Bowmar

MX 140 Electronic Calculator

Instructions

Place
Stamp
Here

BOWMAR INSTRUMENT CORPORATION
8000 Bluffton Road
Fort Wayne, Indiana 46809

ATTN.: Customer Registration

Registration — Starting with Serial # please fill in all the blanks

Model No. MX 140 Serial No. __________ Purchase Date __________

Name ____

Street ____

City ____________________ State ______________ ZIP ________

Dealers Name ____

Type of Store: ____ Dept/Discount ____ Office Equip/Stationery ____________

____ Student/Book ____ Radio/TV/Appliance ____ Mail Order

____ Other: ____

How did you first hear about Bowmar Brains? ____ Friend ____ Dealer ____

____ Magazine Ad ____ TV Ad ____ Other: ______________________

Who purchased? ____ Self ____ Spouse ____ Parent ____ Other: ______________

Was the calculator a gift? ____ Yes ____ No

Age? ____ Under 24 ____ 24-35 ____ 36-50 ____ Over 50

Occupation ____________________ Industry ____________________

Did you fill in ZIP?

WARRANTY

Bowmar/Ali, Inc. warrants to the purchaser of this new Bowmar Calculator that if the machine or any part thereof in the judgment of Bowmar is proven to be defective in material or workmanship within one year from date of original purchase, such defects will be repaired or replaced (at the Company's option) free of charge for parts and labor.

This warranty does not apply to any product which has been damaged by accident or which has been misused, altered, or repaired by anyone other than Bowmar.

This warranty is in lieu of all other warranties expressed or implied, and no person is authorized to assume for Bowmar any other liability in connection with the sale of this product.

To obtain repairs, the Calculator should be delivered, prepaid to Bowmar/Ali, Inc. at address shown below. Please enclose $1.00 with the unit to cover shipping and handling.

ALI SERVICE CENTER
BOX 648
WEST ACTON, MASS. 01720

INTRODUCTION

The Bowmar MX140 is a calculator capable of rapid and accurate solutions to complex problems. Featuring an easy-to-read 12-digit display, it is designed to let you complete your calculations without resorting to paper and pencil.

We suggest that you read through and keep this booklet of operating instructions with your MX140 to be sure of obtaining all of the performance this versatile calculator can provide.

HIGHLIGHTS

- Scientific notation
- Parenthetical operation, 2 level
- Large LED display
- Fully floating decimal
- Full algebraic operation
- Fully operational memory
- Rechargeable and AC operation
- 115/230V switchable adapter/charger

OVERVIEW OF FEATURES

The MX140 performs the following functions:

- Basic Arithmetic (+, –, x, ÷)
- Trig Functions (SIN, COS, TAN)
- Inverse Trig Functions (SIN^{-1}, COS^{-1}, TAN^{-1})
- Logarithms (LN, LOG)
- *Antilogarithms* (e^x, 10^x)
- Exponentiation (Y^X)
- Convenience Functions (1/X, X^2, $\sqrt{X}$, π)
- Memory (STO, RCL, M+, M–, MC, $\overleftrightarrow{XM}$)
- Register Exchange Operations ($\overleftrightarrow{XY}$, $\overleftrightarrow{XM}$)
- Degree/Radian Selection (DEG/RAD)
- Automatic Error Detection and Indication
- Clearing Operations (C, CE, MC, CF, **CF**)

The following operating features are included:

- Data Entry in Standard or Scientific Notation
  (10-digit mantissa; 2-digit exponent)

  Example:

Value	*Possible Entry*	*Display*
10.052	10.052	10.052
6,000,000	6 F EE 6	$6.^{0\,6}$
0.00023	.23 F EE F +/- 3	$0.23^{-0\,3}$

- Automatic Selection of Correct Notation
  (Scientific or Standard) for Displayed Results

- Leading Zero to Avoid Misinterpretation of Decimal Point

- Algebraic Problem Entry

  NOTE: All operations are given equal precedence and are executed from left to right unless parentheses are used.

