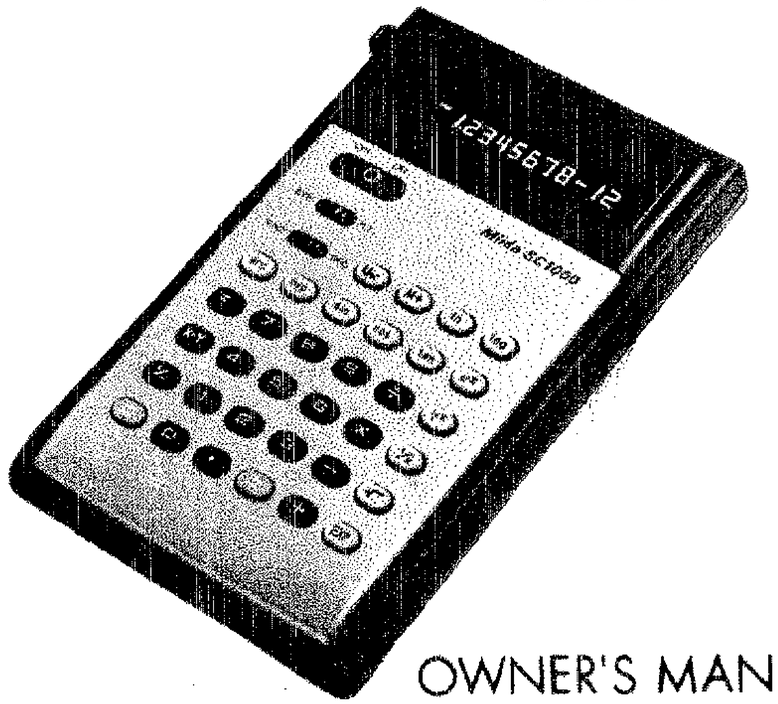
Miida

SC 1000

PORTABLE
SCIENTIFIC
CALCULATOR



OWNER'S MANUAL

Thank you for purchasing our Portable "Scientific" Calculator Model SC1000. Please read this manual carefully to obtain maximum use of our new calculator.

CONTENTS

PRECAUTIONS

1. This calculator incorporates precision electronic components such as LSI. Use or storage of the calculator in the following places must be avoided.
   * Places subject to abrupt temperature changes
   * Places where humidity is extremely high
   * Dusty places
   * Places subject to direct sunlight
2. In cleaning the calculator, do not use volatile solvents or a wet cloth. Always use a dry, soft cloth.
3. If the calculator is to be stored for a period of more than a month, remove the batteries from the calculator.
4. When the power switch is turned on or off, allow two seconds or more between switching on or off. Repeated switching will result in random numeral display. (Depress the ⓒ key to clear the displays.)

SPECIFICATIONS

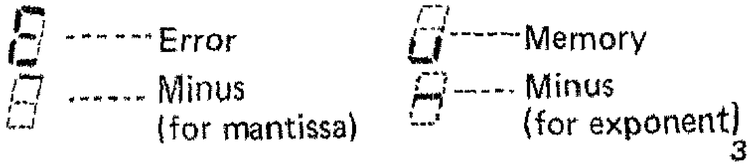
Model:	SC1000
Number of digits:	8 digits for mantissa 2 digits for exponent
Signs:	"E", "U" and "-" signs are displayed at the 1st digit and the other "-" sign is displayed in front of exponent (at the 10th digit).

"E" . . Error condition has occurred and machine is locked electrically.

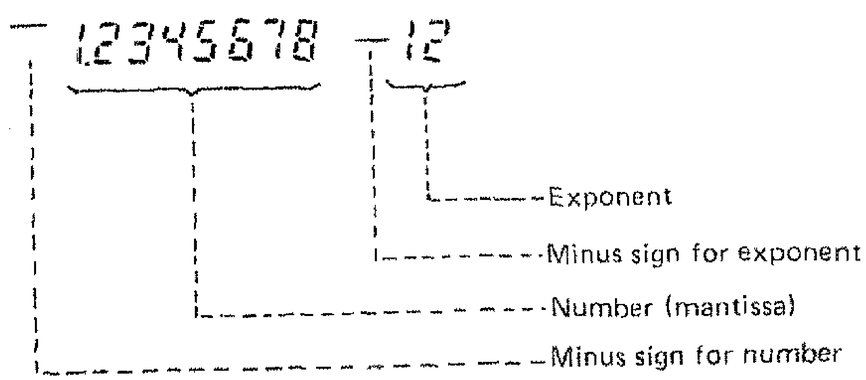
"U" . . U sign means that the memory is in use.

