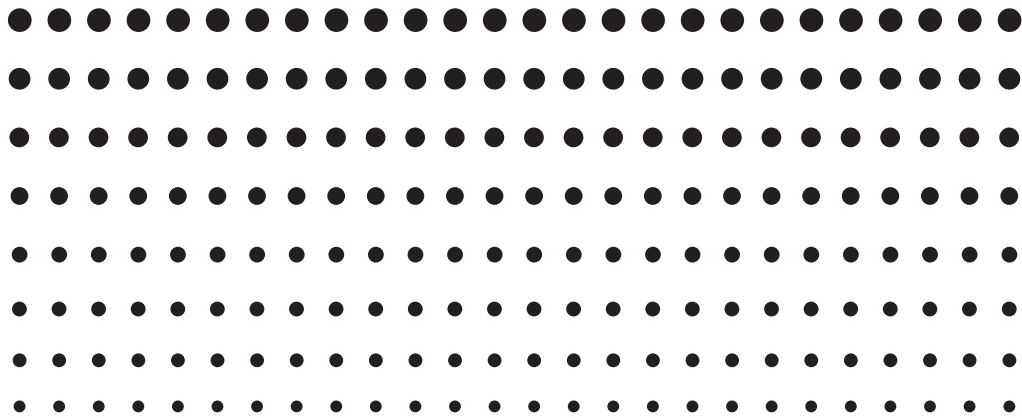


# *fx-3650P II*

## *User's Guide*



CASIO Worldwide Education Website

<http://edu.casio.com>

CASIO EDUCATIONAL FORUM

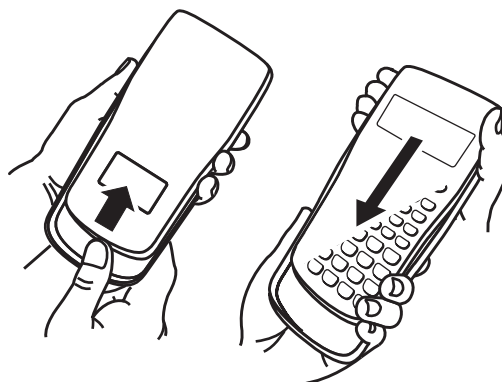
<http://edu.casio.com/forum/>

# Getting Started

Thank you for purchasing this CASIO product.

## ■ Before using the calculator for the first time...

Before using the calculator, slide its hard case downwards to remove it, and then affix the hard case to the back of the calculator as shown in the illustration nearby.



## ◆ After you are finished using the calculator...

Remove the hard case from the back of the calculator, and re-install it onto the front.

## ■ Resetting the Calculator to Initial Defaults

Perform the operation below when you want to return the calculator's setup to its initial defaults. Note that this procedure will also clear all memory contents (independent memory, variable memory, Answer Memory, statistical calculation sample data, and program data).

**SHIFT** **9** (CLR) **3** (All) **EXE**

## ■ About this Manual

- 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.

# 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.

# Operating Precautions

- **Even if the calculator is operating normally, replace the battery at least once every three years (LR44 (GPA76)).**

A dead battery can leak, causing damage to and malfunction of the calculator. Never leave a dead battery in the calculator. Do not try using the calculator while the battery is completely dead.

- **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.**
- **Low battery power can cause memory contents to become corrupted or lost completely. Always keep written records of all important data.**
- **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.**
- **Be sure to keep all user documentation handy for future reference.**

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

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# Before starting a calculation...

## ■ Turning On the Calculator

Press **[ON]**. The calculator will enter the calculation mode (page 5) that it was in the last time you turned it off.

## ◆ Adjusting Display Contrast

If the figures on the display become hard to read, try adjusting display contrast.

1. Press **[SHIFT]** **[MODE]** (SETUP) **[◀]** **[1]** (Contrast).

- This will display the contrast adjustment screen.



2. Use **[◀]** and **[▶]** to adjust display contrast.

3. After the setting is the way you want, press **[AC]** or **[SHIFT]** **[Prog]** (EXIT).

### Note

You can also use **[+]** and **[-]** to adjust contrast while the calculation mode menu that appears when you press the **[MODE]** key is on the display.

### Important!

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

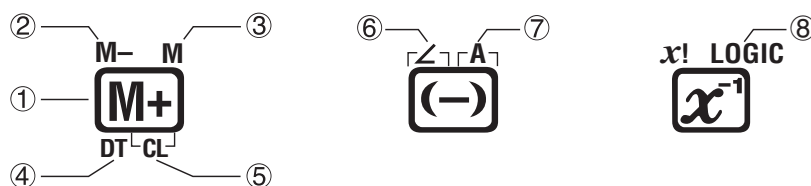
## ◆ Turning Off the Calculator

Press **[SHIFT]** **[AC]** (OFF).

The following information is retained when you turn off the calculator.

- Calculation modes and setup (page 5)
- Answer Memory (page 14), independent memory (page 15), and variable memory (page 16) contents

## ■ Key Markings



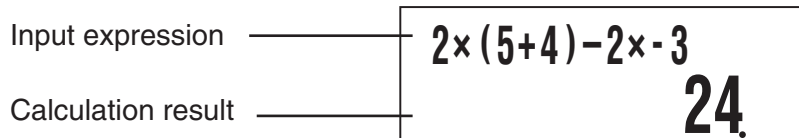
	Function	Colors	To perform the function
①	M+		Press the key.
②	M-	Text: Amber	Press <b>[SHIFT]</b> and then press the key.
③	M	Text: Red	Press <b>[ALPHA]</b> and then press the key.
④	DT	Text: Blue	In the SD or REG Mode, press the key.
⑤	CL	Text: Amber Frame: Blue	In the SD or REG Mode, press <b>[SHIFT]</b> and then press the key.
⑥	∠	Text: Amber Frame: Purple	In the Cmplx Mode, press <b>[SHIFT]</b> and then press the key.

	Function	Colors	To perform the function
⑦	A	Text: Red Frame: Green	Press $\boxed{\text{ALPHA}}$ and then press the key (variable A). In the BASE Mode, press the key.
⑧	LOGIC	Text: Green	In the BASE Mode, press the key.

## ■ Reading the Display

### ◆ Input Expressions and Calculation Results

This calculator can display both the expressions you input and calculation results on the same screen.



### ◆ Display Symbols

The symbols described below appear on the display of the calculator to indicate the current calculation mode, the calculator setup, the progress of calculations, and more. In this manual, the expression “turn on” is used to mean that a symbol appears on the display, and “turn off” means that it disappears.

The nearby sample screen shows the  $\boxed{\text{D}}$  symbol.



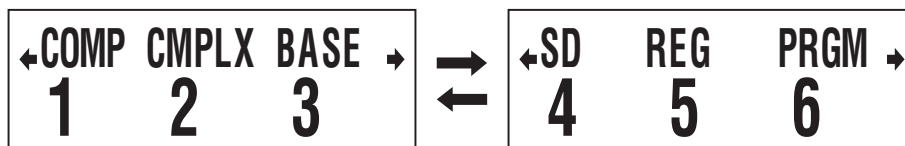
# Calculation Modes and Setup

## ■ Selecting a Calculation Mode

Your calculator has six “calculation modes”.

1. Press  $\boxed{\text{MODE}}$ .

- This displays the calculation mode menu.
- The calculation mode menu has two screens. Press  $\boxed{\text{MODE}}$  to toggle between them. You can also switch between menu screens using  $\boxed{\leftarrow}$  and  $\boxed{\rightarrow}$ .



2. Perform one of the following operations to select the calculation mode you want.

- |   |   |
|---|---|
| $\boxed{1}$ (COMP): COMP (Computation)              | $\boxed{2}$ (CMPLX): CMPLX (Complex Number)       |
| $\boxed{3}$ (BASE): BASE (Base $n$ )                | $\boxed{4}$ (SD): SD (Single Variable Statistics) |
| $\boxed{5}$ (REG): REG (Paired Variable Statistics) | $\boxed{6}$ (PRGM): PRGM (Program)                |

- Pressing a number key from  $\boxed{1}$  to  $\boxed{6}$  selects the applicable mode, regardless of which menu screen is currently displayed.

## ■ Calculator Setup

The calculator setup can be used to configure input and output settings, calculation parameters, and other settings. The setup can be configured using setup screens, which you access by pressing **SHIFT** **MODE** (SETUP). There are six setup screens, and you can use **◀** and **▶** to navigate between them.

### ◆ Specifying the Angle Unit

$$90^\circ = \frac{\pi}{2} \text{ radians} = 100 \text{ grads}$$

Angle Unit	Perform this key operation:
Degrees	<b>SHIFT</b> <b>MODE</b> <b>1</b> (Deg)
Radians	<b>SHIFT</b> <b>MODE</b> <b>2</b> (Rad)
Grads	<b>SHIFT</b> <b>MODE</b> <b>3</b> (Gra)

### ◆ Specifying the Display Digits

Exponential Display	Perform this key operation:
Number of Decimal Places	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>1</b> (Fix) <b>0</b> (0) to <b>9</b> (9)
Significant Digits	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>2</b> (Sci) <b>1</b> (1) to <b>9</b> (9), <b>0</b> (10)
Exponential Display Range	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>3</b> (Norm) <b>1</b> (Norm1) or <b>2</b> (Norm2)

The following explains how calculation results are displayed in accordance with the setting you specify.

- From zero to nine decimal places are displayed in accordance with the number of decimal places (Fix) you specify. Calculation results are rounded off to the specified number of digits.

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

- After you specify the number of significant digits with Sci, calculation results are displayed using the specified number of significant digits and 10 digits to the applicable power. Calculation results are rounded off to the specified number of digits.

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

- Selecting Norm1 or Norm2 causes the display to switch to exponential notation whenever the result is within the ranges defined below.

Norm1:  $10^{-2} > |x|, |x| \geq 10^{10}$       Norm2:  $10^{-9} > |x|, |x| \geq 10^{10}$

Example:  $1 \div 200 = 5. \times 10^{-3}$  (Norm1)      0.005 (Norm2)

### ◆ Specifying the Fraction Display Format

Fraction Format	Perform this key operation:
Mixed Fractions	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>▶</b> <b>1</b> (ab/c)
Improper Fractions	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>▶</b> <b>2</b> (d/c)

## ◆ Specifying the Complex Number Display Format

Complex Number Format	Perform this key operation:
Rectangular Coordinates	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>▶</b> <b>▶</b> <b>1</b> ( $a+bi$ )
Polar Coordinates	<b>SHIFT</b> <b>MODE</b> <b>▶</b> <b>▶</b> <b>▶</b> <b>2</b> ( $r\angle\theta$ )

## ◆ Specifying the Statistical Frequency Setting

Frequency Setting	Perform this key operation:
Frequency On	<b>SHIFT</b> <b>MODE</b> <b>◀</b> <b>◀</b> <b>1</b> (FreqOn)
Frequency Off	<b>SHIFT</b> <b>MODE</b> <b>◀</b> <b>◀</b> <b>2</b> (FreqOff)

## ■ Clearing the Calculation Mode and Setup Settings

Perform the procedure described below to clear the current calculation mode and all setup settings and initialize the calculator to the following.

Calculation Mode ..... COMP (Computation Mode)  
 Angle Unit ..... Deg (Degrees)  
 Exponential Display..... Norm1  
 Fraction Format ..... ab/c (Mixed Fractions)  
 Complex Number Format .....  $a+bi$  (Rectangular Coordinates)  
 Frequency Setting ..... FreqOn (Frequency On)

Perform the following key operation to clear the calculation mode and setup settings.

**SHIFT** **9** (CLR) **2** (Setup) **EXE**

If you do not want to clear the calculator's settings, press **AC** in place of **EXE** in the above operation.

# Inputting Calculation Expressions and Values

## ■ Inputting a Calculation Expression

Your calculator lets you input a calculation expression just as it is written and execute it by pressing **EXE**. The calculator determines the proper priority sequence for addition, subtraction, multiplication, division, functions and parentheses automatically.

**Example:**  $2 \times (5 + 4) - 2 \times (-3) =$

**2** **×** **(** **5** **+** **4** **)** **-**  
**2** **×** **(-** **3** **)** **EXE**

$2 \times (5+4) - 2 \times -3$   
**24.**



## ◆ Inputting Scientific Functions with Parentheses (sin, cos, $\sqrt{\quad}$ , etc.)

Your calculator supports input of the scientific functions with parentheses shown below. Note that after you input the argument, you need to press  $\text{)}\text{}$  to close the parentheses.

sin(, cos(, tan(,  $\sin^{-1}$ (,  $\cos^{-1}$ (,  $\tan^{-1}$ (, sinh(, cosh(, tanh(,  $\sinh^{-1}$ (,  $\cosh^{-1}$ (,  $\tanh^{-1}$ (, log(, ln(,  $e^{\wedge}$ (,  $10^{\wedge}$ (,  $\sqrt{\quad}$ (,  $\sqrt[3]{\quad}$ (, Abs(, Pol(, Rec(, arg(, Conjg(, Not(, Neg(, Rnd(,  $\int$ (,  $d/dx$ (

**Example:** sin 30 =

$\text{sin}$   $\text{3}$   $\text{0}$   $\text{)}$   $\text{EXE}$

sin(30)

05

## ◆ Omitting the Multiplication Sign

You can omit the multiplication sign in the following cases.

- Immediately before an open parenthesis:  $2 \times (5 + 4)$
- Immediately before a scientific function with parentheses:  $2 \times \sin(30)$ ,  $2 \times \sqrt{\quad}(3)$
- Before a prefix symbol (excluding the minus sign):  $2 \times h123$
- Before a variable name, constant, or random number:  $20 \times A$ ,  $2 \times \pi$

### Important!

If you execute a calculation that includes both division and multiplication operations in which a multiplication sign has been omitted, parentheses will be inserted automatically as shown in the examples below.

- When a multiplication sign is omitted immediately before an open parenthesis or after a closed parenthesis.

$$6 \div 2 (1 + 2) \rightarrow 6 \div (2 (1 + 2)) \qquad 6 \div A (1 + 2) \rightarrow 6 \div (A (1 + 2))$$

$$1 \div (2 + 3) \sin(30) \rightarrow 1 \div ((2 + 3) \sin(30))$$

- When a multiplication sign is omitted immediately before a variable, a constant, etc.

$$6 \div 2\pi \rightarrow 6 \div (2\pi) \qquad 2 \div 2\sqrt{\quad}(2) \rightarrow 2 \div (2\sqrt{\quad}(2)) \qquad 4\pi \div 2\pi \rightarrow 4\pi \div (2\pi)$$

- When inputting a function that uses commas (such as Pol, Rec), be sure to input the closed parentheses required by the expression. If you do not input closed parentheses, parentheses may not be inserted automatically as described above.

## ◆ Final Closed Parenthesis

You can omit one or more closed parentheses that come at the end of a calculation, immediately before the  $\text{EXE}$  key is pressed.

