300758-2

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ELECTRONIC SLIDE RULE CALCULATOR

SR-36

Guarantee

Your new electronic calculator carries a parts and labor guarantee for six months from date of purchase.

If during the first 30 days of this period there is evidence of defects in material or workmanship requiring adjustment or repairs, you may return it to your place of purchase for prompt exchange or return it to a Commodore Service Center.

In order to receive free service under this guarantee at a Commodore Service Center, you are required to pay all postage, shipping and insurance charges when returning your calculator to the Commodore Service Center and enclose a check or money order for $2.50 to cover handling charge, return postage and insurance.

We reserve the right to repair a damaged component, replace it entirely, or, if necessary, exchange your machine.

This guarantee is valid only when a copy of your original sales slip or similar proof of purchase accompanies your defective machine.

This guarantee applies only to the original owner. It does not cover damage or malfunctions resulting from fire, accident, neglect, abuse or other causes beyond our control.

The guarantee does not cover the repair or replacement of plastic housings or transformers damaged by the use of improper voltage. Nor, does it cover the replacement of expendable accessories.

The guarantee will also be automatically voided if your machine is repaired or tampered with by any unauthorized person or agency.

In order to record your guarantee you must complete the registration card and mail it within ten days from date of purchase.

This guarantee supersedes, and is in lieu of, all other guarantees whether expressed or implied.

Introduction

Thank you for selecting our electronic slide rule calculator. The SR-36 is a precision-built instrument which we are proud to have produced.

For just a moment, imagine it as Aladdin's Lamp, but instead of a genie, your calculator embodies the creativity, craftsmanship, and dedication of hundreds of people in every division of our company. Inherent in each machine is our promise of flawless performance designed to earn your confidence. This satisfaction is the keynote to our growth and it is to this goal that we continue to dedicate our efforts.

The SR-36 is an excellent example of our endeavors. It represents many hours of research and development, and today stands as perhaps the finest achievement in the field of portable electronic computing instruments.

Consider for a moment its range of applications. The SR-36 instantly computes natural and common logs and antilogs as well. It calculates sines, cosines and tangents of trigonometric arguments and their respective inverses. It handles numbers as small as 1.0×10^{-99} up to $9.999999999 \times 10^{99}$.

The versatility of your new slide rule calculator, enhanced by its parentheses keys, unquestionably places it in an enviable position of leadership above all other comparable machines. Its ten digit capacity plus two digit exponent affords far greater precision than is known to most of the physical constants in the universe.

Equally significant, is its common sense algebraic logic. That is, it uses people logic rather than computer logic. You enter assignments as you would ordinarily write them down on paper. This is essential in giving you a more immediate command of your machine. Moreover, the SR-36 prefers non-scientific notation over scientific notation. Again, people logic, not computer. Of course, when the size and accuracy of a computed result demands an exponential expression, your SR-36 will automatically display it as such. More about this later.

Thus, the SR-36 was designed for you. It is basically an easy-to-comprehend, easy-to-operate machine. Please read through the pages of your booklet carefully. Become familiar with the keyboard and its characteristics. Work through the examples, as they have been designed to give you a thorough understanding of the functions. Practice. Once you discover how easy the SR-36 is to operate, it will become an enjoyable, important aid to you in almost every area of calculation.

Essentially, the SR-36 is a super high-speed, numeric answer machine. Of course, its sophisticated, solid state component architecture enables it to perform an extensive range of problem solving applications across a broad spectrum of mathematics. Nonetheless, it is simply, an answer machine. As such, its operation can be mastered and its advanced electronic brainpower can be easily utilized to serve your most challenging assignments efficiently and accurately.

Introduction
(Continued)

The SR-36 is a display calculator. Since its display is where it tells you what is going on, your acquaintance with your new machine should begin right there.

1.	2	3	4	5	6	7	8	9	1	-	0	4

An important consideration of any calculator is its capacity. The larger its capacity, the greater its accuracy and performance. Your SR-36 has a 14-character capacity. Its first position is reserved for the SIGN of the number you are reading. The next ten positions are for the number, itself, or mantissa. The twelfth position reveals the SIGN of the EXPONENT. And the last two spaces are for the EXPONENT.

We didn't forget the sign of the mantissa in the above illustration. The absence of a sign in the position reserved for it means the expression is positive. Thus, the display above is read as:

$$1.23456791 \times 10^{-4}$$

The result displayed is expressed in scientific notation. Your machine, like yourself, is able to express results both scientifically and in non-scientific terms. This is because the logic of your SR-36 is designed to complement the way human beings, not computers, think. It will favor expressing answers in non-scientific terms and will automatically resort to scientific notation only when the size and accuracy of the number to be displayed requires exponential representation.

Thus, all non-repeating decimal results will be displayed in non-scientific notation, whenever possible.

eg: $1 \div 2 =$ $\boxed{0.5}$

And all repeating decimal results will be displayed in scientific notation.

eg: $1 \div 3 =$ $\boxed{3.333333333\text{-}01}$

Scientific Notation is nothing more than a handy way of abbreviating an excessively large, clumsy number.

