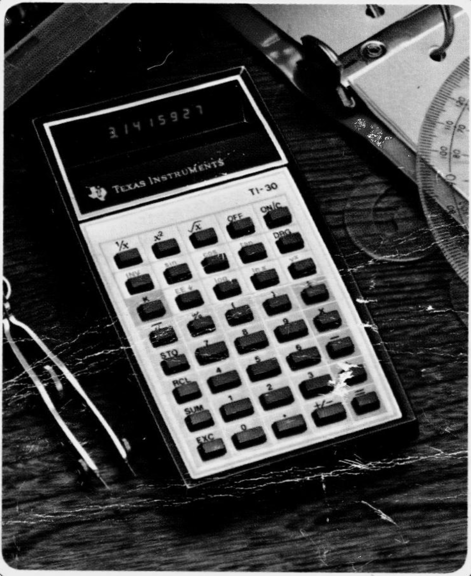
Texas Instruments
electronic slide-rule calculator
TI-30



OWNER'S MANUAL

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I. DESCRIPTION

Problem solving is an integral part of every field of study. It is through the solutions of problems that the critical decisions of business and science are tested and verified. Mastery of those mathematical techniques begins early in school and continues throughout life. The TI-30 slide-rule calculator produces an accurate electronic means of obtaining answers to a wide range of problems beginning with elemental arithmetic and continuing through the most complicated of situations. Use this calculator regularly and it will soon become an inseparable component of your problem solving system. Years of concentrated research in the calculator industry and the latest electronic advances have combined to produce this versatile yet reasonably priced calculator. Here are a few of its features.

Features and Functions

- Complete Solid-State Circuitry with high quality components.
- Sealed Keyboard to minimize dust and moisture accumulation.
- Electronic ON and OFF provides for special power-saving features. Only a traveling decimal is left in the display after typically 25 to 50 seconds of nonuse. The previously displayed value is easily retrieved without interfering with pending operations. The TI-30 turns itself off completely after typically 7 to 14 minutes of nonuse. You will never waste a battery by forgetting to turn your calculator off or by having it turned on accidentally. These features can increase the life of each battery you buy up to 50%.
- Algebraic method of entry allows you to enter mathematical sequences in the same order that they are algebraically stated.
- Disposable battery power source provides independence from AC power supplies. You can always take weeks of computing power with you wherever you go by simply carrying a few spare batteries.
- Easily convertible to a rechargeable power source.

- 48 Calculator Functions

Arithmetic	+, −, ×, ÷	4
Data Entry	+/−, π	2
Display	Scientific Notation Scientific Notation Removal Exponent Increment Exponent Decrement	4
Algebraic	x^2, $\sqrt{x}$, 1/x, y^x, $\sqrt[x]{y}$	5
Clearing	Clear and Clear Entry	2
Data Grouping	Open and close parentheses (up to 15) and full algebraic hierarchy (up to 4 pending operations)	3
Memory	Store, Recall, Sum, Exchange	4
Percent	%, +%, −%, ×%, ÷%	5
Trigonometric	Sin, Cos, Tan, Sin^{-1}, Cos^{-1}, Tan^{-1}, and 3 angular modes (Degrees, Radians, Grads)	9
Logarithmic	ln x, log, e^x, 10^x	4
Constant	Operates with +, −, ×, ÷, y^x and $\sqrt[x]{y}$	6
		48

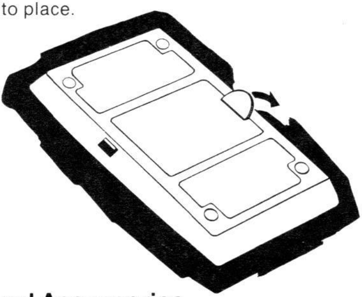
- Automatic Clearing — when the [=] key is pressed to complete the evaluation of an expression, all pending calculations are fulfilled, the answer is displayed, and the calculator is prepared for the start of a new problem.
- Accuracy — The internal calculating capacity is 11 digits even though only 8 can be displayed. This feature permits 11-digit precision in calculation. The 8 digit displayed number is rounded to within ±1 in the 8th digit for all functions except where noted.

Battery Installation and Considerations

The TI-30 operates on a 9-volt non-rechargeable battery, which is not supplied with the calculator since its freshness cannot be ensured. An alkaline battery is recommended for your calculator. It has an operating life of approximately 20 hours. A non-alkaline battery may be used but it should be removed prior to a prolonged period of non-use or immediately after discharge to prevent possible damage to the calculator from leakage.

When the battery becomes discharged, the display becomes dim or may flash or show erroneous symbols and numbers just before fading away.

To install a battery, insert a coin into the slot in the back of the calculator and pry off the battery cover. (see sketch) Attach the battery terminals to the connecting wires in the calculator. Position the connected battery in the compartment according to the diagram on the battery cover and snap the cover back into place.



Optional Accessories

The following optional accessories are available from your calculator dealer or from the nearest Texas Instruments Service Facility or Exchange Center.

Rechargeable Kits RK-1 and RK-2 – These kits are available to convert your calculator from a disposable battery power source to a rechargeable source. The RK-1 kit contains the AC9131 Adapter/Charger and the BP-5 battery pack which will typically provide 2 hours of continuous operation without recharging. About 4 hours of recharging will restore full charge when the calculator is off, 12 hours if the calculator is in use. The RK-2 kit contains the AC9132 Adapter/Charger and the BP-8 battery pack which will typically provide 4 hours of continuous operation without recharging. About 4 hours of recharging will restore full charge when the calculator is off, 6 hours if the calculator is in use. Either battery pack can be charged while in or out of the calculator.

CAUTION: The battery packs *cannot* be recharged by either charger. The BP-5 should only be recharged with the AC9131 and the BP-8 should only be recharged with the AC9132.

Carrying Case – Available at your dealer or from Texas Instruments.

II. KEY DEFINITIONS AND INDEX

[ON/C] **On/Clear Key** – Initially this key applies power to the calculator. Once the calculator is turned on, pressing this key clears an entry if no function or operation key has been pressed. When pressed after an operation or a function, this key clears the display, all pending operations and the constant. Pressing this key twice **at any time** clears the display, all pending operations and the constant.

[OFF] **Off Key** – Removes power from the calculator.

[0] through [9] **Digit Keys** – Enter numbers 0 through 9. See page 9.

[•] **Decimal Point Key** – Enters a decimal point. See page 9.

[+/–] **Change Sign Key** – When pressed after number entry or a calculation, changes the sign of the number. The sign of the exponent is changed when this key is pressed after the [EE↓] key. See page 9.

[π] **Pi Key** – Enters the value of pi correct to 11 digits. (This value is rounded to 8 digits for display only). See page 9.

[+] **Add Key** – Completes any previously entered arithmetic, y^x or $\sqrt[x]{y}$ function and instructs the calculator to add the next entered quantity to the displayed number. See page 15.

[–] **Subtract Key** – Completes any previously entered arithmetic, y^x or $\sqrt[x]{y}$ function and instructs the calculator to subtract the next entered quantity from the displayed number. See page 15.

[X] **Multiply Key** – Completes any previously entered divide or multiply, y^x or $\sqrt[x]{y}$ function and instructs the calculator to multiply the displayed number by the next entered quantity. This displayed value must be less than 1×10^{99} or an error condition may result. See page 15.

[÷] **Divide Key** – Completes any previously entered divide or multiply, y^x or $\sqrt[x]{y}$ function and instructs the calculator to divide the displayed number by the next entered quantity. See page 15.

[=] **Equals Key** – Combines all previously entered numbers and operations. This key is used to obtain both intermediate and final results. See page 15.

[K] Constant Key – Stores a number and its associated operation for repetitive calculations. Enter the number, then the operation, then press [K]. See page 23.

[( ] [ )] Parentheses Keys – Used to isolate particular numerical expressions for separate mathematical interpretation. See page 20.

[y^x] y to the x Power Key – Raises the displayed value y to the xth power. Order of entry is y [y^x] x. y cannot be negative, but both x and y can be fractional. See page 26.

[INV] [y^x] (= $\sqrt[x]{y}$)x Root of y Key – Takes the xth root of the displayed value y. Order of entry is y [INV] [y^x] x. y cannot be negative, but both x and y can be fractional. See page 26.

