0.6 Graphing Transcendental Functions

There are some special functions we need to be able to graph easily.

Directions follow for

- exponential functions (see page 68),
- logarithmic functions (see page 71),
- trigonometric functions (see page 75),

0.6.1 Exponential Functions

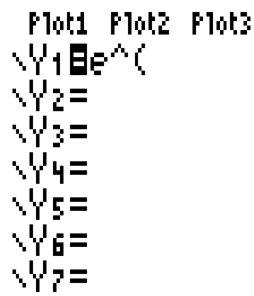
Suppose we want to graph $y = e^{x+1}$ using a window of $[-3, 2]$ by $[-1, 5]$.

TI-83 (this page), TI-89 (see page 69), TI-86 (see page 70).

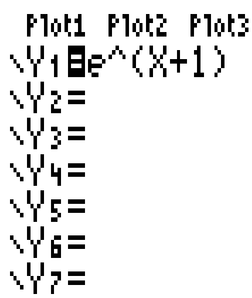
TI-83: Exponential Functions

Press [Y=], and clear any function(s) left over from previous work.

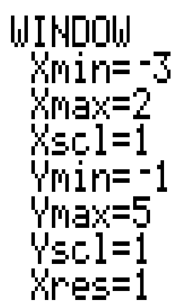
To enter e^{x+1} as the function definition, press [2nd] and [e^x] (second function on [LN]).



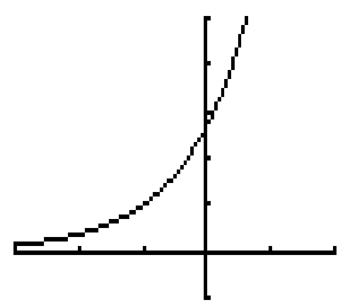
Type `x+1)`



Set a viewing window of $[-3, 2]$ by $[-1, 5]$.



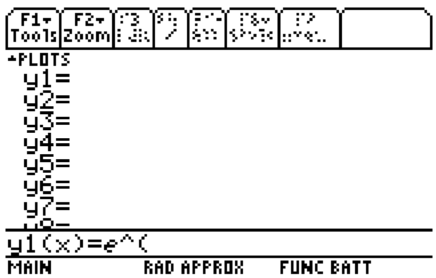
Press [Graph].

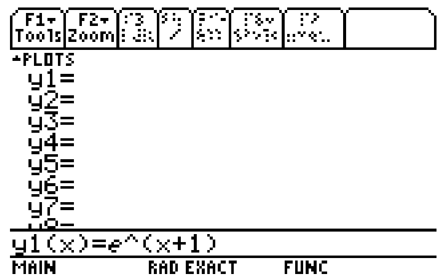


TI-89: Exponential Functions

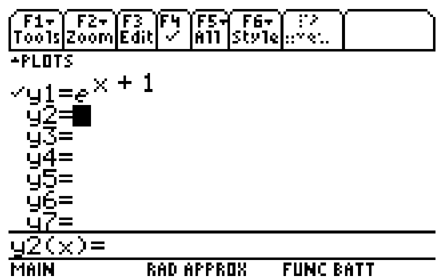
To graph $y = e^{x+1}$, press [♦] key and [F1 Y=]. If a function is left over from a previous graph, put the cursor on the definition and press [Clear].

To enter e^{x+1}, press [♦] and [e^x], (green function on [X]) (left picture).
Type `x+1)` (right picture).

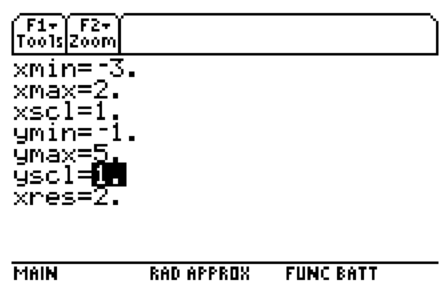




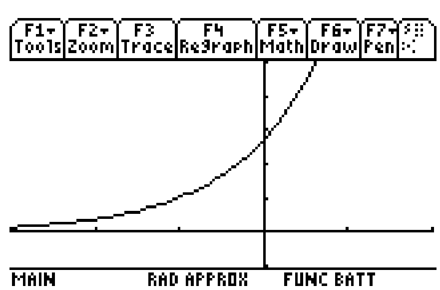
Press [Enter] and verify the function is correct.