For example the non-scientific number two thousand can be written as we all recognize it:

2000

But, if we wanted to join the ranks of our mathematical intelligencia we could express this same value as:

$$2 \times 10^3$$

This would be entered into the calculator as:

2 Exp 3

The display would then read:

$\boxed{2.\ 03}$

Another way of expressing 2000 in scientific notation would be:

$$20 \times 10^2$$

It would be entered as:

2 0 Exp 2 and read as:

$\boxed{20.\ 02}$

Let's take a closer look at what the display is actually telling us.

Introduction
(Continued)

When it is reading:

2. 03

It merely says, "move the decimal three places to the right." So:

2000

If you are now assuming that a negative exponent tells you that the true position of the decimal is LEFT of the displayed decimal the number of places expressed by the exponent, you are correct.

Thus, if the display reads:

1.234567891-07

We would write this expression as:

.0000001234567891

But it's admittedly a lot easier to simply write:

$$1.234567891 \times 10^{-7}$$

Similarly, calculations of excessively lengthy numbers are made comparatively easy when handling them as scientific notations. For example:

$$(25 \times 10^{55}) \times (2 \times 10^{25}) = 50 \times 10^{80}$$

The rule behind this states, "Multiply the mantissas and add the exponents."

Handling negative exponents is just as easy:

$$(2 \times 10^{-3}) \times (3 \times 10^{15}) = 6 \times 10^{12}$$

Power

Your SR-36 is equipped with quick charge, nickel cadmium batteries.

AC Operation
Connect the charger to any standard electrical outlet and plug the jack into the Calculator. After the above connections have been made, the power switch may be turned "ON." (While connected to AC, the batteries are automatically charging whether the power switch is "ON" or "OFF.")

Battery Operation
Disconnect the charger cord and push the power switch, "ON," an interlock switch in the calculator socket will prevent battery operation if the jack remains connected. With normal use a full battery charge can be expected to supply about 2 to 3 hours of working time.

When the battery is low, the signal "L" will appear at the extreme left position of the display. Do not continue battery operation, this indicates the need for a battery charge. Use of the calculator can be continued during the charge cycle.

Battery Charging
Simply follow the same procedure as in AC operation. The calculator may be used during the charge period. If a power cell has completely discharged, the calculator should not be operated on battery power until it has been recharged for at least 3 hours, unless otherwise instructed by a notice

Power
(Continued)

accompanying your machine. To assure a thorough charge, it is recommended that the calculator be left to recharge overnight. Batteries will reach full efficiency after 2 or 3 charge cycles.

Time Out

–

The time out signal appears as a small dash at the right hand side of the display in the 'sign of the exponent' position. This blanking of the display occurs to reduce the power drain on the battery pack and extend direct current operating time. To recall the blanked out data you need only press any function key. A good rule to follow is to press the x←→y key twice. Thus, in the event time out occurs midway during an entry, the double pressing of the x←→y key will enable you to recall the partial entry for completion.

Display Signals

As we have mentioned, the display panel tells you what is occurring through a series of signals. These indicators will always appear in the far left position of display reserved for the SIGN of the MANTISSA.

Negative Number

–

Overflow Error Signal (Positive)

Γ

One example which would result in a positive error condition is:

9 EXP 99 × 9 EXP 99 =

Γ 8.1 99

Here the result exceeds capacity. The positive condition advises the operator to read the exponent as a 3-digit number.

(8.1×10^{199})

Low Battery

L

When the signal appears, it indicates that the nickel cadmium batteries need recharging. You may operate your machine while it is being recharged on standard AC current. Please refer to the recharging instructions in this manual. Do not continue to operate your machine on (DC) battery power when it is in, "Low Battery" condition. To do so may cause irreparable damage to your machine.

Overflow Error Signal (Negative)

F

In the example:

9 EXP 9 9 = M × M +/– =

the display will show the following negative overflow result:

F 8.1 99

(Read as -8.1×10^{199})

These are the four basic signals to watch for on your machine. Understanding the conditions which created them will give you even greater insight into the SR-36 's performance range. When overflow is combined with a low battery indication, the overflow indication has priority. The low battery signal will disappear until the overflow is cleared.

Power
(Continued)

(Negative) low battery | E |

Calculations in which the machine is incapable of displaying results significantly close to zero will show an Underflow condition. The negative sign of the exponent reveals this error.

Positive Underflow:

$$9 \times 10^{-99} \times 9 \times 10^{-99}$$

9 EXP +/− 9 9 × 9 EXP +/− 9 9 =

Read | Γ 8.1−97 | (Read as 8.1 x 10^{-197})

Negative Underflow:

$$1 \times 10^{23} \times -1.23 \times 10^{-99}$$

EXP +/− 2 3 × +/− 1 . 2 3 EXP +/− 9 9 =

Read | F 1.23-22 | (Read as −1.23 x 10^{-122})

Zero Suppression
The position of the figures in the above illustration explains what is meant by saying all figures displayed are RIGHT JUSTIFIED. The logic of the SR-36 commands this positioning and suppresses all leading zeroes.

Keyboard

ON **Power On** At top right corner of keyboard. When switched to on position the display will show | 0. |

0 thru 9 **Data Entry Keys** Enter numerals 0 thru 9. Capacity: Ten digits in mantissa and two digits in exponent.

C **Clear Key** Clears all registers in the calculator except memory. Sets machine at zero to begin a new problem. Clears all error conditions.

CE **Clear Entry Key** Clears display of last keyboard entry (erase key).