  Example: 2 + 3 x 6 = 30, *but*
  2 + F (3 x 6 F) = 20

- Two Parentheses Levels
  Example: 2 + F (3 x F (4 + 5 F) F) = 29

- Chain (Continuous) Calculations
  Example: 4 x 2 - 3 + 5 = 10

OPERATION

AC OPERATION

Connect the Charger to an appropriate electrical outlet as referenced on your Bowmar Charger. Plug the connector into the calculator and turn the power switch on.

BATTERY OPERATION

Disconnect the Charger cord and turn the power switch on. Batteries will need charging when Low Battery Indicator (L or L) appears on display.

BATTERY CHARGING

Simply follow the same procedure as in **AC OPERATION.** The calculator may be used during the charge period if desired. It requires 8 hours to fully charge a battery which has been completely discharged. In most cases, an overnight charge should be adequate.

> *NOTE: Although no damage will result from prolonged periods with the Charger connected, it is advisable to remove the Charger when it is not in use or after a full recharge cycle.*
>
> **CAUTION: To avoid possible damage, use only the Charger provided with the MX140.**

PHYSICAL CHARACTERISTICS

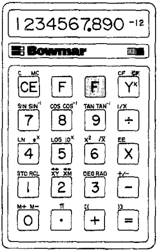
Temperatures:
- Operating: 0° to 50°C
- Storage: –20° to 70°C

Weight: 9 oz
Size: 1-1/2 x 3-1/8 x 5-1/4 in.

Power:
- AC Operation: 115/230V, 50/60 Hz
- Battery Operation: 4 hrs
- Charging Time: 8 hrs

KEYBOARD

The MX140 Keyboard consists of 20 keys: 2 Function Keys, F and **F**, and 18 Data Entry and Operation Keys. (See Diagram.) Each of these 18 keys has a primary function, labeled on the key top, and one or two auxiliary functions labeled above it. The selection of an auxiliary function is employed by depressing a Function Key. The F Key selects the left-hand auxiliary function (e.g., the SIN function above the 7 Key) while **F** selects the right-hand function (e.g., $\sqrt{X}$ above the 6). If only one auxiliary function appears above the key, it will be selected by either F or **F** (e.g., 1/X above ÷). If F is depressed when **F** was intended, simply press **F** and proceed, and vice versa. To cancel an initial depression of either F or **F**, depress Y^X which has its auxiliary functions (CF and **CF**) defined so as to negate an immediately preceding F or **F** depression.


1234567.890 -12
Bowmar
C MC
CE
F
F
CF
Yx
SIN SIN-1
7
COS COS-1
8
TAN TAN-1
9
1/X
÷
LN ex
4
LOG 10x
5
6
EE
X
STO RCL
1
2
DEG RAD
3
+/-
−
M+ M−
0
π
·
+
=

DISPLAY

The Display consists of a 14-position readout. Position 1 (at left) contains the sign of the number displayed (unless it is positive) and/or an indication symbol. Positions 12 through 14 (toward right) display the magnitude, or mantissa, of the number. The last three positions (12 through 14) display the magnitude and sign of the exponent. An exponent will be displayed only if scientific notation ($\pm$ A x 10 $\pm$ N) is used to enter a number or if the result of a calculation requires that the result be presented in this way.

Indication symbols that may appear in the left-most position are as follows:

- – Negative Number
- Γ Positive Answer Overflow or Underflow or Illegal Operation
- F Negative Answer Overflow or Underflow or Illegal Operation
- L Low Battery (Positive Number)
- Ŀ Low Battery (Negative Number)
- \ Radian Mode

The Display will appear blank during all periods of calculation.

In the following section we present each function key and various illustrating operational sequences through which you may familiarize yourself with the MX140.

OPERATING INSTRUCTIONS

DATA ENTRY

To begin a calculation, clear all MX140 registers and memory by pressing F C and F MC.

CE	Clears an entry (or display).
0 → 9	Entry of numerical digits.
F π	Entry of the constant π.
•	*Defines decimal point position*
F EE	Conditions calculator for acceptance of following exponent value.
F +/-	Change sign of mantissa or exponent (if EE was pressed prior to this). Cannot be used after =. In this case multiply by -1.

