Numeric keys

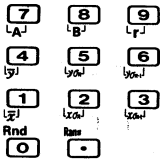
Use these keys to enter values.

Following the [SHIFT] key, the numeric keys perform the following functions. Following [SHIFT], the functions of these keys depend on the current mode of the calculator. Note the following:

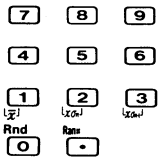
COMP mode ([MODE][0])



LR mode ([MODE][2])



SD mode ([MODE][3])



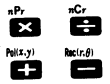
π Not [EXP] Exponent/Pi/Not key

- Press this key after entering the mantissa part of a value when you are using exponential notation (i.e. $2.56 \times 10^{34} \rightarrow$ 2.56 [EXP] 34).
- Following [SHIFT], this key enters the value for pi.
- In the BASE-N mode, use this key to input the logical Not.

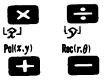
Pol(x,y) + or, Rec(r,θ) − xor, nPr × and, nCr ÷ xnor Arithmetic operation keys

- Arithmetic operations are entered by pressing the keys in the same sequence as the operation is written, from left to right.
- The + and − keys can also be entered as sign of a value.
- The arithmetic operation keys perform the following functions when they are pressed following the [SHIFT] key:

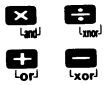
COMP mode ([MODE][0]), SD mode ([MODE][3])



LR mode ([MODE][2])



BASE-N mode ([MODE][1])



% EXE Execute/Percent key

- Press this key to execute a calculation and obtain its result. This key is also used to input data and to proceed to the next execution when an intermediate result is displayed.
- Following [SHIFT], this key performs percentage calculations. Note, however, that you cannot perform percentage calculations while the calculator is in the BASE-N mode.

Ans Answer/Variable name key

- Press this key to recall the latest result obtained using the [EXE] key.
- Following [SHIFT], this key displays the name of the variable to which the currently displayed value is assigned (following a calculation that uses variables).

INS DEL Delete/Insert key

- Press this key to delete the character flashing at the current location of the cursor. When the cursor is located at the end (far right) of the data, pressing this key deletes the character to the left of the cursor.
- Following [SHIFT], press this key to insert characters.

KAC AC ON All Clear/Constant Memory Clear/Power ON key

- Use this key to clear the display of characters or error messages.
- Press this key following [SHIFT] to clear the statistical memories and constant memories.
- You can also use this key to switch power ON.

◀ ▶ Cursor/Replay keys

- These keys move the cursor to the left ◀ and right ▶ to position it for editing of calculations or values. Holding either of the keys down causes the cursor to move at high speed in the respective direction.
- Immediately following operation of the EXE key, these keys take on a *replay* function. Pressing ▶ positions the cursor at the beginning of the calculation you have just executed, while ◀ positions the cursor at the end. Then you can execute the original calculation again, or edit it first and then execute it.

ENG Engineering key

Shifts the decimal of the displayed value three decimal places to the right or left. This in effect results in conversion of the value from one metric unit to another, such as 10^{-3} milliseconds, 10^{-6} microseconds, 10^{-12} picoseconds, or 10^{3} kilohertz, 10^{6} megahertz, 10^{9} gigahertz.

Example

12.3456 EXE	12.3456	
1st ENG	12.3456 00	
2nd ENG	12345.6 -03	
3rd ENG	12345600. -06	
4th ENG	12345600. -06	(No change)

12.3456 EXE	12.3456	
1st SHIFT ENG	0.0123456 03	
2nd SHIFT ENG	0.000012345 06	
3rd SHIFT ENG	0.000000012 09	
4th SHIFT ENG	0.000000012 09	(No change)

IN OUT Formula Memory key

Use this key when performing calculations with the formula memory. See page 57 for details.

OFF Power Off key

Press this key to switch the power of the calculator OFF. The current mode specification, memory contents and memo contents are all retained when power is off.

x^2 √ DEC Square root/Square/Decimal key

- Press this key to calculate the square root of the displayed value.
- Following SHIFT this key squares the displayed value.
- In the BASE-N mode, pressing this key specifies that calculations are to be performed using decimal values ("DEC" displayed).
- Following SHIFT in the BASE-N mode, specifies that the next value entered is a decimal value.

10^x log HEX Common logarithm/Common antilogarithm/Hexadecimal key

- Press this key to determine the common logarithm (base 10) of a value.
- Following SHIFT, press this key to calculate the common antilogarithm (xth power of 10).
- In the BASE-N mode, pressing this key specifies that calculations are to be performed using hexadecimal values ("HEX" displayed).
- Following SHIFT in the BASE-N mode, specifies that the next value entered is a hexadecimal value.

e^x ln BIN Natural Logarithm/Exponential/Binary key

- Press this key to calculate the natural logarithm (base e) of a value.
- Following SHIFT, press this key to calculate the xth power of e.
- In the BASE-N mode, pressing this key specifies that calculations are to be performed using binary values ("BIN" displayed).
- Following SHIFT in the BASE-N mode, specifies that the next value entered is a binary value.

x^y OCT Power/Root/Octal key

- Press this key to calculate x (any value) to the yth (any value) power.
- Enter a value for x, followed by SHIFT, and then a value for y calculate the xth root of y.
- In the BASE-N mode, pressing this key specifies that calculations are to be performed using octal values ("OCT" displayed).
- Following SHIFT in the BASE-N mode, specifies that the next value entered is a octal value.

x^{-1} A Inverse/Factorial key

- Press this key to calculate the inverse of a displayed value.
- Following SHIFT, press this key to calculate the factorial of the displayed value.
- In the BASE-N mode, press this key to enter the hexadecimal value A.

←" B Decimal ↔ Sexagesimal Conversion key

- When inputting a sexagesimal value, press this key after each part (degree or hour, minute, second) of the value. To enter 78°45'12", press: 78 °'" 45 °'" 12 °'".
- Following SHIFT, press this key to convert a displayed decimal value to its sexagesimal equivalent.
- In the BASE-N mode, press this key to enter the hexadecimal value B.

hyp C Hyperbolic key

- Press this key to obtain the corresponding hyperbolic functions when it is pressed before the sin (sinh), cos (cosh), and tan (tanh) keys.
- Following SHIFT (as in SHIFT hyp sin), this key obtains the inverse hyperbolic functions for sin ($\sinh^{-1}$), cos ($\cosh^{-1}$), and tan ($\tanh^{-1}$).
- In the BASE-N mode, press this key to enter the hexadecimal value C.

$\sin^{-1}$ D sin Sine/Arc sine key

- Press this key before entering a value to calculate the sine of the value.
- Following SHIFT, press this key before entering a value to calculate the arc sine of the value.
- In the BASE-N mode, press this key to enter the hexadecimal value D.

cos⁻¹ E / cos / E Cosine/Arc cosine key

- Press this key before entering a value to calculate the cosine of the value.
- Following SHIFT, press this key before entering a value to calculate the arc cosine of the value.
- In the BASE-N mode, press this key to enter the hexadecimal value E.

tan⁻¹ F / tan / F Tangent/Arc tangent key

- Press this key before entering a value to calculate the tangent of the value.
- Following SHIFT, press this key before entering a value to calculate the arc tangent of the value.
- In the BASE-N mode, press this key to enter the hexadecimal value F.

∛(-) / Neg Sign Change/Cube Root/Negative key

- Press this key before entering a value to specify that the value is negative.
- Following SHIFT press this key before entering a value to calculate the cube root of the value.
- In the BASE-N mode, this key returns the negative (two's complement) of a value.

Kin / IK Constant Memory Output/Input key

- Press this key to recall values stored in constant memories 1 through 6. To recall a value stored in constant memory 5, for example, press: IK 5.
- Press this key following SHIFT to input values into constant memories 1 through 6. To enter 12.3 into constant memory 3, for example, press: 12.3 SHIFT Kin 3.

(, X Open Parenthesis/Comma key

- Press this key to enter an open parenthesis.
- Following SHIFT, press this key to enter a comma.

) ; Y Close Parenthesis/Semicolon key

- Press this key to enter a close parenthesis.
- Following SHIFT, press this key to enter a semicolon.

Min / M Memory Recall/Memory In key

- Press this key to display the value stored in the independent memory without changing the memory contents.
- Following SHIFT, this key stores the displayed value in the independent memory. At this time, any value previously stored in the independent memory is lost (i.e. replaced with the new value).

M− / M+ / Data / Data Delete Memory Plus/Memory Minus/Data Input/Data Delete key

- Press this key to add a value to the contents of the independent memory. The value added to the independent memory can either be entered, or it can be the result of an arithmetic operation executed using this key (in place of EXE).
- Following SHIFT, this key subtracts the displayed value from the contents of the independent memory.
- In the LR mode (MODE 2) and SD mode (MODE 3), pressing this key following a data item enters it.
- Following SHIFT in the LR mode (MODE 2) and SD mode (MODE 3), this key deletes the data item specified.

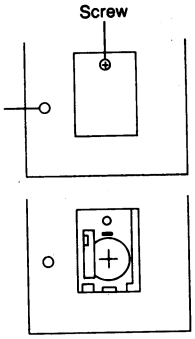
Example

DATA A DT DATA B DT DATA C DT enters data items A, B, and C.
DATA B SHIFT CL deletes data item B.

4/About the Power Supply

- Your calculator is powered by a single lithium batteries (CR2032). If the display becomes dim and difficult to read, it probably means that your battery is weak and should be replaced.
- To avoid damage caused by a leaking battery, be sure to replace it at least once every two years, regardless of how much you used the calculator during that time.
- Contents of the calculator's memory may be erased when you change batteries. Be sure to make a record of any data contained in memory before you replace batteries.

■ Replacing Batteries



① Switch the power of the calculator OFF, and use a screwdriver to remove the screw on the back of the calculator that holds the battery compartment cover in place. Remove the battery compartment cover.

② Remove the old battery by turning the calculator so that the open battery compartment is facing downwards, and tapping gently on the calculator.

③ Wipe the surfaces of a new battery with a soft cloth, and load it into the battery compartment, ensuring that its positive ⊕ pole is facing up.

④ Replace the battery compartment cover and secure it in place with its screw.

⑤ Press the All Reset button on the back of the calculator.

PRECAUTIONS:

Incorrectly using batteries can cause leakage or bursts, and may damage your product. Note the following precautions:

① Be sure that + / − polarity is correct.
② Never leave dead battery in battery compartment as it may cause malfunctions.
③ Remove battery when not using the product for extended period.
④ It is recommended that battery be replaced once every 2-year to prevent the chance of malfunction.
⑤ The supplied battery is not rechargeable.
⑥ Do not expose the battery to direct heat, let it become shorted or try to take it apart. (Keep batteries out of the reach of small children. If swallowed, consult a doctor immediately.)