Set the viewing window of $[-3, 2]$ by $[-1, 5]$.



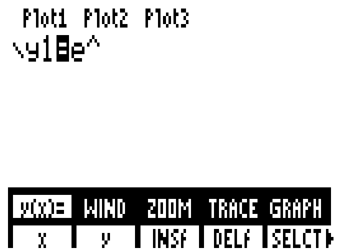
Press [♦] and [F3 Graph].



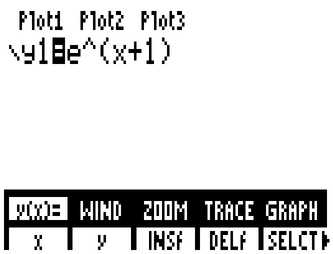
TI-86: Exponential Functions

To graph $y = e^{x+1}$, press Graph, then F1 y(x)=. Clear any previously defined functions.

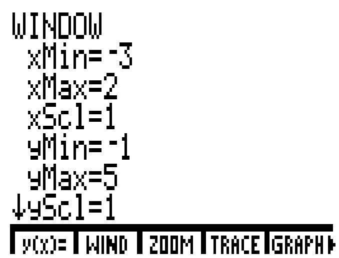
To enter e^{x+1} as the function definition, press 2nd and e^x. (second function on LN)



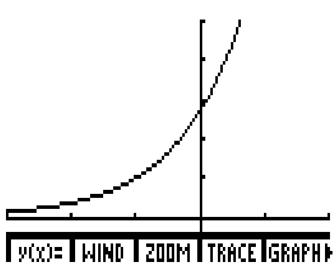
Type `(x+1)`



Press F2 Wind. Set a viewing window of $[-3, 2]$ by $[-1, 5]$.



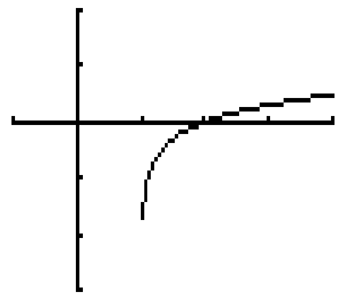
Press F5 Graph.



0.6.2 Logarithmic Functions

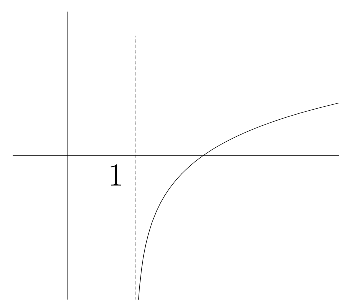
Graphing calculators do not, in general, show us an accurate picture of the behavior of logarithmic functions near the vertical asymptote. In fact, the graph appears to have an endpoint when the curve actually gets closer and closer to the asymptote. To find the equation of the vertical asymptote, we need to set the logarithmic expression equal to zero and solve.

For example, the graph of $f(x) = \log(x - 1)$ is shown. It appears that the graph begins around $(1, -1.7)$.



We know the domain of $f(x)$ is $(1, \infty)$ since $x - 1 > 0$. We also know the logarithmic expression $x - 1 = 0$ when $x = 1$; thus, $f(x)$ has a vertical asymptote at $x = 1$. Hence, the curve must get closer and closer to the asymptote. The resolution of the picture is not precise enough to show how the graph approaches the asymptote. Do not be misled by what you see. Remember what you are learning about the graph of the logarithmic function.

When copying the graph to paper, we must include the vertical asymptote as a dashed line and show the function as it approaches the asymptote.



Now suppose we want to graph $y = \log(3x^2 - 4x + 2)$ or $y = \ln(3x^2 - 4x + 2)$. The only difference here in entering the functions is the logarithm function used. The first uses LOG while the second uses LN. Both functions are special functions on the calculator.

We will graph $y = \log(3x^2 - 4x + 2)$, using a viewing window of $[-3, 5]$ by $[-2, 3]$. The domain of $\log(3x^2 - 4x + 2)$ is $(-\infty, \infty)$ since $3x^2 - 4x + 2 \neq 0$. Also, since $3x^2 - 4x + 2 \neq 0$, we know there is no vertical asymptote for this logarithmic function.

