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## Chapter 1

# General Guide

### Turning On And Off

To turn the calculator on, press [ ON ] ; To turn the calculator off, press [ 2nd ] [ OFF ].

### Battery Replacement

The calculator is powered by one lithium battery (CR2025). If the display becomes weak, the " LOW BATTERY " message appears in the display. Please replace the battery as soon as possible.

To replace battery :

- 1) Slide the battery compartment cover in the direction indicated by the arrow and remove it.
- 2) Remove the old battery and install new one with polarity in correct directions, then replace the battery compartment cover and press [ ON ].

### Auto Power-Off Function

This calculator automatically turns it off when not operated for approximately 9 minutes. It can be reactivated by pressing [ ON ] key and the display, memory, settings are retained.

### Reset Operation

If the calculator is on but you get unexpected results, press [ 2nd ] [ RESET ] in sequence. A message appears on the display to confirm whether you want to reset the calculator and clear memory contents.

RESET : <u>N</u> Y
--------------------

Move the cursor to " Y " by [ ► ], then press [ ENTER ] to clear all variables, programs, pending operations, statistical data, answers, all previous entries, and memory; To cancel the reset operation without clearing the calculator, please choose " N ".

If the calculator is lock and further key operations becomes impossible, please press [ 0 ] [ DEL ] at the same time to release the condition. It will return all settings to default settings.

### Contrast Adjustment

Press [ MODE ] [ MODE ] 1 ( CONT ) to display the contrast screen.

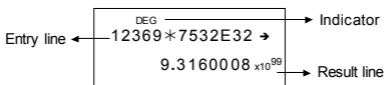


Pressing the [ ▼ ] or [ ▲ ] key can make the contrast of the screen lighter or darker.

To exit from this mode, press [ MODE ] once again.

## Display Readout

The display comprises the entry line, the result line, and indicators.



**Entry line** SRP-350 displays an entry of up to 76 digits. Entries begin on the left; those with more than 12 digits scroll to the left. Press [ ► ] and [ ◀ ] to move the cursor through an entry. However, whenever you input the 69th digit of any calculation, the cursor changes from " ◀ " to " ⚡ " to let you know memory is running low. If you still need to input more, you should divide your calculation into two or more parts.

**Result line** It displays a result of up to 10 digits, as well as a decimal, a negative sign, a " x10 " indicator, and a 2–digits positive or negative exponent.

**Indicators** The following indicators appear on the display to indicate you the current status of the calculator.

Indicator	Meaning
M	Running memory
2nd	2nd set of function keys are active
ALPHA	Alphabetic keys are active
DEGRAD	Angle mode : DEGrees, GRADs, or RADs
Base–n	Base–n mode is active
STAT	Statistics mode is active
PROG	Program mode is active
SCI, ENG	Scientific notation, Engineering notation
FIX	Number of decimal places displayed is fixed
HYP	Hyperbolic-trig function will be calculated
▲	Displayed value is intermediate result
BUSY	While an operation is executing
↶	Allow to use undo function



There are digits to the left or right of the display



There are earlier or later results that can be displayed



This action is inactive while pressing

## Before Starting Calculation

### Using " MODE " key

Press [ MODE ] to display mode menus when specifying an operating mode ( "0 MAIN", "1 STAT", "2 Base-n", "3 PROG" ), checking the memory status ( "0 CAPA" ), or adjusting the contrast ( "1 CONT" )

DEG	
<u>0 MAIN</u>	1 STAT →
2 Base-n	3 PROG

DEG	
← <u>0 CAPA</u>	1 CONT

- 0 MAIN : Use this mode for basic calculations, including scientific function calculations.
- 1 STAT : Use this mode to perform single-variable and paired-variable statistical and regression calculations.
- 2 Base-n : Use this mode to binary, octal, decimal and hexadecimal calculations.
- 3 PROG : Use this mode to store programs in the program area and to run programs.
- 0 CAPA : Use this mode to check how much memory is used and remaining.
- 1 CONT : Use this mode to adjust the contrast of the display.

Give " 1 STAT " as an example :

Method 1 : Press [ MODE ] and then scroll through the menus using [ ► ] [ ◀ ] [ ▲ ] [ ▼ ] until " 1 STAT " is underlined, then enter the desired mode by pressing [ ENTER ].

Method 2 : Press [ MODE ] and then Key in directly the number of the mode, [ 1 ] , to enter the desired mode immediately.

### Using " 2nd " " ALPHA " Keys

To execute the functions marked in yellow, please press [ 2nd ] and then the corresponding key. When you press [ 2nd ], the " 2nd " indicator shown in the display is to tell you that you will be selecting the second function of the next key you press. If you press [ 2nd ] by mistake, simply press [ 2nd ] again to remove the " 2nd " indicator.

To execute the functions marked in blue, please press [ ALPHA ] and then the corresponding key. When you press [ ALPHA ], the "ALPHA" indicator shown in the display is to tell you that you will be selecting the alphabetic function of the next key you press. If you press [ ALPHA ] by mistake, simply press [ ALPHA ] again to remove

the "ALPHA" indicator. Pressing [ 2nd ] [ ALPHA ] will lock the calculator in this mode and allow consecutive input of alphabetic function keys until [ ALPHA ] is pressed.

(Note) : For key color, some models maybe be printed other colors which are different from the above described.

## Make Corrections During Input

The blinking cursor " ◀ " means the calculator is in insert mode.

To delete a character at the cursor, make the character underlined by using [ ◀ ] or [ ▶ ] to move the cursor, and then press [ DEL ] to delete the character. Delete 1 character to the left of the cursor each time you press [ DEL ].

To insert a character, move the cursor to the position of the character where you want to insert, it will be inserted automatically in the front of the character after entering a new character.

To clear all characters, clear all input characters by [  $\text{CL}/\text{ESC}$  ] key.

## Error Position Display Function

When a mathematically illegal calculation is performed or a program you enter causes an error, an error message ( See < Error conditions > ) appears 5 seconds and then the error position display function will tell you with the cursor where the error is. In that case, please make necessary corrections before executing the calculation again.

➤  $14 \div 0 \times 2.3$  mistakenly input instead of  $14 \div 10 \times 2.3$

14 [ $\div$ ] 0 [ x ] 2.3 [ $\text{ENTER}$ ]	DEG DIVIDE BY 0
After 5 seconds	DEG 14 / 0 ◀ 2 . 3      ↑
[ ◀ ] 1 [ $\text{ENTER}$ ]	DEG 14 / 10 * 2 . 3      ↑ 3 . 2 2

## Undo Function

To resume a character which is just deleted by [ DEL ], running memory which is just cleared by [ MRC ], or an operation which is just cleared by [  $\text{CL}/\text{ESC}$  ], please press [ 2nd ] [ ↶ ].

## Replay Function

The replay function can keep input digits up to 168 characters. After execution is completed or during entering, you can press either [ ▲ ]

or [ ▼ ] to display previous input steps and edit values or commands for subsequent execution.

➤ After executing  $1 + 2$ ,  $3 + 4$ ,  $5 + 6$ , use replay function to recall

1 [ + ] 2 [ <u>ENTER</u> ] 3 [ + ] 4 [ <u>ENTER</u> ] 5 [ + ] 6 [ <u>ENTER</u> ]	DEG 5 + 6 11 .	↑
[ ▲ ]	DEG 5 + 6	↑
[ ▲ ]	DEG 3 + 4	↑ ↓
[ ▲ ]	DEG 1 + 2	↑ ↓

(Note) :The replay function isn't cleared even when [ <sup>CL</sup>/ESC ] is pressed or power is turned off, so contents can be recalled. However, replay function is cleared when mode is switched.

## Memory Calculations

### (1) Running memory

Press [ M+ ] to add a result to running memory. Press [ 2nd ] [ M- ] to subtract the value from running memory. To recall the value in running memory, press [ MRC ]. To clear running memory, press [ MRC ] twice.

➤  $[(3 \times 5) + (56 \div 7) - (74 - 8 \times 7)] = 5$

[ MRC ] [ MRC ] [ <sup>CL</sup> /ESC ]	DEG ←	↑
3 [ x ] 5 [ M+ ] 56 [ $\div$ ] 7 [ M+ ] 74 [ - ] 8 [ x ] 7 [ 2nd ] [ M- ]	DEG 74 - 8 * 7 M 18 .	↑
[ MRC ] [ <u>ENTER</u> ]	DEG M 5 .	↑
[ MRC ] [ MRC ] [ <sup>CL</sup> /ESC ]	DEG ←	↑

### (2) Standard memory variables

The calculator has 26 standard memory variables for repeated use -- A, B, C, D,....Z. You can store a real number in any one of those variables.

- [ SAVE ] lets you store values to a specified memory variable.
- [ 2nd ] [ RECALL ] recalls the value of the variable.
- [ ALPHA ] + " memory variable ( A ~ Z ) " recalls the content to a specified memory variable.
- [ 2nd ] [ CL-VAR ] clears all variables

➤ (1) Put the value 30 into variable A

30 [ SAVE ] [▶]	DEG → → <u>A</u> B C D E →
[ <u>ENTER</u> ]	DEG 30 → A ↑ 30 .

➤ (2) Multiple 5 to variable A, then put the result into variable B

5 [x] [ALPHA] [A] [ <u>ENTER</u> ]	DEG 5 * A ↑ 150 .
[ SAVE ] [▶] [▶]	DEG → → A <u>B</u> C D E →
[ <u>ENTER</u> ]	DEG Ans → B ↑ 150 .

➤ (3) Clear the value of variable B

0 [ SAVE ] [▶] [▶] [ <u>ENTER</u> ]	DEG 0 → B ↑ 0 .
[ 2nd ] [ RECALL ] [▶]	DEG A <u>B</u> C D E F G →

(Note) : Besides pressing [ SAVE ] key to store a value, you can also assign values to memory variable M by [ M+ ] or [ 2nd ] [ M- ]. However, when [ SAVE ] is used, previous memory contents stored in variable M are cleared and replaced it with the newly assigned value. When [ M+ ] is used, values is added to present sum in memory. When [ 2nd ] [ M- ] is used, values is subtracted to present sum in memory.

(Note) : To assign mutple data of the same value to more than one memory variable, it can be input using [ ALPHA ] [ ~ ]. For example, to assign the value 98 into memory variable A, B,

C, D, please press 98 [ SAVE ] ( → ) [ ENTER ] [ ALPHA ] [ A ]  
 [ ALPHA ] [ ~ ] [ ALPHA ] [ D ] [ ENTER ].

### (3) Equation storage

The calculator contains a total of 36 program areas ( P0~P9, PA~PZ ) for the storage of equations and programs. You can store one equation in memory for instant recall when you need it. By pressing [ PROG ], the equation is assigned automatically to a program area that nothing is stored, from P0 though PZ. Then you can recall the equation by [ PROG ] at any time, input value, and perform calculations quickly and easily.

➤ (1) Set PROG 0 = 3 A + 5 B, where A = 0, B = 0

3 [ ALPHA ] [ A ] [ + ] 5 [ ALPHA ] [ B ] [ SAVE ] ( → ) [ <u>ENTER</u> ] [ PROG ] [ <u>ENTER</u> ]	DEG 3 A + 5 B → PROG 0    ↑ 0 .
---	---------------------------------------

➤ (2) Set A = 20, B = 18, get PROG 0 = 3 A + 5 B = 150

[ PROG ] 0 [ <u>ENTER</u> ] [ <u>ENTER</u> ] 20	DEG A = 2 0    ↑
[ <u>ENTER</u> ] 18	DEG B = 1 8    ↑
[ <u>ENTER</u> ]	DEG 3 A + 5 B    ↑ 1 5 0 .

## Memory Status


The memory storage for statistical calculations and programs consists of a total of 1200 bytes. You can check how much memory has been used and how many bytes of memory are still available for storage.

Press [ MODE ] [ MODE ] 0 ( CAPA ) to display the memory status.

DEG S :    4 8    P :    5 3 MEM . F r e e : 1 0 9 9
--

S : .... Statistical data      P : .... Program data

When the following conditions occur, in STAT or PROG mode, some messages appear in the screen to let you know memory is running low.

1) **S : 0, P : 840** indicates 360 remaining bytes are still available for storage and the cursor changes from " ◀ " to "  ". If you still need to input more, you should delete your previous entries.

2) **S : 320, P : 840** indicates 40 remaining bytes are still available for storage and the cursor changes from " ◀ " to " ▣ ". If you still need to input more, you should delete your previous entries.

In STAT mode

DEG
LOW MEMORY
CHECK CAPA

3) **S : 0, P : 1200** indicates all bytes in the system have been used. There is no memory for storages of statistical data and programs.