+/− **Change Sign Key** Commands calculator to change the sign of the mantissa appearing in the display. The change sign key can be pressed at any time, before, during or after the entry of a number to effect the sign change. For this reason the +/− key enables you to index a number into the machine just as you would write it down:

Example: −2 + 3 =
Press +/− 2 + 3 =

or

Example: 2 + (−3)
Press 2 + +/− 3 =

Note: If the +/− key is pressed after the EXP key the sign of the exponent will be changed.

EXP **Enter Exponent Key** After this key is pressed the numbers entered will fall into the exponent field. The +/− key, if pressed after the EXP key, will effect the sign change of the exponent only and will not alter the mantissa. e.g. 2.1×10^{-21}.

Press 2 . 1 EXP +/− 2 1
e.g. $9 \times 10^{20} \div 9 \times 10^{19}$
Press 9 EXP 2 0 ÷ 9 EXP 1 9 =

The answer to this argument is 10. and the display will read

10.

As we mentioned, the machine prefers to "think" in non-scientific notation. (It had better, as we designed it that way. If it begins to think on its own, we're all in trouble.) Therefore, the unit has on command, accepted the operands in scientific notation. It automatically displayed the result in non-scientific notation, or in terms with which we, ourselves, are more familiar. It will do this automatically in every instance where there is no risk in destroying the accuracy of the result.

× **Multiplication** Causes the execution of a prior function, displays intermediate result and stores current multiplication function.

÷ **Division** Causes the execution of a prior function, displays intermediate result and stores current divide command.

− **Subtraction** Causes execution of a prior function, displays intermediate result and stores current subtract command.

= **Result** Causes execution of a prior function and displays result of calculation. The conclusion of the previous example reached by pressing =, clears the machine if the user pushes a number key to begin a new example.

However, if the user wishes to apply the currently displayed result in a continuing chain calculation, he may press any of the two-operand function keys
(+, −, ×, ÷, y^x).

The result key will automatically close previously opened parentheses as an entry saving device. Please refer to the "Financial Problem" section for an illustration of this procedure.

Decimal Enters a decimal point.

SPECIAL FUNCTION KEYS

[ ] **Parentheses** We have begun the category of 'special function keys' with the parentheses keys because they set your calculator apart and above just about every other comparable calculator on the market. The advantage of parentheses is that you may accomplish complex and mixed chain computations employing two levels of parentheses to group expressions. Other machines must surrender their memory registers to accomplish this assignment, while yours is still free to store additional data, thus vastly increasing the unit's versatility.

Example: $\left[(a+b)\ y^x\ 2\right] - \left[(c+d)\ y^x\ 2\right]$
$= \sqrt{x}\ 1/x\ \sin\ y^x\ 3 =$
Derives the function:

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

To enter, press:
a + b y^x 2 − [[c +
d y^x 2 = $\sqrt{x}$ $1/x$ sin y^x 3 =

The parentheses keys are operated in precisely the order in which a problem would be written on paper. As each new parentheses is opened, the prior result and prior function are stored until that particular level of parentheses is closed later on in the argument.

Efforts to open more than two levels of parentheses will cause an error or fault condition. Further calculation is not permitted until this condition is rectified by use of the clear key.

As referred to in the explanation of the = key, this key will close all prior parentheses in succession, just in case you neglected to press the] key in proper sequence.

A function key must be used between successive parentheses operations. The machine will not infer multiplication produced by a key sequence: (a−b) (c+d) =. You must index the sequence (a−b) × (c+d) =.

1/x **Reciprocal** Commands the calculator to divide the numeral one by the number displayed and display the result.

$\sqrt{x}$ **Square Root** Commands the calculator to compute square root of the displayed number (in other words, it determines that number, which when multiplied by itself, equals the currently displayed number). The answer is automatically displayed.

An attempt to compute the square root of a negative number will cause an error condition on your display. To clear press C key.

π **Pi** Enters the value of Pi (π) to 10 significant digits into a calculation. Display will read 3.141592654

Trigonometric Function Keys The sin, cos, tan and arc keys are used to process trigonometric functions. Each key will process the displayed figure immediately after it is pressed. They will not affect any other previously calculated result.

To process a trigonometric function, the value is entered (from the keyboard or as a previously calculated result) and then the desired function key is pressed.

The calculator will compute the angle for trig functions in either radians or degrees, depending upon the mode you select.

Keyboard
(Continued)

rad↔deg **Radian↔Degrees** Your machine can easily be placed into a radian mode simply by pressing the rad key. When the lamp is lit all entries will automatically be assumed in radian units. Touch the rad key again to turn off the lamp and restore your unit to the degree mode.

When the machine is in the radian mode input arguments to trig are received as radian units.

During an inverse trig argument you may alter the mode of the machine any time prior to pressing a trigonometric function key in order to derive an answer in a desired mode.

sin **Sine** Commands the calculator to determine the sine of the displayed argument.

cos **Cosine** Commands the calculator to determine the cosine of the displayed argument.

tan **Tangent** Commands the calculator to determine the tangent of the displayed argument.

arc **Inverse Trig** Commands the calculator to determine the angle of the selected trig function whose value is the displayed quantity, when entered as a prefix to the sin, cos or tan keys.

Your SR-36 is well aware of the non-existence of the arc sine and arc cosine of numbers greater than one. It will thus consider any attempt to attain a result of these arguments as invalid by displaying an error signal.

