Texas Instruments
electronic slide rule calculator
SR-11

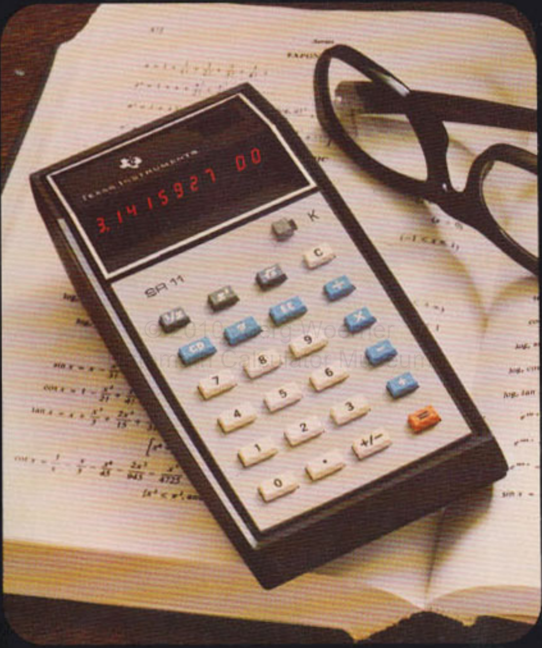

TABLE OF CONTENTS

CALCULATOR DESCRIPTION

The SR-11 Electronic Slide Rule Calculator is designed especially for use by scientists, engineers, and students who require a portable, highly accurate, and reliable computation tool. The SR-11 is capable of solving a wide range of complex scientific problems; but it is also well suited for solving simple arithmetic problems. Designed with state-of-the-are MOS solid-state circuitry, constructed with high quality components throughout, and assembled with precise workmanship, your SR-11 should provide years of reliable service.

Features

Fully Portable – Extremely lightweight. Battery or AC operated.

Versatile – Performs addition, subtraction, multiplication and division. Also, reciprocals, squares, square roots, chain and mixed calculations, all in full floating decimal point. Automatic conversion to scientific notation when calculated answer exceeds eight digits.

Constant Operation – Constant switch permits ready multiplication or division by a constant. Automatic clearing of constant when next function key is pressed prevents unintentional use.

Easy to Operate – Algebraic keyboard permits operations to be performed in the same order as with classical slide rules. For simple arithmetic operations, just touch the numbers and functions as you would write them on paper. Automatic clearing – no need to touch clear key between problems.

Long Life – Solid-state components, integrated circuits, and a display using light emitting diodes provide dependable operation and long life.

Rechargeable Batteries – The SR-11 calculator comes complete with *fast charge* nickel-cadmium batteries which will provide 4 to 6 hours of operation without recharging under normal use. About 3 hours of recharging will restore full charge to the batteries.

Overflow – C sign on display indicates calculation overflow. E indicates negative calculation overflow.

AC Adapter/Charger – Recharge or direct operation from standard outlets – 115 V, 60 Hz or 230 V, 50 Hz – is easily accomplished with the model AC9200 AC Adapter/Charger included with the SR-11 calculator. Just plug the AC Adapter/Charger into a convenient outlet and the attached cord into the calculator. You can operate your calculator indefinitely while connected to the AC Adapter/Charger as the batteries cannot be overcharged.

CAUTION: Do not attempt to operate calculator with charger plugged in *unless* batteries are in place.

Battery Saver Circuit – To save battery power, the light emitting diode display turns off automatically between 15 and 60 seconds after the last keyboard entry, except for the first digit. If the display turns off while entering a problem, the display turns on automatically with the first keyboard entry. To bring back the last calculated result to the display, depress the [+/−] key twice. Therefore, the number in the first digit on the display is a reminder that you have an entry or calculation waiting in your calculator *or* that your calculator is in the power ON position.

OPERATING INSTRUCTIONS

Before Operation

The fast charge nickel-cadmium batteries furnished with your calculator were fully charged at the factory, but may require charging before initial battery operation due to shelf life discharging.

You can operate your calculator while it's being charged. Just plug the charger cord into the calculator and the AC Adapter/Charger into a convenient outlet. You can now calculate while you charge – a full charge requires only 3 hours when switch is off or 6 hours while in normal operation.

It is recommended that you recharge the batteries periodically and that you refrain from discharging them completely, as this operation may reduce battery life.

On/Off Switch

The on/off switch is located on the top right surface of the calculator. It is a horizontally operated slide switch which applies power when pushed to the right, and removes power when pushed to the left. The power-on condition is indicated by illumination of the first digit in the mantissa on the right of the display.

Constant Switch

The constant (K) switch is located on the upper right of the keyboard. Sliding the switch to the right permits multiplication or division by a constant.

Keyboard Description

The keyboard consists of 24 keys which may be classified as either data entry or function keys.

Data Entry Keys

[0] **through** [9] **Digit Keys** – Enters numbers 0 through 9 to a limit of an 8-digit mantissa and a 2-digit exponent.

[π] **Key** – Enters the value of pi (π) to 8 significant digits (3.1415927).

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

[EE] **Enter Exponent Key** – Instructs the calculator that the subsequent number is to be entered as an exponent of 10. To enter a number in scientific notation, first enter the mantissa, press [EE] and enter the desired exponent of 10. After the [EE] key has been pressed, the calculator will display all further results in scientific notation until the [C] key is pressed.

Note: The [EE] key should be used for data entry only. See page 8 for the method of converting a calculation result to scientific notation.

[+/–] **Change Sign Key** – Instructs the calculator to change the sign of the mantissa or exponent appearing in the display. To enter a negative number, first enter the number and then press the [+/–] key. Using this change sign key prior to using the [EE] key changes the sign of the mantissa. If the [+/–] key is pressed after the [EE] key, the sign of the exponent is changed. To change the sign of the mantissa after the exponent has been entered, press the [•] key and then the [+/–] key.

[C] **Clear Key** – Clears (erases) information in calculator and display and sets calculator to zero for start of new problem.

[CD] **Clear Display Key** – Clears the last number entered manually in the keyboard or the last calculator result, whichever is displayed. The [CD] key can be used to correct entry of an erroneous basic function key as well as an erroneous number entry. (See page 15.)

Function Keys

[+] **Add Key** – Instructs the calculator to add to the previous number or result the next entered quantity.

[−] **Subtract Key** – Instructs the calculator to subtract from the previous number or result the next entered quantity.

[X] **Multiply Key** – Instructs the calculator to multiply the previous number or result by the next entered quantity.

[÷] **Divide Key** – Instructs the calculator to divide the previous number or result by the next entered quantity.

[=] **Equals Key** – Instructs the calculator to complete the previously entered operation to provide the desired calculation result.

[1/x] **Reciprocal Key** – Completes any previous calculation and then finds the reciprocal of this result (that is, divides the result into 1).

[x^2] **Square Key** – Completes any previous calculation and then squares this result (that is, multiplies the result by itself).

[$\sqrt{x}$] **Square Root Key** – Completes any previous calculation and then finds the square root of this result (that is, finds the number which multiplied by itself, equals the result).

Note: Repeated pressing of the function keys are not ignored. For example, the sequence 5 [+] [X] or 5 [+] [=] will give 10 on the display. This can be used to obtain a [X] 2 function.

Display Description

In addition to power-on indication and numerical information, the display provides indication of a negative number, decimal point, overflow, underflow and error.

Minus Sign – Appears to the left of the 8-digit mantissa to indicate negative numbers, and appears on the left of the exponent (right of mantissa) to indicate negative exponents.