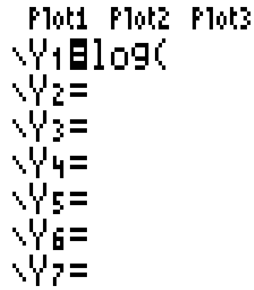
TI-83 (see page 72), TI-89 (see page 73), TI-86 (see page 74).

TI-83: Logarithmic Functions

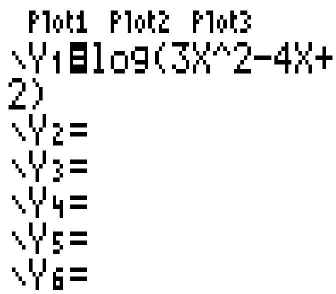
Graph $y = \log(3x^2 - 4x + 2)$.

Both keys LOG and LN are to the left of the number keypad.

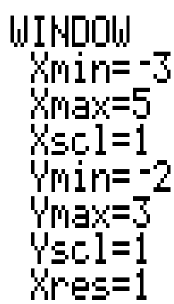
Press Y=. To enter $\log(3x^2 - 4x + 2)$ as the function definition, press LOG.



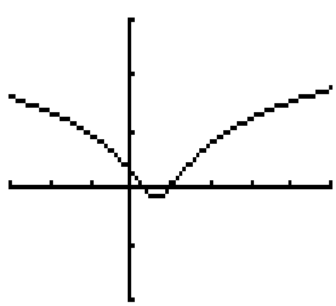
Continue entering the expression, including the closing parenthesis).



Set the window for $[-3, 5]$ by $[-2, 3]$.



Press Graph.

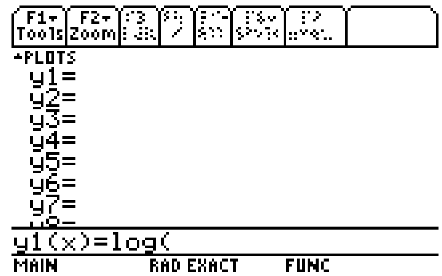


TI-89: Logarithmic Functions

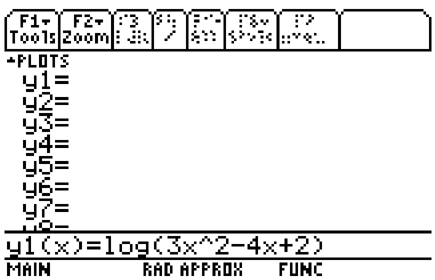
The LOG key is to the left of the number keypad while the natural log function LN is the second function on the variable X.

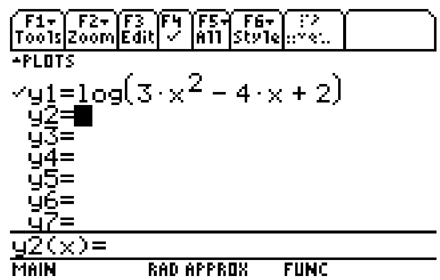
To graph $y = \log(3x^2 - 4x + 2)$, press ♦ key and F1 Y=.

To enter $\log(3x^2 - 4x + 2)$ either use Catalog and find the *log* function, or type it in. Hold down alpha and type `log`, then the left parenthesis (.

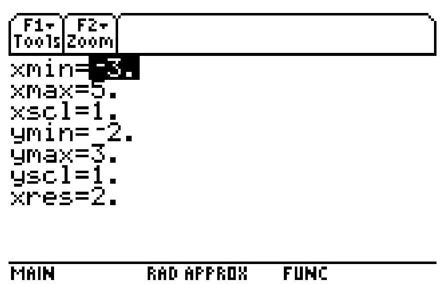


Finish entering the expression (left picture).
Press Enter, and verify the function is correct (right picture).

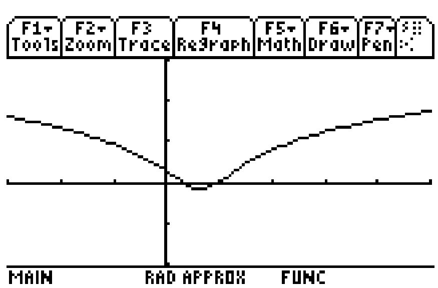




Set the window for $[-3, 5]$ by $[-2, 3]$.



Press ♦ and F3 Graph .