[x^2] Square Key – Calculates the square of the number in the display. See page 25.

[$\sqrt{x}$] Square Root Key – Calculates the square root of the number in the display. $x \geq 0$. See page 25.

[1/x] Reciprocal Key – Divides the display value into 1. $x \neq 0$. See page 27.

[%] Percent Key – Converts displayed number from a percentage to a decimal. Used with +, −, ×, ÷, this key can perform add-on, discount and percentage calculations. See page 27.

[lnx] Natural Logarithm Key – Calculates the natural logarithm (base e) of the number in the display. $x > 0$. See page 28.

[INV] [lnx] Natural Antilogarithm (e to the x Power) Sequence – Calculates the natural antilogarithm of the number in the display (raises e to the displayed power). See page 28.

[log] Common Logarithm Key – Calculates the common logarithm (base 10) of the number in the display. $x > 0$. See page 29.

[INV] [log] Common Antilogarithm (10 to the x Power) Sequence – Calculates the common antilogarithm of the displayed value (raises 10 to the displayed power). See page 29.

[DRG] Degree, Radian, Grad Key – Selects the units for angular measurement. Can be changed whenever desired. See page 30.

[sin] **Sine Key** – Instructs the calculator to find the sine of the displayed value. See page 30.

[INV] [sin] **Arcsine (sin⁻¹) Sequence** – Calculates the smallest angle whose sine is in the display (first or fourth quadrant). See page 31.

[cos] **Cosine Key** – Instructs the calculator to find the cosine of the displayed value. See page 30.

[INV] [cos] **Arccosine (cos⁻¹) Sequence** – Calculates the smallest angle whose cosine is in the display (first or second quadrant). See page 31.

[tan] **Tangent Key** – Instructs the calculator to find the tangent of the displayed value. See page 30.

[INV] [tan] **Arctangent (tan⁻¹) Sequence** – Calculates the smallest angle whose tangent is in the display (first or fourth quadrant). See page 31.

[EE↓] **Exponent Entry and Exponent/Decimal Shift Key** When pressed after a keyboard entry, prepares the calculator to accept the next digits entered as the exponent (see Scientific Notation, page 10). When pressed after a result is obtained, decreases the exponent by one and moves the decimal point of the mantissa one place to the right. [INV] [EE↓] adds one to the exponent and moves the decimal one place to the left. See page 11, 13.

[STO] **Store Key** – Stores the displayed quantity in the memory without removing it from the display. Any previously stored value is cleared. See page 36.

[RCL] **Recall Key** – Retrieves stored data from the memory to the display. Use of this key does not clear the memory. See page 36.

[SUM] **Sum to Memory Key** – Algebraically adds the displayed value to the memory content. This key does not affect the displayed number or calculations in progress. See page 37.

[EXC] **Exchange Key** – Exchanges the content of the memory with the displayed value. The displayed value is stored and the previously stored value is displayed. See page 38.

III. BASIC OPERATIONS

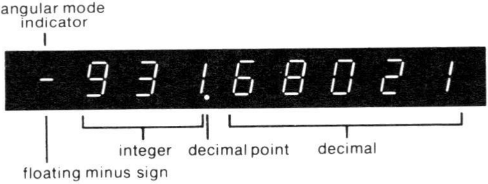
Your calculator is easy to operate because of its algebraic entry format which allows entry of most problems just as they are stated. Although many operations may be obvious, the following instructions and examples help you develop skill and confidence in problem solving.

Turning the Calculator On

Pressing [ON/C], the upper right most key on the keyboard, applies power to the calculator and totally clears the calculator. Power-on condition is indicated by the presence of a lighted digit in the display. The [OFF] key, of course, removes power from the calculator. If the display is not blank after a battery is installed, press [OFF] to reset the calculator.

Initial Display

In addition to power-on and numerical information, the display provides indication of a negative number, decimal point, angular mode and error. As many as 8 digits can be entered. All digit keys pressed after the 8th are ignored.



Any negative number is displayed with a minus sign immediately to the left of the number just as negative numbers are normally written. The minus sign is located here instead of on the far left of the display for ease of reading.

Automatic Turn-Off

Electronic control (as opposed to switch control) of ON and OFF, allows the calculator to minimize power consumption by displaying a number for only a limited length of time. The display reverts to a traveling decimal point after typically 25 to 50 seconds of nonuse. As soon as any key is pressed, the display is restored. The safest method of reactivating the display is to press [EXC] twice. This insures that calculations in progress are not affected and that processing continues as though nothing had happened to the display. The benefit is a substantial increase in the operating life of your battery.

If not interrupted, the traveling decimal display continues for a period of 7 to 14 minutes then automatically turns the calculator completely off.

Data Entry

For maximum versatility, your calculator operates with a floating decimal point. When entering numbers, the decimal remains to the right of the mantissa until [•] is pressed. Then the fractional part of the number is entered and the decimal point floats with the entered number.

[0] through [9] **Digit Keys** – Enter numbers 0 through 9.

[•] **Decimal Point Key** – Enters a decimal point.

[+/–] **Change Sign Key** – When pressed after number entry or a calculation, changes the sign of the displayed number. The sign of the exponent is changed when this key is pressed after the [EE↓] key.

[π] **Pi Key** – Enters the value of pi correct to 11 digits. (This value is rounded to 8 digits for display.)

Numbers up to 8 digits in length can be entered into the calculator directly from the keyboard. The calculator can hold and work with 11 digits. Numbers of this length can be entered as the sum of two numbers.

Example: Enter 389182.70636

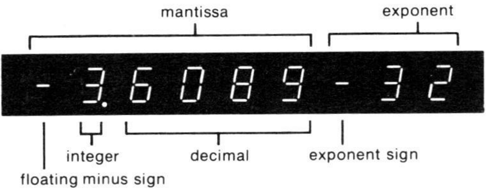
Enter	Press	Display
389182	[+]	389182.
.70636	[=]	389182.71

Clearing

To remove an incorrect entry from the display before any function or operation key is used, press [ON/C]. When pressed after an operation or function key (including [=]), this key clears the display, the constant and all pending operations. Pressing [ON/C] twice always clears the display, the constant and pending operations. The memory is not affected by this key.

Scientific Notation

To enter very large or very small numbers you must use scientific notation where the number is entered as a number (mantissa) multiplied by 10 raised to some power (exponent) such as -3.6089×10^{-32}.



The entry procedure is to key in the mantissa (including its sign), then press [EE↓] and enter the power of ten. Any number smaller than $\pm 1 \times 10^{-8}$ or larger than ±99999999 must be entered in scientific notation.

The number 320,000,000,000 can be written 3.2×10^{11} and can be entered into the calculator as:

Enter	Press	Display
	[ON/C]	0.
3.2	[EE↓]	3.2 00
11		3.2 11

The last two digits on the right side of the display are used to indicate the exponent of 10. Additional digits can be entered after pressing [EE↓], but only the last two numbers pressed are retained as the exponent.

In scientific notation, a positive exponent indicates how many places the decimal point should be shifted to the right. If the exponent is negative, the decimal should be moved to the left.

Regardless of how a mantissa is entered in scientific notation, the calculator normalizes the number, displaying a single digit to the left of the decimal point, when any function or operation key is pressed.

Example: Enter 6025×10^{20}

Enter	Press	Display
	[ON/C]	0.
6025	[EE↓]	6025. 00
20		6025. 20
	[+]	6.025 23

The decimal point of the entered mantissa must not be beyond the 5th digit from the left because the mantissa for scientific notation is limited to 5 digits in the display. Eight digits can be entered, but only 5 are displayed when [EE↓] is pressed. The entire eight digit mantissa is used for calculations. The display does not go into scientific notation format if more than 5 numbers are entered to the left of the decimal point.

The change sign key can be used to attach a negative sign to the mantissa and to the power-of-ten exponent.

Example: Enter -4.818×10^{-10}

Enter	Press	Display
	ON/C	0.
4.818	+/- EE↓	−4.818 00
10	+/-	−4.818−10

A calculated result or quantity recalled from memory can be easily converted from standard display format to scientific notation. Because the EE↓ key controls scientific notation when used after a keyboard entry only, to convert a result in standard display format to scientific notation press X 1 EE↓ =.