Decimal Point – Automatically assumed to be to the right of any number entered unless positioned in another sequence by use of [•] key. When entering numbers, the decimal will not appear until [•] is pressed.

Calculation Overflow and Underflow – C appears on left side of display to indicate a result larger than 9.9999999 X 10^{99} or smaller than 1.0000000 X 10^{-99}.

Error Indication – The SR-11 calculator always attempts to give the most accurate results. If the calculator is instructed to find the square root of a negative value, it will calculate the square root of the positive value and an E will appear at the left of the display.

Indication Removal – The display indication caused by overflow, underflow, or error will continue until the [C] key is pressed.

Scientific Notation

Any number can be entered into the SR-11 in scientific notation – that is, as a number (mantissa) multiplied by 10 raised to some power (exponent). For example 1000 can be written as $1. \times 10^3$.

Enter	Press	Display
1	EE	1 00
3		1 03

Note: The last two digits on the right side of the display are used to indicate exponents.

Very large and very small numbers must be entered in scientific notation. For example, 120,000,000,000 is written as 1.2×10^{11}.

Enter	Press	Display
1.2	EE	1.2 00
11		1.2 11

In both these examples, the exponent indicates how many places the decimal should be moved to the *right*. If the exponent is negative, the decimal should be moved to the *left*. For example 1.2×10^{-11} = 0.000000000012

Enter	Press	Display
1.2	EE	1.2 00
11	+/−	1.2 −11

Note: The negative sign for the exponent appears immediately to the left of the exponent (to the right of the mantissa).

Another feature of the [EE] key is the ability to convert a keyboard entry into true scientific notation. For example, 220 nanoamperes can be converted into amperes as follows.

Enter	Press	Display
220	[EE]	220 00
9	[+/−]	220 −09
	[=]	2.2 −07

As you can see, 220 nanoamperes is equal to 2.2×10^{-7} amperes.

To convert a calculation result to scientific notation, you must multiply the result by 1×10^0.

Enter	Press	Display
16.3	[÷]	16.3
4550	[=]	0.0035824
	[×]	
1	[EE] [=]	3.5824 −03

Note: By using the [EE] key in the beginning of a calculation, you can retain 8 significant digit accuracy even on results less than unity (1).

Enter	Press	Display
16.3	[EE] [÷]	16.3 00
4550	[=]	3.5824175 −03

If you use the [EE] key in a calculation, all results (even in subsequent calculations) will remain in scientific notation until you press the [C] key.

OPERATING EXAMPLES

Performing calculations with your SR-11 calculator is easy. Numbers and functions are entered in the same sequence as the expression is written on paper. The following examples should help in learning to properly operate the calculator.

The SR-11 automatically clears itself between most calculations. Any prior calculation result is cleared if a number key is pressed without having had a basic function key other than [=] pressed beforehand.

Note: Immediately after turning on the calculator and before performing *any* calculations, press the [C] key. Although a zero may appear in the display, it is possible for some other number to be carried internally.

Entry and Calculation Overflow

The calculator will ignore any mantissa digits entered in excess of eight and will use the last two exponent digits entered as shown in the display.

If a calculation result is more than eight digits before the decimal, it is automatically converted to a scientific notation. If a calculation result is greater than 9.9999999×10^{99}, the signal C will be displayed with the answer. The answer shown will normally be correct, but only the *last two* digits of the exponent will be displayed.

CAUTION: When overflow or underflow occurs, and C or E appears at left of display, the calculator is not locked out but will continue to perform operations.

Addition and Subtraction

Example: 4.23 + 4 = 8.23

Enter	Press	Display
4.23	[+]	4.23
4	[=]	8.23

Example: 6 – 1.854 = 4.146

Enter	Press	Display
6	[–]	6.
1.854	[=]	4.146

Example: 12.32 – 7 + 1.6 = 6.92

Enter	Press	Display
12.32	[–]	12.32
7	[+]	5.32
1.6	[=]	6.92

Example: –5.35 – (–4.2) – 3.1 = –4.25

Enter	Press	Display
5.35	[+/–] [–]	–5.35
4.2	[+/–] [–]	–1.15
3.1	[=]	–4.25

Multiplication and Division

Example: 27.2 X 18 = 489.6

Enter	Press	Display
27.2	[X]	27.2
18	[=]	489.6

Example: 11.7 ÷ 5.2 = 2.25

Enter	Press	Display
11.7	[÷]	11.7
5.2	[=]	2.25

Example: (4 X 7.3) ÷ 2 = 14.6

Enter	Press	Display
4	[X]	4.
7.3	[÷]	29.2
2	[=]	14.6

Note: Intermediate result of multiplication is displayed when next [X] or [÷] key is pressed; it is not necessary to press the [=] key to obtain the intermediate result. Nor is it necessary to re-enter the intermediate result for further calculations.

Positive and Negative Number Calculations

A negative sign is assigned to a number by pressing the [+/-] key directly after entering the number.

Example: 7 X –18.5 = –129.5

Enter	Press	Display
7	[X]	7.
18.5	[+/-] [=]	–129.5

Example: –125 ÷ 5 = –25

Enter	Press	Display
125	[+/-] [÷]	–125.
5	[=]	–25.

Alternate Methods:

Enter	Press	Display
	[C]	0
	[+/-]	–0
125	[÷]	–125.
5	[=]	–25.

Enter	Press	Display
	[C]	0
	[–]	0.
125	[÷]	–125.
5	[=]	–25.

Note: When a negative number is to be the first number in a calculation the [–] key or the [+/-] key can be used as long as the [C] key is pressed beforehand to clear the calculator. The [–] is a function key and will not automatically clear the calculator.

Mixed Calculations

Example: (8.3 + 2) ÷ 4 − 6.8 = −4.225

Enter	Press	Display
8.3	[+]	8.3
2	[÷]	10.3
4	[−]	2.575
6.8	[=]	−4.225

Example: (−5.2 − 3) X 4 + 55.2 ÷ 4 = 5.6

Enter	Press	Display
5.2	[+/−] [−]	−5.2
3	[X]	−8.2
4	[+]	−32.8
55.2	[÷]	22.4
4	[=]	5.6

Multiplication and Division by a Constant

The K switch increases the flexibility of the SR-11 calculator by allowing a series of numbers to be multiplied or divided by a constant number. When the K switch is moved to the right, a calculation result or number entered before a [X] function, or a number entered after a [÷] function, is retained as a constant multiplier or divisor. This constant is erased by entry of another constant or by pressing any function key or the [C] key.

K →

Example: 4 X 5 = 20
4 X 6 = 24
4 X 7 = 28

Enter	Press	Display
4	[X]	4.
5	[=]	20.
6	[=]	24.
7	[=]	28.

Example: 105 ÷ 3 = 35
−78 ÷ 3 = −26
29 ÷ 3 = 9.6666666

Enter	Press	Display
105	[÷]	105.
3	[=]	35.
78	[+/−] [=]	−26.
29	[=]	9.6666666

Throughout this manual, whenever use of the constant is specifically desired, the notation K→will precede the problem. All other problems can be worked with the K switch either on (right) or off (left).

Reciprocals

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

Enter	Press	Display
3.2	[1/x]	0.3125

Example: 5.3 ÷ (3.1 + 4.3) = 0.7162162162

Enter	Press	Display
3.1	[+]	3.1
4.3	[=]	7.4
	[1/x] [×]	.1351351
5.3	[=]	.716216

Note: When operating on an expression containing functions enclosed in parenthesis, it is necessary to complete the calculation within the parenthesis first to avoid re-entering intermediate results.

