E

fx-100MS
fx-115MS
fx-570MS
fx-991MS

User's Guide

CASIO Worldwide Education Website

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EEE Yönetmeliğine Uygundur

RJA526827-001V02

CASIO®

Contents

Important Information

- The displays and illustrations (such as key markings) shown in this User's Guide are for illustrative purposes only, and may differ somewhat from the actual items they represent.
- The contents of this manual are subject to change without notice.
- In no event shall CASIO Computer Co., Ltd. be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of this product and items that come with it. Moreover, CASIO Computer Co., Ltd. shall not be liable for any claim of any kind whatsoever by any other party arising out of the use of this product and the items that come with it.
- Be sure to keep all user documentation handy for future reference.

Sample Operations

Sample operations in this manual are indicated by a ✎ icon. Unless specifically stated, all sample operations assume that the calculator is in its initial default setup. Use the procedure under "Initializing the Calculator" to return the calculator to its initial default setup.

Initializing the Calculator

Perform the following procedure when you want to initialize the calculator and return the calculation mode and setup to their initial default settings. Note that this operation also clears all data currently in calculator memory.

[ON] [SHIFT] [MODE] (CLR) [3] (All) [=]

Safety Precautions

⚠ **Battery**

- Keep batteries out of the reach of small children.
- Use only the type of battery specified for this calculator in this manual.

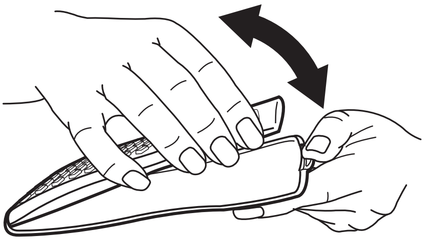
Handling Precautions

- **Dim figures on the display of the calculator indicate that battery power is low. Continued use of the calculator when the battery is low can result in improper operation. Replace the battery as soon as possible when display figures becomes dim. Even if the calculator is operating normally, replace the battery at least once every two years (fx-100MS), or three years (fx-115MS/570MS/991MS). A dead battery can leak, causing damage to and malfunction of the calculator. Never leave a dead battery in the calculator.**
- **The battery that comes with the calculator discharges slightly during shipment and storage. Because of this, it may require replacement sooner than the normal expected battery life.**

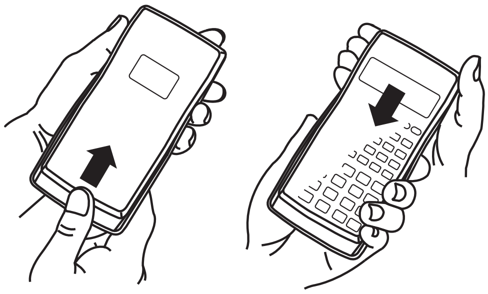
- **Do not use an oxyride battery* or any other type of nickel-based primary battery with this product. Incompatibility between such batteries and product specifications can result in shorter battery life and product malfunction.**
- **Avoid use and storage of the calculator in areas subjected to temperature extremes, and large amounts of humidity and dust.**
- **Do not subject the calculator to excessive impact, pressure, or bending.**
- **Never try to take the calculator apart.**
- **Use a soft, dry cloth to clean the exterior of the calculator.**
- **Whenever discarding the calculator or batteries, be sure to do so in accordance with the laws and regulations in your particular area.**

* Company and product names used in this manual may be registered trademarks or trademarks of their respective owners.

Removing the Hard Case



fx-115MS



fx-100MS/570MS/991MS

Turning Power On and Off

Press [ON] to turn on the calculator.
Press [SHIFT] [AC] (OFF) to turn off the calculator.

Auto Power Off
Your calculator will turn off automatically if you do not perform any operation for about 10 minutes. If this happens, press the [ON] key to turn the calculator back on.

Adjusting Display Contrast

1. Press the [MODE] key a number of times until you reach the setup screen shown to the right.

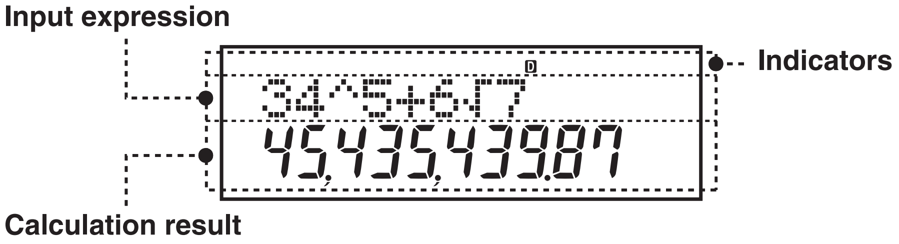
```
Disp ◄CONT►
 1      2
```

2. Press [2].
3. Use ◀ and ▶ to adjust contrast.
4. After the setting is the way you want, press [AC].

Important: If adjusting display contrast does not improve display readability, it probably means that battery power is low. Replace the battery.

Reading the Display

The display of the calculator shows expressions you input, calculation results, and various indicators.



Specifying the Calculation Mode

When you want to perform this type of operation:	Perform this key operation:
General calculations	[MODE] [1] (COMP)
Complex number calculations	[MODE] [2] (CMPLX)
Standard deviation	[MODE] [MODE] [1] (SD)
Regression calculations	[MODE] [MODE] [2] (REG)
Calculations involving specific number systems (binary, octal, decimal, hexadecimal)	[MODE] [MODE] [3] (BASE)
Equation solution	[MODE] [MODE] [MODE] [1] (EQN)
Matrix calculations (fx-570MS/991MS only)	[MODE] [MODE] [MODE] [2] (MAT)
Vector calculations (fx-570MS/991MS only)	[MODE] [MODE] [MODE] [3] (VCT)

Note: • The initial default calculation mode is the COMP Mode. • Mode indicators appear in the upper part of the display, except for the BASE indicators, which appear in the exponent part of the display. • Engineering symbols are automatically turned off while the calculator is the BASE Mode. • You cannot make changes to the angle unit or other display format (Disp) settings while the calculator is in the BASE Mode. • The COMP, CMPLX, SD, and REG Modes can be used in combination with the angle unit settings. • Be sure to check the current calculation mode (SD, REG, COMP, CMPLX) and angle unit setting (Deg, Rad, Gra) before beginning a calculation.

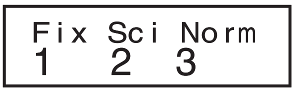
Configuring the Calculator Setup

Pressing the [MODE] key more than three times displays additional setup screens.

Underlined (___) settings are initial defaults.

[1] <u>Deg</u> **[2] Rad** **[3] Gra** Specifies degrees, radians or grads as the angle unit for value input and calculation result display.

Note: In this manual, the **Deg** symbol next to a sample operation indicates degrees.



[1] **Fix** [2] **Sci** [3] **Norm** Specifies the number of digits for display of a calculation result.

Fix: The value you specify (from 0 to 9) controls the number of decimal places for displayed calculation results. Calculation results are rounded off to the specified digit before being displayed.

Example: $100 \div 7 = 14.286$ (Fix 3)

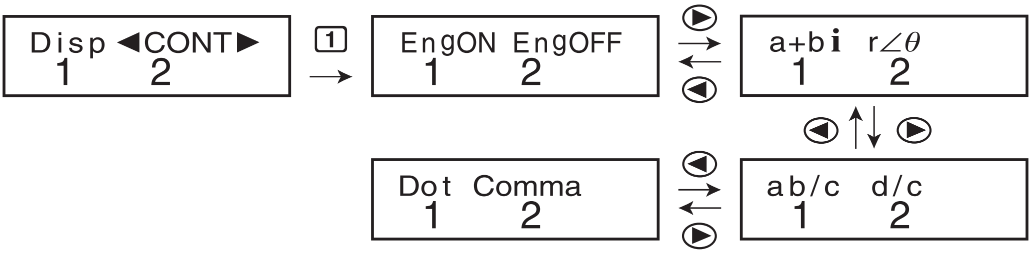
Sci: The value you specify (from 1 to 10) controls the number of significant digits for displayed calculation results. Calculation results are rounded off to the specified digit before being displayed.

Example: $1 \div 7 = 1.4286 \times 10^{-1}$ (Sci 5)

Norm: Selecting one of the two available settings (**Norm 1**, Norm 2) determines the range in which results will be displayed in non-exponential format. Outside the specified range, results are displayed using exponential format.

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

Example: $1 \div 200 = 5 \times 10^{-3}$ (Norm 1); 0.005 (Norm 2)



[1] **EngON** [2] **EngOFF** Specifies whether engineering symbols are used (EngON) or not used (EngOFF) during value input. The "Eng" indicator is displayed while EngON is selected.

[1] **a+bi** [2] **r∠θ** (CMPLX Mode/EQN Mode only) Specifies either rectangular coordinates ($a+bi$) or polar coordinates ($r\angle\theta$) for CMPLX Mode/EQN Mode solutions. The "r∠θ" indicator is displayed while polar coordinates ($r\angle\theta$) are selected.

[1] **ab/c** [2] **d/c** Specifies either mixed fraction (ab/c) or improper fraction (d/c) for display of fractions in calculation results.

[1] **Dot** [2] **Comma** Specifies whether to display a dot or a comma for the calculation result decimal point. A dot is always displayed during input.

Dot: Period decimal point, comma separator

Comma: Comma decimal point, period separator

Initializing Calculation Mode and Setup

To return the calculation mode and setup to the initial defaults shown below, press [ON] [SHIFT] [MODE] (CLR) [2] (Mode) [=].

