

Sharp EL-9900 Graphing Calculator

Basic Keyboard Activities

General Mathematics

Algebra

Programming

Advanced Keyboard Activities

Algebra

Calculus

Statistics

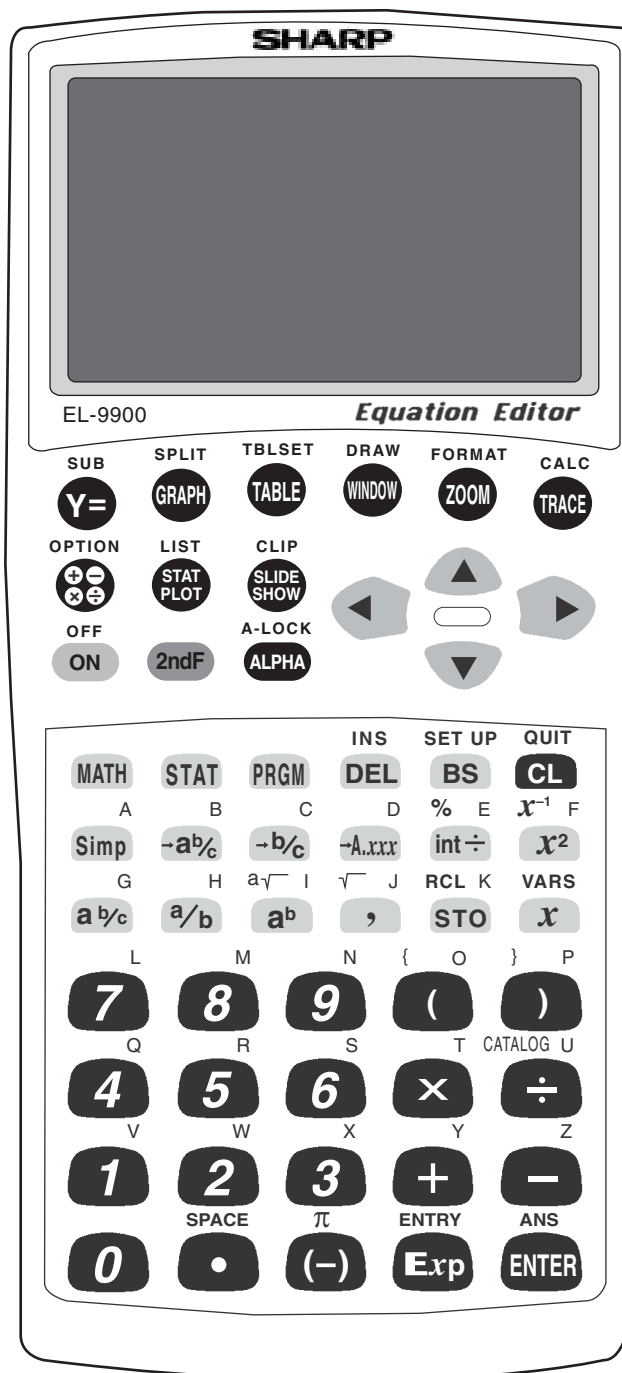
Trigonometry

Programming

Sharp EL-9900

Graphing Calculator

Basic Keypad



BASIC ARITHMETIC

Press $\boxed{+/-}$ to access the calculation screen.

1. Add 9 to 27 twice.

- STEP 1: Enter 27 by pressing $\boxed{2}$ $\boxed{7}$.
STEP 2: Add by pressing the $\boxed{+}$ key.
STEP 3: Enter 9 by pressing $\boxed{9}$.
STEP 4: Find the first sum by pressing the $\boxed{\text{ENTER}}$ key.
STEP 5: Add 9 again by pressing $\boxed{+}$ $\boxed{9}$ $\boxed{\text{ENTER}}$.

27+9	36
Ans+9	45

2. Multiply $\frac{3}{4}$ to $\frac{5}{2}$. Then, convert to a decimal.

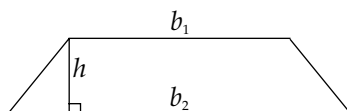
- STEP 1: Enter $\frac{3}{4}$ by pressing $\boxed{3}$ $\boxed{a/b}$ $\boxed{4}$ $\boxed{\blacktriangleright}$.
STEP 2: Multiply by pressing the $\boxed{\times}$ key.
STEP 3: Enter $\frac{5}{2}$ by pressing $\boxed{5}$ $\boxed{a/b}$ $\boxed{2}$ $\boxed{\blacktriangleright}$.
STEP 4: Find the product by pressing $\boxed{\text{ENTER}}$.
STEP 5: Convert to an improper fraction by pressing $\boxed{\rightarrow b/c}$ $\boxed{\text{ENTER}}$.
STEP 6: Convert to a mixed number by pressing $\boxed{\rightarrow a^b/c}$ $\boxed{\text{ENTER}}$.

$\frac{3}{4} \times \frac{5}{2}$	1.875
Ans $\rightarrow b/c$	$\frac{15}{8}$

PARENTHESES AND EDITING

Press  to access the calculation screen.


A trapezoid is a four-sided figure where two of the sides are parallel and the other two sides are not parallel.



The area of a trapezoid is defined to be $\text{Area} = (\frac{h}{2}) \cdot (b_1 + b_2)$ where h is the height or distance between the parallel sides b_1 and b_2 .

1. Calculate $(\frac{5}{2}) \times (3 + 4)$.

STEP 1: Enter $(\frac{5}{2})$ by pressing      .







STEP 2: Multiply by pressing the  key.

STEP 3: Enter $(3 + 4)$ by pressing     .

STEP 4: Calculate by pressing the  key.

The answer is 17.5

2. Edit the previous calculation to find $(\frac{5}{2}) \cdot (7 + 4)$.

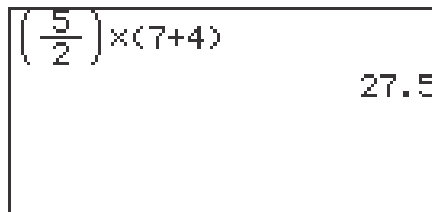
STEP 1: Edit the previous calculation by pressing       to move the blinking cursor to highlight the 3.

STEP 2: Delete the 3 by pressing  to backspace delete.

STEP 3: Insert the 7 by pressing .

STEP 4: Calculate by pressing the  key.

The answer is 27.5.



PERCENTS

Press  to access the calculation screen.

Mixtures contain two or more components. Percents are often used to express the amount of a component in a mixture.

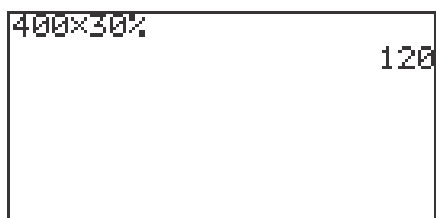
1. Find 30% of 400.

STEP 1: Enter 400 by pressing   .

STEP 2: Multiply by pressing the  key.

STEP 3: Enter 30% by pressing     .

The answer is 120.



2. Find what percent of 500 is 150.

STEP 1: Enter 150 by pressing   .

STEP 2: Divide by pressing the  key.

STEP 3: Enter 500 by pressing   .

STEP 4: Calculate by percentage by pressing   .

The answer is 30%.



PERCENTS (continued)

3. Add 20% to 300.

STEP 1: Enter 300 by pressing $\boxed{3} \boxed{0} \boxed{0}$.

STEP 2: Add by pressing the $\boxed{+}$ key.

STEP 3: Enter 20% by pressing $\boxed{2} \boxed{0} \boxed{\text{2ndF}} \boxed{\%} \boxed{\times}$
 $\boxed{3} \boxed{0} \boxed{0} \boxed{\text{ENTER}}$.

The answer is 360.



4. Subtract 40% from 200.

STEP 1: Enter 200 by pressing $\boxed{2} \boxed{0} \boxed{0}$.

STEP 2: Subtract by pressing the $\boxed{-}$ key.

STEP 3: Enter 40% by pressing $\boxed{4} \boxed{0} \boxed{\text{2ndF}} \boxed{\%} \boxed{\times}$
 $\boxed{2} \boxed{0} \boxed{0} \boxed{\text{ENTER}}$.













The answer is 120.


















MEMORY USAGE

Press  to access the calculation screen.

1. Calculate $2 \cdot 3$ and store the value in A. Recall the A to see the product stored in A.

- STEP 1: Multiply 2 and 3 by pressing     .
The product is 6.
- STEP 2: Store 6 into A by pressing     .
- STEP 3: Clear the screen by pressing  .
- STEP 4: Recall A by pressing    .

2. Calculate $3 \cdot 5$ and store the value in M. Calculate $4 \cdot 5$ and add this product to M. Then, recall the M to see the sum of the products.

- STEP 1: Multiply 3 and 5 by pressing     .
The product is 15.
- STEP 2: Store 15 into M by pressing     .
- STEP 3: Multiply 4 and 5 by pressing     .
The product is 20.
- STEP 4: Add 20 to M by pressing    .
The sum of the products is 35.





3. Recall the previous answer.

- STEP 1: With the display screen cleared, recall the previous answer by pressing    .





POWERS AND ROOTS

Press  to access the calculation screen.

1. Calculate 15^2 .







- STEP 1: Enter 15 by pressing  .
- STEP 2: Square by pressing the  key.
- STEP 3: Calculate by pressing the  key.
The answer is 225.

2. Calculate 3^4 .

- STEP 1: Enter 3 by pressing .
- STEP 2: Exponentiate by pressing the  key.
- STEP 3: Enter 4 by pressing .
- STEP 4: Calculate by pressing the  key.
The answer is 81.

15^2	
	225
3^4	
	81

3. Calculate $\sqrt{196}$.

- STEP 1: Enter the square root by pressing  .
- STEP 2: Enter 196 by pressing   .
- STEP 3: Calculate by pressing the  key.
The answer is 14.

LOGARITHMS AND EXPONENTIALS

Press  to access the calculation screen.

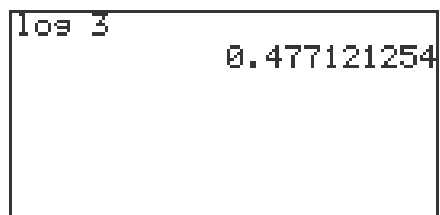
1. Find $\log 3$.

STEP 1: Enter log by pressing   .

STEP 2: Enter 3 by pressing the  key.




STEP 3: Calculate by pressing the  key.

The answer is 0.4771.



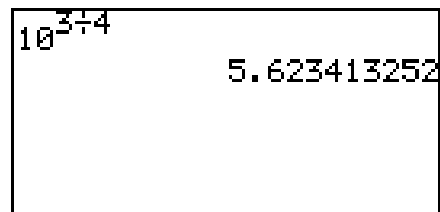
2. Find $10^{(3 \div 4)}$.

STEP 1: Enter 10 by pressing   .

STEP 2: Enter $(3 \div 4)$ by pressing   .

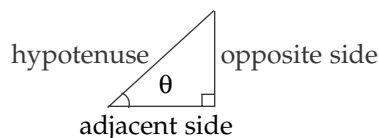
STEP 3: Calculate by pressing the  key.

The answer is 5.6234.



TRIGONOMETRIC FUNCTIONS

The definitions of the trigonometric functions with regard to the right triangle can be used to find distances between points. The sine function is defined to be opposite side/hypotenuse, the cosine function is adjacent side/hypotenuse, and the tangent function is opposite side/adjacent side.



Put the calculator in degree mode by pressing **2ndF** **SETUP** **B** **1** .

1. Find $\sin 30^\circ$.

STEP 1: Press **2ndF** **SIN** to access the calculation screen.

STEP 2: Enter sin 30 by pressing **MATH** **A** **1** **3** **0** .

STEP 3: Calculate by pressing the **ENTER** key.

The answer is 0.5.

2. Find $3\cos 20^\circ$.

STEP 1: Enter 3 cos 20 by pressing **3** **MATH** **A** **2** **2** **0** .

STEP 2: Calculate by pressing the **ENTER** key.

The answer is 2.819

3. Find $\tan 50^\circ$.

STEP 1: Enter tan 50 by pressing **MATH** **A** **3** **5** **0** .

STEP 2: Calculate by pressing the **ENTER** key.


The answer is 1.19.

Remember that cotangent = $1/\text{tangent}$, secant = $1/\text{cosine}$, and cosecant = $1/\text{sine}$.

TRIGONOMETRIC FUNCTIONS (continued)

Put the calculator in radian mode by pressing **2ndF** **SETUP** **B** **2**.

1. Find $\sin 2.1$.

STEP 1: Press  to access the calculation screen.

STEP 2: Enter $\sin 2.1$ by pressing **MATH** **A** **1** **2** **.** **1**.

STEP 3: Calculate by pressing the **ENTER** key.

The answer is .8632

2. Find $\cos (-1.7)$.

STEP 1: Enter $3 \cos (-1.7)$ by pressing **3** **MATH** **A** **2** **(-)** **1** **.** **7**.

STEP 2: Calculate by pressing the **ENTER** key.

The answer is -.3865

3. Find $\tan 0$.

STEP 1: Enter $\tan 0$ by pressing **MATH** **A** **3** **0**.

STEP 2: Calculate by pressing the **ENTER** key.

The answer is zero.

ANGLE CONVERSIONS

Angles can be expressed in degrees and radians. Degrees can be expressed in either decimal degrees or degrees-minutes-seconds. The sum of the angles of a triangle is 180° or π radians.

Press $\boxed{\div}\boxed{\times}\boxed{\div}\boxed{\times}$ to access the calculation screen.

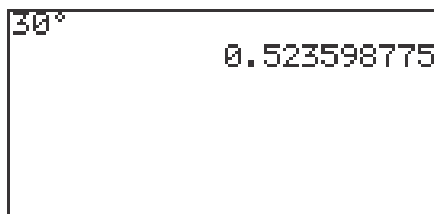
1. Convert 30° to radians.

Put the calculator in radian mode by pressing $\boxed{2\text{ndF}}\boxed{\text{SETUP}}\boxed{\text{B}}\boxed{2}\boxed{\div}\boxed{\times}\boxed{\div}\boxed{\times}$.

STEP 1: Enter 30° by pressing $\boxed{3}\boxed{0}\boxed{\text{MATH}}\boxed{\text{E}}\boxed{1}$.

STEP 2: Convert to radians by pressing $\boxed{\text{ENTER}}$.

The answer is 0.5236.

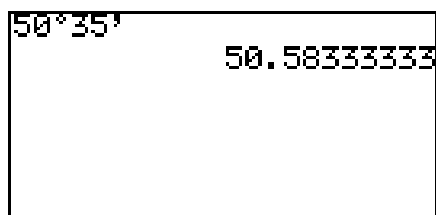


2. Convert $50^\circ 35'$ to decimal degrees.

STEP 1: Enter $50^\circ 35'$ by pressing $\boxed{5}\boxed{0}\boxed{\text{MATH}}\boxed{\text{E}}\boxed{1}\boxed{3}\boxed{5}\boxed{\text{MATH}}\boxed{\text{E}}\boxed{2}$.

STEP 2: Calculate decimal degrees by pressing $\boxed{\text{ENTER}}$.

The answer is 50.5833.



ANGLE CONVERSIONS (continued)

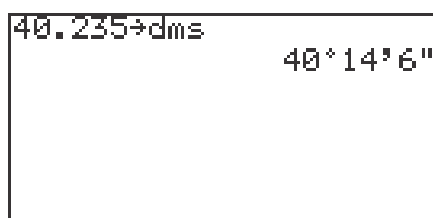
3. Convert 40.235° to degrees-minutes-seconds.

STEP 1: Enter 40.235° by pressing $\boxed{4} \boxed{0} \boxed{\cdot} \boxed{2} \boxed{3} \boxed{5}$.

STEP 2: Calculate degrees-minutes-seconds by pressing

$\boxed{\text{MATH}} \boxed{\text{D}} \boxed{2} \boxed{\text{ENTER}}$.

The answer is $40^\circ 14' 06''$.



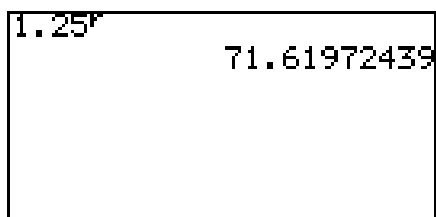
4. Convert 1.25 radians to degrees.

Put the calculator in degree mode by pressing $\boxed{2\text{ndF}} \boxed{\text{SETUP}} \boxed{\text{B}} \boxed{1} \boxed{\begin{smallmatrix} + & - \\ \times & \div \end{smallmatrix}}$.

STEP 1: Enter 1.25 radians by pressing $\boxed{1} \boxed{\cdot} \boxed{2} \boxed{5} \boxed{\text{MATH}}$
 $\boxed{\text{E}} \boxed{4}$.

STEP 2: Convert to degrees by pressing $\boxed{\text{ENTER}}$.

The answer is 71.6° .



PROBABILITY

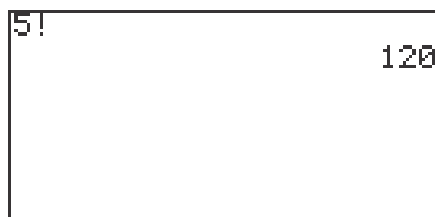
Press  to access the calculation screen.

1. Find five factorial or 5!.

STEP 1: Enter 5! by pressing    .




STEP 2: Calculate by pressing .

The answer is 120.



2. Find the number of combinations of 2 from a group of 5.

STEP 1: Enter the large number 5 by pressing .

STEP 2: Enter the combination symbol by pressing   .

STEP 3: Enter the small number 2 and calculate by pressing

 .

The answer is 10.

Permutations are found in the same manner.

3. Randomly select a person from an ordered group of 10.

STEP 1: Access the random integer command by pressing

  .

STEP 2: Enter the lower bound of 1 by pressing  .

STEP 3: Enter the upper bound of 10 by pressing   .

STEP 4: Calculate the random person by pressing .

Answers will vary.

ONE-VARIABLE STATISTICS

1. Calculate statistics for a one-variable data set.

STEP 1: Turn the calculator on and press **[STAT]** to enter the statistics menu.

Press **[A] (EDIT) [ENTER]** to view the statistics data entry screen.

If there is a data set present within the lists on your calculator, use the arrow keys to move to the list, if necessary, and press **[▲]** to highlight the list label. Press **[DEL] [ENTER]** to delete the old data. Repeat for other lists of data.

STEP 2: Move the highlighter to the cell directly below the L1 in the table.

Enter the following data set:

25 32 28 33 31 27 40 38 29 30

STEP 3: Check the data you have entered and correct any errors you may find.

Press **[2ndF] [QUIT]** to exit the data entry screen. To calculate the numerical descriptions of the data set, press **[STAT] [C] (CALC)** and **[1] (1_Stats)**.

Press **[ENTER]** and the statistical results will appear.

2. The statistics displayed are:

1. the average or mean value of the data set, \bar{x} ;
2. the standard deviation assuming the data set is a sample from a population, s_x ;
3. the standard deviation assuming the data set represents the entire population, σ_x ;
4. the sum of the data values, $\sum x$;
5. the sum of the squared data values, $\sum x^2$;

Press **[▼]** five times to see more of the statistics.

6. the number of values in the data set, n ;
7. the minimum value in the data set, x_{\min} ;
8. the first quartile (25th percentile), Q_1 ;
9. the median (50th percentile), Med ;
10. the third quartile (75th percentile), Q_3 ; and

Press **[▼]** one more time to see the final statistic.

11. the maximum value in the data set, x_{\max} .

HISTOGRAM FOR A ONE-VARIABLE DATA SET

Steps for creating a data set's histogram

STEP 1: Turn the calculator on, press **STAT** **A** (**EDIT**) **ENTER** to view the statistics data entry screen. Delete old data sets.

STEP 2: Move the highlighter to the cell directly below the L1 in the table and enter the following data set:

15 28 17 36 38 19 13 25 27 41

STEP 3: Check the data you have entered by pressing **▲** to move back through the data.

STEP 4: To graph a histogram that represents the data set, you must first press **STAT PLOT** **A** (**PLOT1**) and press **ENTER**. A PLOT1 setup screen will appear. Turn the plot on by pressing **ENTER**. Select one-variable data by pressing **▼** **ENTER**. Set the list to L1 by pressing **▼** **2ndF** **L1** **ENTER**. A blank Freq: prompt indicates the data is non-weighted and the frequencies are one. Choose the histogram graph by pressing **▼** **STAT PLOT** **A** (**HIST**) and **1** (**Hist**).

STEP 5: Set the calculator to rectangular graphing by pressing **2ndF** **SET UP** **E** (**COORD**) **1** (**Rect**) and press **2ndF** **QUIT**.

STEP 6: Set the viewing window by pressing **WINDOW**. Set the horizontal axis to $10 < x < 50$ with Xscl = 10 by pressing **1** **0** **ENTER** **5** **0** **ENTER** **1** **0** **ENTER**. Set the vertical axis to $0 < y < 5$ with Yscl = 1 by pressing **0** **ENTER** **5** **ENTER** **1** **ENTER**.

View the histogram by pressing **GRAPH**.

BOX-AND-WHISKER CHART FOR A ONE-VARIABLE DATA SET

Steps for creating a data set's box-and-whisker chart

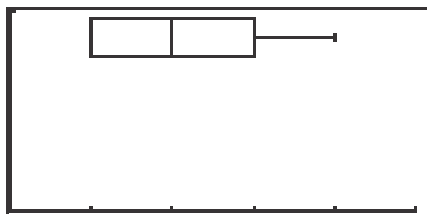
STEP 1: Press **[STAT]** to enter the statistics menu. Delete old data and enter the following data set in L1:

1 1 1 2 2 2 2 3 4 4

STEP 2: To construct a box-and-whisker chart, first press **[STAT PLOT]** **[A]** **[ENTER]**. Press **[ENTER]** to turn PLOT1 on. Press **[▼]** **[ENTER]** to choose one-variable data. Press **[▼]** **[2ndF]** **[L1]** **[ENTER]** to enter L1 as the data list. Leave the Freq prompt blank. Set the graph to a box-and-whisker chart by pressing **[▼]** **[STAT PLOT]** **[E (BOX)]** **[1]** **Box**.

STEP 3: In the example, the data is discrete with a smallest value of 1 and a largest value of 4. Set the viewing window to $0 < x < 5$ with Xscl = 1. Next, set the vertical axis to $0 < y < 1$ with Yscl = 1.

STEP 4: To view the box-and-whisker chart for the data, press **[GRAPH]**.



STEP 5: Press **[TRACE]** followed by **[◀]** and **[▶]** to view the five values making up the box-and whisker chart.

STEP 6: Turn PLOT1 off by pressing **[STAT PLOT]** **[ENTER]** **[▶]** **[ENTER]** **[2ndF]** **[QUIT]**.

PIE CHART FOR A ONE-VARIABLE DATA SET

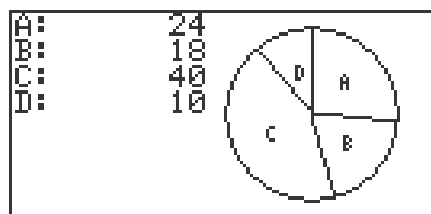
Steps for creating a pie chart from count data

STEP 1: Press **STAT** to enter the statistics menu. Delete old data and enter the following data set in L1 using weights in L2:

24 18 40 10

STEP 2: To construct a pie chart, first press **STAT PLOT** **ENTER** . Press **ENTER** to turn PLOT1 on. Press **▼** **ENTER** to choose one-variable data. Press **▼** **2ndF** **L1** **ENTER** to enter L1 as the data list. Leave the Freq prompt blank. Set the graph to a pie chart by pressing **▼** **STAT PLOT** **F** **(PIE)** **1** **(PIE)** .

STEP 3: To view the pie chart for the data, press **GRAPH** .



STEP 4: Press **TRACE** followed by **◀** and **▶** to highlight and mark the pieces of the pie chart.

STEP 5: Turn PLOT1 off by pressing **STAT PLOT** **ENTER** **▶** **ENTER** **2ndF** **QUIT** .

STATISTICS FOR A TWO-VARIABLE DATA SET

Steps for calculating statistics for a two-variable data set

STEP 1: Turn the calculator on and press **STAT** to enter the statistics menu. Press **A (EDIT)** **ENTER** to access the data entry screen. Delete old data by highlighting L1 and pressing **DEL** **ENTER**. Repeat for other lists.

STEP 2: Enter the following data set:

<u>X</u>	<u>Y</u>
25	32
28	33
31	27
40	38
29	30

STEP 3: Check the data you have entered and correct any errors you may find.

To calculate the numerical descriptions of the two variables, press **2ndF** **QUIT** **STAT** **C (CALC)** **2** **2_Stats**. Press **ENTER** and the statistical results will appear.

STEP 4: Press **▼** to view the remaining statistics.

The statistics displayed are:

1. the average or mean value of the variable, \bar{x} or \bar{y} ;
2. the standard deviation assuming the data points are a sample from a population, s_x or s_y ;
3. the standard deviation assuming the data points represents the entire population, σ_x or σ_y ;
4. the sum of the values, Σx or Σy ;
5. the sum of the squared values, Σx^2 or Σy^2 ;
6. the number of data points, n ;
7. the minimum variable value, x_{\min} or y_{\min} ;
8. the maximum variable value, x_{\max} or y_{\max} ; and
9. the sum of the x and y products, Σxy .

SCATTER DIAGRAM FOR A TWO-VARIABLE DATA SET

Steps for drawing a scatter diagram for a two-variable data set

STEP 1: Consider the following table listing the revenue for a large corporation:

Year	Revenue (in millions of dollars)
1	48.63
2	48.86
3	48.91
4	49.69
5	51.10
6	52.00
7	52.03

STEP 2: Access the statistics data entry screen and delete old data.

STEP 3: Enter the data using L1 for the year and L2 for the revenue (in millions of dollars). Check the data and correct any errors you may find.

STEP 4: Press **STAT PLOT** **A** **(PLOT1)** **ENTER** to access the PLOT1 set up screen. To turn PLOT 1 on, press **ENTER** . Press **▼** **►** **ENTER** to set the data to two-variable. Set L1 for the x variable by pressing **▼** **2ndF** **LIST** **A** **1** **ENTER** . Press **2ndF** **LIST** **2** **ENTER** to set L2 for the y variable. To set the graph to scatter diagram, press **STAT PLOT** **G** **(S.D.)** and **3** **(Scatter □)**.

STEP 5: Construct an autoscaled scatter diagram of this data set by pressing **ZOOM** **A** **(ZOOM)** **9** **(Stat)**.

Press **TRACE** and press **►** repeatedly to verify that Xmin= 1, Xmax= 7, Ymin= 48.63, and Ymax= 52.03.

LINEAR REGRESSIONS

Steps for calculating the best-fitting line

STEP 1: Turn the calculator on and press **STAT** to enter the statistics menu.

Access the data entry screen by pressing **A (EDIT)** **ENTER**.

Delete old data and enter the following data set:

<u>X</u>	<u>Y</u>
25	32
28	33
31	27
40	38
29	30

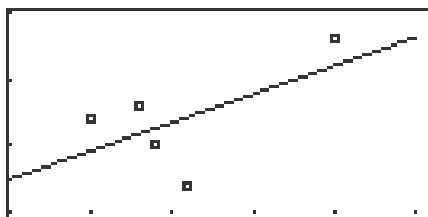
Check the data you have entered and correct any errors you may find.