**Example:**  $(2 + 3) \times (4 - 1) = 15$

$\text{}$   $\text{2}$   $\text{+}$   $\text{3}$   $\text{)}$   $\text{x}$   
 $\text{}$   $\text{4}$   $\text{-}$   $\text{1}$   $\text{EXE}$

$(2+3) \times (4-1)$

15

## ◆ Scrolling the Screen Left and Right

Input Expression \_\_\_\_\_ 12345 + 12345 + 12345

Displayed Expression \_\_\_\_\_  $\leftarrow$  345+12345+12345|

Cursor \_\_\_\_\_

- While the ← symbol is on the screen, you can use the ◀ key to move the cursor to the left and scroll the screen.
- Scrolling to the left causes part of the expression to run off the right side of the display, which is indicated by the ➡ symbol on the right. While the ➡ symbol is on the screen, you can use the ▶ key to move the cursor to the right and scroll the screen.
- You can also press ▲ to jump to the beginning of the expression, or ▼ to jump to the end.

## ◆ Number of Input Characters (Bytes)

As you input a mathematical expression, it is stored in memory called an “input area,” which has a capacity of 99 bytes. This means you can input up to 99 bytes for a single mathematical expression.

Normally, the cursor that indicates the current input location on the display is either a flashing vertical bar (|) or horizontal bar (▬). When the remaining capacity of the input area is 10 bytes or less, the cursor changes to a flashing box (■).

If this happens, stop input of the current expression at some suitable location and calculate its result.

## ■ Editing a Calculation

### ◆ Insert Mode and Overwrite Mode

The calculator has two input modes. The insert mode inserts your input at the cursor location, shifting anything to the right of the cursor to make room. The overwrite mode replaces the key operation at the cursor location with your input.

	Original Expression	Pressing $\oplus$
<b>Insert Mode</b>	$1+2 34$ Cursor _____	$1+2+ 34$
<b>Overwrite Mode</b>	$1+2 \underline{3} 4$ Cursor _____▬	$1+2 + \underline{4}$

The initial default input mode setting is insert mode.

To change to the overwrite mode, press:  $\text{SHIFT}$   $\text{DEL}$  (INS).

### ◆ Editing a Key Operation You Just Input

**Example:** To correct  $369 \times 13$  so it becomes  $369 \times 12$

$\text{3}$   $\text{6}$   $\text{9}$   $\text{X}$   $\text{1}$   $\text{3}$

$369 \times 13|$

$\text{DEL}$   $\text{2}$

$369 \times 12|$

## ◆ Deleting a Key Operation

**Example:** To correct  $369 \times \times 12$  so it becomes  $369 \times 12$

Insert Mode

**3** **6** **9** **X** **X** **1** **2**

369××12|

◀ ◀ DEL

369×|12

Overwrite Mode

**3** **6** **9** **X** **X** **1** **2**

369××12\_

◀ ◀ ◀ DEL

369×12

## ◆ Editing a Key Operation within an Expression

With the insert mode, use ◀ and ▶ to move the cursor to the right of the key operation you want to edit, press DEL to delete it, and then perform the correct key operation. With the overwrite mode, move the cursor to the key operation you want to correct and then perform the correct key operation.

## ◆ Inserting Key Operations into an Expression

Be sure to select the insert mode whenever you want to insert key operations into an expression. Use ◀ and ▶ to move the cursor to the location where you want to insert the key operations, and then perform them.

## ■ Finding the Location of an Error

If your calculation expression is incorrect, an error message will appear on the display when you press EXE to execute it. After an error message appears, press the ◀ or ▶ key and the cursor will jump to the location in your calculation that caused the error so you can correct it.

**Example:** When you input  $14 \div 0 \times 2 =$  instead of  $14 \div 10 \times 2 =$   
(The following examples use the insert mode.)

**1** **4** **÷** **0** **X** **2** **EXE**

Math ERROR

▶ or ◀

14÷0|×2

Location of Error

◀ **1** **EXE**

14÷10×2

2.8

# Basic Calculations

Unless otherwise noted, the calculations in this section can be performed in any of the calculator's calculation mode, except for the BASE Mode.

## Arithmetic Calculations

Arithmetic calculations can be used to perform addition ( $\oplus$ ), subtraction ( $\ominus$ ), multiplication ( $\otimes$ ), and division ( $\oslash$ ).

**Example:**  $7 \times 8 - 4 \times 5 = 36$

$\boxed{7} \boxed{\otimes} \boxed{8} \boxed{\ominus} \boxed{4} \boxed{\otimes} \boxed{5} \boxed{\text{EXE}}$

**36**

## Fractions

Fractions are input using a special separator symbol ( $\lrcorner$ ).

### Fraction Calculation Examples

**Example 1:**  $3\frac{1}{4} + 1\frac{2}{3} = 4\frac{11}{12}$

$\boxed{3} \boxed{a\frac{b}{c}} \boxed{1} \boxed{a\frac{b}{c}} \boxed{4} \boxed{+}$   
 $\boxed{1} \boxed{a\frac{b}{c}} \boxed{2} \boxed{a\frac{b}{c}} \boxed{3} \boxed{\text{EXE}}$

**4 $\lrcorner$ 11 $\lrcorner$ 12**

**Example 2:**  $\frac{2}{3} + \frac{1}{2} = \frac{7}{6}$  (Fraction Display Format: d/c)

$\boxed{2} \boxed{a\frac{b}{c}} \boxed{3} \boxed{+} \boxed{1} \boxed{a\frac{b}{c}} \boxed{2} \boxed{\text{EXE}}$

**7 $\lrcorner$ 6**

### Note

- If the total number of elements (integer + numerator + denominator + separator symbols) of a fraction calculation result is greater than 10 digits, the result will be displayed in decimal format.
- If an input calculation includes a mixture of fraction and decimal values, the result will be displayed in decimal format.
- You can input integers only for the elements of a fraction. Inputting non-integers will produce a decimal format result.

### Switching between Mixed Fraction and Improper Fraction Format

To convert a mixed fraction to an improper fraction (or an improper fraction to a mixed fraction), press  $\boxed{\text{SHIFT}} \boxed{a\frac{b}{c}}$  (d/c).

### Switching between Decimal and Fraction Format

Press  $\boxed{a\frac{b}{c}}$  to toggle between decimal value and fraction display format.

### Note

The calculator cannot switch from decimal to fraction format if the total number of fraction elements (integer + numerator + denominator + separator symbols) is greater than 10 digits.

## ■ Percent Calculations

Inputting a value and with a percent (%) sign makes the value a percent.

### ◆ Percent Calculation Examples

**Example 1:**  $2\% = 0.02$   $\left(\frac{2}{100}\right)$

2 SHIFT ( (%) EXE

002

**Example 2:**  $150 \times 20\% = 30$   $\left(150 \times \frac{20}{100}\right)$

1 5 0 × 2 0  
SHIFT ( (%) EXE

30.

**Example 3:** What percent of 880 is 660?

6 6 0 ÷ 8 8 0  
SHIFT ( (%) EXE

75.

**Example 4:** Increase 2,500 by 15%.

2 5 0 0 + 2 5 0 0 ×  
1 5 SHIFT ( (%) EXE

2875.

**Example 5:** Reduce 3,500 by 25%.

3 5 0 0 - 3 5 0 0 ×  
2 5 SHIFT ( (%) EXE

2625.

**Example 6:** Reduce the sum of 168, 98, and 734 by 20%.

1 6 8 + 9 8 + 7 3 4 EXE

1000.

- Ans × 2 0 SHIFT ( (%) EXE

800.

**Example 7:** 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?

( 5 0 0 + 3 0 0 )  
÷ 5 0 0 SHIFT ( (%) EXE

160.

**Example 8:** What is the percentage change when a value is increased from 40 to 46?

( 4 6 - 4 0 ) ÷ 4 0  
SHIFT ( (%) EXE

15.

## ■ Degree, Minute, Second (Sexagesimal) Calculations

### ◆ Inputting Sexagesimal Values

The following is basic syntax for inputting a sexagesimal value.

{Degrees}  $\square_{\circ}$  {Minutes}  $\square_{\prime}$  {Seconds}  $\square_{\prime\prime}$

**Example:** To input 2°30'30"

$\square_2$   $\square_{\circ}$   $\square_3$   $\square_0$   $\square_{\prime}$   $\square_3$   $\square_0$   $\square_{\prime\prime}$   $\square_{\text{EXE}}$

2° 30' 30"  
2° 30' 30.

- Note that you must always input something for the degrees and minutes, even if they are zero.

### ◆ Sexagesimal Calculation Examples

The following types of sexagesimal calculations will produce sexagesimal results.

- Addition or subtraction of two sexagesimal values
- Multiplication or division of a sexagesimal value and a decimal value

**Example:** 2°20'30" + 39°30" = 3°00'00"

$\square_2$   $\square_{\circ}$   $\square_2$   $\square_0$   $\square_{\prime}$   $\square_3$   $\square_0$   $\square_{\prime\prime}$   $\square_{+}$   
 $\square_0$   $\square_{\circ}$   $\square_3$   $\square_9$   $\square_{\prime}$   $\square_3$   $\square_0$   $\square_{\prime\prime}$   $\square_{\text{EXE}}$

3° 0' 0.

### ◆ Converting between Sexagesimal and Decimal

Pressing  $\square_{\circ}$  while a calculation result is displayed will toggle the value between sexagesimal and decimal.

**Example:** To convert 2.255 to sexagesimal

$\square_2$   $\square_{\cdot}$   $\square_2$   $\square_5$   $\square_5$   $\square_{\text{EXE}}$   $\square_{\circ}$

2° 15' 18.

## Calculation History and Replay

Calculation history maintains a record of each calculation you perform, including the expressions you input and calculation results. You can use calculation history in the COMP, CMPLX, and BASE Modes.

### ■ Accessing Calculation History

The ▲ symbol in the upper right corner of the display indicates that there is data stored in calculation history. To view the data in calculation history, press  $\square_{\blacktriangle}$ . Each press of  $\square_{\blacktriangle}$  will scroll upwards (back) one calculation, displaying both the calculation expression and its result.

**Example:**  $\square_1$   $\square_{+}$   $\square_1$   $\square_{\text{EXE}}$   $\square_2$   $\square_{+}$   $\square_2$   $\square_{\text{EXE}}$   $\square_3$   $\square_{+}$   $\square_3$   $\square_{\text{EXE}}$



While scrolling through calculation history records, the ▼ symbol will appear on the display, which indicates that there are records below (newer than) the current one. When this symbol is turned on, press ⏴ to scroll downwards (forward) through calculation history records.

### Important!

- Calculation history records are all cleared whenever you press **ON**, when you change to a different calculation mode, and whenever you perform any reset operation.
- Calculation history capacity is limited. Whenever you perform a new calculation while calculation history is full, the oldest record in calculation history is deleted automatically to make room for the new one.

## ■ Using Replay

While a calculation history record is on the display, press ⏴ or ⏵ to display the cursor and enter the editing mode. Pressing ⏵ displays the cursor at the beginning of the calculation expression, while ⏴ displays it at the end. After you make the changes you want, press **EXE** to execute the calculation.

**Example:**  $4 \times 3 + 2.5 = 14.5$   
 $4 \times 3 - 7.1 = 4.9$

The diagram illustrates the replay function on a calculator. It shows three stages of the process:

- Inputting the expression  $4 \times 3 + 2.5$  and pressing **EXE** to get the result **14.5**.
- Pressing the left arrow key (⏴) to move the cursor to the start of the expression.
- Pressing **DEL** to delete the expression, then inputting  $4 \times 3 - 7.1$  and pressing **EXE** to get the result **4.9**.

# Calculator Memory Operations

## ■ Using Answer Memory (Ans)

The result of any new calculation you perform on the calculator is stored automatically in Answer Memory (Ans).

### ◆ Ans Update and Delete Timing

When using Ans in a calculation, it is important to keep in mind how and when its contents change. Note the following points.

- The contents of Ans are replaced whenever you perform any of the following operations: calculate a calculation result, add a value to or subtract a value from independent memory, assign a value to a variable or recall the value of a variable, or input statistical data in the SD Mode or REG Mode.
- In the case of a calculation that produces more than one result (like coordinate calculations), the value that appears first on the display is stored in Ans.
- The contents of Ans do not change if the current calculation produces an error.

- When you perform a complex number calculation in the CMPLX Mode, both the real part and the imaginary part of the result are stored in Ans. Note, however, that the imaginary part of the value is cleared if you change to another calculation mode.

## ◆ Automatic Insertion of Ans in Consecutive Calculations

**Example:** To divide the result of  $3 \times 4$  by 30

$3 \times 4$ EXE	12.
(Next) $\div$ 30 EXE	<div style="display: flex; justify-content: space-between;"> <span>Ans <math>\div</math> 30</span> <span style="font-size: 2em;">0.4</span> </div>

Pressing  $\div$  inputs Ans automatically.

### Note

In the case of a function with parenthetical argument (page 8), Ans automatically becomes the argument only in the case that you input the function alone and then press EXE.

## ◆ Inserting Ans into a Calculation Manually

**Example:** To use the result of  $123 + 456$  in another calculation as shown below

$$123 + 456 = \underline{579} \quad 789 - \underline{579} = 210$$

$123 + 456$ EXE	579.
$789 -$ Ans EXE	210.

## ■ Using Independent Memory

Independent memory (M) is used mainly for calculating cumulative totals.

If you can see the M symbol on the display, it means there is a non-zero value in independent memory. Independent memory can be used in all calculation modes, except for the SD Mode and the REG Mode.

M symbol 
<sup>M</sup>  
 10M+

## ◆ Adding to Independent Memory

While a value you input or the result of a calculation is on the display, press  $M+$  to add it to independent memory (M).

**Example:** To add the result of  $105 \div 3$  to independent memory (M)

$105 \div 3$ $M+$	35.
-------------------	-----



## ◆ Subtracting from Independent Memory

While a value you input or the result of a calculation is on the display, press  $\boxed{\text{SHIFT}} \boxed{\text{M+}} (\text{M-})$  to subtract it from independent memory (M).

**Example:** To subtract the result of  $3 \times 2$  from independent memory (M)

$\boxed{3} \boxed{\times} \boxed{2} \boxed{\text{SHIFT}} \boxed{\text{M+}} (\text{M-})$

**6.**

### Note

Pressing  $\boxed{\text{M+}}$  or  $\boxed{\text{SHIFT}} \boxed{\text{M+}} (\text{M-})$  while a calculation result is on the display will add it to or subtract it from independent memory.

### Important!

The value that appears on the display when you press  $\boxed{\text{M+}}$  or  $\boxed{\text{SHIFT}} \boxed{\text{M+}} (\text{M-})$  at the end of a calculation in place of  $\boxed{\text{EXE}}$  is the result of the calculation (which is added to or subtracted from independent memory). It is not the current contents of independent memory.