Calculation Mode: COMP

Angle Unit: Deg

Exponential Display Format: Norm 1, EngOFF

Complex Number Display Format: $a+bi$

Fraction Display Format: a b/c

Decimal Point Character: Dot

Inputting Expressions and Values

$4 \times \sin 30 \times (30 + 10 \times 3) = 120$ **Deg**

4 [×] [sin] 30 [×] [(] 30 [+] 10 [×] 3 [)] [=]

```
4×sin 30×(30
        120.
```

Note: • The memory area used for calculation input can hold 79 "steps". One step is taken up each time you press a number key or arithmetic operator key ([+], [−], [×], [÷]). A [SHIFT] or [ALPHA] key operation does not take up a step, so inputting [SHIFT] [^] ($^x\sqrt{\ }$), for example, takes up only one step. • Whenever you input the 73rd step of any calculation, the cursor changes from "_" to "■" to let you know memory is running low.

Calculation Priority Sequence

When the priority of two expressions is the same, the calculation is performed from left to right.

1st	Function with parentheses: Pol (x, y), Rec (r, θ), differentials (d/dx), integrations ($\int dx$), normal distribution (P**(**, Q**(**, R**(**)
2nd	Type A functions: With these functions, the value is entered and then the function key is pressed. (x^3, x^2, x^{-1}, $x!$, ° ' ", $\hat{x}$, $\hat{x}_1$, $\hat{x}_2$, $\hat{y}$, ►t, °, ^{r}, ^{g}, engineering symbols, metric conversions*) (*fx-570MS/991MS only)
3rd	Powers and roots: ^(x^y), $^x\sqrt{\ }$
4th	Fractions
5th	Implied multiplication of π, e (natural logarithm base), memory name, or variable name: 2π, 3e, 5A, πA, etc.
6th	Type B functions: With these functions, the function key is pressed and then the value is entered. ($\sqrt{\ }$, $^3\sqrt{\ }$, 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, Det*, Trn*, arg, Abs, Conjg) (*fx-570MS/991MS only)
7th	Implied multiplication of Type B functions: $2\sqrt{3}$, Alog2, etc.
8th	Permutation (nPr), combination (nCr), complex number polar coordinate symbol (∠)
9th	Dot product (·) (fx-570MS/991MS only)
10th	Multiplication, division (×, ÷)
11th	Addition, subtraction (+, –)
12th	Logical AND (and)
13th	Logical OR, XOR, XNOR (or, xor, xnor)

- The negative sign (–) is treated as a Type B function, so particular care is required when the calculation includes a high-priority Type A function, or power or root operations.
  Example: $(-2)^4 = 16$; $-2^4 = -16$

Making Corrections During Input

- Use ◀ and ▶ to move the cursor to the location you want.
- Press DEL to delete the number or function at the current cursor position.
- Press SHIFT DEL (INS) to change to an insert cursor ⌈⌋. Inputting something while the insert cursor is on the display inserts the input at the insert cursor position.
- Pressing SHIFT DEL (INS), or = returns to the normal cursor from the insert cursor.

Basic Calculations

Fraction Calculations

$\frac{2}{3} + \frac{1}{2} = 1\frac{1}{6}$	2 a b/c 3 + 1 a b/c 2 =	**1⌟1⌟6.**
$4 - 3\frac{1}{2} = \frac{1}{2}$	4 − 3 a b/c 1 a b/c 2 =	**1⌟2.**

Note: • Mixing fractions and decimal values in a calculation will cause the result to be displayed as a decimal value. • Fractions in calculation results are displayed after being reduced to their lowest terms.

To switch a calculation result between improper fraction and mixed fraction format: Press SHIFT a b/c (d/c).

To switch a calculation result between fraction and decimal format: Press a b/c.

Percent Calculations

$150 \times 20\% = 30$	150 × 20 SHIFT = (%)	**30.**
Calculate what percentage of 880 is 660. (75%)	660 ÷ 880 SHIFT = (%)	**75.**
Increase 2500 by 15%. (2875)	2500 × 15 SHIFT = (%) +	**2875.**
Discount 3500 by 25%. (2625)	3500 × 25 SHIFT = (%) −	**2625.**
Discount the sum of 168, 98, and 734 by 20%. (800)	168 + 98 + 734 = Ans SHIFT RCL (STO) (−) (A) ALPHA (−) (A)* × 20 SHIFT = (%) −	**800.**

* As shown here, if you want to use the current Ans (answer) memory value in a mark up or discount calculation, you need to assign the Ans memory value into a variable and then use the variable in the mark up/discount calculation.

300 grams are added to a test sample originally weighing 500 grams, producing a final test sample of 800 grams. What percent of 500 grams is 800 grams? (160%)

300 [+] 500 [SHIFT] [=] (%) **160.**

What is the percentage change when a value is increased from 40 to 46? (15%)

46 [−] 40 [SHIFT] [=] (%) **15.**

Degree, Minute, Second (Sexagesimal) Calculations

The following is the input format for a sexagesimal value: {degrees} [°'"] {minutes} [°'"] {seconds} [°'"].

Note: You must always input something for the degrees and minutes, even if they are zero.

2°20´30˝ + 39´30˝ = 3°00´00˝

2 [°'"] 20 [°'"] 30 [°'"] [+] 0 [°'"] 39 [°'"] 30 [°'"] [=] **3°0°0.**

Convert 2°15´18˝ to its decimal equivalent.

2 [°'"] 15 [°'"] 18 [°'"] [=] **2°15°18.**

(Converts sexagesimal to decimal.) [°'"] **2.255**

(Converts decimal to sexagesimal.) [SHIFT] [°'"] (←) **2°15°18.**

Multi-Statements

You can use the colon character (:) to connect two or more expressions and execute them in sequence from left to right when you press [=].

3 + 3 : 3 × 3 3 [+] 3 [ALPHA] [∫dx] (:) 3 [×] 3 [=] **6.Disp**

[=] **9.**

Using Engineering Notation

A simple key operation transforms a displayed value to engineering notation.

Transform the value 1234 to engineering notation, shifting the decimal point to the right.

1234 [=] **1234.**

[ENG] **1.234×10^3**

[ENG] **$1234.\times10^0$**

Inputting Engineering Symbols

The following are the nine symbols that can be used when engineering symbols are turned on.

To input this symbol:	Perform this key operation:	Unit
k (kilo)	SHIFT 6 (k)	10^3
M (Mega)	SHIFT 7 (M)	10^6
G (Giga)	SHIFT 8 (G)	10^9
T (Tera)	SHIFT 9 (T)	10^{12}
m (milli)	SHIFT 5 (m)	10^{-3}
μ (micro)	SHIFT 4 (μ)	10^{-6}
n (nano)	SHIFT 3 (n)	10^{-9}
p (pico)	SHIFT 2 (p)	10^{-12}
f (femto)	SHIFT 1 (f)	10^{-15}

100 m (milli) × 5 μ (micro) = 500 n (nano)

MODE ····· 1 (Disp) 1 (EngON)

100 SHIFT 5 (m) × 5 SHIFT 4 (μ) =

100m×5μ n Eng 500.

9 ÷ 10 = 0.9 m (milli)

MODE ····· 1 (Disp) 1 (EngON)

9 ÷ 10 =

9÷10 m Eng 900.

When engineering symbols are turned on, even standard (non-engineering) calculation results are displayed using engineering symbols.

SHIFT ENG (←) **0.9**

ENG

9÷10 m Eng 900.

Note: • For displayed values, the calculator selects the engineering symbol that makes the numeric part of the value fall within the range of 1 to 1000. • Engineering symbols cannot be used when inputting fractions.

Calculation History

In the COMP, CMPLX, or BASE Mode, the calculator remembers up to approximately 150 bytes of data for the newest calculation. You can scroll through calculation history contents using ▲ and ▼.

1 + 1 = 2	1 + 1 =	**2.**
2 + 2 = 4	2 + 2 =	**4.**
3 + 3 = 6	3 + 3 =	**6.**
	(Scrolls back.) ▲	**4.**
	(Scrolls back again.) ▲	**2.**

A calculation stored in calculation history can be displayed as a multi-statement. For information about what you can do with multi-statements, see “Multi-Statements”.

After performing the calculations 1+1, 2+2, 3+3, 4+4, 5+5, and 6+6, the multi-statement will show 4+4:5+5:6+6.

Key operation	Display
1 [+] 1 [=] 2 [+] 2 [=] 3 [+] 3 [=] 4 [+] 4 [=] 5 [+] 5 [=] 6 [+] 6 [=]	6+6 ▲ 12.
[▲] [▲]	4+4 ▲ 8.
[SHIFT] [▲] (COPY)	4+4 : 5+5 : 6+6_ ▲ 8.
[=]	4+4 ▲ 8. Disp

Note: Calculation history data is all cleared whenever you press [ON], when you change to a different calculation mode, or whenever you initialize modes and settings.

Replay

While a calculation result is on the display, you can press [◀] or [▶] to edit the expression you used for the previous calculation.

Calculation	Key operation	Result
<u>4 × 3</u> + 2.5 = 14.5	4 [×] 3 [+] 2.5 [=]	**14.5**
<u>4 × 3</u> − 7.1 = 4.9 (Continuing)	[◀] [DEL] [DEL] [DEL] [DEL] [−] 7.1 [=]	**4.9**

Answer Memory (Ans)

The last calculation result obtained is stored in Ans (answer) memory. Ans memory contents are updated whenever a new calculation result is displayed. In addition to [=], Ans memory contents are also updated with result whenever you press [SHIFT] [=] (%), [M+], [SHIFT] [M+] (M−), or [SHIFT] [RCL] (STO) followed by a letter (A through F, or M, X, or Y).