LOGARITHMIC FUNCTION KEYS

The log function keys enable the handling of log quantities to base e or base 10. The log keys will process displayed data only.

Since the log of a negative number does not exist, your SR-36 will display an error signal should an attempt be made to determine it. The error signal will also occur if the log or Ln of "0" is sought.

Log **Common Log** Commands the calculator to determine the log to the base 10 of the displayed number.

ln **Natural Log** Commands the calculator to determine the log to the base e of the displayed number.

e^x **e to the power of x** Commands the calculator to raise the value of e to the displayed power.

TWO-VARIABLE FUNCTION KEYS

y^x **y to the power of x** This is a two-operand function key which, while raising one figure to the power of another, operates in a manner similar to either multiplication or division.

For example: $3^2 = 9$ Press 3 y^x 2

Keyboard
(Continued)

The result: 9 will be computed and displayed when either the next function key or = key is pressed.

x⟷y **Exchange** In an algebraic logic machine the x⟷y key serves two principal purposes:

A) It allows factor reversal when using a two-operand function such as raising a number to a power.

Argument should be: 2^3

Entry error: 3 y^x 2 $x \longleftrightarrow y$ = 8

B) In subtraction and division, where an incorrect entry was made, the x⟷y key is also beneficial.

Example: 2 ÷ 5

Entry error: 5 ÷ 2 $x \longleftrightarrow y$ = 0.4

The x⟷y key will, of course, perform factor reversals in multiplication and addition.

Since factor reversal in these examples will not alter the results, this note is mentioned to satisfy those curious about the machine logic.

M **Memory** Data storage and data recall are governed by this single M key. Depression of the key after an = key causes the result as displayed, to be stored in the memory. Depression of the M key at any time causes the contents of the memory to be recalled and displayed.

Examples

	Enter Figure	Depress Function Key	Read
Addition			
6.59 + .03 =	6.59	+	6.59
	.03	=	6.62
Subtraction			
.0072 − 63.4 − 12.88 =	.0072	−	.0072
	63.4	−	−63.3928
	12.88	=	−76.2728
Multiplication			
35 × 12 =	35	×	35.
	12	=	420.
Division			
7.35 ÷ 91 =	7.35	÷	7.35
	91	=	8.076923076-02

Note: Calculator has automatically gone into scientific notation to display complete result.

Positive & Negative Number Calculations

A negative sign can be assigned to any number by pressing +/− key.

	Enter Figure	Depress Function Key	Read
2.1 × (−3.2) =	2.1	×	2.1
		+/−	−0.
	3.2	=	−6.72

Examples
(Continued)

	Enter Figure	Depress Function Key	Read
Square Root			
$4.1 + \sqrt{3}$	4.1	+	4.1
	3		3.
		$\sqrt{x}$	1.732050807
		=	5.832050807
$\sqrt{(2 + 3) \times (4 + 5)}$		[	0.
	2	+	2.
	3		3.
		]	5.
		×	5.
		[	0.
	4	+	4.
	5		5.
		]	9.
		=	45.
		$\sqrt{x}$	6.708203932
Reciprocals			
$\frac{1}{2} =$	2		2.
		$1/x$	0.5
$\left(\frac{1.2}{\sqrt{3.1} - (\frac{1}{4})}\right) =$	1.2		1.2
		÷	1.2
		[	0.
	3.1		3.1
		$\sqrt{x}$	1.760681686
		−	1.760681686
	4		4.
		$1/x$	0.25
		]	1.510681686
		=	7.943433822-01

Examples
(Continued)

Business Calculations

Mr. Jones has deposited $500 in an account paying 4.5% interest. He intends to let his investment remain for 12 years. How much will he withdraw at the end of the period?

Future Value = F $F = C\,(1+I)^n$
Current Value = C
Interest = I $F = 500\,(1+4.5\%)^{12}$
No. Years = n

Answer: $847.94

Enter Figure	Depress Function Key	Read
500	×	500.
	[	0.
	[	0.
1	+	1.
.045		0.045
	]	1.045
	y^x	1.045
12		12.
	=	847.94071

In 1968 the XYZ company's sales were $4,000,000. By 1975 the firm expects to have sales of $70,000,000. What is the growth rate of XYZ company, compounded annually?

$$I = \left(\frac{F}{C}\right)^{1/n} - 1$$

$$I = \left[\left(\frac{70{,}000{,}000}{4{,}000{,}000}\right)^{1/7}\right] - 1$$

Answer: 50.5%

Enter Figure	Depress Function Key	Read
	[	0.
70,000,000	÷	70000000.
4,000,000		4000000
	y^x	17.5
7	$1/x$	1.428571428-01
	]	1.50513988
	−	1.50513988
1		1.
	=	0.50513988

Examples
(Continued)

Two Variable Function Calculations

$3^2 =$

Enter Figure	Depress Function Key	Read
3	y^x	3.
2	=	9.

$$2 + \left[(4+5)^{(1.1+2.2)}\right]$$

Enter Figure	Depress Function Key	Read
2	+	2.
	[	0.
	[	0.
4	+	4.
5		5.
	]	9.
	y^x	9.
	[	0.
1.1	+	1.1
2.2		2.2
	]	3.3
	]	1409.2897
	=	1411.2897

John buys a car for $4000. He intends to pay it out at 6.5% interest over a 3-year period. What is his monthly payment?

$$MP = \frac{P \times I}{1 - \left[\left(\frac{1}{1+I}\right)^n\right]}$$

MP = Monthly Payment
P = Principal
I = Monthly Interest Rate
N = No. of Payments

Determine I

$$\frac{6.5}{12} =$$

Enter Figure	Depress Function Key	Read
.065		.065
	÷	.065
12		12.
	=	5.416666666-03
	M	5.416666666-03
1		1.
	−	1.
	[	0.
	[	0.
1		1.
	+	1.