Example: $\frac{1}{1.1 \times 10^{-18}} = 9.090909 \times 10^{17}$

Enter	Press	Display
1.1	EE	1.1 00
18	+/-	1.1 −18
	1/x	9.090909 17

Squares

Example: $(4.2)^2 = 17.64$

Enter	Press	Display
4.2	x^2	17.64

Example: $(99999999)^2 = 9.9999998 \times 10^{15}$

Enter	Press	Display
99999999	x^2	9.9999998 15

Example: $(2.1 \times 10^4)^2 = 4.41 \times 10^8$

Enter	Press	Display
2.1	EE	2.1 00
4	x^2	4.41 08

Square Roots

Example: $\sqrt{6.25} = 2.5$

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

Example: $\sqrt{1.1 \times 10^8} = 1.0488088 \times 10^4$

Enter	Press	Display
1.1	EE	1.1 00
8	$\sqrt{x}$	1.0488088 04

Error Corrections

If a wrong key is accidentally pressed during a calculation (particularly a long one), it is often desirable to correct the error rather than to clear the calculator and begin again.

Corrections can be made to numerical errors in a series of mixed calculations only if the [CD] key is pressed before the next function key in the sequence is pressed.

Example: 3.2 X ~~4.3~~ 4.4 ÷ 5 = 2.816

Enter	Press	Display	Remarks
3.2	[X]	3.2	
4.3		4.3	Error
	[CD]	0	Correction
4.4	[÷]	14.08	
5	[=]	2.816	

A function error made in a series of mixed calculations can be corrected through use of the [CD] and [1] keys.

If an error is made by erroneously pressing the [+] or [−] key, you need only clear the display by pressing the [CD] key and then press the correct key.

Example: 5 + 9.7 ~~+~~ − 2.3 = 12.4

Enter	Press	Display	Remarks
5	[+]	5.	
9.7	[+]	14.7	Error
	[CD] [−]	14.7	Correction
2.3	[=]	12.4	

Note: In essence, this method adds zero to (or subtracts zero from) the previous number or result.

If an error is made by erroneously pressing the [×] or [÷] key, it is corrected by multiplying or dividing the interim result by unity.

Example: 4.1 X 3.2 ~~X~~ ÷ 2 = 6.56

Enter	Press	Display	Remarks
4.1	[×]	4.1	
3.2	[×]	13.12	Error
1	[+]	13.12	Correction
2	[=]	6.56	

Example: 4.1 X 3.2 ~~X 2~~ ÷ 2 = 6.56

Enter	Press	Display	Remarks
4.1	[×]	4.1	
3.2	[×]	13.12	Error
2	[CD]	0	Display Cleared
1	[÷]	13.12	Correction
2	[=]	6.56	

Note: If a number has been entered after the erroneous function key, it is necessary to clear the display before entering unity into the calculator.

ADVANCED MATHEMATICAL METHODS

Many complex problems with interim calculations can be solved easily with the SR-11 by rewriting the problem in a sequential operation. This often eliminates the necessity of writing down several interim results and then re-entering these interim results to obtain the final solution.

Sum of Products

You can calculate the sum of two products such as (A X B) + (C X D) without writing down any intermediate answers, if the equation is rewritten as

$$\left(\frac{A \times B}{D} + C\right) D$$

For example, $(3 \times 4) + (5 \times 6) = \left(\frac{3 \times 4}{6} + 5\right) \times 6$

Enter	Press	Display
3	[×]	3.
4	[÷]	12.
6	[+]	2.
5	[×]	7.
6	[=]	42.

Note that it *is* necessary to enter one of these quantities twice (6). However, this is usually easier than recording and re-entering an interim result. Also, you can select the simplest of the four quantities to enter twice.

This method can be extended to calculate the sum of any number of products. (A X B) + (C X D) + (E X F) can be rewritten as

$$\left[\frac{\left(\frac{A \times B}{D} + C\right) D}{F} + E\right] \times F$$

or

$$\left[\left(\frac{A \times B}{D} + C\right) \times \frac{D}{F} + E\right] \times F$$

For example, (3 X 4) + (5 X 6) + (7 X 8) becomes

$$\left[\left(\frac{3 \times 4}{6} + 5\right) \times \frac{6}{8} + 7\right] \times 8$$

Enter	Press	Display
3	[×]	3.
4	[÷]	12.
6	[+]	2.
5	[×]	7.
6	[÷]	42.
8	[+]	5.25
7	[×]	12.25
8	[=]	98.

The procedure can be extended to calculate the sum of as many products as desired.

Sum of Quotients

The sum of quotients can also easily be calculated.

$\frac{A}{B} + \frac{C}{D}$ can be rewritten as $\frac{\frac{A \times D}{B} + C}{D}$

or $\left(\frac{A \times D}{B} + C\right)/D$

This calculation can also be extended to as many terms as desired

$$\frac{A}{B} + \frac{C}{D} + \frac{E}{F} = \left[\left(\frac{A \times D}{B} + C\right) \times \frac{F}{D} + E\right]/F$$

For example,

$$\frac{3}{4} + \frac{5}{6} + \frac{7}{8} = \left[\left(\frac{3 \times 6}{4} + 5\right) \times \frac{8}{6} + 7\right]/8$$

Enter	Press	Display
3	×	3.
6	÷	18.
4	+	4.5
5	×	9.5
8	÷	76.
6	+	12.666666
7	÷	19.666666
8	=	2.4583332

If you calculate these terms separately and call them up you notice that the last digit in the answer should be a 3 instead of a 2. This "error" results from the calculator truncating the quotient of 75/6 as 12.666666 (six places after the decimal, which is subsequently divided by 8 yielding an answer with seven places after the decimal). Because of the interim calculations, the answer is only correct to six places after the decimal.

Reciprocal of the Sum of Reciprocals

A special case of the sum of products frequently occurs in engineering. For example, the equivalent resistance of resistors in parallel is given below.

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

For three resistors in parallel, this equation can be rewritten as

$$R_T = \frac{1}{\left[\left(\frac{R_2}{R_1} + 1\right) \times \frac{R_3}{R_2} + 1\right] \times \frac{1}{R_3}}$$

For R_1 = 10 Ohms, R_2 = 20 Ohms and R_3 = 30 Ohms

Enter	Press	Display
20	÷	20.
10	+	2.
1	×	3.
30	÷	90
20	+	4.5
1	÷	5.5
30	1/x	5.4545455

Square Root of Sum of Squares

The square root of the sum of squares, $\sqrt{A^2 + B^2}$, can be rewritten as

$$\left[\sqrt{\left(\frac{A}{B}\right)^2 + 1}\right] \times B \quad \text{or} \quad \left[\left(\frac{A}{B}\right)^2 + 1\right]^{1/2} \times B$$

For example, $\sqrt{3^2 + 4^2} = \left[\left(\frac{3}{4}\right)^2 + 1\right]^{1/2} \times 4$

Enter	Press	Display
3	[÷]	3.
4	[x^2] [+]	0.5625
1	[$\sqrt{x}$] [×]	1.25
4	[=]	5.

This method can also be extended to as many terms as desired. The square root of the sum of three squares $\sqrt{A^2 + B^2 + C^2}$ equals

$$\left(\left\{\left[\left(\frac{A}{B}\right)^2 + 1\right]^{1/2} \times \frac{B}{C}\right\}^2 + 1\right)^{1/2} \times C$$

Although this looks very complicated, it is very simple to perform on the SR-11.