STEP 2: To find the best-fitting line (regression line) for the data, press **2ndF** **STAT** **D (REG)** **0** **2 (Rg_ax+b)** and press **ENTER**.

STEP 3: To overlay the regression line and the scatter diagram for the data, you must first set up the scatter diagram by pressing **STAT PLOT** **A (PLOT1)** **ENTER** **ENTER** **▼** **►** **ENTER** **▼** **2ndF** **LIST** **A** **1** **ENTER** **2ndF** **LIST** **2** **ENTER** **STAT PLOT** **G (S.D.)** and **3 (Scatter □)**.

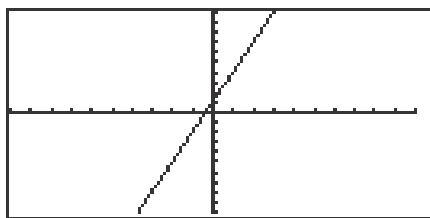
STEP 4: Display the scatter diagram for the data by pressing **WINDOW** and setting Xmin = 20, Xmax = 45, Xscl = 5, Ymin = 25, Ymax = 40, and Yscl = 5. Press **GRAPH** to view the scatter diagram.

STEP 5: To view the overlay of the regression line and the scatter diagram, press **Y=** **CL** **2ndF** **VARS** **H (STAT)** **ENTER** **B (REGEQN)** **1 (RegEqn)** **GRAPH**.



GRAPHING LINEAR EQUATIONS

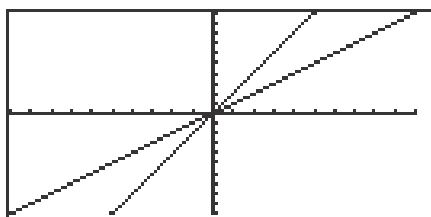
1. Turn the calculator on and press $\boxed{Y=}$.
2. Press \boxed{CL} to remove an old Y1 expression.
3. Enter the linear equation ($y = 3x + 1$) for Y1 by pressing $\boxed{3}$ \boxed{x} $\boxed{+}$ $\boxed{1}$.
4. Enter the viewing window range by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**). This establishes the default viewing ranges for graphing equations. These ranges are $-10 < x < 10$ and $-10 < y < 10$.
The scale for the x and y axes are 1.



5. To graph another equation, press $\boxed{Y=}$ \boxed{CL} to access and clear the Y1= prompt.
6. Enter the next equation, and press \boxed{GRAPH} to view the graph.
7. If the line does not appear in the default viewing window, press \boxed{ZOOM} $\boxed{4}$ (**OUT**) to enlarge the viewing window.

CHARACTERISTICS OF SLOPE

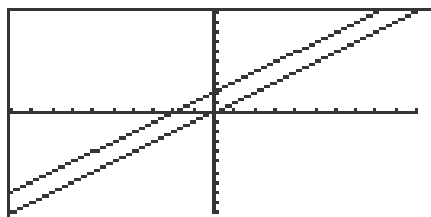
1. Graph the equation $y = 1x$ by pressing $\boxed{Y=}$ \boxed{CL} to remove an old Y1 expression, and press \boxed{x} to enter the equation.
2. Press \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**) to view the graph.
3. Changing the slope to 2 will result in the equation $y = 2x$. Enter this equation for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ $\boxed{2}$ \boxed{x} .
4. To view both the graphs on the same coordinate axes, press \boxed{GRAPH} .
The graph $y = 2x$ has a greater slope than $y = x$.



5. Changing the slope to $\frac{1}{2}$ will result in the equation $y = \frac{1}{2}x$. Enter this equation for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{CL} $\boxed{1}$ $\boxed{a/b}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ \boxed{x} .
6. To view both the graphs on the same coordinate axes, press \boxed{GRAPH} .
The graph $y = \frac{1}{2}x$ has less slope than $y = x$.
7. Changing the slope to -1 will result in the equation $y = -x$. Enter this equation for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{CL} $\boxed{(-)}$ \boxed{x} .
8. To view both the graphs on the same coordinate axes, press \boxed{GRAPH} .
The graph $y = -x$ has the opposite slope of $y = x$.

CHARACTERISTICS OF THE y-INTERCEPT

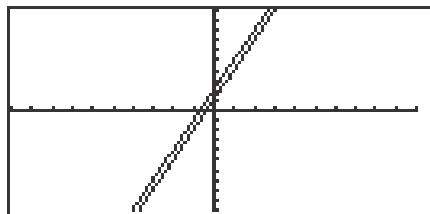
1. Graph the equation $y = x$ by pressing $\boxed{Y=}$ \boxed{CL} to remove an old Y1 expression, and press \boxed{x} to enter the equation.
2. Press \boxed{ENTER} \boxed{CL} to clear Y2 or additional prompts.
3. Use the default viewing range, and press \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**) to view the graph.
4. Adding 2 will result in the equation $y = x + 2$. Enter this equation for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{x} $\boxed{+}$ $\boxed{2}$.
5. To view both the graphs on the same coordinate axes, press \boxed{GRAPH} . The graph $y = x + 2$ has shifted up from the graph of $y = x$. The y-intercept is now $y = 2$.



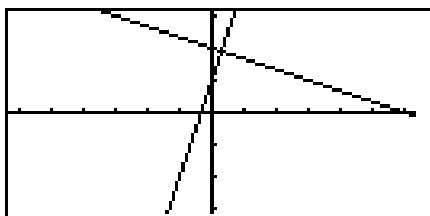
6. Subtracting 2 will result in the equation $y = x - 2$. Enter this equation for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{CL} \boxed{x} $\boxed{-}$ $\boxed{2}$.
7. To view both the graphs on the same coordinate axes, press \boxed{GRAPH} . The graph $y = x - 2$ has shifted down from the graph of $y = x$. The y-intercept is now $y = -2$.

PARALLEL AND PERPENDICULAR LINES

1. Enter the equations $Y_1 = 3X + 1$ and $Y_2 = 3X + 2$ by pressing $\boxed{Y=}$ \boxed{CL} $\boxed{3}$ \boxed{x} $\boxed{+}$ $\boxed{1}$ \boxed{ENTER} \boxed{CL} $\boxed{3}$ \boxed{x} $\boxed{+}$ $\boxed{2}$.
2. Press \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{5}$ **(Default)** to view the graphs.



3. These lines are called parallel since they have an equal slope but different y-intercepts. These lines will not intersect.
4. Enter the equations $Y_1 = 3X - 1$ and $Y_2 = -1/3 X + 1$ by pressing $\boxed{Y=}$ \boxed{CL} $\boxed{3}$ \boxed{x} $\boxed{-}$ $\boxed{1}$ \boxed{ENTER} \boxed{CL} $\boxed{(-)}$ $\boxed{1}$ $\boxed{a/b}$ $\boxed{3}$ $\boxed{\blacktriangleright}$ \boxed{x} $\boxed{+}$ $\boxed{1}$.
5. Press \boxed{ZOOM} \boxed{A} $\boxed{7}$ to view the graphs.

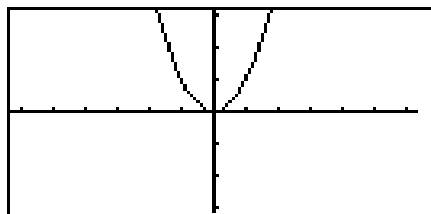


6. These line are called perpendicular since they have slopes that are negative reciprocals of each other ($m_1 = -1/m_2$). Notice, these intersecting lines form four equal angles.
7. Graph two lines with unequal slopes (not negative reciprocals). What do you see? Are the lines parallel, perpendicular or neither?

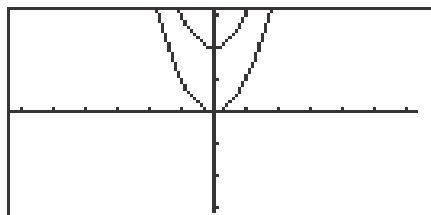
QUADRATIC EQUATIONS

Graphing and translations of quadratic equations

1. Turn the calculator on and press $\boxed{Y=}$. Press \boxed{CL} to remove an old Y1 expression. Press \boxed{ENTER} \boxed{CL} to remove an old Y2 expression.
2. To enter the quadratic equation ($y = x^2$) for Y1, press \boxed{x} $\boxed{x^2}$. Enter the viewing window range by pressing \boxed{ZOOM} \boxed{A} (**Zoom**) $\boxed{7}$ (**Dec**).



3. When 2 is added to x^2 , the resulting equation is $y = x^2 + 2$. Enter this function for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{x} $\boxed{x^2}$ $\boxed{+}$ $\boxed{2}$. Press \boxed{GRAPH} . What does the addition of 2 do?



4. When -2 is added to x^2 , the resulting equation is $y = x^2 - 2$. To change Y2 for this expression, press $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{CL} \boxed{x} $\boxed{x^2}$ $\boxed{-}$ $\boxed{2}$ \boxed{ENTER} \boxed{GRAPH} . What does the addition of -2 do?

EVALUATING A FUNCTION

1. For example, to evaluate $f(x)=x^2-2x+3$ for $x=3$, you will enter the function for Y1 by pressing $\boxed{Y=}$ \boxed{CL} \boxed{x} $\boxed{x^2}$ $\boxed{-}$ $\boxed{2}$ \boxed{x} $\boxed{+}$ $\boxed{3}$. Be sure to clear any other expressions.
2. Press $\boxed{2ndF}$ \boxed{QUIT} \boxed{CL} to return to and clear the calculation screen.
3. To evaluate the function at $x = 3$, first store 3 into the X variable by pressing $\boxed{3}$ \boxed{STO} \boxed{x} \boxed{ENTER} .
4. Evaluate the function stored in Y1 at 3 by pressing $\boxed{2ndF}$ \boxed{VARS} \boxed{A} $\boxed{1}$ \boxed{ENTER} .

$3 \rightarrow X$	3
Y1	6

5. Another way to evaluate a function for several values is using the Sharp's table feature. Press \boxed{TABLE} to view a table of values.

X	Y1		
0	3		
1	2		
2	3		
3	6		
4	11		
5	18		
X=0			

6. You can customize the table by pressing $\boxed{2ndF}$ \boxed{TBLSET} . You can set the table's minimum x value (**TBLStrt**) to another value than zero, and you can change the table's increment value (**TBLStep**) from 1 to another value.

OPERATIONS ON FUNCTIONS

1. Press $\boxed{Y=}$ and clear old expressions.
2. Enter the functions for Y1 and Y2. For example, enter $f(x)=2x + 1$ for Y1 and $g(x)=x^2$ for Y2 by moving the cursor to Y1 and pressing $\boxed{2} \boxed{x} \boxed{+} \boxed{1}$, press $\boxed{\nabla}$ to move the cursor to Y2, and press $\boxed{x} \boxed{x^2}$.

```

Y1=2X+1
Y2=X^2
Y3=
Y4=
Y5=
Y6=
    
```

3. Press $\boxed{2ndF} \boxed{QUIT} \boxed{CL}$ to return to and clear the calculation screen.
4. To evaluate $(f+g)(4)$, first store 4 into the X variable by pressing $\boxed{4} \boxed{STO} \boxed{x} \boxed{ENTER}$.
5. Evaluate $(f+g)(4)$ by pressing $\boxed{2ndF} \boxed{VARS} \boxed{A} \boxed{1}$ (Y1) $\boxed{+} \boxed{2ndF} \boxed{VARS} \boxed{2}$ (Y2) \boxed{ENTER} . This can be repeated for $(f-g)(x)$, $(fg)(x)$, and $(f/g)(x)$.

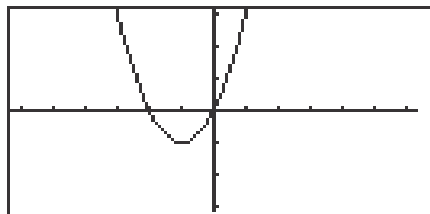
```

4→X
Y1+Y2
4
25
    
```

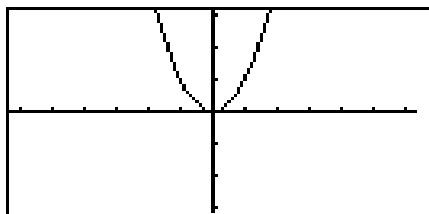
6. Another way to conduct an operation on functions and evaluate it for a value is to use Y3. Press $\boxed{Y=}$ and enter the operation $(f-g)(x)$ into Y3 by pressing $\boxed{2ndF} \boxed{VARS} \boxed{1}$ (Y1) $\boxed{-} \boxed{2ndF} \boxed{VARS} \boxed{2}$ (Y2). Press $\boxed{2ndF} \boxed{QUIT} \boxed{CL}$ to return to and clear the calculation screen. Press $\boxed{2ndF} \boxed{VARS} \boxed{3}$ Y3 $\boxed{(} \boxed{4} \boxed{)} \boxed{ENTER}$.

COMPOSITION OF FUNCTIONS

1. Press $\boxed{Y=}$ and clear old expressions.
2. Enter the two functions to be composed for Y1 and Y2. For example, enter $y=x^2-1$ for Y1 by pressing \boxed{x} $\boxed{x^2}$ $\boxed{-}$ $\boxed{1}$ $\boxed{\text{ENTER}}$ and $y=x+1$ for Y2 by pressing \boxed{x} $\boxed{+}$ $\boxed{1}$ $\boxed{\text{ENTER}}$.
3. Enter the composition of Y2 into Y1 for Y3 by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ \boxed{A} $\boxed{1}$ (Y1) $\boxed{(}$ $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{2}$ (Y2) $\boxed{)}$ $\boxed{\text{ENTER}}$.
4. Keep Y1 and Y2 graphs from appearing by deselecting Y1 and Y2. Do this by pressing $\boxed{\blacktriangle}$ $\boxed{\blacktriangle}$ $\boxed{\blacktriangle}$ $\boxed{\blacktriangleleft}$ $\boxed{\text{ENTER}}$ $\boxed{\blacktriangledown}$ $\boxed{\text{ENTER}}$.
5. Press $\boxed{\text{ZOOM}}$ \boxed{A} $\boxed{7}$ (Dec) to view the composition of Y2 into Y1 in the decimal window.



6. Change the Y3 composition to Y1 in Y2 by pressing $\boxed{Y=}$ $\boxed{\blacktriangledown}$ $\boxed{\blacktriangledown}$ $\boxed{\text{CL}}$ $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{2}$ (Y2) $\boxed{(}$ $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{1}$ (Y1) $\boxed{)}$.
7. Press $\boxed{\text{ZOOM}}$ \boxed{A} $\boxed{7}$ (Decimal) to view the composition of Y1 into Y2 in the decimal window.



FORMULAS

1. Press **2ndF** **QUIT** **CL** to return to and clear the calculation screen.
2. To evaluate the formula for the area of a trapezoid ($\text{Area}=(h/2)(a+b)$), where 'h' is the height between the two bases ('a' and 'b') for different values, you must first type in the formula. For example, to enter the area formula for a trapezoid, press **(** **ALPHA** **H** **÷** **2** **)** **(** **ALPHA** **A** **+** **ALPHA** **B** **)** **ENTER**.
3. Now, store the values for 'h,' 'a,' and 'b' into the calculator. Use h=1, a=2, and b=3. Store these by pressing **1** **STO** **ALPHA** **H** **ENTER** **2** **STO** **ALPHA** **A** **ENTER** **3** **STO** **ALPHA** **B** **ENTER**.

1÷H	1
2÷A	2
3÷B	3

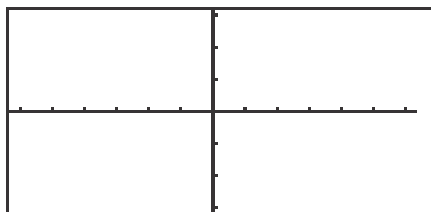
4. Clear the screen by pressing **CL**. Recall the formula by pressing **2ndF** **ENTRY** four times. Press **ENTER** to evaluate the formula for the stored values.

(H÷2)(A+B)	2.5
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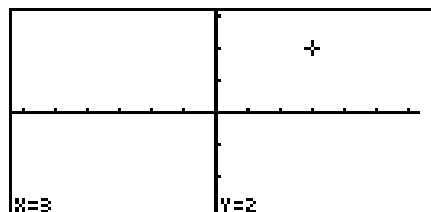
5. Change the height to 4 by pressing **4** **STO** **ALPHA** **H** **ENTER**. Recall the formula by pressing **2ndF** **ENTRY** two times and press **ENTER** to re-evaluate the formula for the new value.

GRAPHING CIRCLES

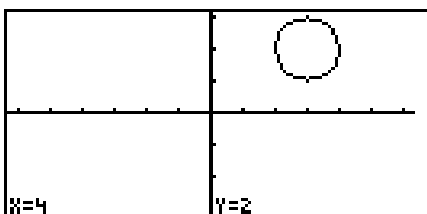
1. Press **Y=** and clear old expressions. Press **ZOOM** **A** **7** to view a clear viewing window.



2. To graph the circle in the form $(x-h)^2 + (y-k)^2 = r^2$, you will use the circle drawing feature. For example, in the circle $(x-3)^2 + (y-2)^2 = 1^2$, $h=3$, $k=2$ and $r=1$. Press **2ndF** **DRAW** **A** **9** **(Circle)**. Move the cursor right to an 'h' of $x=3$ by pressing **▶** repeatedly until $x=3$. Move the cursor up to a 'k' of $y=2$ by pressing **▲** repeatedly until $y=2$. Press **ENTER** to set the center point.



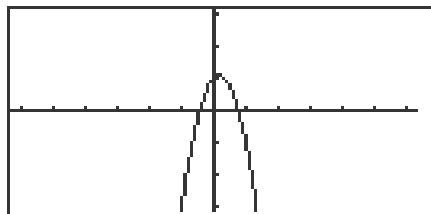
3. Move the cursor the length of the radius in one direction away from the center. In the example use the arrow key. Move the cursor 1 unit away from the center and press **ENTER**. The circle will be drawn with the cursor appearing at the point in the circle to which you moved.



4. If the circle will not completely appear in the viewing window, zoom out on the decimal window to a larger window, because any other windows may distort the circle. Draw the circle again in the larger window.

ZOOMING TO FIND ROOTS

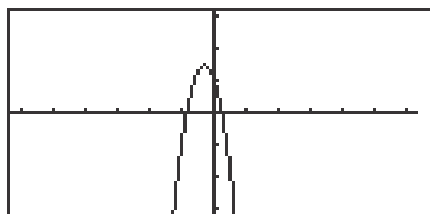
1. Turn the calculator on and press $\boxed{Y=}$. Y prompts will appear on the viewing window. Press \boxed{CL} to remove old Y expressions. Setup the calculator with rectangular coordinates and the equation editor mode by pressing $\boxed{2ndF} \boxed{SET UP} \boxed{E} \text{ (COORD)} \boxed{1} \text{ (Rect)} \boxed{G} \text{ (EDITOR)} \text{ and } \boxed{1} \text{ (Equation)}$. Press \boxed{CL} to exit the menu and return to the Y prompts.
2. To enter the polynomial $y = -3x^2 + x + 1$, press $\boxed{(-)} \boxed{3} \boxed{x} \boxed{x^2} \boxed{+} \boxed{x} \boxed{+} \boxed{1}$.
3. Press $\boxed{ZOOM} \boxed{A} \text{ (Zoom)} \boxed{7} \text{ (Dec)}$ to establish the decimal viewing window and view the graph. Press \boxed{TRACE} to engage the trace feature. Press $\boxed{\blacktriangleleft}$ to move the cursor near the left-hand root.



4. Press $\boxed{ZOOM} \boxed{A} \text{ (ZOOM)} \boxed{3} \text{ (In)}$ to zoom in on the left-hand root. Press \boxed{TRACE} and move the tracer to approximate the root.
5. Press $\boxed{ZOOM} \boxed{G} \text{ (RCL)} \boxed{2} \text{ (PreWin)}$ to return to the decimal viewing window. Press \boxed{TRACE} and move the tracer to find the right-hand root.
6. Press $\boxed{ZOOM} \boxed{A} \text{ (ZOOM)} \boxed{3} \text{ (In)}$ to zoom in. Press \boxed{TRACE} and move the tracer to approximate the root.

JUMPING TO FIND ROOTS

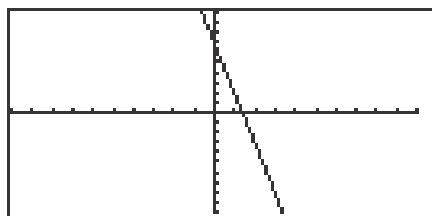
1. Press $\boxed{Y=}$ \boxed{CL} to return to and clear the Y1 prompt.
2. To enter the polynomial $y = -5x^2 - 3x + 1$, press $\boxed{(-)}$ $\boxed{5}$ \boxed{x} $\boxed{x^2}$ $\boxed{-}$ $\boxed{3}$ \boxed{x} $\boxed{+}$ $\boxed{1}$.
3. View the graph in the decimal viewing window by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{7}$ (**Dec**).



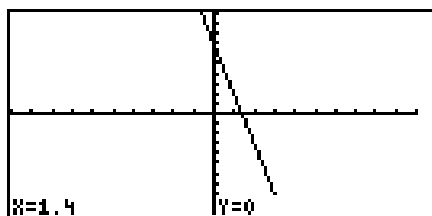
4. Press \boxed{TRACE} and move cursor to the left of the left-hand root. Press $\boxed{2ndF}$ \boxed{CALC} to view the calculate menu.
5. Press $\boxed{5}$ (**X_Incpt**) to find the left-hand root.
6. Press $\boxed{2ndF}$ \boxed{CALC} $\boxed{5}$ (**X_Incpt**) to find the next root.

INEQUALITIES

1. To solve $3(4 - 2x) \geq 5 - x$, rewrite it as $3(4 - 2x) - 5 + x \geq 0$ and determine the values of x where the function $y = 3(4 - 2x) - 5 + x$ is on or above the x -axis.
2. To do this, press $\boxed{Y=}$ \boxed{CL} and enter $3(4 - 2x) - 5 + X$ in the Y1 location.
3. Set the viewing window of the graph by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**). You should be able to clearly view the x -intercept.



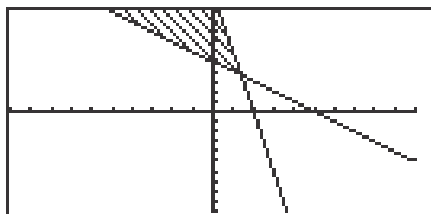
4. Locate the x -intercept at the point $(1.4, 0)$ by pressing $\boxed{2ndF}$ \boxed{CALC} and $\boxed{5}$ (**X_Incpt**).



5. Since the graph is above the x -axis, to the left of the x -intercept, the solution to the inequality $3(4 - 2x) - 5 + x \geq 0$ is all values of x such that $x \leq 1.4$.

INEQUALITIES

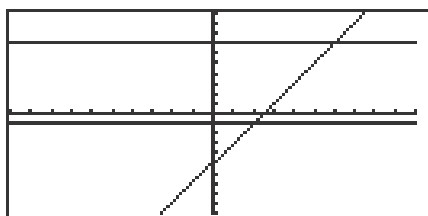
1. To solve the inequality $3(4 - 2x) \geq 5 - x$, press $\boxed{Y=}$ \boxed{CL} , enter $3(4 - 2X)$ for Y1 and $5 - X$ for Y2.
2. Set the viewing window by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**).
3. Next, shade the set of points that make the inequality true by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (**SHADE**) $\boxed{1}$ (**Set**) to access the "Set Shade" screen. Since the inequality you are solving is $Y1 \geq Y2$ the solution is where the graph of Y1 is "on the top" and Y2 is "on the bottom." Do this by pressing $\boxed{2ndF}$ \boxed{VAR} \boxed{A} \boxed{ENTER} $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{2ndF}$ \boxed{VAR} \boxed{ENTER} $\boxed{1}$. Press \boxed{GRAPH} to view the shaded region.



4. Press $\boxed{2ndF}$ \boxed{CALC} $\boxed{2}$ (**Intsct**) to find where the graphs intersect.
5. Since the shaded region is to the left of $x = 1.4$, the solution to the inequality $3(4 - 2x) \geq 5 - x$ is all values of x such that $x \leq 1.4$.
6. Turn off the shading by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (**SHADE**) $\boxed{2}$ (**INITIAL**).

DOUBLE INEQUALITIES

1. The inequality $-1 \leq 2x - 5 \leq 7$ is commonly referred to as a “double” inequality.
2. Clear any previously entered functions by pressing **Y=** **CL**.
3. Enter $Y1 = -1$, $Y2 = 2X - 5$, and $Y3 = 7$.
4. Press **ZOOM** **A** (**ZOOM**) **5** (**Default**) to view the line $y = 2x - 5$ between the lines $y = -1$ and $y = 7$.

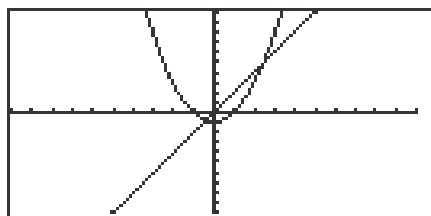


5. Press **2ndF** **CALC** **2** (**Intsct**) to find the point of intersection of the lines $y = 2x - 5$ and $y = -1$ at $(2, -1)$. Press **▲** to move the tracer to the $y = 7$ line. Press **2ndF** **CALC** **2** (**Intsct**) to find $y = 2x - 5$ and $y = 7$ at $(6, 7)$.
6. The solution to the “double” inequality $-1 \leq 2x - 5 \leq 7$ consists of all values of x in between, and including, 2 and 6 (i.e., $x \geq 2$ and $x \leq 6$). The solution is $2 \leq x \leq 6$.

SOLVING A SYSTEM OF EQUATIONS

Graphing a system of equations and using the calculate feature to find the solutions

1. Turn the calculator on and press $\boxed{Y=}$.
2. Press \boxed{CL} to clear an old Y1 expression. Press \boxed{ENTER} \boxed{CL} to clear additional Y prompts.
3. To enter the system of equations:
 $y = x^2 - 1$
 $y = 2x$
press \boxed{x} $\boxed{x^2}$ $\boxed{-}$ $\boxed{1}$ \boxed{ENTER} $\boxed{2}$ \boxed{x} . View the graphs by pressing \boxed{ZOOM} \boxed{A} (Zoom) $\boxed{5}$ (Default).



4. Press $\boxed{2ndF}$ \boxed{CALC} to access the calculate feature. Press $\boxed{2}$ (Intsct). The left-hand intersection will appear on the screen.
5. Press $\boxed{2ndF}$ \boxed{CALC} to access the calculate feature again. Press $\boxed{2}$ (Intsct). The right-hand intersection will appear on the screen.

CREATING A NEW PROGRAM

1. The Basic keyboard can only execute a program. Use the Advanced Keyboard to enter and check the program.
2. Turn the calculator on and press **PRGM** to enter the programming menu. The menu consists of commands to execute, edit, and create new programs.
3. 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.
4. 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.
5. Press **CL** to exit the program commands. When entering a new program, you must press **ENTER** at the end of each line.
6. If you make a mistake entering a program, use the calculator's editing feature 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 with the Advanced Keyboard, 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.
4. Once the program is working, you can execute the program from the Basic Keyboard.