MATHEMATICAL FUNCTIONS OF TWO VARIABLES

In the operation of certain mathematical functions (+, -, X, ÷, Y^x), two variables are employed. Operation of the following functions (+, -, X, ÷, Y^x, =) computes any pending function and stores the new command.

Example: $3 \times 2 + 4 \div 5 = 2$

Operate	Display	Comment
3	3.	
X	3.	Stores multiply command.
2	2.	
+	6.	Executes 3 x 2 and stores a command
4	4.	
÷	10.	Executes 6 + 4 and stores divide command.
5	5.	
=	2.	Executes 10 ÷ 5.

(= Computes all pending functions and sub-problems.)

POWER OF NUMBERS

Y^x computes pending function and stores exponentiation command.

Example: $3^5 = 243$

Operate	Display	Comment
3	3.	
Y^x	3.	
5	5.	
=	243.	Answer

NOTE: If two or more of these function keys are depressed in direct sequence, the last key is assumed by the calculator. Therefore, if the wrong function key (+, –, X, ÷, Y^x) is depressed accidentally, merely press the proper key and continue.

Example: $2 \times 3 - 1 = 5$

Operate	Display	Comment
2	2.	
X	2.	
3	3.	
+	6.	Previous operation executed but wrong command stored.
–	6.	Correct command stored.
1	1.	
=	5.	

MATHEMATICAL FUNCTIONS OF ONE VARIABLE

Each operation consists of a function key depression followed by the appropriate operation key. The result immediately replaces the number operated upon in the display.

F	LOG	Common (Base 10) log
F	10^x	Base 10 exponential
F	LN	Natural log
F	e^x	Base e exponential
F	X^2	Square
F	$\sqrt{X}$	Square root
F	1/X	Reciprocal
F	SIN	Sine
F	COS	Cosine
F	TAN	Tangent
F	SIN^{-1}	Arcsine
F	COS^{-1}	Arcosine
F	TAN^{-1}	Arctangent

TRIGONOMETRIC FUNCTION UNIT SELECTION

F DEG Selection of degree unit system for trig functions.

F RAD Selection of radian unit system for trig functions (indication light at left of display).

NOTE: At power on, the MX140 is set for degrees. Degree/ Radian selection may be changed any time before, after, or during any problem.

INTERNAL REGISTER MANIPULATOR

F $\overleftrightarrow{XY}$ Exchanges contents of X and Y registers. These registers are used in functions of two variables. For example, in the problem 2 x 3 = , the 2 first enters the display (the X register) and then, when the x is entered, the 2 is moved to the Y register.

PARENTHESES

F [(Stores pending command and conditions calculator to accept sub-problem.

F)] Computes sub-problem with parentheses pair displays result, and conditions calculator for execution of pending command. If no prior [(] (open parenthesis) key was depressed, the close parenthesis key is ignored.

Closing parenthesis is not necessary unless followed by another command. Pressing = after entering total problem will execute problem in proper sequence and display answer to total problem directly. Solution to intermediate sub-problem (in parentheses) may be displayed by closing the corresponding parenthetical expression.

Example 1: $8 + (2 \times 3) = 14$

	Operate	Display	Comment
	8	8.	
	+	8.	
	F [(	0.	Prior command stored.
	2	2.	
	X	2.	
	3	3.	
Possibilities for correct result	=	14.	
	or		
	F)]	6.	Sub-problem executed and displayed.
	=	14.	

Example 2: 8 + (2 x (2 + 1)) = 14

Operate	Display	Comment
8	8.	
+	8.	
F [(	0.	Command stored.
2	2.	
X	2.	
F [(	0.	
2	2.	
+	2.	
1	1.	
=	14.	No closing parenthesis results in direct answer.
or		
F)]	3.	Prior sub-problem executed and result displayed.
=	14.	
or		
F)]	3.	Prior sub-problem executed and result displayed.
F)]	6.	First sub-problem executed and displayed.
=	14.	

