Friden 130 Electronic Calculator

Instruction Manual

Price $2.00

Published by

Friden, Inc.
Educational Center
31 Prince Street
Rochester, New York 14607

OPERATING INSTRUCTIONS FOR

Friden* 130 Electronic Calculator

FOREWORD

Operating the Friden Electronic Calculator 130 is like stepping into a new world of computing power for the desk calculator user. Through the magic of electronics, the features of storage capacity, flexibility, speed, silence, and decimal control are advanced to a level never before attained.

Designed to meet the styling requirements of modern business, the Friden 130 is a pleasant complement to any office decor. The complete operating silence of this machine eliminates disturbance of office personnel and promotes efficiency.

This machine is a solid-state device. These non-moving components are the secret to high-speed calculation. Input amounts and results of operation are visible instantly on the face of a cathode ray tube after the entry or function key is operated. Intermediate results are automatically retained in the upper registers. Also, an amount or result may be stored for further use in a memory unit.

A feather-touch eleven-key keyboard provides the means for numerical input. Function keys placed adjacent to this section are arranged for operator convenience and ease of operation.

Accuracy in decimal point control is insured by a fixed point system, around which all input amounts and results are automatically aligned. No other programming is necessary. The decimal point location can be manually selected for five different operating situations according to the requirements of the work at hand.

The 130 Electronic Calculator is able to handle a wide range of business and scientific applications in a logical and direct manner. The high degree of flexibility permitted in approaching problems makes this machine highly adaptable to arithmetic calculations of great variety.

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Friden 130 Electronic Calculator

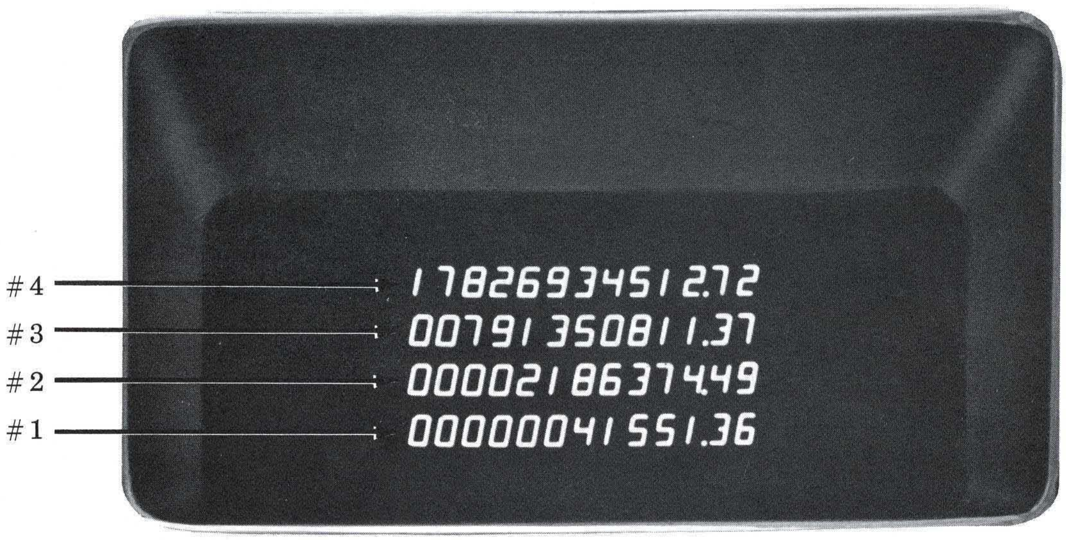
REGISTER DISPLAY

The Friden 130 Electronic Calculator employs a new concept in computation. Commonly referred to as the "stacking" principle, it permits automatic storage of intermediate answers for later usage, according to the requirements of the formula being solved. Four 13-digit registers are arranged in a stack as follows:

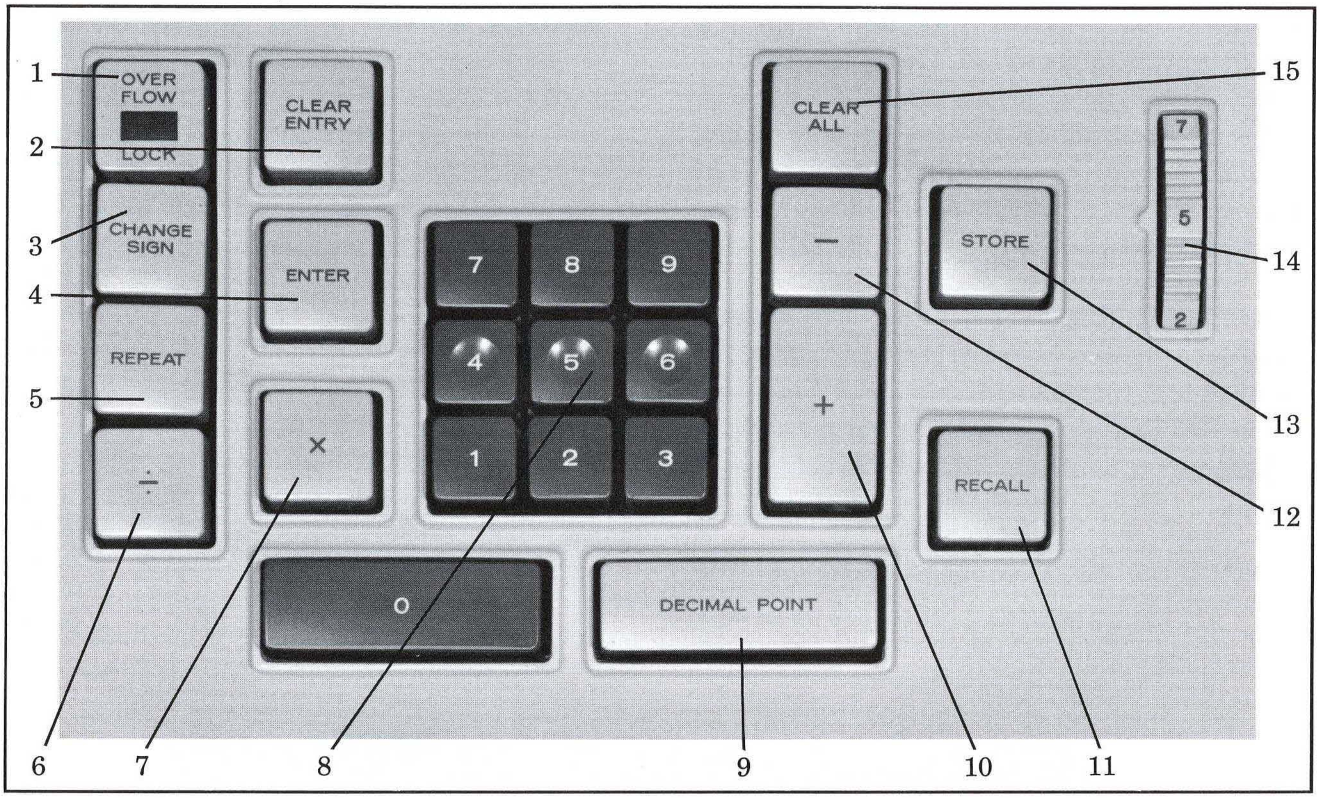
1. WORKING REGISTER (#1). The bottom register is known as the Working Register. All entries and answers appear in it. All numbers enter the Display through this register and are displaced upwards as subsequent entries are made.

2. REGISTER #2. One number of an arithmetic operation appears in this register, the other appears in the Working Register. When, however, the two terms appearing in these registers are combined arithmetically (added, subtracted, multiplied, or divided) the answer appears in the Working Register. Any values which were in the 3rd and 4th registers automatically shift down one position.

3. REGISTERS #3 and #4. These registers are used for storage of intermediate answers. This "stack" of four registers, then, fills and empties from the bottom on a "first in, last out" basis. If a fifth entry is made with all registers full, the contents of Register #4 "overflow" off the top and are lost.



KEYBOARD AND OPERATING CONTROLS



1. Over-Flow Lock
2. Clear Entry Key
3. Change Sign Key
4. Enter Key
5. Repeat Key
6. Division Key
7. Multiplication Key
8. Keyboard
9. Decimal Point Key
10. Plus Key
11. Recall Key
12. Minus Key
13. Store Key
14. Decimal Point Selector
15. Clear All

OPERATING CONTROLS

1. OVER-FLOW LOCK KEY—If a number, entered in Working Register #1, is beyond the left of decimal capacity of the selected decimal point program, the OVER-FLOW LOCK signal lights up. For example, if the Decimal Point Selector is set on "7" it would mean that six digits only, can be indexed in the keyboard to the left of the decimal point. (13 digits capacity minus 7 decimal places equals 6 digits to the left of decimal.) If then 1,234,567.89 is indexed on the keyboard, the OVER-FLOW LOCK signal lights up upon depression of the ENTER key.

There is one other situation in which the OVER-FLOW LOCK signal lights up. That is, where an *answer* exceeds the number of digits to the left of the selected decimal point program. Once the over-flow signal light is on, all keys are locked to prevent further usage. Touching either the CLEAR ENTRY or CLEAR ALL keys will turn off the signal, unlock the keyboard, and simultaneously clear the affected registers. The keyboard may also be unlocked merely by touching the OVER-FLOW Lock key itself.

