
INTRODUCTION

Thank you for your purchase of the SHARP ELSI MATE model EL-500. Though small in size, this unit is capable of performing complex calculations with amazing speed and simplicity.

Careful reading of this manual will enable you to use your new SHARP to its full capability.

OPERATIONAL NOTES

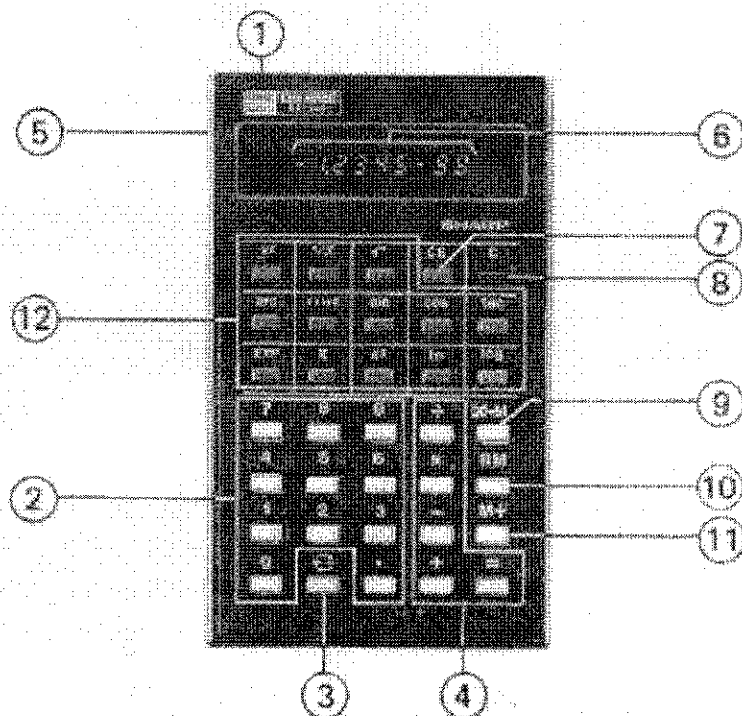
To insure trouble free operation of your SHARP Calculator, we recommend the following:

1. The calculator should be kept in areas free from extreme temperature fluctuations, moisture and dust.
2. A soft, dry cloth should be used to clean the calculator. Do not use solvents or a wet cloth.
3. If the calculator will not be operated for an extended period of time, remove the batteries to avoid possible damage caused by battery leakage. Do not incinerate used batteries when disposing of them.
4. When you are using an optional AC adaptor, turn off the power switch prior to disconnecting the AC cord.
5. If service of your calculator is required, use only an authorized SHARP Service Center.

CONTENTS

	Page
THE KEYBOARD	3
OPERATING CONTROLS	5
SYMBOL	9
OVERFLOW ERRORS	10
BATTERY REPLACEMENT	12
OPERATIONS	13
SPECIFICATIONS	34

THE KEYBOARD



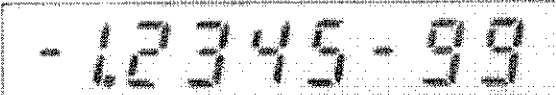
- ① AC adaptor connecting terminal
- ② Numeral keys
- ③ Change sign key
- ④ 4 arithmetic calculation keys
- ⑤ Power switch
- ⑥ Display
- ⑦ Clear entry key
- ⑧ Clear key
- ⑨ Memory-in key
- ⑩ Recall memory key
- ⑪ Memory plus key

- ⑫
 - y^x Power calculation key
 - $1/x$ Reciprocal key
 - $\sqrt{}$ Square root key
 - $\leftrightarrow$ Degree/Minute/Second $\leftrightarrow$ Decimal degree conversion key
 - $\sin$
 - $\cos$
 - $\tan$
 Trigonometric function key
 - $\arcsin$ Arc key
 - π Pi key
 - e^x Natural anti-logarithm key
 - $\log$ Common logarithm key
 - $\ln$ Natural logarithm key
 - $\exp$ Enter exponent key

OPERATING CONTROLS

ON  OFF Power switch

When the power switch is turned on, the calculator is ready for operation.



