Sanyo

Mini Scientific Calculator

CZ-0124

Instruction Manual

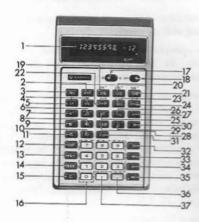# ⦿ SANYO

CONTENTS

1. FEATURES

CZ-0124 is a portable scientific calculator for engineers and students. It performs various calculation instantly. Below is a list of the basic features of this calculator.

1. Large machine capacity: 8 digits mantissa and 2 digits exponent with sign each.

2. Simple operation: Algebraic operation for arithmetic functions. By a one-touch operation the most often used functions can be performed.

3. Wide range of use: Trigonometric functions (sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$), Hyperbolic functions (sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$), Logarithmic functions (Ln, Log, e^x, 10^x), Conversional functions (polar coordinates to rectangular coordinates, rectangular to polar, angle in radian to in degree, in degree to in radian, angle in degree to in degree/minute/second, in degree/minute/second to in degree), Other functions (Y^x, n!, x^2, $\sqrt{x}$, $\sqrt[3]{x}$, $1/x$)

4. Convenient for statistical analysis:
With the $\overline{x\sigma}$ key the calculator is set in statistical calculation mode and calculates the arithmetic mean, the variance and the number of data.

5. Powerful in complex problems: One independent memory and two levels of parenthesis.
Nesting of scientific functions with arithmetic functions.

6. Left hand entry and left hand result.

2. NAME OF PARTS

1. Fluorescent display tube
2. Hyperbolic key
3. Inverse key
4. Log key Power of 10 key (Inverse function mode)
5. Natural Log key e^x key (Inverse function mode)
6. Square root key
7. Y to the X power key
8. Recall/Clear Memory key
9. Memory plus key
10. Factorial key
11. π (Pai) key
12. Exponent key

13. Sign change key
14. Exchange key
15. Clear key
16. Numeric keys
17. Degree/Radian/Grad selector switch
18. Power switch
19. Sine key Arc sine key (Inverse function mode)
    Hyperbolic sine key (Hyperbolic function mode)
    Inverse hyperbolic sine key (Inverse hyperbolic function mode)
20. Cosine key Arc cosine key (Inverse function mode)
    Hyperbolic cosine key (Hyperbolic function mode)
    Inverse hyperbolic cosine key (Inverse hyperbolic function mode)
21. Tangent key Arc tangent key (Inverse function mode)
    Hyperbolic tangent key (Hyperbolic function mode)
    Inverse hyperbolic tangent key (Inverse hyperbolic function mode)
22. Rectangular to polar key
    Polar to rectangular key (Inverse function mode)
23. DMS to decimal degree key
    Decimal degree to DMS key (Inverse function mode)
24. Radian to degree key
    Degree to radian key (Inverse function mode)
25. Cube root key
26. Reciprocal key
27. Square key
28. Memory exchange key
29. Open-bracket/parenthesis key
30. Closed-bracket/parenthesis key
31. Statistical calculation key
32. Multiplication key
33. Division key
34. Plus key
35. Equal key
36. Minus key
37. Decimal point key

3. KEYS AND SWITCHES

C Clear key

After numeric keys, decimal point key, sign change key, or exponent key, depression of the C key will clear the display register "x".

At all other times, depression of the C key will clear entire machine except the memory register. At any time, depression of the C key twice will make the machine cleared except the memory.

After error condition this key is used to resume successful operation.

0 ··· 9 Numeric keys

The appropriate numbers are indexed by depressing these keys.

• Decimal point key

The decimal point can be entered at any location by this key.

+ − × ÷ = Basic arithmetic function keys

Depress these keys in accordance with the algebraic expression.

+⅍ Sign change key

Used to change the sign of any number already displayed by depressing this key. After EXP key this key changes the sign of the exponent.

X⇄Y Exchange key

This key exchanges the contents of display register for constant register.

EXP Exponent key

Used to enter exponents (power of 10).

If EXP key is the first key of number entry, then the mantissa is automatically made to be 1 and the exponent display is unblanked. If EXP key is not the first key, it causes entry of the mantissa to be terminated and previously entered mantissa is not changed. After EXP key numeric key depressions enter a power-of-ten exponent which shifts right-to-left through the two exponent digits.

The • key will be ignored. Additional EXP key will clear the exponent two digit.

Any key other than numeric keys, • , EXP , or +⅍ will terminate both the exponent entry and number entry.

π Pi key

Automatically enters the value of pi (3.1415926) into display.

M⁺ Memory plus key

By this key the numbers displayed are added to the contents of memory. If the addition would cause an overflow, the memory register will be protected to its original value, and the error condition will be set.

X⇄M Memory exchange key

This key exchanges the contents of display register for memory register.

M$_c^R$ Recall/Clear memory key

Recalls the contents of the memory and displays. Depress this key subsequently twice to clear the content of memory.

n! Factorial key

Calculates the factorial of the displayed number. The number must be a positive integer less than 70.

1/X Reciprocal key

Calculates reciprocal of any number displayed.

X² Square key

Calculates a square of the displayed number.

√X Square root key

Calculates a square root of the displayed number.

³√X Cube root key

Calculates a cube root of the displayed number.

Y^X Y to the X power key

Used to obtain X powers of Y.