To divide the result of 3 × 4 by 30

	Key operation	Result
	3 [×] 4 [=]	**12.**
(Continuing)	[÷] 30 [=]	Ans÷30 0.4

Calculation	Key operation	Result
123 + 456 = <u>579</u>	123 [+] 456 [=]	**579.**
789 − <u>579</u> = 210 (Continuing)	789 [−] [Ans] [=]	**210.**

Variables (A, B, C, D, E, F, X, Y)

Your calculator has eight preset variables named A, B, C, D, E, F, X, and Y.

To assign the result of 3 + 5 to variable A

3 [+] 5 [SHIFT] [RCL] (STO) [(−)] (A) **8.**

To multiply the contents of variable A by 10

(Continuing) [ALPHA] [(-)] (A) [×] 10 [=] **80.**

To recall the contents of variable A

(Continuing) [RCL] [(-)] (A) **8.**

To clear the contents of variable A

0 [SHIFT] [RCL] (STO) [(-)] (A) **0.**

Independent Memory (M)

You can add calculation results to or subtract results from independent memory. The “M” appears on the display when there is any value other than zero stored in independent memory.

To clear the contents of M

0 [SHIFT] [RCL] (STO) [M+] (M) **0.**

To add the result of 10 × 5 to M

(Continuing) 10 [×] 5 [M+] **50.**

To subtract the result of 10 + 5 from M

(Continuing) 10 [+] 5 [SHIFT] [M+] (M–) **15.**

To recall the contents of M

(Continuing) [RCL] [M+] (M) **35.**

Note: Variable M is used for independent memory.

Clearing the Contents of All Memories

Independent memory and variable contents are retained even if you press [AC], change the calculation mode, or turn off the calculator. Perform the following procedure when you want to clear the contents of all memories.

[ON] [SHIFT] [MODE] (CLR) [1] (Mcl) [=]

Function Calculations

π : π is displayed as 3.141592654, but π = 3.14159265358980 is used for internal calculations.

***e* :** *e* is displayed as 2.718281828, but *e* = 2.71828182845904 is used for internal calculations.

sin, cos, tan, sin^{-1}, cos^{-1}, tan^{-1} : Trigonometric functions. Specify the angle unit before performing calculations. See 1.

sinh, cosh, tanh, sinh^{-1}, cosh^{-1}, tanh^{-1} : Hyperbolic functions. The angle unit setting does not affect calculations. See 2.

°, ^{r}, ^{g} : These functions specify the angle unit. ° specifies degrees, ^{r} radians, and ^{g} grads. Input a function from the menu that appears when you perform the following key operation: SHIFT Ans (DRG▶). See 3.

10^x, e^x: Exponential functions. See 4.

log: Logarithmic function. See 5.

ln: Natural logarithm to base e. See 6.

x^2, x^3, ^(x^y), $\sqrt{\ }$, $\sqrt[3]{\ }$, $\sqrt[x]{\ }$, x^{-1}: Powers, power roots, and reciprocals. See 7.

Note: x^2, x^3, x^{-1} can be used in complex number calculations.

$\int dx$: The following four inputs are required for integration calculations: a function with the variable x; a and b, which define the integration range of the definite integral; and n, which is the number of partitions (equivalent to N=2^n) for integration using Simpson's rule.

∫dx $f(x)$, a , b , n)

Also see "Integration and Differential Calculation Precautions" for more information. See 8 .

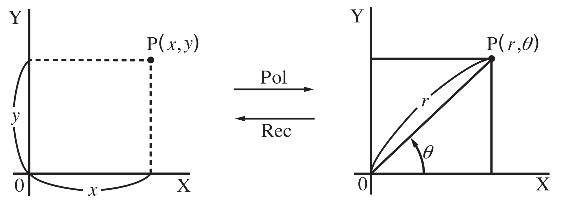
d/dx: Three inputs are required for the differential expression: the function of variable x, the point (a) at which the differential coefficient is calculated, and the change in x (Δx).

SHIFT ∫dx (d/dx) $f(x)$, a , Δx)

Also see "Integration and Differential Calculation Precautions" for more information. See 9.

Pol, Rec: Pol converts rectangular coordinates to polar coordinates, while Rec converts polar coordinates to rectangular coordinates. See 10 .

Pol(x, y) = (r, θ)   Rec(r, θ) = (x, y)



Rectangular Coordinates (Rec)   **Polar Coordinates (Pol)**

Specify the angle unit before performing calculations. Calculation result θ is displayed in the range of $-180° < \theta \leqq 180°$.

x!: Factorial function. See 11.

Ran#: Generates a 3-digit pseudo random number that is less than 1. See 12 .

nPr, nCr: Permutation (nPr) and combination (nCr) functions. See 13 .

Rnd: The argument of this function is made a decimal value and then rounded in accordance with the current number of display digits setting (Norm, Fix, or Sci). With Norm 1 or Norm 2, the argument is rounded off to 10 digits. See 14 .

Note: Using functions can slow down a calculation, which may delay display of the result. To interrupt an ongoing calculation before its result appears, press AC.

Integration and Differential Calculation Precautions

- Integration and differential calculations can be performed in the COMP Mode ([MODE] [1]) only.
- When using a trigonometric function in $f(x)$, specify Rad as the angle unit.

Precautions for Integration Calculation Only

- You can specify an integer in the range of 1 to 9 as the number of partitions, or you can skip input of the number of partitions entirely, if you want.
- Internal integration calculations may take considerable time to complete.
- Display contents are cleared while an integration calculation is being performed internally.

Precautions for Differential Calculation Only

- You can omit input of Δx, if you want. The calculator automatically substitutes an appropriate value for Δx if you do not input one.
- Discontinuous points and extreme changes in the value of x can cause inaccurate results and errors.

Examples

1 $\sin 30° = 0.5$ **Deg** — [sin] 30 [=] → **0.5**

$\sin^{-1} 0.5 = 30°$ **Deg** — [SHIFT] [sin] ($\sin^{-1}$) 0.5 [=] → **30.**

2 $\sinh 1 = 1.175201194$ — [hyp] [sin] (sinh) 1 [=] → **1.175201194**

$\cosh^{-1} 1 = 0$ — [hyp] [SHIFT] [cos] ($\cosh^{-1}$) 1 [=] → **0.**

3 $\pi/2$ radians = 90°, 50 grads = 45° **Deg**

[(] [SHIFT] [EXP] (π) [÷] 2 [)] [SHIFT] [Ans] (DRG▶) [2] (R) [=] → **90.**

50 [SHIFT] [Ans] (DRG▶) [3] (G) [=] → **45.**

4 To calculate $e^5 \times 2$ to three significant digits (Sci 3)

[MODE] ····· [2] (Sci) [3] — [SHIFT] [ln] (e^x) 5 [×] 2 [=] → **2.97×10^2**

5 $\log 1000 = 3$ — [log] 1000 [=] → **3.**

6 To calculate ln 90 (= $\log_e 90$) to three significant digits (Sci 3)

[MODE] ····· [2] (Sci) [3] — [ln] 90 [=] → **4.50×10^0**

7 $1.2 \times 10^2 = 120$ — 1.2 [×] 10 [x^2] [=] → **120.**

$(-5^2)^3 = -15625$ — [(] [(−)] 5 [x^2] [)] [^] 3 [=] → **–15625.**

$\sqrt[5]{32} = 2$ — 5 [SHIFT] [^] ($\sqrt[x]{\ }$) 32 [=] → **2.**

To calculate $\sqrt{2} \times 3$ (= $3\sqrt{2}$ = 4.242640687...) to three decimal places (Fix 3)

[MODE] ····· [1] (Fix) [3] — [√] 2 [×] 3 [=] → **4.243**

8 $\int_1^5 (2x^2 + 3x + 8)\, dx = 150.6666667$ (n = 6)

[∫dx] 2 [ALPHA] [)] (X) [x²] [+] 3 [ALPHA] [)] (X) [+] 8 [,] 1 [,] 5 [,] 6 [)] [=] **150.6666667**

9 To determine the derivative at point x = 2 for the function $y = 3x^2 - 5x + 2$, when the increase or decrease in x is $\Delta x = 2 \times 10^{-4}$

[SHIFT] [∫dx] (d/dx) 3 [ALPHA] [)] (X) [x²] [−] 5 [ALPHA] [)] (X) [+] 2 [,] 2 [,] 2 [EXP] [(−)] 4 [)] [=] **7.**

10 To convert rectangular coordinates ($\sqrt{2}$, $\sqrt{2}$) to polar coordinates **Deg**

[SHIFT] [+] (Pol() [√] 2 [,] [√] 2 [)] [=] r = **2.**

[RCL] [tan] (F) θ = **45.**

- Press [RCL] [cos] (E) to display the value of r, or [RCL] [tan] (F) to display the value of θ.

To convert polar coordinates ($\sqrt{2}$, 45°) to rectangular coordinates **Deg**

[SHIFT] [−] (Rec() [√] 2 [,] 45 [=] x = **1.**

[RCL] [tan] (F) y = **1.**

- Press [RCL] [cos] (E) to display the value of x, or [RCL] [tan] (F) to display the value of y.

11 (5 + 3) ! = 40320 [(] 5 [+] 3 [)] [SHIFT] [x⁻¹] (x!) [=] **40320.**

12 To obtain two random three-digit integers

1000 [SHIFT] [•] (Ran#) [=] **459.**

[=] **48.**

(Actual results will differ.)

13 To determine the number of permutations and combinations possible when selecting four people from a group of 10

Permutations:	10 [SHIFT] [×] (nPr) 4 [=]	**5040.**
Combinations:	10 [SHIFT] [÷] (nCr) 4 [=]	**210.**

14 To perform the following calculations when Fix 3 is selected for the number of display digits: 10 ÷ 3 × 3 and Rnd(10 ÷ 3) × 3

[MODE] ····· [1] (Fix) [3] 10 [÷] 3 [×] 3 [=] **10.000**

10 [÷] 3 [=] [SHIFT] [0] (Rnd) [×] 3 [=] **9.999**

Complex Number Calculations (CMPLX)

To perform complex number calculations, first press MODE 2 (CMPLX) to enter the CMPLX Mode. You can use either rectangular coordinates (a+bi) or polar coordinates ($r\angle\theta$) to input complex numbers. Complex number calculation results are displayed in accordance with the complex number format setting on the setup menu.