Examples
(Continued)

	Enter Figure	Depress Function Key	Read
		M	5.416666666-03
		]	1.005416667
		$1/x$	9.946125152-01
		y^x	9.946125152-01
	36		36.
		]	0.823267748
		=	0.176732252
		$1/x$	5.658276792
		×	5.658276792
	4000		4000.
		×	22633.10717
		M	5.416666666-03
MP = $122.595		=	122.5959972
To enter a negative exponent: 7×10^{-24}	7		7.
		EXP	7.00
		+/−	7.-00
	2		7.-02
	3		7.-23
	2		7.-32
	4		7.-24

We have intentionally indexed an erroneous exponent into the machine to illustrate that the entry can be corrected without clearing the entire statement. To correct our error we simply continue to enter the correct exponent.

Examples
(Continued)

Memory

5+4 =
7+9 =
3+8 =
Accumulated Total =

	Enter Figure	**Depress Function Key**	**Read**
		C	0.
	5		5.
		+	5.
	4		4.
		=	9.
		M	9.
Place in Memory	7		7.
		+	7.
	9		9.
		+	16.
	M		9.
Recall Memory		=	25.
		M	25.
Put combined total in memory	3		3.
		+	3.
	8		8.
		+	11.
		M	25.
		=	36.

To clear memory press O = M

Examples
(Continued)

Trigs & Logs

Handling logs and trig functions is as easy as taking a square root or reciprocal.

By entering a number on the display and depressing the desired function key, the results will be immediately displayed without disturbing the memory register.

	Enter Figure	Depress Function Key	Read
Example: Sin 45°	45	Sin	0.70710678

Note: the radian light is out and we are in the degree mode. Had the light been on we would have computed the sin of 45 radians.

The COS and TAN are computed in the very same manner. The ARC or inverse trig functions are computed by simply using the ARC key as a prefix to the desired trig functions:

	Enter Figure	Depress Function Key	Read
$\sin^{-1}$ .5	.5		0.5
		ARC	0.5
		Sin	30.

Note: The radian light is out. Thus, the result is 30°. Had the unit been in the radian mode the result would have been 0.523598776 radians.

Examples
(Continued)

Similarly, the ARC COS and ARC TANGENT can be computed.

Your calculator computes natural logarithms ln = Log_e and common logarithms Log = Log_{10}.

It also computes natural antilogs e^x, and common antilogs (10^x) by use of the y^x key.

	Enter Figure	Depress Function Key	Read
To determine antilogs			
A) Natural Antilog $e^{4.1}$			
B) Common Antilog $10^{4.1}$	4.1	e^x	60.34028758
To determine Logs			
A) Natural Log ln	10	y^x	10.
	4.1	=	12589.2541
B) Common Log Log 4.1	60.34028758	Ln	4.1
	4.1	Log	6.127838568-01

Your calculator can compute trig functions of angles measured in degrees and decimal fractions of a degree. It will also calculate angles measured in radians and decimal fractions of radians, under the proper command.

Example:
A) Sin $-320°$
B) Cos $51.7°$
C) Tan 31.21 radians

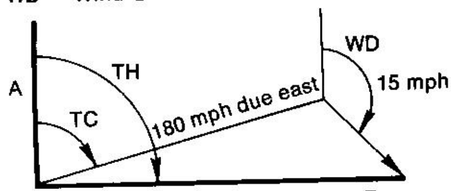
	Enter Figure	Depress Function Key	Read
A)		+/−	−0.
	320		−320.
		Sin	0.642787609
Note: You do not have to press the clear key to begin a new assignment.			
B)	51.7	Cos	0.619779031
Thus far we have correctly answered the first two arguments. The results are expressed in degrees as requested. The final assignment is asked for in radians. To change the mode of your machine, press the Rad key. The lamp signals that the unit is in radian mode and we may now continue.			
C)	31.21	Tan	−0.208887598

Advanced Problems

Navigation

Mr. McG is flying his Cherokee Commanche at a speed of 180 mph. He is on a course of 90° due East. The wind velocity at 135° N.W. is 15 mph. What is Mr. McG's true heading?

TH = True Heading
TC = True Course
WV = Wind Velocity
TAS = True Air Speed
WD = Wind Direction



$$TH = TC + \left[\frac{WV \text{ Sin } (WD - TC)}{TAS}\right]$$

$$TH = 90 + \text{arc sin}\left[\frac{15 \sin (135-90)}{180}\right]$$

Enter Figure	Depress Function Key	Read
	[	0.
135		135.
	–	135.
90		90.
	]	45.
	Sin	0.70710678
	×	0.70710678
15		15.
	÷	10.6066017
180		180.
	=	0.058925565
	Arc Sin	3.37814298
	+	3.37814298
90		90.
	=	93.37814298

(TH) True Heading

Advanced Problems
(Continued)

Mechanics

An arrow is shot at an angle of 30° with an initial velocity of 200 ft /sec. How long will it take to return to earth? How far will it have travelled?