In STAT and PROG mode

DEG
SYSTEM MEMORY
NOT ENOUGH

## Order Of Operations

Each calculation is performed in the following order of precedence:

- Coordinates transformation, Type B functions which are required pressing the function key before entering, for example,  $\sin$ ,  $\cos$ ,  $\tan$ ,  $\sin^{-1}$ ,  $\cos^{-1}$ ,  $\tan^{-1}$ ,  $\sinh$ ,  $\cosh$ ,  $\tanh$ ,  $\sinh^{-1}$ ,  $\cosh^{-1}$ ,  $\tanh^{-1}$ ,  $\log$ ,  $\ln$ ,  $10^x$ ,  $e^x$ ,  $\sqrt{\quad}$ ,  $\sqrt[3]{\quad}$ ,  $d/dx$ ,  $\int dx$ ,  $\text{NEG}$ ,  $\text{NOT}$ ,  $X'(\quad)$ ,  $Y'(\quad)$
- Type A functions which are required entering values before pressing the function key, for example,  $x^2$ ,  $x^{-1}$ ,  $x!$ ,  $\%$ ,  $r$ ,  $g$ ,  $\circ \gg \gg$ .
- Exponentiation,  $\sqrt[3]{\quad}$
- Fractions
- $\pi$ ,  $\text{RAND}$ ,  $\text{RANDI}$ , physical constant, abbreviated multiplication format in the front of variable
- $(-)$
- Abbreviated multiplication format in the front of Type B functions,  $2\sqrt{3}$ ,  $\text{Alog2}$ , etc.
- $n\text{Pr}$ ,  $n\text{Cr}$
- $x \div$
- $+$ ,  $-$
- $\text{AND}$ ,  $\text{NAND}$  --- only Base-n mode
- $\text{OR}$ ,  $\text{XOR}$ ,  $\text{XNOR}$  --- only Base-n mode
- Conversion ( $\text{Ab/c} \leftrightarrow \text{d/e}$ ,  $\text{F} \leftrightarrow \text{D}$ ,  $\text{DMS}$ )
  - When functions with the same priority are used in series, execution is performed from right to left.
 
$$e^x \ln 120 \rightarrow e^x \{ \ln (120) \}$$
 otherwise, execution is from left to right.
  - Compound functions are executed from right to left.

- Anything contained within parentheses receives the highest priority.

## Accuracy And Capacity

Output digits : Up to 10 digits.

Calculating digits : Up to 24 digits

In general, every reasonable calculation is displayed up to 10 digits mantissa, or 10-digits mantissa plus 2-digits exponent up to  $10^{\pm 99}$ .

Numbers used as input must be within the range of the given function as follow :

Functions	Input range
sin x cos x tan x	Deg : $ x  < 4.5 \times 10^{10}$ deg Rad : $ x  < 2.5 \times 10^8 \pi$ rad Grad : $ x  < 5 \times 10^{10}$ grad however, for tan x Deg : $ x  \neq 90(2n+1)$ Rad : $ x  \neq \frac{\pi}{2}(2n+1)$ Grad : $ x  \neq 100(2n+1)$ , (n is an integer)
$\sin^{-1}x, \cos^{-1}x$	$ x  \leq 1$
$\tan^{-1}x$	$ x  < 1 \times 10^{100}$
sinh x, cosh x	$ x  \leq 230.2585092$
tanh x	$ x  < 1 \times 10^{100}$
$\sinh^{-1}x$	$ x  < 5 \times 10^{99}$
$\cosh^{-1}x$	$1 \leq x < 5 \times 10^{99}$
$\tanh^{-1}x$	$ x  < 1$
log x, ln x	$1 \times 10^{-99} \leq x < 1 \times 10^{100}$
$10^x$	$-1 \times 10^{100} < x < 100$
$e^x$	$-1 \times 10^{100} < x \leq 230.2585092$
$\sqrt{x}$	$0 \leq x < 1 \times 10^{100}$
$x^2$	$ x  < 1 \times 10^{50}$
$x^3$	$ x  < 2.15443469003 \times 10^{33}$
$x^{-1}$	$ 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.



## Error Conditions

Error message will appear on the display and further calculation becomes impossible when any of the following conditions occur.

Indicator	Meanings
<b>DOMAIN Er</b>	<ol style="list-style-type: none"><li>(1) When specifying an argument to a function outside the valid range.</li><li>(2) <b>FREQ</b> value &lt; 0 or non-integer.</li><li>(3) Integration interval [ a, b ] is unavailable or interrupted for the integrated function</li><li>(4) When <b>USL</b> value &lt; <b>LSL</b> value</li></ol>
<b>DIVIDE BY O</b>	You attempted to divide by 0.
<b>OVERFLOW Er</b>	When result of function calculations exceeds the range specified.
<b>SYNTAX Er</b>	<ol style="list-style-type: none"><li>(1) Input errors are made.</li><li>(2) When improper arguments are used in commands or functions that require arguments.</li><li>(3) A missing <b>END</b> command for marking the end of the program</li><li>(4) You use improper syntax for the operation.</li><li>(5) There is no corresponding data in the <b>Data</b> command when the <b>Read</b> command is used.</li><li>(6) The number in the <b>Locate</b> command you input is outside the valid range</li></ol>
<b>LENGTH Er</b>	An entry exceeds 84 digits after implied multiplication with auto-correction
<b>OUT OF SPEC</b>	You input a negative $C_{PU}$ or $C_{PL}$ value, where $C_{PU} = \frac{USL - \bar{X}}{3\sigma} \quad , \quad C_{PL} = \frac{\bar{X} - LSL}{3\sigma}$
<b>SYSTEM MEMORY NOT ENOUGH</b>	All bytes in the system have been used. There is no memory for storages of statistical data and programs.
<b>LOW MEMORY CHECK CAPA</b>	Only 40 remaining bytes are still available for storages of statistical data and programs.
<b>NEST Er</b>	<ol style="list-style-type: none"><li>(1) A subroutine nesting exceeds 3 levels.</li><li>(2) A <b>If-Then-Else</b> nesting exceeds 3 levels.</li><li>(3) A <b>For</b> loop nesting exceeds 3 levels.</li><li>(4) A <b>Gosub-PROG</b> nesting exceeds 3 levels.</li></ol>
<b>GOTO Er</b>	<ol style="list-style-type: none"><li>(1) There is no corresponding <b>Label n</b> when <b>Goto n</b> is used.</li><li>(2) In the <b>MAIN</b> mode, attempt to run a program whose file name is invalid.</li></ol>
<b>GOSUB Er</b>	<ol style="list-style-type: none"><li>(1) There is no corresponding <b>PROG n</b> when <b>Gosub PROG n</b> is used</li></ol>

(2) Attempt to jump to a program area in which there is no program stored

**TABLE Er**

Attempt to use the same label name more than once.

To release the above errors, please press [ <sup>CL</sup>/ESC ] key.



➤  $(2 + 3) \times 10^2 = 500$

$( ) 2 [ + ] 3 [ \blacktriangleright ] [ \times ] [ \text{EXP} ] 2$ $[ \underline{\text{ENTER}} ]$	DEG $( 2 + 3 ) * E 2$ 5 0 0 .      ↑
---	--

## Percentage Calculation

[ 2nd ] [ % ] divides the number in the display by 100. You can use this key sequence to calculate percentages, add-ons, discounts, and percentage ratios.

➤  $120 \times 30 \% = 36$

$120 [ \times ] 30 [ 2\text{nd} ] [ \% ] [ \underline{\text{ENTER}} ]$	DEG $1 2 0 * 3 0 \%$ 3 6 .      ↑
--	---

➤  $88 \div 55 \% = 160$

$88 [ \div ] 55 [ 2\text{nd} ] [ \% ] [ \underline{\text{ENTER}} ]$	DEG $8 8 / 5 5 \%$ 1 6 0 .      ↑
---	---

## Display Formats

Decimal places formats are selected by pressing [ 2nd ] [ FIX ] to display the menu. To set decimal places to n ( F0123456789 ), enter a n value directly or press [ ENTER ] key while the an item is underlined. ( The default setting is floating point notation F and the n value is • ).

➤  $6 \div 7 = 0.857142857\dots$

$6 [ \div ] 7 [ \underline{\text{ENTER}} ]$	DEG $6 / 7$ 0 . 8 5 7 1 4 2 8 5 7      ↑
$[ 2\text{nd} ] [ \text{FIX} ] [ \blacktriangleright ] [ \blacktriangleright ] [ \blacktriangleright ] [ \blacktriangleright ] [ \blacktriangleright ]$	DEG F 0 1 2 3 <u>4</u> 5 6 7 8 9
$[ \underline{\text{ENTER}} ]$	DEG                      FIX $6 / 7$ 0 . 8 5 7 1      ↑
$[ 2\text{nd} ] [ \text{FIX} ] 2$	DEG                      FIX $6 / 7$ 0 . 8 6      ↑

[ 2nd ] [ FIX ] [ • ]	DEG 6 / 7 0 . 8 5 7 1 4 2 8 5 7
-----------------------	---------------------------------------

Number display formats are selected by pressing [ 2nd ] [ SCI/ENG ] to display the menu. The items on the menu are **FLO** (for floating point), **SCI** (for scientific), and **ENG** (for engineering).

Each time you specify the ENG mode, a displayed value is automatically shown with the corresponding engineering symbol.

➤  $1 \div 6000 = 0.0001666\dots$

1 [ ÷ ] 6000 [ <u>ENTER</u> ]	DEG 1 / 6 0 0 0 0 . 0 0 0 1 6 6 6 6 7
[ 2nd ] [ SCI / ENG ] [ ▶ ]	DEG 0 F L O <u>1 S C I</u> 2 E N G
[ <u>ENTER</u> ]	DEG                      SCI 1 / 6 0 0 0 1 . 6 6 6 6 6 6 6 6 7 $\times 10^{-4}$
[ 2nd ] [ SCI / ENG ] [ ▶ ]	DEG                      SCI 0 F L O     1 S C I <u>2 E N G</u>
[ <u>ENTER</u> ]	DEG                      ENG 1 / 6 0 0 0 $\mu$ 1 6 6 . 6 6 6 6 6 6 7

## Engineering Symbol Calculation

This calculator also provides a list of symbols for input of value using engineering notation by pressing [ 2nd ] [ ENG SYM ]. There are sixteen symbols in the menu.

yotta =  $10^{24}$ , zetta =  $10^{21}$ , exa =  $10^{18}$ , peta =  $10^{15}$ , tera =  $10^{12}$ , giga =  $10^9$ , mega =  $10^6$ , kilo =  $10^3$ , milli =  $10^{-3}$ , micro =  $10^{-6}$ , nano =  $10^{-9}$ , pico =  $10^{-12}$ , femto =  $10^{-15}$ , atto =  $10^{-18}$ , zepto =  $10^{-21}$ , yocto =  $10^{-24}$

➤ 2G byte + 130 M byte = 2130000000

2 [ 2nd ] [ ENG SYM ] [ 2nd ] [ ENG SYM ] [ ▶ ] [ ▶ ] [ ▶ ]	DEG → 0 K   1 M <u>2 G</u> 3 T 4 P   5 $\mu$ 6 Z   7 Y ←
--	--

[ <u>ENTER</u> ] [ + ] 130 [ 2nd ] [ ENG SYM ] [ 2nd ] [ ENG SYM ] 1 ( M ) [ <u>ENTER</u> ]	DEG 2 G + 1 3 0 M      ↑ 2 1 3 0 0 0 0 0 0 .
---	--

## Answer Function

Answer function stores the most recently calculated result. It is retained even after the power is turned off. Once a numeric value or numeric expression is entered and [ ENTER ] is pressed, the result is stored by this function.

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

123 [ + ] 456 [ <u>ENTER</u> ]	DEG 1 2 3 + 4 5 6      ↑ 5 7 9 .
789 [ - ] [ 2nd ] [ ANS ] [ <u>ENTER</u> ]	DEG 7 8 9 - A n s      ↑ 2 1 0 .

(Note) : Even if execution of a calculation results in an error, however, Answer memory retains its current value.

## Scientific Functional Calculations

Use MAIN ( [ MODE ] 0 ( MAIN ) ) mode for scientific functional calculations.

### Logarithm And Antilogarithm

The calculator can calculate common and natural logarithms and anti-logarithms using [ LOG ], [ LN ], [ 2nd ] [  $10^x$  ], and [ 2nd ] [  $e^x$  ].

➤  $\ln 7 + \log 100 = 3.945910149$

[ LN ] 7 [ ▶ ] [ + ] [ LOG ] 100 [ <u>ENTER</u> ]	DEG $\ln ( 7 ) + \log ( 100 \rightarrow \uparrow$ 3 . 945910149
--	---

➤  $10^2 + e^{-5} = 100.0067379$

[ 2nd ] [ $10^x$ ] 2 [ ▶ ] [ + ] [ 2nd ] [ $e^x$ ] [ ( - ) ] 5 [ <u>ENTER</u> ]	DEG $10 ^ ( 2 ) + e ^ ( - 5 ) \uparrow$ 100 . 0067379
--	---

### Fraction Calculation

Fraction value display is as follow :

5 / 12	Display of $\frac{5}{12}$	56 $\cup$ 5 / 12	Display of $56\frac{5}{12}$
--------	---------------------------	------------------	-----------------------------

(Note): Values are automatically displayed in decimal format whenever the total number of digits of a fractional values ( integer + numerator + denominator + separator marks ) exceeds 10.

To enter a mixed number, enter the integer part, press [ A b/c ], enter the numerator, press [ A b/c ], and enter the denominator ; To enter an improper fraction, enter the numerator, press [ A b/c ], and enter the denominator.