A *Decimal Interlock* is provided to prevent overloading digits to the right of the decimal point. Assuming a decimal selection of 2, then only two digits can be indexed after the decimal point key is depressed. The third and subsequent digits are automatically disregarded.

2. CLEAR ENTRY—A touch of the CLEAR ENTRY key will clear Working Register #1. If a mistake is made in indexing a number, touch the CLEAR ENTRY key and proceed with the problem.

3. CHANGE SIGN Key—This key will permit calculations with algebraic sign changes. As an example take the problem 23.45− (−.895). Use of the CHANGE SIGN key permits entry of .895 into the Working Register with the negative sign attached. The resultant answer will appear with the correct sign. See page 9 for other examples of this feature.

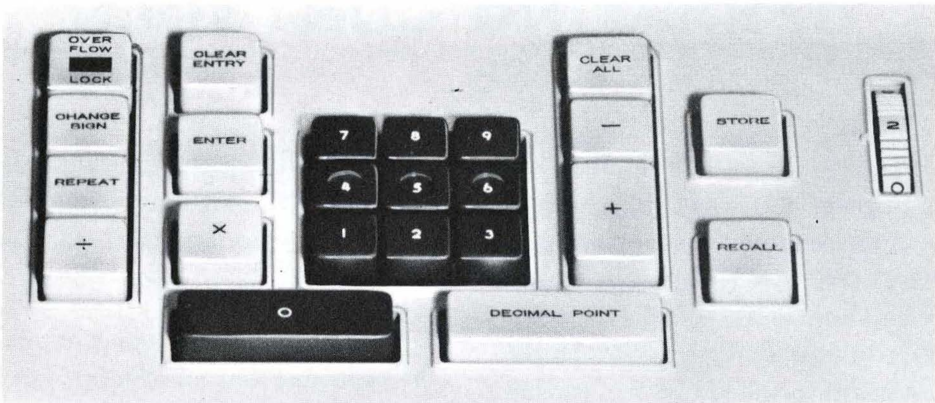
4. ENTER KEY—When a number is indexed in the keyboard that number appears immediately in Working Register #1—but without the decimal point. A touch of the ENTER key, then, decimally aligns it. All function keys cause decimal alignment also. Therefore, when using such keys as CHANGE SIGN, REPEAT, and RECALL, it is not necessary to touch the ENTER key first.

5. REPEAT Key—The REPEAT key duplicates the contents of Register #1 in Register #2. The most common applications utilizing this feature are those involving squaring. But the REPEAT key may be used equally well for problems involving discounts, commissions, chain discounts and compound interest, to name a few. Squaring is a three step operation: (1) Index the number (2) Touch the REPEAT key, (3) Touch the Multiplication (×) key.

6. DIVISION Key—A touch of the Divide key will cause the contents of Register #2 to be divided by the contents of Register #1. The answer will appear, decimally aligned in Register #1. To divide, the procedure is as follows: (1) Index the dividend (2) Touch ENTER key (3) Index the divisor (4) Touch the Divide (÷) key.

If the Divide key is depressed with nothing in the Working Register, the Display goes blank and the machine will run indefinitely in the process of division. Touch the CLEAR ALL key to restore the Display.

7. MULTIPLICATION Key—A touch of the MULTIPLICATION key will cause the contents of Register #1 to be multiplied by the contents of



Register #2. The product will appear, decimally aligned, in Register #1. To multiply, the procedure is as follows: (1) Index the multiplicand (2) Touch ENTER key (3) Index the multiplier (4) Touch the Multiplication (×) key.

8. KEYBOARD—All numbers are indexed on the "11-key" keyboard. The "11th" key is a decimal point key. As a number is indexed on the keyboard it appears in Register #1, digit by digit from the right.

9. DECIMAL POINT Key—The Decimal Point key must be depressed whenever a number with a decimal point in it is indexed in the keyboard. If the Decimal Point key is not used, the machine accepts the entry as a whole number. So 456.78 is indexed as 4-5-6-decimal point-7-8. And 678 is indexed as 6-7-8; the Decimal Point key need not be depressed in this case.

10. PLUS Key—A touch of the PLUS key will cause the contents of Register #1 to be added to the contents of Register #2. The answer will appear, decimally correct, in Register #1. To add, the procedure is as follows: (1) Index first number (2) Touch ENTER key (3) Index next number (4) Touch PLUS (+) key. Repeat steps #3 and 4 for subsequent numbers.

11. RECALL Key—The RECALL Key recalls any number stored in the Memory Unit. The number stored may be repeatedly recalled to Register #1 for subsequent operations.

12. MINUS Key—A touch of the MINUS key will cause the contents in Register #1 to be subtracted from the contents of Register #2. The answer will appear, decimally correct in Register #1. To subtract, the procedure is as follows: (1) Index the first number (2) Touch ENTER key (3) Index the second number (4) Touch the MINUS (−) key.

13. STORE Key—A fifth register, not displayed, is provided for storage of a constant. A touch of the STORE key will transfer a number from Register #1 to the Memory Unit. If a number is already in storage, it replaces the old number with the new one. The stored number may be recalled as often as desired.

14. DECIMAL POINT SELECTOR—Automatic decimal control is maintained in all registers in keeping with the number of decimal places indicated on the decimal programs control wheel. There are five different decimal programs available. These are 0, 2, 5, 7, and 13. To eliminate needless shifting of the Decimal Point Selector, most problems in this manual are worked over a 5 place decimal program.

15. CLEAR ALL Key—A touch of the CLEAR ALL key clears all registers—including the Memory Unit.

ADDITION/SUBTRACTION

GENERAL INSTRUCTIONS

1. An ON/OFF switch is located under the lower right corner of the calculator. Push the lever back, in order to turn the machine on. The Display will appear in a few seconds.
2. Numbers are indexed in the 11-key keyboard just as they are written.
3. If an error is made in indexing a number, touch CLEAR ENTRY and begin over again.
4. The DECIMAL POINT key is used in all cases—except for whole numbers. For example, 28.13 is entered as 2-8-decimal-1-3; the number 68 is entered as 6-8; the decimal point is not required.
5. Since all entries are positive, a CHANGE SIGN key is provided to make these entries negative, when necessary. See example #5 below.
6. Clearing is unnecessary between problems.

PROBLEMS:

1. Addition without Decimals . . . . 68 + 93 = 161
2. Addition with Decimals . . . . 28.13 + 17.24 = 45.37
3. Subtraction with True Credit Balance . . . . 97.24 − 118.43 = −21.19
4. Addition and Subtraction . . . . 15.243 + 17.819 − 23.147 = 9.915
5. Subtracting Algebraically . . . . 22.43 − (−32.46) = 54.89

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
1. 68 + 93 = 161.00000	68 93	*Note:* Move Decimal Point Selector to position 5 ENTER +
2. 28.13 + 17.24 = 45.37000	28•13 17•24	ENTER +
3. 97.24 − 118.43 = 21.19000−	97•24 118•43	ENTER −
4. 15.243 + 17.819 = 33.06200 33.062 − 23.147 = 9.91500	15•243 17•819 23•147	ENTER + −
5. 22.43 − (−32.46) = 54.89000	22•43 32•46	ENTER CHANGE SIGN −

MULTIPLICATION

PROBLEMS:

1. Multiplication without Decimals . . . . 12 × 24 = 288
2. Multiplication with Decimals . . . . 24.02 × .9401 = 22.5812
3. Accumulation of Products
   Positive . . . . (39.445 × 15.2) + (41 × .6) = 624.164
   Negative . . . . (3 × .14) − (.007 × 21) = .273
4. Chain Multiplication . . . . 23.8 × 16.92 × .708 = 285.10876

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. 12 × 24 = 288.00000	12	ENTER
	24	×
2. 24.02 × .9401 = 22.58120	24•02	ENTER
	•9401	×
3. 39.445 × 15.2 = 599.56400	39•445	ENTER
	15•2	×
599.564 + (41 × .6) = 624.16400	41	ENTER
	•6	× +
3 × .14 = .42000	3	ENTER
	•14	×
.42 − (.007 × 21) = .27300	•007	ENTER
	21	× −
4. 23.8 × 16.92 = 402.69600	23•8	ENTER
	16•92	×
402.696 × .708 = 285.10876	•708	×

DIVISION

PROBLEMS:

1. Division without Decimals . . . . $145 \div 12 = 12.08333$
2. Division with Decimals . . . . $4{,}962.184 \div 13.2 = 375.92303$
3. Addition of Quotients . . . . $\frac{624}{13} + \frac{78.2}{4.7} = 64.63829$
4. Addition/Subtraction of Quotients . . . . $\frac{45}{3} + \frac{34.26}{12.1} - \frac{17.76}{3.125} = 12.14820$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
1. $145 \div 12 = 12.08333$	145 12	*Note:* Move Decimal Point Selector to position 5 $\boxed{\text{ENTER}}$ $\boxed{\div}$
2. $4{,}962.184 \div 13.2 = 375.92303$	4962•184 13•2	$\boxed{\text{ENTER}}$ $\boxed{\div}$
3. $\frac{624}{13} = 48.00000$ $+ \frac{78.2}{4.7} = 64.63829$	624 13 78•2 4•7	$\boxed{\text{ENTER}}$ $\boxed{\div}$ $\boxed{\text{ENTER}}$ $\boxed{\div}$ $\boxed{+}$
4. $\frac{45}{3} = 15.00000$ $+ \frac{34.26}{12.1} = 17.83140$ $- \frac{17.76}{3.125} = 12.14820$	45 3 34•26 12•1 17•76 3•125	$\boxed{\text{ENTER}}$ $\boxed{\div}$ $\boxed{\text{ENTER}}$ $\boxed{\div}$ $\boxed{+}$ $\boxed{\text{ENTER}}$ $\boxed{\div}$ $\boxed{-}$