"-"
a) In front of number (mantissa)
Minus condition has occurred

"-"
b) In front of exponent.
The displayed number (mantissa) is less than |1|. For example "–23" means "$x10^{-23}$".



Display format:



Element: 1 LSI-chip

Operation method: Four basic calculations by algebraic notation.
Scientific calculations by individual and corresponding function keys.

Calculation capacity: $10^{-99} \leq |\text{number}| < 10^{100}$

Types of operation:

- Four basic operations
- Chain calculations
- Mixed calculations
- Constant-referenced calculations
- Reciprocal calculations
- Power calculations
- Memory calculations

Functional calculations

(1) Trigonometric function (sin x, cos x, tan x)
(2) Inverse trigonometric ($\sin^{-1}$ x, $\cos^{-1}$ x, $\tan^{-1}$ x)
(3) Hyperbolic trigonometric (sin hx, cos hx, tan hx)
(4) Logarithmic function (log x, ln x)
(5) Exponential function (10^x, e^x)
(6) Square root calculation ($\sqrt{x}$)
(7) Reciprocal calculation (1/x)
(8) Power calculation (y^x)
(9) Circular constant (π)
(10) Exchange function ($x \leftrightarrow y$)

Limit of calculation:

Divider $\neq 0$

Power (y^x); $y > 0$

Square root ($\sqrt{\ }$); $x \geqq 0$

Logarithmic function (ln x, log x); $x > 0$

Inverse trigonometric function (arc sin x, arc cos x); $|x| \leqq 1$

Trigonometric function (tan x)

$|x| \neq 90^\circ \times n$ (n: positive odd number)

or $|x| \neq \frac{\pi}{2} \times n$ (n: positive odd number)

Display coverage (x: displayed number)

$10^{-99} \leqq |x| \leqq 9.9999999 \times 10^{99}$

Calculation accuracy: Four basic calculations, 1/x, $\sqrt{\ }$, π,

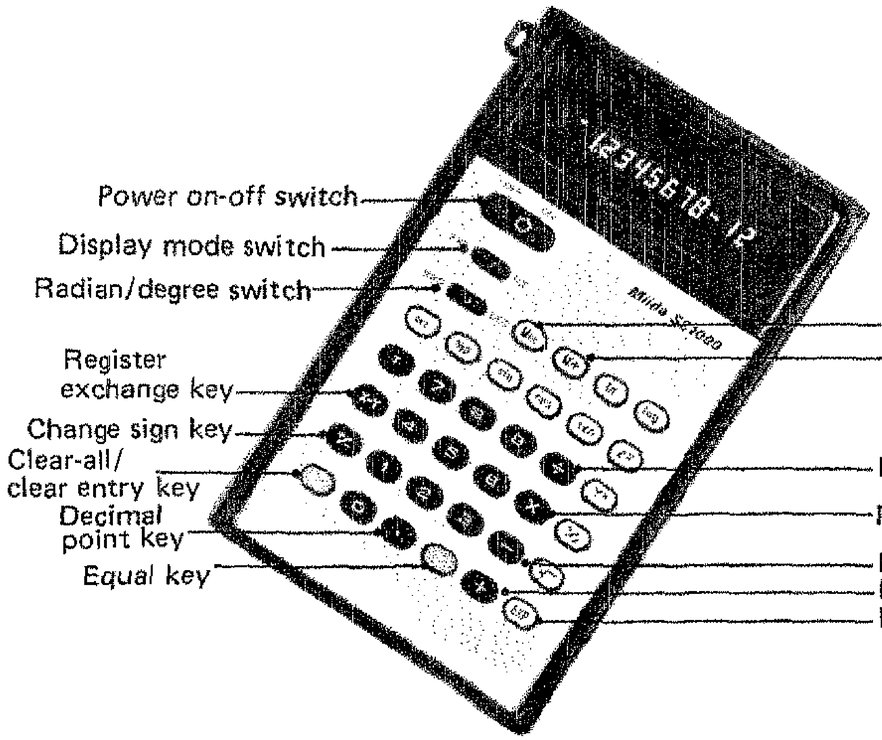
memory	8 digits
sin x, cos x	7 digits
tan x	5 digits
$\sin^{-1}$ x, $\cos^{-1}$ x, $\tan^{-1}$ x	6 digits
sin hx, tan hx	4 digits
cos hx	5 digits
e^x	6 digits
ln x	4 digits
log x	5 digits
y^x	4 digits

Calculating time (maximum):

Four basic calculations, 1/x, $\sqrt{\ }$	0.2 sec.
ln x, log x, e^x	0.3 sec.
y^x, sin hx, cos hx, tan hx	0.4 sec.
$\sin^{-1}$ x, $\cos^{-1}$ x, $\tan^{-1}$ x	0.5 sec.
sin x, cos x, tan x	0.6 sec.