V_V = Vertical Velocity
V_H = Horizontal Velocity
$g = 32.2$ ft/sec^2
d = Distance
t = Time
$V_V = 200 \text{ Sin } 30°$
$V_H = 200 \text{ Cos } 30°$
$d = V_H t$

$$t = \frac{2\,V_V}{g}$$

$$t = \frac{2\,(200 \text{ Sin } 30)}{g}$$

(t) Time = 3.105590055 sec

Enter Figure	Depress Function Key	Read
30		30.
	Sin	0.499999999
	×	0.499999999
200		200.
	÷	99.9999998
32.2		32.2
	×	3.105590055
2		2.
	=	6.21118011
	M	6.21118011

Advanced Problems
(Continued)

$$d = \frac{2\,(200 \text{ Cos } 30)}{g} 200 \text{ Sin } 30°$$

Enter Figure	Depress Function Key	Read
30		30
	Cos	0.866025403
	×	0.866025403
	M	6.21118011
	×	5.379039758
200		200.
	=	1075.807952

$d = 1075.807952$

Time Dilation

An astronaut rockets at 0.866025403 times the speed of light. His flight will last for 100 years and he is 25 years old when he is launched. How old will he be when he returns.

t_S = Space time
t_E = Earth time
$V = C\,(0.866025403)$
C = Speed of light 186,000 miles/sec

$$t_S = \frac{t_E}{\sqrt{1 - \left(\frac{V}{C}\right)^2}}$$

$$= \frac{t_E}{\sqrt{1 - (0.866025403)^2}}$$

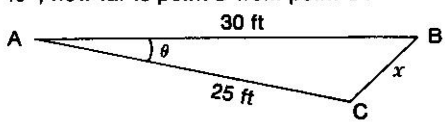
Enter Figure	Depress Function Key	Read
1		1.
	−	1.
	[	0.
.866025403		0.866025403
	y^x	0.866025403
2		2.
	]	0.749999999
	=	0.250000001
	$\sqrt{x}$	5.000000009-01
	×	5.000000009-01
100		100.
	=	50.00000009

t_S = 50 years

Therefore: 50+25 =
t_E = 75 years old.

Surveying

If point A is 25 feet from point C and 30 feet from point B, and <BAC is 40°, how far is point B from point C?



$X^2 = 30^2 + (25^2) - 2\,(25)\,(30)\,\text{Cos } 40°$

Enter Figure	Depress Function Key	Read
30		30.
	y^x	30.
2		2.
	+	900.
	[	0.
25		25.
	y^x	25.
2		2.
	]	625.
	−	1525.

Advanced Problems
(Continued)

(x) Distance in feet from B to C

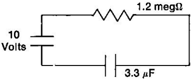
Enter Figure	Depress Function Key	Read
	[	0.
2		2.
	×	2.
25		25.
	×	50.
30		30.
	×	1500.
40		40.
	Cos	0.760044443
	=	375.933335
	$\sqrt{x}$	19.38900036

Electronics

In the RC circuit below, what is the time constant and what is:

a) The voltage across the resistor after 10 seconds.

b) The current flowing after 10 seconds.



T = Time Constant

V_R = Voltage Across Resistor

I = Current

R = 1.2 meg

C = 3.3 μF

T = RC

$V_R = V_O\ e\ -t/RC$

$I = \frac{V_O}{R}\ (I - e\ -t/RC)$

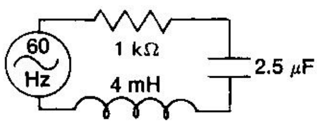
Advanced Problems
(Continued)

	Enter Figure	Depress Function Key	Read
Solving for T	1.2		1.2
		Exp	1.2 00
	6		1.2 06
		×	1200000.
	3.3		3.3
		Exp	3.3 00
		+ / −	3.3-00
	6		3.3-06
		=	3.96
(T) Time Constant in Seconds		M	3.96
Solving for V_R	10		10.
		÷	10.
		M	3.96
		+ / −	−3.96
		=	−2.525252525
		e^x	8.003809864-02
(V_R) Voltage Across Resistor at 10 Seconds		×	8.003809864-02
Solving for I	10		10.
		=	8.003809864-01
	10		10.
		÷	10.
	1.2		1.2
		Exp	1.2 00
	6		1.2 06
		×	8.333333333-06
		[	0.
	1		1.
		−	1.
		[	0.
	10		10.
		÷	10.
	M		3.96
		+ / −	−3.96

Advanced Problems
(Continued)

	Enter Figure	Depress Function Key	Read
		]	−2.525252525
(I) Current after 10 Seconds		e^x	8.00380986-02
		=	7.666349175-06

In the Resistance Inductance Capacitance (RLC) circuit below what is the:
a) Reactance of the inductor
b) Reactance of the capacitor
c) Impedance of the circuit
d) Phase angle



x_L = Reactance of the inductor = $2\pi f_L$

x_C = Reactance of the capacitor = $\dfrac{1}{2\pi f_C}$

$Z = \sqrt{R^2 + (x_L - x_C)^2}$ = Impedance

$\phi = \text{Arctan}\left(\dfrac{x_L - x_C}{R}\right)$

	Enter Figure	Depress Function Key	Read
		π	3.141592654
		×	3.141592654
	2		2.
		×	6.283185308
	60		60.
		×	376.9911185
	4		4.
		Exp	4. 00
(x_L) Reactance of Inductor in Ohms		+/−	4.-00
	3		4.-03
Note: This entry is correct. Sequence calls for 2 depressions of [key.		=	1.507964474
		−	1.507964474