SQUARING A NUMBER

PROBLEMS:

1. Accumulative Squaring without Decimals . . . . $25^2 + 12^2 = 769$
2. Accumulative Squaring with Decimals . . $78.23^2 + 26.35^2 = 6{,}814.25540$
3. Negative Squaring . . . . $34.126^2 - 18.29^2 = 830.05977$
4. Accumulative/Negative Squaring . . . . . . $18.124^2 + 9.18^2 - 15.23^2 - 3.1416^2 = 170.92922$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. $25^2 = 625$	25	REPEAT ☒
$+12^2 = 769$	12	REPEAT ☒ ⊞
2. $78.23^2 = 6119.9329$	78•23	REPEAT ☒
$+26.35^2 = 6{,}814.25540$	26•35	REPEAT ☒ ⊞
3. $34.126^2 = 1{,}164.58387$	34•126	REPEAT ☒
$-18.29^2 = 830.05977$	18•29	REPEAT ☒ ⊟
4. $18.124^2 = 328.47937$	18•124	REPEAT ☒
$+ 9.18^2 = 412.75177$	9•18	REPEAT ☒ ⊞
$-15.23^2 = 180.79887$	15•23	REPEAT ☒ ⊟
$- 3.1416^2 = 170.92922$	3•1416	REPEAT ☒ ⊟

CALCULATING ALGEBRAICALLY

PROBLEMS:

1. Minus ÷ Minus . . . . $(-147.12) \div (-13.67) = 10.76225$
2. Plus × Minus × Minus . . . . $14.25 \times (-8.69) \times (-2.63) = 325.67947$
3. (Minus ÷ Plus) − (Plus ÷ Minus) $[(-278.35) \div 9.035] - [843.7 \div (-28.001)] = -.6769$
4. Plus × Minus ÷ Minus . . . . $[97.14 \times (-8.754)] \div (-2.345) = 362.62838$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
1. $\dfrac{-147.12}{-13.67} = 10.76225$	 147•12 13•67	*Note:* Move Decimal Point Selector to position 5 CHANGE SIGN CHANGE SIGN ÷
2. $14.25 \times (-8.69) = -123.83250$ $\times (-2.63) = 325.67947$	14•25 8•69 2•63	ENTER CHANGE SIGN × CHANGE SIGN ×
3. $\dfrac{-278.35}{9.035} = -30.80796$ $-30.80796 - \left(\dfrac{843.7}{-28.001}\right) = -.67690$	278•35 9•035 843•7 28•001	CHANGE SIGN ÷ ENTER CHANGE SIGN ÷ −
4. $97.14 \times (-8.754) = -850.36356$ $\dfrac{-850.36356}{-2.345} = 362.62838$	97•14 8•754 2•345	ENTER CHANGE SIGN × CHANGE SIGN ÷

SEQUENTIAL OPERATIONS

PROBLEMS:

1. $(27.634 \times 8.13) \div 23.45 \quad = \quad 9.58057$

2. $\dfrac{(12.3 + 6.78) \times 9.84 \times 7.64^2}{14.2 - 6.07} = 1347.93714$

3. $\dfrac{\dfrac{164}{13.1} \times (1.4)^3}{\dfrac{8.9}{2} \times 4.7 \times .89} = 1.84547$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{5}$
1. $27.634 \times 8.13 = 224.66442$	27•634	$\boxed{\text{ENTER}}$
	8•13	$\boxed{\times}$
$224.66442 \div 23.45 = 9.58057$	23•45	$\boxed{\div}$
2. $12.3 + 6.78 = 19.08$	12•3	$\boxed{\text{ENTER}}$
	6•78	$\boxed{+}$
$19.08 \times 9.84 = 187.74720$	9•84	$\boxed{\times}$
$187.74720 \times (7.64)^2 = 10{,}958.72896$	7•64	$\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\times}$
	14•2	$\boxed{\text{ENTER}}$
Divide by $(14.2 - 6.07) = 1347.93714$	6•07	$\boxed{-}$ $\boxed{\div}$
3. $164 \div 13.1 = 12.51908$	164	$\boxed{\text{ENTER}}$
	13•1	$\boxed{\div}$
Multiply by $(1.4)^3 = 34.35235$	1•4	$\boxed{\text{REPEAT}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\times}$ $\boxed{\times}$
$8.9 \div 2 = 4.45$	8•9	$\boxed{\text{ENTER}}$
	2	$\boxed{\div}$
$4.45 \times 4.7 = 20.915$	4•7	$\boxed{\times}$
$20.915 \times .89 = 18.61435$	•89	$\boxed{\times}$
$\dfrac{34.35235}{18.61435} = 1.84547$		$\boxed{\div}$

THE MEMORY UNIT

GENERAL

To enter a number into the Memory Unit, index that number into the keyboard and touch the STORE key. To recall the number from storage, touch the RECALL key. The number entered into storage remains there for subsequent usage. It will continue to remain there until the CLEAR ALL key is touched, or another number is entered into storage.

PROBLEMS:

1. CONSTANT MULTIPLIER
   $1.25 × 21 = 26.25
   1.25 × 64 = 80.00
   1.25 × 182 = 227.50

2. CONSTANT DIVISOR
   145 ÷ 12.13 = 11.95383
   214 ÷ 12.13 = 17.64220
   846 ÷ 12.13 = 69.74443

3. CONSTANT DIVIDEND
   164 ÷ 18.92 = 8.66807
   164 ÷ 24.16 = 6.78807
   164 ÷ 2.013 = 81.47044

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. 1.25 × 21 = 26.25	1•25	STORE
	21	RECALL * ×
1.25 × 64 = 80.00	64	RECALL ×
1.25 × 182 = 227.50	182	RECALL ×
2. 145 ÷ 12.13 = 11.95383	145	ENTER
	12•13	STORE RECALL ÷
214 ÷ 12.13 = 17.64220	214	RECALL ÷
846 ÷ 12.13 = 69.74443	846	RECALL ÷
3. 164 ÷ 18.92 = 8.66807	164	STORE RECALL
	18•92	÷ (Observe Answer) RECALL
164 ÷ 24.16 = 6.78807	24•16	÷ (Observe Answer) RECALL
164 ÷ 2.013 = 81.47044	2•013	÷ (Observe Answer)

*Depression of the RECALL key will cause decimal alignment of the indexed number and recall of the constant from memory in one operation.

RAISING TO A POWER

PROBLEMS:

1. $8^5 = 32{,}768$
2. Same problem; alternate method
3. $(1.02)^{30} = 1.8113602$

Law of Exponents

A number may be easily raised to any power by employing the "Laws of Exponents."* The following laws are valid where m and n are any integers (positive, negative, or zero).

1. To multiply, add exponents.
$$a^m \times a^n = a^{(m+n)}$$
2. To divide, subtract exponents.
$$a^m \div a^n = a^{(m-n)}$$
3. To raise a power to a power, multiply exponents.
$$(a^m)^n = a^{mn}$$
4. The power of a product is the product of the powers.
$$(a\,b)^n = a^n b^n$$
5. A power of a quotient is the quotient of the powers.
$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 7
1. 8^5 $8^2 = 64$ $8^3 = 512$ $8^4 = 4{,}096$ $8^5 = 32{,}768$	8	REPEAT STORE RECALL $\boxed{\times}$ RECALL $\boxed{\times}$ " " " "
2. $8^2 = 64$ $8^4 = 4{,}096$ $8^5 = 32{,}768$	8	REPEAT REPEAT $\boxed{\times}$ REPEAT $\boxed{\times}$ $\boxed{\times}$
3. $(1.02)^2 = 1.0404$ $(1.02)^4 = 1.0824321$ $(1.02)^8 = 1.1716592$ $(1.02)^{16} = 1.3727852$ $(1.02)^{32} = 1.8845392$ $(1.02)^{32} \div (1.02)^2 = (1.02)^{30} = 1.8113602$	1.02	REPEAT $\boxed{\times}$ STORE RECALL REPEAT $\boxed{\times}$ " " " " " " RECALL $\boxed{\div}$

*From G. James and R. C. James, Ed., MATHEMATICS DICTIONARY. Copyright 1949, 1959, D. Van Nostrand Co., Inc., Princeton, New Jersey.