The MX140 will handle a maximum of two parentheses levels (as in second example above). Attempts at using additional parentheses levels will cause an illegal entry indication (Γ) on display and terminate calculation.

Any number of parentheses pairs in succession is possible because closing a pair completes that sub-problem.

Example 3: (2 x 4) + (2 x 5) - (2 x 2) = 14

Operate	Display	Comment
F [(	0.	
2	2.	
X	2.	
4	4.	
F)]	8.	
+	8.	
F [(	0.	

(Cont)

Operate	Display	Comment
2	2.	
X	2.	
5	5.	
F)]	10.	
–	18.	Prior functions executed and new command, –, stored.
F [(	0.	
2	2.	
X	2.	
2	2.	
F)]	4.	
=	14.	

MEMORY CONTROL

The MX140 contains a memory register to assist in data manipulation.

F	STO	Copy of display is stored in memory. Display remains unchanged.
F	RCL	Contents of memory displayed. Memory remains unchanged.
F	MC	Clears memory only.
F	M+	Adds contents of display to contents of memory. Display remains unchanged.
F	M−	Subtracts contents of display from contents of memory. Display remains unchanged.
F	$\overleftrightarrow{XM}$	Exchanges contents of display and memory.

Memory operations can be used at any time.

Example: 1 + 2 F STO x 3 = 9.
(Memory contains 2)
3 x F RCL ÷ 4 = 1.5

ERROR CONDITIONS

There exists a limit to the magnitude of a number the *MX140* is capable of handling. For excessively large or excessively small numbers, an overflow of *underflow indication will appear.*

Largest: $9.999999999 \times 10^{99}$ Smallest: 10^{-99}

RESULT ERRORS

A result displayed with an overflow or underflow indication may be read correctly by adding +100 to a positive exponent and -100 to a negative exponent.

Example: $(9 \times 10^{99}) \times (2 \times 10^{25}) = 1.8 \times 10^{125}$

Operate	Display	*Comment*
9	9.	
F EE	$9.^{00}$	
99	$9.^{99}$	
X	$9.^{99}$	

(Cont)

Operate		Display	Comment
2		2.	
F EE		$2.^{00}$	
25		$2.^{25}$	
=	Γ	1.8^{25}	Read as 1.8×10^{125}

FUNCTION ERRORS

Certain mathematical functions cannot be executed over the full range of numbers because they are undefined. The following table lists the functions of the calculator and the expected range. Functions used outside of this range will result in an error display, $\boxed{\Gamma \quad 0.}$

Function	Range
X + Y	All numbers
X − Y	All numbers
X x Y	All numbers
X ÷ Y	All numbers (Y ≠ 0)

(Cont)

Function	Range
Y^X	$Y > 0$
	$X < 100$ LN $10/\lvert LN\ Y \rvert$
LOG (X)	$X > 0$
10^X	$-99 \leq X < 100$
LN (X)	$X > 0$
e^X	$X < 100$ LN 10
X^2	All numbers
$\sqrt{X}$	$X \geq 0$
1/X	All numbers ($X \neq 0$)
SIN (X)	All numbers
COS (X)	All numbers
TAN (X)	All numbers ($\lvert X \rvert \neq N$ ($\pi/2$ RAD) or N (90°)*
SIN^{-1} (X)	$\lvert X \rvert \leq 1$
COS^{-1} (X)	$\lvert X \rvert \leq 1$
TAN^{-1} (X)	All numbers

*N = Integer

ACCURACY

The accuracy of a device is defined in terms of its error. We categorize two types of errors and summarize the overall accuracy of the calculator in a table.

TRUNCATION ERROR

Truncation error is the error introduced when the mantissa of a number cannot fit on the display. When this occurs for a result, the calculator will round the 10th digit. Truncation errors are cumulative and increase (become worse) with successive operations.

ALGORITHMIC ERRORS

The limited precision of the constants used in a process may contribute to the overall accuracy of a calculation. Certain functions become less accurate within a range of inputs. Thus each function is capable of different degrees of accuracy.