PRIME FACTORIZATION

1. Program the calculator to find the prime factorization of a whole number greater than 2. This method decomposes a number into the prime factors 2, 3, 5, etc.
2. Create a new program with the name DECOMP. 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 using the Advanced Keyboard:

Input N	PRGM A 3 ALPHA N ENTER
2⇒D	2 STO ALPHA D ENTER
Label A	PRGM B 0 1 ALPHA A ENTER
If (N÷D) = int	PRGM B 0 3 (ALPHA N ÷
(N÷D) Goto B	ALPHA D) ALPHA = MATH B 0 5
	(ALPHA N ÷ ALPHA D)
	PRGM B 0 2 ALPHA B ENTER
D+1⇒D	ALPHA D + 1 STO ALPHA D
	ENTER
If D ≤ √N Goto A	PRGM B 0 3 ALPHA D MATH
	F 6 2ndF √ ALPHA N PRGM
	B 0 2 ALPHA A ENTER
Goto C	PRGM B 0 2 ALPHA C ENTER
Label B	PRGM B 0 1 ALPHA B ENTER
N÷D⇒N	ALPHA N ÷ ALPHA D STO ALPHA
	N ENTER
Print D	PRGM A 1 ALPHA D ENTER
Goto A	PRGM B 0 2 ALPHA A ENTER
Label C	PRGM B 0 1 ALPHA C ENTER
Print N	PRGM A 1 ALPHA N ENTER
End	PRGM A 6 ENTER

Press **2ndF** **QUIT** to exit the editor.

PRIME FACTORIZATION (continued)

4. Execute the DECOMP program from the Basic Keyboard by pressing **PRGM** and selecting **DECOMP**. Enter the number for which you want to find the prime factorization. Try 56. Press **5** **6** **ENTER** to find the prime factorization of 56. You should then see the following prime factorization.

DECOMP	
N=	
56	
	2
	2
	2
	7

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.

COMMON FACTORS

1. Program the calculator to find the common factors and the greatest common factor of any pair of whole numbers.
2. Create a new program with the name FACTORS. 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 using the Advanced Keyboard:

Input A	PRGM A 3 ALPHA A ENTER
Input B	PRGM A 3 ALPHA B ENTER
2⇒D	2 STO ALPHA D ENTER
Label A	PRGM B 0 1 ALPHA A ENTER
If fpart (A÷D)π0	PRGM B 0 3 MATH B 4 (
Goto B	ALPHA A ÷ ALPHA D) MATH F
	2 0 PRGM B 0 2 ALPHA B
	ENTER
If fpart (B÷D)π0	PRGM B 0 3 MATH B 4 (
Goto B	ALPHA B ÷ ALPHA D) MATH F
	2 0 PRGM B 0 2 ALPHA B
	ENTER
Print D	PRGM A 1 ALPHA D ENTER
Label B	PRGM B 0 1 ALPHA B ENTER
D+1⇒D	ALPHA D + 1 STO ALPHA D
	ENTER
If D≤min(A,B)	PRGM B 0 3 ALPHA D MATH
Goto A	F 6 MATH B 6 ALPHA A ,
	ALPHA B) PRGM B 0 2
	ALPHA A ENTER
End	PRGM A 6 ENTER

COMMON FACTORS (continued)

4. Execute the FACTORS program from the Basic Keyboard by pressing **PRGM** and selecting **FACTORS**. Enter the numbers for which you want to find the common factors. Try 60 and 48. Press **6** **0** **ENTER** **4** **8** **ENTER** to find the common factors of 60 and 48. You should then see the following common factors.



A calculator screen displaying the common factors of 60 and 48. On the left side, the numbers 60, 48, and an equals sign (=) are stacked vertically. On the right side, the common factors 2, 3, 4, 6, and 12 are stacked vertically.

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.

SYNTHETIC DIVISION

1. Program the calculator to perform synthetic division of a polynomial by a linear divisor.
2. Create a new program with the name **SYNTHETI**. 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 using the Advanced Keyboard:

Input D	PRGM A 3 ALPHA D ENTER
0⇒P	0 STO ALPHA P ENTER
{D+1,1}⇒	2ndF { ALPHA D + 1 , 1 2ndF
dim(mat A)	} STO 2ndF MATRIX C 0 1 2ndF
	MATRIX A 1) ENTER
Print "COEFFIC	PRGM A 1 PRGM 2
IENTS P(X)	2ndF A-LOCK C O E F F I
	C I E N T S SPACE P ALPHA
	(X/θ/T/n) ENTER
Label A	PRGM B 0 1 ALPHA A ENTER
P+1⇒P	ALPHA P + 1 STO ALPHA P
	ENTER
Input C	PRGM A 3 ALPHA C ENTER
C⇒mat A(P,1)	ALPHA C STO 2ndF MATRIX A 1 (
	ALPHA P , 1) ENTER
If P<D+1	PRGM B 0 3 ALPHA P MATH
Goto A	F 5 ALPHA D + 1 PRGM
	B 0 2 ALPHA A ENTER
Label B	PRGM B 0 1 ALPHA B ENTER
Input R	PRGM A 3 ALPHA R ENTER
Label C	PRGM B 0 1 ALPHA C ENTER
1⇒P	1 STO ALPHA P ENTER
0⇒S	0 STO ALPHA S ENTER

SYNTHETIC DIVISION (continued)

Print "COEFFICIENTS Q(X)	PRGM	A	1	PRGM	2				
	2ndF	A-LOCK	C	O	E	F	F	I	C
	I	E	N	T	S	SPACE	Q	ALPHA	(
	X/θ/T/n	)	ENTER						
Label D	PRGM	B	0	1	ALPHA	D	ENTER		
mat A(P,1)⇒F	2ndF	MATRIX	A	1	(	ALPHA	P	,	1
	)	STO	ALPHA	F	ENTER				
F+S⇒Q	ALPHA	F	+	ALPHA	S	STO	ALPHA		
	Q	ENTER							
Print Q	PRGM	A	1	ALPHA	Q	ENTER			
Wait	PRGM	A	4	ENTER					
R×Q⇒S	ALPHA	R	×	ALPHA	Q	STO	ALPHA		
	S	ENTER							
P+1⇒P	ALPHA	P	+	1	STO	ALPHA	P		
	ENTER								
If P<D+1	PRGM	B	0	3	ALPHA	P	MATH		
Goto D	F	5	ALPHA	D	+	1	PRGM	B	0
	2	ALPHA	D	ENTER					
mat A(P,1)⇒F	2ndF	MATRIX	A	1	(	ALPHA	P	,	1
	)	STO	ALPHA	F	ENTER				
F+S⇒Q	ALPHA	F	+	ALPHA	S	STO	ALPHA		
	Q	ENTER							
Print	PRGM	A	1	PRGM	2	2ndF			
"REMAINDER	A-LOCK	R	E	M	A	I	N	D	E
	ALPHA	ENTER							
Print Q	PRGM	A	1	ALPHA	Q	ENTER			
End	PRGM	A	6	ENTER					
Press	2ndF	QUIT	to exit the editor.						

SYNTHETIC DIVISION (continued)

4. Execute the SYNTHETI program from the Basic Keyboard by pressing **PRGM** and selecting **SYNTHETI**. Use synthetic division to divide $P(x) = 2x^3 + 3x^2 + 4x + 5$ by $x - 1$. Enter the degree for $P(x)$ by pressing **3** **ENTER**. Next enter the coefficients and constant for $P(x)$ by pressing **2** **ENTER** **3** **ENTER** **4** **ENTER** **5** **ENTER**. Enter the r value of 1 by pressing **1** **ENTER**. The first coefficient of $Q(x)$ will appear. Press **ENTER** to see additional coefficients. The remainder will be shown to end the program. You should then see the following coefficients, constant and remainder ($Q(x) = 2x^2 + 5x + 9$, remainder = 14).

R=	
1	
COEFFICIENTS Q(X)	
	2
	5
	9
REMAINDER	14

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.

RANDOM WALKS

1. Program the calculator to graph a random walk. A random walk can go in any direction for a random distance. This program stops when the graph tries to go outside the calculator display.
2. Create a new program with the name WALK. 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 using the Advanced Keyboard:

ClrDraw	2ndF DRAW A 1 ENTER
0⇒D	0 STO ALPHA D ENTER
.5⇒X	. 5 STO X/θ/T/n ENTER
.5⇒Y	. 5 STO ALPHA Y ENTER
Label A	PRGM B 0 1 ALPHA A ENTER
.2(random-.5)⇒H	. 2 (MATH C 1 - . 5) STO ALPHA H ENTER
.2(random-.5)⇒K	. 2 (MATH C 1 - . 5) STO ALPHA K ENTER
Line(X,Y,X+H, Y+K)	2ndF DRAW A 2 X/θ/T/n , ALPHA Y , X/θ/T/n + ALPHA H , ALPHA Y + ALPHA K) ENTER
X+H⇒X	X/θ/T/n + ALPHA H STO X/θ/T/n ENTER
Y+K⇒Y	ALPHA Y + ALPHA K STO ALPHA Y ENTER
If X<0 Goto B	PRGM B 0 3 X/θ/T/n MATH F 5 0 PRGM B 0 2 ALPHA B ENTER
If X>1 Goto B	PRGM B 0 3 X/θ/T/n MATH F 3 1 PRGM B 0 2 ALPHA B ENTER
If Y<0 Goto B	PRGM B 0 3 ALPHA Y MATH F 5 0 PRGM B 0 2 ALPHA B ENTER

RANDOM WALKS (continued)

If Y>1 Goto B	PRGM	B	0	3	ALPHA	Y	MATH	F	3
	1	PRGM	B	0	2	ALPHA	B	ENTER	
$D + \sqrt{(H^2 + K^2)} \Rightarrow D$	ALPHA	D	+	2ndF	$\sqrt{}$	(ALPHA	H	
	x^2	+	ALPHA	K	x^2	)	STO	ALPHA	
	D	ENTER							
Goto A	PRGM	B	0	2	ALPHA	A	ENTER		
Label B	PRGM	B	0	1	ALPHA	B	ENTER		
Print D	PRGM	A	1	ALPHA	D	ENTER			
End	PRGM	A	6	ENTER					

4. First, 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 **WINDOW** **0** **ENTER** **1** **ENTER** **1** **ENTER** **0** **ENTER** **1** **ENTER** **1** **ENTER**. Execute the WALK program by pressing **PRGM** and selecting WALK. The program will show you the random walk and then display the distance traveled in the walk. If your walk is short, then press **ENTER** to execute the program again. When you have a long walk, press **GRAPH** to view the graph. A long walk is greater than 10.

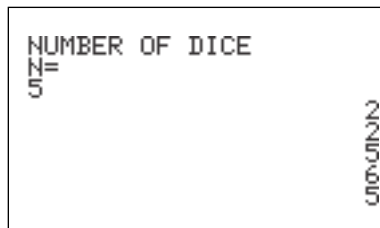
ROLLING DICE

1. Program the calculator to roll a set of dice.
2. Create a new program with the name ROLLING. 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 using the Advanced Keyboard:

Print "NUMBER	PRGM	A	1	PRGM	A	2	2ndF		
OF DICE	A-LOCK	N	U	M	B	E	R		
	SPACE	O	F	SPACE	D	I	C	E	ENTER
Input N	PRGM	A	3	ALPHA	N	ENTER			
0⇒K	0	STO	ALPHA	K	ENTER				
Label A	PRGM	B	0	1	ALPHA	A	ENTER		
Print int (	PRGM	A	1	MATH	B	5	(
random×6)+1	MATH	C	1	×	6)	+	1	ENTER
K+1⇒K	ALPHA	K	+	1	STO	ALPHA	K		
	ENTER								
If K<N	PRGM	B	0	3	ALPHA	K	MATH		
Goto A	F	5	ALPHA	N	PRGM	B	0	2	
	ALPHA	A	ENTER						
End	PRGM	A	6	ENTER					

ROLLING DICE (continued)

4. Execute the ROLLING program by pressing **PRGM** and selecting ROLLING. Enter the number of dice, up to eight, that you wish the calculator to roll for you. Roll five dice by pressing **5** **ENTER** . The program will show the five values for the dice on the screen. You should see a screen similar to the following (the values for the dice should be different).



PYTHAGOREAN TRIPLES

1. Program the calculator to find Pythagorean triples. Pythagorean triples are three numbers x, y, and z that satisfy $x^2 + y^2 = z^2$.
2. Create a new program with the name PYTHAG. 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 using the Advanced Keyboard:

Input N	PRGM	A	3	ALPHA	N	ENTER
2⇒J	2	STO	ALPHA	J	ENTER	
1⇒K	1	STO	ALPHA	K	ENTER	
Label A	PRGM	B	0	1	ALPHA	A
If $\sqrt{(J^2+K^2)} \neq \text{ipart}$	PRGM	B	0	3	2ndF	$\sqrt{\phantom{x}}$
$(\sqrt{(J^2+K^2)})$ Goto B	x^2	+	ALPHA	K	x^2)
	MATH	F	2			
	MATH	B	3	(	2ndF	$\sqrt{\phantom{x}}$
	(	ALPHA	J	x^2	+	ALPHA
	K	x^2	)	)	PRGM	B
	0	2	ALPHA	B	ENTER	
Print J	PRGM	A	1	ALPHA	J	ENTER
Print K	PRGM	A	1	ALPHA	K	ENTER
Print $\sqrt{(J^2+K^2)}$	PRGM	A	1	2ndF	$\sqrt{\phantom{x}}$	(
	ALPHA	J	x^2	+	ALPHA	K
	x^2	)	ENTER			
Print “	PRGM	A	1	PRGM	A	2
Wait	PRGM	A	4	ENTER		
Label B	PRGM	B	0	1	ALPHA	B
K+1⇒K	ALPHA	K	+	1	STO	ALPHA
If $K \leq (J-1)$	PRGM	B	0	3	ALPHA	K
Goto A	F	6	(	ALPHA	J	-
	1	)	PRGM	B	0	
	2	ALPHA	A	ENTER		
J+1⇒J	ALPHA	J	+	1	STO	ALPHA
1⇒K	1	STO	ALPHA	K	ENTER	
If $J \leq N$	PRGM	B	0	3	ALPHA	J
	MATH					

PYTHAGOREAN TRIPLES (continued)

Goto A

[F] [6] [ALPHA] [N] [PRGM] [B] [0] [2]

[ALPHA] [A] [ENTER]

End

[PRGM] [A] [6] [ENTER]

- Execute the PYTHAG program by pressing [PRGM] and selecting **PYTHAG**. Enter the upper bound for the Pythagorean triples. Set the upper bound to 15 by pressing [1] [5] [ENTER]. The program will show the first Pythagorean triple. Press [ENTER] to view additional triples. You should see screens similar to the following ones.

```

      4
      5
      6
      7
      8
      9
     10
  
```

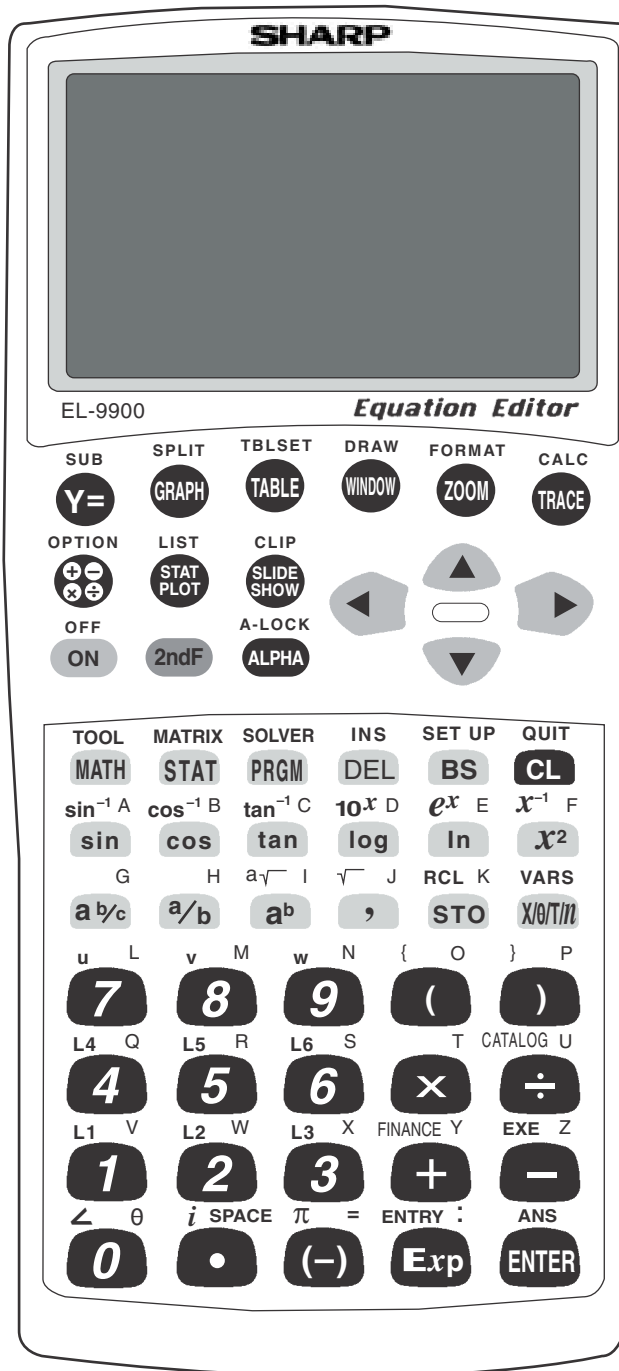
```

     12
     13
     14
     15
  
```

Sharp EL-9900

Graphing Calculator

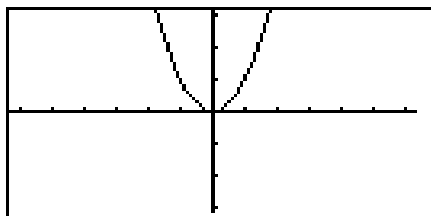
Advanced Keypad



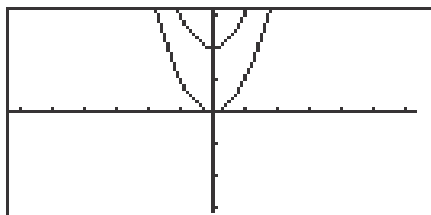
QUADRATIC EQUATIONS

Graphing and translations of quadratic equations

1. Turn the calculator on and press $\boxed{Y=}$. Press \boxed{CL} to remove an old Y1 expression. Press \boxed{ENTER} \boxed{CL} to remove an old Y2 expression.
2. To enter the quadratic equation ($y = x^2$) for Y1, press $\boxed{X/\theta/T/n}$ $\boxed{x^2}$. Enter the viewing window range by pressing \boxed{ZOOM} \boxed{A} **(Zoom)** $\boxed{7}$ **(Dec)**.



3. When 2 is added to x^2 , the resulting equation is $y = x^2 + 2$. Enter this function for Y2 by pressing $\boxed{Y=}$ $\boxed{\nabla}$ $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{+}$ $\boxed{2}$. Press \boxed{GRAPH} . What does the addition of 2 do?



4. When -2 is added to x^2 , the resulting equation is $y = x^2 - 2$. To change Y2 for this expression, press $\boxed{Y=}$ $\boxed{\nabla}$ \boxed{CL} $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{2}$ \boxed{ENTER} \boxed{GRAPH} . What does the addition of -2 do?
5. Summarize the effect of k within the standard equation $y = a(x - h)^2 + k$.

FORMULAS OR LITERAL EQUATIONS

Steps for solving an equation using the equation method

1. Turn the calculator on and press **2ndF** **SOLVER** to access the solver feature. A blank screen should appear. If the screen is not blank, then press **CL** to clear the screen.
2. Select the Equation method for solving by pressing **2ndF** **SOLVER**, **A** (METHOD) **1** (Equation).

3. Enter the formula $P = L \left[\frac{1 - (1 + I/12)^{-N}}{I/12} \right]^{-1}$

Press **ALPHA** **P** **ALPHA** **=** **ALPHA** **L** **(** **a/b** **1** **-** **(** **1** **+** **ALPHA** **I** **÷** **1** **2** **)** **a^b** **(-)** **ALPHA** **N** **▶▶** **ALPHA** **I** **÷** **1** **2** **▶▶** **)** **a^b** **(-)** **1** **.**

This equation is referred to as the amortization formula, with a loan (L) with a fixed rate of interest (I).

4. Press **ENTER** to view the variable list. To find the monthly payment on a \$15,000 car loan made at 9% interest over four years (48 months), enter the values by pressing **▼** **1** **5** **0** **0** **0** **ENTER** **•** **0** **9** **ENTER** **4** **8** **ENTER**. Press **▲** **▲** **▲** and notice the payment (P) is now highlighted by the cursor, press **2ndF** **EXE** to solve for the payment.
5. Pressing **CL** will return you to the variable screen. You can now change or solve for any of the values. Save this formula by pressing **2ndF** **SOLVER** **C** (SAVE) **ENTER** and entering the formula name. Give the formula the name AMORT by pressing **A** **M** **O** **R** **T** **ENTER**.

FORMULAS OR LITERAL EQUATIONS

Steps for solving an equation using the graphic method

1. Turn the calculator on and press **2ndF** **SOLVER** to access the solver feature. Press **CL** to clear the formula entry screen.
Select the Graphic method for solving by pressing **2ndF** **SOLVER** **A** **(METHOD)** **3** **(Graphic)**.
2. Enter the formula $V = \pi r^2 h$ by pressing **ALPHA** **V** **ALPHA** **=** **2ndF** **π** **ALPHA** **R** **a^b** **2** **▶** **ALPHA** **H**.
3. This equation is the formula for calculating the volume of a cylinder (V) in terms of the cylinder's height (H) and radius (R). Press **ENTER** to view the variable list.
4. To find the radius of a cylinder with a volume of 30 cubic inches, and a height of 10 inches, enter the values by pressing **3** **0** **ENTER** **▼** **1** **0** **ENTER**. Press **▲** and notice the radius (R) is now highlighted by the cursor.
5. Press **2ndF** **EXE** to solve for the radius. The graphic solver will prompt you for a variable range to solve within. Set the variable range to 0 and 2 by pressing **0** **ENTER** **2** **ENTER**.
6. Press **2ndF** **EXE** to solve.
7. Pressing **CL** will return you to the variable screen. You can now change or solve for any of the values. Save this formula by pressing **2ndF** **SOLVER**, **C** **(SAVE)** pressing **ENTER**, and entering the formula name. Give the formula the name VCYL by pressing **V** **C** **Y** **L** **ENTER**.

FORMULAS OR LITERAL EQUATIONS

Solving an equation using Newton's method

1. Press **2ndF** **SOLVER** to enter the solver feature. Press **CL** to clear the formula entry screen.
2. Select the Newton's method for solving by pressing **2ndF** **SOLVER**, **A** (**METHOD**) **2** (**Newton**). Enter the formula $A = \frac{1}{2} H(B + C)$ by pressing **ALPHA** **A** **ALPHA** **=** **1** **a/b** **2** **▶** **ALPHA** **H** **(** **ALPHA** **B** **+** **ALPHA** **C** **)**.
3. Press **ENTER** to view the variable list. To find the height of a trapezoid with an area of 25 in², and bases of length 5 and 7 inches, enter the values by pressing **2** **5** **ENTER** **▼** **5** **ENTER** **7** **ENTER** **▲** **▲**. Notice the height (H) is now highlighted by the cursor.
4. Press **2ndF** **EXE** to continue. Newton's method will prompt you for a guess or starting point. Enter a starting point of 1 by pressing **1** **ENTER**.
5. Press **2ndF** **EXE** to solve. A height of 4.1667 will appear on the screen.
6. Pressing **CL** will return you to the variable screen. You can now change or solve for any of the values. Save this formula by pressing **2ndF** **SOLVER**, **C** (**SAVE**) **ENTER** and entering the formula name. Give the formula the name "ATRAP," by pressing **A** **T** **R** **A** **P** **ENTER**.

GRAPHING POLYNOMIALS AND FINDING THE ROOTS

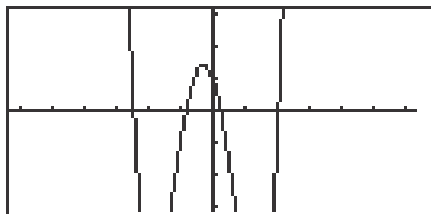
Graphing a polynomial and zooming to find the roots

1. Turn the calculator on and press $\boxed{Y=}$. Y prompts will appear on the viewing window. Press \boxed{CL} to remove old Y expressions. Setup the calculator with rectangular coordinates and the equation editor mode by pressing $\boxed{2ndF} \boxed{SETUP} \boxed{E} \text{ (COORD)} \boxed{1} \text{ (Rect)} \boxed{G} \text{ (EDITOR)}$ and $\boxed{1} \text{ (Equation)}$. Press \boxed{CL} to exit the menu and return to the Y prompts.
2. To enter the polynomial $y = x^3 - 3x^2 + x + 1$, press $\boxed{X/\theta/T/n} \boxed{a^b} \boxed{3} \boxed{\blacktriangleright} \boxed{-} \boxed{3} \boxed{X/\theta/T/n} \boxed{x^2} \boxed{+} \boxed{X/\theta/T/n} \boxed{+} \boxed{1}$.
3. Press $\boxed{ZOOM} \boxed{A} \text{ (Zoom)} \boxed{7} \text{ (Dec)}$ to establish the decimal viewing window and view the graph. Press \boxed{TRACE} to engage the trace feature. Press $\boxed{\blacktriangleleft}$ to move the cursor near the left-hand root.
4. Set the zoom factors to 5 by pressing $\boxed{ZOOM} \boxed{B} \text{ (FACTOR)}$ press $\boxed{ENTER} \boxed{5} \boxed{ENTER} \boxed{5} \boxed{ENTER}$. Press $\boxed{ZOOM} \boxed{A} \text{ (ZOOM)} \boxed{3} \text{ (In)}$ to zoom in on the left-hand root. Press \boxed{TRACE} and move the tracer to approximate the root.
5. Press $\boxed{ZOOM} \boxed{H} \text{ (RCL)} \boxed{2} \text{ (PreWin)}$ to return to the decimal viewing window. Press \boxed{TRACE} and move the tracer to find the middle root.
6. Press $\boxed{\blacktriangleright}$ repeatedly to move the tracer near the right-hand root. Press $\boxed{ZOOM} \boxed{A} \text{ (ZOOM)} \boxed{3} \text{ (In)}$ to zoom in. Press \boxed{TRACE} and move the tracer to approximate the root.

GRAPHING POLYNOMIALS AND FINDING THE ROOTS

Graphing a polynomial and jumping to find the roots

1. Press $\boxed{\text{Y=}}$ $\boxed{\text{CL}}$ to return to and clear the Y1 prompt.
2. To enter the polynomial $y = x^4 + x^3 - 5x^2 - 3x + 1$, press $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{\text{a}^{\text{b}}}$ $\boxed{4}$ $\boxed{\blacktriangleright}$ $\boxed{+}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{\text{a}^{\text{b}}}$ $\boxed{3}$ $\boxed{\blacktriangleright}$ $\boxed{-}$ $\boxed{5}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{3}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{+}$ $\boxed{1}$.
3. View the graph in the decimal viewing window by pressing $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ (**ZOOM**) $\boxed{7}$ (**Dec**).

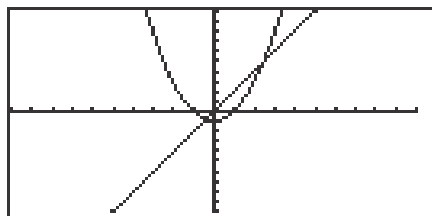


4. Press $\boxed{\text{TRACE}}$ and move cursor to the left of the left-hand root. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ to view the calculate menu.
5. Press $\boxed{5}$ (**X_Incpt**) to find the left-hand root.
6. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{5}$ (**X_Incpt**) to find the next root.
7. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{5}$ (**X_Incpt**) to find the next root.
8. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{5}$ (**X_Incpt**) to find the next root.