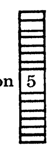
ACCUMULATION OF PRODUCTS/MULTIPLIERS

PROBLEMS:

1.
$$\begin{array}{rcrcr} 64 & \times & 44 & = & 2816 \\ 27 & \times & 56 & = & 1512 \\ \underline{38} & \times & 65 & = & \underline{2470} \\ 129 & & & & 6798 \end{array}$$

2.
$$\begin{array}{rr} \underline{X} & \underline{X^2} \\ 14 & 196 \\ 15 & 225 \\ 16 & 256 \\ 17 & 289 \\ \underline{18} & \underline{324} \\ 80 & 1290 \end{array}$$

FIND: $\Sigma X = 80$
$\Sigma X^2 = 1290$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 
1. 64 × 44 = 2816	64	[REPEAT]
	44	[×] [STORE]
27 × 56 = 1512	27	[REPEAT]
	56	[×] [RECALL] [+] [STORE] [+]
38 × 65 = 6798	38	[REPEAT]
	65	[×] [RECALL] [+] [STORE] [+]
The sum of the products (6798) appears in Register #1.		[RECALL]
The sum of the multipliers (129) appears in Register #2.		
2. $14^2 = 196$	14	[REPEAT] [REPEAT] [×] [STORE]
$+ 15^2 = 421$	15	[REPEAT] [REPEAT] [×] [RECALL] [+] [STORE] [+]
$+ 16^2 = 677$	16	Same as step #2
$+ 17^2 = 966$	17	Same as step #2
$+ 18^2 = 1290$	18	Same as step #2
		[RECALL]
Read Σ X (80) in Register #2		
Read Σ X^2 (1290) in Register #1		

PROBLEMS INVOLVING TWO CONSTANTS

PROBLEMS:

1. $(K_1 \times 0.95) + (K_2 \times 0.65) = 25.345$ $K_1 = 14.5$
2. $(K_1 \times 0.85) + (K_2 \times 0.55) = 22.115$ $K_2 = 17.8$
3. $(K_1 \times .78) + (K_2 \times 0.56) = 21.278$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. Store K_1	14•5	REPEAT *
Store K_2	17•8	STORE
$(14.5 \times 0.95) = 13.775$	•95	×
$+ (17.8 \times 0.65) = 25.345$	•65	RECALL × +
2. Clear previous answer		CLEAR ENTRY REPEAT
$(14.5 \times 0.85) = 12.325$	•85	×
$+ (17.8 \times 0.55) = 22.115$	•55	RECALL × +
3. Clear previous answer		CLEAR ENTRY REPEAT
$(14.5 \times 0.78) = 11.31$	•78	×
$+ (17.8 \times 0.56) = 21.278$	•56	RECALL × +

*The REPEAT key causes duplication of the contents of Working Register #1 in Register #2. The lower value may be used for a first operation. The upper value will be carried for subsequent usage.

INVOICING

PROBLEM:

14 lbs. @ $.56 lb.	=	$ 7.84	
23 lbs. @ .57 lb.	=	13.11	
40 ft. @ .62 ft.	=	24.80	
Sub Total		45.75	
Add: 3% Sales Tax		1.37	
Total		$47.12	

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{5}$
$(14 \times .56) = 7.84$	14	$\boxed{\text{ENTER}}$
	•56	$\boxed{\times}$
$+ (23 \times .57) = 20.95$	23	$\boxed{\text{ENTER}}$
	•57	$\boxed{\times}$ $\boxed{+}$
$+ (40 \times .62) = 45.75$	40	$\boxed{\text{ENTER}}$
	•62	$\boxed{\times}$ $\boxed{+}$
$(45.75 \times .03) + 45.75 = 47.12$		$\boxed{\text{REPEAT}}$
	•03	$\boxed{\times}$ $\boxed{+}$

NOTE: If the problem had called for a 3% discount instead of a 3% sales tax, the final step would be to touch the Minus key instead of the Plus key.

INDIVIDUAL/ACCUMULATED PERCENTAGES

PROBLEM:

DEPT.	SALES	%
A	$ 6845	19.27
B	15322	43.13
C	(5537)	(15.59)
D	6431	18.10
E	16275	45.82
F	(1548)	(4.35)*
G	(2265)	(6.38)
	35523	100.00

*Adjusted for .01

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
	35523	STORE
6845 ÷ 35523 = .19269**	6845	RECALL ÷
15322 ÷ " = .43132	15322	" " +
(5537) ÷ " = .15587	5537	" " −
6431 ÷ " = .18103	6431	" " +
16275 ÷ " = .45815	16275	" " "
(1548) ÷ " = .04357	1548	" " −
(2265) ÷ " = .06376	2265	" " "

**NOTE: To convert from a decimal to a percent, it is necessary to multiply mentally by 100.

PERCENTAGE PROBLEMS

PROBLEMS:

1. What % of \$345.65 is \$78.25? Answer: 22.638%

2. Increase or Decrease and Percent.

Last year	This year	Change	% Change
6375.85	7894.65	+1518.80	+23.82%
8765.45	3975.42	−4790.03	−54.65%

3. Percent Mark-up on Selling Price

Sell	Cost	Gross Profit	Mark-up %
\$942.38	\$656.75	\$285.63	30.31%
325.60	234.65	90.95	27.93%

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
NOTE: The number after the "of" in the problem is always the denominator. 1. 78.25 ÷ 345.65 = .22638 = 22.638%	 78•25 345•65	*Note:* Move Decimal Point Selector to position 5 ENTER ÷
2. 7894.65 − 6375.85 = 1518.80 1580.80 ÷ 6375.85 = .23821 = 23.821%	7894•65 6375•85	ENTER STORE RECALL − RECALL ÷
3975.42 − 8765.45 = −4790.03 −4790.03 ÷ 8765.45 = −.54646 = −54.646%	3975•42 8765•45	ENTER STORE RECALL − RECALL ÷
3. 942.38 − 656.75 = 285.63 285.63 ÷ 942.38 = .30309 = 30.309%	942•38 656•75	STORE RECALL − RECALL ÷
325.60 − 234.65 = 90.95 90.95 ÷ 325.60 = .27933 = 27.933%	325•60 234•65	STORE RECALL − RECALL ÷

SIMPLE AND COMPOUND INTEREST

PROBLEMS:

1. Compute the ordinary simple interest on a loan of $1700.00 at 5¾% for 92 days.
   Interest $=$ (Principal $\times$ Rate $\times$ Days) / 360
   $= (\$1700.00 \times .0575 \times 92) \div 360 = \$24.98$

2. Find the compound amount of $6,150.00 at 5% interest compounded quarterly for four years.
   $$S = P\,(1 + i)^n = 6150.00\left(1 + \frac{.05}{4}\right)^{16} = 6150 \times (1.0125)^{16}$$
   $S = \$7502.32$

3. $1000.00 @ 6% compounded yearly for 12 years.
   $1000.00 \times .06 \times (1.06)^{12} = \$2012.20$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. $1700.00 × .0575 = $97.75	1700	ENTER
	•0575	×
97.75 × 92 = 8,993.00	92	×
8993.00 ÷ 360 = 24.98055	360	÷
		Note: Move Decimal Point Selector to position 7
2. Enter $6150.00 for later use	6150	ENTER
$(1.0125)^2 = 1.025\ 156\ 2$	1•0125	REPEAT ×
$(1.0125)^4 = 1.050\ 945\ 2$		" "
$(1.0125)^8 = 1.104\ 485\ 8$		" "
$(1.0125)^{16} = 1.219\ 888\ 8$		" "
1.2198888 × 6150.00 =		×
7502.3161200 = $7502.32		
3. Enter $1000.00 for later use	1000	ENTER
$(1.06)^2 = 1.1236$	1•06	REPEAT ×
$(1.06)^4 = 1.2624769$		REPEAT ×
$(1.06)^8 = 1.5938479$		REPEAT REPEAT ×
$(1.06)^4 \times (1.06)^8 = (1.06)^{12} = 2.0121961$		×
$(1.06)^{12} \times 1000.00 = 2012.1961000$		×

INTEREST RATE ON INSTALLMENT LOANS

PROBLEM: A colored television set sells for \$720.00 cash. If a buyer agrees to pay \$240.00 cash and the balance in 10 equal monthly payments of \$53.50 each, what rate of interest is he being charged?

FORMULA:

$$R = \frac{72T}{3A(n+1) + T(n-1)}$$

$$= \frac{72 \times 55.00}{(3 \times 480.00 \times 11) + (55.00 \times 9)}$$

R = Interest Rate per annum
A = Amount of Loan (\$720.00 − 240.00 = \$480.00)
T = Total charge (10 × 53.50 − 480.00 = \$55.00)
n = number of periods (10)

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$72T = 72 \times 55.00 = 3960$	72	ENTER
	55	×
$3A = 3 \times 480.00 = 1440$	3	ENTER
	480	×
$3A(n+1) = 1440 \times 11 = 15840$	11	×
$+ T(n-1) = +(55.00 \times 9) = 16{,}335$	55	ENTER
	9	× +
$\frac{72T}{3A(n+1) + T(n-1)} = .2424 = 24.24\%$		÷

CREDIT LOANS
DETERMINATION OF EQUAL MONTHLY PAYMENTS

PROBLEM: A loan of \$220.00 is to be repaid with interest at $2\frac{1}{2}\%$ per month for 12 months. Find the equal monthly payment.

