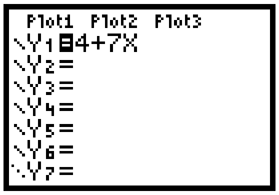
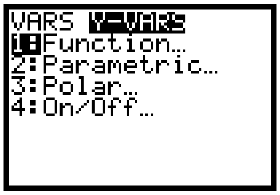
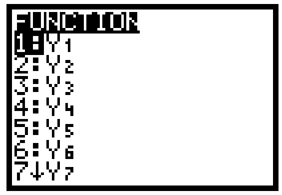
Calculator Notes for the TI-83 and TI-83/84 Plus

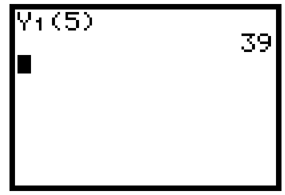
Note 4A • Function Notation

The calculator treats an equation entered into the Y= screen as a function. A function can be evaluated for different *x*-values using standard function notation. For example, $Y_1(5)$ will give the value of the function when *x* is 5. On the Home screen press VARS **Y-VARS 1:Function...** followed by the number of the equation you want, and the *x*-value.









Note 4B • Movin' Around

With bits of tape, label two CBRs A and B. Label two calculators A and B, and connect each to the respective CBR. Use the RANGER program to collect data for 10 seconds. See **Note 3C** for help with the RANGER program.

For both calculators, the time data will be in list L_1 and the distance data will be in list L_2. On the Home screen of calculator B, enter $L_1 \rightarrow L_3$, press ENTER, enter $L_2 \rightarrow L_4$, and press ENTER. This moves calculator B's time and distance data to lists L_3 and L_4.

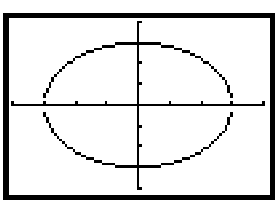
Finally, each group member should link to calculator A and copy lists L_1 and L_2, and link to calculator B and copy lists L_3 and L_4. See **Note 1J** for help with linking lists.

Note 4C • Friendly Windows

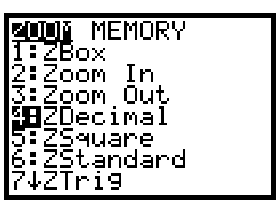
A friendly window scales the *x*-axis to correspond to the Graph screen's width in pixels (94). As a result, when you trace a curve on a friendly window, the spider always falls on points whose *x*-coordinates are "nice" decimal numbers. The *y*-coordinates are computed values and depend on the function being traced; they may or may not be nice decimal values.

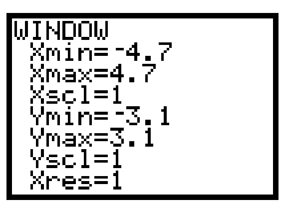
If the *y*-axis is scaled so its units are the same as the units on the *x*-axis, then the window will be a "square" window. On a square window there is no distortion of the graph.

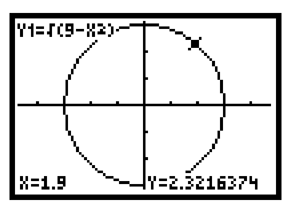
One friendly square window whose trace point has *x*-coordinates that are exact tenths can be found by pressing ZOOM **4:Decimal.**



[−4, 4, 1, −4, 4, 1]







This window is a little small for much of the work in this course. However, if you double the minimum and maximum values in the window screen, you can get a larger friendly square window that is often useful.

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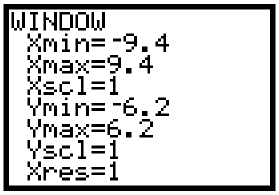
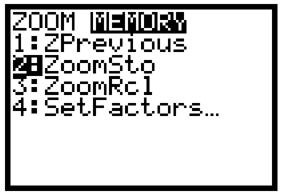
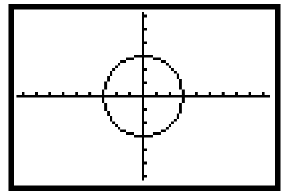
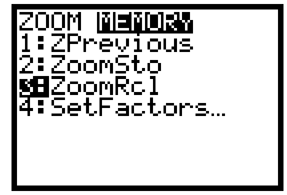
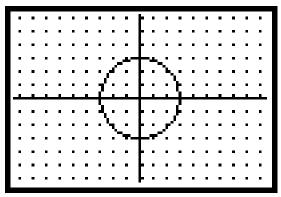
You can save the settings for this larger window and recall it at any time. After setting the window values, press ZOOM **MEMORY 2:ZoomSto**. Now when you want to use it again, press ZOOM **MEMORY 3:ZoomRcl**. This particular window is often referred to as the friendly window with a factor of 2.