SOLVING A SYSTEM OF EQUATIONS

Graphing a system of equations and using the calculate feature to find the solutions

1. Turn the calculator on and press $\boxed{Y=}$.
2. Press \boxed{CL} to clear an old Y1 expression. Press \boxed{ENTER} \boxed{CL} to clear additional Y prompts.
3. To enter the system of equations:
 $y = x^2 - 1$
 $y = 2x$
press $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{1}$ \boxed{ENTER} $\boxed{2}$ $\boxed{X/\theta/T/n}$. View the graphs by pressing \boxed{ZOOM} \boxed{A} **(Zoom)** $\boxed{5}$ **(Default)**.



4. Press $\boxed{2ndF}$ \boxed{CALC} to access the calculate feature. Press $\boxed{2}$ **(Intsct)**. The left-hand intersection will appear on the screen.
5. Press $\boxed{2ndF}$ \boxed{CALC} to access the calculate feature again. Press $\boxed{2}$ **(Intsct)**. The right-hand intersection will appear on the screen.

MATRIC SOLUTIONS TO SYSTEMS OF LINEAR EQUATIONS

1. Press **2ndF** **MATRIX** to access the matrix menu.
2. Press **B** **(EDIT)** **1** **(mat A)** to select matrix A.
3. Now, enter the size or dimension of the matrix. We will enter the 3×3 matrix.

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & -1 \\ 1 & 1 & -2 \end{bmatrix}$$
 Press **3** **ENTER** **3** **ENTER** to set the dimension of the matrix at three rows by three columns.
4. The calculator will now prompt you for the matrix. Enter the elements of the matrix by pressing **1** **ENTER** **2** **ENTER** **1** **ENTER** **2** **ENTER** **1** **ENTER** **(-)** **1** **ENTER** **1** **ENTER** **1** **ENTER** **(-)** **2** **ENTER**.
5. Press **2nd** **QUIT** to exit the display of matrix A.
6. Repeat the process to enter a 3×3 matrix B =

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}.$$
7. Matrix multiplication can be performed if the number of columns of the first matrix is equal to the number of rows of the second matrix. In the matrix multiplication $A \times B$, the elements in the first row of A are multiplied to the corresponding elements in the first column of B. The sum of these multiplications is placed in the 1,1(first row, first column) position of the resulting matrix. This process is repeated until each row of A has been multiplied to each column of B. Press **2nd** **QUIT** to leave matrix entry mode.
8. To multiply the matrices A and B together, press **2ndF** **MATRIX** **A** **(NAME)** **1** **(mat A)** **\times** **2ndF** **MATRIX** **2** **(mat B)** and **ENTER**.

MATRIC SOLUTIONS TO SYSTEMS OF LINEAR EQUATIONS

1. The calculator will directly establish an identity matrix of a given size by pressing **2ndF** **MATRIX** **C** **(OPE)** **0** **5** **(identity)** and pressing **3** **ENTER**. To save the identity matrix in matrix C, press **STO** **2ndF** **MATRIX** **A** **(NAME)** **3** **(mat C)** **ENTER**. Confirm that the identity matrix is stored in matrix C by pressing **2ndF** **MATRIX** **B** **(EDIT)** **3** **(mat C)**. Press **2ndF** **QUIT** to exit the matrix editor and press **CL** to clear the screen.

2. Find the inverse of the square matrix A by pressing **2ndF** **MATRIX** **A** **(NAME)** **1** **(mat A)** **2ndF** **x^{-1}** **ENTER**. Press **▶** to see more of the matrix.

3. To solve the system of equations

$$\begin{aligned}x + 2y + z &= 8 \\2x + y - z &= 1 \\x + y - 2z &= -3\end{aligned}$$

using matrices, use the matrix A entered previously as the coefficient matrix, and enter the constants on the right side of the equal sign into matrix B,

where $B = \begin{bmatrix} 8 \\ 1 \\ -3 \end{bmatrix}$.

Press **2ndF** **QUIT** to exit the display of the B matrix. The solution matrix X is found by multiplying $\text{mat A}^{-1} B \bullet \text{mat B}$.

4. This multiplication is derived from the equation $AX = B$,

$$A^{-1} \bullet A \bullet X = A^{-1} \bullet B \text{ (multiply both sides by } A^{-1} \text{)}$$

$$I \bullet X = A^{-1} \bullet B \text{ (} A^{-1} \bullet A = I, \text{ identity matrix)}$$

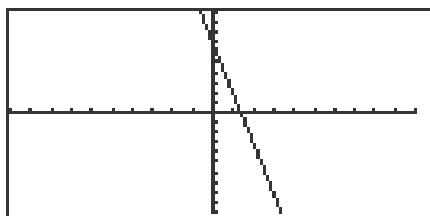
$$X = A^{-1} \bullet B \text{ (} I \bullet X = X \text{)}$$

Multiply $A^{-1} \bullet B$ by pressing **2ndF** **MATRIX** **A** **(NAME)** **1** **(mat A)** **2ndF** **x^{-1}** **\times** **2ndF** **MATRIX** **A** **(NAME)** **2** **(mat B)** and **ENTER**.

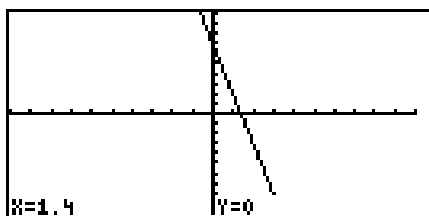
The solution matrix will appear.

INEQUALITIES

1. To solve $3(4 - 2x) \geq 5 - x$, rewrite it as $3(4 - 2x) - 5 + x \geq 0$ and determine the values of x where the function $y = 3(4 - 2x) - 5 + x$ is on or above the x -axis.
2. To do this, press $\boxed{Y=}$ \boxed{CL} and enter $3(4 - 2x) - 5 + X$ in the Y1 location.
3. Set the viewing window of the graph by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**). You should be able to clearly view the x -intercept.



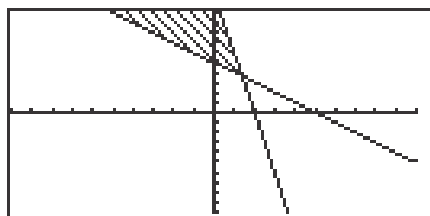
4. Locate the x -intercept at the point $(1.4, 0)$ by pressing $\boxed{2ndF}$ \boxed{CALC} and $\boxed{5}$ (**X_Incpt**).



5. Since the graph is above the x -axis, to the left of the x -intercept, the solution to the inequality $3(4 - 2x) - 5 + x \geq 0$ is all values of x such that $x \leq 1.4$.

INEQUALITIES

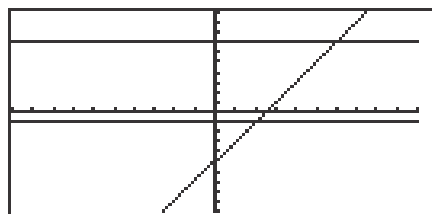
1. To solve the inequality $3(4 - 2x) \geq 5 - x$, press $\boxed{Y=}$ \boxed{CL} , enter $3(4 - 2X)$ for Y1 and $5 - X$ for Y2.
2. Set the viewing window by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{5}$ (**Default**).
3. Next, shade the set of points that make the inequality true by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (**SHADE**) $\boxed{1}$ (**Set**) to access the "Set Shade" screen. Since the inequality you are solving is $Y1 \geq Y2$ the solution is where the graph of Y1 is "on the top" and Y2 is "on the bottom." Do this by pressing $\boxed{2ndF}$ \boxed{VAR} \boxed{A} \boxed{ENTER} $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{2ndF}$ \boxed{VAR} \boxed{ENTER} $\boxed{1}$. Press \boxed{GRAPH} to view the shaded region.



4. Press $\boxed{2ndF}$ \boxed{CALC} $\boxed{2}$ (**Intsct**) to find where the graphs intersect.
5. Since the shaded region is to the left of $x = 1.4$, the solution to the inequality $3(4 - 2x) \geq 5 - x$ is all values of x such that $x \leq 1.4$.
6. Turn off the shading by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (**SHADE**) $\boxed{2}$ (**INITIAL**).

DOUBLE INEQUALITIES

1. The inequality $-1 \leq 2x - 5 \leq 7$ is commonly referred to as a “double” inequality.
2. Clear any previously entered functions by pressing **Y=** **CL**.
3. Enter $Y1 = -1$, $Y2 = 2X - 5$, and $Y3 = 7$.
4. Press **ZOOM** **A** **(ZOOM)** **5** **(Default)** to view the line $y = 2x - 5$ between the lines $y = -1$ and $y = 7$.



5. Press **2ndF** **CALC** **2** **(Intsct)** to find the point of intersection of the lines $y = 2x - 5$ and $y = -1$ at $(2, -1)$. Press **▲** to move the tracer to the $y = 7$ line. Press **2ndF** **CALC** **2** **(Intsct)** to find $y = 2x - 5$ and $y = 7$ at $(6, 7)$.
6. The solution to the “double” inequality $-1 \leq 2x - 5 \leq 7$ consists of all values of x in between, and including, 2 and 6 (i.e., $x \geq 2$ and $x \leq 6$). The solution is $2 \leq x \leq 6$.

SYSTEMS OF INEQUALITIES

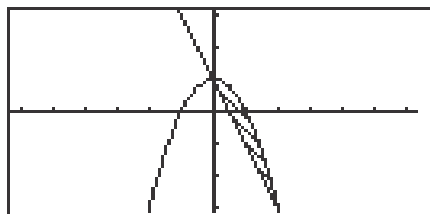
1. The solution region of a system of inequalities consists of all points (a, b) such that when $x = a$ and $y = b$, all inequalities in the system are true.
2. For example, to graph the solution region for the system

$$2x + y \geq 1$$

$$x^2 + y \leq 1,$$
 first rewrite each inequality in the system so that the left-hand-side is y :

$$y \geq 1 - 2x$$

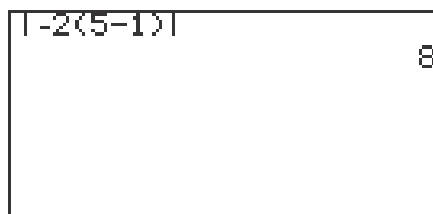
$$y \leq 1 - x^2$$
3. Press $\boxed{\text{Y=}}$ $\boxed{\text{CL}}$ and enter $1 - 2X$ in $Y1$ and $1 - X^2$ in $Y2$.
4. Next, shade the points that have a y -value less than $Y2$ and greater than $Y1$. Do this by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{DRAW}}$ $\boxed{\text{G}}$ **(SHADE)** $\boxed{1}$ **(Set)** $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{A}}$ $\boxed{\text{ENTER}}$ $\boxed{1}$ $\boxed{\blacktriangleright}$ $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{ENTER}}$ $\boxed{2}$.
5. Graph the system by pressing $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ **(ZOOM)** $\boxed{7}$ **(Dec)**.



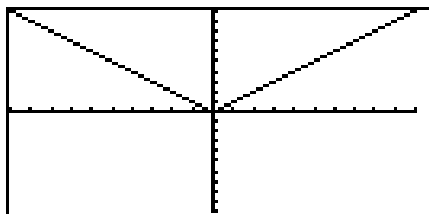
6. Turn off the shading by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{DRAW}}$ $\boxed{\text{G}}$ **(SHADE)** $\boxed{2}$ **(INITIAL)**.

ABSOLUTE VALUE

1. Evaluate $|-2(5 - 1)|$ by pressing $\boxed{\div}\boxed{=}$ to access the home or computation screen. Enter the absolute value symbol by pressing $\boxed{\text{MATH}}\boxed{\text{B}}\boxed{\text{(NUM)}}\boxed{1}\boxed{\text{(abs)}}$. You should see $|\square|$ on the screen. Enter $-2(5-1)$ inside the absolute value symbols and evaluate by pressing $\boxed{(-)}\boxed{2}\boxed{(}\boxed{5}\boxed{-}\boxed{1}\boxed{)}\boxed{\text{ENTER}}$.

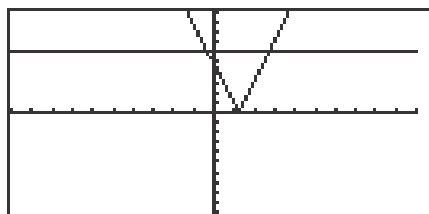


2. Graph $y = |x|$ by pressing $\boxed{\text{Y=}}\boxed{\text{CL}}$ to clear the Y1 prompt. Press $\boxed{\text{ENTER}}$ $\boxed{\text{CL}}$ to clear the remaining prompts if necessary. Enter $|x|$ in Y1 by pressing $\boxed{\text{MATH}}\boxed{\text{B}}\boxed{\text{(NUM)}}\boxed{1}\boxed{\text{(abs)}}$ and pressing $\boxed{\text{X}/\theta/\text{T}/n}$. Press $\boxed{\text{ZOOM}}\boxed{\text{A}}$ $\boxed{\text{(ZOOM)}}\boxed{5}\boxed{\text{(Default)}}$ to draw the graph.

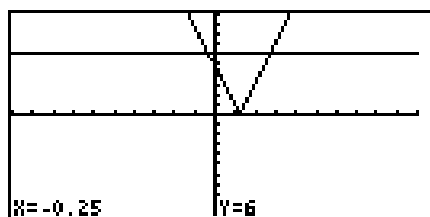


ABSOLUTE VALUE EQUATIONS

1. Solve $|5 - 4x| = 6$ by first pressing $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt.
2. Enter $|5 - 4x|$ in Y1 with the keystrokes $\boxed{\text{MATH}}$ $\boxed{\text{B}}$ **(NUM)** $\boxed{1}$ **(abs)** $\boxed{5}$ $\boxed{-}$ $\boxed{4}$ $\boxed{\text{X}/\theta/\text{T}/n}$.
3. Next, press $\boxed{\text{ENTER}}$ \boxed{CL} $\boxed{6}$ to enter 6 in Y2.
4. Press $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ **(ZOOM)** $\boxed{5}$ **(Default)** to view the two points of intersection of the absolute value and the horizontal line $y = 6$.



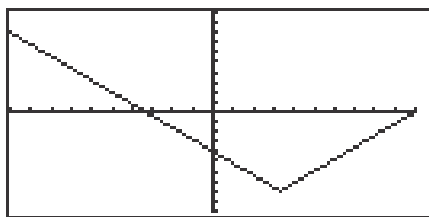
5. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{2}$ **(Intsct)** to find one point of intersection of the two graphs. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{2}$ **(Intsct)** again to find the other point of intersection.



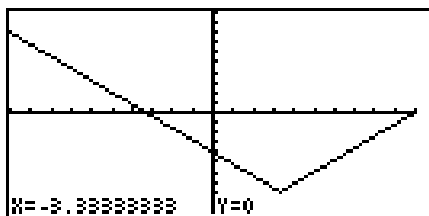
6. The solution to the equation $|5 - 4x| = 6$ consists of the two values -0.25 and 2.75 .

ABSOLUTE VALUE INEQUALITIES

- To solve $\left| \frac{20-6x}{5} \right| < 8$, rewrite the inequality so that the right-hand side of the inequality is zero: $\left| \frac{20-6x}{5} \right| - 8 < 0$.
- Press $\boxed{Y=}$ and clear all the Y prompts.
- Enter the left-hand side of the inequality $\left| \frac{20-6x}{5} \right| - 8$ in Y1 by pressing $\boxed{\text{MATH}} \boxed{\text{B}} \boxed{(\text{NUM})} \boxed{1} \boxed{(\text{abs})} \boxed{a/b} \boxed{2} \boxed{0} \boxed{-} \boxed{6} \boxed{X/\theta/T/n} \boxed{\blacktriangleright} \boxed{5} \boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{-} \boxed{8}$.
- Graph the expression by pressing $\boxed{\text{ZOOM}} \boxed{\text{A}} \boxed{(\text{Zoom})} \boxed{5} \boxed{(\text{Default})}$.
The x -intercepts of the graph are clearly visible.



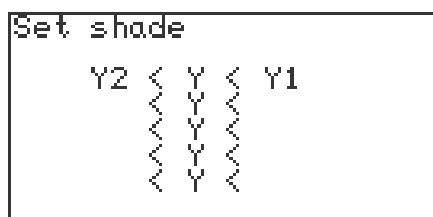
- Press $\boxed{2\text{ndF}} \boxed{\text{CALC}} \boxed{5} \boxed{(\text{X_Incpt})}$ to find the first x -intercept. Press $\boxed{2\text{ndF}} \boxed{\text{CALC}} \boxed{5} \boxed{(\text{X_Incpt})}$ to find the second x -intercept.



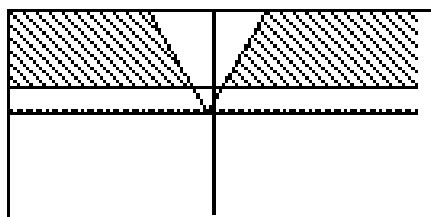
- Since the graph is below the x -axis for x in between the two x -intercepts, the solution is $-3.33 < x < 10$.

ABSOLUTE VALUE INEQUALITIES

1. To solve the inequality $|3.5x + 4| \geq 10$, press $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt. Press \boxed{ENTER} \boxed{CL} to clear additional prompts.
2. Enter the function $|3.5x + 4|$ in Y1 by pressing \boxed{MATH} \boxed{B} (NUM) $\boxed{1}$ (abs) $\boxed{3}$ $\boxed{\cdot}$ $\boxed{5}$ $\boxed{X/\theta/T/n}$ $\boxed{+}$ $\boxed{4}$ \boxed{ENTER} . Enter 10 in Y2 by pressing $\boxed{1}$ $\boxed{0}$.
3. Access the Set Shade screen by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (SHADE) $\boxed{1}$ (SET). Since Y2 is the function "on the bottom," press $\boxed{2ndF}$ \boxed{VARS} \boxed{A} \boxed{ENTER} $\boxed{2}$ (Y2) and since Y1 is the function "on the top," press $\boxed{\blacktriangleright}$ $\boxed{2ndF}$ \boxed{VARS} \boxed{ENTER} $\boxed{1}$ (Y1).



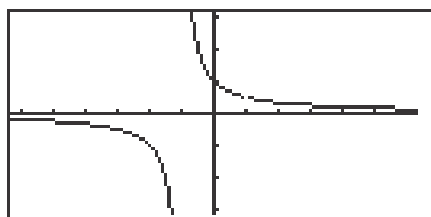
4. Set the viewing window by pressing \boxed{ZOOM} \boxed{A} (Zoom) $\boxed{5}$ (Default). Press \boxed{ZOOM} $\boxed{4}$ (out) to see the intersection.



5. Press $\boxed{2ndF}$ \boxed{CALC} $\boxed{2}$ (Intset) to locate a point of intersection. Repeat to find the other. The intersections are $(-4, 10)$ and $(1.714, 10)$. The solution of the inequality $|3.5x + 4| > 10$ is all values of x such that $x \leq -4$ or $x \geq 1.714$.
6. Turn off the shading by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{G} (SHADE) $\boxed{2}$ (INITIAL).

RATIONAL FUNCTIONS

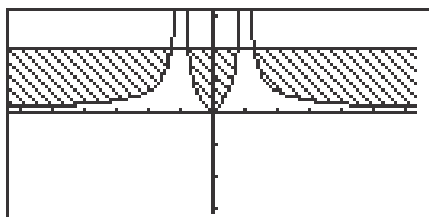
1. Graph the rational function $f(x) = \frac{(x-1)}{(x^2-1)}$ by first pressing $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt. Press \boxed{ENTER} \boxed{CL} to clear additional Y prompts.
2. Enter $Y1 = \frac{(x-1)}{(x^2-1)}$ by pressing $\boxed{a/b}$ $\boxed{X/\theta/T/n}$ $\boxed{-}$ $\boxed{1}$ $\boxed{\blacktriangleright}$ $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{1}$.
3. Graph in the decimal window by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{7}$ (**Dec**).



4. The function consists of two branches separated by the vertical asymptote (the line $x = -1$). Look closely at the graph and observe the "hole" in it at $x = 1$. Press \boxed{TRACE} and investigate the "hole." Note that the hole will be seen only when the window is a "friendly" or decimal window.
5. Notice that there are no x -intercepts for the graph. The y -intercept can easily be found at $x = 0$, $y = 1$ by pressing $\boxed{2ndF}$ \boxed{CALC} and $\boxed{6}$ (**Y_Incpt**).
6. Observe that the line $y = 0$ is very likely a horizontal asymptote of $f(x)$.

RATIONAL INEQUALITIES

1. Solve the inequality $\left| \frac{x}{1-x^2} \right| \leq 2$ using the intersection method with shading, by first pressing $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt.
2. Enter the left-hand side of the inequality in Y1 by pressing $\boxed{\text{MATH}}$ $\boxed{\text{B}}$ (**NUM**) $\boxed{1}$ (**abs**) pressing $\boxed{a/b}$ $\boxed{X/\theta/T/n}$ \blacktriangleright $\boxed{1}$ $\boxed{-}$ $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{\text{ENTER}}$. Enter 2 in Y2 by pressing $\boxed{2}$ $\boxed{\text{ENTER}}$.
3. Press $\boxed{2\text{ndF}}$ $\boxed{\text{DRAW}}$ $\boxed{\text{G}}$ (**SHADE**) $\boxed{1}$ (**SET**) $\boxed{2\text{ndF}}$ $\boxed{\text{VARs}}$ $\boxed{\text{A}}$ $\boxed{\text{ENTER}}$ $\boxed{1}$ (Y1) \blacktriangleright $\boxed{2\text{ndF}}$ $\boxed{\text{VARs}}$ $\boxed{\text{ENTER}}$ $\boxed{2}$ (Y2).
4. View the graph by pressing $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ (**ZOOM**) $\boxed{7}$ (**Dec**).



5. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{2}$ (**Intsct**) repeatedly, to locate the x -values of the points of intersection, $x = -1.281, -0.781, 0.781,$ and 1.281 . The solution is all values of x such that $x \leq -1.281$ or $-0.781 \leq x \leq 0.781$ or $x \geq 1.281$.
6. Turn off the shading by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{DRAW}}$ $\boxed{\text{G}}$ (**SHADE**) $\boxed{2}$ (**INITIAL**).

CONIC SECTIONS

Steps for graphing a parabola in rectangular mode

1. Graph the parabola $x = y^2 - 2$ by first rewriting as $y = \pm \sqrt{x + 2}$.
2. Press $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt. Press \boxed{ENTER} \boxed{CL} to clear additional prompts. Enter $\sqrt{x + 2}$ in Y1 with the keystrokes $\boxed{2ndF}$ $\boxed{\sqrt{}}$ $\boxed{X/\theta/T/n}$ $\boxed{+}$ $\boxed{2}$.
3. Press \boxed{ENTER} and enter $-Y1 = -\sqrt{x + 2}$ in Y2 with the key strokes $\boxed{(-)}$ $\boxed{2ndF}$ \boxed{VARS} \boxed{A} **(EQVARS)** \boxed{ENTER} $\boxed{1}$ **(Y1)**.
4. View the graph by pressing \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{7}$ **(Dec)**.

Steps for graphing a parabola in parametric mode

1. Change to parametric mode by pressing $\boxed{2ndF}$ $\boxed{SET UP}$ \boxed{E} **(COORD)** $\boxed{2}$ **(Param)**. Press $\boxed{2ndF}$ \boxed{QUIT} to exit the set-up screen.
2. Press $\boxed{Y=}$ \boxed{CL} to clear the X1T prompt. To rewrite $x = y^2 - 2$ in parametric form, simply let $y = T$ and substitute in $x = y^2 - 2$ to obtain $x = T^2 - 2$. Enter $X1T = T^2 - 2$ in the calculator by pressing $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{2}$ \boxed{ENTER} . Enter $Y1T = T$ by pressing $\boxed{X/\theta/T/n}$.
3. View the graph by pressing \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{7}$ **(Dec)**.
4. Notice that only a half of the parabola is drawn. To see the rest of the parabola, press \boxed{WINDOW} and adjust the Tmin. Set Tmin to -6 by pressing $\boxed{(-)}$ $\boxed{6}$ \boxed{ENTER} . Press \boxed{GRAPH} to view the complete parabola.
5. Change the calculator back to rectangular mode by pressing $\boxed{2ndF}$ $\boxed{SET UP}$ \boxed{E} **(COORD)** $\boxed{1}$ **(Rect)**.

CONIC SECTIONS (continued)

Steps for graphing a circle in rectangular mode

1. To graph the circle $x^2 + y^2 = 4$, solve for y in terms of x . The result is $y = \pm\sqrt{4 - x^2}$.
2. Press $\boxed{Y=}$ \boxed{CL} to clear the Y1 prompt. Enter $Y1 = \sqrt{4 - X^2}$ by pressing $\boxed{2ndF}$ $\boxed{\sqrt{}}$ $\boxed{4}$ $\boxed{-}$ $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ \boxed{ENTER} and then enter $Y2 = -\sqrt{4 - X^2}$ by pressing \boxed{CL} $\boxed{(-)}$ $\boxed{2ndF}$ \boxed{VARS} \boxed{A} **(EQVARS)** \boxed{ENTER} \boxed{A} **(XY)** $\boxed{1}$ **(Y1)**. View the graph by pressing \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{7}$ **(Dec)**.

Steps for graphing a circle not in standard form

1. First solve the equation for y by completing the square on the y -term and solving for y . For example, draw the graph of the circle $x^2 - 2x + y^2 + 4y = 2$ by rewriting as $y = \pm \sqrt{6 - x^2 + 2x} - 2$.
2. Enter $Y1 = \sqrt{6 - x^2 + 2x}$, $Y2 = Y1 - 2$ and $Y3 = -Y1 - 2$. "Turn off" $Y1$ so that it will not graph by pressing $\boxed{\blacktriangle}$ to move the blinking cursor to the $Y1$ expression. Press $\boxed{\blacktriangleleft}$ to position the blinking cursor over the $=$ sign, and press \boxed{ENTER} so that " $=$ " is no longer darkened.
3. To view the graph, press \boxed{ZOOM} $\boxed{7}$ **(Dec)**.
4. Adjust the screen to see the bottom part of the circle by pressing \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{4}$ **(OUT)**.

EVALUATING LIMITS

1. Set the calculator to floating point decimal display by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{SET UP}}$ $\boxed{\text{C}}$ (**FSE**) and $\boxed{1}$ (**Float Pt**). Set the calculator to rectangular coordinates $\boxed{\text{E}}$ (**COORD**) and $\boxed{1}$ (**Rect**). Press $\boxed{2\text{ndF}}$ $\boxed{\text{QUIT}}$ to exit the set up menu.
2. Consider the function $f(x) = \frac{(2x + 2)}{(x^2 - 1)}$. Press $\boxed{\text{Y=}}$ $\boxed{\text{CL}}$ to access and clear the Y1 prompt. Press $\boxed{\text{ENTER}}$ $\boxed{\text{CL}}$ to clear the remaining prompts.
3. Construct a graph of $f(x)$ in the Decimal viewing window by first entering $\text{Y1} = \frac{(2x + 2)}{(x^2 - 1)}$ with the keystrokes $\boxed{\text{a/b}}$ $\boxed{2}$ $\boxed{\text{X}/\theta/\text{T}/n}$ $\boxed{+}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{\text{X}/\theta/\text{T}/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{1}$, and then press $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ (**ZOOM**) $\boxed{7}$ (**Dec**) to see the graph.
4. Notice that even though $\frac{(2x + 2)}{(x^2 - 1)}$ is not defined at $x = -1$ (as evidenced by the hole in the graph at that point), the functional values appear to be getting closer and closer to -1 . A careful observation of the graph leads to the following estimates:

$$\lim_{x \rightarrow -\infty} f(x) = 0,$$

$$\lim_{x \rightarrow -1} f(x) = -1,$$

$$\lim_{x \rightarrow 1} f(x) \text{ does not exist,}$$

$$\text{and } \lim_{x \rightarrow \infty} f(x) = 0.$$

5. It also appears that the line $y = 0$ is a horizontal asymptote and the line $x = 1$ is a vertical asymptote for this function.

