TI-82 GRAPHING CALCULATOR

BASIC OPERATIONS

by

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A-1 Getting Started

```
MEMORY
1: Check RAM…
2: Delete…
3: Reset…
```

Press [ON] to turn on the calculator.

Press [2nd] [+] to get the MEMORY screen (shown at the right).

Use the down arrow [▼] to choose 3:Reset… and press [ENTER] .

```
RESET MEMORY
1: No
2: Reset
```

The display shows the RESET MEMORY (second screen shown at the right).

Use the down arrow [▼] to choose 2: Reset... and press [ENTER]

.

The screen may look blank. This is because the contrast setting was also reset and now needs to be adjusted.

Press [2nd] and then hold the [▲] down until you see Mem cleared in the middle of the screen. Now the contrast will be dark enough for you to see the screen display.

> Press [2nd] [▲] to make the display darker.
>
> Press [2nd] [▼] to make the display lighter.

To check the battery power, press [2nd] [▲] and note the number that will appear in the upper right corner of the screen. If it is an 8 or 9, you should replace your batteries. The highest number is a 9. Press [CLEAR] to clear the screen.

Press [2nd] [OFF] to turn off the calculator.

A-2 Special Keys, Home Screen and Menus

[2nd]

This key must be pressed to access the operation above and to the left of a key. These operations are a light blue color on the face of the calculator. A flashing up arrow [↑] is displayed as the cursor on the screen after [2nd] key is pressed.

> In this document, the functions on the face of the calculator above a key will be referred to in square boxes just as if the function was printed on the key cap. For example, [ANS] is the function above the [(-)] key.

[ALPHA]

This key must be pressed first to access the operation above and to the right of a key. A flashing [A] is displayed as the cursor on the screen after the [ALPHA] key is pressed.

[A-LOCK]

[2nd] [A-LOCK] locks the calculator into alpha mode. The calculator will remain in alpha mode until the [ALPHA] is pressed again.

[MODE]

Press [MODE] . The highlighted items are active. Select the item you wish using the arrow keys. Press [ENTER] to activate the selection.

Type of notation for display of numbers.	Normal Sci Eng
Number of decimal places displayed.	Float 0123456789
Type of angle measure.	Radian Degree
Function or parametric graphing.	Func Par Pol Seq
Connected/not connected plotted points on graphs.	Connected Dot
Graphs functions separately or all at once.	Sequential Simul
Allows a full screen or split screen to be used.	FullScreen Split

Home Screen

The screen on which calculations are done and commands are entered is called the Home Screen. You can always get to this screen (aborting any calculations in progress) by pressing

QUIT

[2nd] [MODE] . From here on, this will be referred to as [2nd] [QUIT] in this appendix.

Menus

The TI-82 Graphics calculator uses menus for selection of specific functions. The items on the menus are identified by numbers followed by a colon. There are two ways to choose menu items:

> 1. Using the arrow keys to highlight the selection and then pressing [ENTER] .
> 2. Pressing the number corresponding to the menu item.

In this document the menu items will be referred to using the key to be pressed followed by the meaning of the menu. For example, on the ZOOM menu, [1] :ZBox refers to the first menu item.

A-3 Correcting Errors

It is easy to correct errors on the screen when entering data into the calculator. To do so use the arrow keys, [DEL] , and [INS] keys.

[◀] or [▶]	Moves the cursor to the left or right one position.
[▲]	Moves the cursor up one line or replays the last executed input.
[▼]	Moves the cursor down one line.
[DEL]	Deletes one or more characters at the cursor position.
[2nd] [INS]	Inserts one or more characters at the cursor position.

A-4 Calculation

Example 1 Calculate $-8 + 9^2 - \left| \frac{3}{\sqrt{2}} - 5 \right|$.

Turn the calculator on and press [2nd] [QUIT] to return to the Home Screen. Press [CLEAR] to clear the Home Screen. Now we are ready to do a new calculation.

Numbers and characters are entered in the same order as you would read an expression. Do not press [ENTER] unless specifically instructed to do so in these examples. Keystrokes are written in a column but you should enter all the keystrokes without pressing the ENTER key until [ENTER] is displayed in the example.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[2nd] [QUIT] [CLEAR] [(-)] [8] [+] [9] [^] [2] [-] [2nd] [ABS] [(] [3] [÷] [2nd] [√] [2] [-] [5] [)] [ENTER]	`-8+9^2-abs (3/√ 2 -5)` `70.12132034`	It is a good idea to clear the screen before starting a calculation.

A-5 Evaluation of an Algebraic Expression, Lists and Tables

Example 1 Evaluate $\frac{x^4 - 3a}{8w}$ for $x = \pi$, $a = \sqrt{3}$, and $w = 4!$.

Two different methods can be used to evaluate algebraic expressions:

1. Store the values of the variables and then enter the expression. When [ENTER] is pressed the expression is evaluated for the stored values of the variables.
2. Store the expression and store the values of the variables. Recall the expression. Press [ENTER] . The expression will be evaluated for the stored values of the variables.

The advantage of the second method is that the expression can be easily evaluated for several different values of the variables.

Solution:

Method 1

Keystrokes	*Screen Display*
[2nd] [QUIT]	π→X
[2nd] [π] [STO▶] [X,T,θ] [ENTER]	3.141592654
[2nd] [√] [3] [STO▶] [ALPHA] [A] [ENTER]	√ 3→A 1.732050808
[4] [MATH] [▶] [▶] [▶] [4] :! [STO▶] [ALPHA] [W] [ENTER]	4!→W 24

In this document the notation [4] :! refers to the menu item accessed by pressing the number 4.

Keystrokes	*Screen Display*
[(] [X,T,θ] [^] [4] [-] [3] [ALPHA] [A] [)] [÷]	(X^4-3A)/(8W)
[(] [8] [ALPHA] [W] [)] [ENTER]	.4802757219

Method 2

Keystrokes	*Screen Display*
[CLEAR] [Y=] [CLEAR] [(] [X,T,θ] [^] [4] [-] [3] [ALPHA]	Y1=(X^4-3A)/(8W
[A] [)] [÷] [(] [8] [ALPHA] [W] [)] [2nd] [QUIT]	)
[2nd] [π] [STO▶] [X,T,θ] [ENTER]	π→X 3.141592654
[2nd] [√] [3] [STO▶] [ALPHA] [A] [ENTER]	√ 3→A 1.732050808
[4] [MATH] [▶] [▶] [▶] [4] :! [STO▶] [ALPHA] [W] [ENTER]	4!→W 24
[2nd] [Y-VARS] [1] :Function [1] :Y1 [ENTER]	Y1 .4802757219

Example 2 For $f(x) = 3x+5$ and $g(x) = \sqrt{x - \sqrt{x}}$ find $f(2) - g(2)$.

Solution: (Using Method 2 above.)