For example, to calculate $\sqrt{3^2 + 4^2 + 12^2}$

Enter	Press	Display
3	[÷]	3.
4	[x^2] [+]	0.5625
1	[$\sqrt{x}$] [×]	1.25
4	[÷]	5.
12	[x^2] [+]	0.1736111
1	[$\sqrt{x}$] [×]	1.0833333
12	[=]	12.999999

As you know, the correct answer should be 13, which means that we are off 1 digit in the eighth place.

Quadratic Equations

You can easily solve quadratic equations on the SR-11. For the equation, $Ax^2 + Bx + C = 0$, the solution is normally written:

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

If this is rewritten in sequential form, we get

$$x = \frac{\pm\left[\sqrt{(B^2)^{-1} \times (-4AC) + 1}\,\right] \times B - B}{2A}$$

For example, to find the root of the equation $3x^2 + 7x + 4 = 0$:

Enter	Press	Display	Remarks
7	[EE] [x²]	4.9 01	Scientific
	[1/x] [×]	2.0408163 –02	Notation
4	[+/–] [×]	–8.1632652 –02	
3	[×]	–2.4489795 –01	
4	[+]	–9.795918 –01	
1	[√x] [×]	1.4285727 –01	
7	[–]	1.0000008 00	Intermediate
7	[÷]	–5.9999992 00	Answer
2	[+]	–2.9999996 00	
3	[=]	–9.9999986 –01	Root 1
1.0000008	[+/–] [–]	–1.0000008	Re-enter
7	[÷]	–8.0000008 00	Intermediate
2	[÷]	–4.0000004 00	Answer
3	[=]	–1.3333334 00	Root 2

Note that the only re-entry was to determine the root with the negative radical component. In this example, the first answer is accurate to 6 places, and the second to

7 places. If we had not pressed the [EE] key so that the calculator operated in scientific notation, our answer would only have been correct to 5 places.

Evaluating Polynomials

The SR-11 can be used to evaluate a polynomial for a specific value of the variable by a very simple method.

To evaluate $4X^4 + 6X^3 + 3X^2 + 7X - 5$ for $X = 1.75$;

Enter	Press	Display
4	[×]	4.
1.75	[+]	7.
6	[×]	13.
1.75	[+]	22.75
3	[×]	25.75
1.75	[+]	45.0625
7	[×]	52.0625
1.75	[−]	91.109375
5	[=]	86.109375

Note: The expression has in essence been rewritten into $\{[(4X + 6)\ X + 3]\ X + 7\}\ X - 5$. However, it is not necessary to rewrite the expression in order to evaluate it.

The coefficient of any missing term must be considered as zero. Thus, to evaluate $6X^4 - 3X^2 + X - 8$ at $X = 1.4$,

Enter	Press	Display
6	[×]	6.
1.4	[×]	8.4
1.4	[−]	11.76
3	[×]	8.76
1.4	[+]	12.264
1	[×]	13.264
1.4	[−]	18.5696
8	[=]	10.5696

Powers and Roots

You can use the SR-11 to calculate any integer power or root of any number. To calculate any integer power, it is only necessary to use the [x^2], [×], and [÷] function keys. To calculate any integer roots, an iteration process is used.

Powers

Because the SR-11 has an [x^2] key, you can easily calculate the fourth, eighth, sixteenth, etc., power.

To Calculate	Enter	Press
N^2	N	[x^2]
N^4	N	[x^2] [x^2]
N^8	N	[x^2] [x^2] [x^2]

To calculate other integer powers, slide the K switch to the right, enter the number, press the [×] key, and then press the [=] key one less time than the power.

K →

Example: $3^3 = 27$

Enter	Press	Display
3	[×] [=] [=]	27.

Example: $5^5 = 3125$

Enter	Press	Display
5	[×] [=] [=] [=] [=]	3125.

To raise a number to a negative power, you can raise the number to the positive power and then invert.

Example: $4^{-3} = \frac{1}{4^3} = 0.015625$

Enter	Press	Display
4	[×]	4.
	[=] [=]	64.
	[1/x]	0.015625

An alternate method involves use of the [÷] and [=] key.

Enter	Press	Display
4	[÷]	4.
	[=] [=] [=] [=]	0.015625

Note: To raise numbers to negative integral power, you enter the number, press the [÷] key, and then press the [=] key one more time than the power.

Roots

Because the SR-11 has a [$\sqrt{x}$] key, you can calculate the fourth, eighth, sixteenth, etc., root in a similar manner to calculating the fourth, eighth, etc., power.

To Calculate	Enter	Press
$\sqrt{N}$	N	[$\sqrt{x}$]
$\sqrt[4]{N}$	N	[$\sqrt{x}$] [$\sqrt{x}$]
$\sqrt[8]{N}$	N	[$\sqrt{x}$] [$\sqrt{x}$] [$\sqrt{x}$]

To calculate other integer roots, you can use an iterative process based on Newton's Method.

To Calculate	Equation
$\sqrt[3]{N}$	$(N/A_1^3 + 2)\ A_1/3 = A_2$
$\sqrt[5]{N}$	$(N/A_1^5 + 4)\ A_1/5 = A_2$
$\sqrt[6]{N}$	$(N/A_1^6 + 5)\ A_1/6 = A_2$
$\sqrt[7]{N}$	$(N/A_1^7 + 6)\ A_1/7 = A_2$
$\sqrt[n]{N}$	$[N/A_1^n + (n - 1)]\ A_1/n = A_2$

To use these equations, it is necessary to make an initial approximation which is used to derive a more exact one. Fortunately, the process converges rather rapidly to the correct answer.

For example, to find the cube root of 75, we begin with an approximation of $A_1 = 4$.

Since this method will involve taking the reciprocals of numbers between 64 and 75, maximum accuracy is maintained by having the calculator operate in scientific notation.

K →

Enter	Press	Display	Remarks
4		4	A_1
	[EE]	4 00	Scientific
	[×] [=]	1.6 01	Notation
	[=]	6.4 01	Check
	[1/x] [×]	1.5625 −02	
75	[+]	1.171875 00	
2	[×]	3.171875 00	
4	[÷]	1.26875 01	Re-enter A_1
3	[×]	4.2291666 00	A_2
	[=] [=]	7.5642239 01	Check
	[1/x] [×]	1.3220126 −02	
75	[+]	9.9150945 −01	
2	[×]	2.9915094 00	
4.2291666	[÷]	1.2651591 01	Re-enter A_2
3	[×]	4.217197 00	A_3
	[=] [=]	7.5001794 01	Check
	[1/x] [×]	1.3333014 −02	
75	[+]	9.9997605 −01	
2	[×]	2.999976 00	
4.217197	[÷]	1.2651489 01	Re-enter A_3
3	[×]	4.217163 00	A_4
	[=] [=]	7.4999979 01	Check

Note the increase in accuracy with each iteration. The first approximation (or guess) was correct to 1 significant figure (4); the second, to 3 significant figures (4.22); the third, to 5 significant figures (4.2172); and the fourth, to 7 significant figures (4.217163). Also note that the method provides an optional check on the accuracy of the approximation in the beginning of the next iteration by pressing the [=] key before taking the reciprocal.

The cube root of a number can also be found by a repetitive process using the [√x] key. To find the cube root of 75, we again begin with an approximation of 4.