EVALUATING LIMITS (continued)

6. Tables of functional values sometimes provide more detailed information than a graph when investigating limits. The TABLE feature will assist you in constructing a numerical table of values. Press **TABLE** to access the TABLE feature.

X	Y1		
0	-2		
1	-----		
2	2		
3	1		
4	.666667		
5	.5		
X=0			

7. Notice the table provides the x -values and their corresponding y -values according to $Y1$. You can change the table settings by pressing **2ndF** **TBLSET**. You can change the table start value and the table step value. Verify the following values using the the TABLE feature.

x gets smaller and smaller \rightarrow

x	-10	-50	-100	-250	-500	-1000	-10,000
y	-.18182	-.03922	-.01980	.00797	-.00399	-.00200	-.00020

$y = f(x)$ appears to get closer and closer to 0

This provides evidence that $\lim_{x \rightarrow \infty} f(x) = 0$.

x approaches -1 from the left

x	-1.05	-1.01	-1.001	-1.0001		-.9999	-.999	-.99	-.90
y	-.9756	-.99502	-.9995	-.9999		-1.0001	-1.0005	-1.0051	-1.0526

x approaches -1 from the right

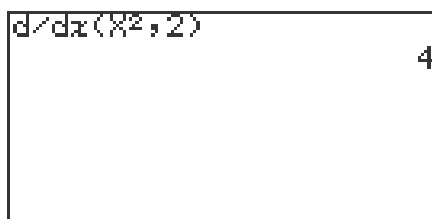
$y = f(x)$ gets closer and closer to -1 from above

$y = f(x)$ gets closer and closer to -1 from below

This provides evidence that $\lim_{x \rightarrow -1} f(x) = -1$.

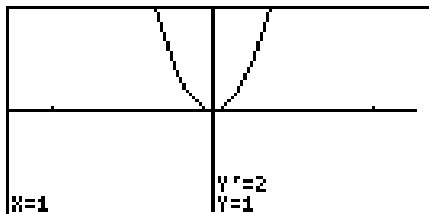
DERIVATIVES

1. The calculator has a built-in function denoted by d/dx that uses numerical methods to estimate the derivative of a function at a given value. The entry form of the derivative function is $d/dx (f(x), a)$.
2. Estimate $f'(2)$ for $f(x) = x^2$ using the derivative function. Press $\boxed{\frac{\oplus}{\boxtimes}} \boxed{\frac{\ominus}{\boxdiv}} \boxed{\text{MATH}}$ $\boxed{\text{A}} \boxed{(\text{CALC})} \boxed{0} \boxed{5} \boxed{(d/dx)} \boxed{X/\theta/T/n} \boxed{x^2} \boxed{,} \boxed{2} \boxed{)}$ to input: $d/dx (X^2, 2)$. Press $\boxed{\text{ENTER}}$ to compute.



The calculator screen displays the expression $d/dx(X^2,2)$ on the top line and the result 4 on the bottom right.

3. The calculator also has a derivative trace.
Activate the derivative trace by pressing $\boxed{2\text{ndF}} \boxed{\text{FORMAT}} \boxed{\text{C}} \boxed{(\text{Y})}$ and $\boxed{1} \boxed{(\text{ON})}$. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the **FORMAT** menu.
4. Press $\boxed{\text{Y=}} \boxed{\text{CL}}$ and enter the function for Y1 by pressing $\boxed{X/\theta/T/n} \boxed{x^2}$.
5. Draw the graph by pressing $\boxed{\text{ZOOM}} \boxed{\text{A}} \boxed{(\text{Zoom})} \boxed{7} \boxed{(\text{Dec})}$.
6. Press $\boxed{\text{TRACE}}$ to activate the trace and press $\boxed{\blacktriangleright}$ to the values for the derivative.



7. Be sure to turn off the derivative trace.

TANGENT LINES

Enter and execute a program for finding a tangent line to a curve at a given point.

1. Turn the calculator on and press **PRGM** to enter the programming menu.
2. Press **C** (**NEW**) and **ENTER** to open a new program.
3. Name the new program TANGENT by pressing **T** **A** **N** **G** **E** **N** **T** **ENTER**.
4. Press **ENTER** at the end of each line. If you make a mistake, use the calculator's editing features to correct the error. Enter the following program:

PROGRAM	KEYSTROKES
Input X	PRGM A 3 X/θ/T/n ENTER
$\frac{d}{dx}(Y1,X) \Rightarrow M$	MATH A 0 5 2ndF VARS A ENTER A 1 , X/θ/T/n) STO ALPHA M ENTER
$Y1(X) \Rightarrow Y$	2ndF VARS A ENTER 1 (X/θ/T/n) STO ALPHA Y ENTER
$-M \times X + Y \Rightarrow B$	(-) ALPHA M × X/θ/T/n + ALPHA Y STO ALPHA B ENTER
ClrT	PRGM C 1 ENTER
Print	PRGM A 1 PRGM 2 2ndF A-LOCK T A N G
"TANGENT	E N T SPACE L I N E = ALPHA ENTER
LINE=	PRGM 1 PRGM 2 ALPHA Y ALPHA = ALPHA
Print	M X/θ/T/n + ALPHA B ENTER
"Y=MX+B	

TANGENT LINES (continued)

Continue to enter the TANGENT program.

Print "M=" PRGM 1 PRGM 2 ALPHA M ALPHA = ENTER
 Print M PRGM 1 ALPHA M ENTER
 Print "B=" PRGM 1 PRGM 2 ALPHA B ALPHA = ENTER
 Print B PRGM 1 ALPHA B ENTER
 End PRGM 6 ENTER

5. Press 2ndF QUIT to save the program and exit the editing mode.
6. Enter $f(x) = x^3 - x^2 + 1$ for Y1 by pressing Y= CL X/θ/T/n a^b 3 ► -
 X/θ/T/n x² + 1 ENTER .
7. Execute the TANGENT program by pressing PRGM A (EXEC) and selecting TANGENT.
8. Enter an X of 1 by pressing 1 ENTER . You should then see the equation for the tangent line to the curve at $x = 1$.

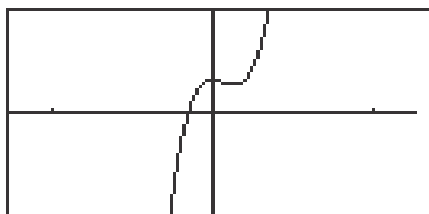
```
TANGENT LINE=
Y=MX+B
M=
B=
1
0
```

9. You can repeat this process for other x values. Press ENTER to execute the program over and over again.
10. If you receive an error statement, press ◀ or ▶ 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 save the corrections by pressing ENTER .
 Press 2ndF QUIT and try executing the program again.

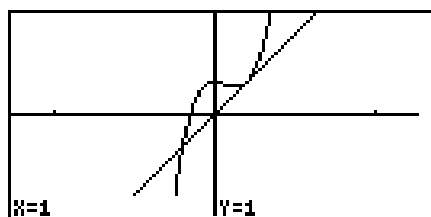
TANGENT LINES

Draw the tangent line to a function at a given point.

1. To draw the tangent line on a displayed graph, you must first enter the graph for Y1. Enter the function $f(x) = x^3 - x^2 + 1$ for Y1 by pressing $\boxed{Y=}$ \boxed{CL} $\boxed{X/\theta/T/n}$ $\boxed{a^b}$ $\boxed{3}$ $\boxed{\blacktriangleright}$ $\boxed{-}$ $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{+}$ $\boxed{1}$ \boxed{ENTER} .
2. Graph the function by pressing \boxed{ZOOM} \boxed{A} (**ZOOM**) $\boxed{7}$ (**Dec**).

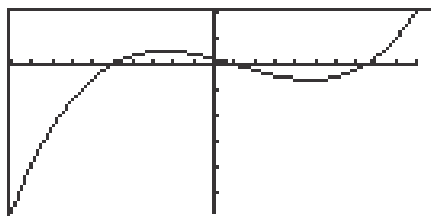


3. Draw the tangent line at $x = 1$ by pressing $\boxed{2ndF}$ \boxed{DRAW} \boxed{A} (**DRAW**) $\boxed{5}$ (**T_line**), move the tracer right to $x = 1$ by pressing $\boxed{\blacktriangleright}$ repeatedly, and then press \boxed{ENTER} .



RELATIVE EXTREMA

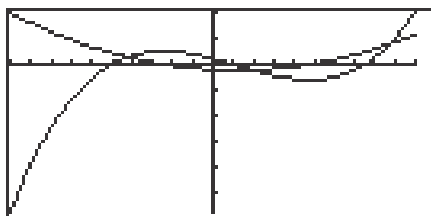
1. Set the graphing calculator to rectangular graphing by pressing $\boxed{2\text{ndF}} \boxed{\text{SET UP}} \boxed{\text{E}} \boxed{\text{(COORD)}} \boxed{1} \boxed{\text{(Rect)}}$. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the SET UP menu.
2. Consider $f(x) = 2x^3 - 7x^2 - 70x + 75$. Press $\boxed{\text{Y=}} \boxed{\text{CL}}$ to access and clear Y1. Press $\boxed{\text{ENTER}} \boxed{\text{CL}}$ to clear additional Y prompts. Enter $f(x)$ for Y1 by pressing $\boxed{2} \boxed{\text{X}/\theta/\text{T}/n} \boxed{\text{a}^b} \boxed{3} \boxed{\blacktriangleright} \boxed{-} \boxed{7} \boxed{\text{X}/\theta/\text{T}/n} \boxed{x^2} \boxed{-} \boxed{7} \boxed{0} \boxed{\text{X}/\theta/\text{T}/n} \boxed{+} \boxed{7} \boxed{5}$.
3. Graph the function by pressing $\boxed{\text{WINDOW}} \boxed{(-)} \boxed{1} \boxed{0} \boxed{\text{ENTER}} \boxed{1} \boxed{0} \boxed{\text{ENTER}} \boxed{1} \boxed{\text{ENTER}} \boxed{\text{ZOOM}} \boxed{\text{A}} \boxed{\text{(Zoom)}} \boxed{1} \boxed{\text{(Auto)}}$.



4. To determine the point at which the relative maximum occurs, press $\boxed{2\text{ndF}} \boxed{\text{CALC}} \boxed{4} \boxed{\text{(Maximum)}}$. The maximum occurs at $x = -2.44$.
5. Find the point at which the relative minimum occurs by pressing $\boxed{2\text{ndF}} \boxed{\text{CALC}} \boxed{3} \boxed{\text{(Minimum)}}$. The minimum occurs at $x = 4.776$.
6. Combining this information with a view of the graph, we see that $f(x)$ is increasing for $x = -\infty$ to -2.4427 and from 4.776 to ∞ while $f(x)$ is decreasing for x between -2.4427 and 4.776 .

GRAPHS OF DERIVATIVES

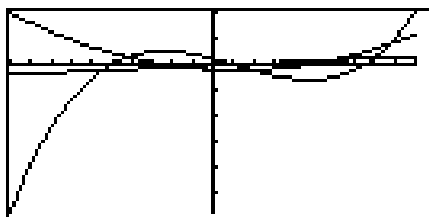
1. Graph $f'(x)$ by pressing $\boxed{Y=}$ $\boxed{\text{ENTER}}$ entering $f(x) = 2x^3 - 7x^2 - 70x + 75$ for Y1, and entering $\frac{d}{dx}$ (Y1) for Y2. Enter Y2 by pressing $\boxed{\text{MATH}}$ $\boxed{\text{A}}$ (**CALC**) $\boxed{0}$ $\boxed{5}$ (**d/dx()**) $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{ENTER}}$ $\boxed{\text{A}}$ (**XY**) $\boxed{1}$ (**Y1**) and press $\boxed{)}$ $\boxed{\text{ENTER}}$.
2. Press $\boxed{\text{WINDOW}}$ $\boxed{(-)}$ $\boxed{1}$ $\boxed{0}$ $\boxed{\text{ENTER}}$ $\boxed{1}$ $\boxed{0}$ $\boxed{\text{ENTER}}$ $\boxed{1}$ $\boxed{\text{ENTER}}$ $\boxed{\text{ZOOM}}$ $\boxed{\text{A}}$ (**Zoom**) $\boxed{1}$ (Auto) to obtain the graphs of $f(x)$ and $f'(x)$.



3. We now want to find the two x -intercepts of $f'(x)$. Press $\boxed{\text{TRACE}}$ $\boxed{\blacktriangledown}$ to place the tracer on the graph of the derivative. Then, press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ and $\boxed{5}$ (**X_Incpt**). Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{5}$ (**X_Incpt**) again to obtain the other x -intercept.
4. Comparing these values to the x -coordinates of the points at which the maxima and minima of $f(x)$ occur, we see they are the same.
5. Where is $f'(x)$ positive? Notice this is where the graph of $f(x)$ is increasing. Where is $f'(x)$ negative? Notice this is where $f(x)$ is decreasing.
6. Next, find the minimum point of $f'(x)$ by first making sure the trace cursor is on the graph of the derivative, pressing $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{3}$ (**Minimum**).
7. Look at $f(x)$ and observe that this appears to be the point at which the function “bends a different way.”
8. Find the point of inflection directly by moving the cursor to the original function and pressing $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{7}$ (**Inflec**).

GRAPHS OF DERIVATIVES (continued)

9. Graph the second derivative by pressing $\boxed{Y=}$ $\boxed{\text{ENTER}}$ $\boxed{\text{ENTER}}$, and input d/dx (Y2) in the Y3 location with the keystrokes $\boxed{\text{MATH}}$ $\boxed{\text{A}}$ (CALC) $\boxed{0}$ $\boxed{5}$ (d/dx) $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{ENTER}}$ $\boxed{\text{A}}$ (XY) $\boxed{2}$ (Y2) and press $\boxed{\text{ENTER}}$.
10. Press $\boxed{\text{GRAPH}}$ to obtain the graphs of $f(x)$, $f'(x)$, and $f''(x)$. Where is $f''(x)$ zero? After pressing $\boxed{\text{TRACE}}$ $\boxed{\blacktriangledown}$ $\boxed{\blacktriangledown}$ to place the tracer on the second derivative, press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{5}$ (X_Incpt) to find that $f''(x) = 0$ at $X = 1.167$.



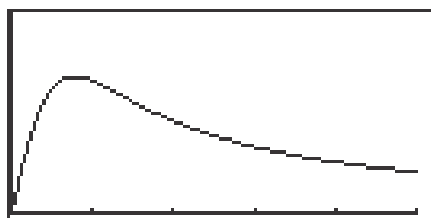
11. Find the y-value of this point of inflection by pressing $\boxed{\blacktriangle}$ $\boxed{\blacktriangle}$ to move the cursor to the original function. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{1}$ (Value) and enter 1.167 and press $\boxed{\text{ENTER}}$.
12. The connections we have discovered between the graphs of $f(x)$, $f'(x)$, and $f''(x)$ are summarized in the tables below.

Interval	$f(x)$ is	$f'(x)$ is	$f''(x)$ is
$x < -2.4427$	increasing, concave down	positive	negative
$-2.4427 < x < 1.1656$	decreasing, concave down	negative	negative
$1.1656 < x < 4.776$	decreasing, concave up	negative	positive
$x > 4.776$	increasing, concave up	positive	positive

x - value	$f(x)$ has	$f'(x)$ has	$f''(x)$ has
$x = -2.4427$	relative maximum	x -intercept	---
$x = 1.16567$	inflection point	minimum	x -intercept
$x = 4.776$	relative minimum	x -intercept	---

OPTIMIZATION

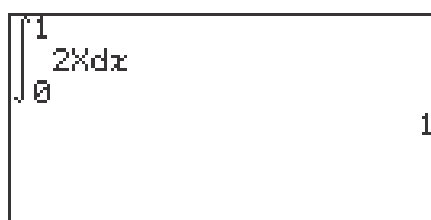
1. Set the calculator to rectangular graphing by pressing $\boxed{2\text{ndF}} \boxed{\text{SETUP}} \boxed{\text{E}}$ (**Coord**) $\boxed{1}$ (**Rect**). Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the setup menu.
2. A new product was introduced through a television advertisement appearing during the Super Bowl. Suppose that the proportion of people that purchased the product x days after the advertisement appeared is given by $f(x) = \frac{(5.3x)}{(x^2 + 15)}$. When did maximum sales occur and what proportion of people purchased the product at that time?
3. Press $\boxed{\text{Y=}} \boxed{\text{CL}}$ to clear the Y1 prompt. Press $\boxed{\text{ENTER}} \boxed{\text{CL}}$ to clear additional prompts. Enter $f(x)$ in the Y1 location with the keystrokes $\boxed{\text{a/b}} \boxed{5} \boxed{\cdot} \boxed{3} \boxed{\text{X}/\theta/\text{T}/n} \boxed{\blacktriangleright} \boxed{\text{X}/\theta/\text{T}/n} \boxed{x^2} \boxed{+} \boxed{1} \boxed{5}$.
4. Let's examine the graph for the first 25 days after the advertisement appeared. Press $\boxed{\text{WINDOW}}$, enter Xmin = 0, Xmax = 25, Xscl = 5, Ymin = 0, Ymax = 1, Yscl = 1.
5. Press $\boxed{\text{GRAPH}}$ to view the graph.



6. When did maximum sales occur and what proportion of people purchased the product at that time? Press $\boxed{2\text{ndF}} \boxed{\text{CALC}}$ and $\boxed{4}$ (**Maximum**) to find a maximum sales at $x = 3.87$ days with a 68% proportion.

SHADING AND CALCULATING AREAS REPRESENTED BY AN INTEGRAL

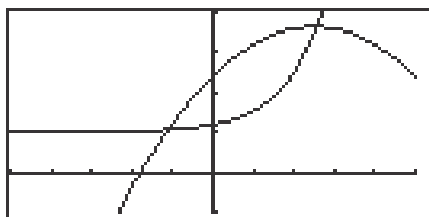
1. Find an estimate of $\int_0^1 2x \, dx$.
2. Integrate a function by pressing $\left[\begin{smallmatrix} + & - \\ \times & \div \end{smallmatrix} \right]$ $\left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right]$ MATH A (CALC) 0 6 $\left(\int \right)$.
3. Enter 0 for the lower limit. Press $\left[\blacktriangle \right]$, input 1 for the upper limit, and press $\left[\blacktriangleright \right]$. Next, press 2 $\text{X}/\theta/\text{T}/n$ to input the integrand. Enter the “dx” by pressing MATH 0 7 (dx) . Press ENTER to compute.



4. Shade the region by first pressing Y= CL to access and clear the Y1 prompt. Clear additional prompts by pressing ENTER CL .
5. Enter $f(x)$ in Y1 with the keystrokes 2 $\text{X}/\theta/\text{T}/n$. Press WINDOW and enter Xmin = 0 and Xmax = 1. Draw the graph by pressing ZOOM A (ZOOM) 1 (Auto) .
6. Shade the region by pressing 2ndF DRAW G (SHADE) and 1 (Set) to access the shading screen.
7. Since $Y1 = 2X$ is the function “on the top,” press $\left[\blacktriangleright \right]$ 2ndF VARS ENTER A (XY) 1 . Leave the lower bound location empty. Press GRAPH to view the shaded region.
8. Turn off the shading by pressing 2ndF DRAW G (SHADE) 2 (INITIAL) .

AREA BETWEEN CURVES

1. Calculate and draw a graph of the area of the region between $f(x) = 5x - x^2 + 12$ and $g(x) = e^x + 5$.
2. Return to and clear the Y prompts by pressing $\boxed{\text{Y=}}$ $\boxed{\text{CL}}$. Clear additional prompts if necessary.
3. Input $f(x)$ in Y1 with the keystrokes $\boxed{5}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{-}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{x^2}$ $\boxed{+}$ $\boxed{1}$ $\boxed{2}$ $\boxed{\text{ENTER}}$. Input $g(x)$ in Y2 with the keystrokes $\boxed{2\text{ndF}}$ $\boxed{e^x}$ $\boxed{\text{X}/\theta/\text{T}/\text{n}}$ $\boxed{+}$ $\boxed{5}$.
4. Enter the viewing window $-5 < x < 5$ and $-5 < y < 20$. Your viewing window should clearly show the region between $f(x)$ and $g(x)$ and, if applicable, display the intersections of the functions. Press $\boxed{\text{GRAPH}}$ to view the graphs.



5. Shade the region between the two curves by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{DRAW}}$ $\boxed{\text{G}}$ $\boxed{\text{(SHADE)}}$ $\boxed{1}$ $\boxed{\text{(SET)}}$. Since Y2 is the function "on the bottom," press $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{ENTER}}$ $\boxed{\text{A}}$ $\boxed{\text{(EQVARS)}}$ $\boxed{\text{ENTER}}$ $\boxed{2}$ $\boxed{\text{(Y2)}}$ and since Y1 is the function "on the top," press $\boxed{2\text{ndF}}$ $\boxed{\text{VARS}}$ $\boxed{\text{ENTER}}$ $\boxed{1}$ $\boxed{\text{(Y1)}}$. Press $\boxed{\text{GRAPH}}$ to view the shaded region.
6. Next, find the limits of integration. Press $\boxed{2\text{ndF}}$ $\boxed{\text{CALC}}$ $\boxed{2}$ $\boxed{\text{(Intsct)}}$. Do this twice to obtain the x -coordinates of the two points of intersection. The points of intersection are $x = -1.09$ and $x = 2.58$.
7. Find the approximate area by pressing $\boxed{+/-}$ $\boxed{\text{CL}}$ $\boxed{\text{MATH}}$ $\boxed{\text{A}}$ $\boxed{\text{(CALC)}}$ $\boxed{0}$ $\boxed{6}$ $\boxed{\text{(f)}}$ enter -1.09 , press $\boxed{\blacktriangle}$, enter 2.58 , press $\boxed{\blacktriangleright}$, enter the function "on the top," $5x - x^2 + 12$, press $\boxed{-}$ $\boxed{\text{(f)}}$, enter the function "on the bottom," $e^x + 5$, press $\boxed{\text{(f)}}$ $\boxed{\text{MATH}}$ $\boxed{0}$ $\boxed{7}$ $\boxed{\text{(dx)}}$. Press $\boxed{\text{ENTER}}$ to obtain the approximate area of 20.34.

PROGRAM FOR RECTANGULAR APPROXIMATION OF AREA

Enter and execute a program for finding the rectangular approximation for an area,

1. Press **2ndF** **PRGM** to enter programming mode. Press **C** (**NEW**) to enter a new program, followed by **ENTER**. Name the new program RECTAPP by pressing **R** **E** **C** **T** **A** **P** **P** followed by **ENTER**.
2. You can now enter in the RECTAPP program. Remember to press **ENTER** at the end of each line. If you make a mistake, use the calculator's editing features to make corrections. Enter the following program:

PROGRAM	KEYSTROKES
Input N	PRGM A 3 ALPHA N ENTER
Input A	PRGM 3 ALPHA A ENTER
$Y_1(A) \Rightarrow L$	2ndF VARS A ENTER A 1 (ALPHA A) STO ALPHA L ENTER
Input B	PRGM 3 ALPHA B ENTER
$Y_1(B) \Rightarrow R$	2ndF VARS ENTER 1 (ALPHA B) STO ALPHA R ENTER
$(B-A) \div N \Rightarrow W$	(ALPHA B - ALPHA A) ÷ ALPHA N STO ALPHA W ENTER
$A+W \div 2 \Rightarrow X$	ALPHA A + ALPHA W ÷ 2 STO X/θ/T/n ENTER
$Y_1(X) \Rightarrow M$	2ndF VARS ENTER 1 (X/θ/T/n) STO ALPHA M ENTER
$A+W \Rightarrow X$	ALPHA A + ALPHA W STO X/θ/T/n ENTER
Label LOOP	PRGM B 0 1 2ndF A-LOCK L O O P ALPHA ENTER
$Y_1(X)+L \Rightarrow L$	2ndF VARS ENTER 1 (X/θ/T/n) + ALPHA L STO ALPHA L ENTER

PROGRAM FOR RECTANGULAR APPROXIMATION OF AREA (continued)

$Y1(X)+R \Rightarrow R$ **2ndF** **VARS** **ENTER** **1** **(** **X/θ/T/n** **)** **+** **ALPHA** **R** **STO**
 ALPHA **R** **ENTER**
 $X+W \div 2 \Rightarrow X$ **X/θ/T/n** **+** **ALPHA** **W** **÷** **2** **STO** **X/θ/T/n** **ENTER**
 $Y1(X)+M \Rightarrow M$ **2ndF** **VARS** **ENTER** **1** **(** **X/θ/T/n** **)** **+** **ALPHA** **M** **STO**
 ALPHA **M** **ENTER**
 $X+W \div 2 \Rightarrow X$ **X/θ/T/n** **+** **ALPHA** **W** **÷** **2** **STO** **X/θ/T/n** **ENTER**
 If $X < B$ Goto
 LOOP **PRGM** **B** **0** **3** **X/θ/T/n** **MATH** **F** **5** **ALPHA**
 B **PRGM** **B** **0** **2** **2ndF** **A-LOCK** **L** **O** **O** **P**
 ALPHA **ENTER**
 ClrT **PRGM** **C** **1** **ENTER**
 Print "LEFT= **PRGM** **A** **1** **PRGM** **2** **2ndF** **A-LOCK** **L** **E** **F** **T** **=**
 ALPHA **ENTER**
 Print $W \times L$ **PRGM** **1** **ALPHA** **W** **×** **ALPHA** **L** **ENTER**
 Print "MID= **PRGM** **1** **PRGM** **2** **2ndF** **A-LOCK** **M** **I** **D**
 = **ALPHA** **ENTER**
 Print $W \times M$ **PRGM** **1** **ALPHA** **W** **×** **ALPHA** **M** **ENTER**
 Print "RIGHT= **PRGM** **1** **PRGM** **2** **2ndF** **A-LOCK** **R** **I** **G** **H** **T**
 = **ALPHA** **ENTER**
 Print $W \times R$ **PRGM** **1** **ALPHA** **W** **×** **ALPHA** **R** **ENTER**
 End **PRGM** **6** **ENTER**

Press **2ndF** **QUIT** to save the program and exit the editing mode.

PROGRAM FOR RECTANGULAR APPROXIMATION OF AREA (continued)

Executing a program

3. Enter the function $f(x) = \cos x$, by pressing $\boxed{Y=}$ \boxed{CL} $\boxed{\cos}$ $\boxed{X/\theta/T/n}$.
Press \boxed{ENTER} \boxed{CL} to clear additional prompts.
4. Execute the RECTAPP program, press \boxed{PRGM} \boxed{A} , highlight the 'RECTAPP' program, and press \boxed{ENTER} . Enter 'N' of 5 by pressing $\boxed{5}$ \boxed{ENTER} , followed by 'A' of 0 and 'B' of 1. You will see a display of left, midpoint and right rectangular approximations for the area under the cosine function between 0 and 1 with 5 intervals in the partition.