FORMULA: $$R = P\frac{i}{1-(1+i)^{-n}} = P\frac{i}{1-\frac{1}{(1+i)^n}}$$

$$= (220.00)\frac{.025}{1-\frac{1}{(1.025)^{12}}} = \$21.45$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$220.00 \times .025 = 5.50$	220	ENTER
	.025	×
$(1.025)^2 = 1.05062$	1.025	REPEAT ×
$(1.025)^4 = 1.1038$		REPEAT × REPEAT
$(1.025)^8 = 1.21837$		REPEAT ×
$(1.025)^4 \times (1.025)^8 = (1.025)^{12} = 1.34483$		× STORE
$1-\frac{1}{(1.025)^{12}} = .25642$	1	REPEAT
		RECALL ÷ −
Monthly Payment = 21.44918 = \$21.45		÷

INSTALLMENT PAYMENTS ON MORTGAGES

PROBLEMS:

	LOAN	RATE	MONTHLY PAYMENT	INTEREST	PAYMENT ON LOAN	BALANCE
1.	\$3500.00	5½%	\$45.00	\$16.04	\$28.96	\$3471.04
2.	\$2275.25	5%	27.50	9.48	18.02	2257.23

ANALYSIS:

Loan × Interest Rate per Annum = Interest
Monthly Payment − Interest = Payment on Loan
Loan − Payment on Loan = Balance of Loan

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. 3500.00 × .055 = 192.50	3500	REPEAT
	.055	×
Interest = 192.50 ÷ 12 = 16.04166	12	÷
Payment = 16.04166 − 45.00 = 28.95834−	45	−
Balance = 3500.00 − 28.96 = 3471.04		+
2. 2275.25 × .05 = 113.7625	2275.25	REPEAT
	.05	×
113.7625 ÷ 12 = 9.48020	12	÷
9.48020 − 27.50 = 18.01980−	27.5	−
2275.25 − 18.02 = 2257.23		+

PROBABILITY

PROBLEM: What is the probability of drawing the Ace, King, Queen, Jack, and Ten of Hearts in any order in five successive draws from a bridge deck.

ANALYSIS: $$P = \frac{5}{52} \times \frac{4}{51} \times \frac{3}{50} \times \frac{2}{49} \times \frac{1}{48}$$

$$= \frac{120}{311{,}875{,}200} = \frac{1}{2{,}598{,}960}$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 2
$5 \times 4 = 20$	5	ENTER
	4	×
$20 \times 3 = 60$	3	×
$60 \times 2 = 120$	2	× STORE
$52 \times 51 = 2652$	52	ENTER
	51	×
$2652 \times 50 = 132{,}600$	50	×
$132{,}600 \times 49 = 649{,}740$	49	×
$649{,}740 \times 48 = 311{,}875{,}200$	48	×
$311{,}875{,}200 \div 120 = 2{,}598{,}960$		RECALL ÷

Conclusion: The probability of drawing the Ace, King, Queen, Jack, and Ten of Hearts in any order in five successive draws from a bridge deck is one chance in 2,598,960.

ACTUARIAL PROBLEM

PROBLEM: Find the value at age 18 of a temporary life annuity of \$1500.00 per year for three years. Assume an interest rate of 2%.

FORMULA: $a_{\overline{18:3|}} = {}_1E_{18} + {}_2E_{18} + {}_3E_{18}$

$$a_{\overline{18:3|}} = (1500)\,\frac{953743^{*}\,(.98039) + 951483\,(.96117) + 949171\,(.94232)}{955942}$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{5}$
Store 1500 for use in step 6 below	1500	$\boxed{\text{ENTER}}$
953743 × .98039 = 935,040.09977	953743	$\boxed{\text{ENTER}}$
	.98039	$\boxed{\times}$
+ (951483 × .96117) = 1,849,577.01488	951483	$\boxed{\text{ENTER}}$
	.96117	$\boxed{\times}$ $\boxed{+}$
+ (949171 × .94232) = 2,743,999.83160	949171	$\boxed{\text{ENTER}}$
	.94232	$\boxed{\times}$ $\boxed{+}$
Divide by Denominator = 2.87046	955942	$\boxed{\div}$
Multiply by \$1500.00 = \$4305.69		$\boxed{\times}$
For an annuity of \$1500 per period, the net single premium is \$4305.69.		

*From "Commissioners 1941 Standard Ordinary Mortality Table."

LIFE INSURANCE PROBABILITY

PROBLEM: What is the probability that a person aged 35 will die in 10 years?

FORMULA: The probability that a person aged x will die in n years is given by the formula:

$$_{n}q_{x} = 1 - \frac{l_{x} + {}_{n}}{l_{x}}$$

SOLUTION*: $_{10}q_{35} = 1 - \frac{l_{45}}{l_{35}} = 1 - \frac{852554}{906554} = \frac{54000}{906554}$

$= .05957$ (or roughly, the odds are 6 in 100)

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$1 - \frac{852554}{906554} = .05957$	1	ENTER
	852554	ENTER
	906554	÷ −

*NOTE: The table below is taken from the 1941 Commissioners Standard Ordinary Mortality Table and is the record of the number of deaths at different ages of a large number of persons.

Age x	*Number Living* l_x	*Number of Deaths* d_x	*Yearly Probability of Dying* q_x
35	906,554	4,161	0.00459
⋮	⋮	⋮	⋮
45	852,554	7,340	0.00861

GEOMETRIC SERIES

PROBLEM: Find the sum of 10 terms, beginning with the first, of the following geometric series:

$$\frac{15}{32}, \frac{15}{16}, \text{ etc.}$$

FORMULA: $s = \dfrac{a - ar^n}{1 - r}$

$$s = \frac{\frac{15}{32} - \left(\frac{15}{32} \times 2^{10}\right)}{1 - 2} = 479.53$$

a = 1st term = $\frac{15}{32}$

r = common ratio = 2

n = number of terms = 10

s = sum of the terms = ?

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{5}$
$\frac{15}{32} = .46875$	15	$\boxed{\text{ENTER}}$
	32	$\boxed{\div}$ $\boxed{\text{REPEAT}}$
$2^2 = 4$	2	$\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\text{REPEAT}}$ $\boxed{\text{STORE}}$
$2^4 = 16$		$\boxed{\text{REPEAT}}$ $\boxed{\times}$
$2^8 = 256$		$\boxed{\text{REPEAT}}$ $\boxed{\times}$
$2^{10} = 1024$		$\boxed{\text{RECALL}}$ $\boxed{\times}$
$\frac{15}{32} \times 2^{10} = .46875 \times 1024 = 480$		$\boxed{\times}$
$\frac{15}{32} - \left(\frac{15}{32} \times 2^{10}\right) = 479.53125-$		$\boxed{-}$
Divide by Minus 1 = 479.53125	1	$\boxed{\text{CHANGE SIGN}}$ $\boxed{\div}$

STANDARD DEVIATION (Ungrouped Data)

PROBLEM:

X Values:
23
21
18
17
15
14
14
12
9
7
5
155

$\Sigma X^2 = 2499$

$\Sigma X = 155$

$n = 11$

$$\sigma = \sqrt{\frac{n(\Sigma X^2) - (\Sigma X)^2}{n^2}}$$

$$\sigma = \sqrt{\frac{(11 \times 2499) - (155)^2}{11^2}} = 5.35$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. Enter 1st X value; square it.	23	REPEAT REPEAT × STORE
2. Enter 2nd X value; square it.	21	REPEAT REPEAT ×
3. Enter 3rd and subsequent X values. Repeat Step # 2 (above)		RECALL + STORE + *
Read ΣX (155) in Register # 1.		
Touch RECALL. Now read ΣX^2 (2499) in Register # 1 and ΣX (155) in Register # 2.		
1. $n\Sigma X^2 = 27{,}489$	11	×
2. $-(\Sigma X)^2 = 3{,}464$	155	REPEAT × −
3. Divide by $n^2 = 28.62809$	11	REPEAT × ÷
4. Use the Square Root Application on page 38 to extract the square root of 28.62809. $\sigma = 5.35$		

*This operation causes ΣX^2 to be accumulated in the Memory Unit and ΣX to be accumulated in the Display.

VOLUME OF A SPHERE

PROBLEM: Assume a sphere with a 7.26 inch radius. Find the volume.

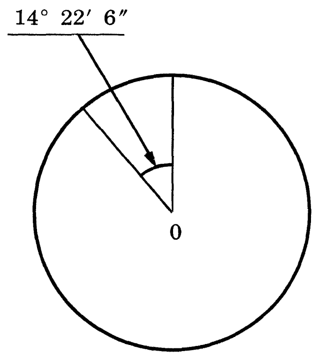
FORMULA: $V = 4/3\pi r^3$

$$V = \frac{4 \times 3.1416 \times (7.26)^3}{3} = 1602.87 \text{ cu. inches}$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{5}$
	4	$\boxed{\text{ENTER}}$
$4 \times \pi = 12.56640$	3•1416	$\boxed{\times}$
$(7.26)^3 = 382.65717$	7•26	$\boxed{\text{REPEAT}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\times}$
$4\pi r^3 = 4808.62306$		$\boxed{\times}$
Divide by 3 = 1602.87435	3	$\boxed{\div}$

CONVERSION OF DENOMINATE NUMBERS

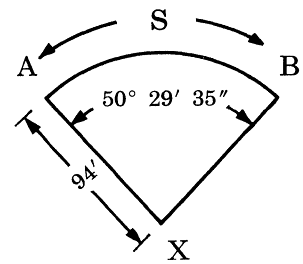
PROBLEM: Divide the angle 14° 22′ 6″ into four equal angles.



NOTE: The same procedure used for degrees, minutes and seconds could be applied equally well to hours, minutes and seconds; yards, feet, inches; drams, ounces, pounds, etc.