K →

Enter	Press	Display	Remarks
4	[×]	4.	
75	[√x] [√x] [×]	4.1617914	1st Trial
75	[√x] [√x] [×]	4.2032515	2nd Trial
75	[√x] [√x] [×]	4.2136809	3rd Trial
75	[√x] [√x] [×]	4.2162923	4th Trial
75	[√x] [√x] [×]	4.2169454	5th Trial
75	[√x] [√x] [×]	4.2171087	6th Trial
75	[√x] [√x] [×]	4.2171496	7th Trial
75	[√x] [√x] [×]	4.2171598	8th Trial
75	[√x] [√x] [×]	4.2171623	9th Trial
75	[√x] [√x] [×]	4.217163	10th Trial
75	[√x] [√x] [×]	4.2171631	11th Trial
75	[√x] [√x] [×]	4.2171631	12th Trial
	[=] [=]	74.999985	Check Accuracy

Repeat the process until you achieve the accuracy you desire or until the accuracy of the machine is reached, as in the 11th and 12th trials. This method has the advantage of being very simple to remember.

Not only are the methods for higher roots very similar (which helps in memorizing them) but they are practically no more complex. For example, to find the fifth root of 8000, we begin with an approximation of 6.

K →

Enter	Press	Display	Remarks
6	[EE] [×]	6. 00	A_1
	[=] [=] [=] [=]	7.776 03	Check
	[1/x] [×]	1.2860082 −04	
8000	[+]	1.0288065 00	
4	[×]	5.0288065 00	
6	[÷]	3.0172839 01	
5	[×]	6.0345678 00	A_2
	[=] [=] [=] [=]	8.0025948 03	Check
	[1/x] [×]	1.2495946 −04	
8000	[+]	9.9967568 −01	
4	[×]	4.9996756 00	
6.0345678	[÷]	3.0170881 01	
5	[×]	6.0341762 00	A_3
	[=] [=] [=] [=]	7.9999985 03	Check

Note that, in this example, the accuracy increased from 1 significant figure in A_1 (6) to 4 significant figures in A_2 (6.034) and to 7 significant figures in A_3 (6.034176). In general, 7 significant figures is the maximum that can be obtained because of truncation errors. In this example, the eighth digit should be a 3 instead of a 2.

A process using the [√x] key similar to the one used in finding cube roots can also be used to find 5th roots. We again begin with $\sqrt[5]{8000} \approx 6$.

K →

Enter	Press	Display	Remarks
6	[÷]	6.	
8000	[1/x] [√x] [√x] [÷]	6.0427506	1st Trial
8000	[1/x] [√x] [√x] [÷]	6.0320346	2nd Trial
8000	[1/x] [√x] [√x] [÷]	6.0347118	3rd Trial
8000	[1/x] [√x] [√x] [÷]	6.0340423	4th Trial
8000	[1/x] [√x] [√x] [÷]	6.0342097	5th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341678	6th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341783	7th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341757	8th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341764	9th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341761	10th Trial
8000	[1/x] [√x] [√x] [÷]	6.0341762	11th Trial
8000	[1/x] [√x] [√x] [×]	6.0341762	12th Trial
	[=] [=] [=] [=]	7999.9985	Check Accuracy

Trigonometric Functions

You can greatly augment the capability of the SR-11 by using tables of trigonometric and logarithmic values, such as *C.R.C. Standard Mathematical Tables* published by Chemical Rubber Co., 18901 Cranwood Parkway, Cleveland, Ohio 44128.

However, you can also use the SR-11 to *calculate* the value of these transcendental functions. In general, values to four or five significant figures can be calculated using the recommended expression. A more complex expression is also given for cases where additional accuracy is needed.

The following expressions for the values of trigonometric functions are derived from the Taylor Series expansions, especially modified for use with the SR-11 calculator. As a result, the trigonometric and inverse trigonometric functions involve angles expressed in radians. To convert degrees into radians, we multiply by $\pi/180$. Conversely, to convert radians into degrees, we multiply by $180/\pi$.

Sine

$$\sin a = \left[\left(\frac{a^2}{20} + 1\right)^{-1} \times 10 - 7\right] \frac{a}{3} \qquad 0 < a < \frac{\pi}{4}$$

Accuracy

a in Degrees	Error in %
0 to 30°	< 0.001%
30 to 45°	< 0.006%

$$= \cos\left(\frac{\pi}{2} - a\right) \qquad \frac{\pi}{4} < a < \frac{\pi}{2}$$

Accuracy

a in Degrees	Error in %
45 to 70°	< 0.001%
70 to 90°	< 0.0001%

For greater accuracy

$$\sin a = \left\{\left[\left(\frac{a^2}{42} + 1\right)^{-1} \times 21 - 11\right] \frac{a^2}{-60} + 1\right\} a$$

Cosine

$$\cos a = \left[\left(\frac{a^2}{30} + 1\right)^{-1} \times 5 - 3\right] \frac{a^2}{-4} + 1 \qquad 0 < a < \frac{\pi}{4}$$

Accuracy

a in Degrees	Error in %
0 to 20°	< 0.0001%
20 to 45°	< 0.001%

$$\cos a = \sin\left(\frac{\pi}{2} - a\right) \qquad \frac{\pi}{4} < a < \frac{\pi}{2}$$

Accuracy

a in Degrees	Error in %
45 to 60°	< 0.006%
60 to 90°	< 0.001%

For greater accuracy

$$\cos a = \left\{\left[\left(\frac{a^2}{56} + 1\right)^{-1} \times 28 - 13\right] \frac{a^2}{360} - .5\right\} a^2 + 1$$

Tangent

$$\tan a = \left[\left(-\frac{2}{5} a^2 + 1\right)^{-1} \times 5 + 1\right] \frac{a}{6} \qquad 0 < a < \frac{\pi}{4}$$

Accuracy

a in Degrees	Error in %
0 to 20°	< 0.001%
20 to 35°	< 0.01%
35 to 45°	< 0.03%

$$= \quad \tan\left(\frac{\pi}{2} - a\right)^{-1} \qquad \frac{\pi}{4} < a < \frac{\pi}{2}$$

Accuracy

a in Degrees	Error in %
45 to 55°	< 0.03%
55 to 70°	< 0.01%
70 to 90°	< 0.001%

For greater accuracy

$$\tan a = \left\{\left[\left(-\frac{17}{42}a^2+1\right)^{-1} \times 84+1\right]\frac{a^2}{255}+1\right\} a$$

For example to calculate the sine of 25°, we first convert the angle to radians by multiplying by π/180.

Enter	Press	Display	Remarks
25	[×]	25.	
[π]	[÷]	78.539817	
180	[=]	0.4363323	a in radians
	[x²] [÷]	0.1903858	
20	[+]	0.0095192	
1	[1/x] [×]	0.9905705	
10	[−]	9.905705	
7	[×]	2.905705	
.4363323	[÷]	1.2678529	Re-enter a in
3	[=]	0.4226176	radians

This answer is correct to six places; the last two digits should be 83 instead of 76.