(2 + 6i) ÷ (2i) = 3 – i (Complex number format: a + bi)

(2 + 6 ENG (i)) ÷ (2 ENG (i)) = Real part = **3**

SHIFT = (Re⇔Im) Imaginary part = **–i**

$\sqrt{2}\angle 45$ = 1+i **Deg** (Complex number format: a + bi)

√ 2 SHIFT (–) (∠) 45 = Real part = **1**

SHIFT = (Re⇔Im) Imaginary part = **i**

- You can use variables A, B, C, and M only in the CMPLX Mode. Variables D, E, F, X, and Y are used by the calculator, which frequently changes their values. You should not use these variables in your expressions.
- The indicator "Re⇔Im" is displayed while a complex number calculation is on the display. Press SHIFT = (Re⇔Im) to toggle the display between the real part (a) and imaginary part (b), and the absolute value (r) and argument (θ).
- If you are planning to perform input and display of the calculation result in polar coordinate format, specify the angle unit before starting the calculation.
- The θ value of the calculation result is displayed in the range of $-180° < \theta \leqq 180°$.

CMPLX Mode Calculation Examples

To obtain the conjugate complex number of 2 + 3i (Complex number format: a + bi)

SHIFT , (Conjg) (2 + 3 ENG (i)) = Real part = **2**

SHIFT = (Re⇔Im) Imaginary part = **–3i**

To obtain the absolute value and argument of 1 + i **Deg**

Absolute Value:

SHIFT) (Abs) (1 + ENG (i)) = **1.414213562**

Argument:

SHIFT ((arg) (1 + ENG (i)) = **45.**

Using a Command to Specify the Calculation Result Format

Either of two special commands (►$r\angle\theta$ or ►a+bi) can be input at the end of a calculation to specify the display format of the calculation results. The command overrides the calculator's complex number format setting.

1 + i = 1.414213562 ∠ 45, 1.414213562 ∠ 45 = 1 + i **Deg**

1 [+] [ENG] (i) [SHIFT] [+] (▶$r∠\theta$) [=]	r = **1.414213562**
[SHIFT] [=] (Re⇔Im)	θ = ∠**45**
[√] 2 [SHIFT] [(–)] (∠) 45 [SHIFT] [–] (▶$a+bi$) [=]	Real part = **1**
[SHIFT] [=] (Re⇔Im)	Imaginary part = **i**

Using CALC

CALC lets you save calculation expressions that contain variables, which you can then recall and execute in the COMP Mode ([MODE] [1]) and the CMPLX Mode ([MODE] [2]). The following describes the types of expressions you can save with CALC.

- Expressions: 2X + 3Y, 2AX + 3BY + C, A + Bi
- Multi-statements: X + Y : X (X + Y)
- Equalities with a single variable on the left and an expression including variables on the right: A = B + C, Y = X^2 + X + 3
  (Use [ALPHA] [CALC] (=) to input the equals sign of the equality.)

To store 3A + B and then substitute the following values to perform the calculation: (A, B) = (5, 10), (7, 20)

3 [ALPHA] [(–)] (A) [+] [ALPHA] [°'''] (B)	3A+B_
[CALC]	A? 0.
	Prompts for input of a value for A; Current value of A
5 [=] 10 [=]	3A+B 25.
[CALC] (or [=])	A 5.
7 [=] 20 [=]	3A+B 41.
To exit CALC: [AC]	

Using SOLVE

SOLVE lets you solve an expression using variable values you want, without the need to transform or simplify the expression. Note that SOLVE can be used in the COMP Mode ([MODE] [1]) only.

Important: The following functions are not allowed inside of an equation: ∫, d/dx, Pol, Rec.

To solve $y = ax^2 + b$ for x when $y = 0$, $a = 1$, and $b = -2$

ALPHA , (Y) ALPHA CALC (=) ALPHA (−) (A) ALPHA) (X) x^2 + ALPHA °’’’ (B)	Y=AX²+B_
SHIFT CALC (SOLVE)	Y? 0.
	Prompts for input of a value for Y · Current value of Y
0 =	A?
1 =	X?
▼	B?
(−) 2 = ▲	X?
SHIFT CALC (SOLVE)	X= 1.414213562
	Solution screen

To exit SOLVE: AC

Important: • Depending on what you input for the initial value (solution variable), SOLVE may not be able to obtain solutions. If this happens, try changing the initial value so they are closer to the solution. • SOLVE may not be able to determine the correct solution, even when one exists. • SOLVE uses Newton's Law, so even if there are multiple solutions, only one of them will be returned. • Due to limitations in Newton's Law, solutions tend to be difficult to obtain for equations like the following: $y = \sin(x)$, $y = e^x$, $y = \sqrt{x}$, $y = x^{-1}$ • If an expression does not include an equals sign (=), SOLVE produces a solution for expression = 0.

Statistical Calculations (SD, REG)

To select this type of statistical calculation: (Regression formula shown in parentheses)	**Perform this key operation:**
Single-variable (X)	MODE MODE 1 (SD)
Paired-variable (X, Y), linear regression ($y = \mathrm{A} + \mathrm{B}x$)	MODE MODE 2 (REG) 1 (Lin)
Paired-variable (X, Y), logarithmic regression ($y = \mathrm{A} + \mathrm{B}\ln x$)	MODE MODE 2 (REG) 2 (Log)
Paired-variable (X, Y), e exponential regression ($y = \mathrm{A}e^{\mathrm{B}\cdot x}$)	MODE MODE 2 (REG) 3 (Exp)
Paired-variable (X, Y), power regression ($y = \mathrm{A}x^{\mathrm{B}}$)	MODE MODE 2 (REG) ▶ 1 (Pwr)
Paired-variable (X, Y), inverse regression ($y = \mathrm{A} + \mathrm{B}/x$)	MODE MODE 2 (REG) ▶ 2 (Inv)
Paired-variable (X, Y), quadratic regression ($y = \mathrm{A} + \mathrm{B}x + \mathrm{C}x^2$)	MODE MODE 2 (REG) ▶ 3 (Quad)

Inputting Data

- In the SD Mode and REG Mode, the [M+] key operates as the [DT] key.
- Always start data input with [SHIFT] [MODE] (CLR) [1] (Scl) [=] to clear statistical memory.
- Input data using the key sequence shown below.
  SD Mode: <x-data> [DT]
  REG Mode: <x-data> [,] <y-data> [DT]
- [DT] [DT] inputs the same data twice.
- You can also input multiple entries of the same data using [SHIFT] [,] (;).

Data Input Precautions

- While inputting data or after inputting data is complete, you can use the [▲] and [▼] keys to scroll through data you have input. If you input multiple entries of the same data using [SHIFT] [,] (;) to specify the data frequency (number of data items) as described above, scrolling through data shows both the data item and a separate screen for the data frequency (Freq).
- Input the new value and then press the [=] key to replace the old value with the new one. This also means that if you want to perform some other operation, you should always press the [AC] key first to exit data display.
- Pressing the [DT] key instead of [=] after changing a value on the display registers the value you input as a new data item, and leaves the old value as it is.
- You can delete a data value displayed using [▲] and [▼] by pressing [SHIFT] [M+] (CL). Deleting a data value causes all values following it to be shifted up.
- The message "Data Full" appears and you will not be able to input any more data if there is no memory left for data storage. If this happens, press the [=] key to display the screen shown below.
  Press [2] to exit data input without registering the value you just input.
  Press [1] if you want to register the value you just input. If you do this, however, you will not be able to display or edit any of the data you have input.

  ```
  EditOFF  ESC
  1        2
  ```

- After inputting statistical data in the SD Mode or REG Mode, you will be unable to display or edit individual data items any longer after perform either the following operations: changing to another mode; changing the regression type.
- Entering the REG Mode and selecting a regression type (Lin, Log, Exp, Pwr, Inv, Quad) clear variables A through F, X, and Y.
- Do not use variables A through F, X, or Y to store data when performing statistical calculations.

Obtaining Statistical Values from Input Data

Supported statistical variables and the keys you should press to recall them are shown below. For single-variable statistical calculations, the variables marked with an asterisk (*) are available.

Sum: Σx^2*, Σx*, Σy^2, Σy, Σxy, Σx^3, Σx^2y, Σx^4, **Number of Items:** n*
Σx^2, Σx, n .... [SHIFT] [1] (S-SUM) [1] to [3]
Σy^2, Σy, Σxy....... [SHIFT] [1] (S-SUM) [▶] [1] to [3]

Σx^3, $\Sigma x^2 y$, Σx^4 .... SHIFT 1 (S-SUM) ▶ ▶ 1 to 3 (Quadratic Regression only)

Mean: $\bar{x}$*, $\bar{y}$, **Population Standard Deviation:** σx*, σy, **Sample Standard Deviation:** sx*, sy

$\bar{x}$, σx, sx .... SHIFT 2 (S-VAR) 1 to 3

$\bar{y}$, σy, sy .... SHIFT 2 (S-VAR) ▶ 1 to 3

Regression Coefficients: A, B, **Correlation Coefficient:** r
Regression Coefficients for Quadratic Regression: A, B, C

SHIFT 2 (S-VAR) ▶ ▶ 1 to 3

Estimated Values: $\hat{x}$, $\hat{y}$
Estimated Values for Quadratic Regression: $\hat{x}_1$, $\hat{x}_2$, $\hat{y}$

SHIFT 2 (S-VAR) ▶ ▶ ▶ 1 to 2 (or 3)

- $\hat{x}$, $\hat{x}_1$, $\hat{x}_2$ and $\hat{y}$ are not variables. They are commands of the type that take an argument immediately before them. See "Calculating Estimated Values" for more information.