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [3] [X,T,θ] [+] [5]		Clear Y1 and store $f(x)$ as Y1.
[ENTER] [CLEAR]	`Y1=3X+5`	
[2nd] [√] [(] [X,T,θ] [-]	`Y2=√(X-√X)`	Clear Y2 and store $g(x)$ as Y2.
[2nd] [√] [X,T,θ] [)]		
[2nd] [QUIT]		Store 2 as X.
[2] [STO▸] [X,T,θ] [ENTER]	`2→X` `2`	
[2nd] [Y-VARS] [1] :Function		
[1] :Y1 [-] [2nd] [Y-VARS]	`Y1-Y2`	Algebraically form $f(x) - g(x)$ and evaluate at $x = 2$.
[1] :Function [2] :Y2 [ENTER]	`10.23463314`	

Example 3 Evaluate the function $g(x) = \sqrt{x - \sqrt{x}}$ to three decimal places for $x = 1.900$, 1.990, 1.999, 2.001, 2.010, and 2.100 using a list.

Solution: Store the expression in the calculator as was done in Example 2 above. Store the values of *x* in a list and simultaneously evaluate the expression for each value of *x*.

Keystrokes	*Screen Display*	*Explanation*
[MODE] [▼] [▶] [▶] [▶] [▶]		Change the mode to three decimal places. Return to the home screen. Clear any existing expressions in the Y= list by clearing or deselecting them.
[ENTER] [2nd] [QUIT]		
[Y=] [CLEAR] [▼] [CLEAR] …		
[2nd] [√] [(] [X,T,θ] [-]	`Y1=√(X-√X)`	Store the expression as Y1 and return to the home screen.
[2nd] [√] [X,T,θ] [)]		
[2nd] [QUIT]		
[2nd] [{] [1.9] [,] [1.99] [,]	`{1.9,1.99,1.999, 2.001,2.01,2.1}→ L1`	Store the values of *x* in the list L1.
[1.999] [,] [2.001] [,] [2.01] [,]		
[2.1] [2nd] [}] [STO▸] [2nd]	`{1.900 1.990 1.…`	
[L1] [ENTER]		

[2nd] [Y-VARS] [1] :Function [1] :Y1 [(] [2nd] [L1] [)] [STO▶] [2nd] [L2] [ENTER]	Y1(L1)→L2 {.722 .761 .765…	Calculate the value of the expression stored as Y2 for the values of *x* in list L1 and store in list L2. To view the results, use the [◀] and [▶] keys.
[2nd] [L2] [ENTER]	L2 {.722 .761 .765…	To recall L2, press 2nd L2. The results are 0.722, 0.761, 0.765, 0.766, 0.770, and 0.807.

Example 4

Evaluate the expression $g(x) = \sqrt{x - \sqrt{x}}$ to three decimal places for values of *x* at each integer from 0 to 1 using a table.

Solution: First store the expression in the Y= list. Set the table parameters to begin at *x* = 0 and to have an increment of 1. Get the table.

Keystrokes	*Screen Display*	*Explanation*
[MODE] [▼] [▶] [▶] [▶] [▶] [ENTER] [2nd] [QUIT]		Change the mode for numbers to three decimal places. Return to the home screen.
[Y=] [CLEAR] [▼] [CLEAR] …		Clear any existing expressions in the in the Y= list by clearing or deselecting them.
[2nd] [√] [(] [X,T,θ] [-] [2nd] [√] [X,T,θ] [)] [2nd] [QUIT]	Y1=√(X-√X)	Store the expression as Y1 and return to the home screen.
[2nd] [TblSet] [0] [ENTER] [1] [ENTER] [ENTER]	TABLE SETUP TblMin=0 ΔTbl=1 Indpnt: Auto Ask Depend: Auto Ask	Set the table to begin evaluating the expression at *x* = 0 with a step size of 1
[▼] [ENTER]		Set the calculator to automatically display values of *x* and Y1.
[2nd] [TABLE] [▼] …[▼]	(see screen below)	Get the table. Arrow down to see more of the table, The highlighted value will appear at the bottom of the table. Reset the mode for numbers to Float.

X	Y1
0.000	0.000
1.000	0.000
2.000	.765
3.000	1.126
4.000	1.414
5.000	1.663
6.000	1.884
X=0	

A-6 Testing Inequalities in One Variable

Example 1 Determine whether or not $x^3 + 5 < 3x^4 - x$ is true for $x = -\sqrt{2}$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
CLEAR MODE ▼ ENTER		Clear the Home Screen. Change the MODE to floating.
(-) 2nd √ 2 STO▸	-√ 2→X	Store the value for *x*.
X,T,θ ENTER	-1.414213562	
X,T,θ MATH 3 :³ + 5		Enter the expression.
2nd TEST 5 :< 3		
X,T,θ ^ 4 - X,T,θ	X³ +5<3X^4-X	
ENTER	1	The result of 1 indicates the expression is true for this value of *x*. If a 0 was displayed, the expression would be false.

A-7 Graphing and the ZStandard Graphing Screen

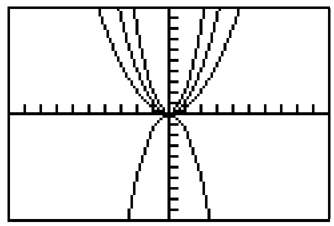
Before doing any graphing on the calculator, the statistical graphing commands need to be turned off.

2nd STAT PLOT 4 :PlotsOff ENTER

Example 1 Graph $y = x^2$, $y = .5x^2$, $y = 2x^2$, and $y = -1.5x^2$ on the same coordinate axes.

Solution:

Keystrokes	*Screen Display*	*Explanation*
Y= CLEAR X,T,θ x²	Y1=X²	Clear the existing function and store the first function as Y1.
ENTER		
CLEAR .5	Y2=.5X²	Clear and store the second function as Y2.
X,T,θ x² ENTER		

Keystrokes	Screen	Comments
CLEAR 2 X,T,θ x^2 ENTER	Y3=2X^2	Clear and store the third function as Y3.
CLEAR (-) 1.5 X,T,θ x^2	Y4=- 1.5X^2	Clear and store the fourth function as Y4.
ZOOM 6 :ZStandard		Choose the ZStandard option from the ZOOM menu.

The ZStandard screen automatically sets the graph for $-10<x<10$ and $-10 < y < 10$. Press WINDOW to see this.

The window dimensions will be denoted as [-10,10]1 by [-10,10]1 in this document.

The graphs will be plotted in order: Y1, then Y2, then Y3, then Y4, etc.

If there is more than one function graphed, the up ▲ and down ▼ arrow keys allow you to move between the graphs displayed.

A-8 TRACE, ZOOM and WINDOW

TRACE allows you to observe both the *x* and *y* coordinate of a point on the graph as the cursor moves along the graph.

ZOOM will magnify a graph so the coordinates of a point can be approximated with greater accuracy.

There are three methods to zoom in:

1. Change the WINDOW values.
2. Use the 2 :Zoom In option on the ZOOM menu in conjunction with
   ZOOM ▶ 4 :Set Factors.
3. Use the 1 :ZBox option on the ZOOM menu.