➤  $7\frac{2}{3} + 14\frac{5}{7} = 22\frac{8}{21}$

7 [ A b/c ] 2 [ A b/c ] 3 [ + ] 14 [ A b/c ] 5 [ A b/c ] 7 [ <u>ENTER</u> ]	DEG $7 \_ 2 \_ 3 + 14 \_ 5 \_ 7 \uparrow$ 22 $\_ 8 / 21$
--	--

During a fraction calculation, if the figure is reducible, a figure is reduced to the lowest terms after pressing a function command key ( [ + ], [ - ], [  $\times$  ] or [  $\div$  ] ) or the [ ENTER ] key. By pressing [ 2nd ] [ A b/c  $\rightarrow$  d/e ], the displayed value will be converted to the improper

fraction and vice versa. To convert between a decimal and fractional result, press [ 2nd ] [ F $\leftrightarrow$ D ].

$$\blacktriangleright 4\frac{2}{4} = 4\frac{1}{2} = 4.5 = \frac{9}{2}$$

4 [A b/c] 2 [A b/c] 4 [ <u>ENTER</u> ]	DEG 4 $\downarrow$ 2 $\downarrow$ 4 4 $\downarrow$ 1 / 2 <span style="float:right">↑</span>
[ 2nd ] [A b/c $\leftrightarrow$ d/e] [ <u>ENTER</u> ]	DEG Ans $\blacktriangleright$ A $\frac{b}{c}$ $\leftrightarrow$ $\frac{d}{e}$ <span style="float:right">↑</span> 9 / 2
[ 2nd ] [A b/c $\leftrightarrow$ d/e] [ <u>ENTER</u> ]	DEG Ans $\blacktriangleright$ A $\frac{b}{c}$ $\leftrightarrow$ $\frac{d}{e}$ <span style="float:right">↑</span> 4 $\downarrow$ 1 / 2
[ 2nd ] [ F $\leftrightarrow$ D ] [ <u>ENTER</u> ]	DEG Ans $\blacktriangleright$ F $\leftrightarrow$ D <span style="float:right">↑</span> 4 . 5

Calculations containing both fractions and decimals are calculated in decimal format.

$$\blacktriangleright 8\frac{4}{5} + 3.75 = 12.55$$

8 [A b/c] 4 [A b/c] 5 [ + ] 3.75 [ <u>ENTER</u> ]	DEG 8 $\downarrow$ 4 $\downarrow$ 5 + 3 . 7 5 <span style="float:right">↑</span> 1 2 . 5 5
--	--

## Angle Unit Conversion

The angle units (DEG, RAD, GRAD) is set by pressing [ DRG ] to display the angle menu.

DEG
<u>0 DEG</u> 1 RAD
2 GRAD

The relation among the three angle units is :

$$180^\circ = \pi \text{ rad} = 200 \text{ grad}$$

Angle conversions :

1. Change the default angle settings to the units you want to convert to.
2. Enter the value of the unit to convert.
3. Press [ 2nd ] [ DMS ] to display the menu. The units you can select are °(degrees), ' (minutes), " (seconds), r (radians), g (gradians) or  $\blacktriangleright$ DMS (Degrees-Minutes-Seconds).

DEG
<u>0°</u> 1' 2" 3 r
4 g 5 ▶DMS

4. Select the units you are converting from.

5. Press [ ENTER ] twice.

➤  $2\pi$  rad. = 360 deg. = 400 grad.

[ DRG ]	DEG <u>0 DEG</u> 1 RAD 2 GRAD
[ <u>ENTER</u> ] 2 [ 2nd ] [ π ] [ 2nd ] [ DMS ] [ ▶ ] [ ▶ ] [ ▶ ]	DEG 0° 1' 2" <u>3 r</u> 4 g 5 ▶DMS
[ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG 2 π r ↑ 360.
[ DRG ] 2 ( GRAD ) [ <u>ENTER</u> ]	GRAD 2 π r ↑ 400.

To convert an angle to DMS notation, select "▶DMS" which converts an entry to DMS notations, i.e., where  $1^{\circ}30'0''$  represents 1 degrees, 30 minutes, 0 seconds. To convert a DMS notation to decimal, select °(degrees), '(minutes), ''(seconds).

➤  $1.5 = 1^{\circ}30'0''$  (DMS)

1.5 [ 2nd ] [ DMS ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ]	DEG 0° 1' 2" 3 r 4 g <u>5 ▶DMS</u>
[ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG 1.5 ▶DMS ↑ 1°30'0''

➤  $2^{\circ}45'10.5'' = 2.752916667$

2 [ 2nd ] [ DMS ]	DEG <u>0°</u> 1' 2" 3 r 4 g 5 ▶DMS
[ <u>ENTER</u> ] 45 [ 2nd ] [ DMS ] [ ▶ ]	DEG 0° <u>1'</u> 2" 3 r 4 g 5 ▶DMS
[ <u>ENTER</u> ] 10.5 [ 2nd ] [ DMS ] [ ▶ ] [ ▶ ]	DEG 0° 1' <u>2''</u> 3 r 4 g 5 ▶DMS
[ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG

2° 45' 10.5" ↑  
2.752916667

## Trigonometric / Inverse-Tri. Functions

SRP-350 provides standard trigonometric functions and inverse trigonometric functions - sin, cos, tan,  $\sin^{-1}$ ,  $\cos^{-1}$  and  $\tan^{-1}$ .

(Note) : When using those keys, make sure the calculator is set for the angle unit you want.

➤  $\sin 30 \text{ deg.} = 0.5$

[ SIN ] 30 [ <u>ENTER</u> ]	DEG s i n ( 3 0 ) ↑ 0 . 5
-----------------------------	---------------------------------

➤  $3 \cos \left( \frac{2}{3} \pi \text{ rad} \right) = -1.5$

3 [ COS ] 2 [ x ] [ 2nd ] [ $\pi$ ] [ $\div$ ] 3 [ <u>ENTER</u> ]	RAD 3 c o s ( 2 * $\pi$ / 3 ) ↑ - 1 . 5
--	---

➤  $3 \sin^{-1} 0.5 = 90 \text{ deg}$

3 [ 2nd ] [ $\sin^{-1}$ ] 0.5 [ <u>ENTER</u> ]	DEG 3 s i n <sup>-1</sup> ( 0 . 5 ) ↑ 9 0 .
--	---

## Hyperbolic / Inverse-Hyp. Functions

SRP-350 uses [ 2nd ] [ HYP ] to calculate the hyperbolic functions and inverse-hyperbolic functions – sinh, cosh, tanh,  $\sinh^{-1}$ ,  $\cosh^{-1}$  and  $\tanh^{-1}$ .

(Note) : When using those keys, make sure the calculator is set for the angle unit you want.

➤  $\cosh 1.5 + 2 = 4.352409615$

[ 2nd ] [ HYP ] [ COS ] 1.5 [ ► ] [ + ] 2 [ <u>ENTER</u> ]	DEG c o s h ( 1 . 5 ) + 2 ↑ 4 . 3 5 2 4 0 9 6 1 5
---	---

➤  $\sinh^{-1} 7 = 2.644120761$

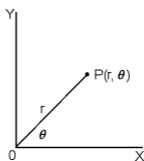
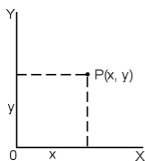
[ 2nd ] [ HYP ] [ 2nd ] [ $\sin^{-1}$ ] 7 [ <u>ENTER</u> ]	DEG s i n h <sup>-1</sup> ( 7 ) ↑ 2 . 6 4 4 1 2 0 7 6 1
---	---

## Coordinates Transformation

Pressing [ 2nd ] [ R◀▶P ] displays a menu to convert rectangular coordinates to polar coordinates or vice versa.

Rectangular Coordinates

Polar Coordinates



$$x + yi = r(\cos \theta + i \sin \theta)$$

(Note) : When using those key, make sure the calculator is set for the angle unit you want.

- If  $x = 5$ ,  $y = 30$ , what are  $r$ ,  $\theta$  ? Ans :  $r = 30.41381265$ ,  $\theta = 80.53767779^\circ$

[2nd][R↔P]	DEG 0 R▶P r    1 R▶P $\theta$ 2 P▶R x    3 P▶R y
[ <u>ENTER</u> ] 5 [ALPHA][▶] 30 [ <u>ENTER</u> ]	DEG R▶P r ( 5 , 30 )    ↑ 30 . 4 1 3 8 1 2 6 5
[2nd][R↔P][▶]	DEG 0 R▶P r    1 R▶P $\theta$ 2 P▶R x    3 P▶R y
[ <u>ENTER</u> ] 5 [ALPHA][▶] 30 [ <u>ENTER</u> ]	DEG R▶P $\theta$ ( 5 , 30 )    ↑ 80 . 5 3 7 6 7 7 7 9

- If  $r = 25$ ,  $\theta = 56^\circ$  what are  $x$ ,  $y$  ? Ans :  $x = 13.97982259$ ,  $y = 20.72593931$

[2nd][R↔P][▶][▶]	DEG 0 R▶P r    1 R▶P $\theta$ <u>2 P▶R x</u> 3 P▶R y
[ <u>ENTER</u> ] 25 [ALPHA][▶] 56 [ <u>ENTER</u> ]	DEG P▶R x ( 25 , 56 )    ↑ 13 . 9 7 9 8 2 2 5 9
[2nd][R↔P][▶][▶][▶]	DEG 0 R▶P r    1 R▶P $\theta$ 2 P▶R x <u>3 P▶R y</u>
[ <u>ENTER</u> ] 25 [ALPHA][▶] 56 [ <u>ENTER</u> ]	DEG P▶P y ( 25 , 56 )    ↑ 20 . 7 2 5 9 3 9 3 1

## Mathematical Functions

Each time [ MATH ] is pressed, various mathematical menus and all argument values corresponding the desired item are shown on the screen. With the following functions :

### • Numerical Calculations

- Min** Input values to obtain the minimum value
- Max** Input values to obtain the maximum value
- Med** Input values to obtain the medium value
- Sum** Input values to obtain the sum
- Avg** Input values to obtain the average value
- Sgn** Input values to indicate the sign of a given number, if negative value, display -1; if zero, display 0; if positive, display 1

➤  $\text{Min}(\sin 30 \text{ Deg.}, \sin 90 \text{ Deg.}) = \text{Min}(0.5, 1) = 0.5$

[ MATH ] 0 ( Min ) [ SIN ] 30 [ ► ] [ ALPHA ] [ ► ] [ SIN ] 90 [ <u>ENTER</u> ]	DEG Min ( sin ( 30 ) , s <sup>→↑</sup> 0.5
--	--

➤  $\text{Max}(\sin 30 \text{ Deg.}, \sin 90 \text{ Deg.}) = \text{Max}(0.5, 1) = 1$

[ MATH ] 1 ( Max ) [ SIN ] 30 [ ► ] [ ALPHA ] [ ► ] [ SIN ] 90 [ <u>ENTER</u> ]	DEG Max ( sin ( 30 ) , s <sup>→↑</sup> 1.
--	---

➤  $\text{Med}(12, 15, 17, 21, 33) = 17$

[ MATH ] 2 ( Med ) 12 [ ALPHA ] [ ► ] 15 [ ALPHA ] [ ► ] 17 [ ALPHA ] [ ► ] 21 [ ALPHA ] [ ► ] 33 [ <u>ENTER</u> ]	DEG Med ( 12 , 15 , 17 , <sup>→↑</sup> 17 .
--	---

➤  $\text{Sum}(13, 15, 23) = 51$

[ MATH ] 3 ( Sum ) 13 [ ALPHA ] [ ► ] 15 [ ALPHA ] [ ► ] 23 [ <u>ENTER</u> ]	DEG Sum ( 13 , 15 , 23 ) <sup>→↑</sup> 51 .
---	---

➤  $\text{Avg}(13, 15, 23) = 17$

[ MATH ] [ MATH ] 0 ( Avg ) 13 [ ALPHA ] [ ► ] 15 [ ALPHA ] [ ► ] 23 [ <u>ENTER</u> ]	DEG Avg ( 13 , 15 , 23 ) <sup>→↑</sup> 17 .
---	---

➤  $\text{Sgn}(\log 0.01) = \text{Sgn}(-2) = -1$

[ MATH ] [ MATH ] 1 ( Sgn ) [ LOG ] 0.01 [ <u>ENTER</u> ]	DEG Sgn ( log ( 0.01 ) ) <sup>→↑</sup> - 1 .
--	--

### • Quotient And Remainder Division

- Int** ÷ Produce the quotient of division operations involving two integers
- Rmdr** Produce the remainder of division operations involving two integers

- To display the quotient produced by  $58 \div 9$

58 [MATH][MATH]2 (Int $\div$ ) 9 [ENTER]	DEG 5 8 I n t $\div$ 9 6 .
---	----------------------------------

- To display the remainder produced by  $58 \div 9$

58 [MATH][MATH]3 (Rmdr) 9 [ENTER]	DEG 5 8 R m d r 9 4 .
--------------------------------------	-----------------------------

• **Factorials, Round, Integers, Fractional, Absolute Values, Random Numbers**

**Int** Input a value to extract the integer part

**Frac** Input a value to extract the fraction part

**Intg** Input a value to obtain the largest integer that is not greater than the value

**Abs** Input a value to obtain the absolute value

**nPr** Calculate the number of possible permutations of n items taken r at a time.

**nCr** Calculate the number of possible combinations of n items taken r at a time

**Rand** Generate a random number between 0 and 1.

**RandI** Generate a random integer value between two specified integers, A and B, where  $A \leq \text{random value} \leq B$ .