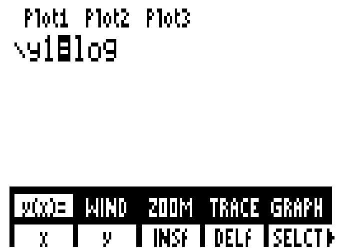


TI-86: Logarithmic Functions

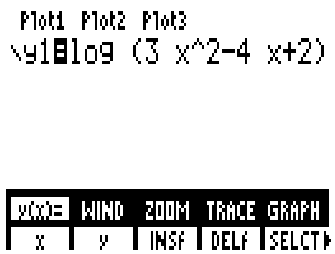
Both keys LOG and LN are to the left and up slightly from the number keypad.

To graph $y = \log(3x^2 - 4x + 2)$, press Graph, then F1 y(x)=.

To enter the function definition, press LOG.

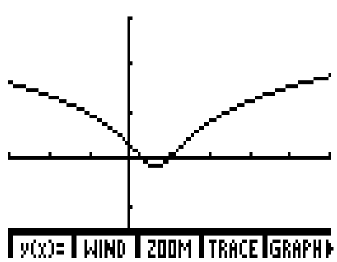


Enter the expression, including the opening and closing parentheses.



Set the viewing window for $[-3, 5]$ by $[-2, 3]$.

Press F5 Graph.



0.6.3 Trigonometric Functions

We graph trigonometric functions in *radian* mode. To graph the desired function, we also need to find the amplitude (when it exists) and the period to help guide us in selecting an appropriate viewing window.

Let's graph $y = \sin(2x - \pi)$ and $y = \sec(\pi x)$.

Find the amplitude (when it exists) and the period of each.

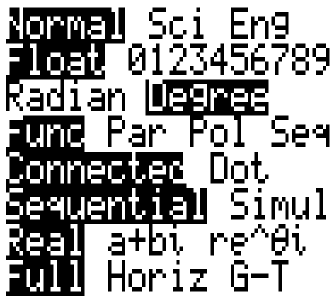
When graphing trigonometric functions squared, such as $\sin^2(x)$, we have two choices.

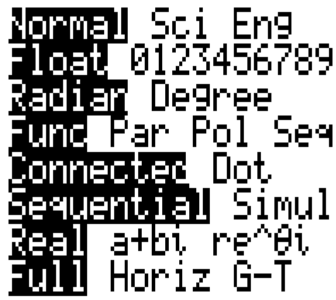
- Enter $\sin(x) \wedge 2$, which is interpreted correctly as $\Big(\sin(x)\Big)^2$.
- Enter $(\sin(x)) \wedge 2$, which is $\Big(\sin(x)\Big)^2$.

TI-83 (see page 76), TI-89 (see page 78), TI-86 (see page 81).

TI-83: Trigonometric Functions

Check first for `Radian` mode by pressing [Mode]. If `Degree` is selected instead of `Radian` (left picture), use the arrow keys to move the cursor down to `Radian` and press [Enter] (right picture). Then press [2nd] and [Quit].

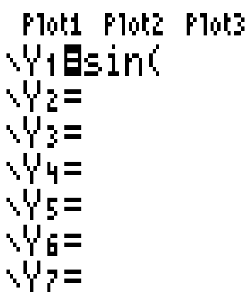


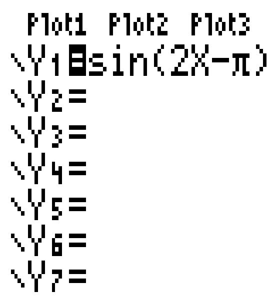


Press [Y=] and clear any previous function definitions.

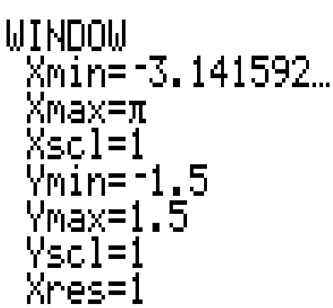
To enter the formula $y_1 = \sin(2x - \pi)$, press [Sin] to get `sin(` (left picture).

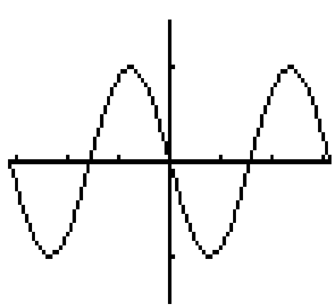
Enter $2x - \pi)$ using [2nd] and [π] (π is the second function for [$\wedge$]) (right picture).