■ Auto Power OFF Function

This unit automatically switches OFF if not operated for approximately 6 minutes. Power can be restored by pressing the [ON] key. Memory contents and mode setting are retained even when power is switched off.

5/Helpful Hints for Easier Calculations

The information given in this section should help you to understand the internal workings of the calculator, so you can enter data in the most efficient manner.

■ Order of Operations

Operations are performed in the following order of precedence:

① Coordinate conversions
Pol (x, y), Rec (r, θ)

② Type A functions
These functions are those in which the value is entered and then the function key is pressed.
x^2, x^{-1}, $x!$, °' '', engineering symbols

③ Power, root
x^y, $\sqrt[x]{}$

④ π, memory, abbreviated multiplication format (see page 21) immediately before variables.
2π, 4 Ⅰ⏋ 1, 5A, πR...

⑤ Type B functions
These functions are those in which the function key is pressed and then the value is entered.
$\sqrt{}$, $\sqrt[3]{}$, log, ln, e^x, 10^x, sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, (—), ( ), d, h, b, o, Neg, Not

⑥ Abbreviated multiplication format (see page 21) immediately before Type B functions.
$2\sqrt{3}$, A log2 ...

⑦ Permutation, combination
nPr, nCr

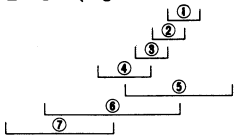
⑧ ×, ÷

⑨ +, −

⑩ and
⑪ or, xor, xnor] BASE-N mode only.

*When multiple functions are of the same precedence, they are performed from right to left. Normal calculations are performed from left to right.
*Complex functions are performed from right to left.
*Terms contained in parentheses receive the highest precedence.

Example $2+3\times(\log\sin 2\pi^2\,\text{rad}+6.8)=22.07101691$



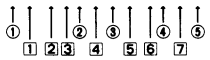
■ About Stacks

A ***stack*** is an area of memory used to temporarily store data. If you visualize the memory as a series of boxes piled vertically, you can see how such an area came to be called a ***stack.***
When your calculator processes a calculation, it divides its contents into two different stacks: a ***numeric stack*** for values, and a ***command stack*** for commands. The numeric stack has a capacity of eight levels (boxes), while the capacity of the command stack is 16 levels. A stack overflow error (indicated by Stk ERROR on the display) will occur if your calculation exceeds these limitations.

Example

The following example shows how the calculator assigns values and commands to their respective stacks:

$2\times((3+4\times(5+4)\div3)\div5)+8=$



Numeric stack

①	2
②	3
③	4
④	5
⑤	4
⋮	

Command stack

1	×
2	(
3	(
4	+
5	×
6	(
7	+
⋮	

*The calculation is performed in accordance with the order of precedence described in the preceding section. Once a calculation is performed, the stacks are cleared.

■ About Input and Display Limitations

The maximum size of a value that you can enter is 10 digits for the mantissa and 2 digits for the exponent. Internally, calculations are performed using a 12-digit mantissa and a 2-digit exponent. Once you complete a calculation, the result is internally rounded off to 10 digits and displayed. If you continue the calculation, the displayed (10-digit) value is used by the calculator for subsequent operations.

■ About Overflows and Errors

When predetermined calculation ranges are exceeded, the calculator will display an ERROR message and disable any further calculation. This will occur in the following cases:

① If an intermediate result (arithmetic, scientific functions, statistical) or a value stored in a memory exceeds $\pm 9.999999999 \times 10^{99}$ (Ma ERROR). Values stored in memory prior to the overflow are retained.

② If a function calculation exceeds the input range shown on page 59 (Ma ERROR).

③ If an error is made in operation during statistical calculation (Ma ERROR).

Example

If $\bar{x}$ or $x\sigma n$ is obtained when $n = 0$.

④ If the capacity of the numeric or command stack is exceeded (Stk ERROR) (see page 16).

Example

Pressing the [(] key 15 times and then performing the calculation $2 + 3 \times 4$.

⑤ If a calculation is entered incorrectly (Syn ERROR).

Example

Entering 5 [+] [+] 3 [EXE]

■ Understanding Steps

The size of a calculation is measured in ***steps,*** with each step representing a value or calculation command. In some cases, one step is the same as one value or one key operation as in the case of arithmetic operators such as [+], [−], [×], and [÷]. In other cases, two key operations represent a single function, and, therefore, one step, such as [SHIFT] [x^2].

If you ever have a doubt about what makes up a step, press the [←] or [→] cursor key. Each press will cause the cursor to move the equivalent of one step on the display.

Your calculator has a capacity of 63 steps. After you input 57 steps the flashing "_" cursor changes to " ■ " to indicate that you are reaching the limit. Calculations longer than 63 steps can be accomplished by breaking them down into smaller separate calculations, and performing them in series.

*Values and commands are flush with the left side of the display as you enter them, while results are flush right.

■ Making Corrections

•Use the [←] and [→] cursor keys to locate the cursor at the position to be modified and enter the desired value or function.

Example $122 + 456 \rightarrow 123 + 456 =$

[1] [2] [2]	122_
[←]	12**2**
[3]	123_

Example $\cos 60 \rightarrow \sin 60$

[cos] [6] [0]	cos 60_
[←] [←] [←]	c**o**s 60
[sin]	sin 6**0**

*After changes, you can execute the new calculation by pressing [EXE], or you can move the cursor back to the right of the calculation and continue to enter more values or functions.

•For deletion, use the [←] and [→] cursor keys to locate the cursor at the position of the deletion and press the [DEL] key. Each press of [DEL] deletes one command or value (i.e. one step).

Example $369 \times \times 2 \rightarrow 369 \times 2$

[3] [6] [9] [×] [×] [2]	369 × ×2_
[←] [←] [DEL]	369 × **2**

•For insertion, use the [←] and [→] cursor keys to locate the cursor at the position of the insertion and press [SHIFT] [INS]. This will enter the insert mode at the cursor's location, indicated by "[ ]". You can then insert commands or values at the position of the "[ ]"

Example $2.36^2 \rightarrow \sin 2.36^2$

[2] [•] [3] [6] [SHIFT] [x^2]	2.36²_
[←] [←] [←] [←] [←]	**2**.36²

[SHIFT] [INS] → 2,36²

[sin] → sin 2,36²

*You can exit the insert mode by pressing [←], [→], [SHIFT] [INS], or [EXE].

■ About Memories

Your calculator comes equipped with one ***independent memory*** and a total of 6 ***constant memories.***

•Independent Memory

The independent memory comes in handy when you want to perform a series of additions and subtractions and then look at the result.

Example

Store the value 123 in the independent memory.

123 [SHIFT] [Min] → M 123.

Recall the contents of the independent memory.

[M] [EXE] → M 123.

Add 25 to and subtract 12 from the independent memory.

25 [M+] **12** [SHIFT] [M−] → M 12.

(This operation can also be performed as 25 [−] 12 [M+])

Recall the contents of the independent memory.

[M] [EXE] → M 136.

Clear the independent memory.

M disappears from the display.

0 [SHIFT] [Min] → 0.

*Addition to (M+) and subtraction from (M−) the independent memory cannot be performed while the calculator is in the SD or LR mode.

Important

•Note that there is an important difference between [Min] and [M+] / [M−].
If you press [Min], the currently displayed value is stored in the independent memory as it is, clearing anything that was in the memory previously. [M+], on the other hand, adds the currently displayed value to the value that is stored in the independent memory. Likewise, [M−] subtracts the displayed value.

•Constant Memories

Six constant memories are available for storage of values which can then be recalled whenever you need them.

Example

Assign the value 123 to constant memory 1.

123 [SHIFT] [Kin] [1] → 123.

Add 30 to the value in constant memory 1 and store the result in constant memory 2.

[IK] [2] [ALPHA] [=] [IK] [1] **[+] 30** → 153.

Recall the contents of constant memory 2.

[IK] [2] [EXE] → 153.

Clear constant memory 1.

0 [SHIFT] [Kin] [1] → 0.

Clear all of the constant memories.

[SHIFT] [KAC] → _

*In the SD and LR modes, the constant memories are used as statistical memories, and so cannot be used during statistical calculations.

■ Answer (Ans) Function

The ***Answer*** function automatically stores the last value entered or calculation result obtained by pressing [EXE]. You can recall the latest value stored by the Answer function by pressing the [Ans] key.

•The Answer function even lets you incorporate results of a past execution into calculations. When you press the [Ans] key, the indicator "Ans" appears within the calculation to indicate that the current contents of the Answer function memory will be inserted at that point.

Example 123 + 456 = 579
789 − 579 = 210

[1] [2] [3] [+] [4] [5] [6] [EXE] → 579.

[7] [8] [9] [−] [Ans] → 789 − Ans_

[EXE] → 210.

A value stored by the Answer function can have a mantissa up to 12 digits long and 2-digit exponent. The Answer function value is not cleared when you press the AC key or when you switch the power of the calculator OFF. The current Answer function value is replaced whenever you press the EXE, %, M+, M−, Min, Ran# 1~6 key. If the execution of a calculation is stopped by an error, the Answer function memory retains the value it contained before execution of the erroneous calculation.

■ Abbreviated Multiplication Format

You can perform multiplication with certain functions and memories without entering the multiplication sign. Note the following:

- Before the following functions
  sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, log, ln, 10^x, e^x, $\sqrt{\ }$, $\sqrt[3]{\ }$, Pol (x, y), Rec (r, θ)

Example

2sin30, 10log1.2, $2\sqrt{3}$, 2Pol(5, 12) .....

- Before constant, variable and memories

Example

2π, 2AB, 5 M, 4 K 2, 3Ans .....

- Before open parenthesis

Example

3(5 + 6), (A + 1)(B − 1) ....

6/Performing Basic Calculations

■ Arithmetic Operations

- Enter arithmetic operations just as they are written, from left to right.
- To enter a negative value, press (−) before you enter the value.