Display



All entries or answer will be displayed in either floating decimals or scientific notation. (See page 13). When operating in scientific notation, the minus sign will be displayed to the left of the negative portion of the number (i.e.: mantissa or exponent).

 ~  Numeral keys } Used to enter numbers.
 Decimal point key }

Ex. 12.3 →    
 0.7 →  



Arithmetic function keys

Depress these keys according to mathematical formula in addition, subtraction multiplication and division.



Equals key

Completes the arithmetic function of $+$, $-$, $\times$, & $\div$.



Clear key

Clears the contents of the calculation registers. The contents of the memory are not affected.



Clear entry key

Used to clear a falsely entered number.

**Change sign key**

Changes the sign of the displayed number from a positive to a negative or from a negative to a positive.

**Memory-in key**

Used to store a displayed number into the memory with clearing the previously stored number.

To clear the memory depress the  key followed by the  key.

**Recall memory key**

Displays the contents of the memory. The contents of the memory remain unchanged.

**Memory plus key**

Used to add the equivalent to a displayed number or a calculated result to the memory.

**Power calculation key**

Used to raise a number to a power.

**Reciprocal key**

Calculates the reciprocal of the displayed number.

**Square root key**

Calculates the square root of the displayed number.

 **Degree/Minute/Second ↔ Decimal degree Conversion key**

This key converts degree/minute/seconds to their decimal equivalents. When preceded by the  key, this key converts decimal degrees to degree/minutes/seconds.

   **Trigonometric functions key**

Used to obtain the sine, cosine or tangent of a displayed number.

 **Arc key**

When followed by the ,  or  keys, this key is used to obtain the inverse trigonometric functions. When followed by the  key, this key converts decimal degrees to degree/minutes/seconds.

 **Pi key**

Used to enter the constant pi (≈ 3.1415926).

 **Natural anti-logarithm key**

Calculates the anti-logarithm base e of the displayed number. ($e \approx 2.71828\dots$)

 **Common logarithm key**

Used to obtain the logarithm with the base 10.

 **Natural logarithm key**

Used to obtain the logarithm with the base e. ($e \approx 2.71828\dots$)

EXP Enter exponent key

Used to enter an exponent of a number when working in scientific notation.

Ex. $2.3 \times 10^{12} \rightarrow 2.3 \text{ EXP } 12$

$2.3 \times 10^{-6} \rightarrow 2.3 \text{ EXP } 6 \text{ } \frac{\square}{\square}$

$10000 \rightarrow 1 \text{ EXP } 4$

Note: If an exponent of more than 2 digits is entered, only the last 2 digits are accepted.

Ex. $5 \text{ EXP } 123 \rightarrow 5. \text{ } 23$

SYMBOL

— Minus symbol

Appears when a displayed number is negative.

OVERFLOW ERRORS

There are several situation which will cause an overflow or an error condition. When this occurs, all of the zeros and decimal points will be displayed. The **[C]** key must be used to reset the error condition.

Note: The contents of the memory at the time of the error is retained.

The following will cause an overflow or error:

1. When the integer portion of the absolute value of any result is greater than 1×10^{99} or smaller than 1×10^{-99} .
2. When any number is divided by zero.
3. If x and/or y satisfy the following conditions when calculating functions.

functions	condition of error
$\sin x$ $\cos x$	$ x > 572957.81$ $0 < x < 1 \times 10^{-99}$
$\tan x$	$ x > 572957.81$ $x = 90(2n - 1) \pm 0.005$ $0 < x < 1 \times 10^{-99}$ * $n = \text{integer}$