HYP Hyperboilic key

Followed by [SIN], [COS], or [TAN] key, the respective hyperbolic function value of the displayed number is calculated independent of the selector switch.

INV Inverse key

This key sets the calculator in the "Inverse function" mode. Followed by a trigonometric key, hyperbolic and trigonometric key, or the keys with upper case designation, the respective inverse function value of the displayed number will be obtained. e.g. the operation [INV] [SIN] will function as "sin⁻¹".

The "Inverse function" mode is reset by the next depression to this key except [INV], [⁺⁄₋] or [M$_c^R$].

SIN⁻¹ COS⁻¹ TAN⁻¹
SIN **COS** **TAN** Trigonometric function keys

Calculates respective function value of displayed angle.

e^X
Ln Natural logarithm key

Calculates logarithm to the base e of the number displayed. Calculates e^X in the inverse mode.

10^X

Log Common logarithm key

Calculates logarithm to the base of 10 of the number displayed. Calculates 10^X in the inverse mode.

D►R

R►D Radian to degree key

This key is used to convert a displayed value in radian into a value in degree, or in degree into in radian in the inverse mode.

►DMS

►DEG DMS to decimal degree key

This key is used to convert a value in degree/minute/second into a value in decimal degree, or in decimal degree into degree/minute/second in the inverse mode. A value to be converted should be entered as xx.yyzz (x, degree; y, minute; z, second). This key operates with the selector switch in degree.

P►R

R►P Rectangular to polar key

Used to convert x and y of rectangular coordinates into r and θ of polar coordinates, or polar to rectangular in the inverse mode.

Example : [X, Y] = [4 , 3] to [R, θ]

D⊙G [C] 3 [X↔Y] 4 [R►P] → | 36. 869897 | θ (degree)

[X↔Y] → | 5. | R

[R, θ] = [2 , 30°] to [X, Y]

D⊙G [C] 2 [X↔Y] 30 [INV] [R►P] → | 1. 7320509 | X coordinate

[X↔Y] → | 1. | Y coordinate

x̄,σ² Statistical calculation key

This key sets the calculator in the statistical calculation mode. In this mode arithmetic mean, number of data and variance can be obtained. The memory register is used as an item counter, so [M•] and [M♯] can not be used. See page 18.

[(Open-bracket/parenthesis key

)] Closed-bracket/parenthesis key

These keys in pairs implement two levels of parenthesis. All arithmetic functions and scientific functions, except P→R, R→P and statistical calculations, may be nested in parenthesis. See page 17.

R

D ⊙ G Degree/Radian/Grad selector switch

In calculation of trigonometric function, the display register is assumed to contain an angle expressed in degrees, radians or grads as selected by this switch. When calculating any inverse trigonometric function, the result is calculated in units as selected by this switch. The midway position of this switch may cause misoperation.

OFF ⊙ ON Power switch

4. INDICATORS

1. How to read numerals displayed
   Normal mode

   sign   8digits numbers

   -1.2345678

   Scientific notation mode

   sign of   8digits mantissa   sign of   magnitude of
   mantissa   exponent   exponent

   $-1.2345678 - 90$

   (Figures above showes $-1.2345678 \times 10^{-90}$)

2. Error indicator "E"
   If error occurs, "E" in the left-most digit will light.
   Error occurs in the following conditions.
   1) The magnitude of result is greater than 9.9999999×10^{99}. (The magnitude of result or input numbers smaller than 1×10^{-100} is assumed as 0.)
   2) Specific functions is attempted over the full range of numbers which may be entered from the key board or developed as intermidiate results during calculation.
      [TABLE-1 (page 27) provides a summary of permitted range of arguments.]
   3) Improper key operation such as not to close parentheses as shown below will make error.

   $\boxed{C}\,\boxed{5}\,\boxed{+}\,\boxed{(\!(}\,15\,\boxed{\times}\,4\,\boxed{=}$ → $\boxed{\text{E0.}}$

   Note: Start the calculations after depressing $\boxed{C}$ key when error occurs.

3. Memory loading indicator "E"
   When the contents of the memory register is non-zero, resulting from a memory operation, "$/$" in the left-most digit will light as a memory loading indicator.

4. Statistical calculation mode indicator "$\bullet$"
   In the statistical calculation mode decimal point of the left-most position will light.

5. POWER SUPPLY

* **Dry battery**

1. Draw the battery case out of the calculator pushing the button on the bottom and load two new penlight (AA size) dry batteries, putting from the (−) side according to the diagram inside.
2. Set the case into the calculator securely.
3. Change the two old batteries at the same time when the display becomes dim.

* **AC adaptor (Option)**

1. Insert the adaptor AC plug into a power outlet and DC plug into the socket of the battery case positioning the power switch of the calculator off.

* **Rechargeable pack (Option)**

1. Recharge the Nicd batteries built in the pack using the AC adaptor. Takes about 7–8 hours for full recharging with the calculator's power switch OFF position.
2. When fully recharged, disconnect the adaptor to avoid overcharging.
3. This pack can be recharged while separated from the calculator.