Example	Operation	Display
$23+4.5-53=-25.5$	23 + 4.5 − 53 EXE	−25.5
$56\times(-12)\div(-2.5)=268.8$	56 × (−) 12 ÷ (−) 2.5 EXE	268.8
$12369\times7532\times74103=6.903680613\times10^{12}$ (6903680613000)	12369 × 7532 × 74103 EXE	6.903680613^{12}
$(4.5\times10^{75})\times(-2.3\times10^{-79})=-1.035\times10^{-3}$ (−0.001035)	4.5 EXP 75 × (−) 2.3 EXP (−) 79 EXE	-1.035^{-03}
$(1\times10^{5})\div7=14285.71429$	1 EXP 5 ÷ 7 EXE	14285.71429
$(1\times10^{5})\div7-14285=0.7142857$	1 EXP 5 ÷ 7 − 14285 EXE	0.7142857

*Internal calculations are performed using a 12-digit mantissa, and results are rounded off to 10-digits. The original 12-digit, however, is retained internally.

•Mixed Arithmetic Calculations

Multiplication and division are given precedence over addition and subtraction.

Example	Operation	Display
$3+5\times6=33$	3 + 5 × 6 EXE	33.
$7\times8-4\times5=36$	7 × 8 − 4 × 5 EXE	36.
$1+2-\underline{3\times4\div5}+6=6.6$	1 + 2 − 3 × 4 ÷ 5 + 6 EXE	6.6

■ Using Parentheses

Example	Operation	Display
$100-(2+3)\times 4=80$	100 − (2 + 3) × 4 EXE	80.
$2+3\times(4+5)=29$	2 + 3 × (4 + 5 EXE	29.
*You can omit any closed parenthesis immediately preceding the EXE key.		
$(7-2)\times(8+5)=65$	(7 − 2) (8 + 5 EXE	65.
*You can omit multiplication signs in front of open parentheses.		
$10-\{2+7\times(3+6)\}=-55$	10 − (2 + 7 (3 + 6 EXE	−55.
$\frac{2\times3+4}{5}=(2\times3+4)\div5=2$	(2 × 3 + 4) ÷ 5 EXE	2.
$\frac{5\times6+6\times8}{15\times4+12\times3}=0.8125$	(5 × 6 + 6 × 8) ÷ (15 × 4 + 12 × 3) EXE	0.8125
$(1.2\times10^{19})-\{(2.5\times10^{20})\times\frac{3}{100}\}=4.5\times10^{18}$	1.2 EXP 19 − (2.5 EXP 20 × 3 ÷ 100) EXE	4.5^{18}
$\frac{6}{4\times5}=0.3$	6 ÷ (4 × 5) EXE	0.3
*The above is the same as 6 ÷ 4 ÷ 5 EXE.		

■ Specifying the Number of Decimal Places and the Number of Significant Digits

- Specify the number of decimal places (FIX) by the operation MODE 7 *n*, where *n* is a value from 0 through 9. The indicator FIX is shown on the display while a decimal place specification is in effect.
- Specify the number of significant digits (SCI) by the operation MODE 8 *n*, where *n* is a value from 0 through 9. In the case of the SCI, 0 is regarded as 10. The indicator SCI is shown on the display while a significant digit specification is in effect.
- You can also move the decimal place of a displayed value three places to the left and right by using the ENG (or SHIFT ENG) key (see page 25).
- The specifications you make for FIX and SCI are retained (even when power is switched off) until you change them with a new specification, or you clear them by MODE 9.
- You can use the operation MODE 9 to not only clear the FIX or SCI specifications, but also to specify the lower limit for exponential display. Each time you press MODE 9 while there is no FIX or SCI specification, the calculator switches between Norm 1 and Norm 2.

Norm 1:
Automatic exponential display for values less than 10^{-2} or greater than 10^{9}.

Norm 2:
Automatic exponential display for values less than 10^{-9} or greater than 10^{9}.

- No matter what you specify for FIX and SCI, calculations within the calculator are always performed using a 12-digit mantissa. If you want to convert the value used inside the calculator to a value having the specified number of digits, press SHIFT Rnd EXE.
- The above specifications are not valid in the BASE-N mode.

Example	Operation	Display
$100\div6=16.66666666\ldots$	100 ÷ 6 EXE	16.66666667
	(Specifies 4 decimal places.) MODE 7 4	16.6667
	(Clears the specification.) MODE 9	16.66666667
	(Specifies 5 significant digits.) MODE 8 5	1.6667^{01}
	(Clears the specification.) MODE 9	16.66666667
*Both the FIX and SCI specifications can be changed at any time, even during a calculation sequence. *Values are displayed rounded off to the number of places specified.		
$1\div1000=0.001=1\times10^{-3}$	(Norm 1) 1 ÷ 1000 EXE	$1.^{-03}$
	(Norm 2) MODE 9	0.001

$200 \div 7 \times 14 = 400$	200 ÷ 7 × 14 EXE	400.
	(Specifies 3 decimal places.) MODE 7 3	400.000
	(Continuing with the displayed 10-digit value) 200 ÷ 7 EXE	28.571
	×	←8.57142857 × _
	14 EXE	400.000
	Performing the same calculation with the specified number of significant digits:	
	200 ÷ 7 EXE	28.571
	(Internal rounding) SHIFT Rnd	28.571
	×	28.571 × _
	14 EXE	399.994
	(Clears the specification.) MODE 9	399.994
$123m \times 456 = 56088m$	123 × 456 EXE	56088.
$= 56.088km$	ENG	56.088^{03}
$78g \times 0.96 = 74.88g$	78 × 0.96 EXE	74.88
$= 0.07488kg$	SHIFT ENG	0.07488^{03}

7/Special Functions

■ Continuous Calculation Function

The ***Continuous Calculation Function*** lets you use the result of one calculation as an element of a successive calculation. Such calculations are performed using the 10-digit mantissa of the displayed value.

Example $3 \times 4 = 12$ continuing to $\div 3.14 =$

3 × 4 EXE	12.
(continuing) ÷ 3.14	12 ÷ 3.14_
EXE	3.821656051

Example $1 \div 3 \times 3 =$

1 ÷ 3 × 3 EXE	1.
1 ÷ 3 EXE	0.3333333333
(continuing) × 3 EXE	0.9999999999

This function can also be used to store a result to memory, with Type A functions (see page 15), or with $+$, $-$, x^y, $\sqrt[x]{\ }$, $^\circ\,'\,''$

Example To store the result of 12×45 to Memory IK 1.

12 × 45 EXE	540.
(continuing) SHIFT Kin 1	540.

Example To square the result of $78 \div 6$ (see page 34)

78 ÷ 6 EXE	13.
(continuing) SHIFT x^2	$13.^2$_
EXE	169.

■ Using the Replay Function

•Press either of the cursor keys after executing a calculation to display the calculation again. Pressing ⇨ positions the cursor at the beginning of the calculation you have just executed, while ⇦ positions the cursor at the end. Then you can move through the calculations using the ⇨ and ⇦ cursor keys to confirm that it is correct or to make changes. Finally, you can execute the original calculation again, or edit it first and then execute it.

Example

123 × 456 EXE	56088.
⇨	123 × 456
EXE	56088.
⇦	123 × 456_

Example $4.12 \times 3.58 + \underline{6.4} = 21.1496$
$4.12 \times 3.58 - \underline{7.1} = 7.6496$

4.12 × 3.58 + 6.4 EXE	21.1496
⇦	↖12 × 3.58 + 6.4_
⇦⇦⇦⇦	4.12 × 3.58 + 6. ↗
− 7.1	↖12 × 3.58 − 7.1_
EXE	7.6496

•Error Location Function

•When an error occurs during a calculation, the most obvious solution would be to clear the calculator by pressing the AC key, and then input the formula again. With the Replay function, you can press the ⇦ or ⇨ cursor key, make the necessary changes, and then execute the new, correct calculation.

Example To correct the calculaiton $14 \div 10 \times 2.3$ EXE, mistakenly entered as: $14 \div 0 \times 2.3$ EXE.

14 ÷ 0 × 2.3 EXE	Ma ERROR
⇨ (or ⇦)	14 ÷ 0 × 2.3

(Error occurred)

⇦ SHIFT INS 1	14 ÷ 10 × 2.3
EXE	3.22

*The Replay function is cleared when you switch modes.
*The Replay function is retained after pressing the AC key or OFF key.

■ Using Multistatements

•You can use the ***Multistatement Function*** to connect multiple formulas into a single statement. Formulas are separated by colons (ALPHA :).
•When execution reaches a colon, the calculator displays the intermediate result up to that point until the EXE key is pressed to resume execution.

Example

4 × 8 ALPHA : 5 ÷ 2 ALPHA : 12 − 4	↖ × 8 : 5 ÷ 2 : 12 − 4_
EXE	32.
EXE	2.5
EXE	8.

•You cannot perform continuous calculations (see page 26) within multistatements.

Example $123 \times 456 : \times 5$
Illegal

8/Scientific Function Calculations

■ Performing Trigonometric and Inverse Trigonometric Functions

- Use the operation [MODE] [4] ~ [6] to specify the unit of angular measurement (deg, rad, grad) to be used for trigonometric and inverse trigonometric calculations.
- The unit of angular measurement specification is retained (even if power is switched off) until you make another specification.
- You cannot specify the unit of angular measurement (degrees, radians, grads) or the display format (FIX, SCI) while the calculator is in the BASE-N mode. Such specifications can only be made if you first exit the BASE-N mode.
- The operations noted below are not possible in the BASE-N mode.

Example	Operation	Display
$\sin 63°52'41'' = 0.897859012$	[MODE] [4] → "D" [sin] 63 [°'''] 52 [°'''] 41 [°'''] [EXE]	0.897859012
$\cos\left(\frac{\pi}{3}\text{ rad}\right) = 0.5$	[MODE] [5] → "R" [cos] ([SHIFT] [π] ÷ 3) [EXE]	0.5
$\tan(-35\text{gra}) = -0.6128007881$	[MODE] [6] → "G" [tan] [(−)] 35 [EXE]	−0.6128007881
$2\cdot\sin 45° \times \cos 65° = 0.5976724775$	[MODE] [4] → "D" 2 × [sin] 45 × [cos] 65 [EXE] (May be omitted)	0.5976724775
$\sin^{-1}0.5 = 30°$ (Determines x for $\sin x = 0.5$)	[SHIFT] [sin] 0.5 [EXE] (May also be entered as .5.)	30.
$\cos^{-1}\frac{\sqrt{2}}{2} = 0.7853981634$ rad $= \frac{\pi}{4}$ rad	[MODE] [5] → "R" [SHIFT] [cos] ([√] 2 ÷ 2) [EXE] ÷ [SHIFT] [π] [EXE]	0.7853981634 0.25
$\tan^{-1}0.741 = 36.53844577°$ $= 36°32'18.4''$	[MODE] [4] → "D" [SHIFT] [tan] 0.741 [EXE] [SHIFT] [°''']	36.53844577 36°32'18.4''
*When the degree / minute / second value exceeds 11 digits, the display will cut off the value to the right. The entire value is stored internally (in decimal format) for calculations.		
$2.5 \times (\sin^{-1}0.8 - \cos^{-1}0.9) = 68°13'13.53''$	2.5 × ([SHIFT] [sin] 0.8 − [SHIFT] [cos] 0.9) [EXE] [SHIFT] [°''']	68°13'13.53''

■ Performing Logarithmic and Exponential Functions

- The operations noted below are not possible in the BASE-N mode.