It is sometimes helpful to see a grid in the background of the screen display. To turn the grid on (or off), press 2nd [FORMAT] and select **GridOn** (or **GridOff**).



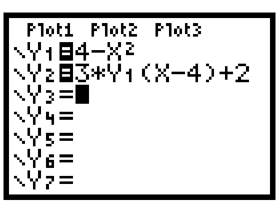
[−9.4, 9.4, 1, −6.2, 6.2, 1]

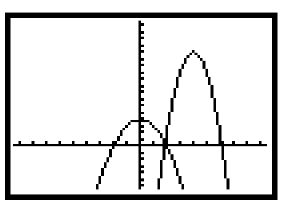
Note 4D • Transformations and Compositions

You can use functions entered into the Y= screen in other functions to show transformations and to construct compositions.

Transformations of Functions

You can enter an equation into the Y= screen and then define a second equation as a transformation of the first. For example, enter $4-X^2$ into Y_1 and define Y_2 as $Y_2=3*Y_1(X-4)+2$. (To get Y_1, press VARS **Y-Vars 1:Function 1:Y_1**.) Y_2 is the image of Y_1 after being stretched vertically by a factor of 3, translated right 4 units and up 2 units.





[−9.4, 9.4, 1, −6.2, 18.6, 1]

Compositions of Functions

If you enter two (or more) equations into the Y= screen, you can define another equation as the composition of the equations you have entered. For

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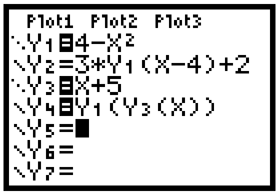
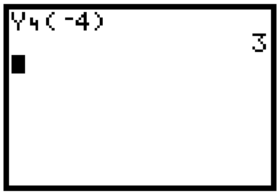
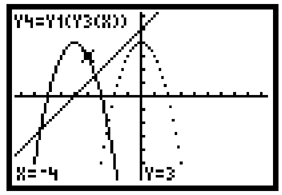
example, enter $4-X^2$ into Y_1 and X+5 into Y_3. Define Y_4 as the composition of Y_1 and Y_3 by entering $Y_4=Y_1(Y_3(X))$.

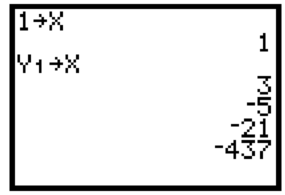






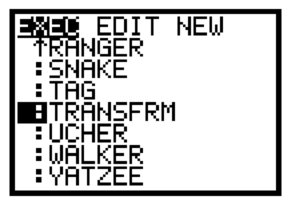
[−9.4, 9.4, 1, −6.2, 6.2, 1]

You can use the Home screen recursive loop $Y_1(X)\rightarrow X$ (or simply $Y_1\rightarrow X$) to evaluate the repeated composition of a function with itself. Store a starting value in X and then press VARS Y-VARS 1:Function 1:Y1 STO▸ X,T,θ,n ENTER ENTER ENTER. . . . (See **Note 1B** for more on Home screen recursion.)

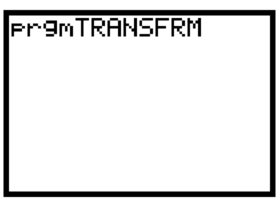


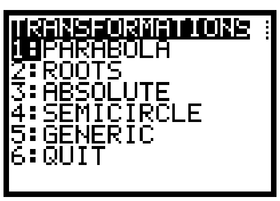
Note 4E • TRANSFRM Program

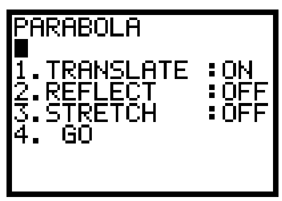
The program TRANSFRM gives you practice finding equations for given graphs. From the first menu, choose the type of function you want to practice. In the second menu, you can turn the different transformations on or off by pressing the number key. Press 4 when you're ready. The calculator will display a graph and stop. Study the graph and determine its equation. Press TRACE if you want to see the coordinates of points. When you have decided on an equation, press Y=, enter your equation into Y_1, and press GRAPH. If your equation is correct, you'll have a match and nothing new will appear on the screen. You can press TRACE and toggle back and forth between the graph of your function in Y_1 and the program's function to confirm that they really do match. If your equation is not correct, the graphs will not match. In that case, press Y= and try again.