With an amplitude of 1, and period of π, set the viewing window for $[-\pi, \pi]$ by $[-1.5, 1.5]$ to graph two full periods of the function. Press [Window] and enter the appropriate values. Notice, you enter $-\pi$, but as soon as you press [Enter], the value is changed to the decimal representation (left picture). Press [Graph] (right picture).

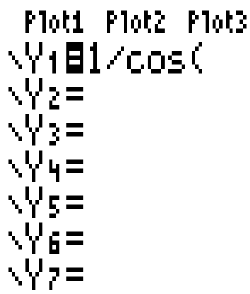


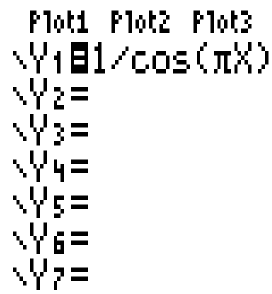


Now, graph $y = \sec(\pi x)$. We need to remember a couple of things first. We know $\sec(\pi x) = \dfrac{1}{\cos(\pi x)}$. The `secant` function has vertical asymptotes, so we should use *dot* mode (see page 22, or page 100).

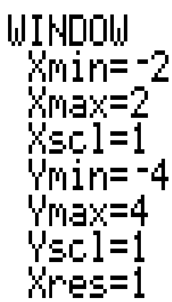
Press [Y=] and clear the previous function definition.

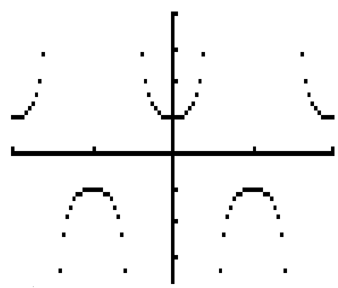
Enter `1/cos(πx)` by typing `1/` and press [Cos] (left picture).
Enter `πx)` to finish the definition (right picture).



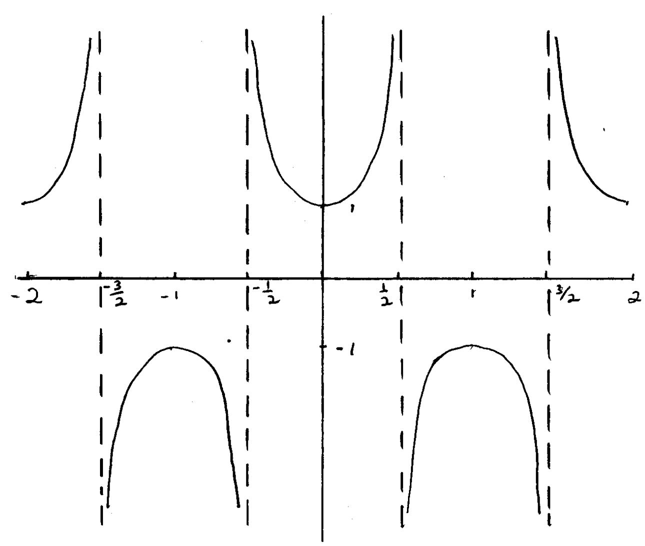


With a period of 2, let's set the viewing window for $[-2, 2]$ by $[-4, 4]$ to graph two full periods. Press [Window] and enter appropriate values (left picture). With the calculator set for *dot* mode, press [Graph] (right picture).



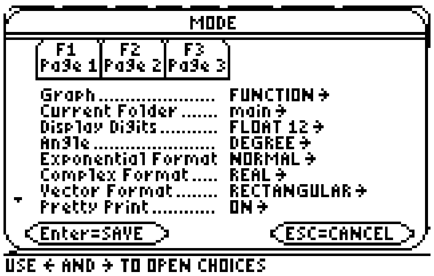


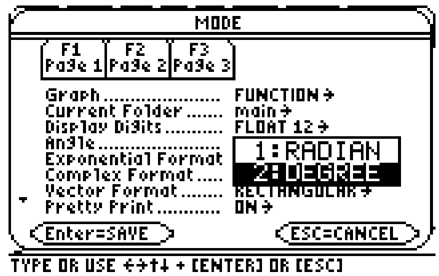
Sketching this graph on paper, we must draw the `secant` function with solid lines, and draw the appropriate vertical asymptotes with dashed lines. Be able to label the scale on the $x-$ and $y-$axes for the $y-$intercept, the asmyptotes, and the local extrema.