Example	Operation	Display
$\log 1.23\ (\log_{10}1.23) = 8.99051114 \times 10^{-2}$	[log] 1.23 [EXE]	0.0899051114
$\ln 90\ (\log 90) = 4.49980967$	[ln] 90 [EXE]	4.49980967
$\log 456 \div \ln 456 = 0.4342944819$	[log] 456 ÷ [ln] 456 [EXE]	0.4342944819
$10^{1.23} = 16.98243652$ (To determine the antilogarithm of common logarithm 1.23)	[SHIFT] [10^x] 1.23 [EXE]	16.98243652
$e^{4.5} = 90.0171313$ (To determine the antilogarithm of natural logarithm 4.5)	[SHIFT] [e^x] 4.5 [EXE]	90.0171313
$10^4 \cdot e^{-4} + 1.2 \cdot 10^{2.3} = 422.5878667$	[SHIFT] [10^x] 4 × [SHIFT] [e^x] [(−)] 4 + 1.2 × [SHIFT] [10^x] 2.3 [EXE]	422.5878667
$5.6^{2.3} = 52.58143837$	5.6 [x^y] 2.3 [EXE]	52.58143837
$\sqrt[7]{123}\ (= 123^{\frac{1}{7}}) = 1.988647795$	7 [SHIFT] [√] 123 [EXE]	1.988647795
$(78-23)^{-12} = 1.305111829 \times 10^{-21}$	(78 − 23) [x^y] [(−)] 12 [EXE]	1.305111829^{-21}
$2 + 3 \times \sqrt[3]{64} - 4 = 10$	2 + 3 × 3 [SHIFT] [√] 64 − 4 [EXE]	10.
$2 \times 3.4^{(5+6.7)} = 3306232$	2 × 3.4 [x^y] (5 + 6.7) [EXE]	3306232.

■ Performing Hyperbolic and Inverse Hyperbolic Functions

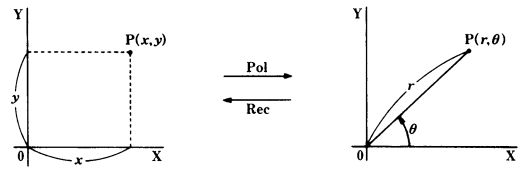
•The operations noted below are not possible in the BASE-N mode.

Example	Operation	Display
$\sinh 3.6 = 18.28545536$	hyp sin 3.6 EXE	**18.28545536**
$\cosh 1.23 = 1.856761057$	hyp cos 1.23 EXE	**1.856761057**
$\tanh 2.5 = 0.9866142982$	hyp tan 2.5 EXE	**0.9866142982**
$\cosh 1.5 - \sinh 1.5 = 0.2231301602 = e^{-1.5}$ (Proof of $\cosh x \pm \sinh x = e^{\pm x}$)	hyp cos 1.5 − hyp sin 1.5 EXE (Continuing) In Ans EXE	**0.2231301602** **−1.5**
$\sinh^{-1}30 = 4.094622224$	hyp SHIFT sin 30 EXE	**4.094622224**
$\cosh^{-1}\left(\frac{20}{15}\right) = 0.7953654612$	hyp SHIFT cos (20 ÷ 15) EXE	**0.7953654612**
To calculate x when $\tanh 4x = 0.88$ $x = \frac{\tanh^{-1}0.88}{4} = 0.3439419141$	hyp SHIFT tan 0.88 ÷ 4 EXE	**0.3439419141**
$\sinh^{-1}2 \times \cosh^{-1}1.5 = 1.389388923$	hyp SHIFT sin 2 × hyp SHIFT cos 1.5 EXE	**1.389388923**
$\sinh^{-1}\left(\frac{2}{3}\right) + \tanh^{-1}\left(\frac{4}{5}\right) = 1.723757406$	hyp SHIFT sin (2 ÷ 3) + hyp SHIFT tan (4 ÷ 5) EXE	**1.723757406**

■ Performing Coordinate Conversions (Pol, Rec)

•Your scientific calculator lets you convert between rectangular coordinates and polar coordinates.

•Rectangular coordinates **•Polar coordinates**



•Calculations results are automatically stored in memories K5 and K6. Following a calculation, the value stored in K5 is displayed, and you can recall the value stored in K6 using the operation IK 6 EXE.

	K5	K6
Pol	r	θ
Rec	x	y

•The value of θ can be determined in the range of $-180° < \theta \leqq 180°$. The same range is also applicable for both radians and grads.

Example	Operation	Display
To calculate r and θ when $x = 14$ and $y = 20.7$	MODE 4 → "D" SHIFT Pol(14 SHIFT , 20.7) EXE (Continuing) IK 6 EXE SHIFT ⇄	**24.98979792 (r)** **55°55′42.2″ (θ)**
To calculate r and θ rad when $x = 7.5$ and $y = -10$	MODE 5 → "R" SHIFT Pol(7.5 SHIFT , (−) 10) EXE (Continuing) IK 6 EXE	**12.5 (r)** **−0.927295218 (θ)**
To calculate x and y when $r = 25$ and $\theta = 56°$	MODE 4 → "D" SHIFT Rec(25 SHIFT , 56) EXE (Continuing) IK 6 EXE	**13.97982259 (x)** **20.72593931 (y)**
To calculate x and y when $r = 4.5$ and $\theta = \frac{2}{3}\pi$ rad	MODE 5 → "R" SHIFT Rec(4.5 SHIFT , (2 ÷ 3 × SHIFT π)) EXE (Continuing) IK 6 EXE	**−2.25 (x)** **3.897114317 (y)**

■ Permutation (nPr), Combination (nCr)

•Total permutations

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

•Total combinations

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

Example	Operation	Display
Taking any four out of ten items and arranging them in a row, how many different arrangement are possible? $_{10}P_4 = 5040$	10 SHIFT nPr 4 EXE	5040.
How many even 4-digit numbers, in which no two digits are identical, can be formed using the numbers 1 through 7? $_7P_4 \times \frac{3}{7} = 360$	7 SHIFT nPr 4 × 3 ÷ 7 EXE	360.
If any four items are removed from 10 items, how many different combinations are possible? $_{10}C_4 = 210$	10 SHIFT nCr 4 EXE	210.
In a class of 15 boys and 10 girls, how many different combinations are possible if 5-member groups are formed, in which at least one member per group must be a girl? $_{25}C_5 - {}_{15}C_5 = 50127$	25 SHIFT nCr 5 − 15 SHIFT nCr 5 EXE	50127.

■ Other Functions ($\sqrt{\ }$, x^2, x^{-1}, $x!$, $\sqrt[3]{\ }$, Ran#)

•The operations noted below are not possible in the BASE-N mode.

Example	Operation	Display
$\sqrt{2}+\sqrt{5} = 3.65028154$	√ 2 + √ 5 EXE	3.65028154
$2^2+3^2+4^2+5^2 = 54$	2 SHIFT x^2 + 3 SHIFT x^2 + 4 SHIFT x^2 + 5 SHIFT x^2 EXE	54.
$\frac{1}{\frac{1}{3}-\frac{1}{4}} = 12$	(3 x^{-1} − 4 x^{-1}) x^{-1} EXE	12.
$8!(=1\times2\times3\times\ldots..\times8) = 40320$	8 SHIFT $x!$ EXE	40320.
$\sqrt[3]{36\times42\times49} = 42$	SHIFT $\sqrt[3]{\ }$ (36 × 42 × 49) EXE	42.
Random number generation (pseudo-random number from 0.000 to 0.999)	SHIFT Ran# EXE	(Ex.) 0.792
$\sqrt{13^2-5^2}+\sqrt{3^2+4^2} = 17$	√ (13 SHIFT x^2 − 5 SHIFT x^2) + √ (3 SHIFT x^2 + 4 SHIFT x^2) EXE	17.
$\sqrt{1-\sin^2 40°} = 0.7660444431$ $= \cos 40°$ (Proof of $\cos\theta = \sqrt{1-\sin^2\theta}$)	MODE 4 → "D" √ (1 − (sin 40) SHIFT x^2) EXE (Continuing) SHIFT cos Ans EXE	0.7660444431 40.
$\frac{1}{2!}+\frac{1}{4!}+\frac{1}{6!}+\frac{1}{8!}$ $= 0.5430803571$	2 SHIFT $x!$ x^{-1} + 4 SHIFT $x!$ x^{-1} + 6 SHIFT $x!$ x^{-1} + 8 SHIFT $x!$ x^{-1} EXE	0.5430803571

■ Performing Percent Calculations

Example	Operation	Display
•Percent To calculate 26% of 1,500.	1500 × 26 SHIFT %	390.
•Add-on To calculate 3,620 increased by 15%.	3620 × 15 SHIFT % +	4163.
•Discount To calculate 4,750 decreased by 4%.	4750 × 4 SHIFT % −	4560.
•Ratio To calculate what percent of 250 is 75.	75 ÷ 250 SHIFT %	30.(%)
•Increase / decrease To calculate what percent increase it is from $120 to $141.	141 − 120 SHIFT %	17.5(%)
To calculate what percent decrease it is from $300 to $240.	240 − 300 SHIFT %	−20.(%)

9/Performing Engineering Symbol Calculations

•Use the keys marked with ENG symbols to perform engineering symbol calculations.
•Use the key operation MODE • to enter the ENG mode (ENG symbol appears on the display). Press MODE • again to cancel the ENG mode.