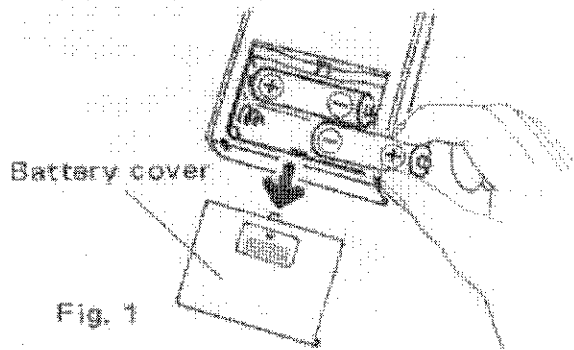
functions	condition of error
$\sin^{-1} x$ $\cos^{-1} x$	$ x > 1$ $ x \leq 1 \times 10^{-39}$
$\ln x$ $\log x$	$x \leq 0$
e^x	$x \geq 230.25851$ $x \leq -227.95593$
y^x	$y \leq 0, x \ln y \geq 230.25851$ $x \ln y \leq -227.95593$
$1/x$	$x = 0$
$\sqrt{x}$	$x < 0$

BATTERY REPLACEMENT

1. Set the power switch at off position.
2. Remove the battery cover sliding it in the direction of the arrow on the cover (Fig. 1).
3. Insert the batteries. Be sure that the "+" and "-" mark on the battery correspond to the "+" and "-" mark in the case.
4. Dimming of the display indicates that the dry batteries are exhausted. In this case replace the dry batteries with new ones.

(The left most digit and right most digit become dimmer than the other digits.)

Note: Always replace both batteries at the same time.



OPERATIONS

Before operation

- Entering numbers

Entries may contain a maximum of 8 digits (7 decimals). Additional digits entered will be ignored.

Example:

Enter	Display
123456789.	12345678.
1.23456789	1.2345678

When entering numbers using scientific notation:

1. The mantissa may contain a maximum of 6 digits (5 digits if negative). If more than 6 digits are entered, use of the **EXP** key will be ignored.

Example:

Enter	Display
123456 EXP 78	123456. 78
1234567 EXP 8	12345678.

2. The exponent portion of the entry may contain 2 digits. If more than 2 digits are entered, only the last 2 digits entered will be accepted.

Example: Enter Display
 5 **EXP** 123 5. 23

- Reading answers
 All answers exceeding 8 integers or with an absolute value smaller than .01 (example ± .0099) will automatically be converted into scientific notation and will be displayed with a 6 digits (5 digits if negative) mantissa and a 2 digits exponent.
- To obtain an accurate result, be sure to perform the following operation before starting calculations.

(display)

Power switch "ON" → 0.

11111111 **X** **=** → 1.23456 14

1) Addition (Subtraction) & Multiplication (Division)

Ex. 1 $123 - 45.6 + 789 =$

Operation	Display	Note
123 $\boxed{-}$ 45.6 $\boxed{+}$ 789 $\boxed{=}$	866.4	Ans.

Ex. 2 $56789 \times (-246) \div 0.12 =$

Operation	Display	Note
56789 $\boxed{\times}$	56789.	
246 $\boxed{\div}$ $\boxed{+/-}$	-13970094.	$56789 \times (-246)$
12 $\boxed{\div}$ $\boxed{=}$	-1.1641 08	Ans.

Ex. 3 $(2.3 \times 10^5 + 6.76 \times 10^6) \div (1.25 \times 10^{-12}) =$

Operation	Display	Note
2.3 $\boxed{\text{EXP}}$ 5 $\boxed{+}$ 6.76 $\boxed{\text{EXP}}$ 6 $\boxed{+}$	6990000.	$2.3 \times 10^5 + 6.76 \times 10^6$
1.25 $\boxed{\text{EXP}}$ 12 $\boxed{\div}$ $\boxed{=}$	5.59200 18	Ans.

2) Constant Calculation

* Constant: Multiplicand or Divisor

Ex. 1 Constant multiplication

$$\begin{aligned} 3 \times 5 &= \dots\dots\dots \textcircled{1} \\ 3 \times 10 &= \dots\dots\dots \textcircled{2} \\ 3 \times (-15) &= \dots\dots\dots \textcircled{3} \end{aligned}$$

Operation	Display	Note
3 $\times$ 5 =	15.	$\textcircled{1}$
10 =	30.	$\textcircled{2}$
15 $\times$ =	-45.	$\textcircled{3}$

Ex. 2 Constant division

$$\begin{aligned} 15 \div 3 &= 5 \dots\dots\dots \textcircled{1} \\ 30 \div 3 &= 10 \dots\dots\dots \textcircled{2} \\ (-45) \div 3 &= -15 \dots\dots\dots \textcircled{3} \end{aligned}$$