## ◆ Viewing Independent Memory Contents

Press  $\boxed{\text{RCL}} \boxed{\text{M+}} (\text{M})$ .

## ◆ Clearing Independent Memory Contents (to 0)

$\boxed{0} \boxed{\text{SHIFT}} \boxed{\text{RCL}} (\text{STO}) \boxed{\text{M+}} (\text{M})$

Clearing independent memory will cause the M symbol to turn off.

## ■ Using Variables

The calculator supports six variables named A, B, C, D, X, and Y, which you can use to store values as required. Variables can be used in all calculation modes.

## ◆ Assigning a Value or Calculation Result to a Variable

Use the procedure shown below to assign a value or a calculation expression to a variable.

**Example:** To assign  $3 + 5$  to variable A  $\boxed{3} \boxed{+} \boxed{5} \boxed{\text{SHIFT}} \boxed{\text{RCL}} (\text{STO}) \boxed{\text{(-)}} (\text{A})$

## ◆ Viewing the Value Assigned to a Variable

To view the value assigned to a variable, press  $\boxed{\text{RCL}}$  and then specify the variable name.

**Example:** To view the value assigned to variable A  $\boxed{\text{RCL}} \boxed{\text{(-)}} (\text{A})$

## ◆ Using a Variable in a Calculation

You can use variables in calculations the same way you use values.

**Example:** To calculate  $5 + A$   $\boxed{5} \boxed{+} \boxed{\text{ALPHA}} \boxed{\text{(-)}} (\text{A}) \boxed{\text{EXE}}$

## ◆ Clearing the Value Assigned to a Variable (to 0)

**Example:** To clear variable A  $\boxed{0} \boxed{\text{SHIFT}} \boxed{\text{RCL}} (\text{STO}) \boxed{\text{(-)}} (\text{A})$

## ■ Clearing All Memory Contents

Perform the following key operation when you want to clear the contents of independent memory, variable memory, and Answer Memory.

**SHIFT** **9** (CLR) **1** (Mem) **EXE**

- If you do not want to clear the calculator's settings, press **AC** in place of **EXE** in the above operation.

## Scientific Function Calculations

Unless otherwise noted, the functions in this section can be used in any of the calculator's calculation modes, except for the BASE Mode.

### Scientific Function Calculation Precautions

- When performing a calculation that includes a built-in scientific function, it may take some time before the calculation result appears. Do not perform any key operation on the calculator until the calculation result appears.
- To interrupt and on-going calculation operation, press **AC**.

### Interpreting Scientific Function Syntax

- Text that represents a function's argument is enclosed in braces (**{ }**). Arguments are normally **{value}** or **{expression}**.
- When braces (**{ }**) are enclosed within parentheses, it means that input of everything inside the parentheses is mandatory.

## ■ Pi ( $\pi$ ) and Natural Logarithm Base $e$

The calculator supports input of pi ( $\pi$ ) and natural logarithm base  $e$  into calculations.  $\pi$  and  $e$  are supported in all modes, except for the BASE Mode. The following are the values that the calculator applies for each of the built-in constants.

$$\pi = 3.14159265358980 \text{ (SHIFT EXP } (\pi))$$

$$e = 2.71828182845904 \text{ (ALPHA ln } (e))$$

## ■ Trigonometric and Inverse Trigonometric Functions

### ◆ Syntax and Input

$\sin(\{n\})$ ,  $\cos(\{n\})$ ,  $\tan(\{n\})$ ,  $\sin^{-1}(\{n\})$ ,  $\cos^{-1}(\{n\})$ ,  $\tan^{-1}(\{n\})$

**Example:**  $\sin 30 = 0.5$ ,  $\sin^{-1}0.5 = 30$  (Angle Unit: Deg)

**sin** **3** **0** **)** **EXE**

05

**SHIFT** **sin** (**sin<sup>-1</sup>**) **0** **.** **5** **)** **EXE**

30

## ◆ Notes

- These functions can be used in the CMPLX Mode, as long as a complex number is not used in the argument. A calculation like  $i \times \sin(30)$  is supported for example, but  $\sin(1 + i)$  is not.
- The angle unit you need to use in a calculation is the one that is currently selected as the default angle unit.

## ■ Angle Unit Conversion

You can convert a value that was input using one angle unit to another angle unit.

After you input a value, press **[SHIFT]** **[Ans]** (**DRG▶**) to display the menu screen shown below.

<b>D</b>	<b>R</b>	<b>G</b>
<b>1</b>	<b>2</b>	<b>3</b>

**1** (D): Degrees

**2** (R): Radians

**3** (G): Grads

**Example:** To convert  $\frac{\pi}{2}$  radians to degrees (Angle Unit: Deg)

**[ ( ]** **[SHIFT]** **[EXP]** ( $\pi$ ) **[÷]** **[2]** **[ ) ]**  
**[SHIFT]** **[Ans]** (**DRG▶**) **[2]** (R) **[EXE]**

$(\pi \div 2)^{\circ}$   
**90.**

## ■ Hyperbolic and Inverse Hyperbolic Functions

### ◆ Syntax and Input

$\sinh(\{n\})$ ,  $\cosh(\{n\})$ ,  $\tanh(\{n\})$ ,  $\sinh^{-1}(\{n\})$ ,  $\cosh^{-1}(\{n\})$ ,  $\tanh^{-1}(\{n\})$

**Example:**  $\sinh 1 = 1.175201194$

**[hyp]** **[sin]** (sinh) **[1]** **[ ) ]** **[EXE]**

**1.175201194**

## ◆ Notes

- After pressing **[hyp]** to specify a hyperbolic function or **[SHIFT]** **[hyp]** to specify an inverse hyperbolic function, press **[sin]**, **[cos]**, or **[tan]**.
- These functions can be used in the CMPLX Mode, but complex number arguments are not supported.

## ■ Exponential and Logarithmic Functions

### ◆ Syntax and Input

$10^{\{n\}}$  .....  $10^{\{n\}}$

$e^{\{n\}}$  .....  $e^{\{n\}}$

$\log(\{n\})$  .....  $\log_{10}\{n\}$  (Common Logarithm)

$\log(\{m\},\{n\})$  .....  $\log_{\{m\}}\{n\}$  (Base  $\{m\}$  Logarithm)

$\ln(\{n\})$  .....  $\log_e\{n\}$  (Natural Logarithm)

**Example 1:**  $\log_2 16 = 4$ ,  $\log 16 = 1.204119983$

$\boxed{\log} \boxed{2} \boxed{,} \boxed{1} \boxed{6} \boxed{)} \boxed{\text{EXE}}$

**4.**

$\boxed{\log} \boxed{1} \boxed{6} \boxed{)} \boxed{\text{EXE}}$

$\log(16)$   
**1.204119983**

Base 10 (common logarithm) is assumed when no base is specified.

**Example 2:**  $\ln 90$  ( $\log_e 90$ ) = 4.49980967

$\boxed{\ln} \boxed{9} \boxed{0} \boxed{)} \boxed{\text{EXE}}$

**4.49980967**

## ■ Power Functions and Power Root Functions

### ◆ Syntax and Input

$\{n\} x^2$ ..... $\{n\}^2$	(Square)
$\{n\} x^3$ ..... $\{n\}^3$	(Cube)
$\{n\} x^{-1}$ ..... $\{n\}^{-1}$	(Reciprocal)
$\{(m)\}^{\wedge}\{n\}$ ..... $\{m\}^{\{n\}}$	(Power)
$\sqrt{\{n\}}$ ..... $\sqrt{\{n\}}$	(Square Root)
$\sqrt[3]{\{n\}}$ ..... $\sqrt[3]{\{n\}}$	(Cube Root)
$\{(m)\}^x \sqrt{\{n\}}$ ..... $\{m\} \sqrt{\{n\}}$	(Power Root)

**Example 1:**  $(\sqrt{2} + 1)(\sqrt{2} - 1) = 1$

$\boxed{(} \boxed{\sqrt{}} \boxed{2} \boxed{)} \boxed{+} \boxed{1} \boxed{)} \boxed{(} \boxed{\sqrt{}} \boxed{2} \boxed{)} \boxed{-} \boxed{1} \boxed{)} \boxed{\text{EXE}}$

$(\sqrt{2}+1)(\sqrt{2}-1)$   
**1.**

**Example 2:**  $-2^{\frac{2}{3}} = -1.587401052$

$\boxed{(-} \boxed{2} \boxed{\wedge} \boxed{2} \boxed{\frac{\square}{\square}} \boxed{3} \boxed{)} \boxed{\text{EXE}}$

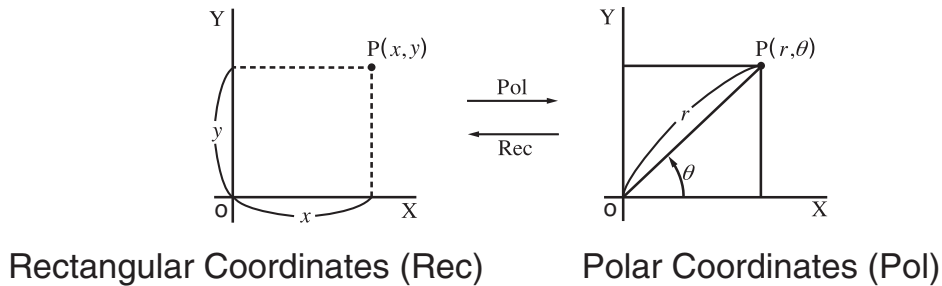
$-2^{(2 \div 3)}$   
**-1.587401052**

### ◆ Notes

- The functions  $x^2$ ,  $x^3$ , and  $x^{-1}$  can be used in complex number calculations in the CMPLX Mode. Complex number arguments are also supported for these functions.
- $\wedge$ ,  $\sqrt{\quad}$ ,  $\sqrt[3]{\quad}$ ,  $\sqrt[x]{\quad}$  are also supported in the CMPLX Mode, but complex number arguments are not supported for these functions.

## Coordinate Conversion (Rectangular ↔ Polar)

Your calculator can convert between rectangular coordinates and polar coordinates.



### Syntax and Input

Rectangular-to-Polar Coordinate Conversion (Pol)

Pol( $x, y$ )

$x$ : Rectangular coordinate  $x$ -value

$y$ : Rectangular coordinate  $y$ -value

Polar-to-Rectangular Coordinate Conversion (Rec)

Rec( $r, \theta$ )

$r$ : Polar coordinate  $r$ -value

$\theta$ : Polar coordinate  $\theta$ -value

**Example 1:** To convert the rectangular coordinates  $(\sqrt{2}, \sqrt{2})$  to polar coordinates

(Angle Unit: Deg)

SHIFT + (Pol) ✓ 2 )  
, ✓ 2 ) ) EXE

2.

(View the value of  $\theta$ )

RCL ▸ (Y)

45.

**Example 2:** To convert the polar coordinates  $(2, 30^\circ)$  to rectangular coordinates

(Angle Unit: Deg)

SHIFT - (Rec) 2 ,  
3 0 ) EXE

1.732050808

(View the value of  $y$ )

RCL ▸ (Y)

1.

### Notes

- These functions can be used in the COMP, SD, and REG Modes.
- Calculation results show the first  $r$  value or  $x$  value only.
- The  $r$ -value (or  $x$ -value) produced by the calculation is assigned to variable X, while the  $\theta$ -value (or  $y$ -value) is assigned to variable Y (page 16). To view the  $\theta$ -value (or  $y$ -value), display the value assigned to variable Y, as shown in the example.
- The values obtained for  $\theta$  when converting from rectangular coordinates to polar coordinates is within the range  $-180^\circ < \theta \leq 180^\circ$ .

- When executing a coordinate conversion function inside of a calculation expression, the calculation is performed using the first value produced by the conversion ( $r$ -value or  $x$ -value).

Example:  $\text{Pol}(\sqrt{2}, \sqrt{2}) + 5 = 2 + 5 = 7$

## Integration Calculation and Differential Calculation

### Integration Calculation

Your calculator performs integration using the Gauss-Kronrod method.

#### Syntax and Input

$\int(f(x), a, b, tol)$

$f(x)$ : Function of X (Input the function used by variable X.)

$a$ : Lower limit of region of integration

$b$ : Upper limit of region of integration

$tol$ : Error tolerance range

- This parameter can be omitted. In that case, a tolerance of  $1 \times 10^{-5}$  is used.

Example:  $\int_1^e \ln(x) = 1$

$\int dx$   $\ln$   $\alpha$  0 (X) ) , 1 ,  $\alpha$   $\ln$  (e) )  $\text{EXE}$

$\int(\ln(X), 1, e)$

1.

### Differential Calculation

Your calculator approximates the derivative based on the central difference method.

#### Syntax and Input

$d/dx(f(x), a, tol)$

$f(x)$ : Function of X (Input the function used by variable X.)

$a$ : Input value of point (differential point) of desired differential coefficient

$tol$ : Error tolerance range

- This parameter can be omitted. In that case, a tolerance of  $1 \times 10^{-10}$  is used.

Example: To obtain the derivative at point  $x = \frac{\pi}{2}$  for the function  $y = \sin(x)$  (Angle Unit: Rad)

$\text{SHIFT}$   $\int dx$  (d/dx)  $\sin$   $\alpha$  0 (X) ) ,  $\text{SHIFT}$   $\text{EXP}$  ( $\pi$ )  $\div$  2 )  $\text{EXE}$

$d/dx(\sin(X), \pi \div 2)$

0.

### Integration and Differential Calculation Precautions

- Integration and differential calculations can be performed in the COMP Mode and PRGM Mode (run mode: COMP) only.
- The following cannot be used in  $f(x)$ : Pol, Rec. The following cannot be used in  $f(x)$ ,  $a$ ,  $b$ , or  $tol$ :  $\int$ ,  $d/dx$ .
- When using a trigonometric function in  $f(x)$ , specify Rad as the angle unit.

- A smaller *tol* value increases precision, but it also increases calculation time. When specifying *tol*, use value that is  $1 \times 10^{-14}$  or greater.

### Precautions for Integration Calculation Only

- Integration normally requires considerable time to perform.
- For  $f(x) < 0$  where  $a \leq x \leq b$  (as in the case of  $\int_0^1 3x^2 - 2 = -1$ ), calculation will produce a negative result.
- Depending on the content of  $f(x)$  and the region of integration, calculation error that exceeds the tolerance may be generated, causing the calculator to display an error message.

