Sharp EL-9900 Graphing Calculator

Basic Keyboard Activities

General Mathematics

Algebra

Programming

Advanced Keyboard Activities

Algebra

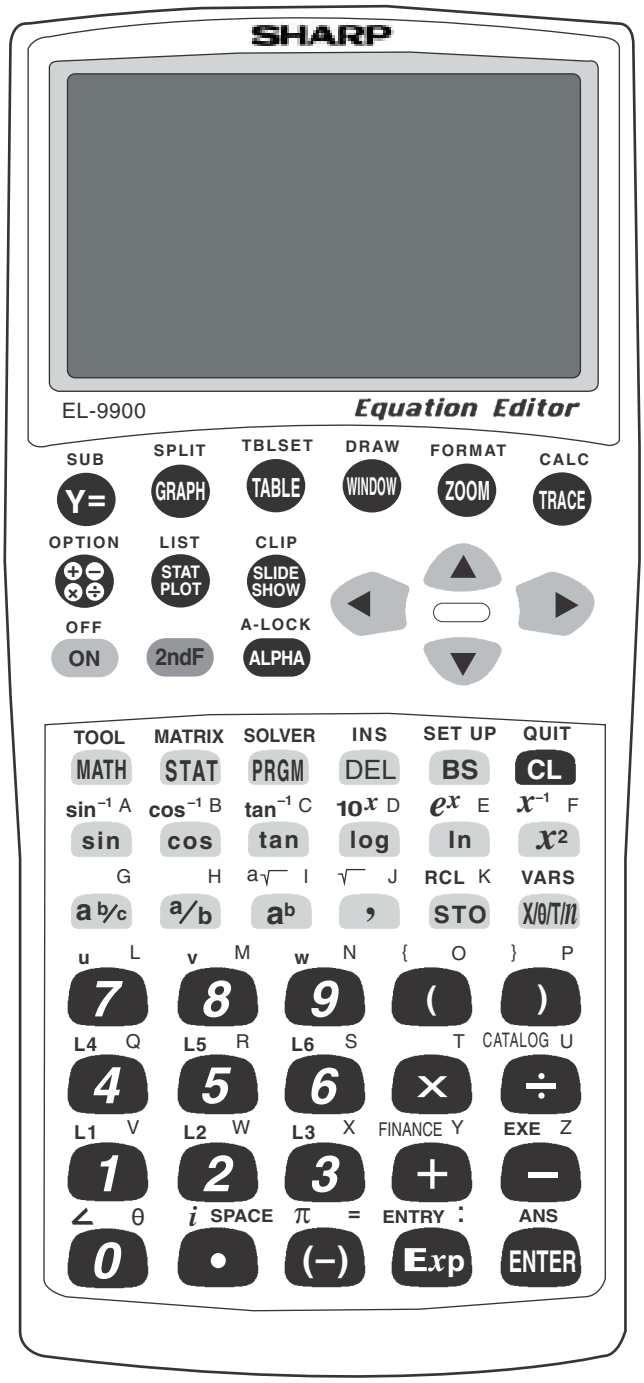
Calculus

Statistics

Trigonometry

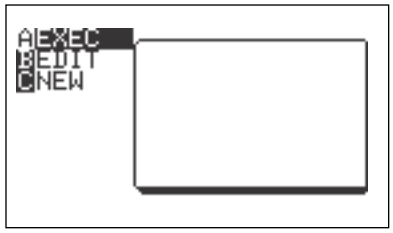
Programming

Sharp EL-9900
Graphing Calculator
Advanced Keypad



CREATING A NEW PROGRAM

1. Turn the calculator on and press [PRGM] to enter the programming menu. The menu consists of commands to execute, edit, and create new programs.



2. Press [C] **(NEW)** and [ENTER] to open a new program. The calculator is now locked in ALPHA mode and is prepared to accept a name for the new program. Enter the program name.

3. You can now enter the program. All program commands are obtained in the program menu. You cannot type program commands using the [ALPHA] key. To reach this menu, press [PRGM] All the program commands begin with an uppercase letter.

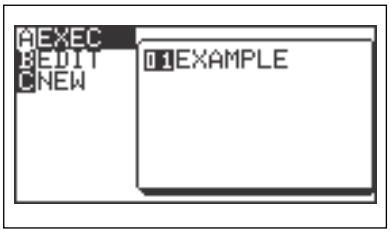
4. Press [CL] to exit the program commands. When entering a new program, you must press [ENTER] at the end of each line.