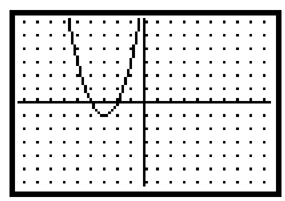


When you are finished with one graph, on the Graph screen press CLEAR ENTER to run the program again.



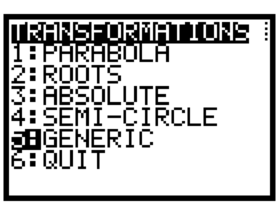


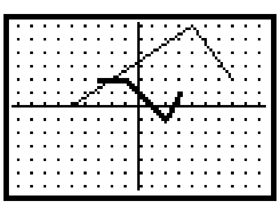




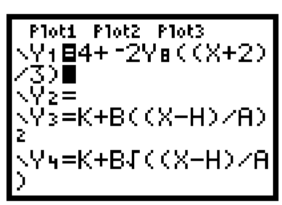
[−9.4, 9.4, 1, −6.2, 6.2, 1]

The option 5:GENERIC will draw the graph of a generic function using a thick line and the graph of its image after a transformation using the regular style. Enter the equation of the image into Y_1. Use $Y_8(X)$ to represent the original function.





[−9.4, 9.4, 1, −6.2, 6.2, 1]



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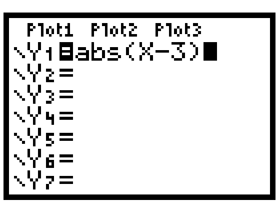
Clean-Up

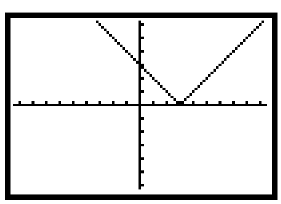
After you quit the program, you may want to go to the Y= screen and clear the functions so they don't interfere with future work.

```
PROGRAM:TRANSFRM
-9.4→Xmin:9.4→Xmax
-6.2→Ymin:6.2→Ymax
1→Yscl:1→Xscl
GridOn:AxesOn
PlotsOff
"K+B((X-H)/A)²"→Y3
"K+B√((X-H)/A)"→Y4
"K+Babs((X-H)/A"→Y5
"K+B√((1-((X-H)/A)²)"→Y6
"K+BY8((X-H)/A)"→Y7
"2(X<-1)/(X≥-3)+(1-X)(X≥-1)
  (X<2)+(-5+2X)(X≥2)/(X≤3)→Y8
GraphStyle(8,2)
Lbl 0:3→F:
If T≠0 and T≠1:1→T
If R≠0 and R≠1:0→R
If D≠0 and D≠1:0→D
Menu("TRANSFORMATIONS","PARABOLA",1,
  "ROOTS",2,"ABSOLUTE",3,"SEMI
  CIRCLE",4,"GENERIC",5,"QUIT",9)
Lbl 5:F+1→F
Lbl 4:F+1→F
Lbl 3:F+1→F
Lbl 2:F+1→F
Lbl 1:1→A:1→B
ClrHome:0→G:0→H:0→K
Disp sub("PARABOLA    SQUARE
  ROOTSABSOLUTE VALSEMICIRCLE
  GENERIC       ",12F-35,12)
Repeat G=82
Output(3,1,"1.TRANLATE  :"+sub
  ("OFFON ",3T+1,3))
Output(4,1,"2.REFLECT   :"+sub
  ("OFFON ",3R+1,3))
Output(5,1,"3.STRETCH
  :"+sub("OFFON ",3D+1,3))
Output(6,1,"4. GO")
getKey→G:
If G=92:1-T→T
If G=93:1-R→R
If G=94:1-D→D
End
If T:Then
randInt(-7,7)→H
randInt(-4,4)→K
End
If R:Then
If rand <0.5:-1→A
If rand <0.5:-1→B
End
If D:Then
A*randInt(1,5)→A
B*randInt(1,4)→B
End
FnOff
FnOn F
If F=7:FnOn 8
DispGraph
Lbl 9
```

Note 4F • Graphing Absolute-Value Functions

To use the absolute-value function, press MATH NUM 1:abs(. For example, to graph $y = |x - 3|$, enter Y1=abs(X−3) into the Y= screen, set an appropriate window, and press GRAPH.