LEFT=	0.884633979
MID=	0.842875074
RIGHT=	0.79269444

5. You can repeat this process for a different number of partitions, different limits, or another function. Press \boxed{ENTER} to execute the program over and over again. Press \boxed{CL} to exit the program.
6. If you receive an error statement, press $\boxed{\blacktriangleleft}$ or $\boxed{\blacktriangleright}$ 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 save the program by pressing $\boxed{2ndF}$ \boxed{QUIT} . Try executing the program again.

TRAPEZOIDAL APPROXIMATION OF AREA

A program for finding the trapezoidal approximation for an area.

```

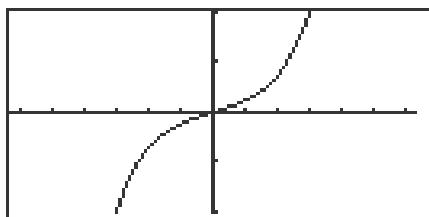
Input N      [PRGM] [A] [3] [ALPHA] [N] [ENTER]
Input A      [PRGM] [3] [ALPHA] [A] [ENTER]
Y1(A)⇒L      [2ndF] [VARS] [A] [ENTER] [A] [1] [(] [ALPHA] [A] [)] [STO]
              [ALPHA] [L] [ENTER]
Input B      [PRGM] [3] [ALPHA] [B] [ENTER]
Y1(B)⇒R      [2ndF] [VARS] [ENTER] [1] [(] [ALPHA] [B] [)] [STO] [ALPHA] [R]
              [ENTER]
0⇒Z          [0] [STO] [ALPHA] [Z] [ENTER]
(B-A)÷N⇒W    [(] [ALPHA] [B] [-] [ALPHA] [A] [)] [÷] [ALPHA] [N] [STO]
              [ALPHA] [W] [ENTER]
A+W⇒X        [ALPHA] [A] [+] [ALPHA] [W] [STO] [X/θ/T/n] [ENTER]
Label LOOP   [PRGM] [B] [0] [1] [2ndF] [A-LOCK] [L] [O] [O] [P]
              [ALPHA] [ENTER]
2Y1(X)+Z⇒Z   [2] [2ndF] [VARS] [ENTER] [1] [(] [X/θ/T/n] [)] [+] [ALPHA] [Z] [STO]
              [ALPHA] [Z] [ENTER]
X+W⇒X        [X/θ/T/n] [+] [ALPHA] [W] [STO] [X/θ/T/n] [ENTER]
If X<BGoto   [PRGM] [B] [0] [3] [X/θ/T/n] [MATH] [F] [5] [ALPHA] [B]
  LOOP       [PRGM] [0] [2] [2ndF] [A-LOCK] [L] [O] [O] [P] [ENTER]
ClrT         [PRGM] [C] [1] [ENTER]
Print "TRAP= [PRGM] [A] [1] [PRGM] [2] [2ndF] [A-LOCK] [T] [R] [A] [P] [=]
              [PRGM] [2] [ENTER]
Print (W÷2)  [PRGM] [1] [(] [ALPHA] [W] [÷] [2] [)] [(] [ALPHA]
(L+Z+R)      [L] [+] [ALPHA] [Z] [+] [ALPHA] [R] [)] [ENTER]
End          [PRGM] [6] [ENTER]
  
```

Execute like the rectangular program to find an approximate area of .83866.

HYPERBOLIC FUNCTIONS

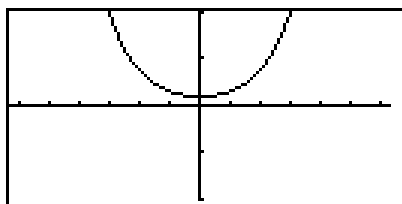
Steps for graphing the hyperbolic sine function.

1. Turn the calculator on and press $\boxed{Y=}$ \boxed{CL} to access and clear the $\boxed{Y1}$ prompt. Press \boxed{ENTER} \boxed{CL} to remove additional expressions.
2. To enter the hyperbolic sine function ($y = \sinh x$) for Y1, press \boxed{MATH} , \boxed{A} (CALC) $\boxed{1}$ $\boxed{5}$ (**sinh**) and press $\boxed{X/\theta/T/n}$.
3. Enter the viewing window by pressing \boxed{ZOOM} \boxed{F} (**HYP**) $\boxed{1}$ (**sinh x**).



Steps for graphing the hyperbolic cosine function.

4. Press $\boxed{Y=}$ \boxed{CL} to remove the hyperbolic sine function.
5. To enter the hyperbolic cosine function ($y = \cosh x$) for Y1, press \boxed{MATH} , $\boxed{1}$ $\boxed{6}$ (**cosh x**) press $\boxed{X/\theta/T/n}$.
6. Press \boxed{GRAPH} to view the graph.

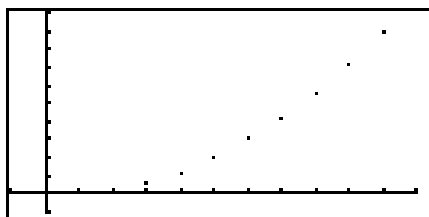


SEQUENCES

1. Turn the calculator on and set the calculator to sequence mode by pressing **2ndF** **SET UP** **E** **(COORD)** **4** **(Seq)**.
2. Press **2ndF** **QUIT** **Y=** to access the sequence prompts. Clear any sequences by pressing **CL**.
3. Enter the sequence generator $a_n = n^2 - n$ for $u(n)$ by pressing **X/θ/T/n** **x²** **-** **X/θ/T/n** **ENTER**. Enter $n_1 = 1$ for $u(nMin)$ by pressing **1** **ENTER**.
4. View a table of sequence values by pressing **TABLE**.

n	$u(n)$		
0			
1	1		
2	2		
3	6		
4	12		
5	20		
$n=0$			

5. Graph the sequence by first setting the format to time and drawing to dot mode. Do this by pressing **2ndF** **FORMAT** **G** **(TYPE)** **2** **(Time)**. Press **2ndF** **QUIT** to exit the FORMAT menu. Change to dot mode by pressing **2ndF** **DRAW** **D** **(LINE)** **ENTER** **▶** **ENTER**. Enter the viewing window by pressing **WINDOW** **1** **ENTER** **1** **0** **ENTER** **1** **ENTER** **1** **ENTER** **(-)** **1** **ENTER** **1** **1** **ENTER** **1** **ENTER** **(-)** **1** **0** **ENTER** **1** **0** **0** **ENTER** **1** **0** **ENTER**. View the sequence by pressing **GRAPH**.



6. Turn off sequence mode and dot mode.

RECURSIVE SEQUENCES

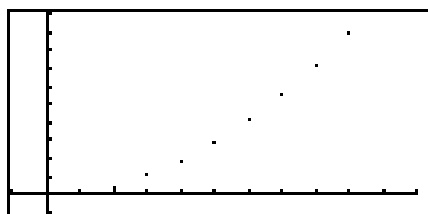
1. Change to sequence mode, time format, and dot mode.
2. Enter the recursive sequence generator $a_n = a_{n-1} + 2n$ for $u(n)$ by pressing
 $\boxed{Y=}$ \boxed{CL} $\boxed{2ndF}$ \boxed{u} $\boxed{(}$ $\boxed{X/\theta/T/n}$ $\boxed{-}$ $\boxed{1}$ $\boxed{)}$ $\boxed{+}$ $\boxed{2}$ $\boxed{X/\theta/T/n}$ \boxed{ENTER} .
 Enter $a_1 = 1$ by pressing $\boxed{1}$ \boxed{ENTER} .

```
u(n)=u(n-1)+2n
u(nMin)={1}
v(n)=
v(nMin)=
w(n)=
w(nMin)=
```

3. View a table of sequence values by pressing \boxed{TABLE} .

n	$u(n)$		
0			
1	1		
2	5		
3	11		
4	19		
5	29		
$n=0$			

4. Graph the sequence in the window as $-1 < x < 11$, $-10 < y < 100$ by pressing \boxed{GRAPH} .



5. Turn off sequence mode and dot mode.

PARTIAL SUM OF A SERIES

Find the partial sum of a series, $\sum 1/X$, for the first 10 terms.

1. Make sure the SET UP to rectangular mode by pressing **2ndF** **SET UP** , **E** (**COORD**) **1** (**Rect**). Press **2ndF** **QUIT** to exit the SET UP menu.
2. First find the sequence of the first 10 terms of series $\sum 1/X$ by first pressing **CL** **2ndF** **LIST** **A** (**OPE**) **5** (**seq()**). Enter the generator $1/X$ by pressing **1** **÷** **X/θ/T/n** **,**. Enter the lower and upper bounds for the sequence by pressing **1** **,** **1** **0** **)**. Find the sequence by pressing **ENTER**. Press **▶** to see more of the sequence.

```
seq(1÷X,1,10)
{1 0.5 0.333333333 0...
```

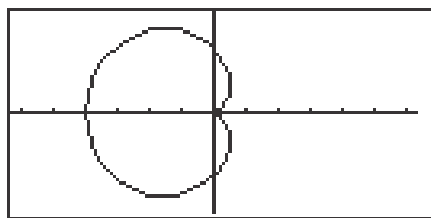
3. Find the partial sum of the first 10 terms by pressing **2ndF** **LIST** **6** (**cumul**) and pressing **2ndF** **ANS** **ENTER**. Press **▶** to move right in the sequence of partial sums until the last term is seen. The partial sum of the first 10 terms is 2.9289.

```
seq(1÷X,1,10)
{1 0.5 0.333333333 0...
cumul Ans
...28968254 2.928968254}
```

GRAPHING POLAR EQUATIONS

Steps for graphing a polar function:

1. Turn the calculator on and press **2ndF** **SET UP** **E** (**COORD**) **3** (**Polar**) to change to polar mode. While in the SET UP menu, the calculator should be setup in radian mode. To complete this setup, press **B** (**DRG**) **2** (**Rad**). Press **2ndF** **QUIT** to exit the SET UP menu.
2. Make sure calculator is in connected mode by pressing **2ndF** **DRAW** **D** (**LINE**) **ENTER**. The first option should be reflected for R1. Set the calculator to display polar coordinates when tracing, by pressing **2ndF** **FORMAT** **F** (**CURSOR**) and **2** (**PolarCoord**). Also, set the calculator to display the expression during tracing by pressing **B** (**EXPRESS**) **1** (**ON**). Press **2ndF** **QUIT** to exit the FORMAT menu.
3. Press **Y=** to access the R1 prompt. Press **CL** to remove an old R1 expression. Press **ENTER** **CL** to clear additional R prompts.
4. Enter the polar function $r = 2(1 - \cos \theta)$ for R1, by pressing **2** **(** **1** **-** **cos** **X/θ/T/n** **)**. Notice, when in polar mode the **X/θ/T/n** key provides a θ for equation entry.
5. Now, graph the polar function in the Decimal viewing window by pressing **ZOOM** **A** (**ZOOM**) **7** (**Dec**).

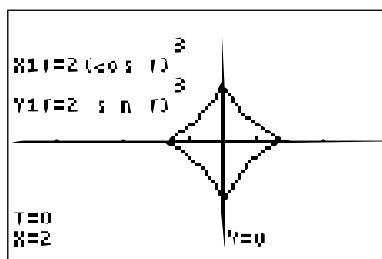


6. This particular shape of curve is called a cardioid. Trace the curve by pressing **TRACE**. Notice the expression is displayed at the top of the screen.

GRAPHING PARAMETRIC EQUATIONS

Steps for graphing a parametric function:

1. Turn the calculator on and press $\boxed{2\text{ndF}} \boxed{\text{SET UP}} \boxed{\text{E}}$ (**COORD**) $\boxed{2}$ (**Param**) to change to parametric mode. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the SET UP menu.
2. Make sure calculator is set to display rectangular coordinates when tracing by pressing $\boxed{2\text{ndF}} \boxed{\text{FORMAT}} \boxed{\text{F}}$ (**CURS**) $\boxed{1}$ (**RectCoord**). Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the FORMAT menu.
3. To enter the parametric function $X1T = 2(\cos T)^3$, $Y1T = 2(\sin T)^3$, press $\boxed{\text{Y=}} \boxed{\text{CL}} \boxed{2} \boxed{(} \boxed{\cos} \boxed{\text{X}/\theta/\text{T}/n} \boxed{)} \boxed{\text{a}^b} \boxed{3} \boxed{\text{ENTER}} \boxed{\text{CL}} \boxed{2} \boxed{(} \boxed{\sin} \boxed{\text{X}/\theta/\text{T}/n} \boxed{)} \boxed{\text{a}^b} \boxed{3} \boxed{\text{ENTER}}$. Notice, when in parametric mode the $\boxed{\text{X}/\theta/\text{T}/n}$ key provides a T for equation entry.
4. Now, graph the parametric function in the Decimal viewing window by pressing $\boxed{\text{ZOOM}} \boxed{\text{A}}$ (**ZOOM**) $\boxed{7}$ (**Dec**).
5. Press $\boxed{\text{TRACE}}$ and notice the expression and T values now appear on the range screen.



CREATION OF A ONE-VARIABLE DATA SET

Steps for creating a non-weighted one-variable data set

1. Turn the calculator on and press **STAT** to enter the statistics menu.
2. Touch **A (EDIT)** **ENTER**, to view the statistics data entry screen.
If there is a data set present within the lists on your calculator, use the arrow keys to move to the list, if necessary, and press **▲** to highlight the list label.
3. Press **DEL** **ENTER** to delete the old data. Repeat for other lists of data.
4. Move the highlighter to the cell directly below the L1 in the table. Enter the following data set:

5	8	7	6	8	9	3	5
---	---	---	---	---	---	---	---

by pressing **5** **ENTER** **8** **ENTER** **7** **ENTER** **6** **ENTER** **8** **ENTER** **9** **ENTER** **3** **ENTER** **5** **ENTER**.
5. To check the data you have entered, press **▲** to move back through the data values.
6. To sort your data set in an ascending manner, press **⌈** **⌋** **STAT** **B (OPE)** **1** **(sortA)** **2ndF** **L1** **)** **ENTER**. Press **STAT** **A (EDIT)** **ENTER**. Notice this first cell now contains the smallest value 3.
7. To save this data set, press **⌈** **⌋** **2ndF** **LIST** **C (L_DATA)** **1** **(StoLD)** **1** **ENTER**. You can store up to ten sets of six lists.
8. To retrieve a data set matrix into a statistical data set, press **⌈** **⌋** **2ndF** **LIST** **C (L_DATA)** **2** **(RcILD)** **1** **ENTER**.

CREATION OF A ONE-VARIABLE DATA SET

Steps for creating a weighted one-variable data set

1. Turn the calculator on and press **STAT** to enter the statistics menu.
2. Press **A** (**EDIT**) **ENTER**, to view the statistics data entry screen.
Remove old data by using the arrow keys to move to the list of data, and press **▲** to highlight the list label. Press **DEL** **ENTER** to delete the old data. Repeat for other lists of data.
3. Move the highlighter to the cell directly below the L1 in the table. Enter the following data set into L1 with the frequencies entered into L2. If a value appears three times within a data set, its weight or frequency is 3. Enter the following data set using the weights:

5 5 5 7 7 7 7 8 9 9
by pressing **5** **ENTER** **7** **ENTER** **8** **ENTER** **9** **ENTER** **▶** **3**
ENTER **4** **ENTER** **1** **ENTER** **2** **ENTER**.

No	1: L1	2: L2	3: L3
1	5	3	-----
2	7	4	
3	8	1	
4	9	2	
5	-----	-----	
6			

4. To save this data set, press **⏏** **2ndF** **LIST** **C** (**L_DATA**)
1 (**StoLD**) **2** **ENTER**.

NUMERICAL DESCRIPTION OF A ONE-VARIABLE DATA SET

Steps for calculating numerical descriptions of a one-variable non-weighted data set

1. Turn the calculator on and press **STAT** to enter the statistics menu.
Press **A** (**EDIT**) **ENTER** to view the statistics data entry screen.
If there is a data set present within the lists on your calculator, use the arrow keys to move to the list, if necessary, and press **▲** to highlight the list label. Press **DEL** **ENTER** to delete the old data. Repeat for other lists of data.
2. Move the highlighter to the cell directly below the L1 in the table.
Enter the following data set:
25 32 28 33 31 27 40 38 29 30
3. Check the data you have entered and correct any errors you may find.
Press **2ndF** **QUIT** to exit the data entry screen. To calculate the numerical descriptions of the data set, press **STAT** **C** (**CALC**) and **1** (**1_Stats**).
Press **ENTER** and the statistical results will appear.
4. The statistics displayed are:
 1. the average or mean value of the data set, \bar{x} ;
 2. the standard deviation assuming the data set is a sample from a population, s_x ;
 3. the standard deviation assuming the data set represents the entire population, σ_x ;
 4. the sum of the data values, Σx ;
 5. the sum of the squared data values, Σx^2 ;Press **▼** five times to see more of the statistics.
 6. the number of values in the data set, n ;
 7. the minimum value in the data set, x_{\min} ;
 8. the first quartile (25th percentile), Q_1 ;
 9. the median (50th percentile), Med ;
 10. the third quartile (75th percentile), Q_3 ; andPress **▼** one more time to see the final statistic.
 11. the maximum value in the data set, x_{\max} .

HISTOGRAM REPRESENTATION OF A ONE-VARIABLE DATA SET

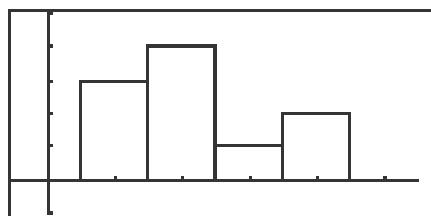
Steps for creating a non-weighted data set's histogram

1. Turn the calculator on, press **STAT** **A** (**EDIT**) **ENTER** to view the statistics data entry screen. Delete old data sets.
2. Move the highlighter to the cell directly below the L1 in the table and enter the following data set:
15 28 17 36 38 19 13 25 27 41
3. Check the data you have entered by pressing **▲** to move back through the data.
4. To graph a histogram that represents the data set, you must first press **STAT PLOT** **A** (**PLOT1**) and press **ENTER**. A PLOT1 setup screen will appear. Turn the plot on by pressing **ENTER**. Select one-variable data by pressing **▼** **ENTER**. Set the list to L1 by pressing **▼** **2ndF** **L1** **ENTER**. A blank Freq: prompt indicates the data is non-weighted and the frequencies are one. Choose the histogram graph by pressing **▼** **STAT PLOT** **A** (**HIST**) and **1** (**Hist**).
5. Set the calculator to rectangular graphing by pressing **2ndF** **SET UP** **E** (**COORD**) **1** (**Rect**) and press **2ndF** **QUIT**.
6. Set the viewing window by pressing **WINDOW**. Set the horizontal axis to $10 < x < 50$ with Xscl = 10 by pressing **1** **0** **ENTER** **5** **0** **ENTER** **1** **0** **ENTER**. Set the vertical axis to $0 < y < 5$ with Yscl = 1 by pressing **0** **ENTER** **5** **ENTER** **1** **ENTER**.
7. To view the histogram, press **GRAPH**.

HISTOGRAM REPRESENTATION OF A ONE-VARIABLE DATA SET

Steps for creating a weighted data set's histogram

1. Press **STAT** **A** (**EDIT**) **ENTER** to view the statistics data entry screen. Delete old data sets.
2. Move the highlighter to the cell directly below the L1 in the table and enter the following data set using weights:
 1 1 1 2 2 2 2 3 4 4
 by pressing **1** **ENTER** **2** **ENTER** **3** **ENTER** **4** **ENTER** **▶** **3**
ENTER **4** **ENTER** **1** **ENTER** **2** **ENTER** .
3. Press **STAT PLOT** **A** (**PLOT1**) **ENTER** and a PLOT1 setup screen will appear. Turn the plot on by pressing **ENTER**. Select one-variable data by pressing **▼** **ENTER**. Set the list to L1 by pressing **▼** **2ndF** **L1** **ENTER**. Set the frequencies to L2 by pressing **2ndF** **L2** **ENTER**. Choose the histogram graph by pressing **STAT PLOT** **A** (**HIST**) and **1** (**Hist**).
4. To set this viewing window, press **WINDOW** and set the horizontal axis to $-5 < x < 5.5$ with Xscl = 1 by pressing **(-)** **5** **ENTER** **5** **•** **5** **ENTER** **1** **ENTER**. Next, set the vertical axis to $-1 < y < 5$ with Yscl = 1 by pressing **(-)** **1** **ENTER** **5** **ENTER** **1** **ENTER**.
5. Press **Y=** and **CL** to clear any graphs. Press **GRAPH** view the histogram.



OTHER GRAPHICAL PORTRAYALS OF A ONE-VARIABLE DATA SET

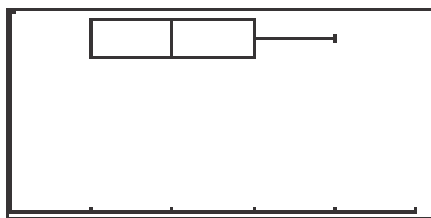
Steps for creating a non-weighted data set's broken-line graph

1. Turn the calculator on and press **STAT** to enter the statistics menu.
Delete old data and enter the following data set for L1:
15 28 17 36 38 19 13 25 27 41
2. Check the data you have entered by pressing **▲** to move back through the data.
3. To graph a broken-line graph for the data set, first press **STAT PLOT** **A** (**PLOT1**) **ENTER**. Turn PLOT1 on by pressing **ENTER**. Press **▼** **ENTER** to choose one-variable data. Press **▼** **2ndF** **L1** **ENTER** to enter L1 as the data list. Clear the frequency prompt by pressing **►** **DEL** **ENTER**. Set the graph to a broken line graph by pressing **STAT PLOT** **B** (**B.L.**) **3** (**Broken**).
4. In our example, the smallest value is 13 and the largest value is 41. The logical intervals for the data set would be 10-19 (tens), 20-29 (twenties), 30-39 (thirties), and 40-49 (forties). To set this viewing window, press **WINDOW** and set the horizontal axis to $10 < x < 50$ with Xscl = 10. Set the vertical axis to $0 < y < 5$ with Yscl = 1.
5. To view the graph, press **GRAPH**.
6. Press **TRACE** and then press **►** repeatedly to trace the points making up the broken-line graph.
7. Turn PLOT1 off by pressing **STAT PLOT** **ENTER** **►** **ENTER** **2ndF** **QUIT**.

OTHER GRAPHICAL PORTRAYALS OF A ONE-VARIABLE DATA SET

Steps for creating a weighted data set's box-and-whisker chart

1. Press **[STAT]** to enter the statistics menu. Delete old data and enter the following data set in L1 using weights in L2:
1 1 1 2 2 2 2 3 4 4
2. To construct a box-and-whisker chart, first press **[STAT PLOT]** **[A]** **[ENTER]**. Press **[ENTER]** to turn PLOT1 on. Press **[▼]** **[ENTER]** to choose one-variable data. Press **[▼]** **[2ndF]** **[L1]** **[ENTER]** to enter L1 as the data list. Set the frequency prompt to L2 by pressing **[2ndF]** **[L2]** **[ENTER]**. Set the graph to a box-and-whisker chart by pressing **[STAT PLOT]** **[E]** **(BOX)** **[1]** **Box**.
3. In the example, the data is discrete with a smallest value of 1 and a largest value of 4. Set the viewing window to $0 < x < 5$ with Xscl = 1. Next, set the vertical axis to $0 < y < 1$ with Yscl = 1.
4. To view the box-and-whisker chart for the data, press **[GRAPH]**.

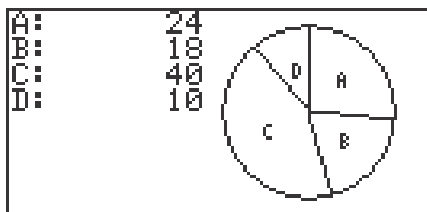


5. Press **[TRACE]** followed by **[◀]** and **[▶]** to view the five values making up the box-and whisker chart.
6. Turn PLOT1 off by pressing **[STAT PLOT]** **[ENTER]** **[▶]** **[ENTER]** **[2ndF]** **[QUIT]**.

OTHER GRAPHICAL PORTRAYALS OF A ONE-VARIABLE DATA SET

Steps for creating a pie chart from count data

1. Press **STAT** to enter the statistics menu. Delete old data and enter the following data set in L1 using weights in L2:
24 18 40 10
2. To construct a pie chart, first press **STAT PLOT** **ENTER** . Press **ENTER** to turn PLOT1 on. Press **▼** **ENTER** to choose one-variable data. Press **▼** **2ndF** **L1** **ENTER** to enter L1 as the data list. Leave the Freq prompt blank. Set the graph to a pie chart by pressing **STAT PLOT** **F** **(PIE)** **1** **(PIE)** .
3. To view the pie chart for the data, press **GRAPH** .



4. Press **TRACE** followed by **◀** and **▶** to highlight and mark the pieces of the pie.
5. Turn PLOT1 off by pressing **STAT PLOT** **ENTER** **▶** **ENTER** **2ndF** **QUIT** .

CREATION OF A TWO-VARIABLE DATA SET

Steps for creating a non-weighted two-variable data set

1. Turn the calculator on and press **[STAT]** to enter the statistics menu.
Press **[A] (EDIT) [ENTER]** to view the data-entry screen. If old data is present, delete it by moving the highlighter over L1 and pressing **[DEL] [ENTER]**. Repeat for other lists.
2. Enter the following data set with X in L1 and Y in L2:

X	Y
5	8
7	6
8	9
3	5

by moving the highlighter to the cell below the L1 header and then pressing **[5] [ENTER] [7] [ENTER] [8] [ENTER] [3] [ENTER] [▶] [8] [ENTER] [6] [ENTER] [9] [ENTER] [5] [ENTER]**.
3. Sometimes, you will need to sort the data in an ascending or descending manner for either the X or Y variables. To sort your data set with the X values ascending, press **[2ndF] [QUIT] [STAT]**, press **[B] (OPE) [1] (sortA)** and press **[2ndF] [L1] [, [2ndF] [L2] [)] [ENTER]**. Press **[STAT] [A] (EDIT) [ENTER]** to view the list. Notice the ordered pairs were rearranged with the X values ascending and their appropriate Y values.
4. Save this data set by pressing **[$\frac{+}{-}$ $\frac{\square}{\times}$ $\frac{\square}{+}$] [2ndF] [LIST] [C] (L_DATA) [1] (StoLD) and press **[1] [ENTER]**.**
5. To recall the statistical data from memory, press **[$\frac{+}{-}$ $\frac{\square}{\times}$ $\frac{\square}{+}$] [2ndF] [LIST], **[C] (L_DATA) [2] (RcILD)** and press **[1] [ENTER]**.**

CREATION OF A TWO-VARIABLE DATA SET

Steps for creating a weighted two-variable data set

1. Turn the calculator on and press **STAT** to enter the statistics menu. Press **A** (**EDIT**) **ENTER** to view the data-entry screen. If old data is present, delete it by moving the highlighter over L1 and pressing **DEL** **ENTER**. Repeat for other lists.
2. Each row will contain a data point (X, Y) and weight or frequency of occurrence. If a point (X,Y) appears four times within a data set, its weight or frequency is 4. Enter the following data set in L1 and L2 using L3 for the weights:

X	Y	W
5	3	7
4	8	9
2	10	3

by pressing **5** **ENTER** **4** **ENTER** **2** **ENTER** **▶** **3** **ENTER** **8** **ENTER** **1** **0** **ENTER** **▶** **7** **ENTER** **9** **ENTER** **3** **ENTER**.