Operation	Unit	Symbol
SHIFT k (=6)	10^{3}	k (Kilo)
SHIFT M (=7)	10^{6}	M (Mega)
SHIFT G (=8)	10^{9}	G (Giga)
SHIFT T (=9)	10^{12}	T (Tera)
SHIFT m (=5)	10^{-3}	m (Milli)
SHIFT μ (=4)	10^{-6}	μ (Micro)
SHIFT n (=3)	10^{-9}	*n* (Nano)
SHIFT p (=2)	10^{-12}	p (Pico)
SHIFT f (=1)	10^{-15}	*f* (Femto)

Example	Operation	Display
	MODE • → "ENG"	
999k (Kilo) + 25k (Kilo) = 1.024M (Mega)	999 SHIFT k + 25 SHIFT k EXE	1.024M
100m (Milli) × 5μ (Micro) = 500n (Nano)	100 SHIFT m × 5 SHIFT μ EXE	500.n
9 ÷ 10 = 0.9 = 900m (Milli)	9 ÷ 10 EXE	900.m
	SHIFT ENG	0.9
	ENG	900.m

10/Performing Binary, Octal, Decimal and Hexadecimal Calculations

- You can perform binary, octal, decimal, and hexadecimal calculations and conversions in the BASE-N mode ([MODE] [1]). The BASE-N indicator is shown on the display in this mode.
- You can specify the default number system by pressing [BIN] for binary (BIN indicator shown on display), [OCT] for octal (OCT indicator), [DEC] for decimal (DEC indicator), and [HEX] for hexadecimal (HEX indicator).
- No matter what the default number system, you can specify the number system for a specific value by pressing [SHIFT] [b] for binary, [SHIFT] [o] for octal, [SHIFT] [d] for decimal or [SHIFT] [h] for hexadecimal before entering the value.
- You cannot specify the unit of angular measurement (degrees, radians, grads) or the display format (FIX, SCI) while the calculator is in the BASE-N mode. Such specifications can only be made if you first exit the BASE-N mode.
- You cannot use scientific functions in the BASE-N mode.
- Only integers can be used in the BASE-N mode, so you aren't able to enter any value that has a fraction or exponent. When a calculation produces a result with a fraction, the fractional part is cut off.
- Remember that each number system has a different range of values. If you try to enter values that are outside the range of the default number system, an error will occur unless you specify another number system for the value using the procedure described above.

Number system	Values
Binary	0, 1
Octal	0, 1, 2, 3, 4, 5, 6, 7
Decimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

- The values A through F in the hexadecimal system are represented as shown below to distinguish them from standard alphabetical characters.

Key	Display
[A] (= [x])	A
[B] (= [10^x])	B
[C] (= [hyp])	C
[D] (= [sin])	D
[E] (= [cos])	E
[F] (= [tan])	F

- Negatives for binary, octal, and hexadecimal are expressed using their two's complement.
- The following table shows the display limitations for calculation results in each number system.

Number system	Display limitation
Binary	32 digits (displayed as 4 blocks of 8 digits each)
Octal	11 digits
Decimal	10 digits
Hexadecimal	8 digits

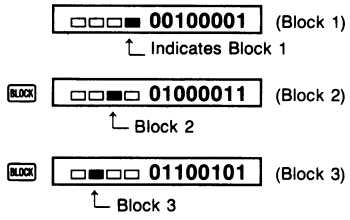
■ Block Display for Binary Values

- Binary results are displayed up to 32 digits long, broken down into 4 blocks of 8 digits each.

Example

Block 4	Block 3	Block 2	Block 1
10000111	01100101	01000011	00100001
← 8 digits →	← 8 digits →	← 8 digits →	← 8 digits →
← 32 digits →			

- Calculation results are always displayed starting with Block 1. Then, each time you press the [BLOCK] key, the display changes in the sequence Block 2→Block 3→Block 4, and then back to Block 1. You can tell which block is currently displayed by looking at the four boxes on the left end of the calculator's display.
When [BLOCK] is pressed following [SHIFT], the display changes in the following sequence:
→ Block 4 → Block 3 → Block 2 → Block 1 →



[BLOCK] ■□□□ 10000111 (Block 4)

↳ Block 4

[BLOCK] □□□■ 00100001 (Returns to Block 1)

[SHIFT] [BLOCK] ■□□□ 10000111 (Returns to Block 4)

■ Performing Binary/Octal/Decimal/Hexadecimal Conversions

•There are two different methods that you can use to convert among binary, octal, decimal, and hexadecimal.

•Conversion to the Default Mode

With this method, set the default number system to the system that you want the final result to be in, and then individually specify the number systems for the values you are inputting.

Example	Operation	Display
	[MODE] [1] → "BASE-N"	
$2A_{16}$, 274_8 conversion to decimal	[DEC] → "DEC"	
	[SHIFT] [h] 2A [EXE]	DEC 42
	[SHIFT] [o] 274 [EXE]	DEC 188
123_{10}, 1010_2 conversion to hexadecimal	[HEX] → "HEX"	
	[SHIFT] [d] 123 [EXE]	HEX 0000007B
	[SHIFT] [b] 1010 [EXE]	HEX 0000000A
15_{16}, 1100_2 conversion to octal	[OCT] → "OCT"	
	[SHIFT] [h] 15 [EXE]	OCT 00000000025
	[SHIFT] [b] 1100 [EXE]	OCT 00000000014
36_{10}, $2C_{16}$ conversion to binary	[BIN] → "BIN"	
	[SHIFT] [d] 36 [EXE]	BIN □□□■ 00100100
	[SHIFT] [h] 2C [EXE]	BIN □□□■ 00101100

•Final Result Conversion

With this method, you determine a final result and then press a number system key to change the result to another system.

Example	Operation	Display
22_{10} conversion to binary, octal, and hexadecimal	[MODE] [1] → "BASE-N"	
	[DEC] → "DEC"	
	22 [EXE]	DEC 22
	[BIN]	BIN □□□■ 00010110
	[OCT]	OCT 00000000026
	[HEX]	HEX 00000016

■ Expressing Negative Values

Example	Operation	Display
	[MODE] [1] → "BASE-N"	
Negative of 110010_2	[BIN] → "BIN"	
	[Neg] 110010 [EXE]	BIN □□□■ 11001110
	[BLOCK]	BIN □□■□ 11111111
	[BLOCK]	BIN □■□□ 11111111
	[BLOCK]	BIN ■□□□ 11111111
Negative of 72_8	[OCT] → "OCT"	
	[Neg] 72 [EXE]	OCT 37777777706
Negative of $3A_{16}$	[HEX] → "HEX"	
	[Neg] 3A [EXE]	HEX FFFFFFC6

■ Performing Binary/Octal/Decimal/Hexadecimal Arithmetic Calculations

Example	Operation	Display
	[MODE] [1] → "BASE-N"	
$10111_2 + 11010_2 = 110001_2$	[BIN] → "BIN"	
	10111 [+] 11010 [EXE]	BIN 00110001
$B47_{16} - DF_{16} = A68_{16}$	[HEX] → "HEX"	
	B47 [−] DF [EXE]	HEX 00000A68
$123_8 \times ABC_{16} = 37AF4_{16}$	[SHIFT] [o] 123 [×] ABC [EXE]	HEX 00037AF4
$= 228084_{10}$	[DEC]	DEC 228084
$1F2D_{16} - 100_{10} = 7881_{10}$	[SHIFT] [h] 1F2D [−] 100 [EXE]	DEC 7881
$= 1EC9_{16}$	[HEX]	HEX 00001EC9
$7654_8 \div 12_{10} = 334.3333333_{10}$	[DEC] → "DEC"	
$= 516_8$	[SHIFT] [o] 7654 [÷] 12 [EXE]	DEC 334
	[OCT]	OCT 00000000516
*Fractional portions are cut off.		
$1234_{10} + 1EF_{16} \div 24_8 = 2352_8$	[SHIFT] [d] 1234 [+] [SHIFT] [h]	
$= 1258_{10}$	1EF [÷] 24 [EXE]	OCT 00000002352
	[DEC]	DEC 1258
*Multiplication and division are given precedence over addition and subtraction in mixed calculations.		

■ Performing Logical Operations

The logical operations of your scientific calculator give you logical products (AND), logical sums (OR), negation (NOT), exclusive logical sums (XOR), and negation of exclusive logical sums (XNOR).

Example	Operation	Display
	[MODE] [1] → "BASE-N"	
19_{16} AND $1A_{16} = 18_{16}$	[HEX] → "HEX"	
	19 [SHIFT] [and] 1A [EXE]	HEX 00000018
1110_2 AND $36_8 = 1110_2$	[BIN] → "BIN"	
	1110 [SHIFT] [and] [SHIFT] [o] 36 [EXE]	BIN 00001110
23_8 OR $61_8 = 63_8$	[OCT] → "OCT"	
	23 [SHIFT] [or] 61 [EXE]	OCT 00000000063
120_{16} OR $1101_2 = 12D_{16}$	[HEX] → "HEX"	
	120 [SHIFT] [or] [SHIFT] [b]	
	1101 [EXE]	HEX 0000012D
1010_2 AND (A_{16} OR 7_{16})	[BIN] → "BIN"	
$= 1010_2$	1010 [SHIFT] [and] ([SHIFT] [h] A	
	[SHIFT] [or] [SHIFT] [h] 7) [EXE]	BIN 00001010
5_{16} XOR $3_{16} = 6_{16}$	[HEX] → "HEX"	
	5 [SHIFT] [xor] 3 [EXE]	HEX 00000006
$2A_{16}$ XNOR $5D_{16}$		
$= FFFFFF88_{16}$	[HEX] → "HEX"	
	2A [SHIFT] [xnor] 5D [EXE]	HEX FFFFFF88
Negation of 1234_8	[OCT] → "OCT"	
	[Not] 1234 [EXE]	OCT 37777776543
Negation of $2FFFED_{16}$	[HEX] → "HEX"	
	[Not] 2FFFED [EXE]	HEX FFD00012

11/Performing Statistical Calculations

For statistics, you have a choice of the SD mode for standard deviation calculations, and the LR mode for regression calculations.

■ Performing Standard Deviation Calculations

•In the SD mode ([MODE] [3]), you can calculate paired two types of standard deviation, mean, number of data, the sum of data, the sum of squares of data.

•Data Input

① Press [MODE] [3] to enter the SD mode.
② Press [SHIFT] [KAC] to clear the statistical memories.
③ Enter each data item, using the following sequence: DATA [DT].

Example

Data: 10, 20, 30
Procedure: 10 [DT] 20 [DT] 30 [DT]

*You can enter identical data items by pressing the [DT] key repeatedly, or by specifying the number of data that are the same.

Example 1

Data: 10, 20, 20, 30
Procedure: 10 [DT] 20 [DT] [DT] 30 [DT]

Each time you press [DT] without entering a new data item, the previously entered data item (here, 20) is entered again.