Operation	Display	Note
15 $\div$ 3 =	5.	$\textcircled{1}$
30 =	10.	$\textcircled{2}$
45 $\div$ =	-15.	$\textcircled{3}$

3) Square Calculation & Power Calculation

Ex. $((4^3)^2)^2 = 4^{12} =$

Operation	Display	Note
4 $\times$ $=$ $=$	64.	4^3
$\times$ $=$	4096.	$64^2 (4^6)$
$\times$ $=$	16777216.	$4096^2 (4^{12})$

- This calculation is also possible by using $[y^x]$ key.

4) Application

Ex. 1. Ratio calculation

$$\begin{array}{r} 123 \\ 123 + 456 + 789 \end{array} = \dots \textcircled{1}$$

$$\begin{array}{r} 456 \\ 123 + 456 + 789 \end{array} = \dots \textcircled{2}$$

$$\begin{array}{r} 789 \\ 123 + 456 + 789 \end{array} = \dots \textcircled{3}$$

Operation	Display	Note
123 $\div$ 456 $\div$ 789 $=$	1.	
123 $=$	0.0899122	①
456 $=$	0.3333333	②
789 $=$	0.5767543	③

5) Memory Calculation

Ex. 1

$$\begin{array}{rcl}
 46 + 78 & = & \text{①} \\
 +) 125 - 59 & = & \text{②} \\
 -) 72 + 86 & = & \text{③} \\
 \hline
 \text{Total} & = & \text{④}
 \end{array}$$

Operation	Display	Note
C X-M 46 $+$ 78 M+	124.	①
125 $-$ 69 M+	66.	②
72 $+$ 86 $=$ M+	-158.	③
RM	32.	④

- When starting memory calculation, depress **C** and **STO** keys to clear the content in the memory.
- When subtracting the result from the content of memory, depress **C** and **M+** keys.

Ex. 2 $(87,654 + 42,753) \times (100,000 - 20,453) =$

Operation	Display	Note
87654 STO 42753 M+	42753.	* The depression of the Numeral and STO keys can also clear the previously stored contents in the memory. Ans.
1 EXP 5 = 20453 X	79547.	
RM =	1.03734 10	

Ex. 3

$572 \times 62 = \dots\dots\dots ①$
 $+) 896 \div 5 = \dots\dots\dots ②$
 $-) 346 \times 32 = \dots\dots\dots ③$
 Total $\dots\dots\dots ④$

Operation	Display	Note
C STO 572 X 62 M+	35464.	①
896 ÷ 5 M+	179.2	②
346 X 32 C M+	-11072.	③
RM	24571.2	④

6) Functional Calculations

- The accuracy of functions will be described in "SPECIFICATIONS".

1. Degree/Minute/Second $\leftrightarrow$ Decimal deg. conversion ($\rightarrow$)

Ex. 1 $24^{\circ}45'54'' =$

Ex. 2 $72^{\circ}43'' =$

Operation	Display	Note
24 $\rightarrow$ 45 $\rightarrow$ 54 $\rightarrow$	24.765	24.765°
72 $\rightarrow$ 0 $\rightarrow$ 43 $\rightarrow$	72.011944	72.011944°

- If the $\rightarrow$ key is depressed after entry of second, it is converted as new degree/minute/second.

Ex. 3 $35.5748^{\circ} =$

Ex. 4 $12.7^{\circ} =$

Operation	Display	Note
35.5748	35.5748	35°
$\rightarrow$ arc $\rightarrow$	34.488	$34'$
$\rightarrow$ arc $\rightarrow$	29.28	$29''$
12.7	12.7	12°
$\rightarrow$ arc $\rightarrow$	42	$42'$

2. Time Calculation

Ex. 5 hrs. 24 min. 36 sec.
 +) 11 hrs. 12 min. 18 sec.

 16 hrs. 36 min. 54 sec.