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. Convert 14° 22′ 6″ to Seconds		
(14° × 3600) = 50,400	14	ENTER
	3600	×
+ (22′ × 60) = 51,720	22	ENTER
	60	× +
Plus 6 seconds = 51,726	6	+
2. Divide by 4 = 12,931.5	4	÷
3. Convert to Degrees, Minutes, Seconds		
(A) 12,931.5 ÷ 3600 = 3.59208	3600	÷
3 Degrees		
(B) (3.59208 −3) × 60 = 35.52480	3	−
35 Minutes	60	×
(C) (35.52480 − 35) × 60 = 31.488	35	−
31 Seconds	60	×
Therefore, the angle 14° 35′ 31″ is divided into four equal angles of 3° 35′ 31″ each.		

AREA OF A SECTOR



PROBLEM: Given the sector AXBS, find the area.

Radius = AX = 94 feet

Angle X = 50° 29′ 35″

FORMULA: $\left(\frac{\angle X^\circ}{360}\right)\pi r^2 = \frac{50^\circ\ 29'\ 35''}{360} \times 3.14159 \times (94)^2 = 3893.44$ Sq. Ft.

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 7
1. Convert 50° 29′ 35″ to a decimal equivalent		
$\frac{29}{60} = .4833333$	60	$\boxed{\text{STORE}}$
	29	$\boxed{\text{RECALL}}$ $\boxed{\div}$
$\frac{29}{60} + \frac{35}{3600} = .4930555$	35	$\boxed{\text{RECALL}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\div}$ $\boxed{+}$
Plus 50° = 50.4930555	50	$\boxed{+}$
2. 50.4930555 ÷ 360 = .1402584	360	$\boxed{\div}$
3. Multiply by πr^2		
3.14159 × 94 × 94	3.14159	$\boxed{\times}$
	94	$\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\times}$
Answer: 3893.4446748 = 3893.44 Sq. Ft.		

INTERPOLATION

PROBLEM: Find the Tangent of 27° 16′ 38″

ANALYSIS:

(1) Tangent 27° 16′ = .51540

(2) Tangent 27° 17′ = .51577

(3) The difference = .00037

(4) $.00037 \times \frac{38}{60} = .00023$

(5) Tangent 27° 16′ 38″ = .51540
+ .00023
= .51563

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
1. Tangent 27° 16′ − Tangent 27° 17′ = .00037	.51540	REPEAT
	.51577	−
2. $.00037 \times \frac{38}{60} = .00023$	38	×
	60	÷ CHANGE SIGN *
3. Tangent 27° 16′ 38″ = .51540 + .00023 = .51563		+

*To eliminate the minus sign

Table of Natural Tangents and Cotangents

′	24° Tang	24° Cotang	25° Tang	25° Cotang	26° Tang	26° Cotang	27° Tang	27° Cotang
0	.44523	2.24604	.46631	2.14451	.48773	2.05030	.50953	1.96261
1	.44558	2.24428	.46666	2.14288	.48809	2.04879	.50989	1.96120
2	.44593	2.24252	.46702	2.14125	.48845	2.04728	.51026	1.95979
3	.44627	2.24077	.46737	2.13963	.48881	2.04577	.51063	1.95838
4	.44662	2.23902	.46772	2.13801	.48917	2.04426	.51099	1.95698
5	.44697	2.23727	.46808	2.13639	.48953	2.04276	.51136	1.95557
6	.44732	2.23553	.46843	2.13477	.48989	2.04125	.51173	1.95417
7	.44767	2.23378	.46879	2.13316	.49026	2.03975	.51209	1.95277
8	.44802	2.23204	.46914	2.13154	.49062	2.03825	.51246	1.95137
9	.44837	2.23030	.46950	2.12993	.49098	2.03675	.51283	1.94997
10	.44872	2.22857	.46985	2.12832	.49134	2.03526	.51319	1.94858
11	.44907	2.22683	.47021	2.12671	.49170	2.03376	.51356	1.94718
12	.44942	2.22510	.47056	2.12511	.49206	2.03227	.51393	1.94579
13	.44977	2.22337	.47092	2.12350	.49242	2.03078	.51430	1.94440
14	.45012	2.22164	.47128	2.12190	.49278	2.02929	.51467	1.94301
15	.45047	2.21992	.47163	2.12030	.49315	2.02780	.51503	1.94162
16	.45082	2.21819	.47199	2.11871	.49351	2.02631	.51540	1.94023
17	.45117	2.21647	.47234	2.11711	.49387	2.02483	.51577	1.93885
18	.45152	2.21475	.47270	2.11552	.49423	2.02335	.51614	1.93746
19	.45187	2.21304	.47305	2.11392	.49459	2.02187	.51651	1.93608
20	.45222	2.21132	.47341	2.11233	.49495	2.02039	.51688	1.93470

EVALUATING AN INTEGRAL

PROBLEM: $\int_2^5 9x^3 - 4x^2 + 5x\,dx = 1266.75$

ANALYSIS: $\int_2^5 9x^3\,dx - \int_2^5 4x^2\,dx + \int_2^5 5x\,dx$

$$\frac{9}{4}x^4\Big]_2^5 - \frac{4}{3}x^3\Big]_2^5 + \frac{5}{2}x^2\Big]_2^5$$

$$\frac{9}{4}(5^4 - 2^4) - \frac{4}{3}(5^3 - 2^3) + \frac{5}{2}(5^2 - 2^2)$$

$$1370.25 - 156 + 52.5 = 1266.75$$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$5^2 = 25$	5	REPEAT STORE RECALL $\boxed{\times}$
$5^4 = 625$		REPEAT $\boxed{\times}$
$2^2 = 4$	2	REPEAT $\boxed{\times}$
$5^4 - 2^4 = 609$		REPEAT $\boxed{\times}$ $\boxed{-}$
$609 \times \frac{9}{4} = 1370.25$	9	$\boxed{\times}$
	4	$\boxed{\div}$
$5^3 = 125$		RECALL REPEAT $\boxed{\times}$
		RECALL $\boxed{\times}$
$2^2 = 4$	2	REPEAT $\boxed{\times}$
$5^3 - 2^3 = 117$	2	$\boxed{\times}$ $\boxed{-}$
$-(117 \times 4/3) = 1214.25$	4	$\boxed{\times}$
	3	$\boxed{\div}$ $\boxed{-}$
$5^2 = 25$		RECALL REPEAT $\boxed{\times}$
$5^2 - 2^2 = 21$	2	REPEAT $\boxed{\times}$ $\boxed{-}$
		RECALL
$+\left(21 \times \frac{5}{2}\right) = 1266.75$	2	$\boxed{\div}$ $\boxed{\times}$ $\boxed{+}$

EVALUATING A POLYNOMIAL

PROBLEM: $Y = 4X^4 + 5X^3 - 3X^2 + X - 1$

When $X = 9$

FIND: Y

METHOD NO. 1

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$X^2 = 9^2 = 81$	9	STORE RECALL REPEAT $\times$
$X^4 = 9^4 = 6561$		REPEAT $\times$
$4X^4 = 4 \times 9^4 = 26{,}244$	4	$\times$
$X^3 = 9^3 = 729$		RECALL REPEAT $\times$
		RECALL $\times$
$+ 5X^3 = + (5 \times 9^3) = 29{,}889$	5	$\times$ $+$
$X^2 = 9^2 = 81$		RECALL REPEAT $\times$
$- 3X^2 = - (3 \times 9^2) = 29{,}646$	3	$\times$ $-$
$+ X = 29{,}655$		RECALL $+$
$- 1 = 29{,}654$	1	$-$

EVALUATING A POLYNOMIAL

PROBLEM: $Y = 4X^4 + 5X^3 - 3X^2 + X - 1$

When $X = -9$

Find: Y

METHOD: $Y = \{[(4X + 5)\ X - 3\,]\ X + 1\}\ X - 1$

METHOD NO. 2

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
$X = -9$	9	CHANGE SIGN STORE
		RECALL
$4X = -36$	4	×
$4X + 5 = -31$	5	+
$(4X + 5)\ X = 279$		RECALL ×
$(4X + 5)\ X - 3 = 276$	3	−
$[(4X + 5)\ X - 3]\ X = -2484$		RECALL ×
$[(4X + 5)\ X - 3]\ X + 1 = -2483$	1	+
$\{[(4X + 5)\ X - 3]\ X + 1\}\ X = 22347$		RECALL ×
$\{[(4X + 5)\ X - 3]\ X + 1\}\ X - 1$	1	−
$Y = 22{,}346$		
Now try this problem: $Y = 25X^3 - 14X^2 - 18X + 38$. When $X = 7$, find Y. Answer (7801)		

DETERMINANTS

Solution of Simultaneous First Degree Equations

PROBLEM:

$$\begin{aligned} 2X + 2Y + 3Z &= 22 \\ 2X - 4Y + 3Z &= 4 \\ 3X + 6Y - 2Z &= 16 \end{aligned}$$

FORMULA:

$$\begin{aligned} a_1x + b_1y + c_1z &= d_1 \\ a_2x + b_2y + c_2z &= d_2 \\ a_3x + b_3y + c_3z &= d_3 \end{aligned}$$

$$x = \frac{\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}; \quad y = \frac{\begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}; \quad z = \frac{\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}$$