6. CALCULATIONS

A. BASIC CALCULATIONS

1. Addition and subtraction

Ex. $123+456-789=-210$

$\boxed{C}123\boxed{+}456\boxed{-}789\boxed{=}$ → $\boxed{-210.}$

2. Multiplication and division

Ex. $123\times456\div(-789)=-71.087452$

$\boxed{C}123\boxed{\times}456\boxed{\div}789\boxed{+/-}\boxed{=}$ → $\boxed{-71.087452}$

Ex. $\dfrac{2.3\times10^{27}\times3\times10^{-17}}{7\times10^{32}}=9.8571428\times10^{-23}$

$\boxed{C}2\boxed{\cdot}3\boxed{EXP}27\boxed{\times}3\boxed{EXP}\boxed{+/-}17\boxed{\div}7\boxed{EXP}32\boxed{=}$

→ $\boxed{9.8571428 \ -23}$

3. Repeated and constant calculation

Ex. $12+56=68$ $34+56=90$

$\boxed{C}12\boxed{+}56\boxed{=}$ → $\boxed{68.}$

$34\boxed{=}$ → $\boxed{90.}$

Ex. $\pi\times2=6.2831852$ $\pi\times3=9.4247778$

$\boxed{C}\boxed{\pi}\boxed{\times}2\boxed{=}$ → $\boxed{6.2831852}$

$3\boxed{=}$ → $\boxed{9.4247778}$

In repeated addition (subtraction), register the addend (subtrahend) as a constant.

In constant multiplication (division), register the multiplicand (devisor) as a constant.

4. Power calculation

Ex. $3^2=9$ $3^3=27$ $27^2=729$

$\boxed{C}3\boxed{\times}\boxed{=}$ → $\boxed{9.}$

$\boxed{=}$ → $\boxed{27.}$

$\boxed{\times}\boxed{=}$ → $\boxed{729.}$

5. Reciprocal calculation

Ex. $\dfrac{8}{3\times2+19}=0.32$

$\boxed{C}3\boxed{\times}2\boxed{+}19\boxed{\div}8\boxed{x \leftrightarrow y}\boxed{=}$ → $\boxed{0.32}$

or $\boxed{C}3\boxed{\times}2\boxed{+}19\boxed{=}\boxed{1/x}\boxed{\times}8\boxed{=}$ → $\boxed{0.32}$

6. Conversion calculation

Ex. Convert $12°\,34'\,56''$ into decimal degrees

$\boxed{C}12\boxed{\cdot}3456\boxed{DEG}$ → $\boxed{12.582222}$

Accordingly, $12.582222°$ is obtained

Ex. $3\div(-6)=-0.5$ $12\div(-6)=-2$
     $5\div2=2.5$ $8\div2=4$

$\boxed{C}3\boxed{\div}6\boxed{+/-}\boxed{=}$ → $\boxed{-0.5}$

$12\boxed{=}$ → $\boxed{-2.}$

$2\boxed{x \leftrightarrow y}5\boxed{=}$ → $\boxed{2.5}$

$8\boxed{=}$ → $\boxed{4.}$

Use $\boxed{x \leftrightarrow y}$ key to exchange constant factor.

Ex. Convert 12.3456° into degree/minute/second

D ⟐ᴿ⟐G C 12 · 3456 INV ⊳DEG → | 12.2044 |

So 12° 20′ 44″ is obtained.

In the same way hour/minute/second into decimal hours or the inverse can be performed.

Ex. Convert π/2 into a value in degree

C π ÷ 2 = R▸D → | 90. |

So π/2 in radian equals 90°

Ex. Convert 30° into a value in radian

C 30 INV R▸D → | 0.5235987 |

So 0.5235987 in radian is obtained.

Ex. Convert x and y of rectangular coordinates into r and θ polar coordinates.

(x, y) = (3, 4)

D ⟐ᴿ⟐G C 4 X:Y 3 R▸P → | 53.130102 |

X:Y → | 5. |
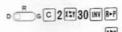
θ = 53.130102° r = 5

Input data in the order of y coordinates and x coordinates.
Output in the order of θ and r.

Ex. Conversion into rectangular coordinates

(r, θ) = (2, 30°)

D ⟐ᴿ⟐G C 2 X:Y 30 INV R▸P → | 1.7320509 |

X:Y → | 1. |

x = 1.7320509 y = 1.

Input data in the order of r and θ.
Output in the order of x and y.

7. Memory calculation

Ex. 45×27 = 1215 ······ (S₁)
     36×18 = 648 ······ (S₂)
     36×56 = 2016 ······ (S₃)
     : S₁ + S₂ − S₃ = −153

C 45 × 27 = → | 1215. |

X:M 36 × 18 = M⁺ → | ⸀648. |

56 = ⊡ M⁺ → | ⸜ 2016. |

M⁎ → | ⸜ 153. |

To clear the contents of memory register, depress the keys as follows.

