Instruction Manual

Model SC-635

TABLE OF CONTENTS

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I. INTRODUCTION

Your new scientific calculator is the most advanced electronic instrument of its type available today. It is a natural extension in the progress of calculator technology. As this technology moves forward, more and more mathematical power is added. The power of the scientific calculator may be seen in the number of functions and the complexity of the mathematics it is capable of handling. It is truly an electronic slide rule, able to handle algebraic and trigonometric problems as well as being useful for basic arithmetic.

The ability to solve complex algebra and trigonometry, quickly and easily, is greatly enhanced by two level parenthetical capability. In stating an equation, information contained within parentheses generally defines a specific variable. The solution to this variable is computed and retained. This allows a problem to be entered very much as it is written or stated.

When required, a number may be entered and displayed in scientific notation. If the result of a calculation is sufficiently large or small, it will be displayed in scientific notation.

In addition to its scientific capability, your calculator may be used for business and personal computations and for many entertaining mathematical games. Some of the business and personal computations include money (cost, interest, taxes, commission etc.), weights and measures, home improvements etc.

The following is a list of features in your scientific calculator:

1. Number entry in floating point or scientific notation.
2. Automatic selection of floating point or scientific notation for result display.
3. Algebraic problem entry with two parentheses levels.
4. 8 digit precision for mantissa.
5. 2 digit precision for exponent.
6. Sign selection and display for both mantissa and exponent.
7. Basic arithmetic (+, −, ×, ÷).
8. Transcendental functions sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, log (common logarithm), ln (natural logarithm), e^x, y^x, 10^x.
9. Convenience functions ($\sqrt{x}$, $1/x$, x^2, n!)

10. Separate full function memory register for storage and/or accumulation of constants or intermediate results.
11. Full chain calculation with any sequence of functions desired.
12. Automatic error indications for overflow, underflow and forbidden operations.
13. Clear operations for system or entry clear.
14. Trigonometric functions performed using degree or radian entry.
15. Radian mode indicator light.
16. Factor reversal ($\downarrow \overset{x}{y} \uparrow$)
17. Separate π key.
18. Automatic display cutoff to conserve battery life.
19. Rechargeable battery.
20. A.C. operation while recharging.

Single function keys are used for all entries which helps eliminate ambiguity in entry operation. Placement and color coding has been carefully engineered for convenience and ease of operation. As you become familiar with the functional operation and keyboard arrangement, surprising operating speed can be developed. Manipulation of the

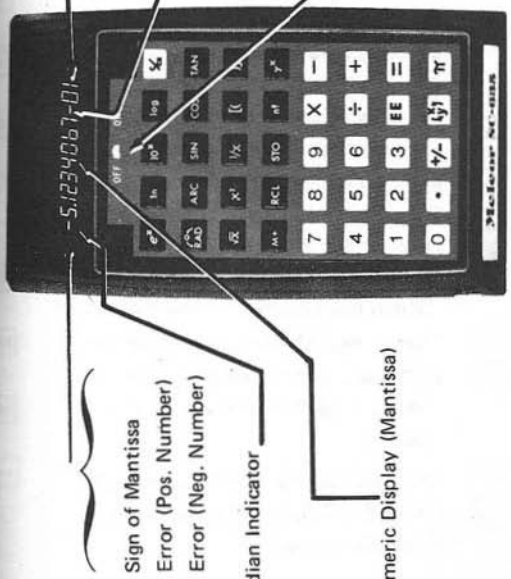
keyboard can be learned in much the same way one learns to type or play the piano.

Your calculator may be operated from its rechargeable batteries for 5 to 6 operating hours. It may also be operated from its battery charger while the batteries are being recharged. The normal recharge cycle is approximately 6 to 9 hours, when the calculator is not being operated. More time should be allowed when operating during charging.

CAUTION: DO NOT OPERATE UNIT FROM CHARGER WITHOUT BATTERY IN PLACE.

II. CONTROLS AND INDICATORS

A. Calculator Keyboard and Display Indicators



B. Symbols and Definitions

e^x Executes Natural Anti Log Function.

ln Executes Natural Log Function.

log Executes Common Log Function.

y^x Executes Prior Function, Stores result in y, to be Raised to x Power Entry.

ARC Entered Prior to SIN, COS, or TAN. Conditions Calculator to Perform SIN^{-1}, COS^{-1}, or TAN^{-1} Function.

SIN Executes SINE Function.

COS Executes COSINE Function.

TAN Executes TANGENT Function.

$\sqrt{x}$ Executes Square Root Function.

x^2 Executes Square Function.

$1/x$ Executes Reciprocal Function.

((Stores Intermediate Result, and Isolates Sub Problem.

)) Causes Execution of Sub Problem Within Parentheses.

+/- Changes Sign of Mantissa or Exponent.

$x \leftrightarrow y$ Exchanges Data Stored in x and y Registers. May be used for factor reversal.

10^x Executes Common Anti-log Function.

n! Causes Immediate Execution of the Factorial Function.

RAD Radian or Degree Mode Selector (Indicator Lite is on in Radian Mode) See special operation.

EE Prepares Calculator for Exponent Entry.

× Executes Prior Function, Stores Multiply Command.

− Executes Prior Function, Stores Subtract Command.

÷ Executes Prior Function, Stores Divide Command.

+ Executes Prior Function Stores Add Command.

= Carries Out All Previously Entered Commands (+, −, ×, ÷).

. Enters Decimal Point.

0–9 Enters Digits of Number.

STO Stores Contents of Display Register to Memory Register.

RCL Recalls and Displays Contents of Memory Register.

M+ Adds Contents of Display Register to Memory Register.

C/CE Clears Display Register in Number Entry Mode. In all other Modes Clears all Data Registers except Memory.