Example 1 Approximate the value of x to two decimal places for $y = x^3 - 2x^2 + \sqrt{x} - 8$ if the value of y is -1.58 .

Solution:

Graph the function using the ZStandard Graphing Screen. (See Section A-7 of this document).

Method 1 Change the WINDOW values.

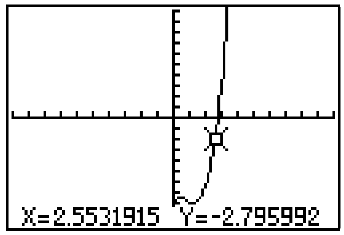
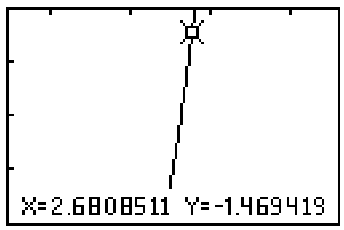
Keystrokes	*Screen Display*	*Explanation*
[TRACE] [▶] …[▶]		Press the right arrow repeatedly until the new type of cursor gives a y value as close to -1.58. The closest point is (2.55…,-2.79…).
[WINDOW] [ENTER] [2] [ENTER] [3] [ENTER] [.1] [ENTER] [(-)] [3] [ENTER] [(-)] [1] [ENTER] [.1] [GRAPH]	WINDOW FORMAT Xmin=2 Xmax=3 Xscl=.1 Ymin=-3 Ymax=-1 Yscl=.1	The x coordinate is between 2 and 3. So we set the WINDOW at $2<x<3$ with scale marks every .1 by $-3<y<-1$ with scale marks every .1. This will be written as [2,3].1 by [-3,-1].1.

Use [TRACE] again to estimate a new x value. Change the [WINDOW] appropriately. Repeat using [TRACE] and changing the [WINDOW] until the approximation of (2.67,-1.58) has been found.

> Note that you may need to press the arrow keys repeatedly before the cursor becomes visible as it starts at the middle value of the x values specified for the window.

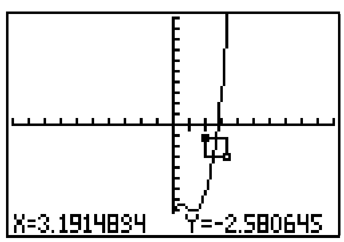
> Occasionally you will see a moving bar in the upper right corner. This means the calculator is working. Wait until the bar disappears before continuing.

Method 2 Use the [2] :Zoom In option on the [ZOOM] menu.

Keystrokes	*Screen Display*	*Explanation*
[ZOOM] [6] :ZStandard		Graph the function using the standard graphing screen.
[ZOOM] [▶] [4] :Set Factors [5] [ENTER] [5]	ZOOM FACTORS XFact=5 YFact=5	Magnification factors need to be set. For this example let us set them at 5 for both horizontal and vertical directions.
[TRACE] [▶] …[▶]	 	Move the cursor using the arrow keys to the point (2.5531915, -2.795992) which has a *y* value close to -1.58.
[ZOOM] [2] :Zoom In [ENTER] [TRACE]	 	Use the [2] :Zoom In from the [ZOOM] menu to get a closer look at the *x* coordinate. Press TRACE to see the coordinates of a point on the graph.

Repeat this procedure until you get a value for the *x* coordinate accurate to two decimal places. The point has coordinates (2.67, -1.58).

Method 3 Use the [1] :Box option on the [ZOOM] menu.

Keystrokes	*Screen Display*	*Explanation*
[ZOOM] [6] :ZStandard		Graph the function using the standard graphing screen.
[ZOOM] [1] :ZBox [▶] …[▼] [ENTER]	 	Use the arrow keys until the cursor is a little to the left and above the point we are trying to find, say at (2.1276596, -1.290323). Press ENTER. This anchors the upper left corner of the box.
[▼] …[▶] [ENTER]		Now use the arrow keys to locate the lower right corner of the box, say at (3.1914894, -2.580645). Press ENTER to get the new display.

Repeat using trace and zoom box until you get a value for the *y* coordinate accurate to two decimal places. The point has coordinates (2.67, -1.58).

A-9 Determining the WINDOW Dimensions and Scale Marks

There are several ways to determine the limits of the *x* and *y* axes to be used in setting the WINDOW. Three are described below:

1. Graph using the default setting of the calculator and zoom out. The disadvantage of this method is that often the function cannot be seen at either the default settings or the zoomed out settings of the WINDOW.

2. Evaluate the function for several values of *x*. Make a first estimate of the window dimensions based on these values.

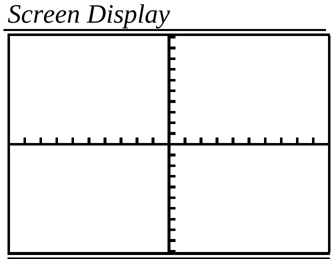
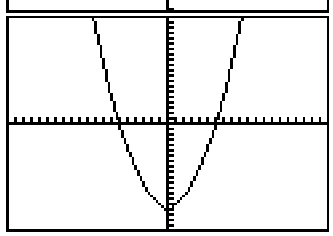
3. Analyze the leading coefficient and/or the constant terms.

A good number to use for the scale marks is one that yields about 20 marks across the axis. For example if the WINDOW is [-30, 30] for the an axis then a good scale value is (30-(-30))/20 or 3.

Example 1 Graph the function $f(x) = .2x^2 + \sqrt[3]{x} - 32$.

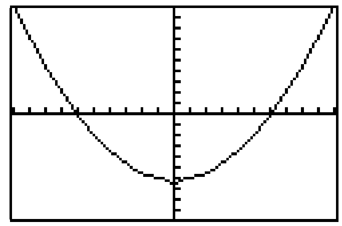
Solution:

Method 1 Use the default setting and zoom out.

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [.2] [X,T,θ] [^] [2] [+] [MATH] [4] :∛ [X,T,θ] [-] [32] [ZOOM] [6] :ZStandard		Nothing is seen on the graph screen because no part of this curve is in this WINDOW.
[ZOOM] [▶] [4] :Set Factors [4] [ENTER] [4]		Set the zoom factors.
[ZOOM] [3] :Zoom Out [▼] … [▶] [ENTER]		After pressing [ZOOM] [3] use the arrow keys to move the cursor to the point you wish to be the center of the new zoom screen. We chose (0, 0). Zooming out shows a parabolic shaped curve.

Method 2 Evaluate the function for several values of x. (See Section A-5 on how to evaluate a function at given values of x.)

x	f(x)
-20	45.3
-10	-14.2
0	-32.0
10	-9.8
20	50.7



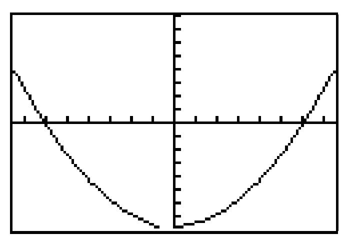
Analyzing this table indicates that a good WINDOW to start with is [-20,20]2 by [-50,50]5. Note the scale is chosen so that about 20 scale marks will be displayed along each of the axes. The scale is chosen as 2 for the x axis since [20-(-20)]/20=2 and 5 for the y axis since [50-(-50)]/20=5.