M⁎ M⁎ or C X:M

Ex. (4 × 5) + (3 × 8) = 44

C 4 × 5 = X:M 3 × 8 = M⁺ M⁎

→ | ⸀44. |

M⁎ C → | 0. |

---

15   16

8. Mixed calculation

Ex. $\quad [15 \times (3+5) \times (4+3) \times (5+1)]$
$\quad + [2 \times (3+1) \times (4+1)] = 5080$

$\boxed{C}\ \boxed{(}\ \boxed{(}\ 15\ \boxed{\times}\ \boxed{(}\ 3\ \boxed{+}\ 5\ \boxed{)}\ \boxed{)} \qquad \rightarrow \boxed{\quad 8.}$

$\boxed{\times}\ \boxed{(}\ \boxed{(}\ 4\ \boxed{+}\ 3\ \boxed{)}\ \boxed{\times}\ \boxed{(}\ \boxed{(}\ 5\ \boxed{+}\ 1\ \boxed{)}\ \boxed{)}\ \boxed{)}$

$\qquad\qquad\qquad\qquad \rightarrow \boxed{\quad 5040.}$

$\boxed{+}\ \boxed{(}\ \boxed{(}\ 2\ \boxed{\times}\ \boxed{(}\ 3\ \boxed{+}\ 1\ \boxed{)} \quad \rightarrow \boxed{\quad 4.}$

$\boxed{\times}\ \boxed{(}\ 4\ \boxed{+}\ 1\ \boxed{)}\ \boxed{)}\ \boxed{)}\ \boxed{=} \quad \rightarrow \boxed{\quad 5080.}$

Ex. $\quad \dfrac{1}{\sqrt{3 + \dfrac{1}{3}(1 - 0.2)^2}} = 0.557856$

$\boxed{C}\ \boxed{(}\ \boxed{(}\ 3\ \boxed{1/x}\ \boxed{\times}\ \boxed{(}\ \boxed{(}\ 1\ \boxed{-}\ \boxed{\cdot}\ 2\ \boxed{)}\ \boxed{)}\ \boxed{x^2}$

$\qquad\qquad\qquad\qquad \rightarrow \boxed{\quad 0.64}$

$\boxed{+}\ 3\ \boxed{)}\ \boxed{)}\ \boxed{\sqrt{x}}\ \boxed{1/x} \quad \rightarrow \boxed{\quad 0.557856}$

Note : 1. $\boxed{C}\ \boxed{(}\ \boxed{(}\ \boxed{(}\ \boxed{(} \qquad \rightarrow \boxed{E\,0.}$

Parentheses should not be used more than three levels.

2. $\boxed{C}\ 3\ \boxed{\times}\ \boxed{(}\ \boxed{(}\ \boxed{)}\ \boxed{)} \rightarrow \boxed{E\,0.}$

$\boxed{(}$ and $\boxed{)}$ keys should be used in pairs.

3. $\boxed{C}\ 2\ \boxed{(}\ \boxed{(}\ 3\ \boxed{+}\ 4\ \boxed{)}\ \boxed{)}\ \boxed{=}$

$\qquad\qquad\qquad \rightarrow \boxed{\quad 7.}$

Just before and after parenthesis in the middle of the calculation the appropriate function key should be depressed if necessary.

B. FUNCTIONAL CALCULATION

1. Statistical calculation

Ex. Given the following data :
$X_1 = 123,\ X_2 = 456,\ X_3 = 789$
Calculate the standard deviation (σ).

$\boxed{C}\ \boxed{\overline{x}\sigma^2}\ 123\ \boxed{+}\ 456\ \boxed{+}\ 789\ \boxed{=}$ Mean value $(\overline{X})$

$\qquad\qquad\qquad\qquad \rightarrow \boxed{\quad .456.}$

$\boxed{\overline{x}\sigma^2}$ Variance $(\sigma^2) \qquad \rightarrow \boxed{\quad .73926.}$

$\boxed{\sqrt{x}}$ Standard deviation (σ)

$\qquad\qquad\qquad\qquad \rightarrow \boxed{\quad .271.89336}$

$\boxed{\overline{x}\,M}$ Number of data $(n) \rightarrow \boxed{\quad .3.}$

Note : $\overline{X} = \dfrac{1}{n}\sum_{i=1}^{n} Xi = \dfrac{1}{3}(X_1 + X_2 + X_3)$

$\sigma^2 = \dfrac{1}{n}\sum_{i=1}^{n} X_i^2 - \overline{X}^2 = \dfrac{1}{3}(X_1^2 + X_2^2 + X_3^2) - \overline{X}^2$

$\sigma = \sqrt{\sigma^2}$

In the statistical calculation mode the memory is used as an item counter, so $\boxed{M^+}$ and $\boxed{M\,!}$ keys are neglected.
Variance (σ^2) has an error within 0.01 per-cent of the mean value (x).

To clear this mode depress $\boxed{C}$ key.
In case that incorrect datum has been entered take the following operation.
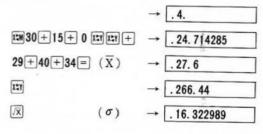
x: incorrect datum   b: correct datum

i) Before $\boxed{+}$ or $\boxed{=}$ key :
$\boxed{C}\ \boxed{\overline{x}\sigma^2}\ a\ \boxed{+}\ x\ \boxed{-}\ x\ \boxed{+}\ b\ \boxed{=}$

ii) After $\boxed{+}$ or $\boxed{=}$ key :
$\boxed{C}\ \boxed{\overline{x}\sigma^2}\ a\ \boxed{+}\ x\ \boxed{+}\ (\text{or}\ \boxed{=})\ \boxed{\overline{x}\sigma^2}\ \boxed{-}\ x\ \boxed{+}\ b\ \boxed{=}$

Ex.