The following chart summarizes the accumulated error from all causes and presents a maximum expected error for each function result.

Example: $\sqrt{3}$ Display: 1.732050807

For $\sqrt{X}$, the chart defines error as "2 cnt in D_{10}" (read as 2 counts in digit 10). Therefore maximum error is ±2 in this digit (the last 7 on the right).

Function	Entry Condition	Result Condition	Maximum Mantissa Error
X + Y			1 cnt in D_{10}
X − Y			1 cnt in D_{10}
X x Y			1 cnt in D_{10}
X ÷ Y			1 cnt in D_{10}
Y^x	$10^{-9} < \lvert X \text{ LN } Y\rvert < 10^2 \text{ LN } 10$		6 cnt in D_{10}
1/X			1 cnt in D_{10}
X^2			1 cnt in D_{10}
$\sqrt{X}$			2 cnt in D_{10}
LOG X		$\lvert R\rvert < \text{LN } 10$	4 cnt in D_{10}
		$\lvert R\rvert \geq \text{LN } 10$	2 cnt in D_9

(Cont)

Function	Entry Condition	Result Condition	Maximum Mantissa Error
e^x	$0 \leqslant \lvert X \times 10^R \rvert < LN\ 10$		5 cnt in D_{10}
	$LN\ 10 \leqslant \lvert X \times 10^R \rvert < LN\ 10$		2 cnt in D_9
	$10\ LN\ 10 \leqslant \lvert X \times 10^R \rvert < 10^2\ LN\ 10$		2 cnt in D_8
SIN	$0^\circ \leqslant \lvert\phi\rvert \leqslant 360^\circ$ (or 2π RAD)		5 cnt in D_9
COS	$0^\circ \leqslant \lvert\phi\rvert \leqslant 360^\circ$ (or 2π RAD)		5 cnt in D_9
TAN	$0^\circ \leqslant \lvert\phi\rvert \leqslant 90^\circ$ (or $\pi/2$ RAD)	$0 \leqslant \lvert\phi\rvert < 85^\circ$	5 cnt in D_9
		$85 \leqslant \lvert\phi\rvert < 89^\circ$	8 cnt in D_8
SIN^{-1}	$10^{-10} \leqslant \lvert X\rvert \leqslant 1$	$0 \leqslant \lvert R\rvert \leqslant 90^\circ$	$E < 3 \times 10^{-7}$
COS^{-1}	$10^{-10} \leqslant \lvert X\rvert \leqslant 1$	$0 \leqslant \lvert R\rvert \leqslant 90^\circ$	$E < 4 \times 10^{-7}$
		$90 \leqslant \lvert R\rvert \leqslant 180^\circ$	$E < 4 \times 10^{-6}$
TAN^{-1}		$0 \leqslant \lvert R\rvert \leqslant 90^\circ$	$E < 3 \times 10^{-7}$
LN X	$\lvert R\rvert \geqslant 10$		1 cnt in D_{10}
	$\lvert R\rvert < 10$		4 cnt in D_{10}

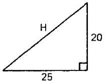
R = Result as displayed　　E = Error

SAMPLE PROBLEMS

Following are seven categories of problems. With these problems we wish to illustrate practical uses for various functions on the calculator. Note that our methods for solution are not absolute, as you may prefer to solve the problem in a different manner and still attain the correct answer. In any case, you may find it useful to attempt to solve the problem yourself before examining our method of computation.

MATHEMATICS

Example 1: Find the length of H.



Solution: $H = \sqrt{x^2 + y^2}$ (Pythagorean theorem)

Where: $x = 25$, $y = 20$

Answer: 32.01562118

Computation: 25 F X^2 + 20 F X^2 = **F** $\sqrt{X}$

Example 2: $5N^2 - 6N - 11$ Solve for N.