Example: $89 \times 987 = 87843 = 8.7843 \times 10^4$

Enter	Press	Display
89	X	89.
987	=	87843.
	X	87843.
1	EE↓	1. 00
	=	8.7843 04

Data in scientific notation form may be entered intermixed with data in standard form. The calculator converts the entered data for proper calculation.

Example: $3.2 \times 10^3 + 12575.321 = 15775.321$

Enter	Press	Display
	ON/C	0.
3.2	EE↓	3.2 00
3	+	3.2 03
12575.321	= X	1.5775 04
1	INV EE↓ =	15775.321

Notice that the complete answer to the problem is 15775.321 and this is the number used for further calculations. Actually, the calculator internally carries all intermediate calculations and final results to 11 places. These numbers are rounded to a maximum of 5 digits for a scientific notation mantissa or an 8-digit standard display.

This example also shows how the display can be removed from scientific notation format. The displayed number must be in the range $\pm 1 \times 10^{-8}$ to $\pm 1 \times 10^{8}$. After a number entry, press [INV] [EE↓] then an operation key or equals to produce a result in standard display format. Once in scientific notation, the calculator will remain in scientific notation format until [ON/C] is pressed or the above procedure performed.

Exponential Shift

The [EE↓] key can be used to alter the appearance of the displayed number without changing its value. When this key is pressed after a result is obtained or after a function or operation key is pressed, it decreases the exponent by one and moves the decimal point of the mantissa one place to the right. [INV] [EE↓] adds one to the exponent and moves the decimal one place to the left under the same conditions.

Example: $1.2 \times 10^{16} + 3.45 \times 10^{14} = 1.2345 \times 10^{16} = 12.345 \times 10^{15} = 1.2345 \times 10^{16}$

Enter	Press	Display
1.2	[EE↓]	1.2 00
16	[+]	1.2 16
3.45	[EE↓]	3.45 00
14	[=]	1.2345 16
	[EE↓]	12.345 15
	[INV] [EE↓]	1.2345 16

Practical Example: What is the diameter of a cable, in microns (1 micron = 10^{-6} meter), whose circumference is 3×10^{-3} meters? $C = \pi d$, $d = C/\pi$.

Enter	Press	Display
3	[EE↓]	3. 00
3	[+/−] [÷]	3.−03
	[π] [=]	9.5493−04
	[EE↓]	95.493−05
	[EE↓]	954.93−06

The diameter is 954.93 microns.

When increasing the magnitude of the mantissa, you cannot shift past a 5-digit integer. When decreasing the mantissa, zeros can be added between the decimal point and the number, possibly pushing some digits out of the display. Once digits have been shifted out of the display, they cannot be returned to the display by the shifting process. Internally, the number is always retained to its full unshifted value. The normalized display is returned whenever any operation, special function, memory or equal key is pressed. To restore the display *and* preserve all pending operations, press [EXC] twice.

Error Indication

The display shows "Error" whenever overflow or underflow occurs or when an improper mathematical operation is requested. When this occurs, any entry from the keyboard is not accepted until [ON/C] or [OFF] is pressed. This clears the error condition and all pending operations. You must now return to the first of your problem and begin again. The error message is given for the following reasons.

1. Number entry or calculation result (including summation into memory) outside the range of the calculator, $\pm 1.0 \times 10^{-99}$ to $\pm 9.9999 \times 10^{99}$.
2. Dividing a number by zero.
3. The mantissa is zero and [log], [lnx] or [1/x] is pressed.
4. The mantissa is negative and [log], [$\sqrt{x}$], [y^x], [lnx] or [INV] [y^x] is pressed.
5. Inverse of sine or cosine (arcsine, arccosine) when the mantissa is greater than 1.
6. Tangent of 90°, 270°, 100 grads, 300 grads or their rotation multiples like 450°, etc.
7. Having more than 15 open levels of parentheses with each pending operation or more than four pending operations.
8. Multiplying a number greater than the 1×10^{99} by another number (decimal or integer) may cause an error condition.

IV. ARITHMETIC FUNCTIONS

To perform simple addition, subtraction, multiplication or division, the calculator with its algebraic type of entry allows you to key in the problem just as it is stated.

This calculator is specially equipped with the Algebraic Operating System. This advanced system allows key sequences to be interpreted correctly by storing certain quantities and operations until the algebraic principles say they can be completed. A more complete discussion of this system occurs later in this section.

It is a safe procedure to press the [ON/C] key before the start of each new problem. This process is not required when the previous problem used [=] to obtain the final result. Following [=] with a numeric entry automatically clears the previous result.

Example: 23.79 + .54 − 6 = 18.33

Enter	Press	Display
	[ON/C]	0.
23.79	[+]	23.79
.54	[−]	24.33
6	[=]	18.33

Again note that the numbers and functions are entered in the same order as they are mathematically stated.

Example: −3.7 − (−7.09) + .014 = 3.404

Enter	Press	Display
3.7	[+/−] [−]	−3.7
7.09	[+/−] [+]	3.39
.014	[=]	3.404

Example: −4 × 7.3 ÷ 2 = −14.6

Enter	Press	Display
4	[+/−] [×]	−4.
7.3	[÷]	−29.2
2	[=]	−14.6

Input Error Correction

At any point in a calculation, [ON/C] can be pressed twice to clear all calculations, including any errors and start over. This drastic action is seldom necessary.

If an incorrect number entry is made, pressing the key before any non-number key clears the incorrect number without affecting any calculation in progress.

Special circuitry has been provided to facilitate the correction of a wrong operation entered while keying in your problem.

When there are no stored operations, as when the first operation is keyed in, and an unwanted operation key is entered, simply press the correct operation and continue. This applies to [+], [−], [÷], [×], [y^x] and [INV] [y^x].

Correction of an incorrect operation entry while there are stored operations in the calculator is dependent on the table below.

INCORRECT ENTRY	DESIRED ENTRY			
	+, −	×, ÷	y^x	$\sqrt[x]{y}$
+, −	CK*	ON/C	ON/C	ON/C
×, ÷	CK	CK	ON/C	ON/C
y^x	CK	CK		ON/C
$\sqrt[x]{y}$	CK	CK	CK	

*CK means to press the correct key and continue.

Locate the incorrect entry you have just made in the column on the left, then follow that row over to the desired operation and apply whatever instruction occurs at that junction.

The [ON/C] key in the table indicates that the incorrect entry cannot safely be corrected to the desired operation for all conditions so the problem must be restarted.

Example: 6 ~~+~~ × 7 ~~−~~ + ~~4~~3 = 45

Enter	Press	Display	Comments
6	[+] [×]	6.	First operation wrong
7	[−] [+]	42.	6 × 7 Completed
4	[ON/C]	0.	Clears 4 (entry)
3	[=]	45.	Answer

A full understanding of the calculator hierarchy discussed in the next few pages will make the input error correction methods obvious.

Combining Operations

After a result is obtained in one calculation it may be directly used as the first number in a second calculation. There is no need to reenter the number from the keyboard.

Example:
1.84 + 0.39 = 2.23 then (1.84 + 0.39)/365 = .00610959

Enter	Press	Display	Comments
1.84	[+]	1.84	
.39	[=]	2.23	1.84 + 0.39
	[÷]	2.23	
365	[=]	.00610959	2.23 ÷ 365

Calculator Hierarchy

In order to efficiently combine operations, you need to understand the standard algebraic rules that have been specifically programmed into the calculator. These algebraic rules assign priorities to the various mathematical operations. Without a fixed set of rules, expressions such as $5 \times 4 + 3 \times 2$ could have several meanings:

$$5 \times (4 + 3) \times 2 = 70$$

or $5 \times 4 + 3 \times 2 = 26$

or $(5 \times 4 + 3) \times 2 = 46$

or $5 \times (4 + 3 \times 2) = 50$

Algebraic rules state that multiplication is to be performed before addition. So, algebraicly, the correct answer is $(5 \times 4) + (3 \times 2) = 26$. The complete list of priorities for interpreting expressions is:

1) Single-variable Functions
2) Exponentiation (y^x), Roots ($\sqrt[x]{y}$)
3) Multiplication, Division
4) Addition, Subtraction
5) Equals

1) Single-variable functions (trigonometric, logarithmic, square, square root, percent and reciprocal) immediately replace the displayed value with their respective functions.
2) Exponentiation (y^x) and roots ($\sqrt[x]{y}$) are performed as soon as the single-variable functions are completed.
3) Multiplication and division are performed as soon as the special functions, exponentiation, root extraction and other multiplication and division are completed.
4) Addition and subtraction are performed only after all operations through multiplication and division as well as other addition and subtraction are completed.
5) Equals completes all operations.