Ambient operating temperature:	
	0° – 40°C (32° – 104°F)
Power source:	DC 6V (4 penlight dry batteries)
	AC 120V ±10%, 60Hz
	(with AC adaptor type AD2860)
Operating duration:	12 hours (Manganese battery)
	20 hours (Alkaline battery)
Power consumption:	DC 0.6 Watt
Dimensions:	3.82"(W), 6.34"(D), 1.08"(H)
Weight:	Approx. 0.73 lbs.
Accessories:	4 penlight dry batteries
	1 carrying case
Optional accessory:	AC adaptor type AD2860

NAMES OF PARTS



- arc Inverse trigonometric function ke
- sin Trigonometric sine function key
- cos Trigonometric cosine function ke
- tan Trigonometric tangent function k
- ln Natural logarithmic key
- log Common logarithmic key
- π Circular constant key
- √ Square root key
- e^x Exponential function key
- hyp Hyperbolic function key
- y^x Power function key
- $\frac{1}{x}$ Reciprocal function key

KEY AND SWITCH FUNCTIONS

Power ON/OFF switch

Sliding the switch to the side marked "ON" turns on the calculator. The number "0" will then appear on the left side of the display panel and two zeroes "00" on the right side on the display panel.

The automatic clear system used in this calculator permits the operator to begin calculation immediately after power is turned on.

Display mode switch

Sliding the switch to the side marked "EXP" switches the display mode to the exponential display mode. For example, the number 123 will be indicated as 1.23×10^2 on the display panel.

Sliding the switch to the side marked "FLT" switches the exponential display mode (1.23×10^2) to the floating decimal point mode (123).

Any number in the range from 0.0000001 to 99999999 is displayed as keyed-in. Any number less than 0.0000001 is displayed as "0" and any number exceeding 99999999 is displayed in the exponential mode.

Clear-all/clear entry key

C — Depressing the key twice consecutively after a numeral key or once after a function key clears the contents of all registers except the memory register. Depressing the key once after a numeral key clears the displayed numerals only, thus serving for entry error correction.

Numeral keys

0 ~ 9 — These keys are used to enter desired numerals for calculation. The numerals corresponding to the keys depressed are displayed on the display panel.

Decimal point key

• — This key represents the decimal point. In case a number less than 1 is entered, the "zero" 0 key need not be depressed before depressing the decimal point key. For example, the number 0.2 can be entered by depressing the keys • and 2 in this order.

Division key

÷ — This key is used for division calculations. Depress the key in the same order as an algebraic notation.

Multiplication key

This key is used for multiplication calculations. Depress the key in the same order as an algebraic notation.

Minus key

This key is used for subtraction calculations. Depress the key in the same order as an algebraic notation.

Plus key

This key is used for addition calculations. Depress the key in the same order as an algebraic notation.

Equal key

This key is used to obtain the calculation result. It is also used for constant calculation.

Change sign key

This key is used to change the sign of a numeral entry, a numeral in the middle of a calculation process or a numeral obtained in the result.

Register exchange key

This key is used to exchange the data stored in the display register and calculation register.

Exponential key

This key is used to enter a number with an exponential notation. For example, the number 1.23×10^5 is entered by depressing the keys ,  ,  ,  , and  in this order.

Memory recall/clear key

This key is used to display or clear the contents of the memory register. Depressing the key once causes the contents of the memory register to be displayed and also serves as an entry key. Depressing the key twice consecutively clears the contents of the memory register.

Memory plus key

This key is used to add the contents of the display register to the contents of the memory register, without changing the contents of the display register.

Reciprocal function key

(1/x) This key is used to calculate the reciprocal of the number displayed and then to display the reciprocal obtained.

Power function key

(Y^x) This key is used to raise to any power the numeral entered before depression of the (Y^x) key, in the exponent of the numeral entered after depression of the (Y^x) key.