5. If you make a mistake entering a program, use the calculator's editing features to correct the error. First, you can press the arrow keys to move around the program. Second, you can use the [DEL] key which deletes a highlighted item, the [BS] key which backspace deletes an item, and the [2ndF] [INS] keys which allow you to insert new items. Third, the calculator operates in typeover mode which allows you to simply type over a mistake. You must press [ENTER] after correcting a mistake for the correction to be saved for future use.

EXECUTING A PROGRAM

1. After entering the program, press [2ndF] [QUIT] to save the program and exit the editing mode.

2. Execute a program by pressing [PRGM] [A] **(EXEC)** and select the program using the arrow keys and press [ENTER] .



3. If you receive an error statement, press [◀] [▶] to go to the line within the program in which the error occurs. Compare your line with the correct one above to find the error. Correct the error using the editing features of the calculator and press [ENTER] to save the correction. Press [2ndF] [QUIT] and try to execute the program again.

THE BISECTION METHOD

1. Program the calculator to perform the bisection method for approximating the root of a polynomial.

2. Create a new program with the name BISECT. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mistake, use the calculator's editing features to correct the error.

3. Enter the following program:

Input A	[PRGM] [A] [3] [ALPHA] [A] [ENTER]
Input B	[PRGM] [A] [3] [ALPHA] [B] [ENTER]
A⇒X	[ALPHA] [A] [STO] [X/θ/T/n] [ENTER]
If Y1>0	[PRGM] [B] [0] [3] [2ndF] [VARS] [A] [ENTER]
Goto A	[A] [1] [MATH] [F] [3] [0] [PRGM] [B] [0] [2] [ALPHA] [A] [ENTER]
A⇒N	[ALPHA] [A] [STO] [ALPHA] [N] [ENTER]
B⇒P	[ALPHA] [B] [STO] [ALPHA] [P] [ENTER]
Goto B	[PRGM] [B] [0] [2] [ALPHA] [B] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
A⇒P	[ALPHA] [A] [STO] [ALPHA] [P] [ENTER]
B⇒N	[ALPHA] [B] [STO] [ALPHA] [N] [ENTER]
Label B	[PRGM] [B] [0] [1] [ALPHA] [B] [ENTER]
(P+N)÷2⇒X	[(] [ALPHA] [P] [+] [ALPHA] [N] [)] [÷] [2] [STO] [X/θ/T/n] [ENTER]
Print X	[PRGM] [A] [1] [X/θ/T/n] [ENTER]
Wait	[PRGM] [A] [4] [ENTER]
If Y1>0	[PRGM] [B] [0] [3] [2ndF] [VARS] [A] [ENTER]
Goto C	[A] [1] [MATH] [F] [3] [0] [PRGM] [B] [0] [2] [ALPHA] [C] [ENTER]
X⇒N	[X/θ/T/n] [STO] [ALPHA] [N] [ENTER]
Goto D	[PRGM] [B] [0] [2] [ALPHA] [D] [ENTER]
Label C	[PRGM] [B] [0] [1] [ALPHA] [C] [ENTER]
X⇒P	[X/θ/T/n] [STO] [ALPHA] [P] [ENTER]
Label D	[PRGM] [B] [0] [1] [ALPHA] [D] [ENTER]

THE BISECTION METHOD (continued)

Continue entering the program BISECT.

If abs(N-P)>.01	PRGM B 0 3 MATH B 1
Goto B	ALPHA N – ALPHA P) MATH F 3 . 0 1 PRGM B 0 2 ALPHA B ENTER
End	PRGM A 6 ENTER

Press 2ndF QUIT to exit the editor.

4. Enter the function for which you are interested in finding the root via the bisection method. Do this by pressing Y= and CL to clear the Y1 prompt. Press ▼ CL to clear additional prompts if necessary. Enter the function $y = x^2 - 2$ for Y1 by pressing X/θ/T/n x^2 – 2 ENTER . Execute the BISECT program by pressing PRGM A **(EXEC)** and selecting BISECT. Enter the lower bound for the root by pressing 1 ENTER. Enter the upper bound for the root by pressing 2 ENTER. The first midpoint will appear on the screen. Press ENTER repeatedly until the program stops. This last midpoint is accurate to at least two decimal places.

ROOTS OF A REAL OR COMPLEX NUMBER

1. Program the calculator to find all the roots of a real or complex number by solving the equation $z^n = a + bi$ using DeMoivre's theorem.

2. Create a new program with the name ROOTS. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mis take, use the calculator's editing features to correct the error.