III. BATTERY AND A.C. OPERATIONS

A. Battery Operation

1. To operate your calculator from its internal battery, set power switch to the "on" position with the battery charger disconnected. The internal battery will provide 5 to 6 hours of operation. **To extend battery operating time, turn off your calculator when it is not in use.**

2. When the battery reaches a low condition, requiring recharge, the display will dim. Operating the calculator in this condition may result in errors. See recharge procedure below.

Note: Because of the nature of the chemical make up in nickel cadmium rechargeable cells, it is possible that their ability to accept recharging may temporarily deteriorate somewhat. This usually does not occur until after many recharge cycles and will exhibit itself as shortened operating cycle. In the event this situation arises, completely discharge the battery by leaving the calculator on for a minimum of 5 hours. Then recharge the batteries for 10 hours. This should remedy this temporary problem.

3. The calculator may be operated from the charger while the battery is recharging.

B. A.C./Recharge Operation

(NOTE: IF ADAPTER FURNISHED IS 115V-230V TYPE, BE SURE SWITCH IS SET TO PROPER POSITION.)

1. Set power switch to "off."

2. Connect battery charger plug to the SC-635 and the A.C. line cord plug to an A.C. power outlet.

3. Set power switch to "on" and note that display indicates zero (0.).

4. To recharge only, connect battery charger as above and leave power switch in the "off" position.

Note: A completely discharged battery will require approximately 6 to 9 hours to recharge. When full charging time is not allowed, reduced time of battery operation will result.

5. The calculator may be continued in operation from the A.C. line or may be returned to battery operation. Simply set the power switch to "off" and disconnect the charger.

CAUTION: DO NOT OPERATE UNIT FROM CHARGER WITHOUT BATTERY IN PLACE

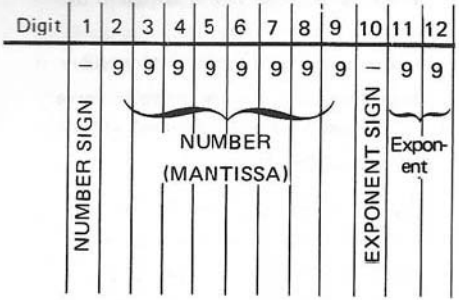
C. Battery Replacement

1. Should it be required, it is recommended that the calculator be returned to factory for battery replacement.

IV. FUNCTIONAL DESCRIPTION

A. Display Format

The twelve digits will display the entry information or calculated results. The display is arranged as follows:



Digit 1 will also display the status of the information as follows:

⌜ = Error (Positive Number)

⌝ = Error (Negative Number)

– = Negative Number

B. Calculation Range

Any positive or negative number between 1×10^{-99} and $(10-10^{-7}) \times 10^{+99}$ may be entered and is displayed.

Numbers resulting from a calculation must fall within the same range and may be either positive or negative numbers. Any numbers falling outside of this range will be displayed as overflow or underflow.

Any attempt to perform operations outside the operating limits of the calculator (eg. $\sqrt{-x}$) will be displayed as an error.

When the error indication is displayed with a (0) zero indication, the sign will always be positive. If the number calculated has a numerical value other than zero and its sign is negative, the error indication will be (⌝). The latter condition can only exist for addition,

subtraction, division or multiplication. All other error indications will have a numerical value of zero.

Digit 10 (third from right) will display a negative sign when the exponent is negative or when the calculator is in the battery saver (display cutoff) mode. Result data, when displayed in either floating point or scientific notation, will appear with leading zeros and trailing fractional zeros suppressed. A fractional number is always displayed with a zero preceding the decimal point (eg. 0.1234).

C. Accuracy

Accuracy is limited first by the 8 digit precision for the mantissa of each factor and the round off error that may be produced when the 9 th digit is dropped. This limit may cause a truncation error of one count in the least significant digit.

The second accuracy limitation is due to algorithmic errors. The exact methods for deriving more complex functions are subject to specific errors inherent in the process. These errors may be contributed to by the limited precision of constants used in the process, combined with truncation errors and scaling errors.

D. Entry Operations

A series of up to 8 digits is entered first, which defines the magnitude (mantissa). A decimal point may be entered at any of the 8 digit positions. Entries of more than 8 whole number digits or 7 fractional digits or any combination of whole number and fractional digits will be ignored by the calculator.

As each number is entered, the preceding number entry will shift one position to the left. A decimal point entry will maintain its appropriate position. Additional repeat decimal point entries will be ignored.

The Algebraic sign of the number entry (mantissa) may be changed during, or just after its entry, by depressing the "change sign" [+/-] key. The sign will be changed each time the key is depressed. For a negative sign entry a negative sign (–) will appear in digit 1, (left-most digit). Digit 1 remains blank for a positive number entry.

Exponent values may be entered by depressing the [EE] key, followed by entering the exponent number up to 99. As each digit is entered it will be displayed as digit 12 (right most digit). The first digit entry will shift to the left (digit 11) when the second number in the exponent is entered. When more than two exponent digits are entered, the last two to be entered will be displayed and held for calculation. The sign of the exponent may be changed anytime prior to, during, or just after the exponent entry, (prior to any subsequent operations). A negative (–) sign will appear in the digit 10 location (immediately to the left of the exponent value) for a negative exponent entry.

If an entry error is made in the course of solving a problem, it may be cleared by pressing the [C/CE], clear entry key once. This will not effect information already stored in the calculator. To clear all registers (except Memory) depress [C/CE] twice.

The following problems are simple introductions to the use of your calculator. They

will familiarize you with the proper procedures to be followed.

In order to add, subtract, multiply and or divide, simply enter the information exactly as the problem is stated. **(Note:** The use of the change sign key [+/–] to establish the sign of the number entry.)