Solution: In finding the two roots to a second order algebraic equation, the quadratic formula is typically employed.

$$N = \frac{-b \pm \sqrt{b^2 - 4\,ac}}{2a} \qquad \text{(quadratic formula)}$$

Where: $a = 5,\ b = -6,\ c = -11$

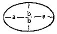
Answer: Root 1 → N = 2.2, Root 2 → N = -1

		Display
Computation:	6 F X^2	b^2
	- F (4 X 5 X 11 F +/-	$-4ac$
	= F $\sqrt{X}$	$\sqrt{b^2 - 4ac}$
	F STO	(Copy stored for second root)
	+ 6	$-b + \sqrt{b^2 - 4ac}$
	÷ 2 ÷ 5 =	Root 1

NOTE: Do not clear memory until both roots are calculated.

	F RCL F +/-	$-\sqrt{b^2 - 4ac}$
	+ 6	$-6 - \sqrt{b^2 - 4ac}$
	÷ 2 ÷ 5 =	Root 2

Example 3: Find the approximate circumference of the following elipse:



$a = 3,\ b = 2$

Solution: $P = 2\pi \sqrt{(a^2 + b^2)/2}$

Where: $a = 3,\ b = 2$

Answer: 16.01904224

Computation: 3 F X^2 + 2 F X^2 ÷ 2 = F $\sqrt{X}$ X F π X 2 =

Example 4: Solve: COS .4238

Answer: 0.911532862

Computation: F RAD .4238 F COS

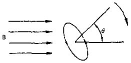
Example 5: Solve: SIN 32° + TAN .325

Answer: 0.866867019

Computation: 32 F SIN + F RAD .325 F TAN =

PHYSICS

Example 1: Find the torque on a loop of wire carrying 2 amps in a magnetic field of 0.4 wb/m^2.



Torque
$\theta = 30^\circ$
Radius of wire loop = 1.65m

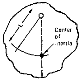
Solution: $\tau = \text{IAB SIN } \theta$

Where: $B = 0.4\ wb/m^2$
τ = torque
I = 2 amps
$\theta = 30^\circ$
$A = \pi R^2$ (area)
$R = 1.65m$

Answer: *3.421194393*

Computation: 2 X F π X 1.65 F X^2 X .4 X 30 F SIN =

Example 2: A rigid body with a mass of 1.5 kg is suspended as shown below. Calculate the moment of inertia of the body if the frequency is measured at 2 Hz. The center of inertia is 0.25m (meters) from the pivot point.



Solution: $I = \left(\frac{1}{2\pi F}\right)^2$ MGL

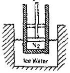
Where: M = 1.5 kg
G = 9.8 m/sec^2 (gravitational constant)
L = 0.25m
F = 2 Hz

Answer: 2.327220935^{-02} kg-m^2

Computation: 2 X F π X 2 = F 1/X F X^2 X 1.5 X 9.8 X .25 =

CHEMISTRY

Example 1: If 2 kg of nitrogen is compressed isothermally to half its original volume, what is the loss of energy? By immersing the apparatus in an ice-water bath, the temperature remains at a constant 273°K.



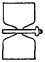
Solution: $W = (MRT/N)\ LN\ (V_2/V_1)$

Where:
$M = 2$ kg
$N = 28$ kg/mole (molecular weight)
V_1 = previous volume
V_2 = present volume
$V_2/V_1 = .5$
$R = 8310$ V/kg - mole - °K (constant)

Answer: *-112321.0349 joules*

Computation: .5 F LN X 273 X 8310 X 2 ÷ 28 =

Example 2: What is the change in entropy if two volumes of an ideal monatomic gas are connected and allowed to come to a thermal equilibrium? The two volumes have 1.2 kg masses, the same specific heat of 0.3, and different temperatures of 73°K and 115°K.