3. Enter the following program:

Input N	[PRGM] [A] [3] [ALPHA] [N] [ENTER]
Input A	[PRGM] [A] [3] [ALPHA] [A] [ENTER]
Input B	[PRGM] [A] [3] [ALPHA] [B] [ENTER]
xy->r(A,B)⇒R	[MATH] [D] [3] [ALPHA] [A] [,] [ALPHA] [B] [)] [STO] [ALPHA] [R] [ENTER]
xy->θ(A,B)⇒θ	[MATH] [D] [4] [ALPHA] [A] [,] [ALPHA] [B] [)] [STO] [ALPHA] [θ] [ENTER]
0⇒K	[0] [STO] [ALPHA] [K] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
Print rθ->x	[PRGM] [A] [1] [MATH] [D] [5]
(R^(1÷N),(θ+ 2πK)÷N)	[ALPHA] [R] [a^b] [(] [1] [÷] [ALPHA] [N] [)] [,] [(] [ALPHA] [θ] [+] [2] [2ndF] [π] [ALPHA] [K] [)] [÷] [ALPHA] [N] [)] [ENTER]
Print rθ->y	[PRGM] [A] [1] [MATH] [D] [6]
(R^(1÷N), (θ+2πK)÷N)	[ALPHA] [R] [a^b] [(] [1] [÷] [ALPHA] [N] [)] [,] [(] [ALPHA] [θ] [+] [2] [2ndF] [π] [ALPHA] [K] [)] [÷] [ALPHA] [N] [)] [ENTER]
Print "	[PRGM] [A] [1] [PRGM] [A] [2] [ENTER]
Wait	[PRGM] [A] [4] [ENTER]
K+1⇒K	[ALPHA] [K] [+] [1] [STO] [ALPHA] [K] [ENTER]
If K<N	[PRGM] [B] [0] [3] [ALPHA] [K] [MATH] [F]
Goto A	[5] [ALPHA] [N] [PRGM] [B] [0] [2] [ALPHA] [A] [ENTER]
End	[PRGM] [A] [6] [ENTER]

Press [2ndF] [QUIT] to exit the editor.

ROOTS OF
A REAL OR COMPLEX NUMBER (continued)

4. Execute the ROOTS program by pressing [PRGM] [A] **(EXEC)** and selecting **ROOTS**. Enter the degree of the root by pressing [6] [ENTER]. Enter the real part of the complex number by pressing [5] [1] [3] [ENTER]. Enter the imaginary part of the complex number by pressing [0] [ENTER]. The first root of 2.83 will appear. Press [ENTER] repeatedly to see additional roots.

5. You can repeat this program for other numbers by pressing [ENTER] to execute the program over and over again. Press [CL] to clear the screen. If you receive an error statement, press [◀] or [▶] to go to the line within the program with the error. Correct the error and execute the program again.

GRAPHING CONICS

1. Program the calculator to graph a conic.

2. Create a new program with the name CONICGRA. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mistake, use the calculator's editing features to correct the error.

3. Enter the following program:

Input A	[PRGM] [A] [3] [ALPHA] [A] [ENTER]
Input B	[PRGM] [A] [3] [ALPHA] [B] [ENTER]
Input C	[PRGM] [A] [3] [ALPHA] [C] [ENTER]
Input D	[PRGM] [A] [3] [ALPHA] [D] [ENTER]
Input E	[PRGM] [A] [3] [ALPHA] [E] [ENTER]
Input F	[PRGM] [A] [3] [ALPHA] [F] [ENTER]
If C=0	[PRGM] [B] [0] [3] [ALPHA] [C] [ALPHA]
Goto A	[=] [0] [PRGM] [B] [0] [2] [ALPHA] [A] [ENTER]
"(-(B×X+E)+	[PRGM] [A] [2] [(] [(-)] [(] [ALPHA]
√((B×X+E)²–	[B] [×] [X/θ/T/n] [+] [ALPHA] [E] [)] [+]
4C(A×X²+	[2ndF] [√] [(] [(] [ALPHA] [B] [×] [X/θ/T/n]
DX+F)))÷	[+] [ALPHA] [B] [×] [X/θ/T/n] [+] [ALPHA] [E]
(2C)"⇒Y1	[)] [x^2] [–] [4] [ALPHA] [C] [(] [ALPHA] [A]
	[×] [X/θ/T/n] [x^2] [+] [ALPHA] [D] [X/θ/T/n] [+]
	[ALPHA] [F] [)] [)] [)] [÷] [(] [2] [ALPHA]
	[C] [)] [PRGM] [A] [2] [STO] [2ndF] [VARS]
	[A] [ENTER] [A] [1] [ENTER]
"(-(B×X+E)–	[PRGM] [A] [2] [(] [(-)] [(] [ALPHA]
√((B×X+E)²–	[B] [×] [X/θ/T/n] [+] [ALPHA] [E] [)] [–]
4C(A×X²+	[2ndF] [√] [(] [(] [ALPHA] [B] [×] [X/θ/T/n]
DX+F)))÷	[+] [ALPHA] [E] [)] [x^2] [–] [4] [ALPHA] [C]
(2C)"⇒Y2	[(] [ALPHA] [A] [×] [X/θ/T/n] [x^2] [+] [ALPHA]
	[D] [X/θ/T/n] [+] [ALPHA] [F] [)] [)] [)] [÷]
	[(] [2] [ALPHA] [C] [)] [PRGM] [A]
	[2] [STO] [2ndF] [VARS] [A] [ENTER] [A] [2] [ENTER]