Examples	**Display**
Addition:	
1. 2+3+4 = 9	
Enter 2, [+], 3, [+], 4, [=]	9.
2. (–2)+(–3)+(–4) = –9	
Enter 2, [+/–], [+], 3, [+/–] [+], 4, [+/–], [=]	–9.
Subtraction:	
1. 9–4–3 = 2	
Enter 9, [–], 4, [–], 3, [=]	2.
2. (–9)–(–4)–(–3) = –2	
Enter 9, [+/–], [–], 4, [+/–], [–], 3, [+/–] [=]	–2.
Multiply:	
1. 2X3X4 = 24	
Enter 2, [X], 3, [X], 4, [=]	24.

2. $(-2)\times(-3)\times(-4) = -24$ **Display**

Enter 2, [+/-], [X], 3, [+/-], [X], 4, [+/-], [=] -24.

Divide:

1. $24\div4\div3 = 2$

Enter 2, 4, [÷], 4, [÷], 3, [=] 2.

2. $(-24)\div(-4)\div(-3) = -2$

Enter 24, [+/-], [÷], 4, [+/-], [÷], 3, [+/-], [=] -2.

Chain and Mixed Problems:

1. $2+3+4+5 = 14$

Enter 2, [+], 3, [+], 4, [+], 5, [=] 14.

2. $-2-3-4-5 = -14$

Enter [−], 2, [−], 3, [−], 4, [−], 5, [=] -14.

3. $2\times3\times4\times5 = 120$

Enter 2, [X], 3, [X], 4, [X], 5, [=] 120.

4. $\frac{(4+3-2)15}{5} - 30 = -15$

Enter 4, [+], 3, [−], 2, [X] 1, 5, [÷], 5, [−], 3, 0, [=] -15.

V. OPERATING PROCEDURE

A. Two Variable Problems

Note that all of the preceding sample problems are two variable problems. That is, they all contain two variable numbers, connected by function commands (+, −, X, ÷). y^x is also a two variable problem and may serve to illustrate the development of problems containing complex expressions, contained within parentheses, (eg. $(a\times b)\ y^x\ (c+d)$ where $x = (e\times f)$ and $y = (g+h)$. The solution of each complex expression, contained within the parentheses, is computed and treated as one of the variables in the chain of calculations. The first result is always the computed result or intermediate variable and the variable entered last is the second.

Examples

1. $\left(\frac{A}{C}+B\right)\times\left(\frac{C}{A}+D\right)$ **Display**

$A = 10, B = 5, C = 2, D = 20$

Enter 1, 0, [÷], 2, [+] 5 [X] [((] 2 [÷], 1, 0, [+] 2, 0, [=] 202.

2. y^x

$y = (a \times b)$, $x = (c - d)$ $a = 2$, $b = 4$, $c = 8$, $d = 4$ **Display**

Enter 2, [X], 4, [y^x], [(( ], 8, [−], 4, [))], [=] 4,096.

Note: In the preceding examples, the closed parenthesis [))] just before the [=] at the end of the problem may be omitted. Pressing the [=] key will automatically complete the intermediate computation within the parenthesis and then complete the final calculation. This function may be considered in the approach to any problem, in that pressing the [=] key without closing the parenthesis will complete all previously entered commands.

B. Single Variable Problems

$\left(e^x, 10^x, \ln, \log, \sin, \cos, \tan, \sqrt{x}, x^2, \frac{1}{x}, n!\right)$

These keys are all single variable functions. They will execute the command immediately upon entry, computing the result of the information displayed at the time of entry. The displayed information may be the result of a single number entry or a complex expression

contained within parentheses. Single variable functions may also be used in multiple sequences.

Examples **Display**

1. x^2

   $x = 9$

   Enter 9, [x^2] 81.

2. sin x

   $x = 45°$

   Enter 45, [SIN] 0.7071068

3. $\sin^{-1} x$

   $x = 0.5$

   Enter [•], 5, [ARC], [SIN] 30. (Degrees)

4. log x

   $x = 2$

   Enter 2, [log] 0.30103

5. $a - \sin b + \sqrt{c}$

   $a = 5$, $b = 30$, $c = 9$

   Enter 5, [−], 30, [SIN], [+], 9, [$\sqrt{x}$], [=] 7.5

Note that a − b sin does not derive the function sin (a−b). The correct entry is [(( ], a, [−], b, [))], [SIN]

6. 10^x **Display**

x = 3.215

Enter 3, [•], 215 [10^x] 1640.5898

7. n!

n = 5

Enter 5 [n!] 120.

C. Mixed Chain Problems

One or two variable problems may be mixed to perform more complex calculations.

D. Mixed Chain Problems with Parentheses

Complex chain problems may be calculated using up to two levels of parentheses, each defining a variable before executing a function command. The entry of a complex chain problem using parentheses is accomplished by operating the parentheses keys in precisely the same order that the problem is written or stated. When a new parentheses is opened, the prior result and prior functions are stored until that level of parentheses is closed later in the problem.

Example

$$\left(\text{Sin}\ \frac{1}{1+\left[\sqrt{(a+b)^2-(c+d)^2}\right]}\right)^3$$

a = 4, b = 5, c = 2, d = 3

Enter 1, [+], [((], [((],
4, [+], 5, [))], [x^2], [−], [((],
2, [+], 3, [))], [y^x], [))], [$\sqrt{x}$], **Display**
[=], [1/x], [SIN], [y^x], 3, [=] 8.7082997-09

Any attempt to use more than two levels of parentheses will cause an error display. The calculator must be cleared before continuing calculations.

Pressing the [=] key will complete all prior calculations, thereby closing all preceding parentheses even though the [))] key is not operated.

Note: A function key must be operated between sets of parentheses. There is no automatic multiplication produced by the key sequence entering (a–b)(c+d) = . The problem must be entered (a–b) X (c+d) =.