Method 3 Analyze the leading coefficient and constant terms.
Since the leading coefficient is .2 the first term will increase .2 units for each 1 unit x^2 increases or 2 units for each 10 units x^2 increases. This means that the first term will increase for every $\sqrt{10}$ (or about 3 units increase) in x. A first choice for the x axis limits can be found using

$$\frac{10 \times (\text{unit increase in } x)}{(\text{first term increase})} = \frac{10 \times 3}{2} = 15$$

A first choice for the scale on the x axis (having about 20 marks on the axis) can be found using $\frac{\text{Xmax-Xmin}}{20} = \frac{15-(-15)}{20} = 1.5$ (round to 2). So the limits on the x axis could be [-15,15]2.

A first choice for the y axis limits could be ±(constant term).
The scale for the y axis can be found using $\frac{\text{Ymax-Ymin}}{20}$ $= \frac{32-(-32)}{20} = 3.2$ (round to 4). So a first choice for the y axis limits could be [-32,32]4. Hence a good first setting for the WINDOW is [-15,15]2 by [-32,32]4.



A good choice for the **scale** is so that about 20 marks appear along the axis.
This is $\frac{\text{Xmax-Xmin}}{20}$ (rounded up to the next integer) for the x axis and $\frac{\text{Ymax-Ymin}}{20}$ (rounded up to the next integer) for the y axis.

A-10 Piecewise-Defined Functions

There are two methods to graph piecewise-defined functions:

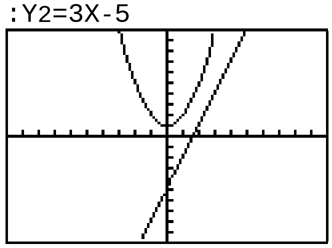
1. Graph each piece of the function separately as an entire function on the same coordinate axes. Use trace and zoom to locate the partition value on each of the graphs.

2. Store each piece of the function separately but include an inequality statement following the expression which will set the WINDOW of values on x for which the function should be graphed. Then graph all pieces on the same coordinate axes.

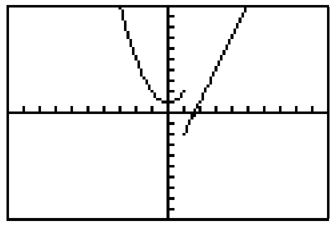
Example 1 Graph $f(x) = \begin{cases} x^2+1 & x < 1 \\ 3x-5 & x \geq 1 \end{cases}$

Solution:

Method 1

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [X,T,θ] [^] [2] [+] [1] [ENTER] [CLEAR] [3] [X,T,θ] [-] [5] [ZOOM] [6] :ZStandard	:Y1=X^2+1 :Y2=3X-5 	Store the functions. Graph. Both functions will be displayed. Use trace and zoom to find the point on the graphs where x=1. When drawing this curve on paper, place an open circle as the endpoint of the piece of the graph not including x=1 and a closed circle as the endpoint of the piece of the graph including x=1.

Method 2

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [(] [X,T,θ] [^] [2] [+] [1] [)] [÷] [(] [X,T,θ] [2nd] [TEST] [5] :< [1] [)] [ENTER] [CLEAR] [(] [3] [X,T,θ] [-] [5] [)] [÷] [(] [X,T,θ] [2nd] [TEST] [4] :≥ [1] [)] [ZOOM] [6] :ZStandard	:Y1=(X^2+1)/(X<1) :Y2:(3X-5)/(X≥1) 	The logical statement $x<1$ will give a 1 when the value of x is less than 1 and a 0 when the value of x is greater than or equal to 1. Hence the first part of the function is divided by 1 when $x<1$ and 0 when $x\geq1$. The function will not graph when it is divided by 0. Similarly for the logical statement $x\geq1$ for the second part of the function. The 1 and 0 are not shown on the screen but are used by the calculator when graphing the functions.

A-11 Solving Equations in One Variable

There are two methods for approximating the solution of an equation using graphing.

1. Write the equation as an expression equal to zero. Graph y=(the expression). Find where the curve crosses the x axis. These x values are the solution to the equation. This can be done using TRACE and ZOOM or using the SOLVE(from the MATH menu.

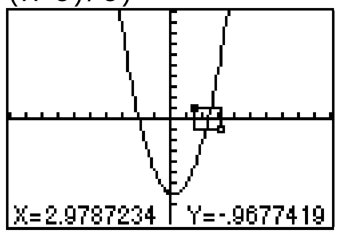
2. Graph y=(left side of the equation) and y=(right side of the equation) on the same coordinate axes. The x coordinate of the points of intersection are the solutions to the equation. This can be done using TRACE and ZOOM or using intersect from the CALC menu.

Example 1 Solve $\frac{3x^2}{2} - 5 = \frac{2(x+3)}{3}$.

Solution:

Method 1 Using TRACE and ZOOM

Write the equation as $\left(\frac{3x^2}{2} - 5\right) - \left(\frac{2(x+3)}{3}\right) = 0$. Graph $y = \left(\frac{3x^2}{2} - 5\right) - \left(\frac{2(x+3)}{3}\right)$ and find the x value where the graph crosses the x axis. This is the x intercept.

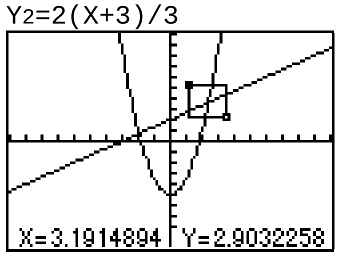
Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [(] [3] [X,T,θ] [^] [2] [÷] [2] [-] [5] [)] [-] [(] [2] [(] [X,T,θ] [+] [3] [)] [÷] [3] [)] [ZOOM] [6] :ZStandard	Y1=(3X^2/2-5)-(2 (X+3)/3) 	Store the expression as Y1. Use trace and zoom to find the *x* intercepts. They are: $x \approx -1.95$ and $x \approx 2.39$. A typical zoom box is shown on the graph at the left. (See Method 3 of Section A-8.)

Method 1 Using SOLVE(

Keystrokes	*Screen Display*	*Explanation*
[MATH] [0] :solve([(] [3] [X,T,θ] [^] [2] [÷] [2] [-] [5] [)] [-] [(] [2] [(] [X,T,θ] [+] [3] [)] [÷] [3] [)] [,] [X,T,θ] [,] [2nd] [{] [0] [,] [3] [2nd] [}] [)]	solve((3X^2/2-5)-(2(X+3)/3),X,{0,3}) 2.393868921	The keystrokes given require the function to be entered in the solve(command. You could store the left and right side of the equation as Y1 and Y2 and put this as the first entry in the solve(command. The general format of this command is solve(*function*,*variable*, *guess*,{*lower*,*upper bound*}) or solve(*function*,*variable*,*guess*) The approximate solutions to this equation are -1.95 and 2.39, rounded to two decimal places.