GRAPHING CONICS (continued)

DispG	PRGM C 4 ENTER
End	PRGM A 6 ENTER
Label A	PRGM B 0 1 ALPHA A ENTER
"(-A×X2–D×X–F)	PRGM A 2 ((-) ALPHA A
÷(B×X+E)"⇒Y1	× X/θ/T/n x^2 – ALPHA D × X/θ/T/n
	– ALPHA F) ÷ (ALPHA B ×
	X/θ/T/n + ALPHA E) PRGM
	A 2 STO 2ndF VARS A ENTER A 1
	ENTER
DispG	PRGM C 4 ENTER
End	PRGM A 6 ENTER

Press 2ndF QUIT to exit the editor.

4. Set the calculator to one-line editor by pressing 2ndF SETUP G 2 Press Y= and CL to clear the Y1 prompt. Press ▼ CL to clear additional prompts if necessary. Set the viewing window for the graphing by pressing ZOOM A 7 . Execute the CONICGRA program by pressing PRGM A **(EXEC)** and selecting CONICGRA.

5. Enter the A, B, C, D, E, and F from the general conic equation $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$. Graph the general conic equation $x^2 + 2y^2 + 4x - 6y - 3 = 0$ by pressing 1 ENTER 0 ENTER 2 ENTER 4 ENTER (-) 6 ENTER (-) 3 ENTER . When the program is through it will return to the home screen. Press GRAPH to view the graph.

6. Gaps in the graph of conics is common. This is due to the graphing of two equations to form the complete graph. You can repeat this program for other conics by pressing ENTER to execute the program over and over again. Press CL to clear the screen. If you receive an error statement, press ◀ or ▶ to go to the line within the program with the error. Correct the error and execute the program again.

Return the calculator to equation editor mode by pressing 2ndF SETUP G 1 .

THE SIERPINSKI TRIANGLE

1. Program the calculator to graph the Sierpinski triangle, which is an infinite set of nested equilateral triangles. The graph is generated from a construction of a fractal by means of an iterated system, or in other words, playing a chaos game.

2. Create a new program with the name SIERPINS. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mis take, use the calculator's editing features to correct the error.

3. Enter the following program:

random ⇒X	[MATH] [C] [1] [STO] [X/θ/T/n] [ENTER]
random ⇒Y	[MATH] [C] [1] [STO] [ALPHA] [Y] [ENTER]
1⇒I	[1] [STO] [ALPHA] [I] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
random ⇒N	[MATH] [C] [1] [STO] [ALPHA] [N] [ENTER]
If N>(1÷3) Goto B	[PRGM] [B] [0] [3] [ALPHA] [N] [MATH] [F] [3] [(] [1] [÷] [3] [)] [PRGM] [B] [0] [2] [ALPHA] [B] [ENTER]
.5(X+1)⇒X	[.] [5] [(] [X/θ/T/n] [+] [1] [)] [STO] [X/θ/T/n] [ENTER]
.5Y⇒Y	[.] [5] [ALPHA] [Y] [STO] [ALPHA] [Y] [ENTER]
Goto D	[PRGM] [B] [0] [2] [ALPHA] [D] [ENTER]
Label B	[PRGM] [B] [0] [1] [ALPHA] [B] [ENTER]
If N≤(2÷3) Goto C	[PRGM] [B] [0] [3] [ALPHA] [N] [MATH] [F] [6] [(] [2] [÷] [3] [)] [PRGM] [B] [0] [2] [ALPHA] [C] [ENTER]
.5(X+.5)⇒X	[.] [5] [(] [X/θ/T/n] [+] [.] [5] [)] [STO] [X/θ/T/n] [ENTER]
.5(Y+1)⇒Y	[.] [5] [(] [ALPHA] [Y] [+] [1] [)] [STO] [ALPHA] [Y] [ENTER]
Goto D	[PRGM] [B] [0] [2] [ALPHA] [D] [ENTER]
Label C	[PRGM] [B] [0] [1] [ALPHA] [C] [ENTER]