VI. SPECIAL OPERATIONS

A. Memory Operation

A full function memory register is provided to permit storage [STO], accumulation [M+], and recall [RCL] of constants or intermediate problem results. A number may be stored into the memory register by depressing the [STO] key. Depression of the [RCL] key will recall

and display the previously stored contents of the memory register.

Operation of the [M+] key will add the contents of the display register to the contents of the memory register. The display register remains unchanged.

B. Exchange Operation

At times it is helpful to reverse the order of factors in a two variable problem or to display an intermediate result. Operating the [x⇄y] key will cause the data stored in the "y" register to be stored in the "x" register and be displayed. Any data in the "x" register will be stored in the "y" register. A second operation of the [x⇄y] key will restore the information to its original state.

C. Clear Operation

[C/CE] key: Operation of the [C/CE] key causes clearing of the display register when the calculator is in the number entry mode. A zero (0) will be displayed and a new entry may be made.

Operation of the [C/CE] key in any mode other than the number entry mode causes clearing of all data registers except the memory register. A zero (0) will be displayed. The clear operation is required to continue calculation after an error display.

Clear Memory: The memory may be cleared by the storage of new data into the memory or by entering 0, [STO] . The memory register is cleared of all data each time the calculator is turned off.

D. Degree/Radian Mode Selection

Degree or radian units may be selected for trigonometric calculations. Normally all numbers for these functions are considered to be in degrees. A single depression of the [DEG RAD] key will switch the calculator to the radian mode, (the radian light will turn on). All succeeding calculations will be in radian units. A second depressions of the [DEG RAD] key will return the calculator to the degree mode, (the radian light will be turned off).

VII. PROBLEM SOLVING

Arithmetic is the basic language of numbers. Your calculator will accept and interpret this language in order to arrive at a logical conclusion. Therefore it is necessary to develop a logical approach to operating your machine. The following examples will aid in understanding and developing a logical approach.

A. Simple Arithmetic **Display**

1. Addition

$2.375 + 0.4182 = 2.7932$

Enter 2, [•] , 375, [+], [•] , 4182, [=] 2.7932

$(-4) + (-3) = -7$

Enter 4, [+/-] , [+] , 3, [+/-] , [=] -7.

2. Subtraction

$2.375 - 0.068 = 2.307$

Enter 2, [•] , 375, [−], [•] 068, [=] 2.307

$(-7) - (-4) = -3$

Enter 7, [+/-] , [−] , 4, [+/-] , [=] -3.

3. Multiplication

$2.375 \times 6.8 = 16.15$

Enter 2, [•] , 375, [X] , 6, [•] , 8, [=] 16.15

$-4 \times -3 = 12$

Enter 4, [+/-] , [X] , 3, [+/-] , [=] 12.

4. Division

$2.375 \div 5 = 0.475$

Enter 2, [•] , 375, [÷] , 5, [=] 0.475

$-9 \div 3 = -3$ **Display**

Enter [+/-] , 9, [÷] , 3, [=] -3.

5. Chain and Mixed Calculations

$$\left(\frac{5+3-4}{8}\right)(-12) = -6$$

Enter 5, [+] , 3, [−] , 4, [÷] , 8, [X] , 12, [+/-] , [=] -6.

6. Fractions

Fractions are simply another way to express the division of one number (numerator) by another number (denominator). Your calculator performs operations involving fractions converting them to decimals.

$$\frac{3\ \text{(Numerator)}}{4\ \text{(Denominator)}} = 0.75$$

Display

Enter 3, [÷] , 4, [=] 0.75

B. Algebra

Algebra is an extension of arithmetic. It will require the same logical approach, as mentioned earlier, in order for your calculator to interpret the information you feed it. The following examples will demonstrate the approach to supplying the additional information required in solving algebraic arithmetic.

In general, an algebraic expression consists of a combination of symbols and signs representing a number. For purposes of illustration, arbitrary numerical values will be assigned to symbols.

$a + b = c$ where $a = 2, b = 3$

Solution, enter 2, [+], 3, [=] 5.

Note that the entry is in exactly the same form as the expression was written. This problem is a two variable problem, since it consists of two numbers, which may vary in value, separated by an operating sign. This type of problem may consist of two or more variables.

Algebraic expressions often require grouping of several parts. Grouping is accomplished by the use of parentheses. Your scientific calculator is designed to handle this type of problem in the easiest, most straightforward manner.

Example

$(a + b) - (c - d)$

where $a = 2, b = 3, c = 5, d = 4$

Note that each of the terms contained within the parentheses has a numerical value which must be computed before a final solution can be reached. This is programmed into the calculator in the following manner:

Enter 2, [+], 3, [−], [(], 5, [−], 4, [=]

The value of a + b will be arrived at when the [−] button is depressed. The value of c − d will be isolated by the opening of the parentheses. Pressing the [=] button will perform the operation of closing the parentheses, completing the calculation of c − d and then subtracting that number from the value of a + b.

In the development of more complex expressions, the parenthetical isolation of terms may be used to a maximum of two levels. That is, complex terms within complex terms may be calculated directly as stated within the algebraic expression.

Example, Use of Parentheses

$$x\left(\frac{1}{\sqrt{[(a+b)^2 - (c+d)^2]}}\right)$$

where $x = 3, a = 4, b = 5, c = 2, d = 3$

Note that in this case we will solve for the lowest order expression first.