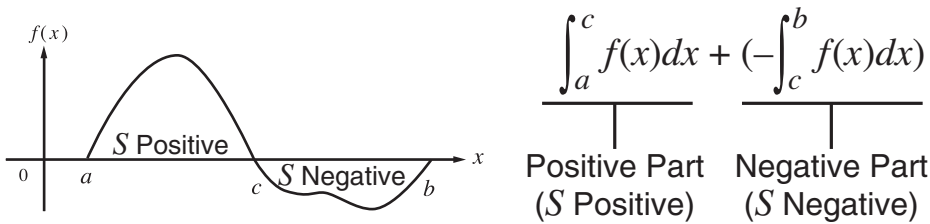
### Precautions for Differential Calculation Only

- If convergence to a solution cannot be found when *tol* input is omitted, the *tol* value will be adjusted automatically to determine the solution.
- Non-consecutive points, abrupt fluctuation, extremely large or small points, inflection points, and the inclusion of points that cannot be differentiated, or a differential point or differential calculation result that approaches zero can cause poor precision or error.

### ◆ Tips for Successful Integration Calculations

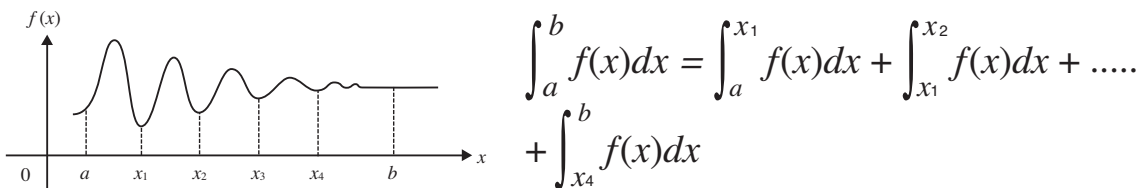
#### When a periodic function or integration interval results in positive and negative $f(x)$ function values

Perform separate integrations for each cycle, or for the positive part and the negative part, and then combine the results.



#### When integration values fluctuate widely due to minute shifts in the integration interval

Divide the integration interval into multiple parts (in a way that breaks areas of wide fluctuation into small parts), perform integration on each part, and then combine the results.



## Other Functions

$x!$ , Abs(, Ran#,  $nPr$ ,  $nCr$ , Rnd(

The  $x!$ ,  $nPr$ , and  $nCr$  functions can be used in the CMPLX Mode, but complex number arguments are not supported.

### Factorial (!)

Syntax:  $\{n\}!$  ( $\{n\}$  must be a natural number or 0.)

**Example:**  $(5 + 3)!$

( 5 + 3 )  
SHIFT x! (x!) EXE

40320.

### Absolute Value (Abs)

When you are performing a real number calculation, Abs( simply obtains the absolute value. This function can be used in the CMPLX Mode to determine the absolute value (size) of a complex number. See “Complex Number Calculations” on page 25 for more information.

Syntax: Abs( $\{n\}$ )

**Example:** Abs  $(2 - 7) = 5$

SHIFT ) (Abs) 2 - 7 ) EXE

5.

### Random Number (Ran#)

This function generates a three-decimal place (0.000 to 0.999) pseudo random number. It does not require an argument, and can be used the same way as a variable.

Syntax: Ran#

**Example:** To use 1000Ran# to obtain three 3-digit random numbers.

1 0 0 0 SHIFT . (Ran#) EXE

287.

EXE

613.

EXE

118.

- The above values are provided for example only. The actual values produced by your calculator for this function will be different.



## ◆ Permutation ( $nPr$ )/Combination ( $nCr$ )

Syntax:  $\{n\}P\{m\}$ ,  $\{n\}C\{m\}$

**Example:** How many four-person permutations and combinations are possible for a group of 10 people?

$\boxed{1} \boxed{0} \text{SHIFT} \boxed{\times} (nPr) \boxed{4} \text{EXE}$

**5040.**

$\boxed{1} \boxed{0} \text{SHIFT} \boxed{\div} (nCr) \boxed{4} \text{EXE}$

**210.**

## ◆ Rounding Function (Rnd)

You can use the rounding function (Rnd) to round the value, expression, or calculation result specified by the argument. Rounding is performed to the number of significant digits in accordance with the number of display digits setting.

### Rounding for Norm1 or Norm2

The mantissa is rounded off to 10 digits.

### Rounding for Fix or Sci

The value is rounded to the specified number of digits.

**Example:**  $200 \div 7 \times 14 = 400$

(3 decimal places)

(Internal calculation uses 15 digits.)

$\text{SHIFT} \text{MODE} \text{▶} \boxed{1} (\text{Fix}) \boxed{3}$   
 $\boxed{2} \boxed{0} \boxed{0} \boxed{\div} \boxed{7} \text{EXE}$

**28571**

$\boxed{\times} \boxed{1} \boxed{4} \text{EXE}$

**400000**

Now perform the same calculation using the rounding (Rnd) function.

(Calculation uses rounded value.)

$\boxed{2} \boxed{0} \boxed{0} \boxed{\div} \boxed{7} \text{EXE}$   
 $\text{SHIFT} \boxed{0} (\text{Rnd}) \text{EXE}$

**28571**

(Rounded result)

$\boxed{\times} \boxed{1} \boxed{4} \text{EXE}$

**399994**

# Using $10^3$ Engineering Notation (ENG)

Engineering notation (ENG) expresses quantities as a product of a positive number between 1 and 10 and a power of 10 that is always a multiple of three. There are two types of engineering notation, ENG $\rightarrow$  and ENG $\leftarrow$ .

The CMPLX Mode does not support use of engineering notation.

## ■ ENG Calculation Examples

**Example 1:** To convert 1234 to engineering notation using ENG $\rightarrow$

1	2	3	4	EXE	1234
				ENG	1.234 <sup>03</sup> <sub>x10</sub>
				ENG	1234 <sup>00</sup> <sub>x10</sub>

**Example 2:** To convert 123 to engineering notation using ENG $\leftarrow$

1	2	3	EXE	123	
			SHIFT	ENG ( $\leftarrow$ )	0.123 <sup>03</sup> <sub>x10</sub>
			SHIFT	ENG ( $\leftarrow$ )	0.000123 <sup>06</sup> <sub>x10</sub>

## Complex Number Calculations (CMPLX)

To perform the example operations in this section, first select CMPLX as the calculation mode.

### ■ Inputting Complex Numbers

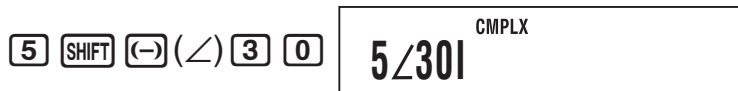
#### ◊ Inputting Imaginary Numbers ( $i$ )

**Example:** To input  $2 + 3i$

2	+	3	ENG	( $i$ )	2+3i <sup>CMPLX</sup>
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## ◆ Inputting Complex Number Values Using Polar Coordinate Format

**Example:** To input  $5 \angle 30$



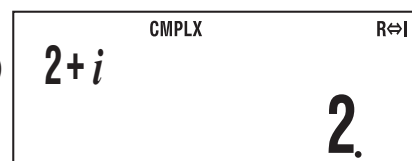
### Important!

When inputting argument  $\theta$ , enter a value that indicates an angle in accordance with the calculator's current default angle unit setting.

## ■ Complex Number Calculation Result Display

When a calculation produces a complex number result,  $R \leftrightarrow I$  symbol turns on in the upper right corner of the display and the only the real part appears at first. To toggle the display between the real part and the imaginary part, press  $\overline{\text{SHIFT}} \text{EXE}$  ( $R \leftrightarrow I$ ).

**Example:** To input  $2 + 1i$  and display its calculation result



Displays real part.

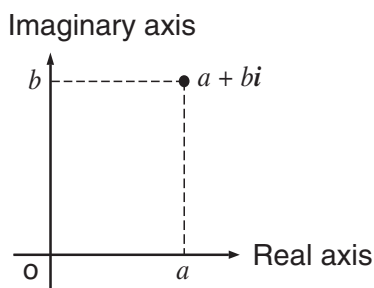


Displays imaginary part.

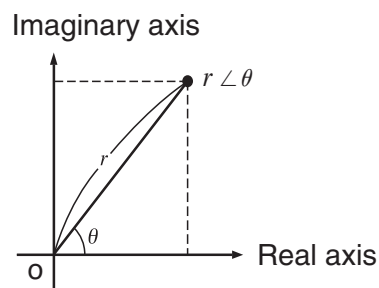
( $i$  symbol turns on during imaginary part display.)

## ◆ Default Complex Number Calculation Result Display Format

You can select either rectangular coordinate format or polar coordinate format for complex number calculation results.



Rectangular Coordinates



Polar Coordinates

Use the setup screens to specify the default display format you want. For details, see "Specifying the Complex Number Display Format" (page 7).

## ■ Calculation Result Display Examples

### ◆ Rectangular Coordinate Format ( $a+bi$ )

**SHIFT** **MODE** (SETUP) **▶▶▶** **1** ( $a+bi$ )

**Example 1:**  $2 \times (\sqrt{3} + i) = 2\sqrt{3} + 2i = 3.464101615 + 2i$

**2** **×** **(** **✓** **3** **)** **+** **ENG** **(i)** **)** **EXE**

3.464101615

**SHIFT** **EXE** (Re↔Im)

2.i

**Example 2:**  $\sqrt{2} \angle 45 = 1 + 1i$  (Angle Unit: Deg)

**✓** **2** **)** **SHIFT** **(↔)** ( $\angle$ )  
**4** **5** **EXE**

1.

**SHIFT** **EXE** (Re↔Im)

1.i

### ◆ Polar Coordinate Format ( $r\angle\theta$ )

**SHIFT** **MODE** (SETUP) **▶▶▶** **2** ( $r\angle\theta$ )

**Example 1:**  $2 \times (\sqrt{3} + i) = 2\sqrt{3} + 2i = 4 \angle 30$

**2** **×** **(** **✓** **3** **)** **+** **ENG** **(i)** **)** **EXE**

4.

**SHIFT** **EXE** (Re↔Im)

$\angle$  30.

$\angle$  symbol turns on during display of  $\theta$ -value.

**Example 2:**  $1 + 1i = 1.414213562 \angle 45$  (Angle Unit: Deg)

**1** **+** **1** **ENG** **(i)** **EXE**

1.414213562

**SHIFT** **EXE** (Re↔Im)

$\angle$  45.

## ■ Conjugate Complex Number (Conjg)

**Example:** Obtain the conjugate complex number of  $2 + 3i$

**SHIFT** **(Conjg)** **2** **+** **3** **ENG** **(i)** **)** **EXE**

2.

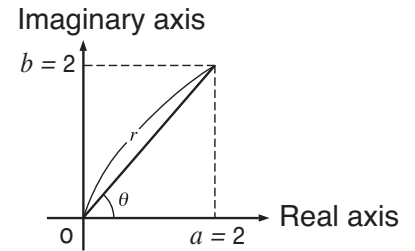
**SHIFT** **EXE** (Re↔Im)

-3.i

## ■ Absolute Value and Argument (Abs, arg)

### Example:

To obtain the absolute value and argument of  $2 + 2i$   
(Angle Unit: Deg)



Absolute Value:

**SHIFT** **]** (Abs) **2** **+** **2** **ENG** **(i)** **]** **EXE**

**2.828427125**

Argument:

**SHIFT** **[** (arg) **2** **+** **2** **ENG** **(i)** **]** **EXE**

**45**

## ■ Overriding the Default Complex Number Display Format

### ◆ Specifying Rectangular Coordinate Format for a Calculation

Input **SHIFT** **=** ( $\blacktriangleright a+bi$ ) at the end of the calculation.

**Example:**  $2\sqrt{2} \angle 45 = 2 + 2i$  (Angle Unit: Deg)

**2** **√** **2** **]** **SHIFT** **(←)** ( $\angle$ ) **4** **5**

**SHIFT** **=** ( $\blacktriangleright a+bi$ ) **EXE**

**2.**

**SHIFT** **EXE** (Re $\leftrightarrow$ Im)

**2.i**

### ◆ Specifying Polar Coordinate Format for a Calculation

Input **SHIFT** **+** ( $\blacktriangleright r\angle\theta$ ) at the end of the calculation.

**Example:**  $2 + 2i = 2\sqrt{2} \angle 45 = 2.828427125 \angle 45$  (Angle Unit: Deg)

**2** **+** **2** **ENG** **(i)**  
**SHIFT** **+** ( $\blacktriangleright r\angle\theta$ ) **EXE**

**2.828427125**

**SHIFT** **EXE** (Re $\leftrightarrow$ Im)

$\angle$

**45**

# Statistical Calculations (SD/REG)

## ■ Statistical Calculation Sample Data

### ◆ Inputting Sample Data

You can input sample data either with statistical frequency turned on (FreqOn) or off (FreqOff). The calculator's initial default setting is FreqOn. You can select the input method you want to use with the setup screen statistical frequency setting (page 7).

### ◆ Maximum Number of Input Data Items

The maximum number of data items you can input depends on whether frequency is on (FreqOn) or off (FreqOff).

SD Mode.....40 items (FreqOn), 80 items (FreqOff)

REG Mode...26 items (FreqOn), 40 items (FreqOff)

### ◆ Sample Data Clear

All sample data currently in memory is cleared whenever you change to another calculation mode and when you change the statistical frequency setting.

## ■ Performing Single-variable Statistical Calculations

To perform the example operations in this section, first select SD as the calculation mode.

### ◆ Inputting Sample Data

#### Frequency On (FreqOn)

The following shows the key operations required when inputting class values  $x_1, x_2, \dots, x_n$ , and frequencies Freq1, Freq2, ... Freqn.

{ $x_1$ } **SHIFT** **▾** (;) {Freq1} **M+** (DT)

{ $x_2$ } **SHIFT** **▾** (;) {Freq2} **M+** (DT)

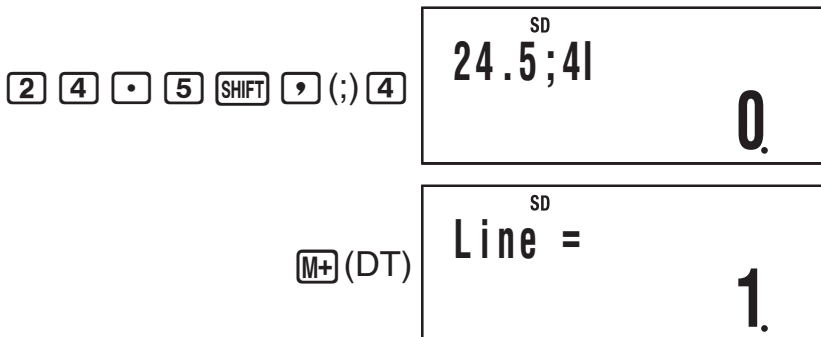
⋮

{ $x_n$ } **SHIFT** **▾** (;) {Freqn} **M+** (DT)

#### Note

If the frequency of a class value is only one, you can input it by pressing { $x_n$ } **M+** (DT) only (without specifying the frequency).