Radian/degree switch

RAD ◼ DEG Sliding the switch to the side marked "RAD" indicates the displayed numeral in radian and sliding to the side marked "DEG" indicates the displayed numeral in degree. The "RAD" and "DEG" positions are independent of calculations involving neither radian nor degree.

Square root key

(√) This key is used to obtain the square root of the number displayed.

Circular constant key

(π) This key serves as an entry key. Depressing this key causes the circular constant 3.1415926, also known as Pi, to be displayed.

Exponential function key

(e^x) Any power of "e" is obtained by depressing this key.

Natural logarithmic key

(ln) This key is employed for calculations of natural logarithmic functions.

Common logarithmic key

(log) This key is employed for calculations of common logarithmic functions.

Sine key

(sin) This key is employed for calculations of trigonometric sine functions. Depression after the (arc) key permits the operator to calculate the inverse sine ($\sin^{-1}$). Depression after the (hyp) key permits the operato to calculate the hyperbolic sine (sin h).

Cosine key

(cos) This key is employed for calculations of trigonometric cosine functions. Depression after the (arc) key permits the operator to calculat the inverse cosine ($\cos^{-1}$). Depression after the (hyp) key permits th operator to calculate the hyperbolic cosine (cos h).

Tangent key

(tan) This key is employed for calculations of tangent functions. Depression after the (arc) key, permits the operator to calculate the inverse tangent ($\tan^{-1}$). Depression after the (hyp) key permits the operator to calculate the hyperbolic tangent (tan h).

Inverse function key

(arc) Depressing this key before the (sin) (cos) or (tan) key, permits the operator to calculate inverse trigonometric functions.

Hyperbolic function key

(hyp) Depressing this key before the (sin) (cos) or (tan) key, permits the operator to calculate the hyperbolic function of each corresponding trigonometric function.

POWER SUPPLY

1. This calculator operates on either dry batteries (DC) or normal household power with the aid of optional AC adaptor AD2860.
2. When an AC power source is used, connect the power cord of AC adaptor AD2860 to the calculator, then insert the adaptor cord into the household power outlet before turning the power switch on.
3. Do not use an AC adaptor other than the AD2860, since use of any other adapto may result in damage to the calculator.
4. When the DC power source is to be used, make sure the AC adaptor is disconnected from the calculator before you switch on the calculator. (If the AC adaptor power cord is connected to the calculator, the batteries will not operate. Be sure to disconnect the cord for DC operation.)
5. When the display becomes dim and/or no figures are displayed when operating or dry batteries, the batteries are exhausted. Replace with new ones (4 penlight dry batteries).

BATTERY REPLACEMENT

The display will become dim after manganese batteries have been used for 12 hours or after alkaline batteries have been used for 20 hours. When this occurs, replace the batteries in the following manner.

1. Turn off the calculator power switch.
2. Remove the battery cover from the calculator.
3. Remove the old batteries from the battery compartment.
4. Place the new batteries in the battery compartment according to the polarity marks ⊕ and ⊖ printed in the battery compartment.
5. Replace the battery cover after the batteries are inserted.
   (The batteries used in this calculator are penlight batteries sold in retail stores.)

PROCEDURES FOR CALCULATIONS

Preparatory Procedures

(1) Use the calculator as is when operating on batteries. When an AC power source is used, connect the AC adaptor to the calculator, then turn on the calculator power switch.

(2) In the event of an incorrect entry, clear the entry by depressing the ⓒ key, then enter the correct entry.

(3) Depress each key correctly. Unnecessary tapping on the keys may shorten the life of the calculator.

(4) Avoid simultaneous multiple depression of the keys.

Calculation Examples

(1) Four Basic Calculations

	KEY ENTRY	SIGN	DISPLAY	
[Example 1]	$(1.23 + 4.56 - 7.89) \times 1.47 \div 2.58 = -1.1965116$			
	[ON/C] [EXP] [FLT]		0.	00
	1.23 [+] 4.56 [−]		5.79	00
	7.89 [×] 1.47 [÷] 2.58 [=]	−	1.1965116	00
[Example 2]	$(1.23 \times 10^{5} + 4.56 \times 10^{5} - 7.89 \times 10^{5}) \times 1.47 \times 10^{9} \div 2.58 \times 10^{-13} = -1.1965116 \times 10^{27}$			
	[ON/C] [EXP] [FLT]		0.	00
	1.23 [EXP] 5 [+] 4.56 [EXP] 5 [−]		5.79	05
	7.89 [EXP] 5 [×] 1.47 [EXP] 9 [÷]	−	3.087	14
	2.58 [EXP] 13 [+/−] [=]	−	1.1965116	27