Inverse Trigonometric Functions

Arc Sine

$$\text{arc} \sin a = \left[\left(-\frac{9}{20}a^2+1\right)^{-1} \times 10+17\right]\frac{a}{27} \quad 0 < a < \frac{1}{2}$$

Accuracy

a	Error in %
0 to 0.2	<0.0001%
0.2 to 0.3	<0.001%
0.3 to 0.45	<0.01%
0.45 to 0.5	<0.03%

$$\text{arc sin a} = \frac{-4 \text{ arc sin b} + \pi}{2} \qquad \frac{1}{2} < a < 1$$

$$\text{where } b = \sqrt{\frac{1-a}{2}}$$

Accuracy

a	Error in %
0.5 to 0.65	<0.05%
0.65 to 0.75	<0.01%
0.75 to 0.9	<0.001%
0.9 to 1.0	<0.0001%

For greater accuracy

$$\text{arc sin a} = \left\{ \left[\left(-\frac{25}{42} a^2 + 1 \right)^{-1} \times 189 + 61 \right] \frac{a^2}{1500} + 1 \right\} a$$

Arc Cosine

$$\text{arc cos a} = \frac{\pi}{2} - \text{arc sin a} \qquad 0 < a < 1$$

Accuracy

Same as for arc sin

Arc Tangent

$$\text{arc tan a} = \left[\left(\frac{3a^2}{5} + 1 \right)^{-1} \times 5 + 4 \right] \frac{a}{9} \qquad 0 < a < 0.5$$

Accuracy

a	Error in %
0 to 0.2	<0.0001%
0.2 to 0.3	<0.001%
0.3 to 0.45	<0.01%
0.45 to 0.5	<0.02%

$$= \text{arc tan b} + 0.4636476$$

$$\text{where } b = \left[\left(\frac{2}{a} + 1 \right)^{-1} \times 5 - 1 \right] /2 \qquad 0.5 < a < 1$$

Accuracy

a	Error in %
0.5 to 0.85	<0.0001%
0.85 to 1	<0.001%

$$\text{arc tan } a = \frac{-2 \text{ arc tan } \left(\frac{1}{a}\right) + \pi}{2} \qquad a > 1$$

Accuracy

Same as above for $\frac{1}{a}$

For greater accuracy,

$$\text{arc tan } a = \left\{ \left[\left(\frac{5a^2}{7} + 1 \right)^{-1} \times 21 + 4 \right] \frac{a^2}{-75} + 1 \right\} a$$

To calculate arc tan 0.75,

Enter	Press	Display	Remarks
2	÷	2.	
.75	+	2.6666666	
1	1/x ×	0.2727272	
5	−	1.363636	
1	÷	0.363636	
2	=	0.181818	b
	x² ×	0.0330577	
.6	+	0.0198346	
1	1/x ×	0.9805511	
5	+	4.9027555	
4	×	8.9027555	
.181818	÷	1.6186811	Re-enter b
9	+	0.1798534	
.4636476	×	0.643501	a in radians
180	÷	115.83018	
π	=	36.86989	a in degrees

This answer is correct to 6 places; the answer should be 36.869897.

Logarithmic Functions

$$\ln a = \left[\left(-\frac{3}{5}b^2 + 1\right)^{-1} \times 5 + 4\right]\frac{2b}{9} \qquad 0.7 < a < 1.6$$

$$\text{where } b = \frac{a-1}{a+1} = (a+1)^{-1} \times (-2) + 1$$

This expression yields values with an error of less than 0.0003% over the range of a from 0.7 to 1.6. For values of a outside this range, use the expression $\ln a = \ln(2^n C)$ where the power of 2 is chosen so that $0.7 < C < 1.6$. Then

$$\ln a = \ln C + 0.6931472n$$

This can be done in a single operation

$$\ln a = \left\{\left[\left(-\frac{3}{5}b^2 + 1\right)^{-1} \times 5 + 4\right]\frac{2b}{9n} + 0.6931472\right\} n \qquad 0.7 < \frac{a}{2^n} < 1.6$$

$$\text{where } b = \frac{\frac{a}{2^n} - 1}{\frac{a}{2^n} + 1} = \left(\frac{a}{2^n} + 1\right)^{-1} \times (-2) + 1$$

Since

$$\log a = \frac{\ln a}{\ln 10}$$

$$= \frac{\ln a}{2.3025851}$$

$$\log a = \left\{ \left[\left(-\frac{3}{5} b^2 + 1 \right)^{-1} \times 5 + 4 \right] \frac{2b}{9n} + 0.6931472 \right\}$$

$$\times \ \frac{n}{2.3025851}$$

$$\text{where } b = \left(\frac{a}{2^n} + 1 \right)^{-1} \times (-2) + 1$$

To calculate ln 35, we first divide 35 by 2^5 or 32

Enter	Press	Display	Remarks
35	[÷]	35.	
32	[+]	1.09375	
1	[1/x] [×]	0.4776119	
2	[+/−] [+]	−0.9552238	
1	[=]	0.0447762	b
	[x²] [×]	0.0020049	
3	[+/−] [÷]	−0.0060147	
5	[+]	−0.0012029	
1	[1/x] [×]	1.0012043	
5	[+]	5.0060215	
4	[×]	9.0060215	
2	[×]	18.012043	
.0447762	[÷]	0.8065108	Re-enter b
9	[÷]	0.0896123	
5	[+]	0.0179224	
.6931472	[×]	0.7110696	
5	[=]	3.5553483	

This answer is correct to 7 places; the final digit should be a 1 instead of a 3.

Exponential Functions

$$e^a = \left\{\left[\left(\frac{a^2}{60} + 1\right)^{-1} \times (-5) + 6\right] / a - 0.5\right\}^{-1} + 1 \quad 0 < a < 1$$

Accuracy

a	Error in %
0 to 0.6	< 0.00001%
0.6 to 0.75	< 0.0001%
0.75 to 1.0	< 0.001%

For values of a greater than unity, use this expression for the fractional part of a and multiply by e raised to the integer part of a. For example, $e^{2.7} = e^2 \times e^{0.7}$. An approximation for $e \approx 193/71 \approx 2.7183098$. The error in this approximation is less than 0.001% or 1 part in 100,000.

To calculate $e^{0.4}$

Enter	Press	Display
.4	[x²] [÷]	0.16
60	[+]	0.0026666
1	[1/x] [×]	0.9973404
5	[+/−] [+]	−4.986702
6	[÷]	1.013298
.4	[−]	2.533245
.5	[1/x] [+]	0.4918246
1	[=]	1.4918246

This answer is correct to 7 places; the eighth digit should be a 7 instead of a 6. For values of a between 0 and 0.6, this method yields answers within ±1 in the eighth place. For values of a approaching unity you can use the expression $e^a = (e^{.5a})^2$.

Exponentials

The value of y^a can be calculated to within 0.05% using the [$\sqrt{x}$] and [x^2] keys. For $1 \leq y \leq 10$ and $0.1 \leq a \leq 1$, the method involves taking the square root of y eleven times, subtracting unity, multiplying by a, adding unity, and then squaring eleven times.

Example: $5.1^{0.49}$

Enter	Press	Display
5.1		5.1
	[$\sqrt{x}$] (11 times)	1.0007957
	[−]	1.0007957
1	[×]	0.0007957
.49	[+]	0.0003898
1	[x^2] (11 times)	2.2212695

This value is within 0.025% of the correct value of 2.2218226.

This method can easily be extended to values of y and a outside these ranges.