Enter	Display
[(], [(], 4, [+], 5, [)], [x²]	81
[−], [(], 2, [+], 3, [)], [x²], [)]	56
[√x],	7.4833148

	Display
[1/x] ,	0.1336306
[X] , 3, [=]	0.4008918

The squaring of a number is performed as a single variable operation by pressing the [x²] key, which immediately completes the function. The same is true of the square root and reciprocal functions. Notice also that the calculator will display the final answer in scientific notation automatically. Any result 10^8 (100 million) and above or 10^{-9} (1 billionth) and below will be displayed in scientific notation. This simply means that the decimal point is moved the number of places indicated in the two right hand displayed digits. For a + exponent display, (no sign in the third digit from the right), move the decimal point to the right. For a – exponent display, (–sign in the third digit from right), move the decimal to the left.

Very large or very small numbers, may be entered directly into the calculator in scientific notation. The numerical value and its sign are entered first. Then the exponent and its sign are entered, after depressing the Exponent Entry Key [EE]

Example, Use of Exponent Entry (Scientific Notation)

$$\frac{a \times b}{c}$$

$a = 6.25 \times 10^{14}$
$b = 4.8 \times 10^{-31}$
$c = 1.5 \times 10^{-27}$

Enter	Display
6, [•] , 25, [EE] , 14, [X] , 4, [•] , 8, [EE] , [+/–] , 31, [÷] , 1, [•] , 5, [EE] , [+/–] , 27, [=]	2. 11

The result is read as 2×10^{11} which indicates the decimal point is moved 11 places to the right, (200,000,000,000.0).

|——11 Places→|

C. Powers and Roots

A number y raised to a power x is that number y multiplied by itself the number if times indicated by the numerical value of the power x (exponent). Stated another way, the exponent is the number of times y appears in the multiplication. The exponent may be non-integral as well as integral numbers.

Conversely the root of a number z is defined as

a number which when multiplied by itself y times will equal z. In this case we can say y to the x power is equal to z and the x root of z is y.

To raise a number y to a power x:

y^x for y = 3, x = 4

Enter	Display
3, [y^x] , 4, [=]	81.

To find the root y of a number z

$\sqrt[y]{z}$ for z = 81, y = 4

Enter

81, [y^x] , 4, [1/x] , [=] 3.

$\left(\text{Note that } \sqrt[y]{z} = z^{\frac{1}{y}}\right)$

Roots may also be taken by the use of logarithms as follows:

Using $\log_{10}$, $\sqrt[y]{z} = \log^{-1}\left(\frac{\log z}{y}\right)$

Enter	Display
81, [log] [÷] , 4, [=] , [10^x]	3.000003

Using $\log_n$, $\sqrt[y]{z} = \log_n^{-1}\left(\frac{\log_n 81}{4}\right)$

Enter	Display
81, [ln] , [÷] , 4, [=] , [e^x]	3.

As an added convenience x^2 and $\sqrt{x}$ keys are included to permit direct computation of squares and square roots since these are commonly used functions.

D. Logarithms

The logarithm of a number N to the base a is the exponent x of the power to which the base a must be raised to equal the number N.

if $a^x = N$ then $\log_a N = x$ (for any base "a")
if $10^x = N$ then $\log_{10} N = x$ (for base 10)

to derive logs to other bases: $\log_a N = \frac{\log_{10} N}{\log_{10} a}$

Your calculator is designed to operate with the most widely used logarithms—base 10 (common log) and base e (natural log).

Logarithms are arrived at in the same manner as the single variable keys. A number x is entered and the desired log key is depressed. The resulting logarithm will be displayed immediately.

Example	Display
Log 2	
Enter 2, [log]	0.30103
$Log_e 2$	
Enter 2, [ln]	0.6931472

The number which corresponds to a given logarithm is called the antilogarithm.

Antilogarithms are derived very simply in the following manner:

Natural anti log (anti $\log_e x = e^x = \log_e^{-1} x$)

anti $\log_e 2$

Enter	Display
2, [e^x]	7.3890561

Common Anti log (anti $\log_{10} x = 10^x = \log^{-1} x$)

anti log 2

Enter	Display
2, [10^x]	100.

E. Trigonometry

Trigonometry is a form of geometric measurement which makes use of angular relationships. These relationships are based on the ratios of the length of sides of triangles.* The ratios are called sine, cosine, tangent and their reciprocals

*Refer to Appendix

cosecant, secant and cotangent respectively. The scientific calculator is designed to compute the value of the sine, cosine or tangent directly. To obtain the numerical value of each, all that is required is that the angle be entered and the desired ratio key be depressed.

Example:

Sinα

$\alpha = 30°$

Enter	Display
30, [SIN]	0.5

cosα

$\alpha = 30°$

Enter	
30, [COS]	0.8660254

tanα

$\alpha = 30°$

Enter	
30, [TAN]	0.5773503

The reciprocal functions can be arrived at simply by using the reciprocal [1/x] key.

Example:

$\text{Cot}\alpha = \dfrac{1}{\text{Tan}\alpha}$

$\alpha = 30°$

Enter	Display
30, [TAN], [1/x]	1.7320507

Your calculator is also capable of extracting the angle when the numerical value of the ratio is known. This is stated as the angle (ARC) whose ratio is x, or typically written as ARC SIN x (or $SIN^{-1}x$).

Examples:

$SIN^{-1}.5$

Enter	Display
[•], 5, [ARC], [SIN]	30. (degrees)

$COS^{-1}.7071067$

Enter	
[•] 7071067, [ARC], [COS]	45. (degrees)

$Tan^{-1}1$

Enter	
1, [ARC], [TAN]	45. (degrees)

F. Degrees/Radians

It is often useful to calculate angles in terms of radian measure instead of degrees. The scientific calculator can do this for you by direct conversion. (1 radian is equal to 57.295779 which is derived from $\frac{180}{\pi}$).

In order to calculate in radians, when the problem is stated in radians, depress the

degree/radian key [DEG/RAD] enter the information and perform the calculation.

When the problem is stated in degrees, compute in degrees and convert to radians as shown below.