To illustrate, consider the interpretative order of the following example.

Example: $4 \div 5^2 \times 7 + 3 \times .5^{\cos 60^\circ} = 3.2413203$

Enter	Press	Display	Comments
4	[÷]	4.	(4÷) is stored
5	[x^2]	25.	(5^2) single-variable function [x^2] evaluated immediately
	[×]	0.16	($4 \div 5^2$) evaluated because × is same priority as ÷.
7	[+]	1.12	× higher priority than + so ($4 \div 5^2 \times 7$) evaluated, + stored
3	[×]	3.	(3×) stored.
.5	[y^x]	0.5	.5 y^x stored
60	[cos]	0.5	Cos 60° evaluated immediately.
	[=]	3.2413203	Completes all operations: $.5^{\cos 60^\circ}$ evaluated, then $3 \times .5^{\cos 60^\circ}$ next, then this is added to 1.12.

Thus, by entering the expression just as it is written, the calculator correctly interprets it.

The important thing to remember here is that operations are enacted strictly according to their relative priority as stated in the rules. The calculator remembers all stored operations and recalls each and its associated number for execution at exactly the correct time and place. Once familiar with the order of these operations, you will find most problems are extremely easy to solve because of the straightforward manner in which they can be entered into the calculator. When parentheses are required to properly write an equation, parentheses are also available on the calculator. In the expressions at the top of page 18, the parentheses entered, as shown, will result in the answers shown.

Parentheses

There are sequences of operations for which you must instruct the calculator exactly how to evaluate the problem and produce the correct answer. For example:

$$4 \times (5 + 9) \div (7 - 4)^{(2 + 3)} = ?$$

To evaluate this expression as written using only the calculator hierarchy, many independent steps would be required. Also, intermediate results would have to be stored and the sequence certainly could not be input in the same order in which it is written. Parentheses should be used here and whenever a mathematical sequence cannot be directly entered using the previously mentioned algebraic rules or when there is doubt in your mind as to how the calculator is going to reduce an expression.

To illustrate the benefit of parentheses, try the following experiment: press [( ] 5 [+] 9 [ )], and you will see the value 14 displayed. The calculator has evaluated 5 + 9 and replaced it with 14 even though the [=] key was not pressed. Because of this function of parentheses, the algebraic rules now apply their hierarchy of operations within each set of parentheses. Use of parentheses insures that your problem can be keyed in just as you have written it down. The calculator remembers each operation and evaluates each part of the expression as soon as all necessary information is available. When a closed parenthesis is encountered, all operations included within the parenthesis pair are completed.

Parentheses have the additional capability of supplying a missing operand, as shown by the following example.

Example: $4 - (4 + 2) = -2$

Enter	Press	Display
4	[−] [( ] [+]	4.
2	[ )]	6.
	[=]	−2

If no value is entered after a (, the calculator uses the value in the display register. In the example a 4 was automatically inserted before the +.

A closed parenthesis can also supply a missing operand. For instance, 3 [+] [)] gives 6. The) used the display value 3 for the missing operand.

Example: $4 \times (5 + 9) \div (7 - 4)^{(2 + 3)} = .23045268$

Key in this expression and follow the path to completion.

Enter	Press	Display	Comments
4	[×] [(]	4.	(4×) stored pending evaluation of parentheses
5	[+]	5.	(5+) stored
9	[)]	14.	(5 + 9) evaluated
	[÷]	56.	Hierarchy evaluates 4 × 14
	[(]	56.	(56÷) stored pending evaluation of parentheses
7	[−]	7.	(7−) stored
4	[)]	3.	(7 − 4) evaluated
	[y^x] [(]	3.	Prepares for exponent
2	[+]	2.	
3	[)]	5.	(2 + 3) evaluated
	[=]	.23045268	$(7 - 4)^{(2 + 3)}$ evaluated then divided into 4 × (5 + 9)

There are limits on how many operations and associated numbers can be stored. Actually, as many as fifteen parentheses can be open at any one time and four operations can be pending, but only in the most complex situations would these limits be approached. One or more leading parentheses shift the level of processing to the second level allowing for only 3 pending operations. If you do attempt to open more than 15 parentheses or if the calculator tries to store more than four operations, the error message appears in the display.

The following example, requiring the storage of 4 operations, shows the order of interpretation provided by the calculator's operating system.

Example: $5 + (8/(9 - (2/3))) = 5.96$

Enter	Press	Display	Comments
5	[+] [(]	5.	(5+) stored
8	[÷] [(]	8.	(8÷) stored
9	[−] [(]	9.	(9−) stored
2	[÷]	2.	(2÷) stored
3	[)]	.66666667	(2/3) evaluated
	[)]	8.3333333	(9 − (2/3)) evaluated
	[)]	0.96	(8/(9 − (2/3)))
	[=]	5.96	5 + (8/(9 − (2/3)))

Because the [=] key has the capability to complete all incomplete operations whenever it is used, it could have been used here instead of the three [)] keys. Try working this problem again and pressing [=] instead of the first [)].

Each time a closed parenthesis is encountered, the contents are evaluated back to the nearest open parenthesis and are replaced with a single value. Knowing this you can structure the order of interpretation for whatever purpose you may want. Specifically, you can check intermediate results.

Example: $3 \times (4^{(2^{-(\sqrt[4]{7})})}) = 4.7000434$

Enter	Press	Display	Comments
	[ON/C]	0.	
3	[X] [(]	3.	
4	[y^x] [(]	4.	
2	[y^x] [(]	2.	
7	[INV] [y^x]	7.	
4	[)]	1.6265766	$\sqrt[4]{7}$
	[+/−]	−1.6265766	$-(\sqrt[4]{7})$
	[)]	.32385579	$2^{-(\sqrt[4]{7})}$
	[)]	1.5666811	$4^{.323\ldots}$
	[=]	4.7000434	$3 \times 4^{.323\ldots}$

Note that in all these examples, the expressions are entered in a straight left to right sequence.

Calculations With a Constant

Repetitive calculations have been simplified through use of the constant feature of the calculator. Entry of a recurring sequence such as +3, × (−17.3) or y^7 can be stored and used by the calculator to operate on any displayed number. To use the constant feature, enter the repetitive number, m, then enter the desired operation, then press [K].

m [+] [K]	adds m to each subsequent entry.
m [−] [K]	subtracts m from each subsequent entry.
m [×] [K]	multiplies each subsequent entry by m.
m [÷] [K]	divides each subsequent entry by m.
m [y^x] [K]	raises each subsequent entry to the m power.
m [INV] [y^x] [K]	takes the m^{th} root of each subsequent entry.

After storing the constant, each calculation is completed by entering the new number and pressing [=]. Clearing the calculator or entering any of the above arithmetic functions eliminates the constant that is currently stored.

Example: $31 + 1.8026 = 32.8026$

$745.797 + 1.8026 = 747.5996$

$-8.002 + 1.8026 = -6.1994$

$3.2 \times 10^{-2} + 1.8026 = 1.8346$

Enter	Press	Display
	[ON/C]	0.
1.8026	[+] [K]	1.8026
31	[=]	32.8026
745.797	[=]	747.5996
8.002	[+/−] [=]	−6.1994
3.2	[EE]	3.2 00
2	[+/−] [=]	1.8346 00

Example: Evaluate $(3.75)^{-3.2}$, $(.1066)^{-3.2}$, $(.0692)^{-3.2}$

Enter	Press	Display
3.2	[+/−] [y^x] [K]	−3.2
3.75	[=]	.01455794
.1066	[=]	1291.7455
.0692	[=]	5148.2603

Accuracy and Rounding

Each calculation produces an 11-digit result. These 11 digits are more than are displayed. The result is therefore rounded to a 8-digit standard display or to 5 digits for scientific notation. The 5/4 rounding technique built into this calculator adds 1 to the least significant digit of the display if the next, non-displayed digit is five or more. If this digit is less than five, no rounding is applied. *In the absence of these extra digits,* inaccurate results would frequently be displayed, such as

$$1/3 \times 3 = .99999999$$

The example shows $1 \div 3 = .33333333$ when multiplied by 3 produces this answer. The internal 11-digit string of nines in your calculator is *rounded* to 1.