Note: While single-variable statistical calculation is selected, you can input the functions and commands for performing normal distribution calculation from the menu that appears when you perform the following key operation: SHIFT 3 (DISTR). See "Performing Normal Distribution Calculations" for details.

---

1 To calculate the mean ($\bar{x}$) and population standard deviation (σx) for the following data: 55, 54, 51, 55, 53, 53, 54, 52

MODE MODE 1 (SD)

55 DT 54 DT 51 DT 55 DT 53 DT DT 54 DT 52 DT

SHIFT 2 (S-VAR) 1 ($\bar{x}$) = **53.375**

SHIFT 2 (S-VAR) 2 (σx) = **1.316956719**

---

2 To calculate the linear regression and logarithmic regression correlation coefficients (r) for the following paired-variable data and determine the regression formula for the strongest correlation: (x, y) = (20, 3150), (110, 7310), (200, 8800), (290, 9310). Specify Fix 3 (three decimal places) for results.

MODE MODE 2 (REG) 1 (Lin) MODE ····· 1 (Fix) 3

20 , 3150 DT 110 , 7310 DT

200 , 8800 DT 290 , 9310 DT

SHIFT 2 (S-VAR) ▶ ▶ 3 (r) = **0.923**

MODE MODE 2 (REG) 2 (Log)

20 , 3150 DT 110 , 7310 DT

200 , 8800 DT 290 , 9310 DT

SHIFT 2 (S-VAR) ▶ ▶ 3 (r) = **0.998**

SHIFT 2 (S-VAR) ▶ ▶ 1 (A) = **–3857.984**

SHIFT 2 (S-VAR) ▶ ▶ 2 (B) = **2357.532**

Logarithmic Regression Formula:
y = –3857.984 + 2357.532ln$x$

Calculating Estimated Values

Based on the regression formula obtained by paired-variable statistical calculation, the estimated value of y can be calculated for a given x-value. The corresponding x-value (two values, x_1 and x_2, in the case of quadratic regression) also can be calculated for a value of y in the regression formula.

---

3 To determine the estimate value for x when y = –130 in the regression formula produced by logarithmic regression of the data in 2. Specify Fix 3 for the result. (Perform the following operation after completing the operations in 2.)

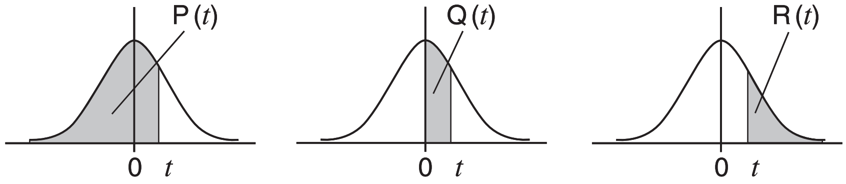
((–) 130) SHIFT 2 (S-VAR) ▶ ▶ ▶ 1 ($\hat{x}$) = **4.861**

Important: Regression coefficient, correlation coefficient, and estimated value calculations can take considerable time when there are a large number of data items.

Performing Normal Distribution Calculations

While single-variable statistical calculation is selected, you can perform normal distribution calculation using the functions shown below from the menu that appears when you perform the following key operation: SHIFT 3 (DISTR).

P, Q, R: These functions take the argument t and determine a probability of standard normal distribution as illustrated below.



►*t*: This function is preceded by the argument X, and determines the normalized variate $X{\blacktriangleright}t = \frac{X - \bar{x}}{\sigma x}$.

---

4 To determine the normalized variate (►t) for x = 53 and normal probability distribution P(t) for the following data: 55, 54, 51, 55, 53, 53, 54, 52

MODE MODE 1 (SD)

55 DT 54 DT 51 DT 55 DT 53 DT DT 54 DT 52 DT

53 SHIFT 3 (DISTR) 4 (►t) = **–0.284747398**

SHIFT 3 (DISTR) 1 (P( ) (–) 0.28) = **0.38974**

Base-*n* Calculations (BASE)

Press MODE MODE 3 (BASE) to enter the BASE Mode when you want to perform calculations using decimal, hexadecimal, binary, and/or octal values. The initial default number mode when you enter the BASE Mode is decimal, which means input and calculation results use the decimal number format. Press one of the following keys to switch number modes: [x^2](DEC) for decimal, [^](HEX) for hexadecimal, [log](BIN) for binary, or [ln](OCT) for octal.

To enter the BASE Mode, switch to the binary mode, and calculate $11_2 + 1_2$

[MODE] [MODE] [3] (BASE)	0. d
[log] (BIN)	0. b
11 [+] 1 [=]	100. b

Note: • Use the following keys to input the letters A through F for hexadecimal values: [(–)](A), [°'''](B), [hyp](C), [sin](D), [cos](E), [tan](F).
• In the BASE Mode, input of fractional (decimal) values and exponents is not supported. If a calculation result has a fractional part, it is cut off.

The following shows details about input and output ranges.

Base-n Mode	Input/Output Ranges
Binary	Positive: $0 \leqq x \leqq 0111111111$ Negative: $1000000000 \leqq x \leqq 1111111111$
Octal	Positive: $0 \leqq x \leqq 3777777777$ Negative: $4000000000 \leqq x \leqq 7777777777$
Decimal	$-2147483648 \leqq x \leqq 2147483647$
Hexadecimal	Positive: $0 \leqq x \leqq$ 7FFFFFFF Negative: $80000000 \leqq x \leqq$ FFFFFFFF

Specifying the Number Mode of a Particular Input Value

You can input a special command immediately following a value to specify the number mode of that value. The special commands are: d (decimal), h (hexadecimal), b (binary), and o (octal).

To calculate $10_{10} + 10_{16} + 10_2 + 10_8$ and display the result as a decimal value

[AC] [x^2](DEC) [x^{-1}](LOGIC) [x^{-1}](LOGIC) [x^{-1}](LOGIC) [1](d) 10 [+]
[x^{-1}](LOGIC) [x^{-1}](LOGIC) [x^{-1}](LOGIC) [2](h) 10 [+]
[x^{-1}](LOGIC) [x^{-1}](LOGIC) [x^{-1}](LOGIC) [3](b) 10 [+]
[x^{-1}](LOGIC) [x^{-1}](LOGIC) [x^{-1}](LOGIC) [4](o) 10 [=] **36**

Converting a Calculation Result to another Type of Value

You can use any one of the following key operations to convert the currently displayed calculation result to another type of value: [x^2](DEC) (decimal), [^](HEX) (hexadecimal), [log](BIN) (binary), [ln](OCT)(octal).

To calculate $15_{10} \times 3_{10}$ in the decimal mode, and then convert the result to hexadecimal, binary, and octal

[AC] [x^2](DEC) 15 [×] 3 [=]	**45**
[^](HEX)	**2d**
[log](BIN)	**101101**
[ln](OCT)	**55**

Note: • You may not be able to convert a value from a number system whose calculation range is greater than the calculation range of the resulting number system. • The message "Math ERROR" indicates that the result has too many digits (overflow).

Logical and Negation Operations

Your calculator provides you with logical operators (And, Or, Xor, Xnor) and functions (Not, Neg) for logical and negation operations on binary values. Use the menu that appears when you press [x^{-1}](LOGIC) to input these logical operators and functions.

All of the following examples are performed in the binary mode ([log](BIN)).

To determine the logical AND of 1010_2 and 1100_2 (1010_2 and 1100_2)

[AC] 1010 [x^{-1}](LOGIC) [1](And) 1100 [=]	**1000**

To negate (take the two's complement) of 101101_2 (Neg(101101_2))

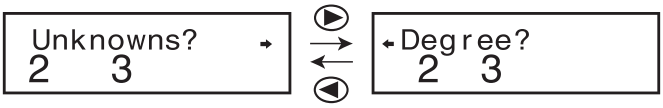
[AC] [x^{-1}](LOGIC) [x^{-1}](LOGIC) [3](Neg) 101101 [=]	**1111010011**

Note: In the case of a negative binary, octal or hexadecimal value, the calculator converts the value to binary, takes the two's complement, and then converts back to the original number base. For decimal (base-10) values, the calculator merely adds a minus sign.

Equation Calculations (EQN)

The EQN Mode lets you solve equations up to three degrees and simultaneous linear equations with up to three unknowns.

1. Press [MODE] [MODE] [MODE] [1](EQN) to enter the EQN Mode.
2. On the menu that appears, select an equation type.



To select this calculation type:	Press this key:
Simultaneous linear equations with two unknowns ($a_nx + b_ny = c_n$)	[2]
Simultaneous linear equations with three unknowns ($a_nx + b_ny + c_nz = d_n$)	[3]

Quadratic equation ($ax^2 + bx + c = 0$)	[▶] [2]
Cubic equation ($ax^3 + bx^2 + cx + d = 0$)	[▶] [3]

3. Use the Coefficient Editor that appears to input coefficient values.
   - To solve $2x^2 + x - 3 = 0$, for example, press [▶] [2] in step 2, and then input the following for the coefficients ($a = 2$, $b = 1$, $c = -3$): 2 [=] 1 [=] [(−)] 3.
   - Any time until you input a value for the final coefficient (c for a quadratic equation, d for a cubic equation), you can use the [▲] and [▼] keys to move between coefficients on the screen and make changes, if you want.
   - Note that you cannot input complex numbers for coefficients.