Examples of Radian Computations:

$\frac{\pi}{3}$ rad + sin .5 rad =

Enter	Display
[DEG/RAD], [π], [÷], 3, [+], [•], 5, [SIN] [=]	1.5266231 (RAD)

$\frac{\pi}{5}$ deg − sin.5 deg. =

Enter	Display
[π], [÷], 5, [−], [•], 5	
[SIN], [=], [DEG/RAD], [ARC], [SIN]	0.6682229 (RAD)

Examples of Conversions:

Degrees to Radians

30°

Enter	Display
30 [SIN], [DEG/RAD], [ARC], [SIN]	0.5235988 (RAD)

Radians to Degrees

.5236 Radians

Enter

[DEG/RAD] [•] 5236 [SIN] [DEG/RAD] [ARC] [SIN]

30.00007 (Deg.)

Your calculator will compute and display angles as decimal degrees. It will be necessary therefore to enter angles in decimal degrees. The following method may be used to convert angles expressed in terms of degrees, minutes and seconds to decimal degrees.

Degrees to Decimal Degrees
45°, 21′, 53″

Enter				Display
60	=	STO	C	
53	÷	RCL	+	0.8833333
21	÷	RCL	+	0.3647222
45	=			45.364722

G. Factorials

n! = n (n–1)(n–2).....(3)(2)(1) and is read "n Factorial."

i.e., 5X4X3X2X1 = 5! (Five Factorial)

Example:	**Display**
8! =	
Enter	
8, n!	40320.
0! =	
Enter	
0, n!	1.

By definition 0! = 1. (see sample problems Section H.)

H. Sample Problems

The following problems will further demonstrate various types of solutions and help develop a "feel" for the use of your calculator.

1. (3 X 5.2) + (4.2 X 3) – (2.1 X 2) =

Enter	Display
3, X , 5, • , 2, + ,	
((, 4, • , 2, X ,	
3,)) , – , ((,	
2, • , 1, X , 2, =	24.

2. (3 + 5.2)(4.2 + 3)(2.1 + 2) =

Enter	
3, + , 5, • , 2 X ,	
((, 4, • , 2, + ,	
3,)) , X , ((,	
2, • , 1, + , 2, =	242.064

3. $\frac{2\sqrt{128}}{3} + \frac{1}{9^2 + 8} =$

Enter 128, √x , X , 2, ÷ ,
3, + , ((, 9, x² ,
+ , 8,)) , 1/x , = 7.553708

4. $\left[\frac{(3.5 \times 10^6)(4.3 \times 10^3)}{3}\right]^2 =$

Enter	Display
3, [•], 5, [EE], 6, [×],	
4, [•], 3, [EE], 3, [÷],	
3, [=] [x^2]	2.5166945 19

5. $\frac{a \times b}{\left[1 - \frac{1}{(1+b)^x}\right]} =$

a = 3, b = 4, x = 5

Enter 3, [×], 4, [÷], [((],
1, [−], [((], 1, [+],
4, [y^x], 5, [))], [1/x], [=]

12.003841

6. **Quadratic Equation** (x has two values)

$ax^2 + bx + c = 0$

$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Solve for $3x^2 - 7x + 2 = 0$

x_1 Enter 7, [+], [((],
7, [x^2], [−], [((],
4, [×], 3, [×], 2, [))], [))],

[$\sqrt{x}$], [÷], [((], **Display**
2, [×], 3, [=] **2.**

x_2 Enter 7, [−], [((], 7, [x^2],
[−], [((], 4, [×],
3, [×], 2, [))], [))],
[$\sqrt{x}$], [÷], [((], 2, [×],
3, [=] 0.3333333

(**Note:** $\sqrt{b^2 - 4ac}$ can be stored in the memory and reused.)

7. Use of π

Given a circle with a radius r = 3, find:

Circumference = (2 π r)

Enter	Display
2, [×], [π], [×], 3 [=]	18.849556

Area (πr^2)

Enter [π], [×], 3, [x^2], [=]	28.274334

Area of a sector $\theta = 20°$

$\left[\text{area} = \frac{br}{2} = \pi r^2 \left(\frac{\theta}{360}\right)\right]$

$\left[b = \left(\pi r \frac{\theta}{180}\right) \text{ and } \theta \text{ in degrees}\right]$

Area of a sector = $\pi r^2 \left(\frac{\theta}{360}\right)$

Enter	Display
[π], [X], 3, [x²], [X], 20, [÷], 360, [=]	1.5707964

8. Given a sphere with a radius r = 6 (d = 12), find:

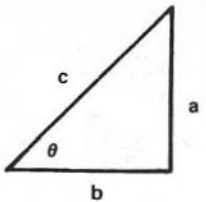
Surface Area = $4\pi r^2 = \pi d^2$

Enter	
[π], [X], 12, [x²], [=]	452.38935

Volume = $\frac{4\pi r^3}{3}$

Enter	
6, [y^x], 3, [X], 4, [X], [π], [÷], 3, [=]	904.7787

9. **Triangles**



$\theta = 23°$ a = 5 find b, c

$b = \frac{a}{\text{Tan } \theta}$

Enter	Display
5, [÷], 23, [TAN], [=]	11.779262

$c = \frac{a}{\text{Sin } \theta}$

Enter	
5, [÷], 23, [SIN], [=]	12.796524

10. **Business**

Car Purchase

Purchase Price =	$2,846
Trade-In	946
Balance Due	$1,900

Borrowing $1,900, monthly payments = $91.05 for 24 months.