The higher order mathematical functions use iterative calculations. The cumulative error from these calculations in most cases is maintained beyond the eight-digit display so that no inaccuracy is displayed.

Most calculations are accurate to ± 1 in the eighth digit as long as the calculator is not in scientific notation. The only exceptions are the tangent function as it approaches undefined limits and y^x where y is within 10^{-6} of 1.

V. SPECIAL FUNCTIONS

The special function keys described in this section are single-variable functions except for y^x and $\sqrt[x]{y}$ which are two-variable functions. The single-variable functions operate only on the displayed value without interfering with calculations in progress. The two-variable functions may be isolated within a calculation by parenthesis or used with the calculator hierarchy.

NOTE: The right-most digit is displayed during the short time the calculator is computing a result. Be sure the calculator has completed an operation before pressing the next key.

Roots and Powers

The square key [x^2] calculates the square of the number x in the display.

Example: $(4.235)^2 = 17.935225$

Enter	Press	Display
4.235	[x^2]	17.935225

The square root key [$\sqrt{x}$] calculates the square root of the number x in the display.

Example: $\sqrt{6.25} = 2.5$

Enter	Press	Display
6.25	[$\sqrt{x}$]	2.5

Example: $[\sqrt{3.1452} - 7 + (3.2)^2]^{1/2} = 2.2390782$

Enter	Press	Display
3.1452	[$\sqrt{x}$] [−]	1.7734712
7	[+]	−5.2265288
3.2	[x^2]	10.24
	[=]	5.0134712
	[$\sqrt{x}$]	2.2390782

Your calculator also provides two universal roots and powers keys that allow you to vary the value of the exponent as well as the value of the base. One is accessed by the [y^x] key. The other is accessed by the [INV] [y^x] key sequence providing $\sqrt[x]{y}$. These functions are the only special functions that do not act on the displayed value immediately. They require a second value before the function can be realized. Use of these two keys is identical. Enter y, press [y^x] or [INV] [y^x] enter x, and press [=] or an arithmetic function key to yield the answer. A closed parenthesis also completes these functions as well as other stored operations back to the nearest open parenthesis.

Example: $2.86^{-.42} = .64317072$

Enter	Press	Display
2.86	[y^x]	2.86
.42	[+/−]	−0.42
	[=]	.64317072

Example: $\sqrt[3.12]{1460} = 10.332744$

Enter	Press	Display
1460	[INV] [y^x]	1460.
3.12	[=]	10.332744

There is a restriction on these functions – the variable y must be non-negative. When y is negative "Error" lights up in the display after x and an operation key are pressed. y cannot be negative because logarithms are used to perform these functions. The 0th root of a number is not a natural mathematical operation and consequently results in an error condition. Any non-negative number taken to the zero power is 1.

Accuracy for these roots and powers is within ±1 in the 8th significant digit over all ranges except for values of y very near 1 and very large exponents or very small roots. For example 1.00008^{436700} has an error of 4 in the 6th digit. These errors increase as y approaches 1 and the exponent becomes extremely large or when roots become extremely small.

Reciprocal

The reciprocal key [1/x] divides the display value x into 1. $x \neq 0$.

Example: $\frac{1}{3.2} = 0.3125$

Enter	Press	Display
3.2	[1/x]	0.3125

Example: $\frac{1}{-1 + \sqrt{7.4}} = .58129595$

Enter	Press	Display	Comments
1	[+/−] [+]	−1.	Enter −1
7.4	[√x] [=]	1.7202941	$-1 + \sqrt{7.4}$
	[1/x]	.58129595	Answer

Percent

The percent key converts the displayed number from a percentage to a decimal.

Example: 43.9% = .439

Enter	Press	Display
43.9	[%]	0.439

When [%] is pressed after an arithmetic operation, add on, discount, and percentage can be computed as follows:

> [+] n [%] [=] adds n% to the number displayed.

Example: What is the total cost of a $15 item when there is a 5% sales tax?

Enter	Press	Display
15	[+]	15
5	[%] [=]	15.75

> [−] n [%] [=] subtracts n% from the number displayed.

Example: How much is paid for a $5 item that has been discounted 2%?

Enter	Press	Display
5	[−]	5.
2	[%] [=]	4.9

[X] n [%] [=] multiplies the number in the display by n%.

Example: What is 2.5% of 15?

Enter	Press	Display
15	[X]	15.
2.5	[%] [=]	0.375

[÷] n [%] [=] divides the displayed number by n%.

Example: 25 is 15% of what number?

Enter	Press	Display
25	[÷]	25.
15	[%] [=]	166.66667

Natural Logarithm and e^x

The natural logarithm key [lnx] calculates the natural logarithm (base e) of the number x in the display. $x > 0$.

Example: ln 1.2 = .18232156

Enter	Press	Display
1.2	[lnx]	.18232156

The natural antilogarithm (e to the x power) sequence [INV] [lnx] calculates the natural antilogarithm of the number in the display. This sequence raises the constant e to the displayed power.

Example: $e^{3.81} = 45.150439$

Enter	Press	Display
3.81	[INV] [lnx]	45.150439

Example: $e^{(7.5 + \ln 1.4)} = 2531.2594$

Enter	Press	Display	Comments
	[( ]	0.	
7.5	[+]	7.5	Enter 7.5
1.4	[lnx]	.33647224	ln 1.4
	[ )]	7.8364722	(7.5 + ln 1.4)
	[INV] [lnx]	2531.2594	Answer

Note that the [=] key is not needed as the special function produces the final result.

Common Logarithm and 10^x

The common logarithm key [log] calculates the common logarithm (base 10) of the number x in the display. $x > 0$.

Example: log 32.01 = 1.5052857

Enter	Press	Display
32.01	[log]	1.5052857

The common antilogarithm (10 to the x power) sequence [INV] [log] calculates the common antilogarithm of the displayed value. This sequence raises 10 to the displayed power.

Example: $10^{-7.12} = 7.5858 \times 10^{-8}$

Enter	Press	Display
7.12	[+/−] [INV] [log]	7.5858–08

Example: $\log(303 + 10^{1.36}) = 2.5130959$

Enter	Press	Display	Comments
	[ON/C] [( ]	0.	
303	[+]	303.	Enter 303
1.36	[INV] [log]	22.908677	$10^{1.36}$
	[ )]	325.90868	$303 + 10^{1.36}$
	[log]	2.5130959	Answer

The results from logarithms (natural and common), when displayed in normal form rather than in scientific notation, are accurate within the displayed digits.

Trigonometric Functions

The degree, radian, grad key [DRG] selects the units for angular measurement. When the calculator is first turned on, it is in the degree mode. Pressing the [DRG] key once places the calculator in the radian mode. Press this key again and your angles are measured in grads (right angle = 100 grads). The mode changes in a rotary fashion each time the key is pushed. Another key push, for instance, returns the calculator to the degree mode.

The display indicates the current angular mode of the calculator. An apostrophe (') in the far left side of the display denotes the radian mode while quote marks (") indicate the grad mode. If the apostrophe and quotes are absent, angles are measured in degrees.

The angular mode has absolutely no effect on calculations unless the trigonometric functions are being used. Selecting the angular mode is an easy step to perform—*and to forget!* Neglecting this step is responsible for a large portion of errors in operating any calculating machine that offers a choice of angular units.

When the trig functions (sine, cosine, and tangent) are activated, they compute their respective functions of the angle in the display. The inverse trig functions find the smallest angle whose function value is in the display.