**Example:** To input the following data: ( $x$ , Freq) = (24.5, 4), (25.5, 6), (26.5, 2)



The diagram illustrates the input sequence for the first data point (24.5, 4) in SD mode. The keypad sequence is: 2, 4, ., 5, SHIFT, ▾, (;), 4. The display shows 'SD 24.5;4| 0.'. Pressing **M+** (DT) results in the display showing 'SD Line = 1.'.

**M+** (DT) tells the calculator this is the end of the first data item.

$\boxed{2}$   $\boxed{5}$   $\boxed{\cdot}$   $\boxed{5}$   $\boxed{\text{SHIFT}}$   $\boxed{\blacktriangleright}$   $\boxed{;}$   $\boxed{6}$   $\boxed{\text{M+}}$  (DT)  
 $\boxed{2}$   $\boxed{6}$   $\boxed{\cdot}$   $\boxed{5}$   $\boxed{\text{SHIFT}}$   $\boxed{\blacktriangleright}$   $\boxed{;}$   $\boxed{2}$   $\boxed{\text{M+}}$  (DT)

<sup>SD</sup>  
 Line = 3.

## Frequency Off (FreqOff)

In this case, input each individual data item as shown below.

$\{x_1\}$   $\boxed{\text{M+}}$  (DT)  $\{x_2\}$   $\boxed{\text{M+}}$  (DT) ...  $\{x_n\}$   $\boxed{\text{M+}}$  (DT)

## ◆ Viewing Current Sample Data

After inputting sample data, you can press  $\blacktriangledown$  to scroll through the data in the sequence you input it. The  $\blacktriangledown$  symbol indicates there is data below the sample that is currently on the display. The  $\blacktriangle$  symbol indicates there is data above.

**Example:** To view the data you input in the example under “Inputting Sample Data” on page 29 (Frequency Setting: FreqOn)

$\boxed{\text{AC}}$   $\blacktriangledown$

<sup>SD</sup>  
 x1= 245  $\blacktriangledown$

$\blacktriangledown$

<sup>SD</sup>  
 Freq1= 4  $\blacktriangle$

When the statistical frequency setting is FreqOn, data is displayed in the sequence:  $x_1$ , Freq1,  $x_2$ , Freq2, and so on. In the case of FreqOff, it is displayed in the sequence:  $x_1$ ,  $x_2$ ,  $x_3$ , and so on. You can also use  $\blacktriangle$  to scroll in the reverse direction.

## ◆ Editing a Data Sample

To edit a data sample, recall it, input the new value(s), and then press  $\boxed{\text{EXE}}$ .

**Example:** To edit the “Freq3” data sample input under “Inputting Sample Data” on page 29

$\boxed{\text{AC}}$   $\blacktriangle$

<sup>SD</sup>  
 Freq3= 2  $\blacktriangle$

$\boxed{3}$   $\boxed{\text{EXE}}$

<sup>SD</sup>  
 Freq3= 3  $\blacktriangle$

## ◆ Deleting a Data Sample

To delete a data sample, recall it and then press  $\boxed{\text{SHIFT}}$   $\boxed{\text{M+}}$  (CL).

**Example:** To delete the “ $x_2$ ” data sample input under “Inputting Sample Data” on page 29

$\boxed{\text{AC}}$   $\blacktriangledown$   $\blacktriangledown$   $\blacktriangledown$

<sup>SD</sup>  
 x2= 255  $\blacktriangle$

$\text{SHIFT}$   $\text{M+}$  (CL)  $\overset{\text{SD}}{\text{Line}} =$  2

**Note**

- The following shows images of how the data appears before and after the delete operation.

Before	After										
<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%; padding: 2px;">x1: 24.5</td><td style="width: 50%; padding: 2px;">Freq1: 4</td></tr> <tr><td style="padding: 2px;">x2: 25.5</td><td style="padding: 2px;">Freq2: 6</td></tr> <tr><td style="padding: 2px;">x3: 26.5</td><td style="padding: 2px;">Freq3: 2</td></tr> </table>	x1: 24.5	Freq1: 4	x2: 25.5	Freq2: 6	x3: 26.5	Freq3: 2	<div style="text-align: center; margin-bottom: 5px;"> </div> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%; padding: 2px;">x1: 24.5</td><td style="width: 50%; padding: 2px;">Freq1: 4</td></tr> <tr><td style="padding: 2px;">x2: 26.5</td><td style="padding: 2px;">Freq2: 2</td></tr> </table>	x1: 24.5	Freq1: 4	x2: 26.5	Freq2: 2
x1: 24.5	Freq1: 4										
x2: 25.5	Freq2: 6										
x3: 26.5	Freq3: 2										
x1: 24.5	Freq1: 4										
x2: 26.5	Freq2: 2										
Shifted upwards.											

- When the statistical frequency setting is turned on (FreqOn), the applicable  $x$ -data and Freq data pair is deleted.

**◆ Deleting All Sample Data**

Perform the following key operation to delete all sample data.

$\text{SHIFT}$   $\text{9}$  (CLR)  $\text{1}$  (Stat)  $\text{EXE}$

If you do not want to delete all sample data, press  $\text{AC}$  in place of  $\text{EXE}$  in the above operation.

**◆ Statistical Calculations Using Input Sample Data**

To perform a statistical calculation, input the applicable command and then press  $\text{EXE}$ .

**◆ SD Mode Statistical Command Reference**

$\Sigma x^2$   $\text{SHIFT}$   $\text{1}$  (S-SUM)  $\text{1}$

Obtains the sum of squares of the sample data.

$$\Sigma x^2 = \Sigma x_i^2$$

$n$   $\text{SHIFT}$   $\text{1}$  (S-SUM)  $\text{3}$

Obtains the number of samples.

$\sigma_x$   $\text{SHIFT}$   $\text{2}$  (S-VAR)  $\text{2}$

Obtains the population standard deviation.

$$\sigma_x = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$$

$\text{minX}$   $\text{SHIFT}$   $\text{2}$  (S-VAR)  $\text{1}$

Determines the minimum value of the samples.

$\Sigma x$   $\text{SHIFT}$   $\text{1}$  (S-SUM)  $\text{2}$

Obtains the sum of the sample data.

$$\Sigma x = \Sigma x_i$$

$\bar{x}$   $\text{SHIFT}$   $\text{2}$  (S-VAR)  $\text{1}$

Obtains the mean.

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$s_x$   $\text{SHIFT}$   $\text{2}$  (S-VAR)  $\text{3}$

Obtains the sample standard deviation.

$$s_x = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n - 1}}$$

$\text{maxX}$   $\text{SHIFT}$   $\text{2}$  (S-VAR)  $\text{2}$

Determines the maximum value of the samples.



# ■ Performing Paired-variable Statistical Calculations

To perform the example operations in this section, first select REG as the calculation mode.

## ◆ Regression Calculation Types

Each time you enter the REG Mode, you must select the type of regression calculation you plan to perform.

### Selecting the Regression Calculation Type

- Enter the REG Mode.
  - This displays the initial regression calculation selection menu. The menu has two screens, and you can use ◀ and ▶ to navigate between them.
- Perform one of the following operations to select the regression calculation you want.

To select this regression type:	And press this key:
Linear ( $y = a + bx$ )	1 (Lin)
Logarithmic ( $y = a + b \ln x$ )	2 (Log)
$e$ Exponential ( $y = ae^{bx}$ )	3 (Exp)
Power ( $y = ax^b$ )	4 (Pwr)
Inverse ( $y = a + b/x$ )	▶ 1 (Inv)
Quadratic ( $y = a + bx + cx^2$ )	▶ 2 (Quad)
$ab$ Exponential ( $y = ab^x$ )	▶ 3 (AB-Exp)

### Note

You can switch to another regression calculation type from within the REG Mode, if you want. Pressing **SHIFT** 2 (S-VAR) 3 (TYPE) will display a menu screen like the one shown in step 1 above. Perform the same operation as the above procedure to select the regression calculation type you want.

## ◆ Inputting Sample Data

### Frequency On (FreqOn)

The following shows the key operations required when inputting class values ( $x_1, y_1$ ), ( $x_2, y_2$ ), ..., ( $x_n, y_n$ ), and frequencies Freq1, Freq2, ... Freq $n$ .

{ $x_1$ } ◻ { $y_1$ } **SHIFT** ◻ (;) {Freq1} **M+** (DT)  
 { $x_2$ } ◻ { $y_2$ } **SHIFT** ◻ (;) {Freq2} **M+** (DT)  
 ⋮  
 { $x_n$ } ◻ { $y_n$ } **SHIFT** ◻ (;) {Freq $n$ } **M+** (DT)

### Note

If the frequency of a class value is only one, you can input it by pressing { $x_n$ } ◻ { $y_n$ } **M+** (DT) only (without specifying the frequency).

## Frequency Off (FreqOff)

In this case, input each individual data item as shown below.

{x1}  $\square$  {y1}  $\square$  (DT)

{x2}  $\square$  {y2}  $\square$  (DT)

⋮

{xn}  $\square$  {yn}  $\square$  (DT)

## ◆ Viewing Current Sample Data

After inputting sample data, you can press  $\blacktriangledown$  to scroll through the data in the sequence you input it. The  $\blacktriangledown$  symbol indicates there is data below the sample that is currently on the display. The  $\blacktriangle$  symbol indicates there is data above.

When the statistical frequency setting is FreqOn, data is displayed in the sequence:  $x_1, y_1, \text{Freq1}, x_2, y_2, \text{Freq2}$ , and so on. In the case of FreqOff, it is displayed in the sequence:  $x_1, y_1, x_2, y_2, x_3, y_3$ , and so on. You can also use  $\blacktriangle$  to scroll in the reverse direction.

## ◆ Editing a Data Sample

To edit a data sample, recall it, input the new value(s), and then press  $\square$ .

## ◆ Deleting a Data Sample

To delete a data sample, recall it and then press  $\square$   $\square$  (CL).

## ◆ Deleting All Sample Data

See “Deleting All Sample Data” (page 31).

## ◆ Statistical Calculations Using Input Sample Data

To perform a statistical calculation, input the applicable command and then press  $\square$ .

## ◆ REG Mode Statistical Command Reference

### Sum and Number of Sample Command (S-SUM Menu)

$\Sigma x^2$   $\square$   $\square$  (S-SUM)  $\square$

Obtains the sum of squares of the sample  $x$ -data.

$$\Sigma x^2 = \Sigma x_i^2$$

$\Sigma x$   $\square$   $\square$  (S-SUM)  $\square$

Obtains the sum of the sample  $x$ -data.

$$\Sigma x = \Sigma x_i$$

$n$   $\square$   $\square$  (S-SUM)  $\square$

Obtains the number of samples.

$\Sigma y^2$   $\square$   $\square$  (S-SUM)  $\blacktriangleright$   $\square$

Obtains the sum of squares of the sample  $y$ -data.

$$\Sigma y^2 = \Sigma y_i^2$$

$\Sigma y$   $\square$   $\square$  (S-SUM)  $\blacktriangleright$   $\square$

Obtains the sum of the sample  $y$ -data.

$$\Sigma y = \Sigma y_i$$

$\Sigma xy$   $\square$   $\square$  (S-SUM)  $\blacktriangleright$   $\square$

Obtains the sum of products of the sample  $x$ -data and  $y$ -data.

$$\Sigma xy = \Sigma x_i y_i$$

$\Sigma x^2 y$       [SHIFT] [1] (S-SUM) [◀] [1]

Obtains the sum of squares of the sample  $x$ -data multiplied by the sample  $y$ -data.

$$\Sigma x^2 y = \Sigma x_i^2 y_i$$

$\Sigma x^3$       [SHIFT] [1] (S-SUM) [◀] [2]

Obtains the sum of cubes of the sample  $x$ -data.

$$\Sigma x^3 = \Sigma x_i^3$$

$\Sigma x^4$       [SHIFT] [1] (S-SUM) [◀] [3]

Obtains the sum of the fourth power of the sample  $x$ -data.

$$\Sigma x^4 = \Sigma x_i^4$$

## Mean and Standard Deviation Commands (VAR Menu)

$\bar{x}$       [SHIFT] [2] (S-VAR) [1] (VAR) [1]

Obtains the mean of the sample  $x$ -data.

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$\sigma_x$       [SHIFT] [2] (S-VAR) [1] (VAR) [2]

Obtains the population standard deviation of the sample  $x$ -data.

$$\sigma_x = \sqrt{\frac{\Sigma (x_i - \bar{x})^2}{n}}$$

$s_x$       [SHIFT] [2] (S-VAR) [1] (VAR) [3]

Obtains the sample standard deviation of the sample  $x$ -data.

$$s_x = \sqrt{\frac{\Sigma (x_i - \bar{x})^2}{n - 1}}$$

$\bar{y}$       [SHIFT] [2] (S-VAR) [1] (VAR) [▶] [1]

Obtains the mean of the sample  $y$ -data.

$$\bar{y} = \frac{\Sigma y_i}{n}$$

$\sigma_y$       [SHIFT] [2] (S-VAR) [1] (VAR) [▶] [2]

Obtains the population standard deviation of the sample  $y$ -data.

$$\sigma_y = \sqrt{\frac{\Sigma (y_i - \bar{y})^2}{n}}$$

$s_y$       [SHIFT] [2] (S-VAR) [1] (VAR) [▶] [3]

Obtains the sample standard deviation of the sample  $y$ -data.

$$s_y = \sqrt{\frac{\Sigma (y_i - \bar{y})^2}{n - 1}}$$

## Regression Coefficient and Estimated Value Commands for Non-quadratic Regression (VAR Menu)

**a**      [SHIFT] [2] (S-VAR) [1] (VAR) [▶] [▶] [1]

Obtains constant term  $a$  of the regression formula.

**b**      [SHIFT] [2] (S-VAR) [1] (VAR) [▶] [▶] [2]

Obtains coefficient  $b$  of the regression formula.

**r** SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3

Obtains correlation coefficient  $r$ .

**$\hat{x}$**  SHIFT 2 (S-VAR) 1 (VAR) ◀ 1

Taking the value input immediately before this command as the  $y$ -value, obtains the estimated value of  $x$  based on the regression formula for the currently selected regression calculation.

**$\hat{y}$**  SHIFT 2 (S-VAR) 1 (VAR) ◀ 2

Taking the value input immediately before this command as the  $x$ -value, obtains the estimated value of  $y$  based on the regression formula for the currently selected regression calculation.

## Regression Coefficient and Estimated Value Commands for Quadratic Regression (VAR Menu)

**a** SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 1

Obtains constant term  $a$  of the regression formula.

**b** SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 2

Obtains coefficient  $b$  of the regression formula.

**c** SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3

Obtains coefficient  $c$  of the regression formula.

**$\hat{x}_1$**  SHIFT 2 (S-VAR) 1 (VAR) ◀ 1

Taking the value input immediately before this command as the  $y$ -value, uses the formula on page 37 to determine one estimated value of  $x$ .