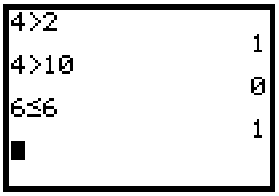


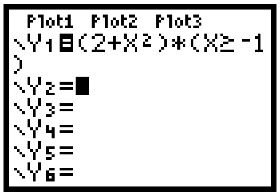
[−9.4, 9.4, 1, −6.2, 6.2, 1]

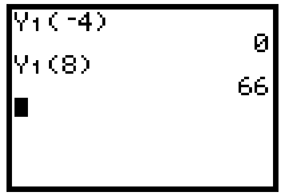
Note 4G • Boolean Expressions

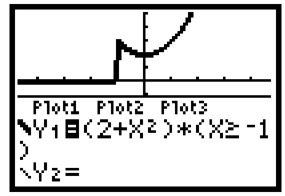
You can limit the domain of a function by using Boolean expressions. These are statements using $<$, $\leq$, $>$, $\geq$, $=$, or $\neq$ that have a value of 1 when true and 0 when false. To find these symbols, press [2nd] [TEST].

For example, the equation $Y_1=(2+X^2)*(X\geq-1)$ will equal zero for all values of x less than -1 and equal $2 + x^2$ for values of x greater than or equal to -1. You can evaluate the function on the Home screen or view it on the Graph screen.



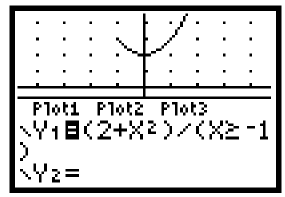






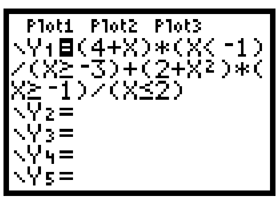
[−4.7, 4.7, 1, −1, 5, 1]

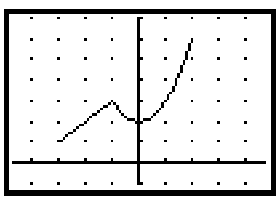
The calculator won't graph anything when it's dividing by 0, so the equation $Y_1=(2+X^2)/(X\geq-1)$ will result in no graph when x is less than -1.



[−4.7, 4.7, 1, −1, 5, 1]

By adding functions that are each multiplied and divided by a Boolean expression, you can create a piecewise function that is defined over a limited domain. The equation $Y_1=(4+X)*(X<-1)/(X\geq-3)+(2+X^2)*(X\geq-1)/(X\leq2)$ will create a function by connecting the line $y = 4 + x$ to the parabola $y = 2 + x^2$ at $(-1, 3)$ and limiting the domain to the interval from -3 to 2.





[−4.7, 4.7, 1, −1, 7, 1]

Note 4H • Drawing Segments

On the Graph screen you can draw an overlay on top of the graph.

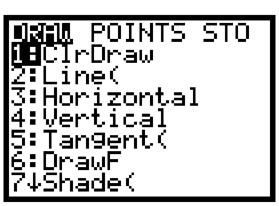
Follow these steps to draw a segment:

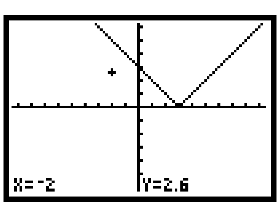
a. Press [2nd] [DRAW] 2:Line(.

b. Arrow to one endpoint of the segment you want and press [ENTER].

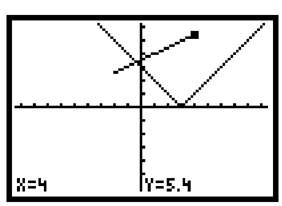
c. Arrow to the other endpoint and press [ENTER] again.

Pressing [ENTER] twice ends one segment and begins another at the same point, so you can make a closed figure.

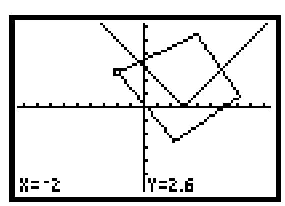




[−9.4, 9.4, 1, −6.2, 6.2, 1]



[−9.4, 9.4, 1, −6.2, 6.2, 1]



[−9.4, 9.4, 1, −6.2, 6.2, 1]

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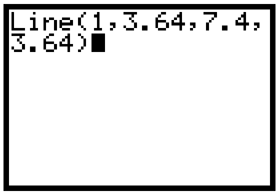
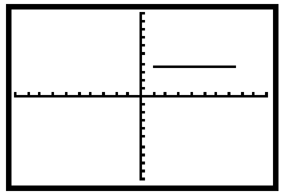
You can also draw segments by entering instructions into the Home screen. To draw a segment between (1, 3.64) and (7.4, 3.64), enter **Line(1,3.64,7.4,3.64)**.





[−10, 10, 1, −10, 10, 1]

To erase any drawing, press 2nd **[Draw] 1:ClrDraw.**