Trigonometric values can be calculated for angles greater than one revolution. As long as the trigonometric function result is displayed in normal form rather than in scientific notation, all display digits are accurate for any degrees $< 3.6 \times 10^{14}$, -200π to 200π radians and $-40{,}000$ to $40{,}000$ grads. In general, the accuracy decreases one digit for each decade outside this range.

Example: $\sin 30° = 0.5 = \sin 390°$

Select degree mode

Enter	Press	Display
30	[sin]	0.5
390	[sin]	0.5

Example: $[\sin(.3012\,\pi)]^{-\tan 16.2^\circ} = 1.0626654$

Select radian mode (')

Enter	Press	Display	Comments
	[ON/C] [(]	' 0.	
.3012	[×]	' 0.3012	
	[π]	'3.1415927	
	[)]	'.94624771	(.3012 π)
	[sin]	'.81122714	Sin (.3012 π)
	[y^x]	'.81122714	
16.2	[DRG] [DRG] [tan]	.29052686	Tan 16.2°
	[+/−] [=]	1.0626654	Answer

The largest angle resulting from an arc function is 180 degrees (π radians or 200 grads). Because certain angles have identical function values within one revolution, i.e., arcsin = .5 for 30° and 150°, the angle returned by each function is restricted as follows:

Arc Function	Quadrant of Resultant Angle
arcsin x ($\sin^{-1}$ x)	First (0 to 90°, π/2, or 100 G)
arcsin − x ($\sin^{-1}$ −x)	Fourth (0 to −90°, −π/2, or −100 G)
arccos x ($\cos^{-1}$ x)	First (0 to 90°, π/2, or 100 G)
arccos − x ($\cos^{-1}$ −x)	Second (90° to 180°, π/2 to π, or 100 to 200 G)
arctan x ($\tan^{-1}$ x)	First (0 to 90°, π/2, or 100 G)
arctan − x ($\tan^{-1}$ −x)	Fourth (0 to −90°, −π/2, or −100 G)

Arcsin .5, for example, always returns 30° as the angle even though sin 150° = .5, sin 390° = .5, etc. as well.

Example:
$\sin^{-1} .712 = 45.397875$ degrees = .79234239 radians

Select degree mode

Enter	Press	Display
.712	[INV] [sin]	45.397875

Select radian mode (')

Enter	Press	Display
.712	[INV] [sin]	'.79234239

Example:

$$\sqrt{\text{arctan } 9.72} + \frac{1}{\text{arcsin } .808} = 9.1905773 \text{ degrees}$$

Select degree mode

Enter	Press	Display	Comments
9.72	[INV] [tan]	84.126039	arctan 9.72
	[√x] [+]	9.1720248	$\sqrt{\text{arctan } 9.72}$
.808	[INV] [sin]	53.900984	arcsin .808
	[1/x]	.01855254	1/arcsin .808
	[=]	9.1905773	Answer

Sine and cosine functions are accurate throughout all displayed digits when displayed in standard form. The tangent of ±90° or ±100 grads results in an error condition because the function is undefined at these points. As the tangent approaches these undefined limits the accuracy is restricted. For example, the tangent of 89 degrees (1.5533 radians or 98.888889 grads) is accurate throughout the 8 displayed digits whereas tan 89.99999° is accurate to 3 places.

Degree, Radian, Grad Conversions

It is frequently necessary to convert angular values from one unit system to another. While there are no special conversion keys for this purpose, the key sequences to convert angular units are relatively simple and can be used without affecting the memory register or calculations in progress. First, be sure the calculator is in the correct angular mode for entry of the angle to be converted.

Conversion	Key Sequence
Degrees to Radians	sin DRG INV sin
Degrees to Grads	sin DRG DRG INV sin
Grads to Degrees	sin DRG INV sin
Grads to Radians	sin DRG DRG INV sin
Radians to Degrees	sin DRG DRG INV sin
Radians to Grads	sin DRG INV sin

Example: Express 50 degrees in radians, then grads, then back to degrees.

Select degree mode

Enter	Press	Display	Comments
50	sin DRG INV sin	'.87266463	Radians
	sin DRG INV sin	"55.555556	Grads
	sin DRG INV sin	50.	Degrees

The angular range of the above conversions must be limited to the first and fourth quadrants:

0 ± 90 degrees

0 ± 100 grads

$0 \pm \pi/2$ radians

Larger angles used in the conversion sequences are returned in the first or fourth quadrants as governed by the calculator arcsine function.

For converting angles in any quadrant from one system to another, the following table of conversion factors can be used.

FROM \ TO	degrees	radians	grads
degrees		$\times \frac{\pi}{180}$	$\div .9$
radians	$\times \frac{180}{\pi}$		$\times \frac{200}{\pi}$
grads	$\times .9$	$\times \frac{\pi}{200}$	

These operations can be performed in any angular mode setting of the calculator.

Example: Convert 120 degrees to radians and grads.

Enter	Press	Display	Comments
120	[×] [π] [÷]	376.99112	
180	[=]	2.0943951	radians
	[×]	2.0943951	
200	[÷] [π] [=]	133.33333	grads
	[×]	133.33333	
.9	[=]	120.	degrees

Because of the independence of these conversions from the angular mode of the calculator, you must be extremely careful when using the results for further calculations. *The angular mode must be adjusted to match the units of the results.*

Hyperbolic Functions

Solving problems involving hyperbolic functions uses the exponential ([INV] [lnx]) capability of your calculator.

Hyperbolic Sine (sinh) x = $1/2(e^x - e^{-x}) = \frac{e^{2x} - 1}{2e^x}$

Hyperbolic Cosine (cosh) x = $1/2\ (e^x + e^{-x}) = \frac{e^{2x} + 1}{2e^x}$

Hyperbolic Tangent (tanh) x = $\frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{e^{2x} - 1}{e^{2x} + 1}$

Example: tanh 2.99 = .99495511

Enter	Press	Display
2.99	[×]	2.99
2	[=]	5.98
	[INV] [lnx] [STO] [−]	395.44037
1	[=] [÷]	394.44037
	[(] [RCL] [+]	395.44037
1	[=]	.99495511

Inverse Hyperbolic Functions

$\sinh^{-1}x = \ln(x + \sqrt{x^2 + 1})$

$\cosh^{-1}x = \ln(x + \sqrt{x^2 - 1})$

$\tanh^{-1}x = 1/2\ \ln\left(\frac{1 + x}{1 - x}\right)$

Example: $\sinh^{-1}$ 86.213 = 5.1500018

Enter	Press	Display
86.213	[+] [(]	86.213
	[x^2] [+]	7432.6814
1	[)]	7433.6814
	[$\sqrt{x}$]	86.218799
	[=]	172.4318
	[lnx]	5.1500018

VI. MEMORY USAGE

The memory keys allow data to be stored and retrieved at will for additional flexibility in calculations. Use of the memory does not affect any calculations in progress, so memory operations can be used wherever needed.

Store and Recall

The Store key [STO] stores the displayed quantity in the memory without removing it from the display. Any previously stored value is cleared.

The Recall key [RCL] retrieves stored data from the memory to the display. Use of this key does not clear the memory.

Example: Store and recall 3.012.

Enter	Press	Display
3.012	[STO]	3.012
	[ON/C]	0.
	[RCL]	3.012

Use of these keys allows you to store a long number that is to be used several times.

Example:

Evaluate $2.4x^4 - 3x^2 + x - 10.25$ for $x = 2.1478963$

Enter	Press	Display	Comments
2.4	[×]	2.4	
2.1478963	[STO] [y^x]	2.1478963	Store x
4	[−]	51.081599	$2.4x^4$
3	[×]	3.	
	[RCL]	2.1478963	Recall x
	[x^2]	4.6134585	x^2
	[+]	37.241223	$2.4x^4 - 3x^2$
	[RCL]	2.1478963	Recall x
	[−]	39.389119	$2.4x^4 - 3x^2 + x$
10.25	[=]	29.139119	Answer

You can see that by storing x the first time it is entered saved you from having to spend 15 more keystrokes to key in x the other two times it is needed. A single press of the [RCL] key brings the eight digit x to the display each time. Notice also that the use of [STO] and [RCL] did not interfere with calculator operations.