Example:

$$5100^{2.49} = (5.1 \times 10^3)^{2.49}$$

$$= (5.1 \times 10^3)^2 \times (5.1 \times 10^3)^{0.49}$$

$$= 5.1^2 \times 10^6 \times 5.1^{0.49} \times 10^{1.47}$$

$$= 5.1^2 \times 5.1^{0.49} \times 10^{0.47} \times 10^7$$

$$= 26.01 \times 2.2212695 \times 2.9510491 \times 10^7$$

$$= 1.704975$$

Calculating $5.1^{0.49}$ and $10^{0.47}$, squaring 5.1 and multiplying these three terms and 10^7 together yields 1.704975×10^9 which is within 0.03% of the correct value of 1.7054922×10^9. Calculating $5100^{2.49}$ directly using the above method would have resulted in an answer of 1.5962477×10^9, which is only accurate within 6.4%.

SAMPLE PROBLEMS

Geometry

Area of a Triangle – Find the area of a triangle with a base of 4 inches and a height of 3 inches.

$$A = \frac{1}{2} b\,h$$

$$= \frac{1}{2} \times 4 \times 3$$

$$= 6 \text{ sq in}$$

Enter	Press	Display
.5	[×]	0.5
4	[×]	2.0
3	[=]	6.

Circle – For a circle with a 3.85 inch radius, find the circumference and the area of a sector subtended by 35°.

Circumference, $C = 2\pi R$

$$= 2 \times \pi \times 3.85$$

$$= 24.190263 \text{ in}$$

Enter	Press	Display
2	[×]	2.
[π]	[×]	6.2831854
3.85	[=]	24.190263

Area of Sector, $A_s = \frac{1}{2} r^2 \theta$ where $\theta = \frac{\text{degrees}}{180} \times \pi$

$$= \frac{1}{2} \times (3.85)^2 \times \frac{35}{180} \times \pi$$

$$= 4.5272747 \text{ sq in}$$

Enter	Press	Display
3.85	[x^2] [÷]	14.8225
2	[X]	7.41125
35	[÷]	259.39375
180	[X]	1.4410763
[π]	[=]	4.5272747

Sphere — Find the volume of a sphere with a radius of 3.7 inches.

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

$$= \frac{4}{3} \times \pi \times (3.7)^3$$

$$= 212.1748 \text{ cu in}$$

K→

Enter	Press	Display
3.7	[X] [=] [=] [X]	50.653
[π]	[X]	159.13109
4	[÷]	636.52436
3	[=]	212.17478

Physics

Thrown Object — If a ball is thrown upward with a velocity of 86 feet per second, what is its velocity at the end of 1.75 seconds? Use g = 32.2 feet per sec^2.

Velocity, $v = v_o - gt$

$$= 86 - (32.2)(1.75)$$

$$= 29.65 \text{ ft/sec}$$

Enter	Press	Display
32.2	[X]	32.2
1.75	[+/−] [+]	−56.35
86	[=]	29.65

Dropped Object — If a stone is dropped from a balloon 1175 feet above ground, how long will it take to reach the ground, and at what velocity?

Time, $s = v_o\, t + \frac{1}{2}\, gt^2$

$\therefore t = \sqrt{\frac{2s}{g}}$ since v_o, initial velocity, is equal to zero

$t = \sqrt{\frac{2 \times 1175}{32.2}}$

$= 8.5429132$ sec

Enter	Press	Display
2	[X]	2.
1175	[÷]	2350.
32.2	[√]	= 8.5429132 sec

Velocity, $v = v_o + gt$

$= 0 + (32.2 \times 8.54)$

$= 274.988$ ft per sec

Enter	Press	Display
32.2	[X]	32.2
8.54	[=]	274.988

Solar Heat Equivalence — How many tons of coal would be required to produce an amount of heat equivalent to solar energy falling on one square mile of earth in the vicinity of the equator? Solar energy falls at 7 BTU per square foot per minute on a clear day, and the heat of combustion of coal is 12,000 BTU per pound.

$$\text{Weight of coal, in tons per min} = \frac{\text{total solar heating per min}}{\text{heating of coal per ton}}$$

$$W = \frac{\text{area in sq ft X rate}}{\text{2000 X heating of coal per lb}}$$

$$= \frac{(5280)^2 \times 7}{2000 \times 12000}$$

= 8.1312 tons per minute

Enter	Press	Display
5280	[x²] [÷]	27878400
2000	[X]	13939.2
7	[÷]	97574.4
12000	[=]	8.1312

Gas Pressure – The internal pressure of a tank of gas is 1300 psi at room temperature. What is the internal pressure if the temperature rises by 25°C (from 298°K to 323°K)?

$$P_2 = \frac{P_1 T_2}{T_1}$$

$$= \frac{1300 \times 323}{298}$$

= 1409.0604 psi

Enter	Press	Display
1300	[X]	1300.
323	[÷]	419900.
298	[=]	1409.0604

Density of Gas – What is the density of helium gas in a tank at a pressure of 125 atm at room temperature, 298°K? The universal gas constant is 8317 nt m/kg°K, the atomic mass of helium is 4.004, and 1 atm = 1.013 X 10^5 nt/m^2.

P = 125 atm R = 8317 nt m/kg°K
M = 4.004 T = 298°K

$$\rho = \frac{PM}{RT}$$

$$= \frac{125 \times 1.013 \times 10^5 \times 4.004}{8317 \times 298}$$

$$= 20.456463 \text{ Kg per m}^2$$

Enter	Press	Display
125	[×]	125.
1.013	[EE]	1.013 00
5	[×]	1.26625 07
4.004	[÷]	5.070065 07
8317	[÷]	6.0960262 03
298	[=]	2.0456463 01

Electrical Engineering

Mechanical Work to Charge a Capacitor – How much mechanical work must be done to charge a 750 μF capacitor to a potential difference of 675 volts, assuming an efficiency of 68 percent in the process?

Stored energy, $E = \frac{1}{2} CV^2$

$$= \frac{1}{2} \times 750 \times 10^{-6} \times (675)^2$$

$$= 1.7085937 \times 10^2 \text{ joules}$$

$$\text{Work required} = \frac{\text{Stored energy}}{\text{Efficiency}} \times 0.738 \text{ ft-lbs/joule}$$

$$= \frac{170.85937}{.68} \times 0.738 = 1.8543266 \times 10^2 \text{ ft-lbs}$$

Enter	Press	Display
675	[x²] [X]	455625.
.5	[X]	227812.5
750	[EE]	750 00
6	[+/−] [÷]	1.7085937 02
.68	[X]	2.5126377 02
.738	[=]	1.8543266 02

Parallel Plate Capacitor – What is the equivalent capacitance of a 12-plate parallel plate tuning capacitor if the area of each side of a plate is 15 square cm and the plates are separated by 0.2 mm?

$$C = \frac{(n-1)\,A}{36\,\pi d \times 10^{9}}$$

$$= \frac{11 \times 15 \times 10^{-4}}{36 \times \pi \times 0.2 \times 10^{-3} \times 10^{9}}$$

$$= \frac{11 \times 15 \times 10^{-10}}{36 \times \pi \times 0.2}$$

$$= 7{,}2946017 \times 10^{-10}$$

$$= 729.46017 \text{ pF}$$

Enter	Press	Display
36	[EE] [X]	36. 00
[π]	[X]	1.1309733 02
.2	[1/x] [X]	4.4209708 02
11	[X]	4.8630678 −01
15	[EE] [+/−]	15 −00
10	[=]	7.2946017 −10

Heat Generated by a Light Bulb – How much heat is generated per minute by a 75 watt incandescent light bulb? One watt = 3.413 BTU per hour.