The table shows the marks of mathematics exam. Calculate the mean value (X̄) and the standard deviation (σ).
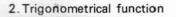
No.	MARK	No.	MARK
1	42	6	15
2	36	7	0
3	0	8	29
4	50	9	40
5	30	10	34

C [x̄,σ] 42 + 36 + 0 [x≷y] [x≷y] + 50 + [xₘ]

Intermediate number of data

→	. 4.
[xₘ] 30 + 15 + 0 [x≷y] [x≷y] + →	. 24. 714285
29 + 40 + 34 = (X̄) →	. 27. 6
[x≷y] →	. 266. 44
[√x] (σ) →	. 16. 322989

If "0" is included in data, [x≷y] key should be depressed twice after [0] key as the example shown above. In the case of checking up the number of data or variance during calculation, make sure that [xₘ] (or [x≷y]) key should be followed after the confirmations in order to return to the previous state.

2. Trigonometrical function

Ex. $\sin 30° + \cos 45° = 1.2071068$

D ⊂==⊃ G C 30 [SIN] + 45 [COS] = → | 1.2071068 |

Ex. $\sin(30° 30' 30'') = 0.5076637$

D ⊂==⊃ G C 30 · 3030 [→DEG] [SIN] → | 0.5076637 |

Ex. $\sin^{-1}(0.2) + \tan^{-1}(0.4) = 0.5818642$ Radian

D ⊂==⊃ G C · 2 [INV] [SIN] + · 4 [INV] [TAN] = → | 0.5818642 |

Note : 90in degree $= \pi/2$ in radian $=100$in grad

3. Hyperbolic function

Ex. $\sinh 2 = 3.6268602$

C 2 [HYP] [SIN] → | 3.6268602 |

Ex. $\text{Tanh}^{-1}(0.5) = 0.5493061$

C · 5 [INV] [HYP] [TAN] → | 0.5493061 |

Note : $\text{Sinh}X = \dfrac{e^x - e^{-x}}{2}$, $\text{Tanh}X = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$

$\text{Cosh}X = \dfrac{e^x + e^{-x}}{2}$

D ⊂==⊃ G
cf. C · 5 [HYP] [INV] [TAN] → | 26.565051 |

In this case [HYP] key is neglected.

4. Logarithmic function

Ex. $Ln 7 + Log123 = 4.0358155$

$\boxed{C}\ 7\ \boxed{Ln}\ \boxed{+}\ 123\ \boxed{Log}\ \boxed{=}$ → $\boxed{4.0358155}$

Ex. $Log_5 456 = \dfrac{Ln456}{Ln5} = 3.8041184$

$\boxed{C}\ 456\ \boxed{Ln}\ \boxed{\div}\ 5\ \boxed{Ln}\ \boxed{=}$ → $\boxed{3.8041184}$

Note : $LognX = \dfrac{LnX}{Lnn}$

5. Exponent function

Ex. $e^{2.3} = 9.9741821$

$\boxed{C}\ 2\ \boxed{\cdot}\ 3\ \boxed{INV}\ \overset{e^x}{\boxed{Ln}}$ → $\boxed{9.9741821}$

Ex. $10^{2.3} - 10^{0.5} = 196.36394$

$\boxed{C}\ 2\ \boxed{\cdot}\ 3\ \boxed{INV}\ \overset{10^x}{\boxed{Log}}\ \boxed{-}\ \boxed{\cdot}\ 5\ \boxed{INV}\ \overset{10^x}{\boxed{Log}}\ \boxed{=}$

→ $\boxed{196.36394}$

6. Power Calculation

Ex. $1.2^{3.5} = 1.8929294$

$\boxed{C}\ 1\ \boxed{\cdot}\ 2\ \boxed{Y^x}\ 3\ \boxed{\cdot}\ 5\ \boxed{=}$ → $\boxed{1.8929294}$

7. Reciprocal calculation

Ex. $\dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{5} = 0.95$

$\boxed{C}\ 2\ \boxed{1/x}\ \boxed{+}\ 4\ \boxed{1/x}\ \boxed{+}\ 5\ \boxed{1/x}\ \boxed{=}$ → $\boxed{0.95}$

8. Root calculation

Ex. $\sqrt{6} + \sqrt[3]{56} = 6.2753521$

$\boxed{C}\ 6\ \boxed{\sqrt{x}}\ \boxed{+}\ 56\ \boxed{\sqrt[3]{x}}\ \boxed{=}$ → $\boxed{6.2753521}$

Ex. $\sqrt[5]{12345} = (12345)^{\frac{1}{5}} = 6.5810953$

$\boxed{C}\ 12345\ \boxed{Y^x}\ 5\ \boxed{1/x}\ \boxed{=}$ → $\boxed{6.5810953}$

Note : $\sqrt[n]{X} = X^{\frac{1}{n}}$

9. Factorial calculation

Ex. $6\ ! = 720$

$\boxed{C}\ 6\ \boxed{n!}$ → $\boxed{720.}$

Ex. $C(5 \cdot 2) = \dfrac{P(5 \cdot 2)}{2\ !} = \dfrac{5\ !}{2\ !(5-2)\ !} = 10$

$\boxed{C}\ 5\ \boxed{n!}\ \boxed{\div}\ 2\ \boxed{n!}\ \boxed{\div}\ \boxed{(}\ \boxed{(}\ 5\ \boxed{-}\ 2\ \boxed{)}\ \boxed{)}\ \boxed{n!}\ \boxed{=}$