Advanced Problems
(Continued)

	Enter Figure	Depress Function Key	Read
		[	0.
		[	0.
	2		2.
		×	2.
		π	3.141592654
		×	6.283185308
	60		60.
		×	376.9911185
	2.5		2.5
		Exp	2.5 00
		+/−	2.5-00
	6		2.5-06
		]	9.424777963-04
(x_C) Reactance of the Capacitor in Ohms		$1/x$	1061.032953
		=	−1059.524989
		M	−1059.524989
	1000		1000.
		y^x	1000.
	2		2.
		+	1000000
		[	0.
		M	−1059.524989
		×	−1059.524989
		M	−1059.524989
		]	1122593.202
		=	2122593.202
(Z) Impedance in Ohms		$\sqrt{x}$	1456.912214
		C	0.
		M	−1059.524989
	1000	÷	−1059.524989
			1000.
		=	−1.059524989
(ϕ) Phase angle in degrees		Arc Tan	−46.6555183

Advanced Problems
(Continued)

Radioactive Decay

If 150 grams of pure radium is allowed to decay for 1500 years how much pure radium will remain?

N = Amount of material
N_O = Original amount
H_f = Half Life

H_f = 1620 years

$$N = N_O e - \left(\frac{\ln^2}{H_f}\right) t$$

	Enter Figure	Depress Function Key	Read
	2		2.
		Lη	0.69314718
		÷	0.69314718
	1620		1620.
		+/−	−1620.
		×	−4.278686296-04
	1500		1500
		=	−6.418029444-01
		e^x	5.263426016-01
		X	5.263426016-01
	150		150.
(N) Amount of material in Grams		=	78.95139024

Conversion Table

Linear measures	12 inches	= 1 foot
	3 feet	= 1 yard
	5½ yards	= 1 rod, pole or perch
	4 poles	= 1 chain
	10 chains	= 1 furlong
	8 furlongs	= 1 mile
Nautical measures	6 feet	= 1 fathom
	100 fathoms	= 1 cable length
	6,080 feet	= 1 nautical mile
Square measures	144 sq. inches	= 1 sq. foot
	9 sq. feet	= 1 sq. yard
	30¼ sq. yards	= 1 sq. rod, pole or perch
	40 sq. rods	= 1 rod
	4 rods	= 1 acre
	4,840 sq. yards	= 1 acre
	640 acres	= 1 sq. mile
Weights *(Avoirdupois)*	437½ grains	= 1 ounce
	16 drams	= 1 ounce
	16 ounces	= 1 pound
	14 pounds	= 1 stone
	28 pounds	= 1 quarter
	4 quarters	= 1 hundredweight
	20 hundredweights	= 1 ton
Cubic measures	1,728 cu. inches	= 1 cu. foot
	27 cu. feet	= 1 cu. yard
	5.8 cu. feet	= 1 bulk barrel
Capacities	8 fluid drams	= 1 fluid ounce
	5 fluid ounces	= 1 gill
	4 gills	= 1 pint
	2 pints	= 1 quart
	4 quarts	= 1 gallon
	2 gallons	= 1 peck
	4 pecks	= 1 bushel
	36 gallons	= 1 bulk barrel
	Shipping:	
	1 register ton	= 100 cubic feet

Metric units

Linear measures	10 millimeters	= 1 centimeter
	10 centimeters	= 1 decimeter
	10 decimeters	= 1 meter
	10 meters	= 1 dekameter
	10 dekameters	= 1 hectometer
	10 hectometers	= 1 kilometer
Square measures	100 sq. millimeters	= 1 sq. centimeter
	100 sq. centimeters	= 1 sq. decimeter
	100 sq. decimeters	= 1 sq. meter
	100 sq. meters	= 1 are
	100 ares	= 1 hectare
	100 hectares	= 1 sq. kilometer
Weights	1,000 milligrams	= 1 gram
	10 grams	= 1 dekagram
	10 dekagrams	= 1 hectogram
	10 hectograms	= 1 kilogram
	100 kilograms	= 1 quintal
	1,000 kilograms	= 1 metric ton
Cubic measures	1,000 cu. millimeters	= 1 cu. centimeter
	1,000 cu. centimeters	= 1 cu. decimeter
	1,000 cu. decimeters	= 1 cu. meter
Capacities	10 milliliters	= 1 centiliter
	10 centiliters	= 1 deciliter
	10 deciliters	= 1 liter
	10 liters	= 1 dekaliter
	10 dekaliters	= 1 hectoliter
	10 hectoliters	= 1 kiloliter
	1 kiloliter	= 1 cu. meter

Conversion Table
(Continued)

Miscellaneous units and ratios

Precious metals

24 carat implies pure metal

1 metric carat	= 200 milligrams
1 fine (troy) oz.	= 480 grains
1 grain	= 64.8 milligrams

Crops

Imperial bushel of:

wheat	= 60 lb.	rice	= 45 lb.
barley	= 50 lb.	maize	= 56 lb.
oats	= 39 lb.	linseed	= 52 lb.
rye	= 56 lb.	potatoes	= 60 lb.