SOLUTION:

$$\begin{array}{ccc|cc} + & + & + & - & - \quad - \end{array}$$

Numerator / Denominator

$$X = \frac{\left|\begin{array}{ccc|cc} 22 & 2 & 3 & 22 & 2 \\ 4 & -4 & 3 & 4 & -4 \\ 16 & 6 & -2 & 16 & 6 \end{array}\right.}{\left|\begin{array}{ccc|cc} 2 & 2 & 3 & 2 & 2 \\ 2 & -4 & 3 & 2 & -4 \\ 3 & 6 & -2 & 3 & 6 \end{array}\right.} = \frac{176 + 96 + 72 + 192 - 396 + 16}{16 + 18 + 36 + 36 - 36 + 8} = \frac{156}{78} = 2$$

$$Y = \frac{\left|\begin{array}{ccc|cc} 2 & 22 & 3 & 2 & 22 \\ 2 & 4 & 3 & 2 & 4 \\ 3 & 16 & -2 & 3 & 16 \end{array}\right.}{\left|\begin{array}{ccc|cc} 2 & 2 & 3 & 2 & 2 \\ 2 & -4 & 3 & 2 & -4 \\ 3 & 6 & -2 & 3 & 6 \end{array}\right.} = \frac{-16 + 198 + 96 - 36 - 96 + 88}{78} = \frac{234}{78} = 3$$

$$Z = \frac{\left|\begin{array}{ccc|cc} 2 & 2 & 22 & 2 & 2 \\ 2 & -4 & 4 & 2 & -4 \\ 3 & 6 & 16 & 3 & 6 \end{array}\right.}{\left|\begin{array}{ccc|cc} 2 & 2 & 3 & 2 & 2 \\ 2 & -4 & 3 & 2 & -4 \\ 3 & 6 & -2 & 3 & 6 \end{array}\right.} = \frac{-128 + 24 + 264 + 264 - 48 - 64}{78} = \frac{312}{78} = 4$$

DETERMINANTS

Note: Move Decimal Point Selector to position $\boxed{5}$

PROCEDURE:

I. TO FIND NUMERATOR

1. Index 22 $\boxed{\text{ENTER}}$
2. Index 4 $\boxed{\text{CHANGE SIGN}}$ $\boxed{\times}$
3. Index 2 $\boxed{\text{CHANGE SIGN}}$ $\boxed{\times}$
4. Index 2 $\boxed{\text{ENTER}}$
5. Index 3 $\boxed{\times}$
6. Index 16 $\boxed{\times}$ $\boxed{+}$
7. Index 3 $\boxed{\text{ENTER}}$
8. Index 4 $\boxed{\times}$
9. Index 6 $\boxed{\times}$ $\boxed{+}$
10. Index 16 $\boxed{\text{ENTER}}$
11. Index 4 $\boxed{\text{CHANGE SIGN}}$ $\boxed{\times}$
12. Index 3 $\boxed{\times}$ $\boxed{-}$
13. Index 6 $\boxed{\text{ENTER}}$
14. Index 3 $\boxed{\times}$
15. Index 22 $\boxed{\times}$ $\boxed{-}$
16. Index 2 $\boxed{\text{CHANGE SIGN}}$
17. Index 4 $\boxed{\times}$
18. Index 2 $\boxed{\times}$ $\boxed{-}$

II. TO FIND DENOMINATOR—FOLLOW SAME PROCEDURE AS IN I ABOVE

III. TO FIND VALUE OF X

1. Touch $\boxed{\text{REPEAT}}$ $\boxed{\text{STORE}}$. The denominator is now stored in the Memory Unit for subsequent use when solving for Y. The numerator now appears in Register #2; the denominator appears in Register #1.
2. Touch $\boxed{\div}$. Value of X (2) appears in Register #1.

IV. TO FIND VALUE OF Y

1. Calculate the top half of the second determinant. This produces the numerator (234).
2. Touch $\boxed{\text{RECALL}}$ and $\boxed{\div}$. This operation brings the denominator from the Memory Unit and divides it into the numerator. Then: $234 \div 78 = 3$. The value of Y (3) appears in Register #1.

V. TO DETERMINE VALUE OF Z

1. The value of Z can be determined by calculating the third determinant as in IV above.
2. However, since value of X and Y are now known the value of Z can be easily determined by substituting values of X and Y in any of the three equations. For example:

$$2X + 2Y + 3Z = 22$$

$$3Z = -2X - 2Y + 22$$

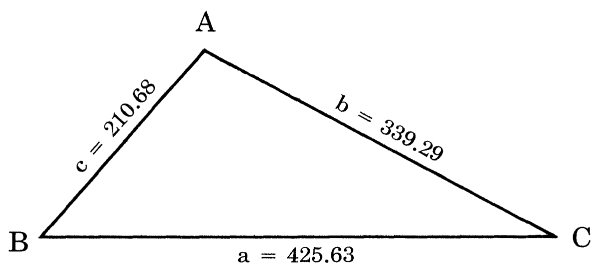
$$Z = \frac{-2X - 2Y + 22}{3}$$

$$= \frac{(-2 \times 2) - (2 \times 3) + 22}{3}$$

$$= \frac{-4 - 6 + 22}{3} = \frac{12}{3} = 4$$

COSINE LAW

PROBLEM: Given 3 sides find an angle.



a = 425.63
b = 339.29
c = 210.68

REQUIRED: Cos C = .87213 Angle C = 29° 17′ 34″

ANALYSIS: $\text{Cos C} = \dfrac{a^2 + b^2 - c^2}{2ab} = \dfrac{(425.63)^2 + (339.29)^2 - (210.68)^2}{2 \times 425.63 \times 339.29} = .87213$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
TO FIND COSINE C		
$(425.63)^2 = 181{,}160.8969$	425.63	$\boxed{\text{REPEAT}}$ $\boxed{\times}$
$+ (339.29)^2 = 296{,}278.601$	339.29	$\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{+}$
$- (210.68)^2 = 251{,}892.5386$	210.68	$\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{-}$
$2 \times 425.63 = 851.26$	2	$\boxed{\text{ENTER}}$
	425.63	$\boxed{\times}$
$\text{Cos C} = \dfrac{a^2 + b^2 - c^2}{2ab} = .87213$	339.29	$\boxed{\times}$ $\boxed{\div}$
TO FIND ANGLE C (interpolate from Trig Tables: Cos 29° 17′ = .87221; Cos 29° 18′ = .87207)		
87221 − 87207 = 14	87221	$\boxed{\text{STORE}}$ $\boxed{\text{RECALL}}$
	87207	$\boxed{-}$
		$\boxed{\text{RECALL}}$
87221 − 87213 = 8	87213	$\boxed{-}$
$8/14 \times 60'' = 34.28571$	60	$\boxed{\times}$
Therefore: ∠C = 29° 17′ 34″	14	$\boxed{\div}$

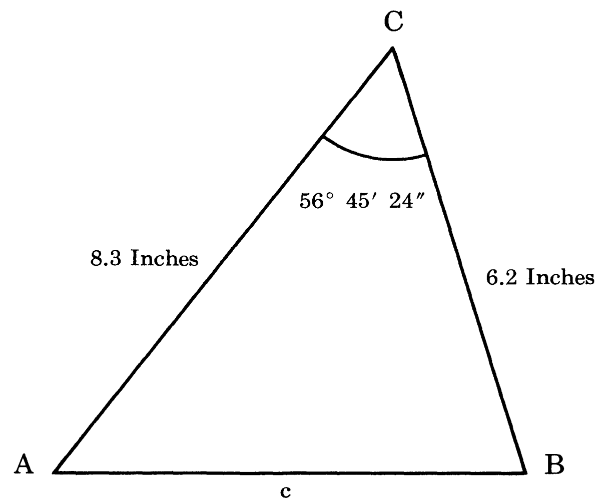
COSINE LAW

PROBLEM: Given two sides and the included angle, find the third side.

FORMULA: $c^2 = a^2 + b^2 - 2\,ab\,\text{Cos}\,C$

EXAMPLE:

$$a = 6.2$$
$$b = 8.3$$
$$\angle C = 56^\circ\,45'\,24''$$
$$\text{Cos}\,C = .54819$$



SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
ANALYSIS: $c^2 = (6.2)^2 + (8.3)^2 - (2 \times 6.2 \times 8.3 \times .54819)$		*Note:* Move Decimal Point Selector to position 5
$a^2 = (6.2)^2 = 38.44$	6•2	REPEAT ⊠
$+b^2 = +(8.3)^2 = 107.33$	8•3	REPEAT ⊠ ⊞
$2a = 12.4$	2	ENTER
	6•2	⊠
$2ab = 12.4 \times 8.3 = 102.92$	8•3	⊠
$-2ab\,\text{Cos}\,C = 102.92 \times .54819$	•54819	⊠ ⊟
$a^2 + b^2 - 2ab\,\text{Cos}\,C = 50.91029$		
Using the square root application on page 38, $c = \sqrt{50.91029} = 7.13514 = 7.135$		

SQUARE ROOT

PROBLEM: Find the square root of 1738 to six significant digits.

FORMULA:

$$\sqrt{N} = \frac{\frac{N}{a} + a}{2}$$

Where: N = the radicand (1738)

a = an approximation of the square root of N

ANALYSIS: Mark off 1738 into couplets. Start at the decimal point and mark off to the left; e.g. 17 38. Determine the largest square in the left most couplet. The largest square in 17 is 16. The The square root of 16 is 4. For each remaining couplet use a zero. The first approximation for $\sqrt{1738}$ is 40.

EXAMPLES: 1) 98.22 The largest square is 81. The square root of 81 is 9 with no additional couplets to the left of the decimal. The approximation is 9.