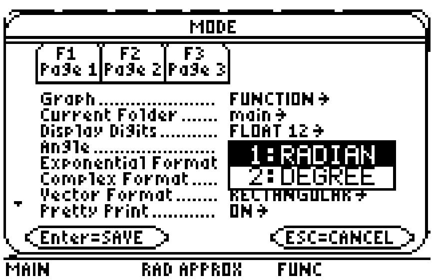
TI-89: Trigonometric Functions

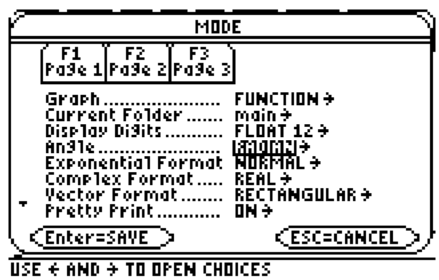
Check first for `Radian` mode. Press (Mode) (left picture). If `Degree` is selected instead of `Radian`, use the arrow keys to move the cursor down to `Angle`. Then hit the right arrow key (right picture).





Use the up arrow to move the cursor to `Radian` (left picture) and press (Enter) (right picture). Press (Enter) once more to save your change and exit `Mode`.

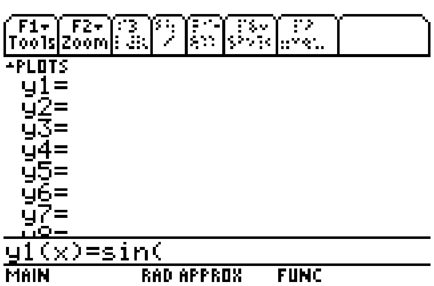


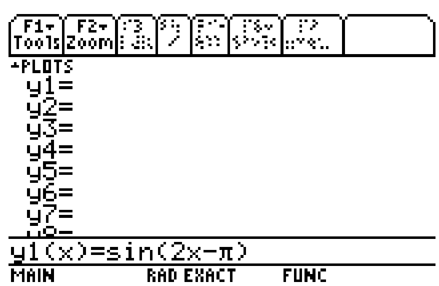


Let's graph $y = \sin(2x - \pi)$.

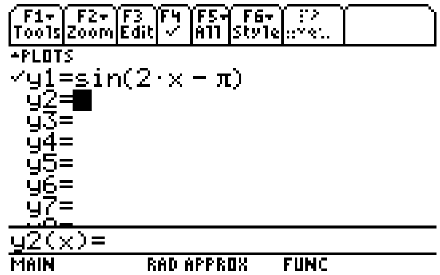
Press the green (♦) key and (F1 Y=). Clear any previous functions.

To enter the formula $y = \sin(2x - \pi)$, press (2nd) and (SIN) to get `sin(` (left picture). Enter `2x` $- \pi$) using (2nd) and (π) (π is the second function for (∧)) (right picture).

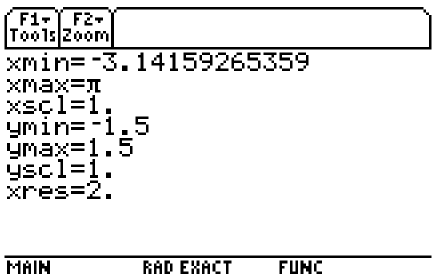


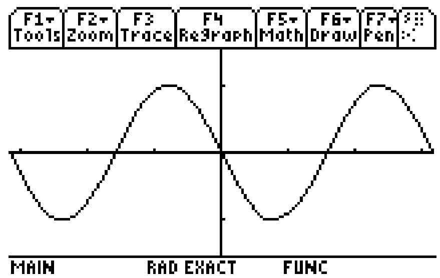


Press (Enter) and verify the formula is correct.



With an amplitude of 1, and period of π, let's set the viewing window for $[-\pi, \pi]$ by $[-1.5, 1.5]$ to graph two full periods of the function. Press (♦) and (F2 Window) and enter the appropriate values. Notice, you enter $-\pi$, but as soon as you press (Enter), the value is changed to the decimal representation (left picture). Press (♦) and (F3 Graph) (right picture).