U.S. bushel same as above except:

barley	= 48 lb.
linseed	= 56 lb.
oats	= 32 lb.

Bale (cotton):

U.S. (net)	= 480 lb.
Indian	= 392 lb.

Water

1 litre weighs 1 kilogram.
1 Imperial gallon weighs 10.022 lbs.

Energy

1,000 British thermal units	= 0.293 kWh
100,000 BTU	= 1 therm
1 horsepower	= 0.7457 kilowatt

Petroleum

1 barrel = 34.97 Imperial gallons
= 42.00 U.S. gallons
= 0.15899 cubic meters

U.S. paper sizes

Letter	=	8½″ x 11″ (215.9 mm x 279.4 mm)
Legal	=	8½″ x 14″ (215.9 mm x 355.6 mm)

Imperial paper sizes

Large post	=	16½″ x 21″ (419.1 mm x 533.4 mm)
Demy	=	17½″ x 22½″ (444.5 mm x 571.5 mm)
Medium	=	18″ x 23″ 457.2 mm x 584.2 mm)

'A' Series (metric sizes):

AO	=	841 mm x 1,189 mm (33.11″ x 46.81″) -
A4	=	210 mm x 297 mm (8.27″ x 11.69″)
A5	=	148 mm x 210 mm (5.83″ x 8.27″)

Type sizes

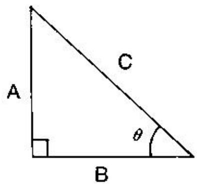
Depth: 72 points = 1 inch
Width: the normal unit is a pica em
1 pica em = 12 points

	Measure	Multiplied by	Equals Equivalent In
Linear measures	Millimeters *(mm)*	0.03937	inches *(in.)*
	Meters *(m)*	1.0936	yards *(yd.)*
		0.5468	fathoms
	Kilometers *(km)*	0.62137	miles (land)
		0.5396	miles (int'l nautical)
	Inches	25.4	millimeters
	Feet	30.48	centimeters
	Yards	0.9144	meters
	Fathoms (6 ft.)	1.8288	meters
	Cables (200 yd.)	182.88	meters
	Miles (land: 5,280 ft.)	1.60934	kilometers
	Miles (nautical: 6,076.115 ft.)	1.85318	kilometers

Conversion Table
(Continued)

	Measure	Multiplied by	Equals Equivalent In
Square measures	Sq. millimeters *(mm²)*	0.00155	sq. inches
	Hectares *(ha)*	2.4711	acres
	Sq. kilometers *(km²)*	247.105	acres
		0.3861	sq. miles
	Sq. inches	645.16	sq. millimeters
	Sq. feet	929.030	sq. centimeters
	Acres	4,046.86	sq. meters
		0.404686	hectares
		0.004047	sq. kilometers
	Sq. miles	2.58999	sq. kilometers
Cubic measures and capacities	Cu. centimeters *(cc, or cm³)*	0.06102	cu. inches
	Liters *(l)* (1,000 cc)	61.024	cu. inches
		0.0353	cu. feet
		0.2642	gallons (U.S.)
		0.2200	gallons (Imp.)
	Hectoliters *(hl)*	26.418	gallons (U.S.)
		21.998	gallons (Imp.)
		2.838	bushels (U.S.)
		2.750	bushels (Imp.)
	Cu. meter *(m³)*	1.30795	cu. yards
		264.178	gallons (U.S.)
		219.976	gallons (Imp.)
		6.1104	bulk barrels
	Cu. inches	16.3871	cu. centimeters
	Pints (Imp.)	34.6775	cu. inches
	Pints (Imp.)	0.568	litres
	Gallons (Imp.)	4.546	litres
	Gallons (U.S.)	3.785	litres
	Cu. feet	28.317	litres
	Bushels (Imp.)	0.3637	hectoliters
	Bushels (U.S.)	0.3524	hectoliters
	Gallons (Imp.)	1.2010	gallons (U.S.)
	Gallons (U.S.)	0.8327	gallons (Imp.)
	Bulk barrels	36.0000	gallons (Imp.)
		43.2343	gallons (U.S.)
		0.1637	cu. meters
Speed and energy	Kilometers/hour	0.62137	miles/hour
		0.5396	knots (sea miles /hour)
	Miles/hour	1.6093	kilometers/hour
		0.8684	knots

Definitions of Trig Functions



$$\frac{A}{C} = \text{Sin}\ \theta$$

$$\frac{B}{C} = \text{Cos}\ \theta$$

$$\frac{A}{B} = \text{Tan}\ \theta$$

$$\frac{C}{A} = \text{CSC}\ \theta$$

$$\frac{C}{B} = \text{Sec}$$

$$\frac{B}{A} = \text{Cotan}$$

$$\text{Sin}^2\ \theta + \text{Cos}^2\ \theta = 1$$

Hyperbolic Relations

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

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

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

$$\text{Sinh}^{-1}\ x = \text{Ln}\left[x + (x^2 + 1)^{1/2}\right]$$

$$\text{Cosh}^{-1}\ x = \text{Ln}\left[x + (x^2 - 1)^{1/2}\right]$$

$$\text{Tanh}^{-1}\ x = \tfrac{1}{2}\ \text{Ln}\left[\frac{1 + x}{1 - x}\right]$$

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