   Important: The following operations are not supported by the Coefficient Editor: [M+], [SHIFT] [M+] (M–), [SHIFT] [RCL] (STO). Pol, Rec, and multi-statements also cannot be input with the Coefficient Editor.
4. After all the values are the way you want, press [=].
   - This will display a solution. Each press of [=] will display another solution. Pressing [=] while the final solution is displayed will return to the Coefficient Editor.
   - You can scroll between the solutions using the [▼] and [▲] keys.
   - To return to the Coefficient Editor while any solution is displayed, press [AC].

Note: Values cannot be converted to engineering notation on the solution screen.

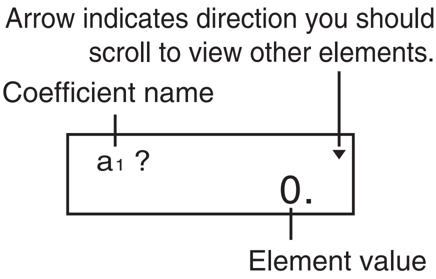
Changing the Current Equation Type Setting

Press [MODE] [MODE] [MODE] [1] (EQN) and then select an equation type from the menu that appears. Changing the equation type causes the values of all Coefficient Editor coefficients to change to zero.

EQN Mode Calculation Examples

$x - y + z = 2$, $x + y - z = 0$, $-x + y + z = 4$

[MODE] [MODE] [MODE] [1] (EQN) [3]



1 [=] [(−)] 1 [=] 1 [=] 2 [=]
1 [=] 1 [=] [(−)] 1 [=] 0 [=]
[(−)] 1 [=] 1 [=] 1 [=] 4

[=]	**(x=)**	**1**
[▼]	**(y=)**	**2**
[▼]	**(z=)**	**3**

$8x^2 - 4x + 5 = 0$ ($x = 0.25 \pm 0.75i$)

[MODE] [MODE] [MODE] [1] (EQN) [▶] [2]

8 [=] [(−)] 4 [=] 5 [=]	**(x1=)**	**0.25**
[SHIFT] [=] (Re⇔Im)	**(x1=)**	**0.75i**

[▼] **(x2=) 0.25**

[SHIFT] [=] (Re⇔Im) **(x2=) –0.75i**

- If a result is a complex number, the real part of the first solution appears first. Press [SHIFT] [=] (Re⇔Im) to toggle the display between the real part and imaginary part of a solution.

$x^3 - 2x^2 - x + 2 = 0$

[MODE] [MODE] [MODE] [1] (EQN) [▶] [3]

1 [=] [(–)] 2 [=] [(–)] 1 [=] 2 [=] **(x1=) 2**

[▼] **(x2=) –1**

[▼] **(x3=) 1**

Matrix Calculations (MAT) (fx-570MS/991MS only)

Use the MAT Mode to perform calculations involving matrices of up to 3 rows by 3 columns. To perform a matrix calculation, you first assign data to special matrix variables (MatA, MatB, MatC), and then use the variables in the calculation as shown in the example below.

Note: Matrix calculations can use up to two levels of the matrix stack. Squaring a matrix, cubing a matrix, or inverting a matrix uses one stack level.

---

1 To assign $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ to MatA and $\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ to MatB, and then perform the following calculations: $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ (MatA×MatB), $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} + \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ (MatA+MatB)

1. Press [MODE] [MODE] [MODE] [2] (MAT) to enter the MAT Mode.
2. Press [SHIFT] [4] (MAT) [1] (Dim) [1] (A).

   MatA(m×n) m?
   0.

3. Input the dimensions of MatA: 2 [=] 2 [=].
   - This will display the Matrix Editor for input of the elements of the 2 × 2 matrix you specified for MatA.

   MatA_{11}
   0.

   Shows the row number and column number of the element. (Example: MatA_{23} indicates row 2, column 3 of MatA.)

4. Input the elements of MatA: 2 [=] 1 [=] 1 [=] 1 [=].
5. Perform the following key operation: [SHIFT] [4] (MAT) [1] (Dim) [2] (B) 2 [=] 2 [=].
   - This will display the Matrix Editor for input of the elements of the 2 × 2 matrix you specified for MatB.
6. Input the elements of MatB: 2 [=] [(–)] 1 [=] [(–)] 1 [=] 2 [=].

7. Press [AC] to advance to the calculation screen, and perform the first calculation (MatA×MatB): [SHIFT] [4] (MAT) [3] (Mat) [1] (A) [×] [SHIFT] [4] (MAT) [3] (Mat) [2] (B) [=].
   • This will display the MatAns screen with the calculation results.

MatA×MatB_ 0.	→	MatAns11 3.

Note: "MatAns" stands for "Matrix Answer Memory". See "Matrix Answer Memory" for more information.

8. Perform the next calculation (MatA+MatB): [AC] [SHIFT] [4] (MAT) [3] (Mat) [1] (A) [+] [SHIFT] [4] (MAT) [3] (Mat) [2] (B) [=].

MatA×MatB_ 0.	→	MatAns11 4.

Matrix Answer Memory

Whenever the result of a calculation executed in the MAT Mode is a matrix, the MatAns screen will appear with the result. The result also will be assigned to a variable named "MatAns".

The MatAns variable can be used in calculations as described below.

- To insert the MatAns variable into a calculation, perform the following key operation: [SHIFT] [4] (MAT) [3] (Mat) [4] (Ans).
- Pressing any one of the following keys while the MatAns screen is displayed will switch automatically to the calculation screen: [+], [−], [×], [÷], [x^{-1}], [x^2], [SHIFT] [x^2] (x^3). The calculation screen will show the MatAns variable followed by the operator or function for the key you pressed.

Assigning and Editing Matrix Variable Data

Important: The following operations are not supported by the Matrix Editor: [M+], [SHIFT] [M+] (M–), [SHIFT] [RCL] (STO). Pol, Rec, and multi-statements also cannot be input with the Matrix Editor.

To assign new data to a matrix variable:

1. Press [SHIFT] [4] (MAT) [1] (Dim), and then, on the menu that appears, select the matrix variable to which you want to assign data.
2. On the next menu that appears, input the dimensions.
3. Use the Matrix Editor that appears to input the elements of the matrix.

2 To assign $\begin{bmatrix}1 & 0 & -1\\ 0 & -1 & 1\end{bmatrix}$ to MatC

[SHIFT] [4] (MAT) [1] (Dim) [3] (C) 2 [=] 3 [=]
1 [=] 0 [=] [(−)] 1 [=] 0 [=] [(−)] 1 [=] 1 [=]

MatC11 1.

To edit the elements of a matrix variable:

1. Press [SHIFT] [4] (MAT) [2] (Edit), and then, on the menu that appears, select the matrix variable you want to edit.

2. Use the Matrix Editor that appears to edit the elements of the matrix.
   - Use the ⊼, ⊻, ◀, and ▶ keys to display the element you want to edit. Input a new value and then press =.

Matrix Calculation Examples

The following examples use MatA = $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ and MatB = $\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ from 1, and MatC = $\begin{bmatrix} 1 & 0 & -1 \\ 0 & -1 & 1 \end{bmatrix}$ from 2. You can input a matrix variable into a key operation by pressing SHIFT 4 (MAT) 3 (Mat) and then pressing one of the following number keys: 1 (A), 2 (B), 3 (C).

---

3 3 × MatA (Matrix scalar multiplication). (Result: $\begin{bmatrix} 6 & 3 \\ 3 & 3 \end{bmatrix}$)

AC 3 × **MatA** =

MatAns11 6.

---

4 Obtain the determinant of MatA (Det(MatA)).

AC SHIFT 4 (MAT) ▶ 1 (Det) **MatA** = **1.**

---

5 Obtain the transposition of MatC (Trn(MatC)). (Result: $\begin{bmatrix} 1 & 0 \\ 0 & -1 \\ -1 & 1 \end{bmatrix}$)

AC SHIFT 4 (MAT) ▶ 2 (Trn) **MatC** =

MatAns11 1.

---

6 Obtain the inverse matrix of MatA (MatA^{-1}). (Result: $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$)

Note: You cannot use ^ for this input. Use the x^{-1} key to input "$^{-1}$".

AC **MatA** x^{-1} =

MatAns11 1.

---

7 Obtain the absolute value of each element of MatB

(Abs(MatB)). (Result: $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$)

AC SHIFT) (Abs) **MatB** =

MatAns11 2.

---

8 Determine the square and cube of MatA (MatA^2, MatA^3).

(Result: $\text{MatA}^2 = \begin{bmatrix} 5 & 3 \\ 3 & 2 \end{bmatrix}$, $\text{MatA}^3 = \begin{bmatrix} 13 & 8 \\ 8 & 5 \end{bmatrix}$)

Note: You cannot use ^ for this input. Use x^2 to specify squaring, and SHIFT x^2 (x^3) to specify cubing.

AC **MatA** x^2 =

MatAns11 5.

AC **MatA** SHIFT x^2 (x^3) =

MatAns11 13.

Vector Calculations (VCT)
(fx-570MS/991MS only)

Use the VCT Mode to perform 2-dimensional and 3-dimensional vector calculations. To perform a vector calculation, you first assign data to special vector variables (VctA, VctB, VctC), and then use the variables in the calculation as shown in the example below.

---

1 To assign (1, 2) to VctA and (3, 4) to VctB, and then perform the following calculation: (1, 2) + (3, 4)

1. Press [MODE] [MODE] [MODE] [3] (VCT) to enter the VCT Mode.
2. Press [SHIFT] [5] (VCT) [1] (Dim) [1] (A).

```
VctA(m) m?
         0.
```

3. Input the dimensions of VctA: 2 [=].
   - This will display the Vector Editor for input of the 2-dimensional vector for VctA.