(2) Constant Calculations

	KEY ENTRY	SIGN	DISPLAY	
[Example 1]	3.6 + 4.2 = 7.8			
	5.7 + 4.2 = 9.9			
	[C] EXP [▭] FLT		0.	00
	3.6 [+] 4.2 [=]		7.8	00
	5.7 [=]		9.9	00
[Example 2]	8.9 − 13.8 = −4.9			
	6.7 − 13.8 = −7.1			
	[C] EXP [▭] FLT		0.	00
	8.9 [−] 13.8 [=]	−	4.9	00
	6.7 [=]	−	7.1	00

	KEY ENTRY	SIGN	DISPLAY	
[Example 3]	$6.01 \times 4.56 \times 10^{-2} = 2.74056 \times 10^{-1}$			
	$1.39 \times 4.56 \times 10^{-2} = 6.3384 \times 10^{-2}$			
	[ON/C] EXP [FLT]		0.	00
	6.01 [×] 4.56 [EXP] 2 [+/-] [=]		2.74056	−01
	1.39 [=]		6.3384	−02
[Example 4]	$9.96 \div 7.89 \times 10^{2} = 1.2623574 \times 10^{-2}$			
	$4.82 \div 7.89 \times 10^{2} = 6.1089987 \times 10^{-3}$			
	[ON/C] EXP [FLT]		0.	00
	9.96 [÷] 7.89 [EXP] 2 [=]		1.2623574	−02
	4.82 [=]		6.1089987	−03

(3) Memory Calculation

[Example] $(17.5 - 9.07) \times \frac{6.23 - 12.9}{9.07+3.81} = -4.3655357$

KEY ENTRY	SIGN	DISPLAY	
MRC MRC C EXP FLT		0.	00
17.5 − 9.07 M+		8.43	00
6.23 − 12.9 ×		6.67	00
MRC MRC = M+		56.2281	00
9.07 + 3.81 ÷		12.88	00
MRC MRC √ =	−	4.3655357	00

(4) Reciprocal Calculation

	KEY ENTRY	SIGN	DISPLAY	
[Example] $\frac{1}{1.23 + 4.56 - 7.89} = -4.7619047 \times 10^{-1}$				
	[2nd] [EXP] [FLT]		0.	00
	1.23 [+] 4.56 [−] 7.89 [=]	−	2.1	00
	[1/x]	−	4.7619047−01	

(5) Power Calculations

		KEY ENTRY	SIGN	DISPLAY
[Example]	$2^{55} = 3.6028723 \times 10^{16}$			
		C EXP FLT		0. 00
		2 y^x 55 =		3.6028723 16
[Example 2]	$123^{\frac{1}{12}} = 1.493338$			
		C EXP FLT		0. 00
		123 y^x 12 $1/x$ =		1.4933377 00

(6) Square Root Calculation

	KEY ENTRY	SIGN	DISPLAY
[Example] $\sqrt{3}$ = 1.7320508			
	[e] EXP [▭] FLT		0. 00
	3 [√]		1.7320508 00

(7) Circular Constant

	KEY ENTRY	SIGN	DISPLAY
[Example] $\pi r^2 = \pi \times 5^2 = 78.539815$ where r = 5			
	[e] EXP [▭] FLT		0. 00
	5 [x] [=] [x]		25. 00
	[π] [=]		78.539815 00

(8) Common and Natural Logarithmic Calculations

KEY ENTRY	SIGN	DISPLAY
log 123 = 2.089905		
ln 123 = 4.8121841		
e EXP FLT		0. 00
123 log		2.089905 00
123 ln		4.8121841 00

(9) Exponential Calculation

KEY ENTRY	SIGN	DISPLAY
[Example 1] $e^{22} = 3.5849101 \times 10^{9}$		
e EXP FLT		0. 00
22 e^x		3.5849101 09

(10) Trigonometric Calculations

		KEY ENTRY	SIGN	DISPLAY
[Example 1]	sin 30° = 0.5			
	cos 30° = 0.8660254			
	tan 30° = 0.5773501			
		ON RAD DEG EXP FLT		0. 00
		30 sin		0.5 00
		30 cos		0.8660254 00
		30 tan		0.5773501 00