Example 2

Data: 10, 20, 20, 20, 20, 20, 20, 30
Procedure: 10 [DT] 20 [SHIFT] [:] 6 [DT] 30 [DT]

The value which you entered after the semicolon (here, 6) tells the calculator how many times to repeat the previously entered data item (here, 20).

•Deleting Entered Data

Example 1

40 [DT] 20 [DT] 30 [DT] 50 [DT]
To delete 50 [DT]: [SHIFT] [CL]

Example 2

40 [DT] 20 [DT] 30 [DT] 50 [DT]
To delete 20 [DT]: 20 [SHIFT] [CL]

Example 3

30 [DT] 50 [DT] 120 [SHIFT] [:]
To clear 120 [SHIFT] [:]: [AC]

Example 4

30 [DT] 50 [DT] 120 [SHIFT] [:] 31
To clear 120 [SHIFT] [:] 31: [AC]

Example 5

30 [DT] 50 [DT] 120 [SHIFT] [:] 31 [DT]
To clear 120 [SHIFT] [:] 31 [DT]: [SHIFT] [CL]

Example 6

50 [DT] 120 [SHIFT] [:] 31 [DT] 40 [DT] 30 [DT]
To clear 120 [SHIFT] [:] 31 [DT]: 120 [SHIFT] [:] 31 [SHIFT] [CL]

•Calculations

The following table shows the results produced by each key operation:

Key Operation	Result	
[SHIFT] [xσn] [EXE]	Population standard deviation $x\sigma_n$	[xσn] = [2]
[SHIFT] [xσn-1] [EXE]	Sample standard deviation $x\sigma_{n-1}$	[xσn-1] = [3]
[SHIFT] [$\bar{x}$] [EXE]	Mean	[$\bar{x}$] = [1]
[IK] [Σx²] [EXE]	Sum of squares of data	[Σx²] = [1]
[IK] [Σx] [EXE]	Sum of data	[Σx] = [2]
[IK] [n] [EXE]	Number of data items	[n] = [3]

◦The following formulas are used for standard deviation:

$$\sigma_n = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}} = \sqrt{\frac{\Sigma x^2-(\Sigma x)^2/n}{n}}$$

(For calculation of population standard deviation using all data for a finite population.)

$$\sigma_{n-1} = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}} = \sqrt{\frac{\Sigma x^2-(\Sigma x)^2/n}{n-1}}$$

(For estimation of sample standard deviation for an entire population using a sample from the population.)

•Mean formula

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{\Sigma x}{n}$$

Example	Operation	Display
Data: 55, 54, 51, 55, 53, 53, 54, 52	MODE 3 → "SD"	
	(Memory clear) SHIFT KAC	
	55 DT 54 DT 51 DT 55 DT 53 DT DT 54 DT 52 DT	52.
*The same results can be obtained no matter in what sequence they are recalled.		
	(Population standard deviation σn) SHIFT $x\sigma n$ EXE	1.316956719
	(Sample standard deviation $\sigma n-1$) SHIFT $x\sigma n-1$ EXE	1.407885953
	(Mean x) SHIFT $\bar{x}$ EXE	53.375
	(Number of data n) IK n EXE	8.
	(Sum Σx) IK Σx EXE	427.
	(Sum of squares Σx^2) IK Σx^2 EXE	22805.
Deviation of unbiased variance, difference between each datum, and mean of above data		
	(Continuing) SHIFT $x\sigma n-1$ SHIFT x^2 EXE	1.982142857
	55 − SHIFT $\bar{x}$ EXE	1.625
	54 − SHIFT $\bar{x}$ EXE	0.625
	51 − SHIFT $\bar{x}$ EXE	−2.375
	⋮	⋮
To calculate $\bar{x}$ and σ_{n-1} for the following table.	SHIFT KAC	
	110 SHIFT : 10 DT	110.
	130 SHIFT : 31 DT	130.
	150 SHIFT : 24 DT	150.
	170 DT DT	170.
	190 DT DT DT	190.
	IK n EXE	70.
	SHIFT $\bar{x}$ EXE	137.7142857
	SHIFT $x\sigma n-1$ EXE	18.42898069

Rank	Value	Frequency
1	110	10
2	130	31
3	150	24
4	170	2
5	190	3

■ Performing Regression Calculations

•In the LR mode (MODE 2), you can perform linear, logarithmic, exponential and power regression calculations.

〈Linear Regression〉

Linear regression is performed by the calculator using the formula $y = A + Bx$.

•Data Input

① Press MODE 2 to enter the LR mode.
② Press SHIFT KAC to clear the statistical memories.
③ Enter each data item, using the following sequence:
〈X-DATA〉 SHIFT , 〈Y-DATA〉 DT

*You can enter identical data items by pressing the DT key repeatedly, or by specifying the number of data pairs that are the same.

Example 1

Data: 10/20, 20/30, 20/30, 40/50
Procedure: 10 SHIFT , 20 DT
20 SHIFT , 30 DT DT
40 SHIFT , 50 DT

Each time you press DT without entering a new data pair, the previously entered data pair (here, 20/30) is entered again.

Example 2

Data: 10/20, 20/30, 20/30, 20/30, 20/30, 20/30, 40/50
Procedure: 10 SHIFT , 20 DT
20 SHIFT , 30 SHIFT : 5 DT
40 SHIFT , 50 DT

The value which you entered after the semicolon (here, 5) tells the calculator how many times to repeat the previously entered data pair (here, 20/30).

•Deleting Entered Data

Example 1

10 SHIFT , 40 DT
20 SHIFT , 20 DT
30 SHIFT , 30 DT
40 SHIFT , 50

To delete 40 SHIFT , 50: AC

Example 2

10 [SHIFT] [,] 40 [DT]
20 [SHIFT] [,] 20 [DT]
30 [SHIFT] [,] 30 [DT]
40 [SHIFT] [,] 50 [DT]

To delete 40 [SHIFT] [,] 50 [DT]: [SHIFT] [CL]

Example 3

10 [SHIFT] [,] 40 [DT]
20 [SHIFT] [,] 20 [DT]
30 [SHIFT] [,] 30 [DT]
40 [SHIFT] [,] 50 [DT]

To delete 20 [SHIFT] [,] 20 [DT]: 20 [SHIFT] [,] 20 [SHIFT] [CL]

•Calculations

The following table shows the results produced by each key operation:

Key Operation	Result	
[SHIFT] [A] [EXE]	Constant term A	[A] = [7]
[SHIFT] [B] [EXE]	Regression coefficient B	[B] = [8]
[SHIFT] [r] [EXE]	Correlation coefficient r	[r] = [9]
[SHIFT] [$\hat{x}$] [EXE]	Estimated value of x	[$\hat{x}$] = [×]
[SHIFT] [$\hat{y}$] [EXE]	Estimated value of y	[$\hat{y}$] = [÷]

•Regression Formulas

The following formulas are used for constant term A, regression coefficient B and correlation coefficient r:

$$A = \frac{\Sigma y - B \cdot \Sigma x}{n} \qquad B = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

$$r = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{\{n \cdot \Sigma x^2 - (\Sigma x)^2\}\{n \cdot \Sigma y^2 - (\Sigma y)^2\}}}$$

Example	Operation	Display
•Length of a steel rod at various temperatures	[MODE] [2] → "LR"	
	(Memory clear) [SHIFT] [KAC]	
	10 [SHIFT] [,] **1003** [DT]	**10.**
	15 [SHIFT] [,] **1005** [DT]	**15.**
	20 [SHIFT] [,] **1010** [DT]	**20.**
	25 [SHIFT] [,] **1011** [DT]	**25.**
	30 [SHIFT] [,] **1014** [DT]	**30.**
	(Constant term A) [SHIFT] [A] [EXE]	**997.4**
	(Regression coefficient B) [SHIFT] [B] [EXE]	**0.56**
	(Correlation coefficient r) [SHIFT] [r] [EXE]	**0.9826073689**
	(Length at 18°C) **18** [SHIFT] [$\hat{y}$] [EXE]	**1007.48**
	(Temperature for 1,000mm length) **1000** [SHIFT] [$\hat{x}$] [EXE]	**4.642857143**
	(Critical coefficient) [SHIFT] [r] [SHIFT] [x^3] [EXE]	**0.9655172414**
	(Covariance) [(] [IK] [Σxy] [−] [IK] [n] [×] [SHIFT] [$\hat{x}$] [×] [SHIFT] [$\hat{y}$] [)] [÷] [(] [IK] [n] [−] **1** [)] [EXE]	**35.**

To calculate the regression formula and correlation coefficient for the above data. Use the regression formula to calculate the length of the rod at 18°C and the temperature when the rod is 1,000mm long. Also calculate the critical coefficient (r^2) and covariance $\left(\frac{\Sigma xy - n \cdot \bar{x} \cdot \bar{y}}{n-1}\right)$.

Temperature	Measured length
10°C	1003mm
15°C	1005mm
20°C	1010mm
25°C	1011mm
30°C	1014mm

⟨Logarithmic Regression⟩

•The calculator uses the formula $y = A + B \cdot \ln x$ for logarithmic regression.

•Data Input

① Press [MODE] [2] to enter the LR mode.
② Press [SHIFT] [KAC] to clear the statistical memories.
③ Enter each data item, using the following sequence:
[ln] ⟨X-DATA⟩ [SHIFT] [,] ⟨Y-DATA⟩ [DT].

*You can enter identical data items using the same two procedures described for linear regression, but you must always press the [ln] key before entering the X-DATA.

•Deleting Entered Data

To delete entered data, use the same procedures described for linear regression, but remember to always press the [ln] key before entering X-DATA.

•Calculations

The following table shows the results produced by each key operation:

Key Operation	Result	
[SHIFT] [A] [EXE]	Constant term A	[A] = [7]
[SHIFT] [B] [EXE]	Regression coefficient B	[B] = [8]
[SHIFT] [r] [EXE]	Correlation coefficient r	[r] = [9]
y [SHIFT] [$\hat{x}$] [EXE] [SHIFT] [e^{x}] [Ans] [EXE]	Estimated value of x	[$\hat{x}$] = [×]
[ln] x [SHIFT] [$\hat{y}$] [EXE]	Estimated value of y	[$\hat{y}$] = [÷]

If we assume that $\ln x = x$, the logarithmic regression formula $y = A + B \cdot \ln x$ becomes the linear regression formula $y = a + bx$. Therefore, the formulas for constant term A, regression coefficient B and correlation coefficient r are identical for logarithmic and linear regression.