**$\hat{x}_2$**  SHIFT 2 (S-VAR) 1 (VAR) ◀ 2

Taking the value input immediately before this command as the  $y$ -value, uses the formula on page 37 to determine one more estimated value of  $x$ .

**$\hat{y}$**  SHIFT 2 (S-VAR) 1 (VAR) ◀ 3

Taking the value input immediately before this command as the  $x$ -value, uses the formula on page 37 to determine the estimated value of  $y$ .

## Minimum and Maximum Value Commands (MINMAX Menu)

**minX** SHIFT 2 (S-VAR) 2 (MINMAX) 1

Obtains the minimum value of the sample  $x$ -data.

**maxX**

[SHIFT] [2] (S-VAR) [2] (MINMAX) [2]

Obtains the maximum value of the sample  $x$ -data.**minY**

[SHIFT] [2] (S-VAR) [2] (MINMAX) [▶] [1]

Obtains the minimum value of the sample  $y$ -data.**maxY**

[SHIFT] [2] (S-VAR) [2] (MINMAX) [▶] [2]

Obtains the maximum value of the sample  $y$ -data.

## ◆ Regression Coefficient and Estimated Value Calculation Formula Table

### Linear Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\sum y_i - b \cdot \sum x_i}{n}$
Regression Coefficient b	$b = \frac{n \cdot \sum x_i y_i - \sum x_i \cdot \sum y_i}{n \cdot \sum x_i^2 - (\sum x_i)^2}$
Correlation Coefficient r	$r = \frac{n \cdot \sum x_i y_i - \sum x_i \cdot \sum y_i}{\sqrt{\{n \cdot \sum x_i^2 - (\sum x_i)^2\} \{n \cdot \sum y_i^2 - (\sum y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = \frac{y - a}{b}$
Estimated Value $\hat{y}$	$\hat{y} = a + bx$

### Quadratic Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\sum y_i}{n} - b \left( \frac{\sum x_i}{n} \right) - c \left( \frac{\sum x_i^2}{n} \right)$
Regression Coefficient b	$b = \frac{S_{xy} \cdot S_{x^2 x^2} - S_{x^2 y} \cdot S_{xx^2}}{S_{xx} \cdot S_{x^2 x^2} - (S_{xx^2})^2}$
Regression Coefficient c	$c = \frac{S_{x^2 y} \cdot S_{xx} - S_{xy} \cdot S_{xx^2}}{S_{xx} \cdot S_{x^2 x^2} - (S_{xx^2})^2}$

However,

$$S_{xx} = \sum x_i^2 - \frac{(\sum x_i)^2}{n}$$

$$S_{xy} = \sum x_i y_i - \frac{(\sum x_i \cdot \sum y_i)}{n}$$

$$S_{xx^2} = \sum x_i^3 - \frac{(\sum x_i \cdot \sum x_i^2)}{n}$$

$$S_{x^2 x^2} = \sum x_i^4 - \frac{(\sum x_i^2)^2}{n}$$

$$S_{x^2 y} = \sum x_i^2 y_i - \frac{(\sum x_i^2 \cdot \sum y_i)}{n}$$

Command	Calculation Formula
Estimated Value $\hat{x}_1$	$\hat{x}_1 = \frac{-b + \sqrt{b^2 - 4c(a - y)}}{2c}$
Estimated Value $\hat{x}_2$	$\hat{x}_2 = \frac{-b - \sqrt{b^2 - 4c(a - y)}}{2c}$
Estimated Value $\hat{y}$	$\hat{y} = a + bx + cx^2$

## Logarithmic Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\sum y_i - b \cdot \sum \ln x_i}{n}$
Regression Coefficient b	$b = \frac{n \cdot \sum (\ln x_i) y_i - \sum \ln x_i \cdot \sum y_i}{n \cdot \sum (\ln x_i)^2 - (\sum \ln x_i)^2}$
Correlation Coefficient r	$r = \frac{n \cdot \sum (\ln x_i) y_i - \sum \ln x_i \cdot \sum y_i}{\sqrt{\{n \cdot \sum (\ln x_i)^2 - (\sum \ln x_i)^2\} \{n \cdot \sum y_i^2 - (\sum y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = e^{\frac{y-a}{b}}$
Estimated Value $\hat{y}$	$\hat{y} = a + b \ln x$

## e Exponential Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\sum \ln y_i - b \cdot \sum x_i}{n}\right)$
Regression Coefficient b	$b = \frac{n \cdot \sum x_i \ln y_i - \sum x_i \cdot \sum \ln y_i}{n \cdot \sum x_i^2 - (\sum x_i)^2}$
Correlation Coefficient r	$r = \frac{n \cdot \sum x_i \ln y_i - \sum x_i \cdot \sum \ln y_i}{\sqrt{\{n \cdot \sum x_i^2 - (\sum x_i)^2\} \{n \cdot \sum (\ln y_i)^2 - (\sum \ln y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = \frac{\ln y - \ln a}{b}$
Estimated Value $\hat{y}$	$\hat{y} = a e^{bx}$

## ab Exponential Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\sum \ln y_i - \ln b \cdot \sum x_i}{n}\right)$
Regression Coefficient b	$b = \exp\left(\frac{n \cdot \sum x_i \ln y_i - \sum x_i \cdot \sum \ln y_i}{n \cdot \sum x_i^2 - (\sum x_i)^2}\right)$
Correlation Coefficient r	$r = \frac{n \cdot \sum x_i \ln y_i - \sum x_i \cdot \sum \ln y_i}{\sqrt{\{n \cdot \sum x_i^2 - (\sum x_i)^2\} \{n \cdot \sum (\ln y_i)^2 - (\sum \ln y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = \frac{\ln y - \ln a}{\ln b}$
Estimated Value $\hat{y}$	$\hat{y} = ab^x$

## Power Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\sum \ln y_i - b \cdot \sum \ln x_i}{n}\right)$
Regression Coefficient b	$b = \frac{n \cdot \sum \ln x_i \ln y_i - \sum \ln x_i \cdot \sum \ln y_i}{n \cdot \sum (\ln x_i)^2 - (\sum \ln x_i)^2}$
Correlation Coefficient r	$r = \frac{n \cdot \sum \ln x_i \ln y_i - \sum \ln x_i \cdot \sum \ln y_i}{\sqrt{\{n \cdot \sum (\ln x_i)^2 - (\sum \ln x_i)^2\} \{n \cdot \sum (\ln y_i)^2 - (\sum \ln y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = e^{\frac{\ln y - \ln a}{b}}$
Estimated Value $\hat{y}$	$\hat{y} = ax^b$

## Inverse Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\sum y_i - b \cdot \sum x_i^{-1}}{n}$
Regression Coefficient b	$b = \frac{S_{xy}}{S_{xx}}$

Command	Calculation Formula
Correlation Coefficient r	$r = \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$

However,

$$S_{xx} = \sum(x_i^{-1})^2 - \frac{(\sum x_i^{-1})^2}{n} \quad S_{yy} = \sum y_i^2 - \frac{(\sum y_i)^2}{n} \quad S_{xy} = \sum(x_i^{-1})y_i - \frac{\sum x_i^{-1} \cdot \sum y_i}{n}$$

Command	Calculation Formula
Estimated Value $\hat{x}$	$\hat{x} = \frac{b}{y - a}$
Estimated Value $\hat{y}$	$\hat{y} = a + \frac{b}{x}$

## Statistical Calculation Example

The nearby data shows how the weight of a newborn at various numbers of days after birth.

- Obtain the regression formula and correlation coefficient produced by linear regression of the data.
- Obtain the regression formula and correlation coefficient produced by logarithmic regression of the data.
- Predict the weight 350 days after birth based on the regression formula that best fits the trend of the data in accordance with the regression results.

Number of Days	Weight (g)
20	3150
50	4800
80	6420
110	7310
140	7940
170	8690
200	8800
230	9130
260	9270
290	9310
320	9390

## Operation Procedure

Enter the REG Mode and select linear regression:

**MODE** **5** (REG) **1** (Lin)

Select FreqOff for the statistical frequency setting:

**SHIFT** **MODE** (SETUP) **◀** **◀** **2** (FreqOff)

Input the sample data:

**2** **0** **,** **3** **1** **5** **0** **M+** (DT) **5** **0** **,** **4** **8** **0** **0** **M+** (DT)  
**8** **0** **,** **6** **4** **2** **0** **M+** (DT) **1** **1** **0** **,** **7** **3** **1** **0** **M+** (DT)  
**1** **4** **0** **,** **7** **9** **4** **0** **M+** (DT) **1** **7** **0** **,** **8** **6** **9** **0** **M+** (DT)  
**2** **0** **0** **,** **8** **8** **0** **0** **M+** (DT) **2** **3** **0** **,** **9** **1** **3** **0** **M+** (DT)  
**2** **6** **0** **,** **9** **2** **7** **0** **M+** (DT) **2** **9** **0** **,** **9** **3** **1** **0** **M+** (DT)  
**3** **2** **0** **,** **9** **3** **9** **0** **M+** (DT)

### ① Linear Regression

Regression Formula Contant Term a:

**SHIFT** **2** (S-VAR) **1** (VAR) **▶** **▶** **1** (a) **EXE**

**4446575758**



Regression Coefficient b:

**SHIFT** **2** (S-VAR) **1** (VAR) **▶▶** **2** (b) **EXE**

**1887575758**

Correlation Coefficient:

**SHIFT** **2** (S-VAR) **1** (VAR) **▶▶** **3** (r) **EXE**

**0904793561**

## ② Logarithmic Regression

Select logarithmic regression:

**SHIFT** **2** (S-VAR) **3** (TYPE) **2** (Log)

REG  
 $x^1 =$   
**20**

Regression Formula Contant Term a:

**AC** **SHIFT** **2** (S-VAR) **1** (VAR) **▶▶** **1** (a) **EXE**

**-4209356544**

Regression Coefficient b:

**SHIFT** **2** (S-VAR) **1** (VAR) **▶▶** **2** (b) **EXE**

**2425756228**

Correlation Coefficient:

**SHIFT** **2** (S-VAR) **1** (VAR) **▶▶** **3** (r) **EXE**

**0991493123**

## ③ Weight Prediction

The absolute value of the correlation coefficient for logarithmic regression is closer to 1, so perform the weight prediction calculation using logarithmic regression.

Obtain  $\hat{y}$  when  $x = 350$ :

**SHIFT** **2** (S-VAR) **1** (VAR) **◀** **3** **5** **0** **2** ( $\hat{y}$ ) **EXE**

REG  
 $350^{\hat{y}}$   
**1000056129**

# Base- $n$ Calculations (BASE)

To perform the example operations in this section, first select BASE as the calculation mode.

## ■ Performing Base- $n$ Calculations

### ◆ Specifying the Default Number Base

Use the following keys to select a default number base  **$x^2$**  (DEC) for decimal,  **$\Delta$**  (HEX) for hexadecimal, **log** (BIN) for binary, or **In** (OCT) for octal.

## ◆ Example Base-*n* Calculations

**Example:** To select binary as the number base and calculate  $1_2 + 1_2$

**AC** **log** (BIN) **1** **+** **1** **EXE**

1+1  
10.<sup>b</sup>

Number base indicator  
(d: decimal, H: hexadecimal, b: binary, o: octal)

- Inputting an invalid value causes a Syntax ERROR.
- In the BASE Mode, input of fractional (decimal) values and exponential values is not supported. Anything to the right of the decimal point of calculation results is cut off.

## ◆ Hexadecimal Value Input and Calculation Example

Use the following keys to input the letters required for hexadecimal values: **(←)** (A), **□□□** (B), **hyp** (C), **sin** (D), **cos** (E), **tan** (F).

**Example:** To select hexadecimal as the number base and calculate  $1F_{16} + 1_{16}$

**AC** **△** (HEX) **1** **tan** (F) **+** **1** **EXE**

20.<sup>H</sup>

## ◆ Effective Calculation Ranges

Number Base	Effective Range
Binary	Positive: $0 \leq x \leq 111111111$ Negative: $1000000000 \leq x \leq 1111111111$
Octal	Positive: $0 \leq x \leq 3777777777$ Negative: $4000000000 \leq x \leq 7777777777$
Decimal	$-2147483648 \leq x \leq 2147483647$
Hexadecimal	Positive: $0 \leq x \leq 7FFFFFFF$ Negative: $80000000 \leq x \leq FFFFFFFF$

A Math ERROR occurs when a calculation result is outside of the applicable range for the current default number base.

## ■ Converting a Displayed Result to another Number Base

Pressing **x<sup>2</sup>** (DEC), **△** (HEX), **log** (BIN), or **ln** (OCT) while a calculation result is displayed will convert the result to the corresponding number base.

**Example:** To convert the decimal value  $30_{10}$  to binary, octal, and hexadecimal format

**AC** **x<sup>2</sup>** (DEC) **3** **0** **EXE**

30.<sup>d</sup>

**log** (BIN)

11110.<sup>b</sup>

**ln** (OCT)

36.<sup>o</sup>

## ■ Using the LOGIC Menu

In the BASE Mode, the  $\mathcal{X}$  key changes function to become a LOGIC menu display key. The LOGIC menu has three screens, and you can use  $\blacktriangleleft$  and  $\blacktriangleright$  to navigate between them.

## ■ Specifying a Number Base for a Particular Value

You can specify a number base that is different from the current default number base while inputting a value.

### ◆ Example Calculation Using Base-*n* Specification

**Example:** To perform the calculation  $5_{10} + 5_{16}$ , and display the result in binary

$\text{AC}$   $\log$  (BIN)  $\mathcal{X}$  (LOGIC)  $\blacktriangleleft$   $1$  (d)  
 $5$   $+$   $\mathcal{X}$  (LOGIC)  $\blacktriangleleft$   $2$  (h)  $5$   $\text{EXE}$

$d5+h5$   
**1010.** <sup>b</sup>

## ■ Performing Calculations Using Logical Operations and Negative Binary Values

Your calculator can perform 10-digit (10-bit) binary logical operations and negative value calculations. All of the examples shown below are performed with BIN (binary) set as the default number base.

### ◆ Logical Product (and)

Returns the result of a bitwise product.

**Example:**  $1010_2$  and  $1100_2 = 1000_2$

$1$   $0$   $1$   $0$   $\mathcal{X}$  (LOGIC)  $1$  (and)  $1$   $1$   $0$   $0$   $\text{EXE}$

**1000.** <sup>b</sup>

### ◆ Logical Sum (or)

Returns the result of a bitwise sum.

**Example:**  $1011_2$  or  $11010_2 = 11011_2$

$1$   $0$   $1$   $1$   $\mathcal{X}$  (LOGIC)  $2$  (or)  $1$   $1$   $0$   $1$   $0$   $\text{EXE}$

**11011.** <sup>b</sup>

### ◆ Exclusive Logical Sum (xor)

Returns the result of a bitwise exclusive logical sum.