Find: Annual interest rate
Total repayment
Total cost of loan
Total actual cost

$$\frac{\text{(Monthly Payment X No. of Months)} - \text{loan amount}}{\text{loan am't. X term in yrs.}} = \text{annual interest rate}$$

Interest rate:	**Display**
Enter	
91, [•], 05, [X], 24, [−]	2185.2
	(Total Repayment)
1900, [÷]	285.2

(Total Loan Cost)

[((] , 1900, [X] , 2, [=] 7.5052632–02

(7.5%)

(Interest Rate)

Total actual cost = Total repayment + Trade-In.

Enter	Display
2185, [•] , 20, [+] ,	
946, [=]	3131.2
	($3131.20)

11. Statistics

Permutations: P(n,x) = the permutation of n things taken x at a time. $= \frac{n!}{(n-x)!}$

Example: In how many distinct ways can 3 letters be selected from the letters A,B,C,D,E?

$n = 5; x = 3 \therefore P(5;3) = \frac{5!}{(5-3)!}$

Enter	Display
5, [n!] , [÷] , [((] 5, [−]	
3, [))] , [n!] , [=]	60.

Combinations: The selection of objects regardless of order. C(n,x) = the combination of n objects taken x at a time. $= \frac{n!}{x!(n-x)!}$

Example: How many combinations of 3 letters can be selected from the letters A,B,C,D,E?

$C(n,x) = C(5,3) = \frac{5!}{3!(5-3)!}$

Enter	Display
5, [n!] , [÷] , [((]	
3, [n!] , [X] , [((]	
5, [−] , 3, [))] , [n!] , [=]	10.

APPENDIX

A. SOME BASIC FORMULAE

Logarithms to any base

$$\text{Log}_a x = \frac{\text{Log}_{10} x}{\text{Log}_{10} a}$$

Properties of Logarithms:

If $\log_a x = N$, then $a^N = x$

$\log_a x = \log_a b \log_b x$

$\log_a xy = \log_a x + \log_a y$

$\log_a x/y = \log_a x - \log_a y$

$\log_a x^y = y \log_a x$

$\log_a b = 1/\log_b a$

$a^{\log_a x} = x$

$\log_a 1 = 0$

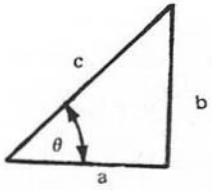
$\log_a a = 1$

$\text{Log}_e x = \ln x = \log_e 10 \log_{10} x =$

$2.30259 \log_{10} x$

$\log_{10} x = \log_{10} e \log_e x = 0.43429 \log_e x.$

Trigonometric Relationships



Right Triangle

$\text{SIN}\ \theta = \frac{b}{c}$

$\text{COS}\ \theta = \frac{a}{c}$

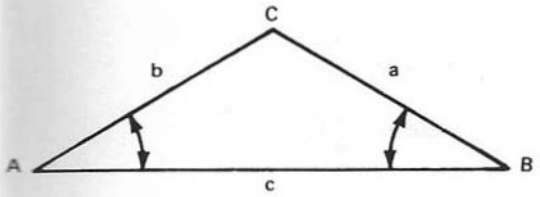
$\text{TAN}\ \theta = \frac{b}{a}$

$c^2 = a^2 + b^2$

$\cot \theta = \frac{a}{b}$

$\sec \theta = \frac{c}{a}$

$\csc \theta = \frac{c}{b}$



$a = \sqrt{b^2 + c^2 - 2bc \cos A}$

$\frac{a}{\sin A} = \frac{b}{\text{Sin}B} = \frac{c}{\text{Sin}C}$

Identities

Reciprocal relationships

$\csc \theta = \frac{1}{\sin \theta}$

$\sec \theta = \frac{1}{\cos \theta}$

$\cot \theta = \frac{1}{\tan \theta}$

Quotient relationships

$$\text{Tan}\,\theta = \frac{\sin\theta}{\cos\theta}$$

$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$

Pythagorean relationships

$$\sin^2\theta + \cos^2\theta = 1$$

$$\text{Tan}^2\theta + 1 = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

Circle

Circumference $c = \pi d = 2\pi r$

Area $A = \frac{cr}{2} = \pi r^2 = \frac{\pi d^2}{4}$

Sphere

Surface Area $S = T = 4\pi r^2$

Volume $V = \frac{4\pi r^3}{3}$

Geometric series

$$S_n = \frac{u_1 (r^n - 1)}{r - 1}$$

r = common ratio
n = no. of terms
u_1 = first term
S_n = sum of n terms

Hyperbolic Functions

$$\text{Cosh}\,x = \frac{e^x + e^{-x}}{2}$$

$$\text{Sinh}\,x = \frac{e^x - e^{-x}}{2}$$

$$\text{Tanh}\,x = \frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{\text{Sinh}x}{\text{Cosh}x}$$

Time of Oscillation of a Simple Pendulum

$$t = \pi\sqrt{\frac{l}{32.16}}$$

where l = length in feet
t = time in seconds

Compound Interest

At interest compounded annually the amount

$$A = P\,(1 + i)^n$$

At interest compounded q times a year -

$$A = P\left(1 + \frac{i}{q}\right)^{nq}$$

At interest compounded annually the present value -

$$P = \frac{A}{(1 + i)^n} = A(1 + i)^{-n} = Av^n \quad v = \frac{1}{1 + i}$$

At interest compounded q times per year -

$$P = A\left(1 + \frac{i}{q}\right)^{-nq}$$

Temperature Conversion

$$\text{Degrees C} = (^\circ\text{F} - 32) \times \frac{5}{9}$$

$$\text{Degrees F} = \frac{9}{5}{}^\circ\text{C} + 32$$

$$\text{Degrees K} = \text{Degrees C} + 273$$

B. Conversion Factors

Multiply	By	To Get
Atmospheres	76	Cm. of Mercury
Atmospheres	29.92	Inches of Mercury
Atmospheres	33.90	Feet of Water
Atmospheres	14.70	Lbs./Sq. Inch
Centimeters	0.03281	Feet
Centimeters	0.3937	Inches
Cubic Feet	2.832×10^4	Cubic Cms.
Cubic Feet	1728	Cubic Inches
Cubic Feet	7.481	Gallons
Cubic Feet Air	.08	Pounds
Cubic Feet Water	62.43	Pounds
Cubic Inches	16.39	Cubic Cms.
Feet	30.48	Centimeters