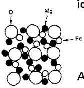
Solution: $S_2 - S_1 = MC \ LN \ \dfrac{(T_1 + T_2)^2}{4T_1T_2}$

Where: $S_2 - S_1$ = change in entropy
$M = 1.2 + 1.2 = 2.4$ kg
$C = 0.3$
$T_1 = 73°K$
$T_2 = 115°K$

Answer: 3.686255568^{-02}

Computation: 73 + 115 = F X^2 ÷ 4 ÷ 73 ÷ 115 = F LN
X .3 X 2.4 =

Example 3: Calculate the MgO/FeO weight ratio for the ionic solid solution where Fe^{2+} is substituted for Mg^{2+} in the MgO Structure. The ion ratio is:



$$\frac{Mg^{2+}}{Fe^{2+}} = \frac{17}{10} = \text{Mole Ratio}$$

Atomic Numbers: $O = 16$, $Mg = 24.31$, $Fe = 55.85$

Avogadro's Number: 6.02×10^{23}

Solution:

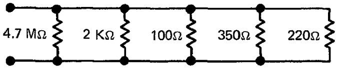
$$\text{Weight Ratio} = \frac{\text{Weight MgO} = \dfrac{17\,(24.31+16)}{6.02 \times 10^{23}}}{\text{Weight FeO} = \dfrac{10\,(55.85+16)}{6.02 \times 10^{23}}} = \frac{17\,(24.31+16)}{10\,(55.85+16)}$$

Answer: 9.537508698^{-01}

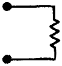
Computation: 17 X F (24.31 + 16 = ÷ 10 ÷ F (55.85 + 16 =

ELECTRONICS

Example 1: Give the equivalent of the following parallel resistances.



Solution:

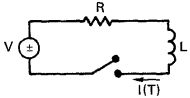


$$\text{Reg} = \cfrac{1}{\cfrac{1}{4.7 \times 10^6} + \cfrac{1}{2000} + \cfrac{1}{100} + \cfrac{1}{350} + \cfrac{1}{220}}$$

Answer: 55.857152580Ω

Computation: 4.7 F EE 6 F 1/X + 2000 F 1/X + 100 F 1/X + 350 F 1/X + 220 F 1/X = F 1/X

Example 2: Find the current I(T) 0.1 msec after the switch is closed.



R = 100
L = 1.5H
V = 24V

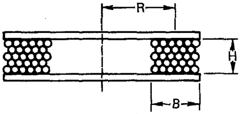
Solution: Expression for current in the RL network is:

$$I(T) = \frac{V}{R}(1 - e^{-RT/L})$$

Answer: 1.59467808^{-03} amps.

Computation: 100 F +/- X .1 F EE 3 F +/- ÷ 1.5 = **F** e^x F +/- + 1 X 24 ÷ 100 =

Example 3: What is the approximate self-inductance in microhenrys of the illustrated coil?



H = 0.2 in.
R = 1.5 in.
B = 0.2 in.
N = no. of turns = 25

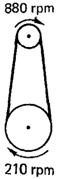
Solution: $L = \dfrac{.8\,(RN)^2}{6R + 9H + 10B}$

Answer: 87.890625 μH

Computation: 1.5 X 25 = F X^2 X .8 ÷ F (6 X 1.5 + F (9 X .2 F) + F (10 X .2 =

MECHANICS

Example 1: What size pulley must be used on an 880 rpm meter employed to drive a fan at 210 rpm when the fan pulley diameter is 24 in.?



Solution: $$D_r = \frac{D_n \times N_n}{N_r}$$

Where: D_r = diameter of driver
D_n = diameter of driven = 24 in.
N_r = rev. of driver = 880 rpm
N_n = rev. of driven = 210 rpm

Answer: 5.727272727 in.

Computation: 24 X 210 ÷ 880 =

Example 2: A steel pulley-carrying line shaft must transmit 4 hp at 300 rpm. How thick must the shaft be if the only force is tortional?

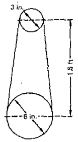
Solution: $D = 3.75 \sqrt[3]{HP/N} = 3.75\ (HP/N)^{1/3}$

Where: HP = 4 hp
N = 300 rpm

Answer: 0.889223325 in.

Computation: *3.75* X F (*4* ÷ *300* Y^X F (*1* ÷ *3* =

Example 3: The shaft center distances between two pulleys in an open *belt drive* is 1.5 ft. If the pulley diameters are 6 in. and 3 in. respectively, what is the length of belting required?