→ $\boxed{10.}$
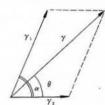
Note : Combinations $C(n \cdot r) = \dfrac{P(n \cdot r)}{r\ !}$
Permutations

$P(n \cdot r) = n \times (n-1) \times (n-2) \times \cdots \times (n-r+1)$

$= \dfrac{n\ !}{(n-r)\ !}$
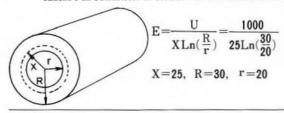
C. ENGINEERING CALCULATIONS

Ex. Calculate sum of two vectors

$\gamma_1 = 15$, $\gamma_2 = 5$, $\alpha = 60°$
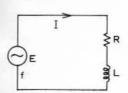
$\gamma = \sqrt{\gamma_1^2 + \gamma_2^2 + 2 \cdot \gamma_1 \cdot \gamma_2 \cos\alpha}$

$\theta = \text{Tan}^{-1}\left(\dfrac{\gamma_1 \cdot \sin\alpha}{\gamma_1 \cdot \cos\alpha + \gamma_2}\right)$

$\boxed{D}\!\!\bigcirc\!\!^{R}\!\!_{G}$ $\boxed{C}$ 15 $\boxed{x^2}$ $\boxed{x \rightarrow M}$ 5 $\boxed{x^2}$ $\boxed{M^+}$ 2 $\times$ 15 $\times$ 5 $\times$ 60 $\boxed{\text{COS}}$

$\boxed{=}$ $\boxed{M^-}$ $\boxed{M_C^R}$ $\boxed{\sqrt{x}}$ (γ) $\rightarrow$ $\boxed{\text{'18. 027756}}$

$\boxed{C}$ 15 $\times$ 60 $\boxed{\text{SIN}}$ $\div$ $\boxed{((}$ 15 $\times$ 60 $\boxed{\text{COS}}$ $\boxed{+}$ 5 $\boxed{)}$

$\boxed{=}$ $\boxed{\text{INV}}$ $\boxed{\text{TAN}}$ (θ) $\rightarrow$ $\boxed{\text{46. 102111}}$

Ex. Calculate the field strength at inner surface x in the concentric cylinder with outer radius R and inner radius r in condition of 1.000 V between both sides.

$E = \dfrac{U}{X \text{Ln}\left(\dfrac{R}{r}\right)} = \dfrac{1000}{25 \text{Ln}\left(\dfrac{30}{20}\right)}$

$X = 25$, $R = 30$, $r = 20$

$\boxed{C}$ 1000 $\boxed{\div}$ $\boxed{((}$ 25 $\times$ $\boxed{((}$ 30 $\boxed{\div}$ 20 $\boxed{)}$ $\boxed{\text{Ln}}$ $\boxed{)}$ $\boxed{=}$

$\rightarrow$ $\boxed{\text{98. 652145}}$

Ex. Calculate the current I.

E···voltage	$100(V)$
R···net registance	$15(\Omega)$
f···frequency	$50(Hz)$
L···inductance	$0.01(H)$
I···electric current	$?(A)$

$I = \dfrac{E}{\sqrt{R^2 + (2\pi fL)^2}} = \dfrac{100}{\sqrt{15^2 + (2\pi \times 50 \times 0.01)^2}}$

$\boxed{C}$ 100 $\boxed{\div}$ $\boxed{((}$ 15 $\boxed{x^2}$ $\boxed{+}$ $\boxed{((}$ 2 $\times$ $\boxed{\pi}$ $\times$ 50 $\times$

$\boxed{\cdot}$ 01 $\boxed{)}$ $\boxed{x^2}$ $\boxed{)}$ $\boxed{\sqrt{x}}$ $\boxed{=}$ $\rightarrow$ $\boxed{\text{6. 5250917}}$

Ex. Calculate the period of conical pendulum

$T = 2\pi\sqrt{\dfrac{\ell \cdot \cos(\theta/2)}{g}}$

T : Period		(s)
ℓ : thread length		$30(cm)$
θ : maximum angle		$90°$
g : gravitational acceleration		$(9.8 m/s^2)$
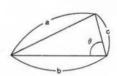
$\boxed{D}\!\!\bigcirc\!\!^{R}\!\!_{G}$ $\boxed{C}$ 2 $\times$ $\boxed{\pi}$ $\times$ $\boxed{((}$ $\boxed{\cdot}$ 3 $\times$ $\boxed{((}$ 90 $\boxed{\div}$

2 $\boxed{)}$ $\boxed{\text{COS}}$ $\boxed{\div}$ 9 $\boxed{\cdot}$ 8 $\boxed{)}$ $\boxed{\sqrt{x}}$ $\boxed{=}$ $\rightarrow$ $\boxed{\text{0. 9244205}}$

Ex. Obtain a side

$$a=\sqrt{b^2+c^2-2bc\cos\theta}$$
$$b=456, \quad c=123, \quad \theta=78°$$

D ⦿ G $\boxed{C}$ 456 $\boxed{x^2}$ $\boxed{+}$ 123 $\boxed{x^2}$ $\boxed{-}$ $\boxed{((}$ 2 $\boxed{\times}$ 456 $\boxed{\times}$