Sum to Memory

The Sum to Memory key [SUM] algebraically adds the display value to the memory content. This key does not affect the displayed number or calculations in progress.

Important: The clear key [ON/C] does not clear memory except when the calculator is first turned on. Therefore the first quantity should be stored using [STO], or a zero should be stored to ensure the memory is empty before using [SUM].

This key is used to accumulate the results from a series of independent calculations. [SUM] replaces the arithmetic sequence [+] [RCL] [=] [STO].

Example:

$28.3 \times 7 = 198.1$

$173 + 16 = 189$

$312 - 42 + 7.8 = 277.8$

Total 664.9

Enter	Press	Display	Memory
28.3	[×]	28.3	0.
7	[=] [STO]	198.1	198.1
173	[+]	173.	198.1
16	[=] [SUM]	189.	387.1
312	[−]	312	387.1
42	[+]	270.	387.1
7.8	[=] [SUM]	277.8	664.9
	[RCL]	664.9	664.9

This example could have been performed simply by linking each expression together with a [+] and not using the memory. But if each of the three expressions had been far more complicated, then solving the entire problem sequentially could be risky. An uncorrectable mistake during calculations would mean starting over from the first. Summing to memory saves each completed expression making the calculation of each new series of terms independent of the previous ones.

Memory Exchange

The Exchange key [EXC] swaps the content of the memory with the display value. The display value is stored and the previously stored value is displayed.

This key combines the store and recall operations into a single key. Use of this key, like the other memory keys, does not disturb a sequence of calculations and can consequently be used anywhere in the solution of a problem.

The [EXC] key permits you to solve problem 1 and store the result. Then solve problem 2 and compare the results of the two problems while retaining both answers. Also, numbers can be temporarily stored and used as needed.

Example: Evaluate $A^2 + 2AB + B^2 =$ for A = .258963 and B = 1.25632

Enter	Press	Display	Comments
.258963	[STO] [x^2] [+]	.06706184	Store A, A^2 displayed
1.25632	[×]	1.25632	Enter B
	[EXC]	0.258963	Store B, recall A
	[×]	0.3253404	A × B displayed
2	[+]	.71774263	$A^2 + 2AB$ displayed
	[RCL]	1.25632	Recall B
	[x^2]	1.5783399	B^2
	[=]	2.2960826	Answer

When A is recalled from memory for the last time it is needed, B is instantly stored in its place by the single keystroke [EXC].

VII. COMPLEX MATHEMATICAL METHODS

Complex problems can be solved with this calculator with its multilevel algebraic hierarchy.

Sum of Products or Quotients

This type of operation can be performed by directly keying in the expression just as it is mathematically stated.

Example: $(2 \times 3) + (4 \times 5) = 26$

Enter	Press	Display
2	[×]	2.
3	[+]	6.
4	[×]	4.
5	[=]	26.

Example: $1/2 - 3/4 = -.25$

Enter	Press	Display
1	[÷]	1.
2	[−]	0.5
3	[÷]	3.
4	[=]	−0.25

All of the special functions operate only on the displayed quantity: they do not complete any pending operations.

Example: $\sin 30^\circ \cos 60^\circ + \cos 30^\circ \sin 60^\circ = 1$

Select degree mode

Enter	Press	Display
30	[sin] [×]	0.5
60	[cos] [+]	0.25
30	[cos] [×]	.86602541
60	[sin] [=]	1.

Example: $\frac{3 \ln 2}{4 \ln 2 + 6 \ln 5} = .16730271$

Enter	Press	Display
4	[×]	4.
2	[lnx]	.69314718
	[+]	2.7725887
6	[×]	6.
5	[lnx]	1.6094379
	[=]	12.429216
	[1/x] [×]	0.0804556
3	[×]	.24136679
2	[lnx]	.69314718
	[=]	.16730271

Product or Quotient of Sums

Parentheses are usually necessary in these calculations to ensure the proper interpretation of expressions.

Example: $(2 + 3) \times (4 + 5) = 45$

Enter	Press	Display
	[ON/C] [(]	0.
2	[+]	2.
3	[)] [×] [(]	5.
4	[+]	4.
5	[=]	45.

Example: $(e^{-1.2} + 3) \times (4 + 5^{2.6}) = 229.97174$

Enter	Press	Display
	[ON/C] [(]	0.
1.2	[+/−] [INV] [ln x] [+]	.30119421
3	[)] [×] [(]	3.3011942
4	[+]	4.
5	[y^x]	5.
2.6	[=]	229.97174

Example: $\dfrac{3 + \sin(.45\pi) \times (\pi^2 - 2)}{\tan[(2.7)^2 + \ln(8.21)^3]} = 6.3279647$

Select radian mode

Enter	Press	Display
	[ON/C] [(]	' 0.
3	[+] [(]	' 3.
.45	[×]	' 0.45
	[π]	'3.1415927
	[)]	'1.4137167
	[sin] [×] [(]	'.98768834
	[π]	'3.1415927
	[x^2] [−]	'9.8696044
2	[)]	'7.8696044
	[)] [÷] [(] [(]	'10.772717
2.7	[x^2] [+] [(]	' 7.29
8.21	[y^x]	' 8.21
3	[)]	'553.38766
	[ln x]	'6.3160588
	[)]	'13.606059
	[tan]	'1.7023983
	[=]	'6.3279647

Quadratic Equation

For an equation in the form $ax^2 + bx + c = 0$, the solutions for x are

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

Example: Find the roots of the equation $3x^2 + 8x + 5 = 0$.

Using the above equation: $a = 3, b = 8, c = 5$

$$x = \frac{-8 \pm \sqrt{(8)^2 - (4)(3)(5)}}{2 \times 3}$$

Solving for the positive sign first

Enter	Press	Display
	[ON/C] [( ]	0.
8	[+/−] [+] [( ]	−8.
8	[x^2] [−]	64.
4	[×]	4.
3	[×]	12.
5	[ )]	4.
	[$\sqrt{x}$] [STO]	2.
	[ )] [÷] [( ]	−6.
2	[×]	2.
3	[=] [( ]	−1. Root 1
8	[+/−] [−]	−8.
	[RCL]	2.
	[ )] [÷] [( ]	−10.
2	[×]	2.
3	[=]	−1.6666667 Root 2

APPENDIX A
Conversion Factors

English to Metric

To Find	Multiply	By
microns	mils	**25.4**
centimeters	inches	**2.54**
meters	feet	**0.3048**
meters	yards	**0.9144**
kilometers	miles	**1.609344**
grams	ounces	28.349523
kilograms	pounds	**0.45359237**
liters	gallons (U.S.)	3.7854118
liters	gallons (Imp.)	4.546090
milliliters (cc)	fl. ounces	29.573530
sq. centimeters	sq. inches	**6.4516**
sq. meters	sq. feet	**0.09290304**
sq. meters	sq. yards	**0.83612736**
milliliters (cc)	cu. inches	**16.387064**
cu. meters	cu. feet	2.8316847×10^{-2}
cu. meters	cu. yards	0.76455486

Temperature Conversions

$$^{\circ}F = \frac{9}{5}(^{\circ}C) + 32$$

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

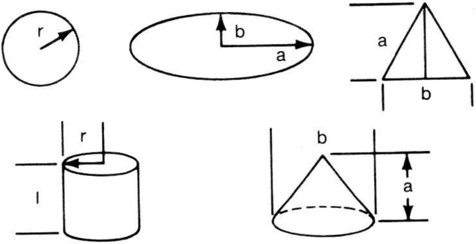
Boldface numbers are exact; others are rounded.