	KEY ENTRY	SIGN	DISPLAY
[Example 2]	$\sin \frac{\pi}{6} = 0.49999997$		
	$\cos \frac{\pi}{6} = 0.86602545$		
	$\tan \frac{\pi}{6} = 0.57735016$		
	(MRC) (MRC) C		0. 00
	RAD (ON/C) DEG EXP (n) FLT		0. 00
	π ÷ 6 = (M+)	⌊⌋	5.2359876−01
	(MRC) sin	⌊⌋	4.9999997−01
	(MRC) cos	⌊⌋	8.6602545−01
	(MRC) (MRC) tan		5.7735016−01

(11) Inverse Trigonometric Calculations

	KEY ENTRY	SIGN	DISPLAY	
[Example 1]	$\tan^{-1}\sqrt{3}$ = 59.99998 or 1.0471972 radian			
	[C] EXP [▪] FLT		0.	00
	RAD [▪] DEG		0.	00
	3 [√] [arc] [tan]		59.99998	00
	RAD [▪] DEG		59.99998	00
	3 [√] [arc] [tan]		1.0471972	00
[Example 2]	$\sin^{-1}\frac{\sqrt{3}}{2}$ = 59.99998 $\cos^{-1}\frac{1}{2}$ = 60			
	[C] EXP [▪] FLT		0.	00
	RAD [▪] DEG		0.	00
	3 [√] [÷] 2 [=]		0.8660254	00
	[arc] [sin]		59.99998	00
	2 [1/x] [arc] [cos]		60.	00

(12) Hyperbolic Calculations

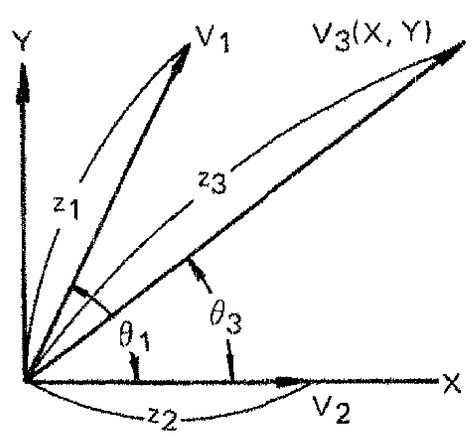
	KEY ENTRY	SIGN	DISPLAY
[Example]	sin h 0.2 $= 2.0133505 \times 10^{-1}$		
	cos h 230 $= 3.8610011 \times 10^{99}$		
	tan h $7.01 \times 10^{-3} = 7.0096779 \times 10^{-3}$		
	EXP FLT		0. 00
	0.2 hyp sin		2.0133505 −01
	230 hyp cos		3.8610011 99
	7.01 EXP 3 +/− hyp tan		7.0096779 −03

(13) Applications

[Example 1] VECTOR

Find the magnitude, angle, x and y of vector V3 according to the following formula.

* $x = z_2 + z_1 \cos\theta_1$
* $y = z_1 \sin\theta_1$
* z_3 (Magnitude) $= \sqrt{x^2 + y^2}$
* $\theta_3 = \tan^{-1}\frac{y}{x}$



where

$z_1 = 5, z_2 = 8, \theta_1 = 1.17$ (rad)

$x = 8 + 5 \times \cos 1.17 = 9.9507585$

$y = 5 \times \sin 1.17 = 4.6037529$

Answer:

$z_3 = \sqrt{(9.9507583)^2 + (4.6037529)^2}$

$= 10.964129$

$\theta = \tan^{-1}\frac{4.6037529}{9.9507583} = 0.4333266$ (rad)

$= 24.827774$ (degree)

(Radian/degree switch: RAD)

KEY ENTRY	SIGN	DISPLAY		NOTE
[MRC] [MRC] [C]		0.	00	
RAD [ON/C] DEG EXP [ON/C] FLT		0.	00	
1.17 [sin]		9.2075059	−01	
[×] 5 [=]		4.6037529	00	(y)
[×] [=] [M+]	⌴	2.119454	01	(y^2)
1.17 [cos]	⌴	3.9015171	−01	
[×] 5 [+] 8 [=]	⌴	9.9507585	00	(x)
[×] [=]	⌴	9.9017594	01	(x^2)
[÷] [MRC] [x⇄y] [=]	⌴	2.1404822	−01	(y^2/x^2)
[√]	⌴	4.626534	−01	(x/y)
[arc] [tan]	⌴	4.3332651	−01	(θ)
[x⇄y] [M+]	⌴	9.9017594	01	(x^2)
[MRC]	⌴	1.2021213	02	($x^2 + y^2$)
[√]	⌴	1.0964129	01	($Z_3 = \sqrt{x^2 + y^2}$