**Rnd** Round off the result

- $\text{Int} ( 10 \div 8 ) = \text{Int} ( 1.25 ) = 1$

[MATH][MATH][MATH]0 (Int) 10 [ $\div$ ] 8 [ENTER]	DEG I n t ( 1 0 / 8 ) 1 .
--	---------------------------------

- $\text{Frac} ( 10 \div 8 ) = \text{Frac} ( 1.25 ) = 0.25$

[MATH][MATH][MATH]1 (Frac) 10 [ $\div$ ] 8 [ENTER]	DEG F r a c ( 1 0 / 8 ) 0 . 2 5
---	---------------------------------------

- $\text{Intg} ( 25 \div 4 ) = \text{Intg} ( 6.25 ) = 6$

[MATH][MATH][MATH]2 (Intg) 25 [ $\div$ ] 4 [ENTER]	DEG I n t g ( 2 5 / 4 ) 6 .
---	-----------------------------------

- $\text{Abs} ( \log 0.01 ) = \text{Abs} ( - 2 ) = 2$

[MATH][MATH][MATH]3 (Abs) [LOG] 0.01 [ENTER]	DEG A b s ( l o g ( 0 . 0 1 ) 2 .
---	---

- $\frac{7!}{[(7-4)!]} = 840$

7 [ MATH ] [ MATH ] [ MATH ] [ MATH ] 0 ( nPr ) 4 [ <u>ENTER</u> ]	DEG 7 nPr 4 840.
---	------------------------

➤  $\frac{7!}{4![(7-4)!]} = 35$

7 [ MATH ] [ MATH ] [ MATH ] [ MATH ] 1 ( nCr ) 4 [ <u>ENTER</u> ]	DEG 7 nCr 4 35.
---	-----------------------

➤ Generates a random number between 0 and 1

[ MATH ] [ MATH ] [ MATH ] [ MATH ] 2 ( Rand ) [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG Rand 0.743865967
--	----------------------------

➤ Generates a random integer between 7 and 9

[ MATH ] [ MATH ] [ MATH ] [ MATH ] 3 ( Randl ) 7 [ ALPHA ] [ <u>→</u> ] 9 [ <u>ENTER</u> ]	DEG Randl ( 7 , 9 ) 7.
---	------------------------------

➤  $\text{Rnd} ( 82.3 \div 5 ) = \text{Rnd} ( 16.46 ) = 16.5 ( \text{FIX} : 1 )$

[ MATH ] [ MATH ] [ MATH ] [ MATH ] [ MATH ] 0 ( Rnd ) 82.5 [ <u>÷</u> ] 5 [ <u>ENTER</u> ]	DEG FIX Rnd ( 82.5 ÷ 5 ) 16.5
---	--

## • Fraction Simplification

### (A) To simplify using the calculator's divisor

According to the below syntax to use the calculator's factor for simplification:

Simp ( <fraction > )

The calculator automatically uses the maximum possible prime divisor ( MF = ) for simplification.

➤ To simplify the fraction  $\frac{42}{24}$  using the calculator's factor

[ MATH ] [ MATH ] [ MATH ] [ MATH ] [ MATH ] 1 ( Simp ) 42 [ A b/c ] 24	DEG Simp ( 42 <u> </u> 24 ◀
[ <u>ENTER</u> ]	DEG MF = 6 42 / 24
[ <u>ENTER</u> ]	DEG F = 2 21 / 12

[ <u>ENTER</u> ]	DEG F = 3 ↑ 7 / 4
------------------	-------------------------

### (B) To simplify using your factor

According to the below syntax to specify your factor for simplification :

Simp ( <fraction > , < factor > )

You can specify only a positive integer as the factor.

➤ To simplify the fraction  $\frac{42}{24}$  using your factor 6

[ MATH ] [ MATH ] [ MATH ] [ MATH ] [ MATH ] 1 ( Simp ) 42 [ A <sup>b/c</sup> ] 24 [ ALPHA ] [ ➤ ] 6 [ <u>ENTER</u> ]	DEG MF = 6 ↑ 4 2 / 2 4
[ <u>ENTER</u> ]	DEG F = 6 ↑ 7 / 4

(Note): If the value you specify is invalid as a factor for simplification, the calculator automatically uses the smallest possible prime divisor.

### Other Functions ( $X^{-1}$ , $\sqrt{\quad}$ , $\sqrt[3]{\quad}$ , $\sqrt[n]{\quad}$ , $X^2$ , $X^3$ , $\wedge$ , $X!$ )

The calculator also provides reciprocal ( [ 2nd ] [  $x^{-1}$  ] ), square root ( [  $\sqrt{\quad}$  ] ), cubic root ( [ 2nd ] [  $\sqrt[3]{\quad}$  ] ), universal root ( [ 2nd ] [  $\sqrt[n]{\quad}$  ] ), square ( [  $x^2$  ] ), cubic ( [  $x^3$  ] ), factorial ( [ 2nd ] [ x! ] ) and exponentiation ( [  $\wedge$  ] ) functions.

➤  $\frac{1}{1.25} = 0.8$

1.25 [ 2nd ] [ $x^{-1}$ ] [ <u>ENTER</u> ]	DEG 1 . 2 5 <sup>-1</sup> ↑ 0 . 8
--	---

➤  $2^2 + \sqrt{4+21} + \sqrt[3]{125} + 5^3 = 139$

2 [ $x^2$ ] [ + ] [ $\sqrt{\quad}$ ] 4 [ + ] 21 [ $\blacktriangleright$ ] [ + ] [ 2nd ] [ $\sqrt[3]{\quad}$ ] 125 [ $\blacktriangleright$ ] [ + ] 5 [ $x^3$ ] [ <u>ENTER</u> ]	DEG $2^2 + \sqrt{(4+21)} + \sqrt[3]{125}$ ➤ ↑ 1 3 9 .
--	---

➤  $7^5 + \sqrt[4]{625} = 16812$

7 [ $\wedge$ ] 5 [ + ] 4 [ 2nd ] [ $\sqrt[4]{\quad}$ ] 625 [ <u>ENTER</u> ]	DEG $7^5 + 4\sqrt[4]{(625)}$ ↑ 1 6 8 1 2 .
--	--

➤  $5! = 120$

5 [2nd] [X!] [ENTER]	DEG 5! 120.
----------------------	-------------------

## Unit Conversions

The calculator has a built-in unit conversion feature that enables you to convert numbers among different units.

1. Enter the number you want to convert.
2. Press [ CONV ] to display the menu. There are 7 menus, covering distance, area, temperature, capacity, weight, energy, and pressure.
3. Use the [ CONV ], or [ ▼ ] or [ ▲ ] to scroll through the list of units until a appropriate units menu is shown, then [ ENTER ].
4. Pressing [ ► ] or [ ◀ ] can convert the number to another unit.

➤  $1 \text{ yd}^2 = 9 \text{ ft}^2 = 0.83612736 \text{ m}^2$

1 [CONV] [CONV] [►] [ENTER]	DEG ft <sup>2</sup> <u>yd<sup>2</sup></u> km <sup>2</sup> → 1.
[◀]	DEG <u>ft<sup>2</sup></u> yd <sup>2</sup> km <sup>2</sup> → 9.
[►][►][►]	DEG ← <u>m<sup>2</sup></u> hectares → 0.83612736

## Physics Constants

You can use a number physics constants in your calculations. With the following constants:

Symbol	Meaning	Value
c	Speed of light in vacuum	299792458 m / s
g	Standard acceleration of gravity	9.80665 m.s <sup>-2</sup>
V <sub>m</sub>	Molar volume of ideal gas	0.022413996 m <sup>3</sup> mol <sup>-1</sup>
N <sub>A</sub>	Avogadro constant	6.02214199 x 10 <sup>23</sup> mol <sup>-1</sup>
m <sub>e</sub>	Electron mass	9.10938188 x 10 <sup>-31</sup> Kg
G	Newtonian constant of gravitation	6.673 x 10 <sup>-11</sup> Nm <sup>2</sup> kg <sup>-2</sup>
e	Elementary charge	1.602176462 x 10 <sup>-19</sup> c
m <sub>p</sub>	Planck mass	1.67262158 x 10 <sup>-27</sup> kg
m <sub>n</sub>	Neutron mass	1.67492716 x 10 <sup>-27</sup> kg
m <sub>μ</sub>	Muon mass	1.88353109 x 10 <sup>-28</sup>
h	Planck constant	6.62606876 x10 <sup>-34</sup> J.S.
k	Boltzmann constant	1.3806503 x 10 <sup>-23</sup> J.K <sup>-1</sup>

$\phi_0$	Magnetic flux quantum	$2.067833636 \times 10^{-15}$ Vs
$a_0$	Bohr radius	$5.291772083 \times 10^{-11}$ m
$\epsilon_0$	Electric constant	$8.854187817 \times 10^{-12}$ F/m
IR	Molar gas constant	8.314472 J/(mol · K)
IF	Faraday constant	96485.3415 C/mol <sup>-1</sup>
$R_\infty$	Rydberg constant	10973731.57
$\gamma_e$	Electron gyromagnetic ratio	$2.817940285 \times 10^{-15}$
$A_U$	Astronomical unit	$1.4959787 \times 10^{11}$
$\bar{h}$	Planck constant over 2 pi	$1.054571596 \times 10^{-34}$
$\mu$	Atomic mass constant	$1.66053873 \times 10^{-27}$ kg
$\mu_0$	Magnetic constant	$0.000001257 \times 10^{-7}$ H/m
$\mu_B$	Bohr magneton	$9.27400899 \times 10^{-24}$ J/T
$\mu_N$	Nuclear magneton	$5.05078317 \times 10^{-27}$ J/T
$\mu_p$	Proton magnetic moment	$1.410606633 \times 10^{-26}$
$\mu_e$	Electron magnetic moment	$-9.28476362 \times 10^{-24}$
$\mu_n$	Neutron magnetic moment	$-9.662364 \times 10^{-27}$
$\mu_\mu$	Muon magnetic moment	$-4.49044813 \times 10^{-26}$
$\alpha$	Fine structure constant	0.007297353
$\lambda_c$	Compton wavelength	$2.426310215 \times 10^{-12}$
$\lambda_{cn}$	Neutron Compton wavelength	$1.319590898 \times 10^{-15}$
$\lambda_{cp}$	Proton Compton wavelength	$1.321409847 \times 10^{-15}$
$\sigma$	Stefan–Boltzmann constant	0.000000057
t	Celsius temperature	273.15
atm	Standard atmosphere	1.01325
$\gamma_p$	Proton gyromagnetic ratio	267522212
$C_1$	First radiation constant	$3.74177107 \times 10^{-16}$
$C_2$	Second radiation constant	0.014387752
pc	Parsec	$3.0856776 \times 10^{16}$

Data is referred to Peter J.Mohr and Barry N.Taylor, CODATA Recommended Values of the Fundamental Physical Constants:1998, Journal of Physical and Chemical Reference Data,Vol.28, No.6,1999 and Reviews of Modern Physics,Vol.72, No.2, 2000.

To insert a constant at the cursor position, press [ 2nd ] [ CONST ] to display the physics constants menu. Scroll through the menu until the constant you want is underlined.

➤  $3 \times G = 1.806642597 \times 10^{24}$

3 [ x ] [ 2nd ] [ CONST ] [ ▶ ] [ ▶ ] [ ▶ ]	DEG c g Vm <u>N<sub>A</sub></u> m e → 6 . 0 2 2 1 4 1 9 9 <sup>x10<sup>23</sup></sup>
--	---

[ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG 3 x 6 . 0 2 2 1 4 1 9 9 E $\rightarrow \uparrow$ 1 . 8 0 6 6 4 2 5 9 7 $\times 10^{24}$
-----------------------------------	---

## Multistatement Function

Multistatements are formed by connecting a number of individual statements for sequential execution. You can use multistatement in manual For statements that are connected with a display result command (  $\blacktriangle$  ), when execution reaches the end of a statement followed by  $\blacktriangle$ , execution stops and the result up to that point appears on the display. You can resume execution by pressing [ ENTER ].

➤ Use Multistatement function to the two statements : ( E = 15 )

$$\begin{cases} E \times 13 = 195 \\ 180 \div E = 12 \end{cases}$$

15 [ SAVE ] [ $\blacktriangleright$ ] [ $\blacktriangleright$ ] [ $\blacktriangleright$ ] [ $\blacktriangleright$ ] [ $\blacktriangleright$ ] ( E ) [ <u>ENTER</u> ]	DEG 1 5 $\rightarrow$ E $\uparrow$ 1 5 .
[ ALPHA ] [ E ] [ x ] 13 [ ALPHA ] [ $\blacktriangle$ ] 180 [ $\div$ ] [ ALPHA ] [ E ] [ <u>ENTER</u> ]	DEG E * 1 3 $\blacktriangle$ 1 8 0 / E $\blacktriangle \uparrow$ 1 9 5 .
[ <u>ENTER</u> ]	DEG E * 1 3 $\blacktriangle$ 1 8 0 / E $\uparrow$ 1 2 .
[ <u>ENTER</u> ]	DEG E * 1 3 $\blacktriangle$ 1 8 0 / E $\blacktriangle \uparrow$ 1 9 5 .

## Integration And Differentiation

This calculator can perform numerical integration and differentiation by [ 2nd ] [  $\int dx$  ] and [ 2nd ] [ d/dx ].

### • Integration

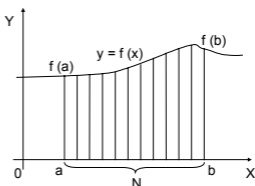
The calculator uses Simpson's rule to perform integration calculations as shown in the below :

$$\int_a^b f(x) dx, N = 2^N$$

## Simpson's Rule

$$\text{Area} = \frac{h}{3} \{ f(a) + 4 \{ f(a + h) + f(a + 3h) + \dots + f(a + (N-1)h) \} + 2 \{ f(a + 2h) + f(a + 4h) + \dots + f(a + (N-2)h) \} + f(b) \},$$

$$\text{Where } h = \frac{b-a}{N}$$



In general, the larger  $n$  is, the more calculation time is required and the higher precision for the result is. In some case, the results of your integration may be erroneous even if the larger  $n$  is used. In particular, when significant digits are less than 1, an error message sometimes will be shown.

where  $[a, b]$  is integration interval and  $N$  is the number of division. ( $n$  is an integer from 1 to 9)

(Note) : The calculator always perform trigonometric integration using radians as the unit of angular measurement.

(Note) : Integration involving certain types of functions or ranges can result in relatively large errors being generated in the values produced.

Enter the function  $f(x)$ . You can use  $[ALPHA][X]$  key to enter the variable  $x$  into the function.