Operation	Display	Note
5	5.	} 5 hrs. 24 min. 36 sec.
24	5.4	
36	5.41	
X-M	5.41	} 11 hrs. 12 min. 18 sec.
11	11.	
12	11.2	
18	11.205	
M+	11.205	
RM	16.615	} 16 hrs. 36 min. } ans. 54 sec.
arc	36.9	
arc	54	

3. Trigonometric functions (sin, cos, tan)

Ex. 1 $\sin 63^\circ =$

Ex. 2 $\cos \frac{\pi}{4} =$

Ex. 3 $\tan 135^\circ =$

Operation	Display	Note
63 sin	0.8910065	Ans.
$\pi \div 4 =$	0.7853981	
cos	0.9999061	Ans.
135 tan	-1.	Ans.

4. Inverse trigonometric functions (arc sin , arc cos , arc tan)

The result of inverse trigonometric functions should be in the limit as shown below.

$$\theta = \sin^{-1} x \dots\dots -90^\circ \leq \theta \leq 90^\circ$$

$$\theta = \cos^{-1} x \dots\dots 0^\circ \leq \theta \leq 180^\circ$$

$$\theta = \tan^{-1} x \dots\dots -90^\circ \leq \theta \leq 90^\circ$$

Ex. 1 $\sin^{-1} 0.5 =$

Ex. 2 $\cos^{-1} 0.43 =$

Ex. 3 $\tan^{-1} 1 =$

Operation	Display	Note
.5 arc sin	30.	Ans.
.43 arc cos	64.53244	Ans.
1 arc tan	45.	Ans.

5. Exponential function (e^x)

Ex. 1 $e^{-123} =$

Operation	Display	Note
123 $\frac{1}{x}$ e^x	3.81749 - 54	Ans.

6. Logarithmic functions ($\ln$, $\log$)

Ex. 1 $\ln 7 =$

Ex. 2 $\log 35 =$

Operation	Display	Note
7 $\ln$	1.94591	Ans.
35 $\log$	1.544068	Ans.

7. Common antilog or 10^x

Ex. 10^x where $x = 1.39794$

Operation	Display	Note
10 y^x 1.39794 $=$	2.3025852 25.	Ans.

8. Power function (y^x)

Ex. 1 $(24 + 37)^{18.7} =$

Ex. 2 $8^{1/3} =$

Ex. 3 $24^{-8} =$

Operation	Display	Note
24 $+$ 37 $=$ y^x 18.7 $=$	2.43034 33	Ans.
8 y^x 3 $1/x$ $=$	2.	Ans.
24 y^x 8 $1/x$ $=$	9.08469 - 12	Ans.

9. Reciprocal calculation (1/x)

Ex. $\frac{1}{\frac{1}{45} + \frac{1}{30}} =$

Operation	Display	Note
45 1/x + 30 1/x = 1/x	0.0555555 18.	$\frac{1}{45} + \frac{1}{30}$ Ans.

10. Square root extraction (√)

Ex. 1 $\sqrt{75 + 91} \times \sqrt{24} =$

Ex. 2 $2 \times \pi \times \sqrt{\frac{397}{980}} =$

Operation	Display	Note
75 + 91 = √	12.884098	$\sqrt{75 + 91}$
× 24 √ =	63.11893	Ans.
397 ÷ 980 = √	0.6364762	
× 2 × π =	3.9990981	Ans.

Applications

Ex. Base to base transformation of logarithm

Formula $\log_a b = \frac{\log b}{\log a}$

In the case of Falls $a = 3, b = 57$

Operation	Display	Note
3 log x-m 57 log + RM =	3.6801445	Ans.

Ex. 2 Hyperbolic function

Formula:

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

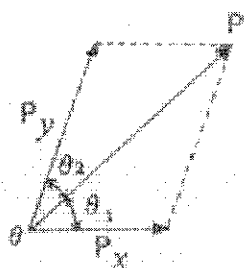
$$\cosh x = \frac{e^x + e^{-x}}{2}$$

$$\tanh x = \frac{e^{2x} - 1}{e^{2x} + 1}$$

sin h 0.6 =

Operation	Display	Note
.6 e^x $y \rightarrow M$ $1/x$ $\frac{1}{x}$ $M+$ RM $\div$ 2 $=$	0.6366537	Ans.