No	1: L1	2: L2	3: L3
1	5	3	7
2	4	8	9
3	2	10	3
4	-----	-----	-----
5			
6			

3. Save this data set by pressing **⏏** **2ndF** **LIST** **C** (**L_DATA**) **1** (**StoLD**) and press **2** **ENTER**.

NUMERICAL DESCRIPTION OF A TWO-VARIABLE DATA SET

Steps for calculating numerical descriptions of a two-variable data set

1. Turn the calculator on and press **STAT** to enter the statistics menu. Press **A** (**EDIT**) **ENTER** to access the data entry screen. Delete old data by highlighting L1 and pressing **DEL** **ENTER**. Repeat for other lists.

Enter the following data set:

X Y

25 32

28 33

31 27

40 38

29 30

2. Check the data you have entered and correct any errors you may find. To calculate the numerical descriptions of the two variables, press **2ndF** **QUIT** **STAT** **C** (**CALC**) **2** **2_Stats**. Press **ENTER** and the statistical results will appear.
3. Press **▼** to view the remaining statistics.
4. The statistics displayed are:
 1. the average or mean value of the variable, \bar{x} or \bar{y} ;
 2. the standard deviation assuming the data points are a sample from a population, s_x or s_y ;
 3. the standard deviation assuming the data points represent the entire population, σ_x or σ_y ;
 4. the sum of the values, Σx or Σy ;
 5. the sum of the squared values, Σx^2 or Σy^2 ;
 6. the number of data points, n ;
 7. the minimum variable value, x_{\min} or y_{\min} ;
 8. the maximum variable value, x_{\max} or y_{\max} ; and
 9. the sum of the x and y products, Σxy .

NUMERICAL DESCRIPTION OF A TWO-VARIABLE DATA SET

Steps for calculating numerical descriptions of a weighted two-variable data set

1. Turn the calculator on and press **STAT** **A** **ENTER** to enter the statistics menu. Delete old data set by highlighting L1 and pressing **DEL** **ENTER** . Repeat for other lists.
2. Enter the following data set which represents the frequency of observing doubles with a particular pair of dice. The dice were rolled until fifty doubles were observed.

<u>X</u>	<u>Y</u>	<u>W</u>
1	1	8
2	2	10
3	3	12
4	4	9
5	5	6
6	6	5

Each row will contain a data pair and the frequency of occurrence.

3. Check the data you have entered. To calculate the numerical descriptions of the two variables, press **2ndF** **QUIT** **STAT** **C** (**CALC**) and **2** (**2_Stats**). Press **2ndF** **L1** **,** **2ndF** **L2** **,** **2ndF** **L3** **ENTER** and the statistical results will appear.
4. Press **▼** to view more of the numerical descriptions.

GRAPHICAL PORTRAYAL OF A TWO-VARIABLE DATA SET

Steps for drawing a scatter diagram of a two-variable data set

1. Consider the following table listing the revenue for a large corporation:

<u>Year</u>	<u>Revenue (in millions of dollars)</u>
1	48.63
2	48.86
3	48.91
4	49.69
5	51.10
6	52.00
7	52.03

2. Access the statistics data entry screen and delete old data.
3. Enter the data using L1 for the year and L2 for the revenue (in millions of dollars). Check the data and correct any errors you may find.
4. Press **STAT PLOT** **A** **(PLOT1)** **ENTER** to access the PLOT1 set up screen. To turn PLOT 1 on, press **ENTER**. Press **▼** **►** **ENTER** to set the data to two-variable. Set L1 for the x variable by pressing **▼** **2ndF** **L1** **ENTER**. Press **2ndF** **L2** **ENTER** to set L2 for the y variable. To set the graph to scatter diagram, press **STAT PLOT** **G** **(S.D.)** and **3** **(Scatter □)**.
5. Construct an autoscaled scatter diagram of this data set by pressing **ZOOM** **A** **(ZOOM)** **9** **(Stat)**.
6. Press **TRACE** and press **►** repeatedly to verify that Xmin= 1, Xmax= 7, Ymin= 48.63, and Ymax= 52.03.

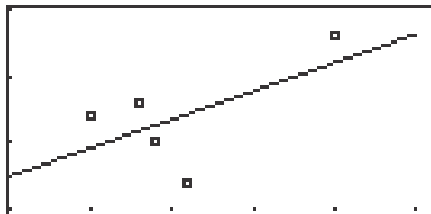
LINEAR REGRESSIONS

Steps for calculating the best-fitting line

1. Turn the calculator on and press **STAT** to enter the statistics menu.
Access the data entry screen by pressing **A (EDIT)** **ENTER** .
Delete old data and enter the following data set:

X	Y
25	32
28	33
31	27
40	38
29	30

Check the data you have entered and correct any errors you may find.
2. To find the best-fitting line (regression line) for the data, press **$\frac{+}{-}$ $\frac{-}{+}$ **STAT** **D (REG)** **0** **2 (Rg_ax+b)** and press **ENTER** .**
3. To overlay the regression line and the scatter diagram for the data, you must first set up the scatter diagram by pressing **STAT PLOT** **A (PLOT1)** **ENTER** **ENTER** **▼** **►** **ENTER** **▼** **2ndF** **L1** **ENTER** **2ndF** **L2** **ENTER** **STAT PLOT** **G (S.D.)** and **3 (Scatter □)**.
4. Display the scatter diagram for the data by pressing **WINDOW** and setting Xmin = 20, Xmax = 45, Xscl = 5, Ymin = 25, Ymax = 40, and Yscl = 5. Press **GRAPH** to view the scatter diagram.
5. To view the overlay of the regression line and the scatter diagram, press **Y=** **CL** **2ndF** **VARS** **H (STAT)** **ENTER** **B (REGEQN)** **1 (RegEqn)** **GRAPH** .



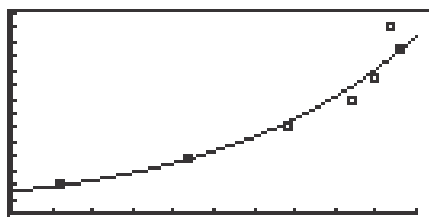
OTHER REGRESSIONS

Steps for calculating other regression models

1. Access the data entry screen and delete old data. Enter the following data set:

<u>X</u>	<u>Y</u>
6	10
22	19
34	31
42	39
45	47
48	58
47	66

2. Check the data you have entered and correct any errors you may find.
3. Set up the scatter diagram using the STAT PLOT window
4. Display the scatter diagram for the data by pressing **WINDOW** and setting Xmin = 0, Xmax = 50, Xscl = 5, Ymin = 0, Ymax = 70, and Yscl = 5. Press **GRAPH** to view the scatter diagram.
5. To find the best-fitting exponential curve ($Y = a \cdot e^{bx}$) for the data, press **2nd** **STAT** **D** **(REG)** **1** **0** **(Rg_ae^{bx})** and press **ENTER**.
6. To view the overlay of the regression curve and the scatter diagram, press **Y=** **CL** **2ndF** **VARS** **H** **(STAT)** **ENTER** **B** **(REGEQN)** **1** **(RegEqn)** and press **GRAPH**.

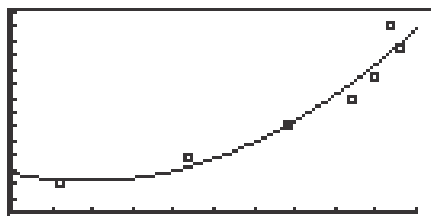


7. Repeat this process to find and view other regression models.

OTHER REGRESSIONS (continued)

Steps for calculating other regression models

1. To find the best-fitting quadratic curve ($y = ax^2 + bx + c$) for the data, press $\boxed{\begin{smallmatrix} + & - \\ \times & \div \end{smallmatrix}} \boxed{\begin{smallmatrix} \div \\ \div \end{smallmatrix}} \boxed{\text{STAT}} \boxed{\text{D}} \boxed{\text{(REG)}} \boxed{0} \boxed{4} \boxed{\text{(Rg}_x^2\text{)}} and press $\boxed{\text{ENTER}}$.$
2. To view the overlay of the regression curve and the scatter diagram, press $\boxed{\text{Y=}} \boxed{\text{CL}} \boxed{2\text{ndF}} \boxed{\text{VAR}} \boxed{\text{H}} \boxed{\text{(STAT)}} \boxed{\text{ENTER}} \boxed{\text{B}} \boxed{\text{(REGEQN)}} \boxed{1} \boxed{\text{(RegEqn)}} and press $\boxed{\text{GRAPH}}$. The following overlay will be displayed.$



Model of best fit

1. Notice, the r^2 value for the quadratic regression model is about .9337.
2. Whereas the r^2 value for the exponential regression model was .9786.
3. The exponential regression model (with the r^2 value closer to 1) is considered the better-fitting model. The exponential regression model even fits better than the linear model with an r^2 value of .8553.
4. Continue this analysis with other regression models.

STATISTICAL TESTS

Steps for performing a one-small-sample hypothesis test for the population mean

1. Turn the calculator on and access the data entry screen. Delete old data and enter the following data set for L1:

7	10	7	6	8	10	15	14	11	12	6	11
11	5	7	9	9	7	4	4	6	5	13	
2. Check the data you have entered and correct any errors you may find.
The data shown above reflects the number of wins for the Chicago Bears in each complete regular season since 1978.
3. Test the alternate hypothesis that "da Bears" are a winning football team against the null hypothesis that "da Bears" are a .500 ball club (8 wins).
4. Set up the statistical test by pressing **2ndF** **QUIT** **STAT** **E** (**TEST**) and **0** **3** (**Ttest1samp**).
5. Set the alternate hypothesis to $\mu > \mu_0$ by pressing **►** **►** **ENTER** .
Set the null hypothesis equal to 8 wins by pressing **▼** **8** **ENTER** .
Set the List to L1 by pressing **2ndF** **L1** **ENTER** .
6. Press **2ndF** **EXE** to compute the statistical test.
7. The first item on the screen, $\mu > 8$, is the alternate hypothesis of the statistical test. The second item on the screen is the observed statistic from the sample. The third item on the screen is the decision statistic or p value.
8. The p value is .201, which is greater than .05. Our decision is to support the null hypothesis that $\mu = 8$. This test shows that "da Bears" average 8 wins a season and thus are .500 ball club. However, the fourth item shows that on the average, "da Bears" win approximately 8.56 games a season, which says they are winners.

STATISTICAL TESTS (continued)

Steps for performing a two-small-sample hypothesis test for the population means

1. Access the data entry screen and enter the additional data for L2.

(Use the Bears data in L1.):

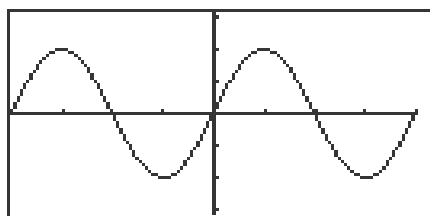
L2 <u>Packers</u>	8	5	5	8	8	8	8	4	5	4	10	6
	4	9	9	9	11	13	13	11	8	9	12	

2. Check the data you have entered and correct any errors you may find.
The data shown above reflects the number of wins for the Green Bay Packers in each complete regular season since 1978. Test the alternate hypothesis that "da Bears" are a better (on the average win more games) football team than the Packers during these recent years.
3. Set up the statistical test by pressing **2ndF** **QUIT** **STAT** **E** (**TEST**) **0** **4** (**Ttest2samp**).
4. Set the alternate hypothesis to $\mu_1 > \mu_2$ by pressing **▶** **▶** **ENTER** .
Pool the standard deviations in the calculation by pressing **▼** **▶** **ENTER** .
Set the List1 to L1 by pressing **▼** **2ndF** **L1** **ENTER** . Set List2 to L2 by pressing **2ndF** **L2** **ENTER** . Press **2ndF** **EXE** to compute the statistical test.
5. The first item on the screen, $\mu_1 > \mu_2$, is the alternate hypothesis of the statistical test. The second item is the observed statistic from the sample . The third item is decision statistic or p value. In our problem, the p value is .3119 which is more than .05. Our decision is to support the null hypothesis that $\mu_1 = \mu_2$. This test shows that "da Bears" average about the same number of wins a season as the Packers. However, the fifth and sixth values show, on the average, "da Bears" win approximately 8.56 games a season, whereas the Packers win 8.13. The Bears win more on the average, but statistically, they are not significantly different.

GRAPHS OF TRIGONOMETRIC FUNCTIONS

Steps for graphing the sine function

1. Turn the calculator on and press $\boxed{Y=}$.
2. Press \boxed{CL} to remove an old Y1 expression.
3. Press $\boxed{\blacktriangledown} \boxed{CL}$ to clear additional expressions.
4. To set up the calculator press $\boxed{2ndF} \boxed{SET UP} \boxed{B} \text{ (DRG)} \boxed{2} \text{ (Rad)}$
 $\boxed{E} \text{ (COORD)} \boxed{1} \text{ (Rect)} \boxed{G} \text{ (EDITOR)} \text{ and } \boxed{1} \text{ (Equation)}.$
5. Press $\boxed{2ndF} \boxed{QUIT}$ again to return to the Y prompts.
6. Enter the sine function ($y = \sin x$) for Y1, by pressing $\boxed{\sin} \boxed{X/\theta/T/n}$.
7. Enter the viewing window range by pressing $\boxed{ZOOM} \boxed{E} \text{ (TRIG)}$ and $\boxed{1} \text{ (sin } x \text{)}.$



Steps for graphing the cosecant function.

1. Press $\boxed{Y=} \boxed{CL}$ to remove an old Y1 expression.
2. Enter the cosecant function for Y1 by pressing $\boxed{MATH} \boxed{A} \text{ (CALC)}$
 $\boxed{1} \boxed{0} \text{ (csc)} \text{ and press } \boxed{X/\theta/T/n}.$
3. Continue to use the sine function's built-in viewing range.
4. Press \boxed{GRAPH} to view the graph.

EVALUATING TRIGONOMETRIC FUNCTIONS

Steps for evaluating $\sin 45^\circ$ directly

1. Turn the calculator on and press $\boxed{\text{ON}}$ to access the computation screen.
2. Press $\boxed{\text{CL}}$ to clear the viewing window of any old expressions.
3. Set the calculator to operate in degrees by pressing $\boxed{2\text{ndF}} \boxed{\text{SET UP}} \boxed{\text{B}} \text{ (DRG)} \boxed{1} \text{ (Deg)}$. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the menu.
4. Enter and evaluate the expression by pressing $\boxed{\sin} \boxed{4} \boxed{5} \boxed{\text{ENTER}}$.

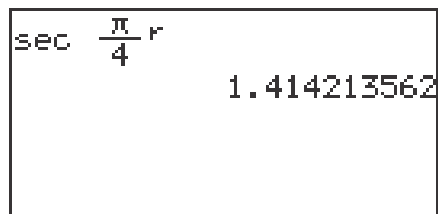
Steps for approximating $\sin \left(\frac{\pi}{3} \right)$ graphically

1. Press $\boxed{\text{Y=}}$ followed by $\boxed{\text{CL}}$ to clear an old expression for Y1.
2. Enter the function $\sin x$ by pressing $\boxed{\sin} \boxed{\text{X}/\theta/\text{T}/n}$. Set the calculator to radian mode by pressing $\boxed{2\text{nd F}} \boxed{\text{SET UP}} \boxed{\text{B}} \text{ (DRG)}$ and $\boxed{2} \text{ (Rad)}$. Press $\boxed{2\text{nd F}} \boxed{\text{QUIT}}$ to exit the menu.
3. View the graph by pressing $\boxed{\text{ZOOM}} \boxed{\text{E}} \text{ (TRIG)} \boxed{1} \sin x$.
4. Now, engage the trace by pressing $\boxed{\text{TRACE}}$ and tracing near $x = \frac{\pi}{3} = 1.047$.
5. With the cursor located near $x = 1.047$, you can zoom in to find a better approximation for the y value. Press $\boxed{\text{ZOOM}} \boxed{\text{A}} \text{ (ZOOM)} \boxed{3} \text{ (In)}$ to zoom in on the cursor.
6. Once again, trace over near $x = 1.047$. Zoom in one more time to see an even better approximation. The y value of .866 approximates $\sin \left(\frac{\pi}{3} \right)$.

EVALUATING TRIGONOMETRIC FUNCTIONS

Steps for evaluating $\sec\left(\frac{\pi}{4}\right)$ directly in degree mode

1. Press $\left[\frac{\pi}{\square}\right]$ to enter computation mode.
2. Press 2ndF SET UP to verify the calculator is in degree mode. If it is not, change it to degree mode. Press 2ndF QUIT to exit the menu.
3. Enter and evaluate the expression by pressing MATH A (**CALC**) 0 9 (**sec**) 2ndF π a/b 4 \blacktriangleright MATH E (**ANGLE**) 4 (**r**) and pressing ENTER .



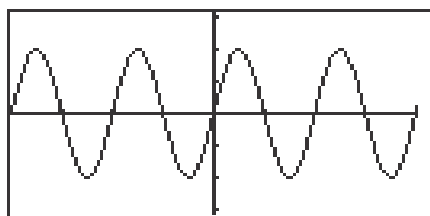
The calculator display shows the expression $\sec \frac{\pi}{4} \text{ r}$ and the result 1.414213562.

Steps for approximating $\tan 20^\circ$ graphically

1. Press Y= and press CL to remove an old expression for Y1.
2. Press 2ndF SET UP to verify the calculator is in degree mode. If it is not, change it. Press 2ndF QUIT to exit the menu.
3. Enter the function $\tan x$ for Y1 by pressing \tan $\text{X}/\theta/\text{T}/n$.
4. Instead of graphing the function in the default viewing window for tangent, press WINDOW adjust the Xmin and Xmax to 10° and 30° (value of interest $\pm 10^\circ$) respectively to start out closer to the value of interest. Set the Xscl = 1. Press ZOOM A (**ZOOM**) and 1 (**Auto**) to view the graph.
5. Now, engage the trace by pressing TRACE . Notice the tracer appears at $x = 20^\circ$ since it is the middle of the x values. The approximate for $\tan 20^\circ$ is .36397.

GRAPHICAL VERIFICATION OF FORMULAS AND IDENTITIES

1. Verify the double angle formula $\sin 2\theta = 2 \sin \theta \cos \theta$, by graphing $Y1 = \sin(2x)$ and $Y2 = 2 \sin x \cos x$ and show that they are in fact the same graph.
2. Turn the calculator on and press $\boxed{Y=}$. Press \boxed{CL} to clear $Y1$ of an old expression. Press $\boxed{\blacktriangledown} \boxed{CL}$ to clear additional expressions.
3. Make sure the calculator is in radian mode by pressing $\boxed{2ndF} \boxed{SET UP}$, $\boxed{B} \text{ (DRG)}$ and $\boxed{2} \text{ (Rad)}$. Press $\boxed{2ndF} \boxed{QUIT}$ to exit the menu.
4. Now enter $\sin(2x)$ for $Y1$ by pressing $\boxed{\sin} \boxed{(} \boxed{2} \boxed{X/\theta/T/n} \boxed{)} \boxed{ENTER}$ and the $2 \sin x \cos x$ for $Y2$ by pressing $\boxed{2} \boxed{\sin} \boxed{X/\theta/T/n} \boxed{\cos} \boxed{X/\theta/T/n} \boxed{ENTER}$.
5. Set your viewing window by pressing $\boxed{ZOOM} \boxed{E} \text{ (TRIG)} \boxed{1} \text{ (sin x)}$.

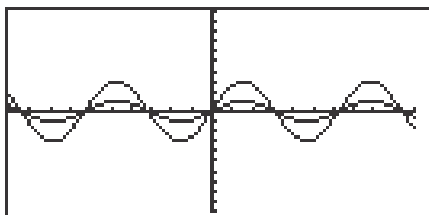


6. They appear as one graph. An invalid formula or identity would result in two graphs.

AMPLITUDE

Investigate changes in amplitude.

1. Turn the calculator on and press $\boxed{Y=}$ and \boxed{CL} to clear old expressions.
2. Enter $y = \sin x$ for Y1 by pressing $\boxed{\sin}$ $\boxed{X/\theta/T/n}$.
3. Enter $y = 3 \sin x$ for Y2 by pressing $\boxed{3}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$.
4. Press \boxed{ZOOM} \boxed{A} **(ZOOM)** $\boxed{5}$ **(Default)** to view the graphs.



5. Notice that the 3 in front of the sine function makes the curve oscillate between 3 and -3 instead of 1 and -1.
6. Press $\boxed{Y=}$ $\boxed{\blacktriangledown}$ \boxed{CL} to clear Y2. Enter $y = -2 \sin x$ for Y2 by pressing $\boxed{(-)}$ $\boxed{2}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$.
7. Press \boxed{GRAPH} to view the graphs. Notice that the -2 in front of the sine function makes the curve reflect on the x-axis and makes the curve oscillate between -2 and 2.

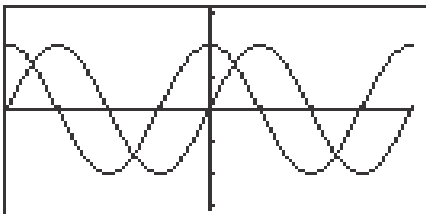
PERIOD AND PHASE SHIFT

Investigate the change in a trigonometric function by multiplying the argument θ by 2.

1. Press $\boxed{Y=}$ \boxed{CL} to access and clear Y1 of an old expression.
2. Make sure the calculator is in radian mode by pressing $\boxed{2ndF}$ $\boxed{SET\ UP}$, \boxed{B} (**DRG**) and $\boxed{2}$ (**Rad**). Press $\boxed{2ndF}$ \boxed{QUIT} to exit the menu.
3. Now, enter $\sin x$ for Y1 by pressing $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ \boxed{ENTER} and the $\sin(2x)$ for Y2 by pressing \boxed{CL} $\boxed{\sin}$ $\boxed{(}$ $\boxed{2}$ $\boxed{X/\theta/T/n}$ $\boxed{)}$ \boxed{ENTER} .
4. Set your viewing window by pressing \boxed{ZOOM} \boxed{E} (**TRIG**) and $\boxed{1}$ (**$\sin x$**). Note the change in the second graph versus the first graph. Engage the trace to show the period has changed from 2π to π .

Investigate the change in a trigonometric function by subtracting $\frac{3\pi}{2}$ to the argument θ .

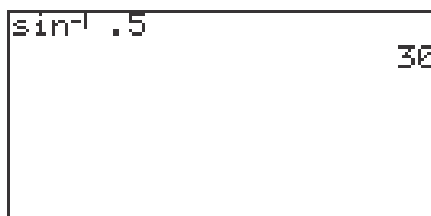
1. Press $\boxed{Y=}$ $\boxed{\blacktriangledown}$ \boxed{CL} and enter $Y = \sin(X - 3\pi/2)$ for Y2 by pressing $\boxed{\sin}$ $\boxed{(}$ $\boxed{X/\theta/T/n}$ $\boxed{-}$ $\boxed{3}$ $\boxed{2ndF}$ $\boxed{\pi}$ $\boxed{\div}$ $\boxed{2}$ $\boxed{)}$ \boxed{ENTER} .
2. Press \boxed{GRAPH} to view the graphs. Observe and note the changes in $\sin x$ when you change the phase shift.



INVERSE TRIGONOMETRIC FUNCTIONS

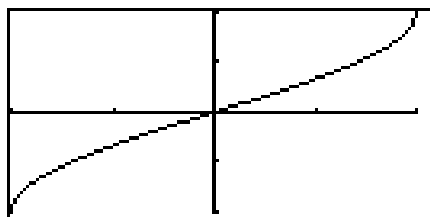
To compute the inverse sine function in degrees:

1. Turn the calculator on and press $\boxed{\text{ON}}$ $\boxed{\text{CL}}$ to enter computation mode.
2. Change to degree mode by pressing $\boxed{2\text{ndF}}$ $\boxed{\text{SET UP}}$ $\boxed{\text{B}}$ (**DRG**) and $\boxed{1}$ (**Deg**). Press $\boxed{2\text{ndF}}$ $\boxed{\text{QUIT}}$ to exit the menu.
3. Find $\sin^{-1}(.5)$ by pressing $\boxed{2\text{ndF}}$ $\boxed{\sin^{-1}}$ $\boxed{\cdot}$ $\boxed{5}$ $\boxed{\text{ENTER}}$. The answer of 30° is shown below.



To graph the inverse sine function in degrees:

1. Press $\boxed{\text{Y=}}$ $\boxed{\text{CL}}$ to access and clear the Y1 expression.
2. Press $\boxed{\text{ENTER}}$ $\boxed{\text{CL}}$ to clear additional Y expressions.
3. Enter $\sin^{-1} x$ for Y1 by pressing $\boxed{2\text{ndF}}$ $\boxed{\sin^{-1}}$ $\boxed{\text{X}/\theta/\text{T}/n}$ $\boxed{\text{ENTER}}$.
4. Set your viewing window by pressing $\boxed{\text{ZOOM}}$ $\boxed{\text{E}}$ (**TRIG**) and $\boxed{4}$ (**$\sin^{-1} x$**).



INVERSE TRIGONOMETRIC FUNCTIONS

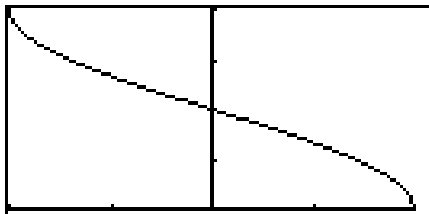
To compute the inverse sine function in radians:

1. Turn the calculator on and press $\boxed{+/-}$ $\boxed{=}$ \boxed{CL} to access and clear the home screen.
2. Change to radian mode by pressing $\boxed{2ndF}$ $\boxed{SET UP}$ \boxed{B} **(DRG)** and $\boxed{2}$ **(Rad)**. Press $\boxed{2ndF}$ \boxed{QUIT} to exit the menu.
3. Find $\sin^{-1}(.4)$, press $\boxed{2ndF}$ $\boxed{\sin^{-1}}$ $\boxed{\bullet}$ $\boxed{4}$ \boxed{ENTER} . The answer of .4115 radians is shown below. To find the result in terms of π press $\boxed{\div}$ $\boxed{2ndF}$ $\boxed{\pi}$ \boxed{ENTER} .

$\sin^{-1} .4$	0.411516846
Ans $\div\pi$	0.13098988

To graph the inverse cosine function in radians:

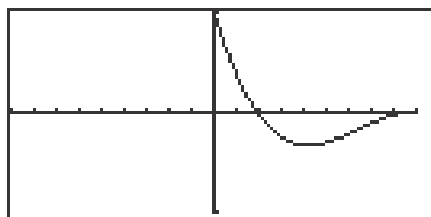
1. Press $\boxed{Y=}$ \boxed{CL} to access and clear the Y1 prompt.
2. Enter $\cos^{-1} x$ for Y1 by pressing $\boxed{2ndF}$ $\boxed{\cos^{-1}}$ $\boxed{X/\theta/T/n}$ \boxed{ENTER} .
3. Set your viewing window by pressing \boxed{ZOOM} \boxed{E} **(TRIG)** and $\boxed{5}$ **($\cos^{-1} x$)**.