Enter the lower and upper limits of integration ( $a$  and  $b$ ). Give the number of division to specify  $2^n = N$ , where the value of  $n$  is an integer from 1 to 9 and the default value is 5.

$$\triangleright \int_1^5 (x+1)^3 dx = 320$$

[2nd][∫ dx][()][ALPHA][X] [+]1[▶][^]3	DEG ∫ ((X+1)^3)dx      ↑
[ENTER]1	DEG a <sub>1</sub> = 1      ↑ ↓
[ENTER]5	DEG b <sub>1</sub> = 5      ↑ ↓
[ENTER]	DEG 2n   n = 5 (1 ~ 9)      ↑ ↓

[ <u>ENTER</u> ]	DEG ∫ ( ( X + 1 ) ^ 3 ) dx    ↑ 3 2 0 .
------------------	---

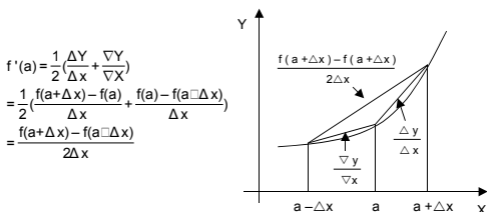
### • Differentiation

The calculator uses Central difference to perform differential calculations as shown in the below :

$$f'(a) = \lim_{\Delta x \rightarrow 0} \frac{f(a + \Delta x) - f(a)}{\Delta x}$$

Where a is the point you want to determine the derivative and  $\Delta x$  is increase / decrease of x.

Central difference



$$\begin{aligned} f'(a) &= \frac{1}{2} \left( \frac{\Delta Y}{\Delta x} + \frac{\nabla Y}{\nabla X} \right) \\ &= \frac{1}{2} \left( \frac{f(a + \Delta x) - f(a)}{\Delta x} + \frac{f(a) - f(a - \Delta x)}{\Delta x} \right) \\ &= \frac{f(a + \Delta x) - f(a - \Delta x)}{2\Delta x} \end{aligned}$$

The smaller  $\Delta x$  is, the more calculation time is required and the higher precision for the derivative is. In general, the precision is  $\pm 1$  at the least significant digit of the result.

However, you needn't input a value of and just press [ ENTER ] to skip it. The calculator automatically assigns the default value of  $10^{-8}$ .

Enter the function f(x). You can use [ ALPHA ] [ X ] key to enter the variable x into the function.

Enter point  $x_1 = a$  to determinate the derivative. Then enter the increase / decrease of x ( $\Delta x$ )

➤  $f(x) = x^3 + 4x^2 + x - 6 \Rightarrow f'(3) = (3x^2 + 8x + 1) \Big|_{x=3} = 52$

[ 2nd ] [ d/dx ] [ ( ) ] [ ALPHA ] [ X ] [ ^ ] 3 [ + ] 4 [ ALPHA ] [ X ] [ ^ ] 2 [ + ] [ ALPHA ] [ X ] [ - ] 6	DEG ← X ^ 3 + 4 X ^ 2 + X - 6 ) → ↑
[ <u>ENTER</u> ] 3	DEG x <sub>1</sub> = 3    ↑ ↓

[ <u>ENTER</u> ]	DEG $\Delta x 1 = 1 E - 0 8$ ↑ ↓
[ <u>ENTER</u> ]	DEG $\frac{d}{dx} ( ( X ^ 3 + 4 X ^ 2 + X ) )$ → ↑ 5 2 .

(Note): If the result for integration or differentiation takes a long time to calculate and you want to interrupt, please press [ CL/ESC ]. A message appears on the display to confirm whether you want to interrupt.

STOP : N Y

Move the cursor to "Y" to interrupt or "N" to return.

### • Application of integration and differentiation

Integrals and differentials can be added, subtracted, multiplied and divided with each other. For example,  $\int_a^b f(x)dx + \int_c^d g(x)dx$

$$\int_a^b f(x)dx \times \int_c^d g(x)dx, f'(a) + \int_a^b g(x)dx, N = 2^N.$$

$$\begin{cases} f_1(x) = \sin(3x + 30) \\ f_2(x) = \cos^3(x) \end{cases}$$

$$\Rightarrow f_1'(10) - f_2'(30)$$

$$= [3\cos(3x + 30)]|_{x=10} - \{-[3\cos(x)^2 x \sin(x)]\}|_{x=30}$$

$$= 0.045814893(\text{rad.}) = 2.625(\text{deg.})$$

[ 2nd ][ d/dx ][ SIN ] 3 [ ALPHA ][ X ] [ + ] 30 [ ► ] [ ► ] [ - ] [ 2nd ][ d/dx ][ ( ) ] [ COS ][ ALPHA ][ X ] [ ► ] [ ^ ] 3	DEG $\leftarrow -\frac{d}{dx} ( ( \cos(x) )^3 )$ → ↑
[ <u>ENTER</u> ] 10 [ <u>ENTER</u> ] [ <u>ENTER</u> ] 30 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG $\frac{d}{dx} \sin(3x + 30)$ → ↑ 0 . 0 4 5 8 1 4 8 9 3
[ 2nd ][ ANS ][ x ] 180 [ ÷ ] [ 2nd ] [ π ] [ <u>ENTER</u> ]	DEG Ans * 180 / π      ↑ 2 . 6 2 5

Integrated or differential results can be used in addition, multiplication, and division, and in function. For example,  $5 \times \int_a^b f(x)dx$ ,  $\cos(5 \times \int_a^b f(x)dx)$ .

$$\Rightarrow \cos \left[ \int_1^5 (x+1)^3 dx \right] = \cos(320) = 0.766044443$$

[ COS ][ 2nd ][ ∫ dx ][ ( ) ] [ ALPHA ][ X ] [ + ] 1 [ ► ] [ ^ ] 3	DEG $\leftarrow \cos \left( \int ( ( X + 1 ) ^ 3 ) dx \right)$ → ↑
---	---

[ <u>ENTER</u> ] 1 [ <u>ENTER</u> ] 5 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG cos ( ∫ ( ( X + 1 ) ^ 3 →↑ 0 . 7 6 6 0 4 4 4 4 3
--	--

After you perform an integration, you can integrate the same  $f(x)$  again, with different limits of integration,  $a$  and  $b$ , or a different number of divisions,  $n$ . Differentiation also provides the feature.

$$\begin{aligned} \int_1^5 (x+1)^3 dx &= 320 \\ \int_3^8 (x+1)^3 dx &= 1576.25 \end{aligned}$$

[ 2nd ] [ ∫ dx ] [ ( ) ] [ ALPHA ] [ X ] [ + ] 1 [ ► ] [ ^ ] 3 [ <u>ENTER</u> ] 1 [ <u>ENTER</u> ] 5 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG ∫ ( ( X + 1 ) ^ 3 ) dx ↑ 3 2 0 .
[ <u>ENTER</u> ] 3 [ <u>ENTER</u> ] 8 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG ∫ ( ( X + 1 ) ^ 3 ) dx ↑ 1 5 7 6 . 2 5

When integration interval  $[a, b]$  is unavailable or interrupted for the integrated function, an error message will appear on the display. It means you need to change the lower and upper limits of integration ( $a, b$ ) for the integrated function.

$$\int_{-0.5}^{0.5} \frac{1}{(x^2 - 3x + 2)} dx = 0.58789835$$

[ 2nd ] [ ∫ dx ] 1 [ ÷ ] [ ( ) ] [ ALPHA ] [ X ] [ x <sup>2</sup> ] [ - ] 3 [ ALPHA ] [ X ] [ + ] 2	DEG ∫ ( 1 / ( X <sup>2</sup> - 3 X + 2 ) ) →↑
[ <u>ENTER</u> ] [ (-) ] 0.5 [ <u>ENTER</u> ] 1.5 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG DIVIDE BY 0
After 5 Seconds	DEG ← 1 / ( X <sup>2</sup> - 3 X + 2 ) ←x →↑
[ <u>ENTER</u> ] [ (-) ] 0.5 [ <u>ENTER</u> ] 0.5 [ <u>ENTER</u> ] [ <u>ENTER</u> ]	DEG ∫ ( 1 / ( X <sup>2</sup> - 3 X + 2 ) ) →↑ 0 . 5 8 7 8 9 8 3 5

## Base-N Calculations

Use Base-n ( [ MODE ] 2 ( Base-n ) ) mode for Base-n calculations.

The unit enables you to calculate in number base other than decimal. The calculator can add, subtract, multiply, and divide binary, octal, and hexadecimal numbers.

The following shows the numerals that can be used in each number base.

Binary base ( b ) : 0, 1

Octal base ( o ) : 0, 1, 2, 3, 4, 5, 6, 7

Decimal base ( d ) : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Hexadecimal base ( h ) : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

To distinguish the A, B, C, D, E and F used in the hexadecimal base from standard letters, they appear as shown in the below.

Key	Entry line	Result line	Key	Entry line	Result line
/A	/A	A	ID	ID	D
IB	IB	B	IE	IE	E
IC	IC	C	IF	IF	F

Press [ dhbo ] to display the menu, and make one of the items underlined followed [ ENTER ].

Base-n					
<u>DEC</u>	HEX	BIN			d
OCT	d	h	b	o	

DEC Specify decimal as default

HEX Specify hexadecimal as default

BIN Specify binary as default

OCT Specify octal as default

d Specify decimal base for input value

h Specify hexadecimal base for input value

b Specify binary base for input value

o Specify octal base for input value

A corresponding symbol – " d ", " h ", " b ", " o " appears on the display. (The default setting is d : decimal base).

### Converting A Displayed Value From One Number System To Another

➤  $37_8 = 31_{10} = 1F_{16}$

[ dhbo ] [ ▼ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] ( o ) [ <u>ENTER</u> ] 37 [ <u>ENTER</u> ]	Base-n o 37 3 1 ↑ d
[ dhbo ] [ ▶ ]	Base-n D <u>H</u> B O 1 F ↑ h

Pressing [ ↻ ] can use block function to display a result in octal or binary base which exceeds 8 digits. The system is designed to display up to 4 blocks.

➤  $54757783_{10} = 11010000111000100110010111_2$

[ dhbo ] [ ▶ ] [ ▶ ] ( BIN ) [ <u>ENTER</u> ]	Base-n ← ↑ b
[ dhbo ] [ ▼ ] [ ▶ ] ( d ) [ <u>ENTER</u> ] 54757783 [ <u>ENTER</u> ]	Base-n d 5 4 7 5 7 7 8 3 1 0 0 1 0 1 1 1 ↑ 1b
[ ↻ ]	Base-n d 5 4 7 5 7 7 8 3 1 0 0 0 1 0 0 1 ↑ 2b
[ ↻ ]	Base-n d 5 4 7 5 7 7 8 3 0 1 0 0 0 0 1 1 ↑ 3b
[ ↻ ]	Base-n d 5 4 7 5 7 7 8 3 1 1 ↑ 4b

## Negative Expression

In binary, octal, and hexadecimal bases, the calculator represents negative numbers using complement notation. The complement is the result of subtracting that number from 10000000000 in that number's base by pressing [ NEG ] key in non-decimal bases.

➤  $3/A_{16} = \text{NEG FFFFFFFC6}_{16}$

[ dhbo ] [ ▶ ] ( HEX ) [ <u>ENTER</u> ]	Base-n ← ↑ h
[ NEG ] [ dhbo ] [ ▼ ] [ ▶ ] [ ▶ ] ( h ) [ <u>ENTER</u> ] 3 [ /A ] [ <u>ENTER</u> ]	Base-n NEG h 3/A F F F F F F C 6 ↑ h

## Basic Arithmetic Operations For Bases

➤  $11E1F_{16} + 1234_{10} \div 1001_2 = 1170_8$   
E - 37

<pre>[ dhbo ][ ▼ ] ( OCT ) [ ENTER ] [ dhbo ][ ▼ ][ ▶ ][ ▶ ] ( h ) [ ENTER ] 1 [ IE ] [ IF ] [ + ]</pre>	<pre>Base-n h 1 EIF + ◀ ↑ o</pre>
<pre>[ dhbo ][ ▼ ][ ▶ ] ( d ) [ ENTER ] 1234 [ ÷ ] [ dhbo ][ ▼ ][ ▶ ][ ▶ ] [ ▶ ] ( b ) [ ENTER ] 1001 [ ENTER ]</pre>	<pre>Base-n h 1 EIF + d 1 2 3 4 / b 1 →↑ 1 1 7 0 o</pre>

## Logical Operation

Logical operations are performed through logical products (AND), negative logical (NAND), logical sums (OR), exclusive logical sums (XOR), negation (NOT), and negation of exclusive logical sums (XNOR).

➤  $1010_2 \text{ AND } (1234_8 \div 1001_2) = 12_8$

<pre>[ dhbo ][ ▼ ] ( OCT ) [ ENTER ] [ dhbo ][ ▼ ][ ▶ ][ ▶ ][ ▶ ] ( b ) [ ENTER ] 1010 [ AND ] [ ( ) ]</pre>	<pre>Base-n b 1 0 1 0 AND ( ◀ ↑ o</pre>
<pre>1234 [ ÷ ] [ dhbo ][ ▼ ][ ▶ ][ ▶ ] [ ▶ ] ( b ) [ ENTER ] 1001 [ ENTER ]</pre>	<pre>Base-n b 1 0 1 0 AND ( o 1 →↑ 1 2 o</pre>

## Statistical Calculations

Use STAT ( [ MODE ] 1 ( STAT ) ) mode for statistical calculations.

There are four menu operations in statistics menu : **1-VAR** ( for analyzing data in a single dataset), **2-VAR** ( for analyzing paired data from two datasets ), **REG** ( for performing regression calculations ), and **D-CL** ( for clearing all datasets).