THE SIERPINSKI TRIANGLE (continued)

.5X⇒X	. 5 X/θ/T/n STO X/θ/T/n ENTER
.5Y⇒Y	. 5 ALPHA Y STO ALPHA Y ENTER
Label D	PRGM B 0 1 ALPHA D ENTER
PntON(X,Y)	2ndF DRAW B 0 1 X/θ/T/n , ALPHA Y) ENTER
I+1⇒I	ALPHA I + 1 STO ALPHA I ENTER
If I≤2000 Goto A	PRGM B 0 3 ALPHA I MATH F 6 2 0 0 0 PRGM B 0 2 ALPHA A ENTER
End	PRGM A 6 ENTER

Press 2ndF QUIT to exit the editor.

3. Press Y= and CL to clear the Y1 prompt. Press ▼ and CL to clear additional prompts. Press WINDOW 0 ENTER 1 ENTER 1 ENTER 0 ENTER 1 ENTER 1 ENTER. Execute the SIERPINS program by pressing PRGM A **(EXEC)** and selecting SIERPINS. The program will **slowly generate** 2000 random points that create the Sierpinski Triangle.

THE MANDELBROT SET

1. Program the calculator to plot the Mandelbrot set, which is the set of all points in the complex plane such that $|z_n|<2$ for all n, where z_n is the nth iterate of 0 under $z_{n+1}=z_n^2+c$. The graph is generated from a construction of a fractal by means of an iterated system.

2. Create a new program with the name MANDEL. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mis take, use the calculator's editing features to correct the error.

3. Enter the following program:

1⇒J	[1] [STO] [ALPHA] [J] [ENTER]
0⇒K	[0] [STO] [ALPHA] [K] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
K+1⇒K	[ALPHA] [K] [+] [1] [STO] [ALPHA] [K] [ENTER]
-2+4J÷100⇒M	[(-)] [2] [+] [4] [ALPHA] [J] [÷] [1] [0] [0] [STO] [ALPHA] [M] [ENTER]
2–4K÷100⇒N	[2] [–] [4] [ALPHA] [K] [÷] [1] [0] [0] [STO] [ALPHA] [N] [ENTER]
M⇒X	[ALPHA] [M] [STO] [X/θ/T/n] [ENTER]
N⇒Y	[ALPHA] [N] [STO] [ALPHA] [Y] [ENTER]
1⇒C	[1] [STO] [ALPHA] [C] [ENTER]
Label B	[PRGM] [B] [0] [1] [ALPHA] [B] [ENTER]
$X^2-Y^2+M\Rightarrow R$	[X/θ/T/n] [x^2] [–] [ALPHA] [Y] [x^2] [+] [ALPHA] [M] [STO] [ALPHA] [R] [ENTER]
2X×Y+N⇒S	[2] [X/θ/T/n] [×] [ALPHA] [Y] [+] [ALPHA] [N] [STO] [ALPHA] [S] [ENTER]
$R^2+S^2\Rightarrow Z$	[ALPHA] [R] [x^2] [+] [ALPHA] [S] [x^2] [STO] [ALPHA] [Z] [ENTER]
If Z>4 Goto C	[PRGM] [B] [0] [3] [ALPHA] [Z] [MATH] [F] [3] [4] [PRGM] [B] [0] [2] [ALPHA] [C] [ENTER]

THE MANDELBROT SET (continued)

R⇒X	ALPHA R STO X/θ/T/n ENTER
S⇒Y	ALPHA S STO ALPHA Y ENTER
C+1⇒C	ALPHA C + 1 STO ALPHA C ENTER
If C≤30 Goto B	PRGM B 0 3 ALPHA C MATH F 6 3 0 PRGM B 0 2 ALPHA B ENTER
PntON(M,N)	2ndF DRAW B 1 ALPHA M , ALPHA N) ENTER
PntON(M,-N)	2ndF DRAW B 1 ALPHA M , (-) ALPHA N) ENTER
Label C	PRGM B 0 1 ALPHA C ENTER
If K≤50 Goto A	PRGM B 0 3 ALPHA K MATH F 6 5 0 PRGM B 0 2 ALPHA A ENTER
0⇒K	0 STO ALPHA K ENTER
J+1⇒J	ALPHA J + 1 STO ALPHA J ENTER
If J≤100 Goto A	PRGM B 0 3 ALPHA J MATH F 6 1 0 0 PRGM B 0 2 ALPHA A ENTER
End	PRGM A 6 ENTER

Press 2ndF QUIT to exit the editor.