A number of logarithmic regression calculation results differ from those produced by linear regression. Note the following:

Linear regression	Logarithmic regression
Σx	$\Sigma \ln x$
Σx^2	$\Sigma (\ln x)^2$
Σxy	$\Sigma \ln x \cdot y$

Example	Operation	Display
	[MODE] [2] → "LR"	
	[SHIFT] [KAC]	
	[ln] 29 [SHIFT] [,] 1.6 [DT]	3.36729583
	[ln] 50 [SHIFT] [,] 23.5 [DT]	3.912023005
	[ln] 74 [SHIFT] [,] 38.0 [DT]	4.304065093
	[ln] 103 [SHIFT] [,] 46.4 [DT]	4.634728988
	[ln] 118 [SHIFT] [,] 48.9 [DT]	4.770684624
	(Constant term A) [SHIFT] [A] [EXE]	−111.1283976
	(Regression coefficient B) [SHIFT] [B] [EXE]	34.02014748
	(Correlation coefficient r) [SHIFT] [r] [EXE]	0.9940139464
	($\hat{y}$ when $xi = 80$) [ln] 80 [SHIFT] [$\hat{y}$] [EXE]	37.94879482
	($\hat{x}$ when $yi = 73$) 73 [SHIFT] [$\hat{x}$] [EXE] [SHIFT] [e^{x}] [Ans] [EXE]	224.1541314

xi	yi
29	1.6
50	23.5
74	38.0
103	46.4
118	48.9

To perform logarithmic regression on the above data to determine the regression formula and the correlation coefficient. Then use the regression formula to estimate $\hat{y}$ when $xi = 80$ and $\hat{x}$ when $yi = 73$.

〈Exponential Regression〉

•The calculator uses the formula $y = A \cdot e^{B \cdot x}$ ($\ln y = \ln A + Bx$) for exponential regression.

•Data Input

① Press [MODE] [2] to enter the LR mode.
② Press [SHIFT] [KAC] to clear the statistical memories.
③ Enter each data item, using the following sequence:
〈X-DATA〉 [SHIFT] [,] [ln] 〈Y-DATA〉 [DT].

*You can enter identical data items using the same two procedures described for linear regression, but you must always press the [ln] key before entering the Y-DATA.

•Deleting Entered Data

*To delete entered data, use the same procedures described for linear regression, but remember to always press the [ln] key before entering Y-DATA.

•Calculations

The following table shows the results produced by each key operation:

Key Operation	Result	
[SHIFT] [e^{x}] [SHIFT] [A] [EXE]	Constant term A	[A] = [7]
[SHIFT] [B] [EXE]	Regression coefficient B	[B] = [8]
[SHIFT] [r] [EXE]	Correlation coefficient r	[r] = [9]
[ln] y [SHIFT] [$\hat{x}$] [EXE]	Estimated value of x	[$\hat{x}$] = [×]
x [SHIFT] [$\hat{y}$] [EXE] [SHIFT] [e^{x}] [Ans] [EXE]	Estimated value of y	[$\hat{y}$] = [÷]

If we assume that $\ln y = y$ and $\ln A = a'$, the exponential regression formula $y = A \cdot e^{B \cdot x}$ ($\ln y = \ln A + Bx$) becomes the linear regression formula $y = a + bx$. Therefore, the formulas for constant term A, regression coefficient B and correlation coefficient r are identical for exponential and linear regression.

A number of exponential regression calculation results differ from those produced by linear regression. Note the following:

Linear regression	Exponential regression
Σy	$\Sigma \ln y$
Σy^2	$\Sigma (\ln y)^2$
Σxy	$\Sigma x \cdot \ln y$

Example	Operation	Display
	[MODE] [2] → "LR"	
	[SHIFT] [KAC]	
xi 6.9, yi 21.4	**6.9** [SHIFT] [,] [ln] **21.4** [DT]	**6.9**
xi 12.9, yi 15.7	**12.9** [SHIFT] [,] [ln] **15.7** [DT]	**12.9**
xi 19.8, yi 12.1	**19.8** [SHIFT] [,] [ln] **12.1** [DT]	**19.8**
xi 26.7, yi 8.5	**26.7** [SHIFT] [,] [ln] **8.5** [DT]	**26.7**
xi 35.1, yi 5.2	**35.1** [SHIFT] [,] [ln] **5.2** [DT]	**35.1**
To perform exponential regression on the above data to determine the regression formula and the correlation coefficient. Then use the regression formula to estimate $\hat{y}$ when $xi = 16$ and $\hat{x}$ when $yi = 20$.	(Constant term A) [SHIFT] [e^{x}] [SHIFT] [A] [EXE]	**30.49758742**
	(Regression coefficient B) [SHIFT] [B] [EXE]	**−0.0492037083**
	(Correlation coefficient r) [SHIFT] [r] [EXE]	**−0.9972473517**
	($\hat{y}$ when $xi = 16$) **16** [SHIFT] [$\hat{y}$] [EXE] [SHIFT] [e^{x}] [Ans] [EXE]	**13.87915739**
	($\hat{x}$ when $yi = 20$) [ln] **20** [SHIFT] [$\hat{x}$] [EXE]	**8.574868045**

〈Power Regression〉

•The calculator uses the formula $y = A \cdot x^B$ ($\ln y = \ln A + B \ln x$) for power regression.

•Data Input

① Press [MODE] [2] to enter the LR mode.
② Press [SHIFT] [KAC] to clear the statistical memories.
③ Enter each data item, using the following sequence:
[ln] 〈X-DATA〉 [SHIFT] [,] [ln] 〈Y-DATA〉 [DT].

*You can enter identical data items using the same two procedures described for linear regression, but you must always press the [ln] key before entering both X-DATA and Y-DATA.

•Deleting Entered Data

To delete entered data, use the same procedures described for linear regression, but remember to always press the [ln] key before entering X-DATA and Y-DATA.

•Calculations

The following table shows the results produced by each key operation:

Key Operation	Result	
[SHIFT] [e^x] [SHIFT] [A] [EXE]	Constant term A	[A] = [7]
[SHIFT] [B] [EXE]	Regression coefficient B	[B] = [8]
[SHIFT] [r] [EXE]	Correlation coefficient r	[r] = [9]
[ln] y [SHIFT] [$\hat{x}$] [EXE] [SHIFT] [e^x] [Ans] [EXE]	Estimated value of x	[$\hat{x}$] = [×]
[ln] x [SHIFT] [$\hat{y}$] [EXE] [SHIFT] [e^x] [Ans] [EXE]	Estimated value of y	[$\hat{y}$] = [÷]

If we assume that $\ln y = y$, $\ln A = a'$ and $\ln x = x$, the power regression formula $y = A \cdot x^B$ ($\ln y = \ln A + B \ln x$) becomes the linear regression formula $y = a + bx$. Therefore, the formulas for constant term A, regression coefficient B and correlation coefficient r are identical for power and linear regression.

A number of power regression calculation results differ from those produced by linear regression. Note the following:

Linear regression	Power regression
Σx	$\Sigma \ln x$
Σx^2	$\Sigma (\ln x)^2$
Σy	$\Sigma \ln y$
Σy^2	$\Sigma (\ln y)^2$
Σxy	$\Sigma \ln x \cdot \ln y$

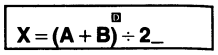
Example	Operation	Display
	[MODE] [2] → **"LR"**	
	[SHIFT] [KAC]	
	[ln] **28** [SHIFT] [,] [ln] **2410** [DT]	**3.33220451**
	[ln] **30** [SHIFT] [,] [ln] **3033** [DT]	**3.401197382**
	[ln] **33** [SHIFT] [,] [ln] **3895** [DT]	**3.496507561**
	[ln] **35** [SHIFT] [,] [ln] **4491** [DT]	**3.555348061**
	[ln] **38** [SHIFT] [,] [ln] **5717** [DT]	**3.63758616**
To perform power regression on the above data to determine the regression formula and the correlation coefficient. Then use the regression formula to estimate $\hat{y}$ when $xi = 40$ and $\hat{x}$ when $yi = 1000$.	(Constant term A)	
	[SHIFT] [e^x] [SHIFT] [A] [EXE]	**0.2388010963**
	(Regression coefficient B)	
	[SHIFT] [B] [EXE]	**2.771866138**
	(Correlation coefficient r)	
	[SHIFT] [r] [EXE]	**0.9989062545**
	($\hat{y}$ when $xi = 40$)	
	[ln] **40** [SHIFT] [$\hat{y}$] [EXE] [SHIFT] [e^x] [Ans] [EXE]	**6587.674882**
	($\hat{x}$ when $yi = 1000$)	
	[ln] **1000** [SHIFT] [$\hat{x}$] [EXE] [SHIFT] [e^x]	
	[Ans] [EXE]	**20.26225639**

12/Using Variables in Calculations

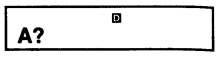
- A total of 8 variables are available. Each variable has a name, represented by the 8 letters of the alphabet from A through F, X and Y.
- When you execute a formula that contains variables, the calculator will ask you to input values for the variables whenever the calculation is executed.

Example Enter and execute X = (A + B) ÷ 2

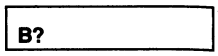
Enter the formula.
[ALPHA][X][ALPHA][=][(][ALPHA][A][+][ALPHA][B][)][÷]2



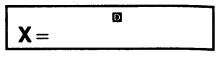
Execute the formula.
[EXE]



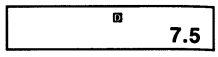
Enter values for the variables.
7[EXE]



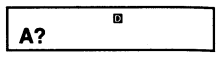
8[EXE]



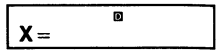
(After approx. 0.5 seconds)



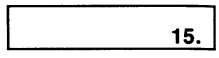
Execute the formula again.
[EXE]



Enter different values.
10[EXE]20[EXE]



(After approx. 0.5 seconds)

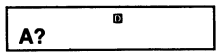


- After you execute a formula once, the variable keeps the same value unless you enter another one. In the example above, we first assigned a value of 7 to variable A. If we wanted to keep the 7 the second time we executed the same calculation, we could have simply pressed [EXE] when the calculator asked for input of a value for A, because A was already assigned 7 the first time around. Note, however, that all variables are cleared when you press the [AC] key or when you switch the power of the calculator off.
- You can omit the "X=" when inputting the formula used in the example. If you do, the display "X=" will not appear before the result of the formula.

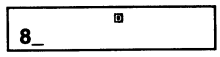
If you press [SHIFT] followed by [Var. Name], the calculator will display the name of the variable that has been assigned the displayed value, as long as you hold down the [Var. Name] key.