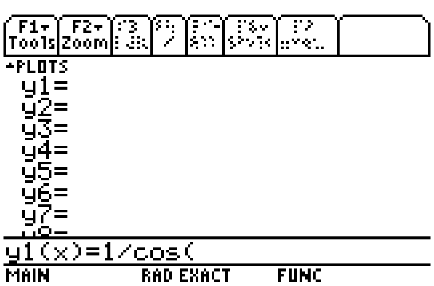


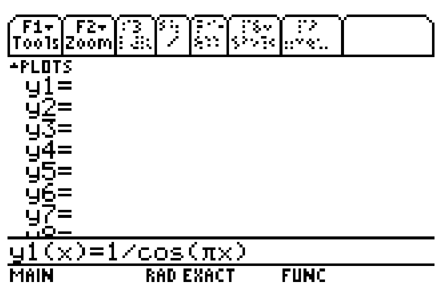


Now, graph $y = \sec(\pi x)$. We need to remember a couple of things first. We know $\sec(\pi x) = \dfrac{1}{\cos(\pi x)}$ and the `secant` function has vertical asymptotes, so we should use *dot* mode (see page 25, or page 102).

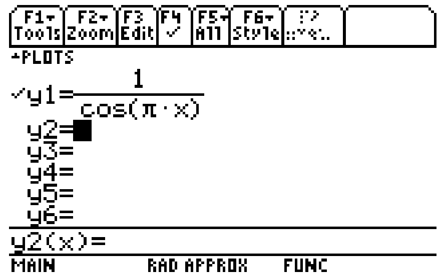
Press the green (♦) key and (F1 Y=) and clear the previous function definition.

Enter `1/cos(πx)` by typing `1/` and press (Cos) (left picture). Enter `πx)` (right picture).

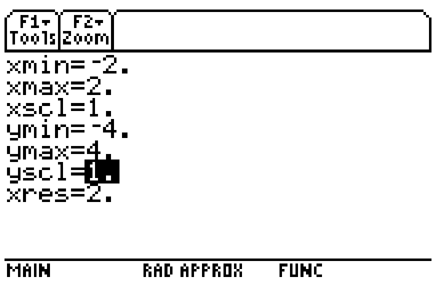


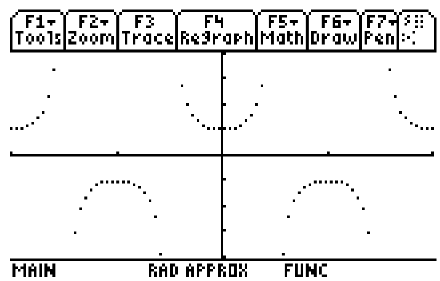


Press Enter and verify that it is correct.

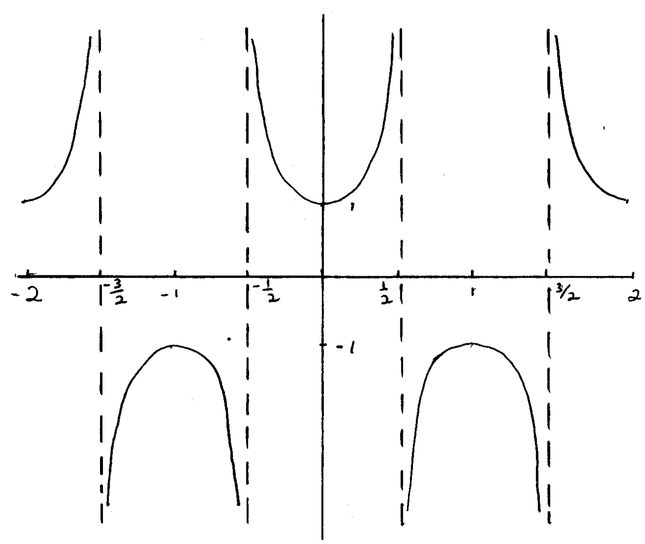


With a period of 2, let's set the viewing window for $[-2, 2]$ by $[-4, 4]$ to graph two full periods. Press ♦ and F2 Window and enter the appropriate values (left picture). With the calculator set for *dot* mode (see section 0.8.1), press ♦ and F3 Graph (right picture).