4. Press Y= and CL to clear the Y1 prompt. Press ▼ and CL to clear additional prompts. Press 2ndF DRAW A 1 ENTER to clear an old drawing. Press WINDOW (-) 2 ENTER 2 ENTER 1 ENTER (-) 2 ENTER 2 ENTER 1 ENTER . Execute the MANDEL program by pressing PRGM A **(EXEC)** and select MANDEL. The program will roughly and *very slowly* generate the Mandelbrot set.

NEWTON'S METHOD

1. Program the calculator to perform Newton's method to find the root of a function.

2. Create a new program with the name NEWTONS. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mistake, use the calculator's editing features to correct the error.

3. Enter the following program:

Input A	[PRGM] [A] [3] [ALPHA] [A] [ENTER]
Input X	[PRGM] [A] [3] [X/θ/T/n] [ENTER]
If d/dx(Y1,X)=0	[PRGM] [B] [0] [3] [MATH] [A] [0] [5]
Goto B	[2ndF] [VARS] [A] [ENTER] [A] [1] [,] [X/θ/T/n] [)]
	[ALPHA] [=] [0] [PRGM] [B] [0] [2]
	[ALPHA] [B] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
X–Y1/d/dx(Y1,X)	[X/θ/T/n] [–] [2ndF] [VARS] [A] [ENTER] [A] [1] [÷]
⇒N	[MATH] [A] [0] [5] [2ndF] [VARS] [A] [ENTER] [A]
	[1] [,] [X/θ/T/n] [)] [STO] [ALPHA] [N] [ENTER]
If abs(X–N)>5	[PRGM] [B] [0] [3] [MATH] [B] [1]
Goto B	[X/θ/T/n] [–] [ALPHA] [N] [)] [MATH] [F] [3]
	[5] [PRGM] [B] [0] [2] [ALPHA] [B] [ENTER]
Print N	[PRGM] [A] [1] [ALPHA] [N] [ENTER]
Wait	[PRGM] [A] [4] [ENTER]
If abs(X–N)≤A	[PRGM] [B] [0] [3] [MATH] [B] [1]
Goto C	[X/θ/T/n] [–] [ALPHA] [N] [)] [MATH] [F] [6]
	[ALPHA] [A] [PRGM] [B] [0] [2] [ALPHA] [C] [ENTER]
N⇒X	[ALPHA] [N] [STO] [X/θ/T/n] [ENTER]
Goto A	[PRGM] [B] [0] [2] [ALPHA] [A] [ENTER]
Label B	[PRGM] [B] [0] [1] [ALPHA] [B] [ENTER]
Print "GUESS	[PRGM] [A] [1] [PRGM] [A] [2]
BETTER	[2ndF] [A-LOCK] [G] [U] [E] [S] [S] [SPACE]
	[B] [E] [T] [T] [E] [R] [ENTER]
Label C	[PRGM] [B] [0] [1] [ALPHA] [C] [ENTER]
End	[PRGM] [A] [6] [ENTER]

NEWTON'S METHOD (continued)

4. Press [Y=] and [CL] to clear the Y1 prompt. Press [▼] and [CL] to clear additional prompts. Press [▲] to return to the Y1 prompt. Enter the function for which you want to find the roots. Enter $x^2 - 2$ by pressing [X/θ/T/n] [x^2] [–] [2] [ENTER]. Execute the NEWTONS program by pressing [PRGM] [A] (EXEC) and select NEWTONS. The program will prompt you for the accuracy you desire in calculating the root. Enter .001 by pressing [.] [0] [0] [1] [ENTER]. Next, the program will prompt you for your guess. Enter 1 by pressing [1] [ENTER]. A blinking cursor in the upper right-hand corner tells you the program is still working. Continue to press [ENTER] until the blinking cursor is gone. The last value on the screen is your approximate for the root.

   You can repeat this program for other roots by pressing [ENTER] to execute the program again with another guess. You can repeat the program for other functions by pressing [Y=] and changing the Y1 function to the new one. If you receive an error statement, press [◀] or [▶] to go to the line within the program with the error. Correct the error and execute the program again.

CONVERGENCE OF A SERIES

1. Program the calculator to bounce a ball. The ball will be dropped from a given height, with a given bounce factor (the percentage the ball bounces up of the distance dropped). The number of bounces will also be requested. Repeated runs of the program, with a fixed height and fixed bounce factor, will allow you to examine the convergence of the series. The series is the sum of the distance traveled by the ball in its bounces.

2. Create a new program with the name BOUNCE. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mis take, use the calculator's editing features to correct the error.