[Example 2] SETTING OF CIRCULAR CURVE (Civil engineering design)

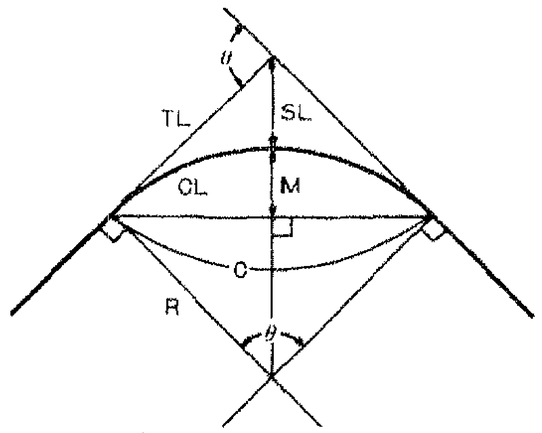
$$TL = R\tan\frac{\theta}{2}$$

$$C = 2R\sin\frac{\theta}{2}$$

$$M = R\left(1 - \cos\frac{\theta}{2}\right)$$

$$SL = R\left(\sec\frac{\theta}{2} - 1\right)$$

$$CL = R \cdot \theta$$



where

$R = 500$

$\theta = 100^\circ = \frac{100}{180} \cdot \pi$ radian

KEY ENTRY	SIGN	DISPLAY		NOTE
MRC MRC C		0.	00	
RAD DEG EXP FLT		0.	00	
100 ÷ 180 × π = M+		1.7453292	00	
× 500 =		8.726646	02	(CL)
MRC MRC ÷ 2 = M+		8.726646	−01	(θ/2)
MRC tan × 500 =		5.9587665	02	(TL)
MRC sin × 500 ×		3.8302221	02	
2 =		7.6604442	02	(C)
MRC cos +/− + 1 ×		3.572124	−01	
500 =		1.786062	02	(M)
MRC MRC cos 1/x − 1 ×		5.557236	−01	
500 =		2.778618	02	(SL)

[Example 3] TRANSIENT PHENOMENON (Electronic circuit)

Calculate the time required for voltage Ec to reach 1.5V, after the switch (SW) is closed in the attached diagram, where E=5V, c=4.7μF and R=100kΩ.

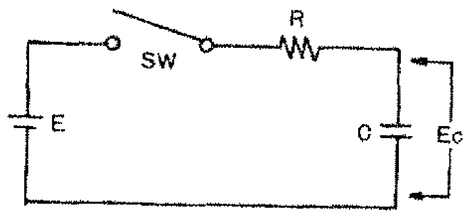
$$Ec = E\left(1 - e^{-\frac{t}{CR}}\right)$$

Answer:

$$\therefore t = -CR \ln \frac{E - Ec}{E}$$

$$= -4.7 \times 10^{-6} \times 100 \times 10^{3} \times \ln \frac{5 - 1.5}{5}$$

$$= 1.6763748 \times 10^{-1} \text{ sec.}$$



KEY ENTRY	SIGN	DISPLAY	NOT
C EXP FLT		0. 00	
5 − 1.5 ÷ ( ) =		7. −01	
ln	−	3.5667549−01	
× 100 × EXP 3 ×	−	3.5667549 04	
4.7 +/− EXP 6 +/− =		1.6763748−01	(t)

[Example 4] ELECTRON AND ELECTROMAGNETIC WAVE (Physics)

Assume that an electron present in the length of 4μ is in the ground state. Calculate maximum wave length of the electro-magnetic wave required to oscillate the electron.

Consider that the oscillation by an electromagnetic wave with a maximum frequency brings the ground state of the electron to its minimum oscillating state.