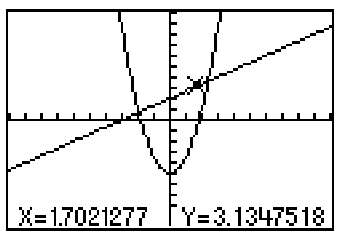
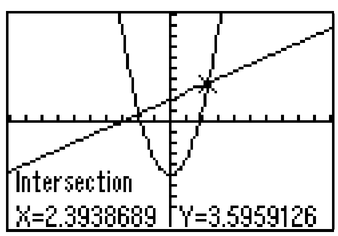
Method 2 using TRACE and ZOOM

Graph $y = \frac{3x^2}{2} - 5$ and $y = \frac{2(x+3)}{3}$ on the same coordinate axes and find the *x* coordinate of their points of intersection.

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [3] [X,T,θ] [^] [2] [÷] [2] [-] [5] [ENTER] [CLEAR] [2] [(] [X,T,θ] [+] [3] [)] [÷] [3] [ZOOM] [6] :ZStandard	Y1=3X^2/2-5 Y2=2(X+3)/3 	Store the two functions. Find the points of intersection. Use trace and zoom to find the *x* values: $x \approx -1.95$ and $x \approx 2.39$. A typical zoom box is shown on the graph at the left.

Method 2 using intersect

Graph $y = \frac{3x^2}{2} - 5$ and $y = \frac{2(x+3)}{3}$ on the same coordinate axes and find the x coordinate of their points of intersection.

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [3] [X,T,θ] [^] [2] [÷] [2] [-] [5] [ENTER] [CLEAR] [2] [(] [X,T,θ] [+] [3] [)] [÷] [3]	Y_1=3X^2/2-5 Y_2=2(X+3)/3	Store the two functions and graph using the standard window dimensions.
[ZOOM] [6] :ZStandard		
[2nd] [CALC] [5] :intersect		Select intersect from the CALC menu.
[ENTER]		Select the first curve. Look in the upper right corner for the function number.
[ENTER]		Select the second curve.
[▶] …[▶] [ENTER]		Move the cursor so it is near the intersection point and press ENTER.
		The approximate solution is 2.39. Use CALC again to find the other solution of -1.95.

A-12 Solving Inequalities in One Variable

There are two methods for approximating the solution of an inequality using graphing.

1. Write the inequality with zero on one side of the inequality sign. Graph *y*=(the expression). Find the *x* intercepts. The solution will be an inequality with the *x* values (*x* intercepts) as the cutoff numbers. The points of intersection can be found using TRACE and ZOOM or using the SOLVE(from the MATH menu.

2. Graph *y*=(left side of the inequality) and *y*=(right side of the inequality) on the same coordinate axes. The *x* coordinate of the points of intersection are the solutions to the equation. Identify which side of the *x* value satisfies the inequality by observing the graphs of the two functions.
   The points of intersection can be found using TRACE and ZOOM or using intersect from the CALC menu.

Example 1 Approximate the solution to $\frac{3x^2}{2} - 5 \leq \frac{2(x+3)}{3}$. Use two decimal place accuracy.

Solution:

Method 1 Write the equation as $\left(\frac{3x^2}{2} - 5\right) - \left(\frac{2(x+3)}{3}\right) \leq 0$. Graph $y = \left(\frac{3x^2}{2} - 5\right) - \left(\frac{2(x+3)}{3}\right)$ and find the *x* intercepts. This was done in Section A-10 Example 1 Method 1.

The *x* intercepts are -1.95 and 2.39. The solution to the inequality is the interval on *x* for which the graph is below the *x* axis. The solution is $-1.95 \leq x \leq 2.39$.

Method 2 Graph $y = \frac{3x^2}{2} - 5$ and $y = \frac{2(x+3)}{3}$ on the same coordinate axes and find the *x* coordinate of their points of intersection. See Section A-10 Example 1 Method 2. The *x* coordinate of the points of intersections are -1.95 and 2.39. We see that the parabola is below the *x* line for $-1.95 \leq x \leq 2.39$. Hence the inequality is satisfied for $-1.95 \leq x \leq 2.39$.

A-13 Storing an Expression That Will Not Graph

Example 1 Store the expression $B^2 - 4AC$ so that it will not be graphed but so that it can be evaluated at any time.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[Y=] [▼] [▼] [▼] [CLEAR]		Choose Y4 using the arrow keys. (Any of Y1, Y2, Y3, … could be used.) Store the expression.
[ALPHA] [B] [^] [2] [-] [4]	`Y4=B^2-4A*C`	
[ALPHA] [A] [x] [ALPHA] [C]		
[◀] …[◀] [ENTER]		Use the left arrow repeatedly until the cursor is over the = sign. Press [ENTER]. The highlighting will disappear from the = sign. Now you can still evaluate the expression by recalling it using [Y-VARS], but it will not graph.

A-14 Permutations and Combinations

Example 1 Find (A) $P_{10,3}$ and (B) $C_{12,4}$ or $\binom{12}{4}$.

***Solution (A)*:**

The quantity can be found by using the definition $\frac{10!}{7!}$ or the built-in function nPr.

Keystrokes	*Screen Display*	*Explanation*
[10]	`10`	Enter the first number. Get the math menu and choose `PRB` using the arrow keys. Choose `nPr` and press [ENTER].

[MATH]	`MATH NUM HYP PRB`
	`1:rand`
	`2:nPr`
	`3:nCr`
	`4:!`	

[▶] [▶] [▶]		
[2] :nPr [3] [ENTER]	`10 nPr 3` `720`	

Solution (B):

The quantity can be found by using the definition $\frac{12!}{4!8!}$ or using the built-in function nCr.

Keystrokes	*Screen Display*	*Explanation*
[12] [MATH] [▶] [▶] [▶]	12 MATH NUM HYP PRB 1:Rand 2:nPr 3:nCr 4:!	Enter the first number. Get the math menu and choose PRB using the arrow keys. Choose nCr and press [ENTER] .
[3] :nCr [4] [ENTER]	12 nCr 4 495	

A-15 Matrices

Example 1 Given the matrices

$$A = \begin{bmatrix} 1 & -2 \\ 3 & 0 \\ 5 & -8 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 1 & 5 \\ 3 & 2 & -1 \\ 0 & 8 & -3 \end{bmatrix} \quad C = \begin{bmatrix} 1 \\ -5 \\ 10 \end{bmatrix}$$

Find (A) -3BC (B) B^{-1} (C) A^T (D) det B

Solution (A):

Keystrokes	*Screen Display*	*Explanation*
[MATRX] [▶] [▶]	NAMES MATH EDIT 1:[A] 2:[B] 3:[C] 4:[D] 5:[E]	Enter the matrix mode. Choose EDIT using the arrow keys.
[1] :[A]	MATRIX[A] 3 x2 [1 -2] [3 0] [5 -8]	Choose the A matrix.
[3] [ENTER] [2] [ENTER]	3,2 =-8	Enter the dimensions of the matrix.