(Using the previous formula)

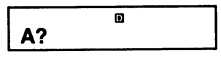
[EXE]



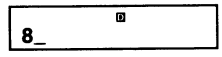
Enter a value for Variable A.
8



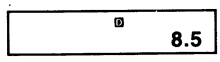
Confirm the variable name.
[SHIFT][Var. Name] (While [Var. Name] is held down.)



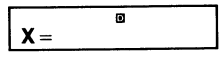
(Release [Var. Name].)



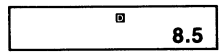
Continue with the execution.
[EXE]9[EXE]



Confirm the variable name.
[SHIFT][Var. Name] (While [Var. Name] is held down.)



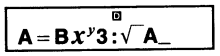
(Release [Var. Name].)



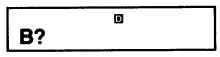
You can connect multiple formulas that contain variables into a multistatement (see page 28).

Example Enter and execute two formulas with variables.

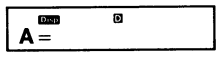
Enter the formulas.
[ALPHA][A][ALPHA][=][ALPHA][B][x^y]3[ALPHA][:][$\sqrt{}$][ALPHA][A]



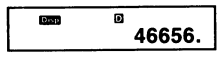
Execute the first formula.
[EXE]



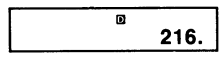
Enter values for the variables.
36[EXE]



(After approx. 0.5 seconds)



Execute the next formula.
[EXE]



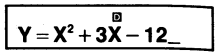
13/Using the Formula Storage Function

Your calculator is capable of storage of one formula, up to 63 steps long. The formula itself, as well as its mode (COMP, BASE-N, LR, SD) are stored, so any time you need it, you simply go to the proper mode, recall the formula, and press [EXE] to execute it. The following keys are used with the formula storage function.

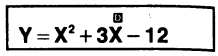
[SHIFT] [IN] — Stores displayed formula
[OUT] — Recalls stored formula

Example Store the following formula, and execute it.
$Y = X^2 + 3X - 12$

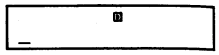
Enter the formula.
[ALPHA] [Y] [ALPHA] [=] [ALPHA] [X] [SHIFT] [x^2] [+] 3 [ALPHA] [X]
[−] 12



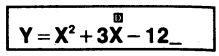
Store the formula.
[SHIFT] [IN]



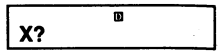
Clear the calculator.
[AC]



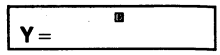
Recall the formula.
[OUT]



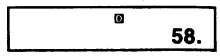
Execute the formula.
[EXE]



Assign values to the variables.
7 [EXE]



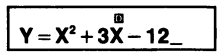
(After approx. 0.5 seconds)



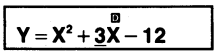
After you recall a formula from memory, you can edit it as you wish.

Example Edit the stored formula to $Y = X^2 + 5X - 12$.

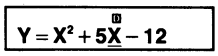
Recall the formula.
[OUT]



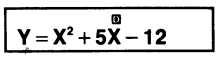
Move the cursor to the location of the change.
[←] [←] [←] [←] [←]



Make the change.
5



Store the new formula (if you wish).
[SHIFT] [IN]



•To clear the contents of the formula memory, press [AC] [SHIFT] [IN].

■ Error Message Table

Message	Meaning	Countermeasures
Syn ERROR	① Error in calculation formula format.	① Press [←] or [→] to locate error, and correct.
Ma ERROR	① Calculation result exceeds allowable range. ② Input range of function exceeded (see page 59). ③ Mathematical error (i.e. division by zero).	① ② ③ Confirm that entered values are within range. Be sure to also check values stored in memory.
Stk ERROR	•Overflow of numeric stack or command stack.	•Simplify calculation so that limitations of stacks are not exceeded (8 levels for numeric stack; 16 levels for command stack). •Break calculation down into smaller parts and execute individually.

■ Input Ranges of Functions

Function	Input range
sin cos tan	(DEG) $\|x\| < 9 \times 10^{9}$° (RAD) $\|x\| < 5 \times 10^{7}\pi$rad (GRA) $\|x\| < 1 \times 10^{10}$grad
$\sin^{-1}$ $\cos^{-1}$	$\|x\| \leqq 1$
$\tan^{-1}$	$\|x\| < 1 \times 10^{100}$
sinh cosh	$\|x\| < 230.2585092$
tanh	$\|x\| < 1 \times 10^{100}$
$\sinh^{-1}$	$\|x\| < 5 \times 10^{99}$
$\cosh^{-1}$	$1 \leqq x < 5 \times 10^{99}$
$\tanh^{-1}$	$\|x\| < 1$
log ln	$1 \times 10^{-99} \leqq x < 1 \times 10^{100}$
10^{x}	$-1 \times 10^{100} < x < 100$
e^{x}	$-1 \times 10^{100} < x \leqq 230.2585092$
$\sqrt{\ }$	$0 \leqq x < 1 \times 10^{100}$
x^{2}	$\|x\| < 1 \times 10^{50}$
x^{-1}	$\|x\| < 1 \times 10^{100}$, $x \neq 0$
$\sqrt[3]{\ }$	$\|x\| < 1 \times 10^{100}$
$x!$	$0 \leqq x \leqq 69$ (x is integer)
Pol (x, y)	$x^{2} + y^{2} < 1 \times 10^{100}$
Rec (r, θ)	$0 \leqq r < 1 \times 10^{100}$ (DEG) $\|\theta\| < 9 \times 10^{9}$° (RAD) $\|\theta\| < 5 \times 10^{7}\pi$rad (GRA) $\|\theta\| < 1 \times 10^{10}$grad

Function	Input range
°' ''	$\|a\|$, b, $c < 1 \times 10^{100}$ $0 \leqq$ b, c
$\overleftarrow{\text{°' ''}}$	$\|x\| < 2.777777777 \times 10^{96}$ Sexageimal display: $\|x\| \leqq 2777777.777$
x^{y}	$x > 0$: $-1 \times 10^{100} < y \log x < 100$ $x = 0$: $y > 0$ $x < 0$: $y = n$, $\frac{1}{2n+1}$ (n is integer) When: $-1 \times 10^{100} < y \log\|x\| < 100$
$\sqrt[x]{y}$	$y > 0$: $x \neq 0$ $-1 \times 10^{100} < \frac{1}{x} \log y < 100$ $y = 0$: $x > 0$ $y < 0$: $x = 2n + 1$, $\frac{1}{n}$ ($n \neq 0$, n is integer) When: $-1 \times 10^{100} < \frac{1}{x} \log\|y\| < 100$
SD	$\|x\| < 1 \times 10^{50}$ $\|n\| < 1 \times 10^{100}$ σ_n, $\bar{x}$: $n \neq 0$ σ_{n-1}: $n \neq 0, 1$
LR	$\|x\|$, $\|y\| < 1 \times 10^{50}$ $\|n\| < 1 \times 10^{100}$ $x\sigma_n$, $y\sigma_n$, $\bar{x}$, $\bar{y}$, a, b, r: $n \neq 0$ $x\sigma_{n-1}$, $y\sigma_{n-1}$: $n \neq 0, 1$
$_{n}P_{r}$ $_{n}C_{r}$	Result $< 1 \times 10^{100}$ (n and r are integers) $0 \leqq r \leqq n$, $n < 1 \times 10^{10}$
BASE-N	Following conversion: DEC: $-2147483648 \leqq x \leqq 2147483647$ BIN: $-10000000000000000000000000000000 \leqq x$ $\leqq 11111111111111111111111111111111$ (Negative) $0 \leqq x \leqq 11111111111111111111111111111111$ (0, Positive) OCT:$20000000000 \leqq x \leqq 37777777777$ (Negative) $0 \leqq x \leqq 17777777777$ (0, Positive) HEX: $-80000000 \leqq x \leqq$ FFFFFFFF (Negative) $0 \leqq x \leqq$ 7FFFFFFF (0, Positive)

*As a rule, the precision of results is ±1 at the 10th digit.
*Internal continuous calculations for such operations as x^y, $x^{1/y}$, $x!$, $\sqrt[3]{x}$ may cause cumulative errors which affect accuracy.
*For tan x $|x| \neq 90° \times (2n+1)$, $|x| \neq \frac{\pi}{2}\text{rad} \times (2n+1)$, $|x| \neq 100\text{gra}(2n+1)$: when n is an integer.
*The idiosyncrasies of $\sinh x$ and $\tanh x$ are such that accuracy is affected as their values approach $x=0$.

14/Specifications

Model:
fx-4100P

Calculation

Basic calculation functions:
Negative numbers, exponents, parenthetical arithmetic operations (with priority sequence judgement function — true algebraic logic)

Built-in functions:
Trigonometric/inverse trigonometric functions (angular units: degrees, radians, grads), hyperbolic/inverse hyperbolic functions, logarithmic/exponential functions, inverse numbers, factorials, square roots, cube roots, powers, roots, squares, decimal-sexagesimal conversions, binary/octal/decimal/hexadecimal calculations, π, random numbers

Statistical calculation functions:
Standard deviation — number of data, sum of data, sum of squares, mean, standard deviation (two types)
Regression analysis — number of data, sum of x, sum of y, sum of squares of x, sum of squares of y, mean of x, mean of y, standard deviation of x (two types), standard deviation of y (two types), constant term, regression coefficient, correlation coefficient, estimated value of x, estimated value of y

Memories:
1 independent memory
6 constant memories
8 variable memories

Calculation range:
$\pm 1 \times 10^{-99} \sim \pm 9.999999999 \times 10^{99}$, and 0. Internal calculation uses 12-digit mantissa.

Rounding:
Performed according to the specified number of significant digits or the number of specified decimal places.

Exponential display:
Norm 1 — $10^{-2} > |x|,\ |x| \geqq 10^{10}$
Norm 2 — $10^{-9} > |x|,\ |x| \geqq 10^{10}$

General

Display:
12-digit dot matrix display, 10-digit mantissa plus 2-digit exponent

Power supply: One lithium battery (CR2032)

Power consumption: 0.002W

Battery life: Approximately 5,500 hours for CR2032 (continuous use)

Auto power OFF:
Approximately six minutes after last key operation

Ambient temperature range:
0°C ~ 40°C (32°F ~ 104°F)

Dimensions: 9H × 73W × 129mmD (3/8″H × 2 7/8″W × 5″D)

Weight: 71 g (2.5 oz)