Arrow indicates direction you should scroll to view other elements.

```
VctA1        →
         0.
```

Dimensions of vector

4. Input the elements of VctA: 1 [=] 2 [=].
5. Perform the following key operation: [SHIFT] [5] (VCT) [1] (Dim) [2] (B) 2 [=].
   - This will display the Vector Editor for input of the 2-dimensional vector for VctB.
6. Input the elements of VctB: 3 [=] 4 [=].
7. Press [AC] to advance to the calculation screen, and perform the calculation (VctA + VctB): [SHIFT] [5] (VCT) [3] (Vct) [1] (A) [+] [SHIFT] [5] (VCT) [3] (Vct) [2] (B) [=].
   - This will display the VctAns screen with the calculation results.

```
VctA+VctB_         VctAns1      →
         0.    →            4.
```

Note: "VctAns" stands for "Vector Answer Memory". See "Vector Answer Memory" for more information.

Vector Answer Memory

Whenever the result of a calculation executed in the VCT Mode is a vector, the VctAns screen will appear with the result. The result also will be assigned to a variable named "VctAns".

The VctAns variable can be used in calculations as described below.

- To insert the VctAns variable into a calculation, perform the following key operation: [SHIFT] [5] (VCT) [3] (Vct) [4] (Ans).
- Pressing any one of the following keys while the VctAns screen is displayed will switch automatically to the calculation screen: [+], [−], [×], [÷]. The calculation screen will show the VctAns variable followed by the operator for the key you pressed.

Assigning and Editing Vector Variable Data

Important: The following operations are not supported by the Vector Editor: M+, SHIFT M+(M–), SHIFT RCL(STO). Pol, Rec, and multi-statements also cannot be input with the Vector Editor.

To assign new data to a vector variable:

1. Press SHIFT 5(VCT) 1(Dim), and then, on the menu that appears, select the vector variable to which you want to assign data.
2. On the next menu that appears, input the dimensions.
3. Use the Vector Editor that appears to input the elements of the vector.

---

2 To assign (2, –1, 2) to VctC

SHIFT 5(VCT) 1(Dim) 3(C) 3 =
2 = (–) 1 = 2 =

VctC1	2.

To edit the elements of a vector variable:

1. Press SHIFT 5(VCT) 2(Edit), and then, on the menu that appears, select the vector variable you want to edit.
2. Use the Vector Editor that appears to edit the elements of the vector.
   - Use the ◀ and ▶ keys to display the element you want to edit. Input a new value and then press =.

Vector Calculation Examples

The following examples use VctA = (1, 2) and VctB = (3, 4) from **1**, and VctC = (2, –1, 2) from **2**. You can input a vector variable into a key operation by pressing SHIFT 5(VCT) 3(Vct) and then pressing one of the following number keys: 1(A), 2(B), 3(C).

---

3 3 × VctA = (3, 6) (Vector scalar multiplication), 3 × VctA – VctB = (0, 2) (Calculation example using VctAns)

AC 3 × **VctA** =

VctAns1	3.

– **VctB** =

VctAns1	0.

---

4 VctA • VctB (Vector dot product)

AC **VctA** SHIFT 5(VCT) ▶ 1(Dot) **VctB** =

VctA·VctB	11.

---

5 VctA × VctB = (0, 0, –2) (Vector cross product)

AC **VctA** × **VctB** =

VctAns1	0.

6 Obtain the absolute values of VctC.

AC SHIFT) (Abs) **VctC** =

```
Abs VctC
        3.
```

7 Determine the angle formed by VctA and VctB to three decimal places (Fix 3). **Deg**

(cos $\theta = \frac{(A \bullet B)}{|A||B|}$, which becomes $\theta = \cos^{-1} \frac{(A \bullet B)}{|A||B|}$)

MODE ····· 1 (Fix) 3

AC (**VctA** SHIFT 5 (VCT) ▶ 1 (Dot) **VctB**) ÷

(SHIFT) (Abs) **VctA** SHIFT) (Abs) **VctB**) =

```
(VctA·VctB)÷
       0.984
```

SHIFT cos ($\cos^{-1}$) Ans =

```
cos⁻¹ Ans
      10.305
```

Scientific Constants

(fx-570MS/991MS only)

Your calculator comes with 40 built-in scientific constants that can be used in any mode besides BASE. Each scientific constant is displayed as a unique symbol (such as π), which can be used inside of calculations.

To input a scientific constant into a calculation, press CONST and then input the two-digit number that corresponds to the constant you want.

To input the scientific constant C_0 (speed of light in a vacuum), and display its value

AC CONST

```
CONST--
```

2 8 (C_0) =

```
C0
  299,792,458.
```

The following shows the two-digit numbers for each of the scientific constants.

01: (mp) proton mass	02: (mn) neutron mass
03: (me) electron mass	04: (mμ) muon mass
05: (a_0) Bohr radius	06: (h) Planck constant
07: (μN) nuclear magneton	08: (μB) Bohr magneton
09: ($\hbar$) Planck constant, rationalized	10: (α) fine-structure constant
11: (re) classical electron radius	12: (λc) Compton wavelength

13: (γp) proton gyromagnetic ratio	14: (λcp) proton Compton wavelength
15: (λcn) neutron Compton wavelength	16: ($R\infty$) Rydberg constant
17: (u) atomic mass unit	18: (μp) proton magnetic moment
19: (μe) electron magnetic moment	20: (μn) neutron magnetic moment
21: ($\mu\mu$) muon magnetic moment	22: (F) Faraday constant
23: (e) elementary charge	24: (NA) Avogadro constant
25: (k) Boltzmann constant	26: (Vm) molar volume of ideal gas
27: (R) molar gas constant	28: (C_0) speed of light in vacuum
29: (C_1) first radiation constant	30: (C_2) second radiation constant
31: (σ) Stefan-Boltzmann constant	32: (ε_0) electric constant
33: (μ_0) magnetic constant	34: (ϕ_0) magnetic flux quantum
35: (g) standard acceleration of gravity	36: (G_0) conductance quantum
37: (Z_0) characteristic impedance of vacuum	38: (t) Celsius temperature
39: (G) Newtonian constant of gravitation	40: (atm) standard atmosphere (SI unit: Pa)

The values are based on CODATA recommended values (2010).

Metric Conversion (fx-570MS/991MS only)

The calculator's built-in metric conversion commands make it simple to convert values from one unit to another. You can use the metric conversion commands in any calculation mode except for BASE.

To input a metric conversion command into a calculation, press [SHIFT] [CONST] (CONV) and then input the two-digit number that corresponds to the command you want. When inputting a negative value, enclose it within parentheses [(], [)].

To convert –31°C into Fahrenheit

[AC] [(] [(–)] 31 [)] [SHIFT] [CONST] (CONV) [3] [8] (°C ▶°F) [=]

(–31) °C▶°F
–23.8

The following shows the two-digit numbers for each of the metric conversion commands.

01: in ▶ cm	02: cm ▶ in	03: ft ▶ m
04: m ▶ ft	05: yd ▶ m	06: m ▶ yd
07: mile ▶ km	08: km ▶ mile	09: n mile ▶ m
10: m ▶ n mile	11: acre ▶ m^2	12: m^2 ▶ acre
13: gal (US) ▶ ℓ	14: ℓ ▶ gal (US)	15: gal (UK) ▶ ℓ
16: ℓ ▶ gal (UK)	17: pc ▶ km	18: km ▶ pc
19: km/h ▶ m/s	20: m/s ▶ km/h	21: oz ▶ g
22: g ▶ oz	23: lb ▶ kg	24: kg ▶ lb
25: atm ▶ Pa	26: Pa ▶ atm	27: mmHg ▶ Pa
28: Pa ▶ mmHg	29: hp ▶ kW	30: kW ▶ hp
31: kgf/cm^2 ▶ Pa	32: Pa ▶ kgf/cm^2	33: kgf • m ▶ J
34: J ▶ kgf • m	35: lbf/in^2 ▶ kPa	36: kPa ▶ lbf/in^2
37: °F ▶ °C	38: °C ▶ °F	39: J ▶ cal
40: cal ▶ J		

Conversion formula data is based on the "NIST Special Publication 811 (2008)".

Note: The J▶cal command performs conversion for values at a temperature of 15°C.

Calculation Ranges, Number of Digits, and Precision

Calculation Range and Precision

Calculation Range	$\pm 1 \times 10^{-99}$ to $\pm 9.999999999 \times 10^{99}$ or 0
Number of Digits for Internal Calculation	15 digits
Precision	In general, ±1 at the 10th digit for a single calculation. Precision for exponential display is ±1 at the least significant digit. Errors are cumulative in the case of consecutive calculations.