3. Enter the following program:

Input H	[PRGM] [A] [3] [ALPHA] [H] [ENTER]
Input F	[PRGM] [A] [3] [ALPHA] [F] [ENTER]
Input N	[PRGM] [A] [3] [ALPHA] [N] [ENTER]
0⇒X	[0] [STO] [X/θ/T/n] [ENTER]
0⇒D	[0] [STO] [ALPHA] [D] [ENTER]
-1⇒Xmin	[(-)] [1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [1] [ENTER]
2N+1⇒Xmax	[2] [ALPHA] [N] [+] [1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [2] [ENTER]
1⇒Xscl	[1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [3] [ENTER]
-1⇒Ymin	[(-)] [1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [4] [ENTER]
H+1⇒Ymax	[ALPHA] [H] [+] [1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [5] [ENTER]
1⇒Yscl	[1] [STO] [2ndF] [VARS] [B] [ENTER] [A] [6] [ENTER]
ClrDraw	[2ndF] [DRAW] [A] [1] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
Line(X,H,X+1,	[2ndF] [DRAW] [A] [2] [X/θ/T/n] [,] [ALPHA]
0)	[H] [,] [X/θ/T/n] [+] [1] [,] [0] [)] [ENTER]

CONVERGENCE OF A SERIES (continued)

D+H⇒D	ALPHA D + ALPHA H STO ALPHA D ENTER
F×H⇒H	ALPHA F × ALPHA H STO ALPHA H ENTER
Line(X+1,0,X+2, H)	2ndF DRAW A 2 X/θ/T/n + 1 , 0 , X/θ/T/n + 2 , ALPHA H) ENTER
D+H⇒D	ALPHA D + ALPHA H STO ALPHA D ENTER
X+2⇒X	X/θ/T/n + 2 STO X/θ/T/n ENTER
If X<2N	PRGM B 0 3 X/θ/T/n MATH F
Goto A	5 2 ALPHA N PRGM B 0 2 ALPHA A ENTER
ClrT	PRGM C 1 ENTER
Print "DIST	PRGM A 1 PRGM A 2
TRAVELED IS	2ndF A-LOCK D I S T SPACE T R A V E L E D SPACE I S ENTER
Print D	PRGM A 1 ALPHA D ENTER
End	PRGM A 6 ENTER

Press 2ndF QUIT to exit the editor.

4. Press Y= and CL to clear the Y1 prompt. Press ▼ and CL to clear additional prompts. Execute the BOUNCE program by pressing PRGM A **(EXEC)** and select BOUNCE. The program will prompt you for the height from which to drop the ball. Enter 8 feet by pressing 8 ENTER. Next, the program will prompt you for your bounce factor. Enter the percentage 80% as the decimal equivalent of .8 by pressing . 8 ENTER. Finally, the program will prompt you for the number of bounces. Enter 5 bounces by pressing 5 ENTER. The program draws the ball bouncing and then displays the total distance traveled. Press GRAPH to return to the bouncing-ball graph. A blinking cursor in the upper right-hand corner tells you the program is still working.

SLOPE FIELDS

1. Program the calculator to graph the slope field for a differential equation at a finite set of points.

2. Create a new program with the name SFIELD. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mistake, use the calculator's editing features to correct the error.

3. Enter the following program:

ClrDraw	[2ndF] [DRAW] [A] [1] [ENTER]
.1⇒H	[.] [1] [STO] [ALPHA] [H] [ENTER]
ipart Xmin⇒J	[MATH] [B] [3] [2ndF] [VARS] [B] [ENTER] [A] [1] [STO] [ALPHA] [J] [ENTER]
ipart Ymin⇒K	[MATH] [B] [3] [2ndF] [VARS] [B] [ENTER] [A] [4] [STO] [ALPHA] [K] [ENTER]
J⇒X	[ALPHA] [J] [STO] [X/θ/T/n] [ENTER]
K⇒Y	[ALPHA] [K] [STO] [ALPHA] [Y] [ENTER]
Label A	[PRGM] [B] [0] [1] [ALPHA] [A] [ENTER]
X+H⇒A	[X/θ/T/n] [+] [ALPHA] [H] [STO] [ALPHA] [A] [ENTER]
If X≠0 Goto B	[PRGM] [B] [0] [3] [X/θ/T/n] [MATH] [F] [2] [0] [PRGM] [B] [0] [2] [ALPHA] [B] [ENTER]
.00001⇒X	[.] [0] [0] [0] [0] [1] [STO] [X/θ/T/n] [ENTER]
Label B	[PRGM] [B] [0] [1] [ALPHA] [B] [ENTER]
(sin X÷X)	[(] [sin] [X/θ/T/n] [÷] [X/θ/T/n] [)] [(] [ALPHA]
(A–X) +Y⇒B	[A] [–] [X/θ/T/n] [)] [+] [ALPHA] [Y] [STO] [ALPHA] [B] [ENTER]
A⇒C	[ALPHA] [A] [STO] [ALPHA] [C] [ENTER]
B⇒D	[ALPHA] [B] [STO] [ALPHA] [D] [ENTER]
X–H⇒A	[X/θ/T/n] [–] [ALPHA] [H] [STO] [ALPHA] [A] [ENTER]
(sin X÷X)	[(] [sin] [X/θ/T/n] [÷] [X/θ/T/n] [)] [(] [ALPHA]
(A–X) +Y⇒B	[A] [–] [X/θ/T/n] [)] [+] [ALPHA] [Y] [STO] [ALPHA] [B] [ENTER]