DEG	STAT
0 1-VAR	1 2-VAR
2 REG	3 D-CL

### Single-Variable / Two-Variable Statistics

- From the statistics menu, choose **1-VAR** or **2-VAR** and press [  $\underline{\text{ENTER}}$  ].
- Press [ DATA ] and there are three menu: **DATA-INPUT**, **LIMIT**, **DISTR**. Please select **DATA-INPUT** and press [  $\underline{\text{ENTER}}$  ].
- Enter an x - value and press [ ▼ ].
- Enter the frequency ( **FREQ** ) of the x - value (in **1-VAR** mode) or the corresponding y - value ( in **2-VAR** mode ) and press [ ▼ ].
- To enter more data, repeat from step 3.
- Press [ 2nd ] [ STATVAR ] and scroll through the statistical result menus by [ ► ] or [ ◀ ] to find out statistical variables you want. ( See table below )

Variable	Meaning
<b>n</b>	Number of the x values or x-y pairs entered.
$\bar{x}$ or $\bar{y}$	Mean of the x values or y values
<b>Sx</b> or <b>Sy</b>	Sample standard deviation of x values or y values.
$\sigma x$ or $\sigma y$	Population standard deviation of x values or y values
$\Sigma x$ or $\Sigma y$	Sum of all x values or y values
$\Sigma x^2$ or $\Sigma y^2$	Sum of all $x^2$ values or $y^2$ values
$\Sigma xy$	Sum of (x x y) for all x-y pairs

### Probability Distribution

- Based on the datasets in 1-VAR mode, press [ DATA ] and there are three menu : **DATA-INPUT**, **LIMIT**, **DISTR**. Please choose **DISTR** and press [  $\underline{\text{ENTER}}$  ].
- Enter a **a<sub>x</sub>** value, then press [  $\underline{\text{ENTER}}$  ].

3. Press [ 2nd ] [ STATVAR ] and scroll through the statistical results menu by [ ► ] or [ ◀ ] to find out probability distribution variables you want. (See table below)

Variable	Meaning
t	Test value $t = \frac{a_x - \bar{x}}{\sigma}$
P ( t )	Represent the cumulative fraction of the standard normal distribution that is less than the value t
R ( t )	Represent the cumulative fraction of the standard normal distribution that lies between the value t and 0. $R ( t ) = 1 - ( t )$
Q ( t )	Represent the cumulative fraction of the standard normal distribution that is greater than the value t $Q ( t ) =   0.5 - ( t )  $

## Process Capability

- Press [ DATA ] and there are three menu : **DATA-INPUT**, **LIMIT**, **DISTR**. Please select **LIMIT** and press [ ENTER ].
- Enter a lower spec. limit value ( **X LSL** or **Y LSL** ), then press [ ▼ ].
- Enter a upper spec. limit value ( **X USL** or **Y USL** ), then press [ ENTER ].
- Enter the datasets you want under **DATA-INPUT** mode.
- Press [ 2nd ] [ STATVAR ] and scroll through the statistical results menu by [ ► ] or [ ◀ ] to find out process capability variables you want. ( See table below )

Variable	Meaning
<b>Cax</b> or <b>Cay</b>	Capability accuracy of the x values or y values $C_{ax} = \frac{\left  \left( \frac{X_{USL} + X_{LSL}}{2} - \bar{x} \right) \right }{\frac{X_{USL} - X_{LSL}}{2}}, C_{ay} = \frac{\left  \left( \frac{Y_{USL} + Y_{LSL}}{2} - \bar{y} \right) \right }{\frac{Y_{USL} - Y_{LSL}}{2}}$
<b>Cpx</b> or <b>Cpy</b>	Potential capability precision of the x values or y values, $C_{px} = \frac{X_{USL} - X_{LSL}}{6\sigma}, C_{py} = \frac{Y_{USL} - Y_{LSL}}{6\sigma}$
<b>Cpkx</b> or <b>Cpky</b>	Minimum (CPU, CPL) of the x values or y values, where CPU is upper spec. limit of capability precision and CPL is lower spec. limit of capability precision $C_{pkx} = \text{Min} ( C_{PUX}, C_{PLX} ) = C_{px} ( 1 - C_{ax} )$ $C_{pky} = \text{Min} ( C_{PUY}, C_{PLY} ) = C_{py} ( 1 - C_{ay} )$
<b>ppm</b>	Parts per million, Defection Per Million Opportunities

(Note) : When calculating process capability in **2-VAR** mode, the  $x_n$  and  $y_n$  are independent with each other.



[ <u>ENTER</u> ] 2 [ ▼ ] 6 [ ▼ ] 3 [ ▼ ] 9 [ <u>ENTER</u> ]	DEG STAT Y USL = 9 9 .
[ DATA ]	DEG STAT <u>0 DATA - INPUT</u> 1 LIMIT 2 DISTR
[ <u>ENTER</u> ] 3 [ ▼ ] 4 [ ▼ ] 5 [ ▼ ] 7	DEG STAT Y <sub>2</sub> = 7
[ 2nd ] [ SATVAR ] [ ▶ ] [ ▶ ]	DEG STAT n $\bar{x}$ $\bar{y}$ S <sub>x</sub> $\sigma_x$ → 5 . 5
[ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ]	DEG STAT ← C <sub>a</sub> x <u>C<sub>p</sub> x</u> C <sub>p</sub> k x → 0 . 6 6 6 6 6 6 6 6 7

## Correcting Data

1. Press [ DATA ].
2. To change dataset, please select **DATA-INPUT**. To change upper spec. limit value, or lower spec. limit value, please select **LIMIT**. To change  $a_x$ , please select **DISTR**.
3. Press [ ▼ ] to scroll through the data you have entered.
4. To change an entry, display it and enter the new data. The new data you enter overwrites the old entry. Press [ ▼ ] or [ ENTER ] to save the change.

(Note) : Even you exit STAT mode, all data in **1-VAR** and **2-VAR** mode are still retained unless you clear all data by selecting **D-CL** mode.

## Regression calculation

After entering the REG menu, there are six regression types as follow :

DEG	STAT	
<u>0 Lin</u>	1 Log	2 e ^
3 Pwr	4 Inv	5 x <sup>2</sup>

<b>Lin</b>	Linear regression	$y = a + b x$
<b>Log</b>	Logarithmic regression	$y = a + b \ln x$
<b>e ^</b>	Exponential regression	$y = a \cdot e^{bx}$
<b>Pwr</b>	Power regression	$y = a \cdot x^b$
<b>Inv</b>	Inverse regression	$y = a + \frac{b}{x}$
<b>x<sup>2</sup></b>	Quadratic regression	$y = a + b x + c x^2$

1. Select any of the six regression types and press [  $\text{ENTER}$  ].
2. Press [ DATA ] and there are three menu: **DATA-INPUT**, **LIMIT**, **DISTR**. Please select **DATA-INPUT** and press [  $\text{ENTER}$  ].
3. Enter an x-value and press [  $\blacktriangledown$  ] and the corresponding y - value and press [  $\blacktriangledown$  ].
4. To enter more data, repeat from step 3.
5. Press [ 2nd ] [ STATVAR ] and scroll through the statistical result menus by [  $\blacktriangleleft$  ] [  $\blacktriangleright$  ] to find out regression variables you want. ( See table below )

- **Linear regression**

- a ...Regression constant term
- b ...Regression coefficient
- r ...Correlation coefficient

	DEG	STAT		
<u>a</u>	b	r	x'	y'

- **Logarithmic regression**

- a ...Regression constant term
- b ...Regression coefficient
- r ...Correlation coefficient

	DEG	STAT		
<u>a</u>	b	r	x'	y'

- **Exponential regression**

- a ...Regression coefficient
- b ...Regression constant term
- r ...Correlation coefficient

	DEG	STAT		
<u>a</u>	b	r	x'	y'

- **Power regression**

- a ...Regression constant term
- b ...Regression coefficient
- r ...Correlation coefficient

	DEG	STAT		
<u>a</u>	b	r	x'	y'

- **Inverse regression**

- a ...Regression constant term
- b ...Regression coefficient
- r ...Correlation coefficient

	DEG	STAT		
<u>a</u>	b	r	x'	y'

- **Quadratic regression**

- a ...Regression constant term
- b ...Regression first coefficient
- c ...Regression second coefficient

	DEG	STAT		
<u>a</u>	b	c	x'	y'

6. To predict a value for x (or y) given a value for y (or x), select the x' (or y' variable, press [  $\text{ENTER}$  ], enter the given value, and press [  $\text{ENTER}$  ] again.



# Chapter 7

## Programming

### Before Programming

Use PROG ( [ MODE ] 3 ( PROG ) ) mode for programming functions.

The programming function helps to make complex, often-repeated calculations quick and easy. Commands and calculations are executed sequentially, just like the manual calculation multistatements. Multiple programs can be stored under file names for easy recall and editing.

– Program main menu –

DEG PROG	→
<u>0 NEW</u> 1 EDIT	1136
2 RUN        3 DEL	

DEG      PROG	←
<u>0 TRACE</u> 1 RENAM	1136

- NEW ... New program      EDIT ... Program edit  
 RUN ... Execute program    DEL ... Program delete  
 TRACE ... Trace program    RENAM ... Rename program

### Creating A New Program

- To store a program that calculates the surface area ( S ) and volume ( V ) of a regular tetrahedron shown in the table below, which the length of one side ( A ) is known. Store the calculation formula under the file name TETRA

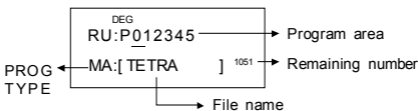


A	S	V
3.5	? cm <sup>2</sup>	? cm <sup>3</sup>
5	? cm <sup>2</sup>	? cm <sup>3</sup>
12	? cm <sup>2</sup>	? cm <sup>3</sup>

The following are the formulas used for calculating surface area ( S ) and volume ( V ) of a regular tetrahedron for which the length of one side ( A ) is known.

$$S = \sqrt{3} A^2 \quad V = \frac{\sqrt{2}}{12} A^3$$

#### (A) To specify a program type and register a file name



**Remaining numbers** : The number indicates the amount of storage space available for programs, and it will decrease as programs or statistical data are input.

**PROG TYPE** : Each program must be specified a working mode that the calculator should enter when executing the program you are inputting. Besides normal function calculations in the MAIN ( MA ) mode, to perform binary, decimal and hexadecimal calculations and conversions, please choose Base-n ( BA ) mode.

**Filename** : When inputting a new program, you first register the file name and then input the actual program. The file name can be up to eight characters long and the characters you can use are A through Z, or 0 through 9.

A file name can be one to eight characters long. If you try to use a file name which is the same as those existing ones, a message appears on the display to confirm whether you want to overwrite the program or not.

DEG	PROG	
O v e r w r i t e :		
<u>N</u>	Y	1136

Move the cursor to " Y " to overwrite the program or " N " to abort the procedure without overwriting anything.

**Program Area** : This unit contains a total of 36 program areas ( P0 ~P9, PA~PZ ) for storage of programs, and assigns programs automatically into a program area that nothing is stored, P0 though PZ.

➤ To register the file name TETRA, which the program type is MAIN.



1. While the program main menu is on the display, press 0 ( NEW ) and specify a program type.

[ MODE ] 3 ( PROG ) 0 ( NEW )	<table> <tr> <td style="text-align: center;">DEG</td> <td style="text-align: center;">PROG</td> </tr> <tr> <td colspan="2" style="text-align: center;">P R O G   T Y P E :</td> </tr> <tr> <td style="text-align: center;"><u>0 M A I N</u></td> <td style="text-align: right;">1 B a s e - n <sup>1103</sup></td> </tr> </table>	DEG	PROG	P R O G   T Y P E :		<u>0 M A I N</u>	1 B a s e - n <sup>1103</sup>
DEG	PROG						
P R O G   T Y P E :							
<u>0 M A I N</u>	1 B a s e - n <sup>1103</sup>						

2. Input the name of the file. The alpha-lock " ALPHA "is on. The cursor changes form to indicate alpha character input.

[ <u>ENTER</u> ] [ T ] [ E ] [ T ] [ R ] [ A ]	<table> <tr> <td style="text-align: center;">ALPHA DEG</td> <td style="text-align: center;">PROG</td> </tr> <tr> <td colspan="2" style="text-align: center;">F i l e n a m e :</td> </tr> <tr> <td style="text-align: center;">M A : [ T E T R A ◀ ]</td> <td style="text-align: right;"><sup>1103</sup></td> </tr> </table>	ALPHA DEG	PROG	F i l e n a m e :		M A : [ T E T R A ◀ ]	<sup>1103</sup>
ALPHA DEG	PROG						
F i l e n a m e :							
M A : [ T E T R A ◀ ]	<sup>1103</sup>						

3. Press [ ENTER ] to register the file name and change to the program input screen.

[ <u>ENTER</u> ]	DEG      PROG   E n d      1090
------------------	---

( Note ) : You can delete a character while inputting a file name by moving the cursor to the character you want to delete and pressing [ DEL ].

To exit the file name input screen and return to the program main menu without registering a file name, press [  $\overset{CL}{\text{ESC}}$  ].

### (B) To Input Program Contents

Program contents are input using the same basic procedures that you use for manual calculations. Each command line is ended with a semicolon ( ; ) while you press [ ENTER ]. To enter more than one instruction or expression on a single command line, please separate each with a semicolon ( ; ).

The following shows how you would input the required formulas as manual calculation and as a program.