P = 75 watts X 3.413 BTU/hr ÷ 60 min/hr = 4.26625 BTU/min

Enter	Press	Display
75	[×]	75.
3.413	[÷]	255.975
60	[=]	4.26625

Voltage, Power, Resistance – What voltage is required to operate the bulb at 75 W if the bulb resistance is 161 Ω?

$$V = \sqrt{PR} = \sqrt{75 \times 161} = 109.8863 \text{ volts}$$

Enter	Press	Display
75	[×]	75.
161	[√x]	109.8863

Mechanical Engineering

Acceleration, Speed – What is the acceleration in ft/sec² of an automobile when its speed changes from 75 mph to 45 mph in 4 seconds?

$$a = \frac{V_f - V_o}{t}$$

$$= \frac{45 \text{ mph-}75 \text{ mph}}{4 \text{ sec}} \times 5280 \text{ ft/mile} \times \frac{1}{3600 \text{ sec/hr}}$$

$$= -11 \text{ ft/sec}^2$$

Enter	Press	Display
45	[−]	45.
75	[÷]	−30.
4	[×]	−7.5
5280	[÷]	−39600.
3600	[=]	−11.

Transmitting Torque – What is the transmitting torque of a 165-hp engine operating at 1800 rpm?

$$T = \frac{63000 \text{ hp}}{N}$$

$$= \frac{63000 \times 165}{1800}$$

$$= 5.775 \times 10^3 \text{ in-lb}$$

Enter	Press	Display
63	[EE]	63 00
3	[×]	63. 03
165	[÷]	1.0395 07
1800	[=]	5.775 03

Rod Deflection – What is the deflection of the end of a metal rod due to a force of 20,000 lb? The length of the rod is 2.5 feet and the cross sectional area is 0.385 square feet. E, the elastic modulus, is 30 X 10^6 psi.

$$d = \frac{PL}{AE}$$

$$= \frac{20{,}000 \times 2.5 \times 12}{.385 \times 144 \times 30 \times 10^6}$$

$$= 3.6075036 \times 10^{-4} \text{ inches}$$

Enter	Press	Display
.385	[×]	.385
144	[×]	55.44
30	[EE]	30 00
6	[=]	1.6632 09
	[1/x] [×]	6.012506 –10
20	[EE]	20 00
3	[×]	1.2025012 –05
2.5	[×]	3.006253 –05
12	[=]	3.6075036 –04

Civil Engineering

Surveying – Determine the temperature correction and the approximate slope correction for a steel tape used at a temperature of 85°F. The tape standardized temperature is 70°F, the measured length is 12,750 feet, and the difference in elevation is 13 feet.

Temperature correction, $C_t = 0.0000065\, S\, (T - T_o)$

$$= 0.0000065 \times 12750 \times (85 - 70)$$

$$= 1.243125$$

Enter	Press	Display
85	[–]	85.
70	[X]	15.
65	[EE] [+/–]	65 –00
7	[X]	9.75 –05
12750	[=]	1.243125 00

Slope Correction, $C_h = \frac{h^2}{2S}$

$$= \frac{1}{2 \times 12750} (13)^2$$

$$= 6.6274509 \times 10^{-3}$$

Enter	Press	Display
13	[EE] [x^2] [÷]	1.69 02
2	[÷]	8.45 01
12750	[=]	6.6274509 –03

Structural Analysis – Determine the compressive stress in the extreme fibre of concrete in a rectangular concrete beam with only tensile reinforcing subjected to a bending moment of 28,500 lb-in. The width of the beam is 2.5 feet and the effective depth is 8.5 inches. Use the approximate design values of 7/8 and 1/3 for j and k respectively.

$$f_c = \frac{2M}{j\,k\,bd^2}$$

$$= \frac{2 \times 28500}{.875 \times .333 \times 2.5 \times (8.5)^2 \times 12}$$

$$= 90.253378 \text{ psi}$$

Enter	Press	Display
8.5	[x^2] [×]	72.25
.875	[×]	63.21875
.333	[×]	21.051843
2.5	[×]	52.629607
12	[EE] [1/x] [×]	1.5833926 –03
2	[×]	3.1667852 –03
28500	[=]	9.0253378 01

For additional information concerning your calculator, write the Consumer Relations Department at:

Texas Instruments Incorporated
P.O. Box 5012, M/S 10
Dallas, Texas 75222

or call Henry M. Meltzer, Consumer Relations Manager at (214) 238-2741. (We regret that we cannot accept collect calls.)

In Case of Difficulty

1. Check to be sure calculator is correctly plugged into a proper outlet that has power and that the AC Adapter/ Charger voltage switch is set on the correct voltage.

2. Check to be sure ON-OFF switch is in the ON position. Presence of digits in the display indicates power is on.

3. If display fails to light on battery operation, recharge batteries.

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

If none of these corrects the difficulty, return the unit prepaid for repair to your nearest Texas Instruments Consumer Service Facility listed on following page. Please include information on your difficulty as well as return information of name, address, city, state and zip code.

CAUTION: Use of other than the AC Adapter/Charger AC9200 may apply improper voltage to your SR-11 calculator and will cause damage.

Warranty Registration

Owner's Copy

To protect your warranty, complete and mail the attached Warranty Registration Card within 10 days of purchase or receipt as a gift. Also record the serial number of your calculator below. Any correspondence concerning your calculator must include both model and serial number.

SR-11		
Model No.	**Serial No.**	**Purchase Date**

1 ☐ Mr.
2 ☐ Miss
3 ☐ Mrs.

Warranty Registration Card

Mail within 10 days to protect your warranty

SR-11

Owner's First Name **Initial** **Last Name** **Model No.** **Serial No.** **Purchase Date**

Owner's Mailing Address **City** **State** **Zip**

Please help us in planning other useful products by providing the following information:

Was Your TI Calculator a Gift?
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Where the Calculator Will be Used (Check One)
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2 ☐ Occupation
3 ☐ Both

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3 ☐ Mail Order
4 ☐ Other (Specify)

Your Occupation (Check One)
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2 ☐ Salesman
3 ☐ Accountant
4 ☐ Farmer/Rancher
5 ☐ Student
6 ☐ Educator
7 ☐ Homemaker
8 ☐ Doctor/Lawyer
9 ☐ Banker/Financier
10 ☐ Other (Specify)

Your Approximate Age
1 ☐ Under 18
2 ☐ 18-24
3 ☐ 25-34
4 ☐ 35-54
5 ☐ 55 and over

Your Approximate Yearly Family Income
1 ☐ Under $5000
2 ☐ $5,000 to $10,000
3 ☐ $10,000 to $15,000
4 ☐ Over $15,000

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TEXAS INSTRUMENTS INCORPORATED
P.O. BOX 5012, M/S 10
DALLAS, TEXAS 75222

Texas Instruments

electronic slide rule calculator

SR-11

ONE YEAR WARRANTY

The SR-11 electronic calculator from Texas Instruments is warranted to the original purchaser for a period of one year from the original purchase date – under normal use and service against defective materials or workmanship.

Defective parts will be repaired, adjusted and/or replaced at no charge when the calculator is returned prepaid to a Texas Instruments Consumer Service Facility listed below.

The warranty is void if the calculator has been visibly damaged by accident or misuse, if the serial number has been altered or defaced, or if the calculator has been serviced or modified by any person other than a Texas Instruments Consumer Service Facility.

This warranty contains the entire obligation of Texas Instruments Incorporated and no other warranties expressed, implied, or statutory are given.

The warranty is void unless the attached Warranty Registration Card has been properly completed and mailed to Texas Instruments Incorporated within 10 days of purchase.

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Orange, California 92668

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