Ex. 3 Resolution of vector.



Formulas

$$P = 22.5 \text{ kg}, \quad \theta_1 = 47^\circ, \quad \theta_2 = 24^\circ$$

$$P_x =$$

$$P_y =$$

$$P_x = \frac{P \times \sin \theta_2}{\sin (\theta_1 + \theta_2)} = \frac{22.5 \times \sin 24^\circ}{\sin (47^\circ + 24^\circ)} \text{ (kg)}$$

$$P_y = \frac{P \times \sin \theta_1}{\sin (\theta_1 + \theta_2)} = \frac{22.5 \times \sin 47^\circ}{\sin (47^\circ + 24^\circ)} \text{ (kg)}$$

Operation	Display	Note
47 + 24 = sin	0.9456186	
24 sin X 22.5	22.5	
$\div$ RM =	9.6788954	P_x Ans.
47 sin X 22.5 $\div$ RM =	17.403632	P_y Ans.

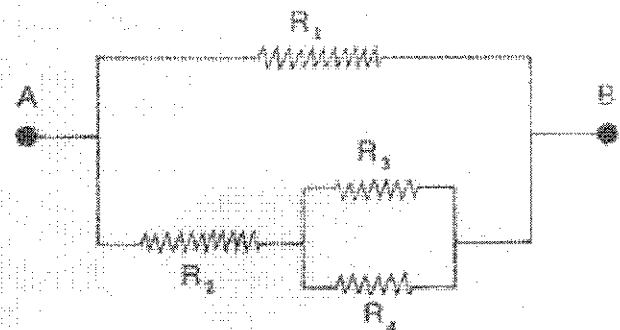
Ex. 4 Resistance calculation

Resistance between A and B:

$$R_{AB} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2 + \frac{1}{\frac{1}{R_3} + \frac{1}{R_4}}}}$$

In the case of

$$\begin{aligned} R_1 &= 20\Omega \\ R_2 &= 30\Omega \\ R_3 &= 40\Omega \text{ and} \\ R_4 &= 50\Omega \end{aligned}$$

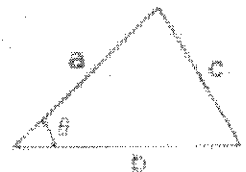


Operation	Display	Note
40 $1/x$ + 50 $1/x$ =	0.045	
$1/x$ + 30 = $1/x$	0.0191489	
+ 20 $1/x$ = $1/x$	14.461538	Ans. Ω

Ex. 5 Cosine theorem

Formula $C = \sqrt{a^2 + b^2 - 2ab \cos \theta}$

In the case of $a = 14.7 \text{ cm}$, $b = 17.8 \text{ cm}$ and $\theta = 43^\circ 32' 54''$



Operation	Display	Note
14.7 $\times$ = $\rightarrow$ AM	216.09	
17.8 $\times$ M+ 43 $\rightarrow$	43.	
32 $\rightarrow$ 54 $\rightarrow$ COS	0.7247935	
$\times$ 2 $\times$ 14.7 $\times$ 17.8	17.8	
$\rightarrow$ M+ RM $\rightarrow$	12.3948	C Ans.

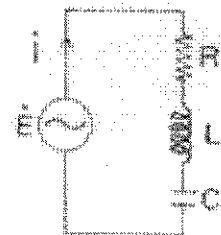
Ex. 6 Calculation of impedance of AC circuit

(Formula)

$$|Z| = Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\theta = \tan^{-1} \frac{\omega L - \frac{1}{\omega C}}{R}$$

Here, $\omega = 2\pi f$



Calculate impedance Z and phase angle θ of the AC circuit shown above. Here, $R = 100$ $[\Omega]$, $L = 4$ $[H]$, $C = 3$ $[\mu F]$, $E = 100$ $[V]$ and $f = 60$ $[Hz]$
(calculation)

$$Z = \sqrt{100^2 + \left(2 \times \pi \times 60 \times 4 - \frac{1}{2 \times \pi \times 60 \times 3 \times 10^{-6}}\right)^2} \quad [\Omega]$$

$$\theta = \tan^{-1} \frac{2 \times \pi \times 60 \times 4 - \frac{1}{2 \times \pi \times 60 \times 3 \times 10^{-6}}}{100}$$