2) 6 62 41.33 The largest square in 6 is 4. The square root of 4 is 2 with two additional couplets to the left of the decimal point. The approximation is 200.

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 5
a	40	1 $\boxed{\text{STORE}}$
N	1738	2 $\boxed{\text{REPEAT}}$ 3 $\boxed{\text{RECALL}}$
$\frac{N}{a} = 43.45000$		4 $\boxed{\div}$
$\frac{N}{a} + a = 83.45000$		5 $\boxed{\text{RECALL}}$ 6 $\boxed{+}$
$\frac{\frac{N}{a} + a}{2} = 41.72500$	7 2	8 $\boxed{\div}$

41.725 is the second approximation of the square root of 1738.

For closer values of $\sqrt{N}$, repeat the following sequence: STORE, REPEAT, RECALL, DIVIDE, RECALL, PLUS, 2, DIVIDE.

Third approximation = 41.68934

Fourth approximation = 41.68932

PROOF: Touch $\boxed{\text{REPEAT}}$ $\boxed{\times}$. Answer: 1737.99940 or 1738 rounded off.

SQUARE ROOT

PROBLEM: Find the square root of .0008317 to six significant digits.

METHOD:

$$\sqrt{N} = \frac{\frac{N}{a} + a}{2} \quad \text{Where:}$$

N = the radicand .0008317 and
a = an approximation of the square root of N

ANALYSIS: Mark off .0008317 into couplets starting from the decimal point .$\underline{00}$ $\underline{08}$ $\underline{31}$ 7. Again starting from the decimal point, for each couplet with only zeros set one zero in the approximation. For .$\underline{00}$ 08317 there is only one zero couplet so the approximation would be .0——. For the first couplet with numbers other than zeros, determine the square root of the largest square in that number. The largest square in 08 or 8 is 4 and the square root of 4 is 2. The first approximation of .0008317 is .02.

EXAMPLES: 1) .$\underline{08}$ $\underline{31}$ 7. There are no zero couplets and the square root of the largest square in 8 is 2. The approximation is .2.

2) .$\underline{00}$ $\underline{83}$ 17. There is one zero couplet and the square root of the largest square in 83 is 9. The approximation is .09.

3) .$\underline{00}$ $\underline{00}$ $\underline{00}$ $\underline{45}$. There are three zero couplets and the square root of the largest square in 45 is 6. The approximation is .0006.

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 7
a	.02	① STORE
N	.0008317	② REPEAT ③ RECALL
$\frac{N}{a} = .041585$		④ ÷
$\frac{N}{a} + a = .061585$		⑤ RECALL ⑥ +
$\frac{\frac{N}{a} + a}{2} = .0307925$	⑦ 2	⑧ ÷

.0307925 is the second approximation of the square root of .0008317

For closer values of $\sqrt{N}$, repeat the following sequence: STORE, REPEAT, RECALL, DIVIDE, RECALL, PLUS, 2, DIVIDE.
Third approximation = .0289011
Fourth approximation = .0288392
Fifth approximation = .0288392

PROOF: Touch REPEAT ×. Answer: .0008316

CUBE ROOT

GENERAL

A convenient method of extracting cube root on the 130 Electronic Calculator lies in the application of the general formula:

$$\sqrt[r]{N} = \frac{1}{r}\left(\frac{N}{a^{r-1}} + (r-1)a\right)$$

In this formula, *r* represents the desired root of any number. *a* is the approximate root (*r*) of *N*. This formula can be used to extract any root of any positive number by using this one basic method.

For cube roots the formula becomes:

$$\sqrt[3]{N} = \frac{1}{3}\left(\frac{N}{a^2} + 2a\right)$$

"*a*," in this formula, is the approximation of the root as determined from an abbreviated cube root table. (See the condensed cube root table printed below.)

PROCEDURE

The procedure consists of solving the formula once with the value of *a* taken from the table. Then the process is repeated using that answer as a closer approximation. For additional accuracy, use this cube root as *a*, and solve the formula again. A distinct advantage of this method lies in the fact that, even if an error is made during the process, continued substitutions of the values found for *a* will correct the error and yield the desired root.

DECIMALS

When *N* has *more* than 4 digits to the left of the decimal, divide by 1,000 or 1,000,000 so that there will always be 2 to 4 digits to the left of the decimal. For example:

$$\frac{752{,}392}{1{,}000} = 752.392$$

Then after obtaining the cube root, multiply by the cube root of 1,000 (10) or 1,000,000 (100) to to point off the cube root correctly.

$$\sqrt[3]{752{,}392} = 9.09525 \times 10 = 90.9525$$

When *N* has *less* than 2 digits to the left of the decimal, multiply by 1,000 or 1,000,000 so that there will always be 2 to 4 digits to the left of the decimal. For example:

$$.00752392 \times 1{,}000{,}000 = 7523.92$$

Then, after obtaining the cube root divide by 10 or 100 to point off the cube root correctly.

$$\sqrt[3]{.007\ 523\ 92} = \frac{19.595\ 12}{100} = .195\ 9512$$

CUBE ROOT TABLE

N	$\sqrt[3]{N}$	N	$\sqrt[3]{N}$	N	$\sqrt[3]{N}$	N	$\sqrt[3]{N}$
1	1	216	6	1 331	11	4 096	16
8	2	343	7	1 728	12	4 913	17
27	3	512	8	2 197	13	5 832	18
64	4	729	9	2 744	14	6 859	19
125	5	1 000	10	3 375	15	8 000	20

CUBE ROOT

PROBLEM: $\sqrt[3]{23{,}147.523}$

ANALYSIS: To adjust this problem to the machine, divide the radicand by 1,000. The extracted cube root will then be multiplied by 10. From the table, find the cube nearest 23 (27). Its root, 3, is used for the first value of *a*.

FORMULA: $\sqrt[3]{23{,}147.523} = 1/3 \left[\frac{23.147523}{3^2} + (2 \times 3) \right]$

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position $\boxed{7}$
<u>2ND APPROXIMATION</u>		
	3	$\boxed{\text{STORE}}$
$23.147523 \div (3)^2 = 2.5719470$	23.147523	$\boxed{\text{REPEAT}}$ $\boxed{\text{RECALL}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\div}$
plus $(2 \times 3) = 8.5719470$	2	$\boxed{\text{RECALL}}$ $\boxed{\times}$ $\boxed{+}$
Divide by 3 $= 2.8573156$	3	$\boxed{\div}$
<u>3RD APPROXIMATION</u>		
Store 2.857 315 6		$\boxed{\text{STORE}}$
$23.147523 \div (2.857\ 315\ 6)^2 = 2.835\ 228\ 7$		$\boxed{\text{REPEAT}}$ $\boxed{\text{RECALL}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\div}$
Plus $(2 \times 2.857\ 315\ 6)$	2	$\boxed{\text{RECALL}}$ $\boxed{\times}$ $\boxed{+}$
Divide by 3 $= 2.849\ 953\ 3$	3	$\boxed{\div}$
4th approximation $= 2.849\ 934\ 2$		
5th approximation $= 2.849\ 934\ 2$		
THEN $10 \times 2.849\ 934\ 2 = 28.499\ 342 = \sqrt[3]{23{,}147.523}$		
PROOF: $\boxed{\text{REPEAT}}$ $\boxed{\text{REPEAT}}$ $\boxed{\times}$ $\boxed{\times}$ $= 23{,}147.5215$		

OVERCAPACITY PROBLEMS

PROBLEM: $98,765,432.10 × .61857432091 = $61,093,760.09

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 2
Index 1st Factor: 98,765,432.10	98765432•10	ENTER
(Move Decimal Point Selector to position 13)		
Index 2nd Factor: .618 574 320 91	•61857432091	×
(Restore Decimal Point Selector to position 2)		

Read answer ($61,093,760.09) at decimal position 2 in Register #1

NOTE: The decimal position selected at the time the multiply key is depressed determines the decimal orientation of the product. Switching from 2 to 13 before entering the second term had the effect of dividing the first term by 10^{11}. Restoring the decimal program to position 2 has the effect of multiplying the product by 10^{11} to give the true answer.

DOUBLE PRECISION MULTIPLICATION

PROBLEMS:

1. 13 Digits by 13 Digits

   5,847,637,290,816 × 7,855,023,964,807 = 45,933,331,056,858,760,408,312,512

2. 10 Digits by 10 Digits

   1,857,263,807 × 1,187,524,396 = 2,205,546,080,620,335,572

SOLUTION	INDEX IN KEYBOARD	TOUCH CONTROL KEYS IN SEQUENCE
		Note: Move Decimal Point Selector to position 0
1. Index 1st Factor	5847637290816	REPEAT
Index 2nd Factor	7855023964807	STORE Change Decimal to 13
1st 13 Digits = 4 593 333 105 685		RECALL ×
		CLEAR ENTRY
		Change Decimal to 0
2nd 13 Digits = 8 760 408 312 512		RECALL ×
		(Depress OVERFLOW LOCK to release keyboard)
		Restore Decimal to 0
2. Index 1st Factor	1857263807	REPEAT
Index 2nd Factor	1187524396	STORE Change Decimal to 13
1st 13 Digits = 0 000 000 220 554		RECALL × (Write down answer)
		CLEAR ENTRY
		Change Decimal to 0
2nd 13 Digits = 6 080 620 335 572		RECALL ×
		(Depress OVERFLOW LOCK to release keyboard)

INDEX

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