General

To Find	Multiply	By
atmospheres	feet of water @ 4°C	.0294990
atmospheres	inches of mercury @ 0°C	.0334211
atmospheres	pounds per sq. inch	.068046
BTU	foot-pounds	.00128593
BTU	joules	9.4845×10^{-4}
cu. ft.	cords	**128**
degree (angle)	radians	57.29578
ergs	foot-pounds	13558200
feet	miles	**5280**
feet of water @ 4°C	atmosphere	33.8995
foot-pounds	horsepower-hours	1.98×10^{6}
foot-pounds	kilowatt-hours	2655220
foot-pounds per min.	horsepower	3.3×10^{4}
horsepower	foot-pounds per sec.	.00181818
inches of mercury @ 0°C	pounds per sq. inch	2.03602
joules	BTU	1054.3504
joules	foot-pounds	1.35582
kilowatts	BTU per min.	.01757251
kilowatts	foot-pounds per min.	2.2597×10^{-5}
kilowatts	horsepower	.7457
knots	miles per hour	0.86897624
miles	feet	1.89393×10^{-4}
nautical miles	miles	0.86897624
radians	degrees	.017453293
sq. feet	acres	**43560**
watts	BTU per min.	17.5725

Boldface numbers are exact; others are rounded.

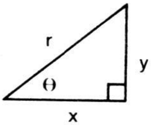
APPENDIX B
Geometric Formulas



Circumference:	Circle $2\pi r$	
Area:	Circle	πr^2
	Ellipse	πab
	Sphere	$4\pi r^2$
	Cylinder	$2\pi r[r+l]$
	Triangle	$\frac{1}{2}ab$
Volume:	Ellipsoid of revolution about "a" axis	$4/3\pi b^2 a$
	Ellipsoid of revolution about "b" axis	$4/3\pi a^2 b$
	Sphere	$4/3\pi r^3$
	Cylinder	$\pi r^2 l$
	Cone	$\frac{\pi b^2 a}{12}$
Analytical:	Circle	$\frac{x^2}{r^2}+\frac{y^2}{r^2}=1$
	Ellipse	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$
	Hyperbola	$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$
	Parabola	$y^2=\pm 2px$
	Line	$y=mx+b$

APPENDIX C
Mathematical Expressions

Trigonometric Relations



$$\sin \Theta = \frac{y}{r}$$

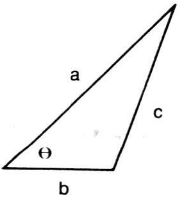
$$\cos \Theta = \frac{x}{r}$$

$$\tan \Theta = \frac{y}{x}$$

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

$$e^{i\Theta} = \cos \Theta + i \sin \Theta \qquad i = \sqrt{-1}$$

Law of Cosines



$$a^2 + b^2 - 2ab \cos \Theta = c^2$$

Laws of Exponents

$$a^x \times a^y = a^{x+y} \qquad \frac{1}{a^x} = a^{-x}$$

$$(ab)^x = a^x \times b^x \qquad \frac{a^x}{a^y} = a^{x-y}$$

$$(a^x)^y = a^{xy} \qquad a^0 = 1$$

Laws of Logarithms

$$\ln(y^x) = x \ln y$$

$$\ln(ab) = \ln a + \ln b$$

$$\ln\left(\frac{a}{b}\right) = \ln a - \ln b$$

APPENDIX D
Service Information

In Case of Difficulty

1. If using the optional rechargeable kits RK-1 or RK-2, check for power at AC outlet and proper insertion of plug into calculator.

   CAUTION: Use of other than a 9-volt battery or recharging kits RK-1 or RK-2 with electronic battery may apply improper voltage to your TI-30 calculator and will cause damage. Remember also that the battery packs cannot be recharged with either charger. The BP-5 should only be recharged with the AC9131 and the BP-8 should only be recharged with the AC9132.

2. If the display contains only a decimal point moving across the window, the calculator has automatically lapsed into a power-saving mode. The value that was present in the display can be easily retrieved and displayed by pressing the exchange key [EXC] twice. This procedure does not adversely affect any calculations in progress.

3. If display fails to light on battery operation, check for an improperly inserted or discharged battery. See *Battery Installation* instructions in Section I.

4. Review operating instructions to be certain calculations are performed correctly.

5. When a battery is inserted into the calculator and the display is not blank, pressing [OFF] should blank the display and prepare the calculator for your use.

If none of the above procedures corrects the difficulty, return the **calculator** (and rechargeable kit or electronic battery if you have one) PREPAID and INSURED to the applicable SERVICE FACILITY listed on the back cover.

NOTE: The P.O. box number listed for the Lubbock Service Facility is for United States parcel post shipments only. If you desire to use another carrier, the street address is:

Texas Instruments Incorporated
2305 University Ave.
Lubbock, Texas 79415

For your protection, the calculator must be sent insured; Texas Instruments cannot assume any responsibility for loss of or damage to uninsured shipments.

Please include information on the difficulty experienced with the calculator, as well as return address information including name, address, city, state and zip code. The shipment should be carefully packaged and adequately protected against shock and rough handling.

Calculator Exchange Centers

If your calculator requires service, instead of returning the unit to a service facility for repair, you may elect to exchange the calculator for a factory-rebuilt calculator of the SAME MODEL at one of the exchange centers which have been established across the United States. A $3.00 charge will be made by the exchange center for in-warranty exchanges. Out-of-warranty exchanges will be charged at the rates in effect at the time of the exchange. Please call the Consumer Relations Department for further details and the location of the nearest exchange center.

If You Need Service Information

If you need service information for your calculator, write Consumer Relations at:

Texas Instruments Incorporated
P.O. Box 53
Lubbock, Texas 79408

or call Consumer Relations at 800-858-1802 (toll-free within all contiguous United States except Texas) or 800-692-1353 (toll-free within Texas). If outside contiguous United States call 806-747-3841. (We regret that we cannot accept collect calls at this number.)

IMPORTANT

THE WARRANTY IS VOID IF THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.

IMPORTANT: In addition to retaining your sales receipt or other proof-of-purchase date documentation, please record the following information. Any correspondence concerning the calculator must mention the model, serial number, and date-of-purchase.

TI-30		
Model No.	Serial No.	Purchase Date

Texas Instruments reserves the right to make changes in materials & specifications without notice.

ONE-YEAR LIMITED WARRANTY

WARRANTEE

This Texas Instruments electronic calculator warranty extends to the original purchaser of the calculator.

WARRANTY DURATION

This Texas Instruments electronic calculator is warranted to the original purchaser for a period of one (1) year from the original purchase date.

WARRANTY COVERAGE

This Texas Instruments electronic calculator is warranted against defective materials or workmanship. **THIS WARRANTY IS VOID IF: (i) THE CALCULATOR HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, NEGLECT, IMPROPER SERVICE OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIAL OR WORKMANSHIP, (ii) THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.**

WARRANTY PERFORMANCE

During the above one (1) year warranty period your calculator will either be repaired or replaced with a reconditioned model of an equivalent quality (at TI's option) when the calculator is returned, postage prepaid and insured, to a Texas Instruments Service facility listed below. In the event of replacement with a reconditioned model, the replacement unit will continue the warranty of the original calculator or 90 days, whichever is longer. Other than the postage and insurance requirement, no charge will be made for such repair, adjustment, and/or replacement.

WARRANTY DISCLAIMERS

ANY IMPLIED WARRANTIES ARISING OUT OF THIS SALE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE ONE (1) YEAR PERIOD. TEXAS INSTRUMENTS SHALL NOT BE LIABLE FOR LOSS OF USE OF THE CALCULATOR OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE PURCHASER.

Some states do not allow the exclusion or limitation of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you.

LEGAL REMEDIES

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

TEXAS INSTRUMENTS CONSUMER SERVICE FACILITIES

Texas Instruments Service Facility
P.O. Box 2500
Lubbock, Texas 79408

Texas Instruments Service Facility
41 Shelley Road
Richmond Hill, Ontario, Canada

Consumers in California and Oregon may contact the following Texas Instruments offices for additional assistance or information:

Texas Instruments Consumer Service
3186 Airway Drive Bldg J
Costa Mesa, California 92626
(714) 540-7190

Texas Instruments Consumer Service
10700 Southwest Beaverton Highway
Park Plaza West, Suite 11
Beaverton, Oregon 97005
(503) 643-6758

CONSUMER RELATIONS DEPARTMENT

If you have questions or need assistance with your calculator, write the Consumer Relations Department at: **Texas Instruments Incorporated, P.O. Box 22283, Dallas, Texas 75222.** Or, call Consumer Relations at 800-527-4980 (toll-free within all contiguous United States except Texas) or 800-492-4298 (toll-free within Texas).

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