[1] [ENTER] [(-)] [2] [ENTER] [3] [ENTER] [0] [ENTER] [5] [ENTER] [(-)] [8] [ENTER]	MATRX	Enter the matrix elements.
[MATRX]		Return to the matrix menu and repeat the procedure to enter matrix B and C.
[2nd] [QUIT]		Return to the home screen to do calculations.
[(-)] [3] [MATRX] [2] :[B] [MATRX] [3] :[C]	-3[B][C] [[-141] [51] [210]]	Operations are entered as usual only use the matrix symbols.

Solution (B):

Keystrokes	*Screen Display*	*Explanation*
[MATRX] [2] :[B] [x^{-1}] [ENTER]	$[B]^{-1}$ [[.015037594 .... [.0676691729 -... [.1804511278 -...	Notice the way inverses are found. The rest of the matrix can be seen using the right arrow keys.

Solution (C):

[MATRX] [1] :[A] [MATRX] [▶] [2] :^{T} [ENTER]	$[A]^T$ [[1 3 5] [-2 0 -8]]	Choose the transpose from the MATRX MATH menu.

Solution (D):

[MATRX] [▶] [1] :det [MATRX] [2] :[B] [ENTER]	det[B] 133	Choose the determinant option from the MATRX MATH menu.

Example 2 Find the reduced form of matrix $\begin{bmatrix} 2 & 1 & 5 & 1 \\ 3 & 2 & -1 & -5 \\ 0 & 8 & -3 & 10 \end{bmatrix}$

Solution:

Keystrokes	*Screen Display*	*Explanation*

[MATRX] [▶] [▶]	`NAMES MATH EDIT`
	`1:[A]`
	`2:[B]`
	`3:[C]`
	`4:[D]`
	`5:[E]`
		Enter the matrix mode and choose EDIT using the arrow keys.

[1] :[A]	`MATRIX[A] 3 x4`
	`[0 0 0 …`
	`[0 0 0 …`
	`[0 0 0 …`
		Choose the A matrix.

[3] [ENTER] [4] [ENTER]		Store the dimensions of the matrix.
[2] [ENTER] [1] [ENTER] [5] [ENTER] [1] [ENTER] [3] [ENTER] [2] [ENTER] etc.	`1,1 =0`	Enter the elements row by row.
[2nd] [QUIT]		When all elements are entered, press [2nd] [QUIT] to get the Home Screen.
[MATRX] [1] :[A] [ENTER]		Display the matrix from the MATRX menu.

[MATRX] [▶] [0] :*row([.5]
[,] [MATRX] [1] :[A]
[,] [1] [)] [ENTER]
	`*row(.5,[A],1)`
	`[[ 1 .5 2.5 .5]`
	` [ 3 2 -1 -5]`
	` [ 0 8 -3 10]]`
		Multiply row 1 of matrix A by .5. Another way to say this that might help to remember the order of entries within the parentheses is to think:
		.5 times matrix A row 1.

[STO▶]
[MATRX] [1] :[A] [ENTER]
	`Ans→[A]`
	`[[ 1 .5 2.5 .5]`
	` [ 3 2 -1 -5]`
	` [ 0 8 -3 10]]`
		Store the result in matrix A location. It is a good idea to store the answer. You can always operate on the latest answer using [2nd] [ANS] .

[MATRIX] [▶] [ALPHA] [A]
:*row+([(-)] [3] [,]
[MATRIX] [1] :[A] [,]
[1] [,] [2] [)] [ENTER]
	`*row+(-3,[A],1,2`
	`)`
	`[[ 1 .5 2.5 .5 …]`
	` [ 0 .5 -8.5 -6. …]`
	` [ 0 8 -3 10 …]]`
		However, if you make a mistake and the new matrix is not stored, you will need to start over from the beginning.
		
		Multiply -3 times matrix A row 1 to add to row 2.

[STO▶] [MATRIX] [1] :[A] [ENTER]	`Ans→[A]`
	`[[ 1 .5  2.5  .5  …]`
	` [ 0 .5  -8.5 -6  …]`
	` [ 0 8   -3   10  …]]`
		Store the result as matrix A.

[MATRIX] [▶] [0] :*row([2] [,] [MATRIX] [1] : [A] [,] [2] [)] [ENTER]	`*row(2,[A],2)`
	`[[ 1 .5 2.5  .5 ]`
	` [ 0 1  -17  -13]`
	` [ 0 8  -3   10 ]]`
		2 times matrix A row 2.

[STO▶] [MATRIX] [1] :[A] [ENTER]	`Ans→[A]`
	`[[ 1 .5 2.5  .5 ]`
	` [ 0 1  -17  -13]`
	` [ 0 8  -3   10 ]]`
		Store the result as matrix A.

Continue using row operations to arrive at the reduced form of $\begin{bmatrix} 1 & 0 & 0 & -2.428... \\ 0 & 1 & 0 & 1.571... \\ 0 & 0 & 1 & .857... \end{bmatrix}$.

To swap rows of a matrix use [8] :rowSwap(from the [MATRX] [▶] menu.

rowSwap([A],2,3) will swap rows 2 and 3 in matrix [A].

To add one row to another use [9] :row+(from the [MATRX] [▶] menu.

Hence if a system of equations is

$$\begin{aligned} 2x_1 + 1x_2 + 5x_3 &= 1 \\ 3x_1 + 2x_2 - x_3 &= -5 \\ 8x_2 - 3x_3 &= 10 \end{aligned}$$

with augmented coefficient matrix

$$\begin{bmatrix} 2 & 1 & 5 & 1 \\ 3 & 2 & -1 & -5 \\ 0 & 8 & -3 & 10 \end{bmatrix}$$

the solution, rounded to two decimal places, of the system of equations is

$x_1 = -2.43$
$x_2 = 1.57$
$x_3 = .857$

A-16 Graphing an Inequality

There are two methods to graph an inequality.

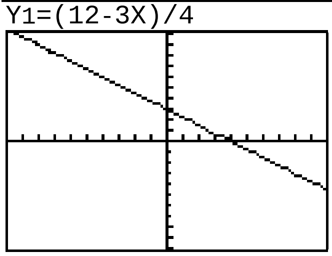
1. Graph the boundary curve. Determine the half-plane by choosing a test point not on the boundary curve and substituting into the inequality.
2. Repeat Method 1 to determine which side of the graph is to be shaded. Use the SHADE option on the calculator to get a shaded graph.