#### • Manual Calculation

Surface Area ( S ) ... [  $\sqrt{\quad}$  ] 3 [  $\blacktriangleright$  ] [ x ] < value of A > [  $x^2$  ]

Volume ( V ) ... [  $\sqrt{\quad}$  ] 2 [  $\blacktriangleright$  ] [  $\div$  ] 12 [ x ] < value of A > [  $\wedge$  ] 3

You could also perform the above calculation by assigning the value for the length of the one side to variable A.

#### • Program

Surface Area ( S ) ... [  $\sqrt{\quad}$  ] 3 [  $\blacktriangleright$  ] [ x ] [ ALPHA ] [ A ] [  $x^2$  ]

Volume ( V ) ... [  $\sqrt{\quad}$  ] 2 [  $\blacktriangleright$  ] [  $\div$  ] 12 [ x ] [ ALPHA ] [ A ] [  $\wedge$  ] 3

➤ To input program contents for the file named TETRA

Follow the following steps to input the contents of the program.

Contents :    ① *Input A ;*

Steps :        ① [ INST ] 2 ( Input ) [ ALPHA ] [ A ] [ ENTER ]

Contents :    ②  $S = \sqrt{(3) * A^2}$  ;

Steps :        ② [ ALPHA ] [ S ] [ ALPHA ] [ = ] [  $\sqrt{\quad}$  ] 3 [  $\blacktriangleright$  ] [ x ]  
[ ALPHA ] [ A ] [  $x^2$  ] [ ENTER ]

Contents :    ③  $V = \sqrt{(2) / 12 * A^3}$  ;

Steps :        ③ [ ALPHA ] [ V ] [ ALPHA ] [ = ] [  $\sqrt{\quad}$  ] 2 [  $\blacktriangleright$  ] [  $\div$  ] 12  
[ x ] [ ALPHA ] [ A ] [  $\wedge$  ] 3 [ ENTER ]

Contents :    ④ *Print "S = ", S ;*

Steps :        ④ [ INST ] [ INST ] [ INST ] [ INST ] 2 ( Print )  
[ ALPHA ] [ " ] [ ALPHA ] [ S ] [ ALPHA ] [ = ]  
[ ALPHA ] [ " ] [ ALPHA ] [  $\blacktriangleright$  ] [ ALPHA ] [ S ]  
[ ENTER ]

Contents : ⑤ *Print " V = ", V ;*

Steps : ⑤ [ INST ] [ INST ] [ INST ] [ INST ] 2 ( Print )  
[ ALPHA ] [ " ] [ ALPHA ] [ V ] [ ALPHA ] [ = ]  
[ ALPHA ] [ " ] [ ALPHA ] [ ► ] [ ALPHA ] [ V ]  
[ ENTER ]

Contents : ⑥ *End*

For more program examples, please see 《Program Examples》 .

## Running A Program

- To run program contents for the file named TETRA  
Let's try running the above program we input.

A	S	V
3.5	21.2176223927 cm <sup>2</sup>	5.05286720723 cm <sup>3</sup>
5	43.3012701892 cm <sup>2</sup>	14.7313912747 cm <sup>3</sup>
12	249.41531629 cm <sup>2</sup>	203.646752982 cm <sup>3</sup>

1. While the program main menu is on the display, press 2 ( RUN ) and specify a file name. While the file name list is on the display, use [ ▲ ] or [ ▼ ] to move the cursor to the name of the program you want to run.

2 ( RUN ) [ ► ] [ ► ]	DEG    PROG RU : P 0 1 <u>2</u> MA : [ TETRA    ] 1051
-----------------------	--

2. Press [ ENTER ] to run the program and input a value for A.

[ <u>ENTER</u> ] 3.5	DEG    PROG A = 3 . 5 ◀
----------------------	----------------------------

3. Press [ ENTER ] to run the program. The final result is on the display. You can press [ ▲ ] to display previous results.

[ <u>ENTER</u> ]	DEG    PROG V = 5 . 0 5 2 8 6 7 2 0 7 →↑
[ ▲ ] [ ▲ ]	DEG    PROG S = 2 1 . 2 1 7 6 2 2 3 9 →↑ ↓

4. To rerun the program from the beginning, please press [ ENTER ] and input more the value A.

(Note) : You can also run a program while in the MAIN mode by inputting : [ PROG ] [ ALPHA ] [ " ] < file name > [ ALPHA ] [ " ] [ ENTER ] or [ PROG ] < item of program area >

## Useful Program Commands

In addition to calculation commands, this calculator also includes a variety of relational and jump commands that can be used to create programs that make repeat calculations quick and easy.

Press [ INST ] to display the program command menus.

DEG	PROG
0 If	1 Then →
2 Input	3 Else

DEG	PROG
← 0 Goto	1 For →
2 GoSub	3 Label

DEG	PROG
← 0 Data	1 Locte →
2 Read	3 Sleep

DEG	PROG
← 0 Rstore	1 Rem →
2 Print	3 Swap

DEG	PROG
← 0 Switch	1 Case →
2 Defatul	3 Clr-D

DEG	PROG
← 0 Clr-T	1 Do-W →
2 While	3 EXIT

DEG	PROG
← 0 End	

## Basic Program Command

Command : Input

Function : Prompts for input of values for assignment to variables during program execution.

Syntax : (1) *Input* < variable name >;  
(2) *Input* < variable name >, < variable name >, ..., < variable name >;

Example : (1) *Input A* ;  
(2) *Input A , B , S* ;

Description :

1. This command momentarily interrupts program execution and prompts for input of a value or expression for assignment to a variable. When the Input command is executed, " < variable name > = " to appears on the display and the calculator stands by for input.
2. To input more than one variable name, please separate them with a comma ( , ).

Command : If~Then~Else

Function : A conditional branch is performed only if certain relational expressions are met.

Syntax : (1) *If* ( < condition > ) *Then* { < statement > } ;  
(2) *If* ( < condition > ) *Then* { < statement > } ;  
*Else* { < statement > } ;

Example : (1) *If* (  $A == 0$  ) *Then* {  $B = 3C$  } ;  
(2) *If* (  $A == 0$  ) *Then* {  $B = 3C$  } ; *Else* {  $S = 5C$  } ;

Description :

1. For If-Then command, the Then-statement is executed only when the relational expressions are true. If not, the Then-statement is not executed.
2. For IF-Then-Else command, the Then-statement is executed only when the relational expressions are true. If not, the Else-statement is executed.

Command : Print

Function : Print the text listed in the double quotation marks and the value of the variable name during program execution.

Syntax : (1) *Print " < text > "* ;  
(2) *Print < variable name > ;*  
(3) *Print " < text > ", < variable name > ;*

Example : (1) *Print " POWER = " ;*  
(2) *Print A ;*  
(3) *Print " POWER = ", A ;*

Description :

1. Multiple items in a Print command are separated by commas ( , ).

Command : For

Function : Often, programs need loops that process each data item from some known fixed size collection. This can be handled quite adequately using a standard For loop.

Syntax : *For ( start condition ; continue condition ; re-evaluation )*  
*{ statements } ;*

Example : *For ( A = 1 ; A ≤ 4 ; A ++ )*  
*{ C = 3 \* A ; Print " ANS = ", C } ;*

Description :

The order of processing each part of a For loop :

1. The first part of the For loop, For ( A = 1 ;, initializes the value of A to 1. A = 1 on the iteration. A ≤ 4 is true, so the statement block is executed, At the end of the iteration, A is incremented by 1.
2. Next, A = 2 on the iteration. A ≤ 4 is still true, so the statement block is executed. At the end of the iteration, A is increased by 1. And so on.
3. A is incremented again, the condition re-evaluated etc., until A reaches a value of 5. When this occurs, A ≤ 4 is false, so the statement block isn't executed and terminates this program.

Command : Goto~Label

Function : The Goto command performs an jump to a specified Label location.

Syntax : *Goto < value > ;*  
*Label < value > ;*

Example : *Goto 1 ;*  
*Label 1 ;*

Description :

1. When program execution reaches the statement " Goto n " execution then jump to " Label n " ( n is the same value as Goto n and is a value from 0 to 9 ). It is useful to return execution to the beginning for repetitive calculations, or to repeat calculations from a point within a program area.
2. If there is no Label–statement whose value matches that specified by the Goto-statement, an error ( GOTO Er ) occurs.

Command : Gosub

Function : This command specifies execution of another program as a subroutine.

Syntax : *Gosub PROG <file name > ;*

Example : *Gosub PROG "ABC " ;*

Description :

1. Some programming problems require that you write a program that references the same series of operations several times. References can be made to a group of operations if you write them as a subroutine.
2. You write the Gosub command as part of the main program ( calling program ). The main program ( calling program ) transfers control to the subprogram, the subprogram completes its operation and control is shifted back to the main program.
3. If a subroutine with the file name specified by the PROG command does not exist, an error ( GOSUB Er ) occurs.

Command : Data ~ Read

Function : The Read command reads the contents in the Data command.

Syntax : *Data ( <data > , <data > , .... <data > ) ;*

*Read ( <variable name > , ..... , <variable name > )*

Example : *Data ( 52 , 31 , 23 ) ;*

*Read ( I , A , Q ) ;*

Description :

1. When a large amount of data is to be processed, the use of Input command could be used, but it causes unnecessary typing for a user to have to enter values that are already known. In this time, you can use the Data / Read commands operate within the program to assign values to variables.
2. The Read command causes the reading of data provided by one or more Data commands.
3. When a Read command is executed the entire program is scanned, starting at the first line, for a Data command. When one is located as many data items as are needed are taken from data and stored in the variable names specified by the Read command. If there are not enough data items in the current Data command, another is sought.

4. If another Read statement is encountered, it continues to look for data items where the last Read left off. Data items are not reused. If the Read command cannot find enough data items to satisfy all its variables, it produces an error message and the program stops execution.

**Command : Restore**

Function : The command resets data items.

Syntax : *Restore ;*

Description :

1. Once a data item is READ it cannot be READ again, unless you use a Restore command. The Restore command resets data items, so that the next item that is READ is the first item of the first Data command in the program, regardless of how many items have been previously READ.

**Command : Rem**

Function : You may include comments in your program with the Rem statement. The program completely ignores Rem lines, but they are intended to assist a person trying to understand how your program works.

Syntax : *Rem < statement > ;*

Example : *Rem PRESSURE CONVERSION ;*

**Command : Locate**

Function : This command displays the contents in the Input or Print command at a specific location on the text screen.

Syntax : (1) *Locate ( < column number > , < row number > ) ;*

*Input < variable name > ;*

(2) *Locate ( < column number > , < row number > ) ;*

*Print "< text > " ;*

Example : (1) *Locate ( 2 , 2 ) ;*

*Input A ;*

(2) *Locate ( 1 , 2 ) ;*

*Print " ANSWER " ;*

Description :

1. This command displays values ( including variable contents ) or text at a specific location on the text screen.
2. The row number is designated by an integer from 1 to 2, which the column number is designed by a integer from 1 to 13.



3. In some cases, the ClrText command should be executed before running the above program.

**Command : Swap**

Function : This command can swap the contents in two variables.

Syntax : *Swap ( < variable name > , < variable name > ) ;*

Example : *Swap ( A , B ) ;*

Command : Sleep

Function : This command can suspend execution of the program for a specified time. The maximum number of seconds is about 104 seconds. It is useful for displaying intermediate results and other information.

Syntax : *Sleep ( < time > ) ;*

Example : *Sleep ( 5 ) ;*

Command : Switch~Case~Default

Function : Select one processing option from among n Case commands, or Default command.

Syntax : (1) *Switch ( < condition > )*      (2) *Switch ( < condition > )*  
*{ Case 1 : < statement > ;*      *{ Case 1 : < statement > ;*  
*Case 2 : < statement > ;*      *Case 2 : < statement > ;*  
.....      .....  
*Case n : < statement > ;}*      *Case n : < statement > ;*  
*Default : < statement > ; }*

Description :

1. Sometimes you want the program to branch off depending on what the user inputs. The If command could be used, but this can get complex at times, so you could use the Switch-Case statement instead.
2. You can have as many cases as you want, including a default case which is evaluated if all the cases fail. When a Switch command is executed, the program will branch off depending on what is returned by the statement in the Case command. The Default command is executed when else other than the case command(s) is returned.

Command : ClrDisplay

Function : This command clears screen.

Syntax : *ClrDisplay ;*

Description :

This command clears the screen during program execution.

Command : ClrText

Function : This command clears the text contents and screen.

Syntax : *ClrText ;*

Description:

This command clears text from the screen during program execution.

Command : While

Function : This command repeats specific commands as long as its condition is true.

Syntax : *While ( < condition > ) Then { < statement > } ;*

Example : *While ( < condition > ) Then { < statement > } ;*

Description :

1. The condition comes after the While-statement, the condition is tested before the commands inside the loop are executed.
2. This command repeats the commands contained in the loop as long as its condition is true. When the condition is false, execution proceeds from the statement following the While-statement.

Command : Do~While

Function: This command repeats specific commands as long as its condition is true.

Syntax : Do { < *statement* > } While ( < *condition* > );

Description:

1. The condition comes after the While-statement, the condition is tested after all of the commands inside the loop are executed.
2. This command repeats in the loop as the condition is true. When the condition is false, execution proceeds from the statement following the Do~While statement.

Command : Exit

Function : This command terminates execution of a program.

Syntax : *Exit* ;

Description:

1. This command terminates program execution.
2. Execution of this command inside of a loop terminates program execution without an error being generated.

Command : End

Function : The End statement signifies the end of the program and should be the last statement executed when a program is RUN.

Syntax : *End* ;

Example : *End* ;

1. End command must be the last statement in every program.
2. Normally, while creating a new program, the End command will be added and displayed automatically on the beginning of the program.