SLOPE FIELDS (continued)

A⇒E	ALPHA A STO ALPHA E ENTER
B⇒F	ALPHA B STO ALPHA F ENTER
Line(C,D,E,F)	2ndF DRAW A 2 ALPHA C , ALPHA D , ALPHA E , ALPHA F) ENTER
X+1⇒X	X/q/T/n + 1 STO X/θ/T/n ENTER
If X<Xmax	PRGM B 0 3 X/θ/T/n MATH F
Goto A	5 2ndF VARS B ENTER A 2 PRGM B 0 2 ALPHA A ENTER
J⇒X	ALPHA J STO X/θ/T/n ENTER
Y+1⇒Y	ALPHA Y + 1 STO ALPHA Y ENTER
If Y<Ymax	PRGM B 0 3 ALPHA Y MATH
Goto A	F 5 2ndF VARS B ENTER A 5 PRGM B 0 2 ALPHA A ENTER
End	PRGM A 6 ENTER

4. Press Y= and CL to clear the Y1 prompt. Press ▼ and CL to clear additional prompts. The differential equation $y' = (\sin x)/x$ has been entered into the program at lines twelve and sixteen. Enter a different differential by editing the program at lines twelve and sixteen. Press ZOOM A 7 to set the window for viewing the slope field, however, different viewing windows can be used. Execute the SFIELD program by pressing PRGM A **(EXEC)** and select SFIELD. When the program is done, press GRAPH .

VECTORS

1. Program the calculator to find the length of a three-dimensional vector and the unit vector in the direction of the vector.

2. Create a new program with the name VECTOR. Enter the following program and remember to press [ENTER] at the end of each line. If you make a mistake, use the calculator's editing features to correct the error.

3. Enter the following program:

Input A	[PRGM] [A] [3] [ALPHA] [A] [ENTER]
Input B	[PRGM] [3] [ALPHA] [B] [ENTER]
Input C	[PRGM] [3] [ALPHA] [C] [ENTER]
Print "THE	[PRGM] [1] [PRGM] [2]
LENGTH IS	[2ndF] [A-LOCK] [T] [H] [E] [SPACE] [L] [E]
	[N] [G] [T] [H] [SPACE] [I] [S] [ENTER]
$\sqrt{(A^2+B^2+C^2)} \Rightarrow L$	[2ndF] [√] [(] [ALPHA] [A] [x^2] [+] [ALPHA]
	[B] [x^2] [+] [ALPHA] [C] [x^2] [)] [STO]
	[ALPHA] [L] [ENTER]
Print L	[PRGM] [1] [ALPHA] [L] [ENTER]
Print "THE UNIT	[PRGM] [1] [PRGM] [2]
VECTOR IS	[2ndF] [A-LOCK] [T] [H] [E] [SPACE] [U] [N]
	[I] [T] [SPACE] [V] [E] [C] [T] [O] [R]
	[SPACE] [I] [S] [ENTER]
Print A÷L	[PRGM] [1] [ALPHA] [A] [÷]
	[ALPHA] [L] [ENTER]
Print B÷L	[PRGM] [1] [ALPHA] [B] [÷]
	[ALPHA] [L] [ENTER]
Print C÷L	[PRGM] [1] [ALPHA] [C] [÷]
	[ALPHA] [L] [ENTER]
End	[PRGM] [6] [ENTER]

VECTORS (continued)

4. Execute the VECTOR program by pressing [PRGM] [A] **(EXEC)** and select VECTOR. The program will prompt you for the vector components A, B, and C. For example, to find the length of the vector <1, 2, 3> and the unit vector in its direction, press [1] [ENTER] [2] [ENTER] [3] [ENTER].