Example 1 Graph $3x + 4y \le 12$

Solution:

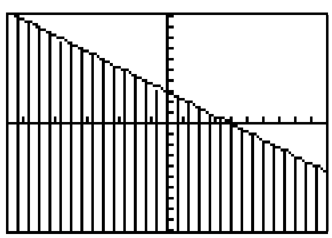
Change the inequality sign to an equal sign: $3x+4y=12$. Solve the equation for y: $y = (12-3x)/4$. Enter this into the calculator in the function list and graph.

Method 1

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [(] [12] [-] [3] [X,T,θ] [)] [÷] [4] [ZOOM] [6] :ZStandard	`Y1=(12-3X)/4` 	Graph $3x+4y=12$ by first writing as $y=(12-3x)/4$. [Determine the half-plane by choosing the point (0, 0) and substituting into the inequality **by hand**. $3\cdot0+4\cdot0<12$ is a true statement. The inequality is true for this point. Hence, we want the lower half-plane.]

Method 2

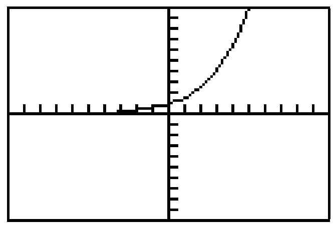
Keystrokes	*Screen Display*	*Explanation*

[2nd] [QUIT]
[2nd] [DRAW] [7] :Shade(
[(-)] [10] [,]
[(] [12] [-] [3] [X,T,θ] [)] [÷] [4]
[,] [2] [,] [(-)] [10]
[,] [10] [)] [ENTER]
	`Shade(-10,(12-3X`
	`)/4,2,-10,10)`
	
		Repeat Method 1 to determine the appropriate half plane. Enter the Shade command. The numbers in the Shade command are:
		Lower boundary (a function)
		Upper boundary (a function)
		Resolution (a number from 1 to 8 for shading pattern.)
		Left boundary (a number)
		Right boundary (a number)

A-17 Exponential and Hyperbolic Functions

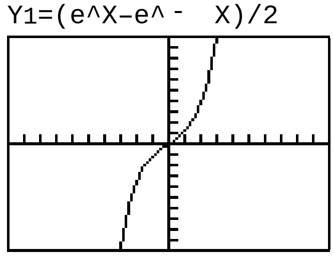
Example 1 Graph $y = 10^{0.2x}$

Solution:

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [10] [^] [(] [.2] [X,T,θ] [)] [ZOOM] [6] :ZStandard	`Y1=10^(.2X)` 	Store the function and graph. Note the entire exponent needs to be in parentheses.

Example 2 Graph $y = \frac{e^{x} - e^{-x}}{2}$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [(] [2nd] [e^x] [X,T,θ] [-] [2nd] [e^x] [(-)] [X,T,θ] [)] [÷] [2] [ZOOM] [6] :ZStandard	`Y1=(e^X−e^- X)/2` 	Store the function and graph.
[Y=] [▼] [CLEAR] [MATH] [▶] [▶] [1] :sinh [X,T,θ] [GRAPH]	`Y2=sinh(x)`	This is also the hyperbolic sine. So we could use sinh . Get the sinh from the HYP menu. Enter X as the variable and graph. Store it as Y2. When you graph both graphs, you only see one. That is because Y1 and Y2 define the same function.

A-18 Scientific Notation, Significant Digits, and Fixed Number of Decimal Places

Example 1 Calculate $(-8.513\times10^{-3})(1.58235\times10^{2})$. Enter numbers in scientific notation.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[(-)] [8.513]	‾8.513E ‾3	Enter the first number.
[2nd] [EE] [(-)]	‾.008513	The number displayed is not in scientific notation. (It is not necessary to press ENTER at this point. This is done here to show how the numbers are displayed on the screen.)
[3] [ENTER]		
[×] [1.58235]	Ans*1.58235E 2	Multiply by the second number.
[2nd] [EE] [2] [ENTER]	‾1.347054555	

Example 2 Set the scientific notation to six significant digits and calculate $(351.892)(5.32815\times10^{-8})$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[MODE] [▶] [ENTER]	Normal Sci Eng Float 0123456789 Radian Degree Func Par Pol Seq Connected Dot Sequential Simul FullScreen Split	Select Sci using the arrow keys and press ENTER.
[▼] [▶] [▶] [▶] [▶] [▶] [▶]		Select 5 decimal places using the arrow keys and press ENTER. Five decimal places will give six significant digits in scientific mode.
[ENTER]		
[2nd] [QUIT]		Return to the Home screen.
[351.892] [×] [5.32815]	351.892*5.32815E ‾8	Enter the numbers.
[2nd] [EE] [(-)] [8] [ENTER]	1.87493E ‾5	Note the result is displayed in scientific notation with six significant digits.

Example 3 Fix the number of decimal places at 2 and calculate the interest earned on $53,218.00 in two years when invested at 5.21% simple interest.

Solution:

Keystrokes	*Screen Display*	*Explanation*
MODE ENTER	Normal Sci Eng Float 0123456789 Radian Degree Func Par Pol Seq Connected Dot Sequential Simul FullScreen Split	Choose normal notation with 2 fixed decimal points.
▼ ▶ ▶ ▶ ENTER		
2nd QUIT		Return to the Home Screen.
53218 × .0521 × 2 ENTER	53218*.0521*2 5545.32	Only two decimal places are shown in the answer. The interest is $5545.32.

A-19 Angles and Trigonometric Functions

Example 1 Evaluate $f(x) = \sin x$ and $g(x) = \tan^{-1} x$ at $x = \frac{5\pi}{8}$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
MODE ▼ ▼ ENTER	Norm Sci Eng Float 0123456789 Radian Degree Func Par Pol Seq Connected Dot Sequential Simul FullScreen Split	The angle measure is given in radians. Set the calculator for radian measure before starting calculations.
2nd QUIT		Return to the Home screen.
5 2nd π ÷ 8 STO▶ X,T,θ ENTER	5π/8→X 1.963495408	Store $\frac{5\pi}{8}$ as *x*.
SIN X,T,θ ENTER	sin X .9238795325	Get sine function and evaluate.
2nd TAN⁻¹ X,T,θ ENTER	tan⁻¹ X 1.099739749	Get the inverse tangent function and evaluate.

Example 2 Evaluate $f(x) = \csc x$ at $x = 32° 5' 45''$.

Solution:

Keystrokes	*Screen Display*	*Explanation*

[MODE] [▼] [▼] [▶] [ENTER]
[2nd] [QUIT]
	`Norm Sci Eng`
	`Float 0123456789`
	`Radian Degree`
	`Func Par Pol Seq`
	`Connected Dot`
	`Sequential Simul`
	`FullScreen Split`
		The angle measure is given in degrees. Set the calculator for degree measure before starting calculations. Return to the Home screen using.