(Key operation)

$$2 \times \pi \times 60 \times 4 = 1507.96 \quad 3 \times 10^{-6} = 3 \times 10^{-6}$$

$$\rightarrow 1/x \div 100 = 1.50796 \times 10^{-4} \rightarrow 80.8921 \quad (\theta)$$

$$RM \times = 100 \times 1.50796 \times 10^{-4} \rightarrow 631.73521 \quad (Z)$$

Correction of errors

Ex. 1 When $123 + 455$ is to be corrected to $123 + 456$:

Operation	Display	Note
$123 + 455$	455.	
CE	0.	
$456 =$	579.	Ans. $123 + 456$

Ex. 2 When $7 \times$ is to be corrected $7 \div 8$:

Operation	Display	Note
$7 \times$	7.	
$\div$	7.	
$8 =$	0.875	Ans.

- When any of 4 arithmetical calculations keys ($+$, $-$, $\times$, $\div$) is set by mistake, it is corrected by depressing anew a desired key.

SPECIFICATIONS

Model: EL-500

Display capacity: Floating decimal point display: 8 digits

Exponent display: Mantissa 6 digits (5 digits in negatives)
Exponent 2 digits

Calculation range:

- Entry and four arithmetic calculations:

1st operand, 2nd operand results: $1 \times 10^{-99} \sim 9.99999 \times 10^{99}$
 $-1 \times 10^{-99} \sim -9.99999 \times 10^{99}$

- Functional calculations:

Functions	Max. error	Calculation range	Remarks
$\sin x$	± 3 at the 7 digit	$ x \leq 720$	When the value of x is out of the range of left calculation, the accuracy is low.
$\cos x$			
$\tan x$		$ x \leq 360$	

Functions	Max. error	Calculation range	Remarks
$\sin^{-1} x$ $\cos^{-1} x$	± 3 at the 7 digit	$1 \times 10^{-30} < x \leq 1$	When the value of x is in the vicinity of 0 or ± 1 , the accuracy is low.
$\tan^{-1} x$	± 2 at the 7 digit	All area that the entry is available	When the value of x is in the vicinity of 0 and $x > 1000$ the accuracy is low.
$\ln x$ $\log x$	± 2 at the 7 digit ± 3 at the 7 digit	$x > 0$	When the value of x is in the vicinity of 1, the accuracy is low.
e^x	± 5 at the 7 digit	$-227.95593 < x < 230.25851$	When the value of x is in the vicinity of 0, the accuracy is low.
y^x	± 5 at the 6 digit	$y \geq 1.1$	When the value of y is in the vicinity of 1, the accuracy is low.

Functions	Max. error	Calculation range	Remarks
$1/x$	_____	All area that the entry is available (except 0)	
$\sqrt{x}$	_____	$x \geq 0$	

Decimal point:

Floating decimal point system or scientific notation

Sign:

Minus sign appears for mantissa and exponent.

Calculations:

Four arithmetic calculations, constant calculation, square calculation, power calculation, memory calculation, trigonometric function, inverse trigonometric function, exponential function, logarithmic function, y to the x power calculation, degree/minute/second $\leftrightarrow$ decimal notation degree conversion, reciprocal calculation, square root calculation and practical calculations.

Components:

LSI

Display:

Fluorescent display tube

Power supply:

D.C.: 3V, type AA battery x 2

A.C.: AC 120V, 60Hz (with the use of optionally available
AC adaptor (EA-17))

Operating time: Mangan long-life dry battery: Approx. 10 hours in the case of continuous operation.
Display: 5555, ambient temperature: 20°C (68°F)
The operating time slightly varies depending upon the use or type of battery.

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

Power consumption: D.C.: 3V, 0.2W (in the case of type AA dry battery)

Dimensions: 30(H) x 80(W) x 138(D) mm,
1-3/16"(H) x 3-1/8"(W) x 5-13/32"(d)

Weight: 210g (0.46 lbs.) (with dry batteries)

Accessories: Type AA dry battery x 2, carrying case.

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