Solution:
$$L = \frac{\pi D_1}{2} + \frac{\pi D_2}{2} + 2\sqrt{C^2 + \left(\frac{D_1 - D_2}{2}\right)^2}$$

Where: $D_1 = 6$ in. $= 0.5$ ft
$D_2 = 3$ in. $= 0.25$ ft
$C = 1.5$ ft

Answer: 4.188495889 ft

Computation: F π X .5 ÷ 2 = F STO F π X .25 ÷ 2 = F M+ 2 X F (1.5 F X^2 + F (.5 - .25 ÷ 2 F) F X^2 F) F $\sqrt{X}$ = F M+ F RCL

UNIT CONVERSIONS

Example 1: Convert the following from feet to meters.

	A) 32 ft =	C) 2 ft =
	B) 10 ft =	D) 0.25 ft =
Solution:	1m = 3.280840 ft	
Answer:	A) 9.753599687m	C) 6.095999804^{-01}m
	B) 3.047999902m	D) 7.619999756^{-02}m
Computation:	32 ÷ 3.28084 F STO =	2 ÷ F RCL =
	10 ÷ F RCL =	.25 ÷ F RCL =

Example 2: Convert the following from kilometers to miles.

	A) 500 km =	C) 10 km =
	B) 300 km =	D) 2 km =
Solution:	1 mi = 1.609344 km	

Answer:	A) *310.6855961 mi*	C) 6.213711922 mi
	B) *186.4113576 mi*	D) 1.242742384 *mi*
Computation:	500 ÷ 1.609344 F STO =	10 ÷ F RCL =
	300 ÷ F RCL =	2 ÷ F RCL =

Example 3:	Convert the following from pounds to kilograms.	
	A) 200 lbs =	C) 5 lbs =
	B) 10 lbs =	D) 0.25 lbs =
Solution:	1 lb = 0.453592 kg	
Answer:	A) 90.7184 kg	C) 2.26796 kg
	B) 4.53592 kg	D) 0.113398 kg
Computation:	200 X .453592 F STO =	5 X F RCL =
	10 X F RCL =	.25 X F RCL =

BUSINESS

Example 1: Finance – What will the monthly payment be on a \$100,000 loan, borrowed for three years at 13% per year?

$$M = P \frac{i\,(1+i)^n}{(1+i)^n - 1}$$

Where: M = monthly payment
P = principal (\$100,000)
i = monthly interest rate (annual rate (.13)/12)
n = number of periods = 12 months x 3 years = 36

Answer: 3369.395253 = \$3,369.40

Computation: .13 ÷ 12 + 1 Y^x 36 = F STO X .13 ÷ 12 ÷
F (F RCL - 1 = X 100000 =

Example 2: Inventory Management – If the demand for widgets is uniform and at the rate of 2,000 per month, the setup cost for a lot of widgets is $25,000, and the cost of holding a widget in inventory for a month is $1.75, in what size lots should widgets be manufactured?

$$Q = \sqrt{\frac{2KM}{h}}$$

Where: Q = "Economic Order Quantity"
K = setup cost = 25000
M = demand per unit time = 2000
h = holding cost per unit time = 1.75

Answer: 7559.289459 = 7559 widgets

Computation: 2 X 25000 X 2000 ÷ 1.75 = F $\sqrt{X}$

Example 3: Marketing (and Statistics) – A survey of 1,945 readers of Playhouse Magazine found the distribution of "regular" and "occasional" readers by sex as shown in the following table:

Type of Reader	Female	Male	Total
Regular	152	523	675
Occasional	498	772	1270
Total	650	1295	1945

Using a χ^2 (chi squared) test, determine whether there is a relationship between sex and the type of reader of Playhouse.

NOTE: At the .01 probability level, χ^2 = 6.635.

$$\chi^2 = \sum_{i=1}^{s} \frac{(X_i - \theta_i)^2}{\theta_i}$$

Stk. No. 16615 A920-903/0 Printed in U.S.A.

BOWMAR CONSUMER PRODUCTS DIVISION
97 Piper Road, Acton, Massachusetts 01720