**Example:**  $1010_2$  xor  $1100_2 = 110_2$

$1$   $0$   $1$   $0$   $\mathcal{X}$  (LOGIC)  $\blacktriangleright$   $1$  (xor)  $1$   $1$   $0$   $0$   $\text{EXE}$

**110.** <sup>b</sup>

## ◆ Exclusive Logical Sum Negation (xnor)

Returns the result of the negation of a bitwise exclusive logical sum.

**Example:**  $1111_2 \text{ xnor } 101_2 = 111110101_2$

$\boxed{1} \boxed{1} \boxed{1} \boxed{1} \boxed{x}$  (LOGIC)  $\boxed{3}$  (xnor)  $\boxed{1} \boxed{0} \boxed{1} \boxed{\text{EXE}}$

**111110101.** <sup>b</sup>

## ◆ Complement/Inversion (Not)

Returns the complement (bitwise inversion) of a value.

**Example:**  $\text{Not}(1010_2) = 111110101_2$

$\boxed{x}$  (LOGIC)  $\boxed{\text{Not}}$   $\boxed{1} \boxed{0} \boxed{1} \boxed{0} \boxed{\text{EXE}}$

**111110101.** <sup>b</sup>

## ◆ Negation (Neg)

Returns the two's complement of a value.

**Example:**  $\text{Neg}(101101_2) = 1111010011_2$

$\boxed{x}$  (LOGIC)  $\boxed{\text{Neg}}$   $\boxed{1} \boxed{0} \boxed{1} \boxed{1} \boxed{0} \boxed{1} \boxed{\text{EXE}}$

**1111010011.** <sup>b</sup>

# Program Mode (PRGM)

You can use the PRGM Mode to create and store programs for calculations you need to perform on a regular basis. You can include any calculation that can be performed in the COMP, CMPLX, BASE, SD, or REG Mode in a program.

## ■ Program Mode Overview

### ◆ Specifying a Program Run Mode

Though you create and run programs in the PRGM Mode, each program has a “run mode” that it runs in. You can specify COMP, CMPLX, BASE, SD, or REG as a program’s run mode. This means you need to think about what you want your program to do and select the appropriate run mode.

### ◆ Program Memory

Program memory has a total capacity of 390 bytes, which can be shared by up to four programs. Further program storage is not possible after program memory becomes full.

## ■ Creating a Program

### ◆ Creating a New Program

**Example:** To create a program that converts inches to centimeters (1 inch = 2.54 cm)

$\boxed{? \rightarrow A : A \times 2.54}$

1. Press **MODE** **6** (PRGM) to enter the PRGM Mode.

EDIT	RUN	DEL
1	2	3

2. Press **1** (EDIT).

PRGM **1**

**EDIT Program**

**P-1234 380**

Program areas that already contain program data (P1 through P4)

Remaining program memory capacity

3. Press the number key that corresponds to an unused program area number.

- This displays the run mode selection menu. Use **▶** and **◀** to switch between menu screen 1 and screen 2.

◀MODE:COMP CMPLX ▶

1 2

↔

◀MODE:BASE SD REG▶

3 4 5

Screen 1
Screen 2

4. Press the number key that corresponds to the mode you want to assign as the program's run mode.

- Here, select **1** (COMP) on screen 1. This selects COMP as the run mode, and displays the program editing screen.

| 000

### Important!

You cannot change the run mode of a program once it has been assigned. A run mode can be assigned only when you are creating a new program.

5. Input the program.

?→A:A×2.54

010

- Here we will input the program shown below.

Program	? → A : A × 2.54
Key Operation	<b>SHIFT</b> <b>3</b> (P-CMD) <b>1</b> (?) <b>SHIFT</b> <b>RCL</b> (→) (←) (A) <b>EXE</b> <b>ALPHA</b> (←) (A) <b>X</b> <b>2</b> <b>.</b> <b>5</b> <b>4</b>

- **SHIFT** **3** (P-CMD) displays a special program command input screen. See “Inputting Commands” on page 46 for more information.

6. After inputting the program, press **AC** or **SHIFT** **Prog** (EXIT).

- To run the program you just created, press **EXE** here to display the RUN Program screen. For more information, see “Running a Program” below.
- To return to the normal calculation screen, press **MODE** **1** to enter the COMP Mode.

## ◆ Editing an Existing Program

1. Press **MODE** **6** (PRGM) **1** (EDIT) to display the EDIT Program screen.
2. Use number keys **1** through **4** to select the program area that contains the program you want to edit.
3. Use **▶** and **◀** to move the cursor around the program, and perform the required operations to edit the contents of the program or to add new contents.
  - Pressing **▲** jumps to the beginning of the program, while **▼** jumps to the end.
4. After you finish editing the program, press **AC** or **SHIFT** **Prog** (EXIT).

## ■ Running a Program

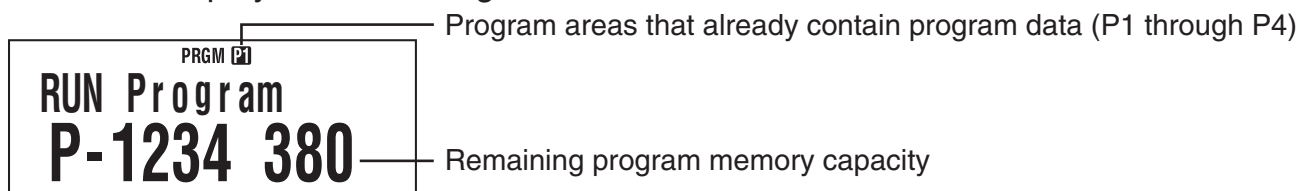
You can run a program in the PRGM Mode or from another mode.

### ◆ Running a Program from Outside the PRGM Mode

1. Press **Prog**.
2. Use number keys **1** through **4** to select a program area and execute its program.

### ◆ Running a Program in the PRGM Mode

1. Press **MODE** **6** (PRGM) to display the PRGM Mode initial screen.
2. Press **2** (RUN).
  - This will display the RUN Program screen.



3. Use number keys **1** through **4** to select the program area that contains the program you want to run.
  - This will execute the program in the program area you select.

### ◆ What to do if an error message appears

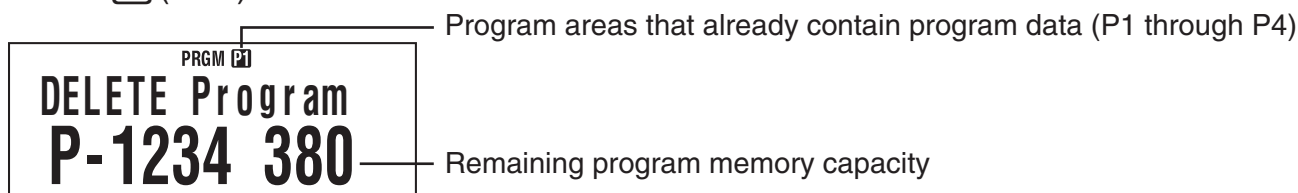
Press **◀** or **▶**. This will display the editing screen for the program, with the cursor located at the location where the error was generated so you can correct the problem.

## ■ Deleting a Program

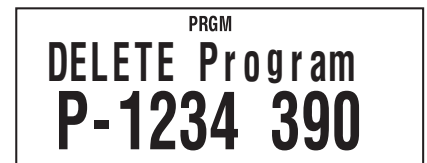
You can delete an existing program by specifying its program area number.

### ◆ Deleting the Program in a Specific Program Area

1. Press **MODE** **6** (PRGM) to display the PRGM Mode initial screen.
2. Press **3** (DEL).



- Use number keys **[1]** through **[4]** to select the program area whose program you want to delete.
  - The symbol next to the number of the program area that contained the program you just deleted will turn off, and the remaining program memory capacity value will increase.



## ■ Inputting Commands

### ◀ Inputting Special Program Commands

- While the program editing screen is on the display, press **[SHIFT]** **[3]** (P-CMD).
  - This displays page 1 of the command menu.
- Use **[▶]** and **[◀]** to scroll through the pages and display the one that contains the command you want.
- Use number keys **[1]** through **[4]** to select and input the command you want.

#### Note

To input a separator symbol (:), press **[EXE]**.

### ◀ Functions that Can be Input as Program Commands

You can input the settings and other operations that you perform during normal calculations as program commands. For more information, see the “Command Reference” below.

## ■ Command Reference

This section provides details on each of the commands that you can use in programs. Commands that have **P-CMD** in the title can be input on the screen that appears when you press **[SHIFT]** **[3]** (P-CMD) or **[Prog]**.

### ◀ Basic Operation Commands **P-CMD**

#### ? (Input Prompt)

Syntax	? → {variable}
Function	Displays the input prompt “{variable}?” and assigns the input value to a variable.
Example	? → A

#### → (Variable Assignment)

Syntax	{expression ; ?} → {variable}
Function	Assigns the value obtained by the element on the left to the variable on the right.
Example	A+5 → A

#### : (Separator Code)

Syntax	{statement} : {statement} : ... : {statement}
Function	Separates statements. Does not stop program execution.
Example	? → A : A <sup>2</sup> : Ans <sup>2</sup>

## ▲ (Output Command)

Syntax	{statement} ▲ {statement}
Function	Pauses program execution and displays the result of the current execution. The <b>Disp</b> symbol is turned on while program execution is paused by this command.
Example	? → A : A <sup>2</sup> ▲ Ans <sup>2</sup>

## ◆ Unconditional Jump Command **P-CMD**

### Goto ~ Lbl

Syntax	Goto <i>n</i> : .... : Lbl <i>n</i> or Lbl <i>n</i> : .... : Goto <i>n</i> ( <i>n</i> = integer from 0 to 9)
Function	Execution of Goto <i>n</i> jumps to corresponding Lbl <i>n</i> .
Example	? → A : Lbl 1 : ? → B : A × B ÷ 2 ▲ Goto 1

### Important!

A Syntax ERROR occurs if there is no corresponding Lbl *n* in the same program where Goto *n* is located.

## ◆ Conditional Jump Commands and Conditional Expressions

### **P-CMD**

⇒

Syntax	① {expression} {relational operator} {expression} ⇒ {statement1} : {statement2} : .... ② {expression} ⇒ {statement1} : {statement2} : ....
Function	Conditional branching command used in combination with relational operators (=, ≠, >, ≥, <, ≤). Syntax ①: {statement1} is executed if the condition to the left of the ⇒ command is true, and then {statement2} and everything after it is executed in sequence. {statement1} is skipped if the condition to the left of the ⇒ command is false, and then {statement2} and everything after it is executed. Syntax ②: A non-zero evaluation result of the condition to the left of the ⇒ command is interpreted as “true”, so {statement1} is executed, followed by {statement2} and everything after it in succession. A zero evaluation result of the condition to the left of the ⇒ command is interpreted as “false”, so {statement1} is skipped, and {statement2} and everything after it is executed.
Example	Lbl 1 : ? → A : A ≥ 0 ⇒ √(A) ▲ Goto 1

### =, ≠, >, ≥, <, ≤ (Relational Operators)

Syntax	{expression} {relational operator} {expression}
Function	These commands evaluate the expressions on either side, and return a value of true (1) or false (0). These commands are used in combination with the branching command ⇒, and when structuring the {conditional expression} of If statements and While statements.
Example	See the entries for ⇒ (page 47), If statement (page 48), and While statement (page 49).



## Note

These commands evaluate the expressions on either side, and return 1 if true and 0 if false, and store the result in Ans.

## ◆ Control Structure Commands/If Statement **P-CMD**

The If statement is used to control program execution branching according to whether the expression following If (which is the branching condition) is true or false.

### If Statement Precautions

- An If must always be accompanied by a Then. Using an If without a corresponding Then will result in a Syntax ERROR.
- An expression, Goto command, or Break command can be used for the {expression\*} following Then and Else.

### If~Then (~Else) ~IfEnd

Syntax	If {conditional expression} : Then {expression*} : Else {expression*} : IfEnd : {statement} : ...
Function	<ul style="list-style-type: none"><li>• The statements following Then are executed up to Else, and then the statements following IfEnd are executed when the conditional statement following If is true. The statements following Else and then the statements following IfEnd are executed when the conditional statement following If is false.</li><li>• Else {expression} may be omitted.</li><li>• Always include the IfEnd:{statement}. Omitting it will not cause an error, but certain program contents can cause unexpected execution results by everything after the If statement.</li></ul>
Example 1	? → A : If A < 10 : Then 10A ▲ Else 9A ▲ IfEnd : Ans×1.05
Example 2	? → A : If A > 0 : Then A × 10 → A : IfEnd : Ans×1.05

## ◆ Control Structure Commands/For Statement **P-CMD**

The For statement repeats execution of the statements between For and Next as long as the value assigned to the control variable is within the specified range.

### For Statement Precautions

A For statement must always be accompanied by a Next statement. Using a For without a corresponding Next will result in a Syntax ERROR.

### For~To~Next

Syntax	For {expression (starting value)} → {variable (control variable)} To {expression (ending value)} : {statement} : ... {statement} : Next : ...
Function	Execution of the statements from For to Next repeats as the control variable is incremented by 1 with each execution, starting from the starting value. When the value of the control value reaches the ending value, execution jumps to the statement following Next. Program execution stops if there is no statement following Next.
Example	For 1 → A To 10 : A <sup>2</sup> → B : B ▲ Next

## For~To~Step~Next

Syntax	For {expression (starting value)} → {variable (control variable)} To {expression (ending value)} Step {expression (step)} : {statement} : ... {statement} : Next : ....
Function	Execution of the statements from For to Next repeats as the control variable is incremented by the step amount with each execution, starting from the starting value. Except for that, this command is the same as For~To~Next.
Example	For 1 → A To 10 Step 0.5 : A <sup>2</sup> → B : B ▲ Next

## ◆ Control Structure Commands/While Statement **P-CMD**

### While~WhileEnd

Syntax	While {conditional expression} : {statement} : ... {statement} : WhileEnd : ....
Function	The statements from While to WhileEnd are repeated while the conditional expression following While is true (non-zero). When the conditional expression following While becomes false (0), the statement following WhileEnd is executed.
Example	? → A : While A < 10 : A <sup>2</sup> ▲ A+1 → A : WhileEnd : A÷2

### Note

If the condition of the While statement is false the first time this command is executed, execution jumps directly to the statement following WhileEnd without executing the statements from While to WhileEnd even once.

## ◆ Program Control Commands **P-CMD**

### Break

Syntax	.. : {Then ; Else ; ⇒ } Break : ..
Function	This command forces a break in a For or While loop, and jumps to the next command. Normally, this command is used inside of a Then statement in order to apply a Break condition.
Example	? → A : While A > 0 : If A > 2 : Then Break : IfEnd : WhileEnd : A ▲

## ◆ Setup Commands

These commands function the same way as the calculator's various setup settings. For more information, see "Calculator Setup" on page 6.

### Important!

With some setup commands, the settings you configure remain in effect even after you finish running the program.