123 $\boxed{\times}$ 78 $\boxed{COS}$ $\boxed{))}$ $\boxed{=}$ $\boxed{\sqrt{x}}$ → $\boxed{446.92538}$

Ex. Calculate area of equilateral pentagon
(radius : 10)
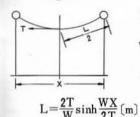
$$S(area)=\frac{nr^2}{2}\sin\frac{2\pi}{n}$$

r : radius·················10
n : number of side····· 5

D ⦿ G $\boxed{C}$ 2 $\boxed{\times}$ $\boxed{\pi}$ $\boxed{\div}$ 5 $\boxed{=}$ $\boxed{SIN}$ $\boxed{\times}$ 5 $\boxed{\times}$

10 $\boxed{x^2}$ $\boxed{\div}$ 2 $\boxed{=}$ → $\boxed{237.76412}$

or $\boxed{C}$ 5 $\boxed{EXP}$ 2 $\boxed{\div}$ 2 $\boxed{\times}$ $\boxed{((}$ 2 $\boxed{\times}$ $\boxed{\pi}$ $\boxed{\div}$

5 $\boxed{))}$ $\boxed{SIN}$ $\boxed{=}$ → $\boxed{237.76412}$

or $\boxed{C}$ 5 $\boxed{EXP}$ 2 $\boxed{\div}$ 2 $\boxed{=}$ $\boxed{X:M}$ 2 $\boxed{\times}$ $\boxed{\pi}$ $\boxed{\div}$

5 $\boxed{=}$ $\boxed{SIN}$ $\boxed{\times}$ $\boxed{M^x_c}$ $\boxed{=}$ → $\boxed{'237.76412}$

Ex. Obtain a needful length of the simple cable
stretched between two poles of the same
height.
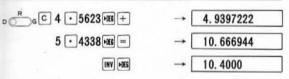
X : Interval between two
poles   50 [m]
W : Weight of cable
0.78 [kg/m]
T : Horizontal tension at
the lowest point
62 [kg]

$$L=\frac{2T}{W}\sinh\frac{WX}{2T} \text{ [m]}$$

$\boxed{C}$ 2 $\boxed{\times}$ 62 $\boxed{\div}$ $\boxed{\cdot}$ 78 $\boxed{\times}$ $\boxed{((}$ $\boxed{\cdot}$ 78 $\boxed{\times}$ 50 $\boxed{\div}$ 62 $\boxed{\div}$ 2 $\boxed{))}$

$\boxed{HYP}$ $\boxed{SIN}$ $\boxed{=}$ → $\boxed{50.828376}$

Ex. Obtain the sum of A and B
A···4 hours 56 minutes 23 seconds
B···5 hours 43 minutes 38 seconds

D ⦿ G $\boxed{C}$ 4 $\boxed{\cdot}$ 5623 $\boxed{→DEG}$ $\boxed{+}$ → $\boxed{4.9397222}$

5 $\boxed{\cdot}$ 4338 $\boxed{→DEG}$ $\boxed{=}$ → $\boxed{10.666944}$

$\boxed{INV}$ $\boxed{→DEG}$ → $\boxed{10.4000}$

So 10 hours 40 minutes and about 0 second is
obtained.

7. INPUT ARGUMENT AND ACCURACY

TABLE-1. INPUT ARGUMENT RANGE

FUNCTION	ERROR RANGE
$+, -, \times, \div$	$\mid$ Answer $\mid \geq 10^{100}$ or Divisor $= 0$
$\sqrt{X}, \sqrt[3]{X}$	$X < 0$
X^2	$\mid X \mid \geq 10^{50}$
$1/X$	$X = 0$
$n\ !$	$X < 0, X \geq 70$ or X is not a integral number
LnX, LogX	$X \leq 0$
e^x	$X \geq 100Ln10$
10^x	$X \geq 100$
Y^x	$Y \leq 0$ or $X \ Ln Y \geq 100Ln10$
tanX	$X = 90° \times (2N-1)$
$\sin^{-1}X, \cos^{-1}X$	$\mid X \mid > 1$
sinhX, coshX	$\mid X \mid \geq 100Ln10$
$\cosh^{-1}X$	$X < 1$
$\tanh^{-1}X$	$\mid X \mid \geq 1$

Specific functions can not be executed over the full range of numbers which may be entered from keyboard or developed as intermediate result during calculation. When the argument falls outside the permitted range, error occurs.