Function Calculation Input Ranges and Precision

Functions	Input Range	
sin$x$ cos$x$	DEG	$0 \leqq \lvert x \rvert < 9 \times 10^{9}$
	RAD	$0 \leqq \lvert x \rvert < 157079632.7$
	GRA	$0 \leqq \lvert x \rvert < 1 \times 10^{10}$

tan$x$	DEG	Same as sin$x$, except when $\lvert x \rvert = (2n-1) \times 90$.
	RAD	Same as sin$x$, except when $\lvert x \rvert = (2n-1) \times \pi/2$.
	GRA	Same as sin$x$, except when $\lvert x \rvert = (2n-1) \times 100$.
$\sin^{-1}x$ $\cos^{-1}x$		$0 \leqq \lvert x \rvert \leqq 1$
$\tan^{-1}x$		$0 \leqq \lvert x \rvert \leqq 9.999999999 \times 10^{99}$
sinh$x$ cosh$x$		$0 \leqq \lvert x \rvert \leqq 230.2585092$
$\sinh^{-1}x$		$0 \leqq \lvert x \rvert \leqq 4.999999999 \times 10^{99}$
$\cosh^{-1}x$		$1 \leqq x \leqq 4.999999999 \times 10^{99}$
tanh$x$		$0 \leqq \lvert x \rvert \leqq 9.999999999 \times 10^{99}$
$\tanh^{-1}x$		$0 \leqq \lvert x \rvert \leqq 9.999999999 \times 10^{-1}$
log$x$/ln$x$		$0 < x \leqq 9.999999999 \times 10^{99}$
10^x		$-9.999999999 \times 10^{99} \leqq x \leqq 99.99999999$
e^x		$-9.999999999 \times 10^{99} \leqq x \leqq 230.2585092$
$\sqrt{x}$		$0 \leqq x < 1 \times 10^{100}$
x^2		$\lvert x \rvert < 1 \times 10^{50}$
x^{-1}		$\lvert x \rvert < 1 \times 10^{100}$; $x \neq 0$
$\sqrt[3]{x}$		$\lvert x \rvert < 1 \times 10^{100}$
$x!$		$0 \leqq x \leqq 69$ (x is an integer)
nPr		$0 \leqq n < 1 \times 10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq \{n!/(n-r)!\} < 1 \times 10^{100}$
nCr		$0 \leqq n < 1 \times 10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq n!/r! < 1 \times 10^{100}$ or $1 \leqq n!/(n-r)! < 1 \times 10^{100}$
Pol(x, y)		$\lvert x \rvert, \lvert y \rvert \leqq 9.999999999 \times 10^{99}$ $\sqrt{x^2+y^2} \leqq 9.999999999 \times 10^{99}$
Rec(r, θ)		$0 \leqq r \leqq 9.999999999 \times 10^{99}$ θ: Same as sin$x$
°’ ”		$\lvert a \rvert, b, c < 1 \times 10^{100}$; $0 \leqq b, c$ The display seconds value is subject to an error of ±1 at the second decimal place.
←°’ ”		$\lvert x \rvert < 1 \times 10^{100}$ Decimal ↔ Sexagesimal Conversions $0°0°0° \leqq \lvert x \rvert \leqq 9999999°59°$
^(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 an integer) However: $-1 \times 10^{100} < y\log\lvert x \rvert < 100$

$\sqrt[x]{y}$	$y > 0$: $x \neq 0$, $-1 \times 10^{100} < 1/x \log y < 100$ $y = 0$: $x > 0$ $y < 0$: $x = 2n+1$, $\frac{1}{n}$ ($n \neq 0$; n is an integer) However: $-1 \times 10^{100} < 1/x \log\|y\| < 100$
a^b/c	Total of integer, numerator, and denominator must be 10 digits or less (including division marks).
SD (REG)	$\|x\| < 1 \times 10^{50}$; $\|y\| < 1 \times 10^{50}$; $\|n\| < 1 \times 10^{100}$ σx, σy, $\bar{x}$, $\bar{y}$: $n \neq 0$ sx, sy, A, B, r : $n \neq 0, 1$

- Precision is basically the same as that described under "Calculation Range and Precision", above.
- Calculations that use any of the functions or settings shown below require consecutive internal calculations to be performed, which can cause accumulation of error that occurs with each calculation. ^(x^y), $\sqrt[x]{y}$, $\sqrt[3]{\ }$, $x!$, nPr, nCr; °, ʳ, ᵍ (angle unit: radians); σx, sx, regression coefficient.
- Error is cumulative and tends to be large in the vicinity of a function's singular point and inflection point.
- During statistical calculation, error is cumulative when data values have a large number of digits and the differences between data values is small. Error will be large when data values are greater than six digits.

Error Messages

The calculator will display an error message whenever an error occurs for any reason during a calculation.

- Press ◀ or ▶ to return to the calculation screen. The cursor will be positioned at the location where the error occurred, ready for input. Make the necessary corrections to the calculation and execute it again.
- Press AC to return to the calculation screen. Note that this also clears the calculation that contained the error.

Math ERROR

Cause: • The intermediate or final result of the calculation you are performing exceeds the allowable calculation range. • Your input exceeds the allowable input range. • The calculation you are performing contains an illegal mathematical operation (such as division by zero).

Action: • Check the input values and reduce the number of digits. • When using independent memory or a variable as the argument of a function, make sure that the memory or variable value is within the allowable range for the function.

Stack ERROR
Cause: • The calculation you are performing has caused the capacity of the numeric stack or the command stack to be exceeded. • The calculation you are performing has caused the capacity of the matrix or vector stack to be exceeded.
Action: • Simplify the calculation expression. • Try splitting the calculation into two or more parts.

Syntax ERROR
Cause: There is a problem with the format of the calculation you are performing.
Action: Make necessary corrections.

Arg ERROR
Cause: Improper use of an argument.
Action: Make necessary corrections.

Dim ERROR (MAT and VCT Modes only)
Cause: • The matrix or vector you are trying to use in a calculation was input without specifying its dimension. • You are trying to perform a calculation with matrices or vectors whose dimensions do not allow that type of calculation.
Action: • Specify the dimension of the matrix or vector and then perform the calculation again. • Check the dimensions specified for the matrices or vectors to see if they are compatible with the calculation.

Can't solve Error (SOLVE feature only)
Cause: The calculator could not obtain a solution.
Action: • Check for errors in the equation that you input. • Input a value for the solution variable that is close to the expected solution and try again.

Before Assuming Malfunction of the Calculator...

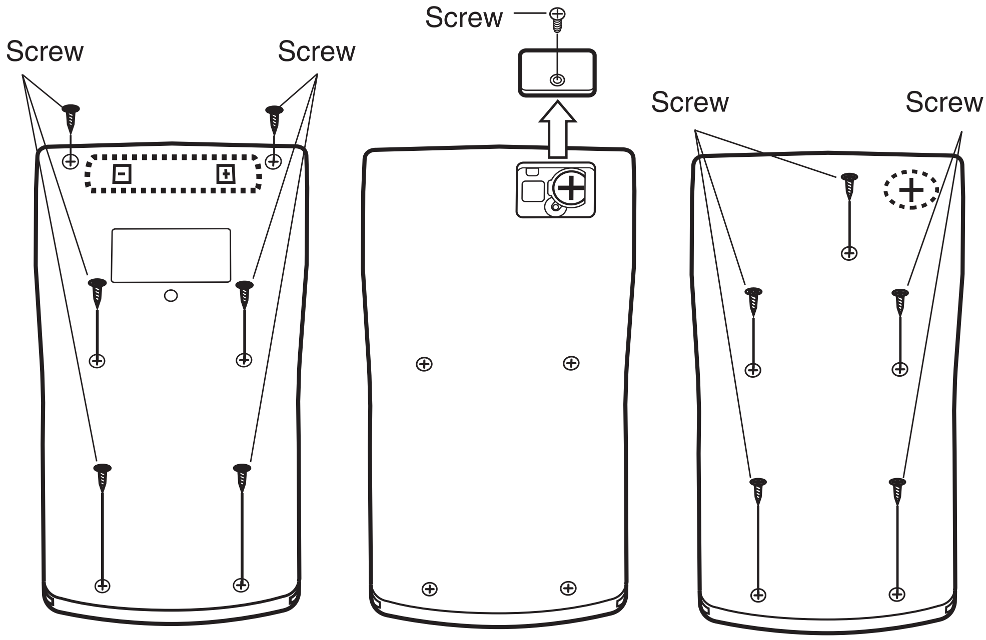
Perform the following steps whenever an error occurs during a calculation or when calculation results are not what you expected. Note that you should make separate copies of important data before performing these steps.

1. Check the calculation expression to make sure that it does not contain any errors.
2. Make sure that you are using the correct mode for the type of calculation you are trying to perform.
3. If the above steps do not correct your problem, press the ON key.
4. Initialize all modes and settings. See "Initializing Calculation Mode and Setup".

Replacing the Battery

Important: Removing the battery will cause all of the calculator's memory contents to be deleted.

1. Press SHIFT AC (OFF) to turn off the calculator.
   • To ensure that you do not accidentally turn on power while replacing the battery, slide the hard case onto the front of the calculator (fx-570MS).
2. Remove the cover as shown in the illustration and replace the battery, taking care that its plus (+) and minus (–) ends are facing correctly.



fx-100MS **fx-570MS** **fx-115MS/991MS**

3. Replace the cover.
4. Initialize the calculator: ON SHIFT MODE (CLR) 3 (All) =
   • Do not skip the above step!

Specifications

Power Requirements:
fx-100MS: AA-size battery R6P (SUM-3) × 1
fx-570MS: Button battery LR44 (GPA76) × 1
fx-115MS/991MS: Built-in solar cell; button battery LR44 (GPA76) × 1

Approximate Battery Life:
fx-100MS: 17,000 hours (continuous display of flashing cursor)
fx-570MS: 9,000 hours (continuous display of flashing cursor)
fx-115MS/991MS: 3 years (based on one hour of operation per day)

Power Consumption: 0.0001 W (fx-100MS/570MS)

Operating Temperature: 0°C to 40°C (32°F to 104°F)

Dimensions (H×W×D)**/Approximate Weight** (including the battery)

fx-100MS	20.0 × 78 × 155 mm 13/16″ × 3 1/16″ × 6 1/8″	133 g (4.7 oz)
fx-115MS	12.6 × 80 × 159 mm 1/2″ × 3 1/8″ × 6 1/4″	100 g (3.5 oz)
fx-570MS fx-991MS	12.7 × 78 × 154.5 mm 1/2″ × 3 1/16″ × 6 1/16″	105 g (3.7 oz)

Manufacturer:
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