Multiply	By	To Get
Feet	.3048	Meters
Feet of Water	.02950	Atmospheres
Feet of Water	.8826	Inches of Mercury
Feet of Water	62.43	Pounds/Sq. Foot
Gallons	3785	Cubic Centimeters
Gallons	.1337	Cubic Feet
Gallons	231	Cubic Inches
Grams	.03527	Ounces
Grams	2.205×10^{-3}	Pounds
Grams/Centimeter	5.60×10^{-3}	Pounds/Inch
Grams/Cu. Cm.	62.43	Lbs./Cu. Foot
Grams/Cu. Cm.	.03613	Lbs./Cu. Inch
Horse-Power	745	Watts
Inches	2.54	Centimeters

Multiply	By	To Get
Inches of Mercury	.03342	Atmosphere
Inches of Mercury	1.133	Feet of Water
Inches of Mercury	.4912	Pounds/Sq. Inch
Inches of Water	.002458	Atmospheres
Inches of Water	.07355	Inches of Mercury
Inches of Water	5.204	Pounds/Sq. Foot
Inches of Water	.03613	Pounds/Sq. Inch
Kilograms	2.205	Pounds
Kilometers	3281	Feet
Kilometers	.6214	Miles
Kilowatts	56.88	BTU/Min.
Kilowatts	4.427×10^{4}	Foot-Pounds/Min.
Kilowatts	1.341	Horse - Power
Knots	6080	Feet/Hr.

Multiply	By	To Get
Knots	1.1508	Miles/Hr.
Liters	.03531	Cubic Feet
Liters	61.02	Cubic Inches
Liters	.2642	Gallons
Meters	3.281	Feet
Meters	39.37	Inches
Meters	6.214×10^{-4}	Miles
Miles	1.609×10^{5}	Centimeters
Miles	5280	Feet
Miles	1.609	Kilometers
Miles/Hour	44.70	Cm./Second
Miles/Hour	88	Feet/Min.
Miles/Hour	1.467	Feet/Sec.
Miles/Hour	.8684	Knots

Multiply	By	To Get
Minutes (Angle)	2.909×10^{4}	Radians
Ounces	28.35	Grams
Ounces	.0625	Pounds
Ounces (Fluid)	1.805	Cubic Inches
Ounces (Fluid)	29.57	Cubic Centimeters
Pounds	453.6	Grams
Pounds of Air	12.5	Cubic Feet
Pounds of Water	.01602	Cubic Feet
Pounds of Water	27.62	Cubic Inches
Pounds of Water	.1198	Gallons
Pounds/Sq. Foot	4.725×10^{-4}	Atmospheres
Pounds/Sq. Inch	.06804	Atmospheres
Pounds/Sq. Inch	2.036	Inches of Mercury

Multiply	By	To Get
Radians	57.30	Degrees
Square Centimeters	1.076×10^{-3}	Sq. Feet
Square Centimeters	0.1550	Sq. Inches
Square Inches	6.452	Sq. Centimeters
Watts	1.341×10^{-3}	Horse-Power
Watt Hours	3.413	BTU
Years (365 Days)	8760	Hours

C. Useful Numerical Data

1 cubic foot of water at 4°C (weight)	62.43 lb
1 foot of water at 4°C (pressure)	0.4335 lb/in
Velocity of light in vacuum, c	186 280 mi./second = 2.998×10^{10} cm/second
Velocity of sound in dry air at 20°C, 760 mm Hg	1127 ft/second
Degreé of longitude at equator	68.703 statute miles, 59.661 nautical miles
Acceleration due to gravity at sea level, 40° latitude, g	32.1578 ft/second^2
$(2g)^{1/2}$	8.020
1 inch of mercury at 4°C	1.132 ft water = $0.4908\ \text{lb/in.}^2$

Base of natural logs e	2.718
1 radian	$180° \div \pi = 57.3°$
360 degrees	2π radians
π	3.1416
Sin 1′	0.00029089
Arc 1°	0.01745 radian
Side of square	0.707X (diagonal of square)

The following prefixes are used to indicate multiples for submultiples of units:

Multiple	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ†
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

When a unit symbol prefix is identical to a unit symbol, special care must be taken. m•N indicates the product of the units meter and newton, while mN is the symbol for millinewton.

† Lower-case u is frequently used in typing.

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WARRANTY

This warranty is in lieu of all other warranties expressed or implied, and no person is authorized to change the warranty made in connection with the sale of this calculator.

Melcor Electronics Corporation warrants to the original purchaser of this new calculator that if the calculator or any part thereof in the judgement of Melcor is proven to be defective in material or workmanship within one year from date of original purchase, such defects will be repaired or replaced, as Melcor alone shall determine, free of charge for parts and labor.

This warranty shall be void as to any calculator which has been damaged by accident or misuse, abused, altered or repaired by anyone other than authorized personnel, or if the serial number has been removed or altered.

To obtain repairs the calculator must be returned, prepaid, to Melcor Electronics at the address shown below.

Melcor Electronics Corporation
1750 New Highway, Farmingdale, New York 11735

IMPORTANT

Fill out warranty registration and return to Melcor within 10 days of purchase to validate warranty. Record serial number and date of purchase. Include serial number and model number in any correspondence.

SC-63	666 523	17.2.76
Model No.	Serial No.	Date of Purchase