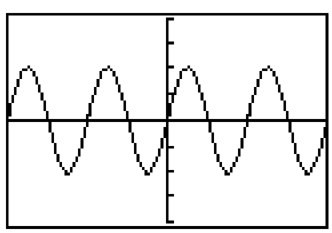
[1] [÷] [SIN] [(] [32] [+]
[5] [÷] [60] [+] [45] [÷]
[3600] [)] [ENTER]
	`1/sin (32+5/60+4`
	`5/3600)`
	`1.882044822`
		Use $\frac{1}{\sin x}$ as csc *x*.
		
		Change the minutes and seconds to decimal values while entering the angle measure.

Example 3 Graph $f(x) = 1.5 \sin 2x$.

Solution:

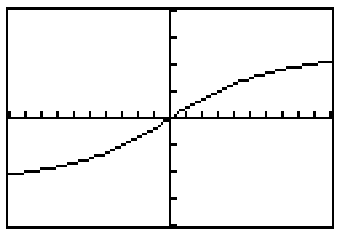
Keystrokes	*Screen Display*	*Explanation*

[MODE] [▼] [▼] [ENTER]	`Normal Sci Eng`
	`Float 0123456789`
	`Radian Degree`
	`Func Par Pol Seq`
	`Connected Dot`
	`Sequential Simul`
	`FullScreen Split`
		Set MODE to Radian measure.

[Y=] [CLEAR] [1.5] [SIN] [2] [X,T,θ]	`:Y1=1.5sin 2X`	Store $f(x)$ as Y1.
[ZOOM] [7] :Trig		Use the trigonometric option on the ZOOM menu to get tick marks set at radian measures on the horizontal axis since the angle measure is in radians. Press [WINDOW] to see the WINDOW dimensions are [-6.15…, 6.15…]1.57 by [-4,4]1.

Example 4 Graph $g(x) = 3\tan^{-1}(.2x)$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[Y=] [CLEAR] [3] [2nd] [TAN⁻¹] [.2] [X,T,θ]	:Y1=3tan⁻¹ .2X	Store $g(x)$ as Y1.
[WINDOW] [▼] [(-)] [10] [ENTER] [10] [ENTER] [1] [ENTER] [(-)] [6.28] [ENTER] [6.28] [ENTER] [1.57]		Set the WINDOW at [-10,10]1 by [-6.28,6.28]1.57
[GRAPH]		Graph the function.

A-20 Polar Coordinates and Polar Graphs

Example 1 Change the rectangular coordinates $(-\sqrt{3}\ ,5)$ to polar form with $r \geq 0$ and $0 \leq \theta \leq 2\pi$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[2nd] [ANGLE] [5] :R▶Pr(	ANGLE 1:° 2:' 3:r 4:▶DMS 5:R▶Pr(6:R▶Pθ(7↓P▶Rx(	Get the angle menu. Choose rectangular to polar conversion that displays the *r* value.
[(-)] [2nd] [√] [3] [,] [5] [)] [ENTER]	R▶Pr(⁻√ 3,5) 5.291502622	Enter the value of *x* and *y* coordinates. The displayed value is *r*.
[2nd] [ANGLE] [6] :R▶Pθ(		Get the angle menu again. Choose the rectangular to polar conversion that displays the value of *θ.*
[(-)] [2nd] [√] [3] [,] [5] [)] [ENTER]	R▶Pθ(⁻√ 3,5) 1.904269499	Enter the value of *x* and *y* coordinates. The displayed value is *θ.*

Example 2 Change the polar coordinates (5,π /7) to rectangular coordinates.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[2nd] [ANGLE] [7] :P▶Rx(	ANGLE 1:° 2:' 3:r 4:▶DMS 5:R▶Pr(6:R▶Pθ(7↓P▶Rx(	Get the angle menu. Choose polar to rectangular conversion that displays the value of *x*.
[5] [,] [2nd] [π] [÷] [7] [)] [ENTER]	P▶Rx(5,π/7) 4.50484434	Enter the value of *r* and *θ*. The displayed value is *x*.
[2nd] [ANGLE] [8] :P▶Ry(		Get the angle menu again. Choose polar to rectangular conversion that displays the value of *y*.
[5] [,] [2nd] [π] [÷] [7] [)] [ENTER]	P▶Ry(5,π/7) 2.169418696	Enter the value of *r* and *θ*. The displayed value is *y*.

Example 3 Find the value of *r* for $r = 5 - 5\sin\theta$ at $\theta = \frac{\pi}{7}$.

Solution:

Keystrokes	*Screen Display*	*Explanation*
[2nd] [π] [÷] [7] [STO▶]	π/7→θ .4487989505	Store $\frac{\pi}{7}$ as θ .
[ALPHA] [θ] [ENTER]		θ is above the [3] .
[5] [-] [5] [SIN] [ALPHA] [θ] [ENTER]	5-5sin θ 2.830581304	Enter 5-5sin θ and evaluate.

Example 4 Graph $r = 5 - 5 \sin \theta$

Polar equations can be graphed by using the polar graphing mode of the calculator.

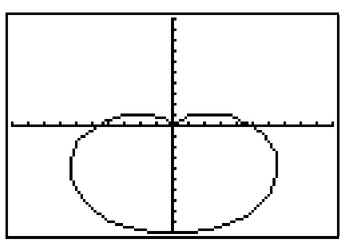
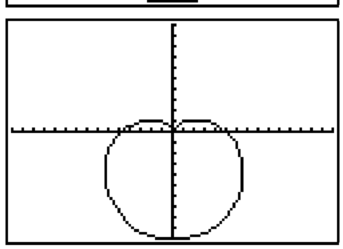
In general the steps to graph a polar function are:

Step 1 Set the calculator in polar graph mode.
Step 2 Enter the function in the Y= list (This list now has r= as the function names.)
Step 3 Set the WINDOW FORMAT to PolarGC
Step 4 Graph using the standard graph setting [ZOOM] [6] :ZStandard and then the square setting of the calculator [ZOOM] [5] :ZSquare to get a graph with equal spacing between the scale marks.
Step 5 Zoom in to get a larger graph if you wish.

Solution:

Keystrokes	*Screen Display*	*Explanation*

[MODE]
[▼] [▼] [▼] [▶] [▶]
[ENTER]
	`Normal Sci Eng`
	`Float 0123456789`
	`Radian Degree`
	`Func Par Pol Seq`
	`Connected Dot`
	`Sequential Simul`
	`FullScreen Split`
		Select polar mode.

[2nd] [QUIT]		Return to the Home screen.
[Y=] [(] [5] [-] [5] [SIN] [X,T,θ] [)]	`r1=5-5sin θ`	Get the Y= list and enter the function as r1.
[WINDOW] [▶] [▼] [▶] [ENTER]		Get the FORMAT menu on the WINDOW menu. Select PolarGC for polar graphs.
[ZOOM] [6] :Standard		Graph using the standard dimensions for the window. The graph on the standard screen is slightly distorted since the scale marks on the *y* axis are closer together than the scale marks on the *x* axis.
[ZOOM] [5] :Square		The square option on the Zoom Menu makes the scale marks the same distance apart on both axes. Press [WINDOW] to see how the window dimensions are changed.