## Increment And Decrement

Post-fixed : < *variable name* > ++ ; or < *variable name* > -- ;

Pre-fixed : ++ < *variable name* > ; or -- < *variable name* > ;

A memory variable is decreased or increased by one. With pre-fixed the memory variable is computed before the expression is evaluated whereas with post-fixed the memory variable is computed after the expression is evaluated.

## Relational Operators

The relational operators can be used for **For** loop and conditional branching in your program. The six operators are :

== ( Equal to ), < ( Less than ), > ( Greater than ), ≠ ( Not equal to ), ≤ ( Less than or equal to ), ≥ ( Greater than or equal to )

## Debugging A Program

A problem in a program that keeps the program from running correctly is called a " bug " and the process of eliminating such problems is called "Debugging " Either of the following symptoms indicates that your program contains bugs and that debugging is required.

### (A) To eliminate bugs that cause error messages

An error message, like the one shown below, appears about 5 seconds whenever something illegal occurs during program execution.

SYNTAX Er
-----------

After an error message, the blinking cursor points out where the error was generated. Check the 《Error Conditions》 and correct it.

You also can select " TRACE " in the program main menu to enter the TRACE mode for debugging. The system will check the program step by step and tell you where an error is, if it has.

### (B) To eliminate bugs those cause bad results

If your program produces results that are not what you normally expect, check the contents of the program and make necessary changes. See 《Editing Program Contents》 for details on how to change program contents.

## Renaming A Program

➤ To rename a TETRA file name.

1. While the program main menu is on the display, press 1 ( RENAM ). Find the file name of the program you want in the file name list.

[▼][▼]1 (RENAM)[▶][▶] [ENTER]	ALPHA DEG      PROG RE : P 0 1 <u>2</u> 3 4 5 MA : [ ◀ ETRA ] 759
----------------------------------	---

2. Make correction for the file name to rename it .

[▶][▶][▶][▶][▶][H]	ALPHA DEG      PROG RE : P 0 1 <u>2</u> 3 4 5 MA : [ TETRAH◀ ] 759
--------------------	--

3. Press [ ENTER ] to store it.

## Editing Program Contents

➤ To edit program contents named TETRA

1. While the program main menu is on the display, press 1 ( EDIT ). Find the file name of the program you want in the file name list.



1. After pressing 1 ( ALL ), a message appears on the display to confirm whether you want to delete all program or not.
2. Move the cursor to " Y " to delete all programs or " N " to abort the procedure without deleting anything.

## Program Examples

- Create a program for common difference sequence and numbers,  
 where A : First item, D : Common difference, N : number,  
 Sum :  $S(N) = A + (A + D) + (A + 2D) + (A + 3D) + \dots =$   
 Nth item :  $A(N) = A + (N - 1)D$

PROG TYPE : MAIN		Filename : DIFFER	
Content			
1	P r i n t	" 1 : A ( N )	2 : S ( N ) " ; ▲ ;
2	L o c a t e	( 6 , 1 ) ;	
3	I n p u t	P , A , D , N ;	
4	I f	( P = 1 ) T h e n { G o t o	1 } ;
5	S =	N ( 2 A + ( N - 1 ) D ) / 2 ;	R e m S U M ;
6	P r i n t	" S ( " , N , " ) = " , S ;	
7	G o t o	2 ;	
8	L a b e l	1 : T = A + ( N - 1 ) D ;	R e m N I
		T E M ;	
9	P r i n t	" A ( " , N , " ) = " , T ;	
1	L a b e l	2 : E n d	

RUN

- When the message " 1 : A(N), 2 : S(N) " appears on the display, you can input a " P " value to any of the following values for specifying the type of operation to be performed.
- 1.... A(N)                      2.... S(N)

(1) A = 3 , D = 2, N = 4  $\Rightarrow$  A ( N ) = A ( 4 ) = 9

[ <u>ENTER</u> ]	DEG    PROG 1 : A ( N )    2 : S ( N ) → ▲
[ <u>ENTER</u> ] 1	DEG    PROG P = 1 ◀
[ <u>ENTER</u> ] 3 [ <u>ENTER</u> ] 2 [ <u>ENTER</u> ] 4 [ <u>ENTER</u> ]	DEG    PROG A ( 4 ) = 9                      ↑

(2) A = 3 , D = 11, N = 15  $\Rightarrow$  S ( N ) = S ( 15 ) = 1230

[ <u>ENTER</u> ]	DEG    PROG 1 : A ( N )    2 : S ( N ) →
[ <u>ENTER</u> ] 2	DEG    PROG P = 2 ◀
[ <u>ENTER</u> ] 5 [ <u>ENTER</u> ] 11 [ <u>ENTER</u> ] 15 [ <u>ENTER</u> ]	DEG    PROG S ( 1 5 ) = 1 2 3 0    ↑

➤ Create a program to determine solutions for quadratic equation  $AX^2 + BX + C = 0$ ,  $D = B^2 - 4AC$

$$F.1) D > 0 \Rightarrow X_1 = \frac{-B + \sqrt{D}}{2A}, X_2 = \frac{-B - \sqrt{D}}{2A}$$

$$F.2) D = 0 \Rightarrow X = \frac{-B}{2A}$$

$$F.3) D < 0 \Rightarrow X_1 = \frac{-B}{2A} + \left(\frac{\sqrt{-D}}{2A}\right)i, X_2 = \frac{-B}{2A} - \left(\frac{\sqrt{-D}}{2A}\right)i$$

PROG TYPE : MAIN		Filename : QUAD																							
Content																									
1	I	n	p	u	t	A	,	B	,	C	;														
2	D	=	B	<sup>2</sup>	-	4	A	C	;																
3	E	=	-	B	/	2	A	;	F	=	√	(	A	b	s	(	D	)	/	2	A	;			
4	G	=	E	+	F	;	H	=	E	-	F	;													
5	I	f	(	D	>	0	)	T	h	e	n	{	P	r	i	n	t	"	X	1	=	"	,	G	,
	"		X	2	=	"	,	H	;	}															
6	I	f	(	D	=	0	)	T	h	e	n	{	P	r	i	n	t	"	X	=	"	,	E	;	}
7	I	f	(	D	<	0	)	T	h	e	n	{	P	r	i	n	t	"	X	1	=	"	,	E	,
	"	+	"	,	F	,	"	i	"	,	"	X	2	=	"	,	E	,	"	-	"	,	F	,	
	"	i	"	;	}																				
8	E	n	d																						

RUN

$$(1) 2X^2 - 7X + 5 = 0 \Rightarrow X_1 = 2.5, X_2 = 1$$

[ <u>ENTER</u> ] 2	DEG    PROG A = 2 ◀
[ <u>ENTER</u> ] [ (- ) ] 7 [ <u>ENTER</u> ] 5	DEG    PROG C = 5 ◀
[ <u>ENTER</u> ]	DEG    PROG X 1 = 2 . 5    X 2 = 1    ↑

$$(2) 25X^2 - 70X + 49 = 0 \Rightarrow X = 1.4$$

[ <u>ENTER</u> ] 25 [ <u>ENTER</u> ] [ ( - ) ] 70 [ <u>ENTER</u> ] 49	DEG    PROG C = 4 9 ◀
[ <u>ENTER</u> ]	DEG    PROG X = 1 . 4                    ↑

$$(3) X^2 + 2X + 5 = 0 \Rightarrow X_1 = -1 + 2i, X_2 = -1 - 2i$$

[ <u>ENTER</u> ] 1 [ <u>ENTER</u> ] 2 [ <u>ENTER</u> ] 5	DEG    PROG C = 5 ◀
[ <u>ENTER</u> ]	DEG    PROG X 1 = - 1 + 2 i    X 2 = - → ↑

- Create three subroutines to store the below formulas and use GoSub-PROG commands to write a main program ( calling program ) for executing  
 Subroutine 1 : CHARGE = N x 3  
 Subroutine 2 : POWER = I ÷ A  
 Subroutine 3 : VOLTAGE = I ÷ ( B x Q x A )

PROG TYPE : MAIN    Filename : CHARGE    Note : Subroutine	
Content	
1	Q = N * 3 ;
2	P r i n t " C H A R G E = " , Q ; ◀ ;
3	E n d

PROG TYPE : MAIN    Filename : POWER    Note : Subroutine	
Content	
1	J = I / A ;
2	P r i n t " P O W E R = " , J ; ◀ ;
3	E n d

PROG TYPE : MAIN    Filename : VOLTAGE    Note : Subroutine	
Content	
1	V = I / ( B * Q * A ) ;
2	P r i n t " V O L T A G E = " , V ;
3	E n d

PROG TYPE : MAIN    Filename : CALL    Note : Calling program																										
Content																										
1	I	n	p	u	t	N	;																			
2	G	o	s	u	b	P	R	O	G	"	C	H	A	R	G	E	"	;								
3	I	n	p	u	t	I	,	A	;																	
4	G	o	s	u	b	P	R	O	G	"	P	O	W	E	R	"	;									
5	B	=	2	7	;																					
6	G	o	s	u	b	P	R	O	G	"	V	O	L	T	A	G	E	"	;							
7	E	n	d																							

RUN

N = 1.5, I = 486, A = 2 ⇒ CHARGE = 4.5, POWER = 243, VOLTAGE = 2

[ <u>ENTER</u> ] 1.5	DEG    PROG N = 1 . 5 ◀
[ <u>ENTER</u> ]	DEG    PROG CHARGE = 4 . 5    ▲ ↑
[ <u>ENTER</u> ] 486 [ <u>ENTER</u> ] 2	DEG    PROG A = 2 ◀
[ <u>ENTER</u> ]	DEG    PROG POWER = 2 4 3    ▲
[ <u>ENTER</u> ]	DEG    PROG VOLTAGE = 2    ▲ ↑

➤ Use For command to create a program that calculate  $1 + 6 = ?$ ,  $1 + 5 = ?$ ,  $1 + 4 = ?$ ,  $2 + 6 = ?$ ,  $2 + 5 = ?$   $2 + 4 = ?$

PROG TYPE : MAIN    Filename : MULTIP																										
Content																										
1	C	l	r	D	i	s	p	l	a	y	;															
2	F	o	r	(	A	=	1	;	A	≤	2	;	A	++	)	;										
3	{	F	o	r	(	B	=	6	;	B	≥	4	;	B	--	)	;									
4	{	C	=	A	+	B	;	P	r	i	n	t	A	,	"	+	"	,	B	,	"	=	"	,	C	
5	E	n	d																							

RUN

[ <u>ENTER</u> ]	DEG    PROG 2 + 4 = 6	↑
[ ▲ ][ ▲ ][ ▲ ][ ▲ ]	DEG    PROG 1 + 4 = 5	↑ ↓

- Use Do-While command to create a program that calculates  $1 + 2 + 3 + 4 \dots + 50 = ?$

PROG TYPE : MAIN    Filename : SUM	
Content	
1	A = 0 ; I = 0 ;
2	Do { A = A + I ; I = ++ I } ;
3	While ( I ≤ 50 ) ;
4	Print " SUM = " , A ;
5	End

RUN

[ <u>ENTER</u> ]	DEG    PROG SUM = 1 2 7 5
------------------	------------------------------

- Set the program type of the program area as " Base-n " and create a program that calculate the following question :

ANS =  $1010_2$  And ( Y Or  $7_{16}$  )

PROG TYPE : Base-n    Filename : DIFFER	
Content	
1	I n p u t    Y ;
2	C = b 1 0 1 0    A n d    ( Y    O r    h 7 ) ;
3	P r i n t    " A N S = " , C ;
4	E n d

RUN

(1)  $Y = /A_{16} \Rightarrow Ans = 10_{10}$

[ <u>ENTER</u> ]	Base-n    PROG Y = ◀	d
[ dhbo ][ ▼ ][ ▶ ][ ▶ ]	Base-n    PROG DEC    HEX    BIN OCT    d <u>h</u> b    o	
[ <u>ENTER</u> ][ /A ]	Base-n    PROG Y = h /A	d

[ <u>ENTER</u> ]	Base-n    PROG ANS = 1 0	↑ d
------------------	-----------------------------	--------

EDIT

(2)  $Y = 11011_8 \Rightarrow \text{Ans} = 1010_2$

[ <u>ENTER</u> ]	Base-n    PROG Input Y; C = b 1 0 1 0    AND ( 763	↓
[ dhbo ] [ ▶ ] [ ▶ ]	Base-n    PROG DEC    HEX <u>BIN</u> OCT    d    h    b    o	
[ <u>ENTER</u> ]	Base-n    PROG ◀ n p u t Y ; C = b 1 0 1 0    AND ( 763	↓

RUN

[ <u>ENTER</u> ]	Base-n    PROG Y = ◀	d
[ dhbo ] [ ▼ ] [ ▶ ] [ ▶ ] [ ▶ ] [ ▶ ]	Base-n    PROG DEC    HEX <u>BIN</u> OCT    d    h    b <u>o</u>	b
[ <u>ENTER</u> ] 11011	Base-n    PROG Y = o 1 1 0 1 1 ◀	b
[ <u>ENTER</u> ]	Base-n    PROG ANS = 1 0 1 0	↑ b

- Use Data-Read commands to create a program that calculates the following formulas used for calculating surface area ( S ) and volume ( V ) of a regular tetrahedron for which the length of one side ( A ) are 3.5 , 5 , 12

$$S = \sqrt{3}A^2 \quad V = \frac{\sqrt{2}}{12}A^3$$



A	S	V
3.5	? cm <sup>2</sup>	? cm <sup>3</sup>
5	? cm <sup>2</sup>	? cm <sup>3</sup>
12	? cm <sup>2</sup>	? cm <sup>3</sup>