## Angle Unit Commands

<b>Deg, Rad, Gra</b>		(COMP, CMPLX, SD, REG)
Syntax	.. : Deg : .. .. : Rad : .. .. : Gra : ..	
Operation	<b>SHIFT</b> <b>MODE</b> (SETUP) <b>1</b> (Deg) <b>SHIFT</b> <b>MODE</b> (SETUP) <b>2</b> (Rad) <b>SHIFT</b> <b>MODE</b> (SETUP) <b>3</b> (Gra)	
Function	These commands specify the angle unit setting.	

## Display Format Command

<b>Fix</b>		(COMP, CMPLX, SD, REG)
Syntax	.. : Fix { <i>n</i> } : .. ( <i>n</i> = an integer from 0 to 9)	
Operation	<b>SHIFT</b> <b>MODE</b> (SETUP) <b>1</b> (Fix) <b>0</b> to <b>9</b>	
Function	This command fixes the number of decimal places (from 0 to 9) for output of calculation results.	

<b>Sci</b>		(COMP, CMPLX, SD, REG)
Syntax	.. : Sci { <i>n</i> } : .. ( <i>n</i> = an integer from 0 to 9)	
Operation	<b>SHIFT</b> <b>MODE</b> (SETUP) <b>2</b> (Sci) <b>0</b> to <b>9</b>	
Function	This command fixes the number of significant digits (from 1 to 10) for output of calculation results. Pressing <b>SHIFT</b> <b>MODE</b> (SETUP) <b>2</b> (Sci) and then <b>0</b> specifies 10 significant digits.	

<b>Norm</b>		(COMP, CMPLX, SD, REG)
Syntax	.. : Norm {1 ; 2} : ..	
Operation	<b>SHIFT</b> <b>MODE</b> (SETUP) <b>3</b> (Norm) <b>1</b> or <b>2</b>	
Function	This command specifies either Norm1 or Norm2 for output of calculation results.	

## Statistical Frequency Command

<b>FreqOn, FreqOff</b>		(SD, REG)
Syntax	.. : FreqOn : .. .. : FreqOff : ..	
Operation	<b>SHIFT</b> <b>MODE</b> (SETUP) <b>1</b> (FreqOn) <b>SHIFT</b> <b>MODE</b> (SETUP) <b>2</b> (FreqOff)	
Function	This command turns statistical frequency on (FreqOn) or off (FreqOff).	

## ◆ Clear Commands

### ClrMemory

(COMP, CMPLX, BASE)

Syntax .. : ClrMemory : ..

Operation **SHIFT** **9** (CLR) **1** (Mem)

Function This command clears all variables to zero.

#### Note

To clear a specific variable, use 0 → {variable}.

### ClrStat

(SD, REG)

Syntax .. : ClrStat : ..

Operation **SHIFT** **9** (CLR) **1** (Stat)

Function This command clears all statistical sample data currently in memory.

## ◆ Independent Memory Commands

### M+, M−

(COMP, CMPLX, BASE)

Syntax .. : {expression} M+ : .. / .. : {expression} M− : ..

Operation **M+** / **SHIFT** **M+** (M−)

Function M+ adds the value of the expression to independent memory, while M− subtracts it.

## ◆ Rounding (Rnd) Command

### Rnd(

(COMP, CMPLX, SD, REG)

Syntax .. : {expression} : Rnd(Ans : ..

Operation **SHIFT** **0** (Rnd)

Function This command rounds a calculation result in accordance with the number of digits specified by the display format.

## ◆ Number Base Commands

### Dec, Hex, Bin, Oct

(BASE)

Syntax .. : Dec : .. / .. : Hex : .. / .. : Bin : .. / .. : Oct : ..

Operation **x<sup>2</sup>** (DEC) / **∧** (HEX) / **log** (BIN) / **ln** (OCT)

Function These commands specify the number base for base-*n* calculations.

## ◆ Statistical Data Input Command

DT	(SD, REG)
Syntax	.. : {expression (x-value)} ; {expression (Freq-value)} DT : .. <span style="float: right;">.....SD Mode, FreqOn</span>
	.. : {expression (x-value)} DT : .. <span style="float: right;">.....SD Mode, FreqOff</span>
	.. : {expression (x-value)} , {expression (y-value)} ; {expression (Freq-value)} DT : .. <span style="float: right;">.....REG Mode, FreqOn</span>
	.. : {expression (x-value)} , {expression (y-value)} DT : .. <span style="float: right;">.....REG Mode, FreqOff</span>

### Important!

To input a semicolon (;) in the above syntax, press  $\text{SHIFT}$   $\text{;}$  (;). To input a comma (,), press  $\text{SHIFT}$   $\text{,}$ .

Operation  $\text{M+}$  (Inputs DT.)

Function Use this command to input one set of sample data. The DT command functions the same way as the  $\text{M+}$  key (DT key) in the SD Mode and REG Mode.

## ◆ Functions Not Supported in Programs

The following functions are not supported inside of functions.

- Calculation result conversion functions ( $\text{ENG} \rightarrow$ ,  $\text{ENG} \leftarrow$ , Sexagesimal  $\leftrightarrow$  Decimal Conversion, Fraction  $\leftrightarrow$  Decimal Conversion)
- Display switching ( $\text{SHIFT}$   $\text{EXE}$  (Re $\leftrightarrow$ Im)) while a complex number calculation result is displayed
- Reset ( $\text{SHIFT}$   $\text{9}$  (CLR)  $\text{3}$  (All)  $\text{EXE}$ )
- Setup information clear ( $\text{SHIFT}$   $\text{9}$  (CLR)  $\text{2}$  (Setup)  $\text{EXE}$ )



- As shown in the examples below, multiplication where the sign is omitted is given higher priority than signed multiplication and division.

$$1 \div 2\pi = \frac{1}{2\pi} = 0.159154943$$

$$1 \div 2 \times \pi = \frac{1}{2}\pi = 1.570796327$$

## ■ Calculation Ranges, Number of Digits, and Precision

The following table shows the general calculation range (value input and output range), number of digits used for internal calculations, and calculation precision.

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

## ◆ Function Calculation Input Ranges and Precision

Functions	Input Range	
sinx cosx	DEG	$0 \leq  x  < 9 \times 10^9$
	RAD	$0 \leq  x  < 157079632.7$
	GRA	$0 \leq  x  < 1 \times 10^{10}$
tanx	DEG	Same as sinx, except when $ x  = (2n-1) \times 90$ .
	RAD	Same as sinx, except when $ x  = (2n-1) \times \pi/2$ .
	GRA	Same as sinx, except when $ x  = (2n-1) \times 100$ .
sin <sup>-1</sup> x cos <sup>-1</sup> x	$0 \leq  x  \leq 1$	
tan <sup>-1</sup> x	$0 \leq  x  \leq 9.999999999 \times 10^{99}$	
sinhx coshx	$0 \leq  x  \leq 230.2585092$	
sinh <sup>-1</sup> x	$0 \leq  x  \leq 4.999999999 \times 10^{99}$	
cosh <sup>-1</sup> x	$1 \leq x \leq 4.999999999 \times 10^{99}$	
tanhx	$0 \leq  x  \leq 9.999999999 \times 10^{99}$	
tanh <sup>-1</sup> x	$0 \leq  x  \leq 9.999999999 \times 10^{-1}$	
logx/lngx	$0 < x \leq 9.999999999 \times 10^{99}$	
10 <sup>x</sup>	$-9.999999999 \times 10^{99} \leq x \leq 99.99999999$	
e <sup>x</sup>	$-9.999999999 \times 10^{99} \leq x \leq 230.2585092$	

Functions	Input Range
$\sqrt{x}$	$0 \leq x < 1 \times 10^{100}$
$x^2$	$ x  < 1 \times 10^{50}$
$1/x$	$ x  < 1 \times 10^{100}; x \neq 0$
$\sqrt[3]{x}$	$ x  < 1 \times 10^{100}$
$x!$	$0 \leq x \leq 69$ ( $x$ is an integer)
$nPr$	$0 \leq n < 1 \times 10^{10}, 0 \leq r \leq n$ ( $n, r$ are integers) $1 \leq \{n!/(n-r)!\} < 1 \times 10^{100}$
$nCr$	$0 \leq n < 1 \times 10^{10}, 0 \leq r \leq n$ ( $n, r$ are integers) $1 \leq n!/r! < 1 \times 10^{100}$ or $1 \leq n!/(n-r)! < 1 \times 10^{100}$
$\text{Pol}(x, y)$	$ x ,  y  \leq 9.999999999 \times 10^{99}$ $\sqrt{x^2 + y^2} \leq 9.999999999 \times 10^{99}$
$\text{Rec}(r, \theta)$	$0 \leq r \leq 9.999999999 \times 10^{99}$ $\theta$ : Same as $\sin x$
$\circ, \text{”}$	$ a , b, c < 1 \times 10^{100}$ $0 \leq b, c$
$\overleftarrow{\circ, \text{”}}$	$ x  < 1 \times 10^{100}$ Decimal $\leftrightarrow$ Sexagesimal Conversions $0^\circ 0' 0'' \leq  x  \leq 99999999^\circ 59' 59''$
$\wedge(x^y)$	$x > 0: -1 \times 10^{100} < y \log x < 100$ $x = 0: y > 0$ $x < 0: y = n, \frac{m}{2n+1}$ ( $m, n$ are integers) However: $-1 \times 10^{100} < y \log  x  < 100$
$x\sqrt{y}$	$y > 0: x \neq 0, -1 \times 10^{100} < 1/x \log y < 100$ $y = 0: x > 0$ $y < 0: x = 2n+1, \frac{2n+1}{m}$ ( $m \neq 0; m, n$ are integers) 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 separator symbols).

- $\wedge(x^y), x\sqrt{y}, \sqrt[3]{\phantom{x}}, x!, nPr, nCr$  type functions require consecutive internal calculation, which can result in accumulation of errors that occur within each individual calculation.
- Errors are cumulative and tend to be large in the vicinity of a function's singular point and inflection point.

## ■ Error Messages

An error message will appear on the screen if you perform a calculation that causes a calculator's limit to be exceeded, or if you try to perform some operation that is not allowed.

**Math ERROR**

Sample Error Message



## ◆ Recovering from an Error Message

You can recover from an error message by performing the key operations described below, regardless of the error type.

- Press ◀ or ▶ to display the editing screen for the calculation expression you input immediately before the error occurred, with the cursor positioned at the location that caused the error. For more information, see “Finding the Location of an Error” on page 10.
- Pressing [AC] will clear the calculation expression you input immediately before the error occurred. Note that a calculation expression that causes an error will not be included in calculation history.

## ◆ Error Message Reference

This section lists all of the error messages that the calculator displays, as well as their causes and what you need to do to avoid them.

### Math ERROR

<b>Cause</b>	<ul style="list-style-type: none"><li>• An intermediate or the final result of the calculation falls outside of the allowable calculation range.</li><li>• An input value is outside the allowable input range.</li><li>• You are trying to perform an illegal mathematical operation (such as division by zero).</li></ul>
<b>Action</b>	<ul style="list-style-type: none"><li>• Check your input values and reduce the number of digits, if required.</li><li>• 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.</li></ul>

For information about the allowable value input range, see “Calculation Ranges, Number of Digits, and Precision” on page 54.

### Stack ERROR

<b>Cause</b>	The calculation has causes the capacity of the numeric stack or the command stack to be exceeded.
<b>Action</b>	<ul style="list-style-type: none"><li>• Simplify the calculation expression so it does not exceed the capacity of the stacks.</li><li>• Try splitting the calculation into two or more parts.</li></ul>

### Syntax ERROR

<b>Cause</b>	The calculation has a format problem.
<b>Action</b>	Check the syntax and make the required corrections.

### Argument ERROR

<b>Cause</b>	The calculation has a problem with how an argument being used.
<b>Action</b>	Check how arguments are being used and make the required corrections.

## Time Out Error

<b>Cause</b>	The current differential or integration calculation ends without the ending condition being fulfilled.
<b>Action</b>	Differential or integration calculation: Try increasing the <i>tol</i> value. Note that this also decreases solution precision.

## Data Full

<b>Cause</b>	You are attempting to store sample data in the SD Mode or REG Mode when the allowable number of data samples are already stored in memory.
<b>Action</b>	Keep the number of data samples within the allowable limit. For more information, see “Maximum Number of Input Data Items” on page 29.

## Go ERROR

<b>Cause</b>	A program (that you created in the PRGM Mode) has a “Goto <i>n</i> ” command without a corresponding “Lbl <i>n</i> ” label.
<b>Action</b>	Either add a “Lbl <i>n</i> ” for the “Goto <i>n</i> ” command, or delete the applicable “Goto <i>n</i> ” command.

## ■ 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. If one step does not correct the problem, move on to the next step. Note that you should make copies of important data before performing these steps.

- ① Check the calculation expression to make sure it does not include 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 restore normal operation, press the **ON** key. The calculator will perform a self-check of its status as it starts up. If the calculator discovers a problem, it will return its calculation mode and setup to their initial defaults, and clear all data currently in memory.
- ④ If step ③ does not restore normal operation, initialize all modes and settings by pressing **SHIFT** **9** (CLR) **2** (Setup) **EXE**.

# Power Requirements

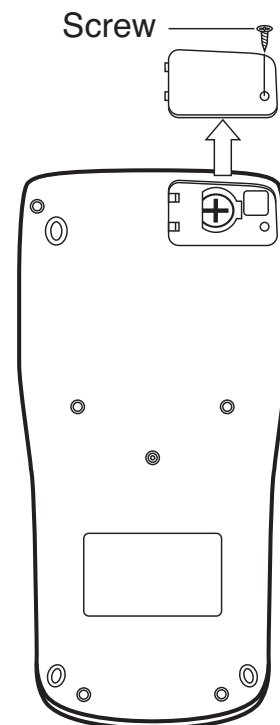
## ◆ Replacing the Battery

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 become dim. Even if the calculator is operating normally, replace the battery at least once every three years.

### 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.
2. Remove the cover as shown in the illustration and replace the battery, taking care that its plus (+) and minus (-) ends are facing correctly.
3. Replace the cover.
4. Initialize the calculator: **ON** **SHIFT** **9** (CLR) **3** (All) **EXE** (Yes)
  - Do not skip the above step!



## ◆ 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.

# Specifications

### Power Requirements:

Solar Cell: Built into front of calculator (fixed)

Button Battery: LR44 (GPA76) × 1

### Approximate Battery Life:

3 years (based on 1 hour of operation per day)

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

**Dimensions:** 11.1 (H) × 80 (W) × 162 (D) mm  
 $\frac{3}{8}$ " (H) ×  $3\frac{1}{8}$ " (W) ×  $6\frac{3}{8}$ " (D)

**Approximate Weight:** 95 g (3.4 oz) including the battery

**Bundled Accessories:** Hard Case



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