TABLE-2. ACCURACY

FUNCTION	ERROR
LnX, LogX	± 3 in the 8th digit
e^x	$X < -99Ln10$ Answer $= 0$ $10Ln10 \leq \mid X \mid < 100Ln10$ ± 1 in the 6th $Ln10 \leq \mid X \mid < 10Ln10$ ± 1 in the 7th $0 \leq \mid X \mid < Ln10$ ± 4 in the 8th
10^x	$X < -99$ Answer $= 0$ $10 \leq \mid X \mid < 100$ ± 1 in the 6th $1 \leq \mid X \mid < 10$ ± 1 in the 7th $0 \leq \mid X \mid < 1$ ± 4 in the 8th
sinX	$0 \leq \mid X \mid < 10^{-7}$rad. Answer $= 0$ $10^{-7} \leq \mid X \mid < 10^{-2}$rad. ± 4 in the 10^{-8} $10^{-2} \leq \mid X \mid \leq \pi/2$rad. ± 3 in the 8th
cosX	$0 \leq \mid X \mid < \pi/2 - 10^{-2}$rad. ± 3 in the 8th $\pi/2 - 10^{-2} \leq \mid X \mid < \pi/2 - 10^{-6}$rad. ± 4 in the 10^{-5} $\pi/2 \ 10^{-6} \leq \mid X \mid \leq \pi/2$rad. Answer $= 0$
sinX, cosX	$2\pi \times 10^1 \leq \mid X \mid < 2\pi \times 10^8$rad. Significant digits max. 6 $\mid X \mid \geq 2\pi \times 10^8$rad. sinX $= 0$, cosX $= 1$
tanX	$0 \leq \mid X \mid < 10^{-7}$rad. Answer $= 0$ $10^{-7} \leq \mid X \mid < 10^{-2}$rad. ± 3 in the 10^{-8} $10^{-2} \leq \mid X \mid < 82°$ ± 3 in the 8th $82° \leq \mid X \mid < 89.9°$ ± 3 in the 7th $89.9° \leq \mid X \mid < 89.99°$ ± 5 in the 6th $89.99° \leq \mid X \mid < 89.999°$ ± 2 in the 5th $89.999° \leq \mid X \mid < 89.9999°$ ± 7 in the 4th $89.9999° \leq \mid X \mid < 89.99999°$ ± 7 in the 3rd $89.99999° \leq \mid X \mid < 89.999999°$ ± 2 in the 2nd $\mid X \mid = 89.999999°$ $+3$ in the 1st $3600° \leq \mid X \mid < (360 \times 10^8)°$ Significant digit max. 6 $\mid X \mid \doteq 90° \times (2N-1)$ Significant digit max. 6 $\mid X \mid > (360 \times 10^8)°$ tanX $= 0$

(CONTINUED)

FUNCTION	ERROR
$\sin^{-1}X$	$0 \leq |X| < 10^{-7}$ Answer $=0$ $10^{-7} \leq |X| < 10^{-2}$ ± 3 in the 10^{-8} $10^{-2} \leq |X| \leq 1$ ± 5 in the 8th
$\cos^{-1}X$	$0 \leq |X| < 0.99$ ± 5 in the 8th $0.99 \leq |X| \leq 1$ ± 3 in the 10^{-7}
$\tan^{-1}X$	$0 \leq |X| < 10^{-7}$ Answer $=0$ $10^{-7} \leq |X| < 10^{-2}$ ± 4 in the 10^{-8} $10^{-2} \leq |X| < 10^{9}$ ± 3 in the 8th $10^{9} \leq |X|$ |Answer| $=90°$
$\sinh X, \cosh X$	$0 \leq |X| < \mathrm{Ln}10$ ± 6 in the 8th $\mathrm{Ln}10 \leq |X| < 10\mathrm{Ln}10$ ± 1 in the 7th $10\mathrm{Ln}10 \leq |X| < 100\mathrm{Ln}10$ ± 1 in the 6th
$\tanh X$	$0 \leq |X| < \mathrm{Ln}10$ ± 6 in the 8th $\mathrm{Ln}10 \leq |X| < 4\mathrm{Ln}10$ ± 1 in the 7th $4\mathrm{Ln}10 \leq |X| < 10^{100}$ |Answer| $=1$
$\sinh^{-1}X$	$0 \leq |X| < 10^{100}$ ± 5 in the 8th
$\cosh^{-1}X$	$1 \leq |X| < 10^{100}$ ± 5 in the 8th
$\tanh^{-1}X$	$-1 < X < 1$ ± 6 in the 8th
$+, -, \times, \div$ $\sqrt{\ }, 1/X$	± 1 in the 8th digit

"$\pm N$ in the Mth" means that M digit accuracy will be obtained by the correction to the Mth digit from left within $\pm N$.

In case that the magnitude of the input or result is smaller than 1×10^{-100}, it is assumed to be zero.

8. SPECIFICATIONS

Type	Electronic mini calculator
Model	CZ-0124
Numeric keys	10 key system
Display	Scientific notation mode: 8 digits mantissa +2 digits exponent Normal mode: 8 digits Full size fluorescent multitube with minus sign for mantissa and exponent each. Indicators for improper operations, memory loading and statistical calculation mode.
Memory	One memory
Decimal point	Floating point or scientific
Credit balance	True number with minus sign
Machine range	$1 \times 10^{-99} \leq |X| \leq 9.9999999 \times 10^{99}$
Functions	Basic four arithmetic functions $(+, -, \times, \div.)$, π entry, Mixed chain calculation, Serial calculation, Memory calculations, Two levels of parentheses, Factorial calculation, Scientific functions (sin, cos, tan, Y^X, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, e^X, 10^X, Ln, Log, $1/X$, $\sqrt{X}$, $\sqrt[3]{X}$, X^2, P→R, R→P, DEG→DMS, DMS→DEG, DEG→RAD and RAD→DEG), statistical cal.
Elements	1 chip LSI
Power supply	2 x AA size dry cell batteris or AC adaptor CU-25 (Option) or rechargeable pack RU-01 (Option)
Power Consumption	DC 0.6W
Dimensions	36(H) x 86(W) x 157(D)mm
Weight	240g including of batteries