The energy required for oscillation is:

$$h\nu = \frac{h^2}{2mL^2} - \frac{h^2}{8mL^2} = \frac{3h^2}{8mL^2}$$

$$\therefore \nu = \frac{3h}{8mL^2} \qquad \therefore \lambda = \frac{C}{\nu} = \frac{8mL^2c}{3h}$$

where λ : Wave length

ν : Vibration frequency

c : Light velocity (2.998×10^5 m/s)

m : Mass (9.108×10^{-31} kg)

L : Length of section (4×10^{-6} m)

h : Plank constant (6.625×10^{-34} J·s)

Answer:

$$\lambda = \frac{8 \times 9.108 \times 10^{-31} \times (4 \times 10^{-6})^2 \times 2.998 \times 10^8}{3 \times 6.625 \times 10^{-34}} = 17.58561 \text{ m}$$

KEY ENTRY	SIGN	DISPLAY	NOT
[ON] EXP [CE] FLT			
8 [×] 9.108 [EXP] 31 [+/-]		9.108	−31
[×] 4 [EXP] 6 [+/-] [=] [=] [×]		1.165824	−40
2.998 [EXP] 8 [=]		3.4951403	−32
3 [÷] 6.625 [EXP] 34 [+/-]		6.625	−34
[=]		1.758561	01 (λ)

[Example 5] BAND BRAKE (Mechanical design)

In the band brake shown in the diagram, a brake torque of T=30,000 kg·mm is sought.
Given a=140mm, d=400mm and F=15kg, find the effective length of the brake bar where the frictional coefficient of the band and brake bar is μ=0.3 and the contact angle is θ=216°.

Braking force

$$P = \frac{T}{\frac{d}{2}}$$

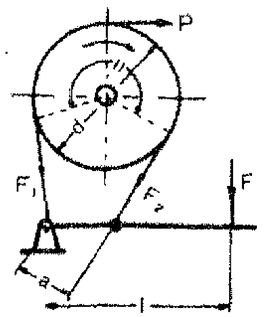
$$F_2 = P\frac{1}{e^{\mu\theta}-1} = \frac{2T}{d}\cdot\frac{1}{e^{\mu\theta}-1}$$

$$Fl = F_2 a$$

Answer: $$\therefore\ l = \frac{F_2}{F}a = \frac{1}{F}\cdot\frac{2T}{d}\cdot\frac{1}{e^{\mu\theta}-1}\cdot a$$

$$= \frac{2 \times 30000 \times 140}{15 \times 400 \times (e^{0.3 \times \pi \times 216 \div 180} - 1)}$$

$$= 667.0895 \fallingdotseq 667.1\text{mm}$$



KEY ENTRY	SIGN	DISPLAY	NOTE
C EXP FLT		0. 00	
0.3 × π × 216 =		203.57518 00	
180 ÷ sin − 1 =		2.0986686 00	$(e^{\mu\theta}$ —
1/x × 2 × 30000 ×		28589.55 00	
140 ÷ 15 ÷ 400 =		667.0895 00	(1)

[Example 6] DEPTH OF PN JUNCTION IN SEMICONDUCTOR (Physics)

A constant quantity of impurities attached to the surface of a semiconductor are diffused into the semiconductor. PN junction is made at depth x_0 :

$$x_0 = 2\sqrt{Dt}\ \left[\ln \frac{Q}{c\sqrt{\pi Dt}}\right]^{1/2}$$

where D : Diffusion constant $= 10^{-10}\ cm^2/sec$

t : Diffusion time $= 1.32 \times 10^4$ sec

Q : Impurity concentration $= 10^{17}/cm^2$

C : Acceptor concentration $= 10^4/cm^3$

Calculate the x_0

Answer:

$$x_0 = 2\sqrt{10^{-10}} \times 1.32 \times 10^4\ \left[\ln \frac{10^{17}}{10^4 \times \sqrt{\pi \times 10^{-10} \times 1.32 \times 10^4}}\right]^{1/2}$$

$$= 1.381 \times 10^{-2}\ cm$$

KEY ENTRY	SIGN	DISPLAY		NOTE
[MRC] [M-] [C]		0.	00	
EXP [CM] FLT		0.	00	
1.32 [EXP] 4 [×] [EXP] 10 [%] [=]		1.32	−06	(Dt)
[M+] [×] [π] [=] [√]	⌴	2.0363944	−03	$(\sqrt{\pi D}$
[×] [EXP] 4 [÷] [EXP] 17 [x-y] [=]	⌴	4.91064	15	$(C\frac{C}{\sqrt{\pi L}}$
[ln] [√]	⌴	6.010838	00	
[×] [MRC] [√] [×] 2 [=]	⌴	1.3811853	−02	(x_0)

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