SOLVING TRIGONOMETRIC EQUATIONS

To solve a trigonometric equation graphically using the zoom feature:

1. Turn the calculator on and press $\boxed{Y=}$ \boxed{CL} to access and clear Y1 of an old expression. Set the calculator to degree mode by pressing $\boxed{2ndF}$ $\boxed{SET UP}$ \boxed{B} (**DRG**) and $\boxed{1}$ (**Deg**). Press $\boxed{2ndF}$ \boxed{QUIT} to exit the menu.
2. To find the solutions of $3\sin^2 x - 4\sin x + 1 = 0$, press $\boxed{3}$ $\boxed{(}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ $\boxed{)}$ $\boxed{a^b}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{-}$ $\boxed{4}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ $\boxed{+}$ $\boxed{1}$ \boxed{ENTER} .
3. Set your viewing window to the principal values for sine by pressing \boxed{WINDOW} $\boxed{(-)}$ $\boxed{9}$ $\boxed{0}$ \boxed{ENTER} $\boxed{9}$ $\boxed{0}$ \boxed{ENTER} $\boxed{1}$ $\boxed{0}$ \boxed{ENTER} $\boxed{(-)}$ $\boxed{1}$ \boxed{ENTER} $\boxed{1}$ \boxed{ENTER} $\boxed{1}$ \boxed{ENTER} . Press \boxed{GRAPH} to view the graph.



4. To save this original graph and viewing window, press \boxed{ZOOM} \boxed{G} (**STO**) and $\boxed{1}$ (**StoWin**).
5. Set the zoom factors by pressing \boxed{ZOOM} \boxed{B} (**FACTOR**) \boxed{ENTER} $\boxed{5}$ \boxed{ENTER} $\boxed{5}$ \boxed{ENTER} . Press \boxed{GRAPH} to exit the menu.
6. To find the left intercept press \boxed{TRACE} and move the cursor near this intercept by continuing to press the $\boxed{\blacktriangleright}$ key.
7. Now, press \boxed{ZOOM} \boxed{A} (**ZOOM**) and $\boxed{3}$ (**In**) to zoom in on the left intercept and solution of this equation. Press \boxed{TRACE} and $\boxed{\blacktriangleleft}$ to trace near and approximate the intercept.
8. Return to the original screen by pressing \boxed{ZOOM} \boxed{H} (**RCL**) and $\boxed{1}$ (**RclWin**). Trace to find the right intercept.

SOLVING TRIGONOMETRIC EQUATIONS

To solve a trigonometric equation graphically using the CALC feature:

1. Press $\boxed{Y=}$ \boxed{CL} to access and clear Y1. Set the calculator to radian mode by pressing $\boxed{2ndF}$ $\boxed{SET UP}$ \boxed{B} (**DRG**) and $\boxed{2}$ (**Rad**). Press $\boxed{2ndF}$ \boxed{QUIT} to exit the menu.
2. To find the solutions of $2\sin^2 x - \cos x - 1 = 0$, press $\boxed{2}$ $\boxed{(}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ $\boxed{)}$ $\boxed{a^b}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{-}$ $\boxed{\cos}$ $\boxed{X/\theta/T/n}$ $\boxed{-}$ $\boxed{1}$ \boxed{ENTER} .
3. Set your viewing window by pressing \boxed{WINDOW} $\boxed{(-)}$ $\boxed{2ndF}$ $\boxed{\pi}$ $\boxed{\div}$ $\boxed{2}$ \boxed{ENTER} $\boxed{2ndF}$ $\boxed{\pi}$ \boxed{ENTER} $\boxed{2ndF}$ $\boxed{\pi}$ $\boxed{\div}$ $\boxed{4}$ \boxed{ENTER} $\boxed{(-)}$ $\boxed{1}$ \boxed{ENTER} $\boxed{1}$ \boxed{ENTER} $\boxed{1}$ \boxed{ENTER} . Press \boxed{GRAPH} to view the graph.
4. To "calculate" an intercept (solution), press $\boxed{2ndF}$ \boxed{CALC} $\boxed{5}$ (**X_Incpt**). You can calculate the other two intercepts by pressing $\boxed{2ndF}$ \boxed{CALC} $\boxed{5}$ (**X_Incpt**) again.

To solve an equation with functions on both the left and right sides:

1. Press $\boxed{Y=}$ \boxed{CL} to access and clear Y1 of an old expression. To find the solutions of $2\tan x \sin x + 2\sin x = \tan x + 1$, you will enter the left side as Y1, by pressing $\boxed{2}$ $\boxed{\tan}$ $\boxed{X/\theta/T/n}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ $\boxed{+}$ $\boxed{2}$ $\boxed{\sin}$ $\boxed{X/\theta/T/n}$ \boxed{ENTER} .
2. Enter the right side as Y2, by pressing $\boxed{\tan}$ $\boxed{X/\theta/T/n}$ $\boxed{+}$ $\boxed{1}$ \boxed{ENTER} .
3. Set your viewing window by pressing \boxed{WINDOW} $\boxed{(-)}$ $\boxed{2ndF}$ $\boxed{\pi}$ $\boxed{\div}$ $\boxed{2}$ \boxed{ENTER} $\boxed{2ndF}$ $\boxed{\pi}$ \boxed{ENTER} $\boxed{2ndF}$ $\boxed{\pi}$ $\boxed{\div}$ $\boxed{4}$ \boxed{ENTER} $\boxed{(-)}$ $\boxed{2}$ \boxed{ENTER} $\boxed{2}$ \boxed{ENTER} $\boxed{1}$ \boxed{ENTER} . Press \boxed{GRAPH} to view the graph.
4. There appears to be four solutions to the equation. To "calculate" the intersections (solutions), press \boxed{TRACE} , move the tracer right until it appears on the screen. Next, press $\boxed{2ndF}$ \boxed{CALC} $\boxed{2}$ (**Intsct**). Do this several times.

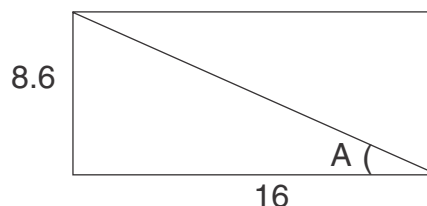
APPLICATIONS WITH RIGHT TRIANGLES

Steps for using the calculator to solving applications with right triangles

1. Turn the calculator on and set it to degree mode by pressing $\boxed{2\text{ndF}} \boxed{\text{SET UP}}$, $\boxed{B} \text{ (DRG)} \boxed{1} \text{ (Deg)}$. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the set up menu.
2. Given a right triangle with $A = 3$ and $C = 6$, find B and θ using the SOLVER. To access the SOLVER, press $\boxed{2\text{ndF}} \boxed{\text{SOLVER}}$, and press $\boxed{\text{CL}}$ to delete any equation that may appear on the screen.
3. Type in the equation $\sin \theta = \frac{A}{C}$ with the keystrokes $\boxed{\sin} \boxed{\text{ALPHA}} \boxed{\theta} \boxed{\text{ALPHA}} \boxed{=} \boxed{a/b} \boxed{\text{ALPHA}} \boxed{A} \boxed{\blacktriangleright} \boxed{\text{ALPHA}} \boxed{C}$.
4. Press $\boxed{2\text{ndF}} \boxed{\text{SOLVER}} \boxed{A} \text{ (METHOD)} \boxed{1} \text{ (Equation)}$ to choose the Equation solver. Press $\boxed{\text{ENTER}}$ and see the list of variables.
5. Press $\boxed{\blacktriangledown}$ to move the blinking cursor over the A and press $\boxed{3} \boxed{\text{ENTER}}$. Type in the value of C by pressing $\boxed{6} \boxed{\text{ENTER}}$. Solve for θ by pressing $\boxed{\blacktriangle} \boxed{\blacktriangle} \boxed{2\text{nd}} \boxed{\text{EXE}}$.
6. To use the SOLVER to find B , edit the current equation to the new equation $\cos \theta = \frac{B}{C}$. Do this by pressing $\boxed{\text{CL}} \boxed{\text{CL}}$ to display the current equation $\sin \theta = \frac{A}{C}$. With the cursor over the s in \sin , press $\boxed{\cos}$ to insert \cos . Press $\boxed{\text{DEL}}$ to delete \sin . Press $\boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{\blacktriangleright}$ to move the cursor over the A in the numerator of the fraction. Press $\boxed{\text{ALPHA}} \boxed{B}$ to insert B . Press $\boxed{\text{DEL}}$ to delete A .
7. Press $\boxed{\text{ENTER}}$ to see the variable list. The value for θ and C will remain as before. Press $\boxed{\blacktriangledown}$ to position the cursor over the B and press $\boxed{2\text{ndF}} \boxed{\text{EXE}}$ to find B .

APPLICATIONS WITH RIGHT TRIANGLES

A rectangle has a length 16 cm and a width 8.6 cm. Find the degree measure of angle A. Determine the length of the diagonal of the rectangle.



1. Press $\boxed{+/-}$ $\boxed{2ndF}$ \boxed{SOLVER} to access the SOLVER, and press \boxed{CL} to delete the equation that is on the screen.
2. Enter the equation $\tan \theta = \frac{A}{B}$ by pressing $\boxed{\tan}$ \boxed{ALPHA} $\boxed{\theta}$ \boxed{ALPHA} $\boxed{=}$ $\boxed{a/b}$ \boxed{ALPHA} \boxed{A} $\boxed{\blacktriangleright}$ \boxed{ALPHA} \boxed{B} .

3. Press \boxed{ENTER} to view the variable list.
4. Enter 8.6 for A and 16 for B. (The value of θ will be listed as the one that was used in the previously entered equation.)
5. Position the cursor over θ and press $\boxed{2ndF}$ \boxed{EXE} to find θ .
6. To determine the length of the diagonal of the rectangle, return to the equation by pressing \boxed{CL} \boxed{CL} and edit the current equation to read $\sin \theta = A/C$.
7. Press \boxed{ENTER} to see the variable list. The value of θ should be as before, so enter 8.6 for A and solve for C.

LAW OF SINES

Use the Graphic Solver with the Law of Sines.

1. Set the calculator to degrees by pressing **2ndF** **SET UP** **B** (**DRG**) and **1** (**Deg**). Press **2ndF** **QUIT** to exit the set up screen.
2. To access the SOLVER, press **2ndF** **SOLVER** **CL**. Enter $\frac{\sin A}{X} = \frac{\sin B}{Y}$ by pressing **a/b** **sin** **ALPHA** **A** **▶** **ALPHA** **X** **▶** **ALPHA** **=** **a/b** **sin** **ALPHA** **B** **▶** **ALPHA** **Y**.
3. Store it into memory by pressing **2ndF** **SOLVER** **C** (**SAVE**) pressing **ENTER**, and typing in LAWSINES. Press **ENTER** to store the formula.
4. Press **2ndF** **SOLVER** **A** (**METHOD**) **3** (**Graphic**) to choose the Graphic Solver. Press **ENTER** for the list of variables.
5. With the blinking cursor over the A, type in 95 and press **ENTER**. Next, type 15 for x, the length of the side opposite the 95°, and press **ENTER**. Enter 48 for B in the same manner. Solve for y by positioning the blinking cursor over the y and press **2ndF** **EXE**.
6. You must enter the range values for the unknown (from BEGIN to END) within which you expect to find the solution. Let the BEGIN = 5 by pressing **5** **ENTER**. Enter a value for END that you do not expect y to exceed, say 25, by pressing **2** **5** **ENTER**. Press **2ndF** **EXE** and an autoscaled plot will be drawn showing graphs of the left and right sides of the current equation.
7. The calculator will now display a box in the center of the viewing screen while it looks for the intersection of the two graphs. The solution is displayed at the bottom of the screen.

LAW OF COSINES

Use the Newton Solver with the Law of Cosines.

1. Access the SOLVER with $\boxed{2\text{ndF}} \boxed{\text{SOLVER}}$ (or press $\boxed{\text{CL}}$ twice if you are still in the SOLVER). Press $\boxed{\text{CL}}$ to delete the current equation. Return to the Equation Solver by pressing $\boxed{2\text{ndF}} \boxed{\text{SOLVER}} \boxed{\text{A}}$ (**METHOD**) and $\boxed{1}$ (**Equation**).
2. Next enter the Law of Cosines by pressing $\boxed{\text{ALPHA}} \boxed{\text{Z}} \boxed{x^2} \boxed{\text{ALPHA}} \boxed{=}$
 $\boxed{\text{ALPHA}} \boxed{\text{X}} \boxed{x^2} \boxed{+} \boxed{\text{ALPHA}} \boxed{\text{Y}} \boxed{x^2} \boxed{-} \boxed{2} \boxed{\text{ALPHA}} \boxed{\text{X}} \boxed{\times} \boxed{\text{ALPHA}}$
 $\boxed{\text{Y}} \boxed{\times} \boxed{\cos} \boxed{\text{ALPHA}} \boxed{\theta}$.
3. Store this equation in the calculator.
4. Given a triangle in which two sides of lengths 13 cm and 8 cm enclose a 50° angle. Find the length of the third side.
5. Press $\boxed{\text{ENTER}}$ to view the list of variables. Press $\boxed{\blacktriangledown}$ to position the cursor on X and enter 13. Next, enter 8 for Y and 50 for θ . Press $\boxed{\blacktriangle}$ to move the cursor over Z and press $\boxed{0} \boxed{\text{ENTER}}$.
6. Press $\boxed{2\text{ndF}} \boxed{\text{EXE}}$ to solve for Z. Notice that the SOLVER has automatically changed to the Newton Solver. You should supply an initial estimate of the solution in the START position (0 is the default value) and a step size STEP (.001 is the default value).
7. Press $\boxed{2\text{ndF}} \boxed{\text{EXE}}$ to find the solution. (If you receive an error message, try changing the START value or increasing the STEP value.)
8. Notice the left and right sides of the equation are displayed as equal values, and the $L - R = 0$.

AREA OF A TRIANGLE

1. Set the calculator to operate in degrees with $\boxed{2\text{ndF}} \boxed{\text{SET UP}} \boxed{\text{B}} \text{ (DRG)}$ and $\boxed{1} \text{ (Deg)}$. Press $\boxed{2\text{ndF}} \boxed{\text{QUIT}}$ to exit the set up screen.
2. Access the SOLVER by pressing $\boxed{2\text{ndF}} \boxed{\text{SOLVER}}$, and press $\boxed{\text{CL}}$ to delete any equation on the screen.
3. Type in the equation $A = \frac{1}{2} B \cdot H$ with the keystrokes: $\boxed{\text{ALPHA}} \boxed{\text{A}} \boxed{\text{ALPHA}} \boxed{=}$ $\boxed{\text{a/b}}$ $\boxed{1}$ $\boxed{\blacktriangleright}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{\text{ALPHA}} \boxed{\text{B}}$ $\boxed{\times}$ $\boxed{\text{ALPHA}} \boxed{\text{H}}$
4. Press $\boxed{2\text{ndF}} \boxed{\text{SOLVER}} \boxed{\text{A}} \text{ (METHOD)} \boxed{1} \text{ (Equation)}$ to choose the Equation solver. Press $\boxed{\text{ENTER}}$ to see the list of variables for your equation.
5. Find the area of a triangle with base = 4 and height = 8.35. Use $\boxed{\blacktriangledown}$ to move the blinking cursor over B and type in 4. Type in 8.35 for H and press $\boxed{\text{ENTER}}$. Press $\boxed{\blacktriangle}$ twice to move the prompt to the A variable. Press $\boxed{2\text{ndF}} \boxed{\text{EXE}}$ to find the area of 16.7.
6. Save the formula by pressing $\boxed{2\text{ndF}} \boxed{\text{SOLVER}} \boxed{\text{C}} \text{ (SAVE)}$. Enter a name and press $\boxed{\text{ENTER}}$.
7. Enter $A = \frac{1}{2} B \cdot C \cdot \sin \theta$ by pressing $\boxed{\text{CL}}$ a couple times to return to and delete the current equation. Type in the equation with the keystrokes: $\boxed{\text{ALPHA}} \boxed{\text{A}}$ $\boxed{\text{ALPHA}} \boxed{=}$ $\boxed{\text{a/b}}$ $\boxed{1}$ $\boxed{\blacktriangleright}$ $\boxed{2}$ $\boxed{\blacktriangleright}$ $\boxed{\text{ALPHA}} \boxed{\text{B}}$ $\boxed{\times}$ $\boxed{\text{ALPHA}} \boxed{\text{C}}$ $\boxed{\times}$ $\boxed{\sin}$ $\boxed{\text{ALPHA}} \boxed{\theta}$.
8. Consider the triangle where sides of lengths 4.8 and 5.73 enclose a 47° angle. Press $\boxed{\text{ENTER}}$ to access the variable list, enter 5.73 for B, 4.8 for C (or vice-versa), and 47 for θ . Move the cursor to the A variable. Press $\boxed{2\text{ndF}} \boxed{\text{EXE}}$ to solve for the area.

AREA OF A TRIANGLE (continued)

9. Continue with the formula and press **2ndF** **SOLVER** **A** **(METHOD)** and **3** **(Graphic)** to choose the Graphic solver.

10. To start the problem from the beginning, set A to 0. Move the cursor to the A variable and press **2ndF** **EXE** to see the Graphic solver variable range screen.

11. Since area is always nonnegative, 0 could be used for BEGIN. Enter END a value that you do not expect area to exceed, say 25. (A little bit of estimation helps here! If your value for END is too small, increase it and try again.)

12. Press **2ndF** **EXE** and an autoscaled graph of the two sides of the equation is drawn and the solution is obtained.

13. Enter Heron's formula, $A = \sqrt{[S(S-X)(S-Y)(S-Z)]}$, press **CL**, and type the following: **ALPHA** **A** **ALPHA** **=** **2ndF** **$\sqrt{}$** **ALPHA** **S** **(** **ALPHA** **S** **-** **ALPHA** **X** **)** **(** **ALPHA** **S** **-** **ALPHA** **Y** **)** **(** **ALPHA** **S** **-** **ALPHA** **Z** **)**.

14. Note that the square root symbol extends over the entire right hand side of the equation, automatically grouping the expression under it.

15. You could enter the semiperimeter, $S = \frac{1}{2}(X + Y + Z)$, in a separate formula in the SOLVER, but it is probably easier to find the value of S in the computation mode and then use Heron's formula in the SOLVER. Press **ENTER** to view the variable list.

16. Use Heron's formula to find the area of a triangle with three sides of length 7, 8, and 9. The value for S will be 12. Enter these into the solver and press **2ndF** **EXE** to find the area.

AREA OF A CIRCULAR SECTOR

A lawn sprinkler is set so that the region of the lawn that is watered is approximately a sector of a circle of radius 6 feet. If the central angle of the sector is $\frac{\pi}{5}$ radians, find the area of the region that is watered by the sprinkler.

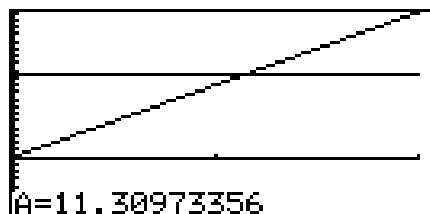
1. Set the calculator to radian mode by pressing **2ndF** **SET UP** **B** (**DRG**) and **2** (**Rad**). Press **2ndF** **QUIT** to exit the set up screen.
2. Access the SOLVER by pressing **2ndF** **SOLVER**. Press **CL** to delete any equation that appears on the screen.
3. Type in the equation $A = \frac{1}{2} R^2 \theta$ by pressing **ALPHA** **A** **ALPHA** **=** **1** **a/b** **2** **►** **ALPHA** **R** **x²** **ALPHA** **θ**.
4. Use the Equation solver by pressing **2ndF** **SOLVER** **A** (**METHOD**) and **1** (**Equation**). Press **ENTER** and see the list of variables.
5. Use **▼** to place the cursor over R, type in 6, and press **ENTER**. Type in θ by pressing **2ndF** **π** **÷** **5** **ENTER**. Press **▲** twice to place the cursor on the A variable. Press **2ndF** **EXE** to find the area in square feet.
6. Use the Newton solver by pressing **2ndF** **SOLVER** **A** (**METHOD**) and **2** (**Newton**). Reset A to 0 to start the problem from the beginning. The values of R and θ are correct for this problem, so use **▲** to place the cursor over the A variable and press **2ndF** **EXE** to view the Newton solver screen.
7. Since area is never negative, you could set START = 0. Leave the STEP size as .001 and remember that you should change it to a slightly larger value if an error message results. Press **2ndF** **EXE** to find the area in square feet.

AREA OF A CIRCULAR SECTOR (continued)

8. Continue the problem and find the area using the Graphic Solver.
9. Press **2ndF** **SOLVER** **A** **(METHOD)** **3** **(Graphic)**.
10. Reset A to 0 to start the problem from the beginning.
11. Place the cursor on the A variable and press **2ndF** **EXE** .
12. Recall that BEGIN and END are the lower and upper values between which you feel the solution will lie. Enter a 20 for END so that the intersection of the two graphs is visible on the screen.

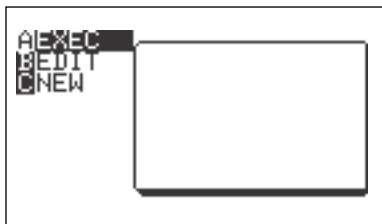
```
Graphic solver
Variable range
BEGIN=0
END=20
```

13. Press **2ndF** **EXE** to find the area.



CREATING A NEW PROGRAM

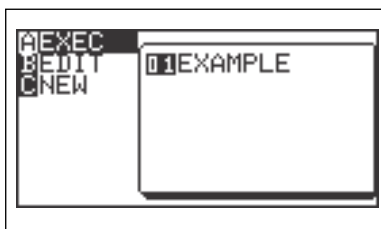
1. Turn the calculator on and press **PRGM** to enter the programming menu. The menu consists of commands to execute, edit, and create new programs.



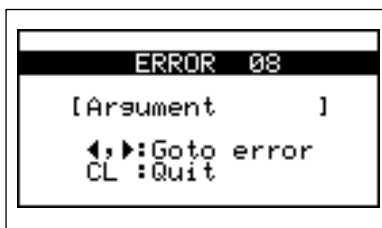
2. Press **C** (**NEW**) and **ENTER** to open a new program. The calculator is now locked in ALPHA mode and is prepared to accept a name for the new program. Enter the program name.
3. You can now enter the program. All program commands are obtained in the program menu. You cannot type program commands 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 $\text{abs}(N-P) > .01$ **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** **x²** **-** **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 mistake, 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+	ALPHA R a^b (1 ÷ ALPHA N)
2πK)÷N)	, (ALPHA θ + 2 2ndF π ALPHA K) ÷ ALPHA N) ENTER
Print rθ→y	PRGM A 1 MATH D 6
(R^(1÷N),	ALPHA R a^b (1 ÷ ALPHA N)
(θ+2πK)÷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
$\sqrt{((B \times X + E)^2 -$	B × X/θ/T/n + ALPHA E) +
$4C(A \times X^2 +$	2ndF √ ((ALPHA B × X/θ/T/n
$DX + F))) \div$	+ ALPHA B × X/θ/T/n + ALPHA E
$(2C) \Rightarrow Y1$	) x² - 4 ALPHA C (ALPHA A
	× X/θ/T/n x² + 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
$\sqrt{((B \times X + E)^2 -$	B × X/θ/T/n + ALPHA E) -
$4C(A \times X^2 +$	2ndF √ ((ALPHA B × X/θ/T/n
$DX + F))) \div$	+ ALPHA E) x² - 4 ALPHA C
$(2C) \Rightarrow Y2$	(ALPHA A × X/θ/T/n x² + 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)
 ÷(B×X+E)”⇒Y1 PRGM A 2 ((-) ALPHA A
 × X/θ/T/n x² - 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.

- 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.
- 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.
- 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 mistake, use the calculator's editing features to correct the error.
3. Enter the following program:

random \Rightarrow X	MATH	C	1	STO	X/θ/T/n	ENTER				
random \Rightarrow Y	MATH	C	1	STO	ALPHA	Y	ENTER			
1 \Rightarrow I	1	STO	ALPHA	I	ENTER					
Label A	PRGM	B	0	1	ALPHA	A	ENTER			
random \Rightarrow 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) \Rightarrow X	.	5	(X/θ/T/n	+	1)	STO	X/θ/T/n	
	ENTER									
.5Y \Rightarrow 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) \Rightarrow X	.	5	(X/θ/T/n	+	.	5)	STO	
	X/θ/T/n	ENTER								
.5(Y+1) \Rightarrow 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.

- 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 n th 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 mistake, 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⇒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 ⇒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.																

- 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 $\boxed{Y=}$ and \boxed{CL} to clear the Y1 prompt. Press $\boxed{\blacktriangledown}$ and \boxed{CL} to clear additional prompts. Press $\boxed{\blacktriangle}$ to return to the Y1 prompt. Enter the function for which you want to find the roots. Enter $x^2 - 2$ by pressing $\boxed{X/\theta/T/n}$ $\boxed{x^2}$ $\boxed{-}$ $\boxed{2}$ \boxed{ENTER} . Execute the NEWTONS program by pressing \boxed{PRGM} \boxed{A} (EXEC) and select NEWTONS. The program will prompt you for the accuracy you desire in calculating the root. Enter .001 by pressing $\boxed{.}$ $\boxed{0}$ $\boxed{0}$ $\boxed{1}$ \boxed{ENTER} . Next, the program will prompt you for your guess. Enter 1 by pressing $\boxed{1}$ \boxed{ENTER} . A blinking cursor in the upper right-hand corner tells you the program is still working. Continue to press \boxed{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 \boxed{ENTER} to execute the program again with another guess. You can repeat the program for other functions by pressing $\boxed{Y=}$ and changing the Y1 function to the new one. If you receive an error statement, press $\boxed{\blacktriangleleft}$ or $\boxed{\blacktriangleright}$ 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 mistake, 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 \Rightarrow X	0 STO X/θ/T/n ENTER
0 \Rightarrow D	0 STO ALPHA D ENTER
-1 \Rightarrow Xmin	(-) 1 STO 2ndF VARS B ENTER A 1 ENTER
2N+1 \Rightarrow Xmax	2 ALPHA N + 1 STO 2ndF VARS B ENTER A 2 ENTER
1 \Rightarrow Xscl	1 STO 2ndF VARS B ENTER A 3 ENTER
-1 \Rightarrow Ymin	(-) 1 STO 2ndF VARS B ENTER A 4 ENTER
H+1 \Rightarrow Ymax	ALPHA H + 1 STO 2ndF VARS B ENTER A 5 ENTER
1 \Rightarrow 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, 0)	2ndF DRAW A 2 X/θ/T/n , ALPHA H , X/θ/T/n + 1 , 0) ENTER

CONVERGENCE OF A SERIES (continued)

$D+H \Rightarrow D$ ALPHA D + ALPHA H STO ALPHA
D ENTER
 $F \times H \Rightarrow H$ ALPHA F \times 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
 $D+H \Rightarrow D$ ALPHA D + ALPHA H STO ALPHA
D ENTER
 $X+2 \Rightarrow X$ 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.

- 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
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
Goto A	F	5	2ndF	VARS	B	ENTER
	A	5				
	PRGM	B	0	2	ALPHA	A
						ENTER
End	PRGM	A	6	ENTER		

- 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	$\sqrt{}$	(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 $\langle 1, 2, 3 \rangle$ and the unit vector in its direction, press **1** **ENTER** **2** **ENTER** **3** **ENTER** .