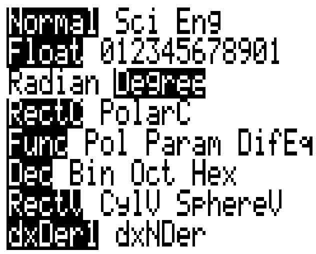


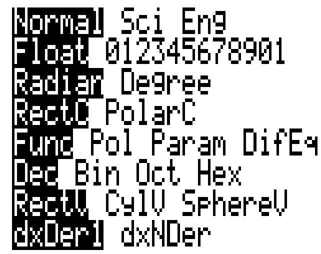
Sketching this graph on paper, we must draw the `secant` function with solid lines, and draw the appropriate vertical asymptotes with dashed lines. Be able to label the scale on the $x-$ and $y-$axes for the $y-$intercept, the asymptotes, and the local extrema.



TI-86: Trigonometric Functions

Check first for `Radian` mode by pressing 2nd and Mode (where `Mode` is the second function on More). If `Degree` is selected instead of `Radian` (left picture), use the arrow keys to move the cursor down to `Radian` and press Enter (right picture). Press 2nd and Quit .

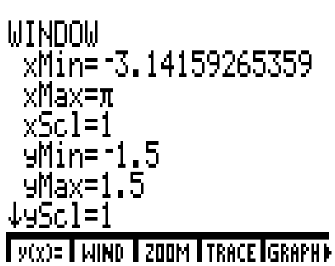


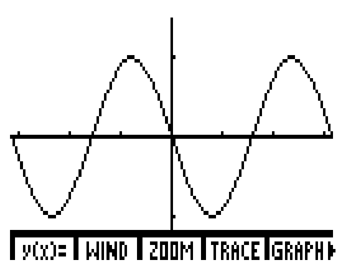


Press Graph , then F1 y(x)= and clear any previous functions.

To enter the formula $y_1 = \sin(2x - \pi)$, press Sin to get **sin** (left picture).
Enter (2x − π) using 2nd and π (π is the second function for ∧) (right picture).

With an amplitude of 1, and period of π, set the viewing window for $[-\pi, \pi]$ by $[-1.5, 1.5]$ to graph two full periods of the function. Press 2nd and F2 Wind and enter the appropriate values. Notice, you enter $-\pi$, but as soon as you press Enter , the value is changed to the decimal representation (left picture). Press F5 Graph (right picture).

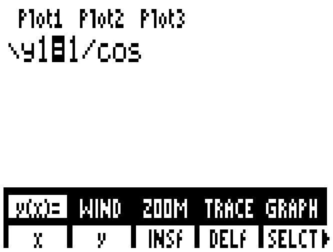


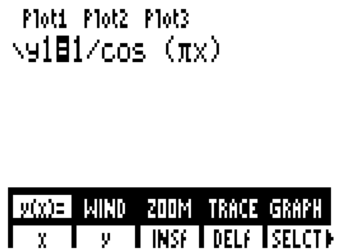


Now, graph $y = \sec(\pi x)$. We need to remember a couple of things first. We know $\sec(\pi x) = \dfrac{1}{\cos(\pi x)}$. The `secant` function has vertical asymptotes, so we should use *dot* mode (see page 27, or page 104).

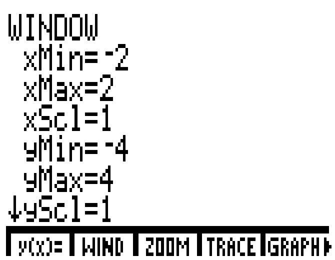
Press [F1 y(x)=] and clear the previous function definition.

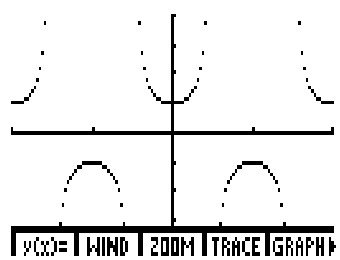
Enter `1/cos(πx)` by typing `1/` and press [Cos] (left picture).
Enter `(πx)` to finish the definition (right picture).





With a period of 2, let's set the viewing window for $[-2, 2]$ by $[-4, 4]$ to graph two full periods. Press [2nd] and [F2 Wind] and enter appropriate values (left picture). With the calculator set for *dot* mode, press [F5 Graph] (right picture).





Sketching this graph on paper, we must draw the `secant` function with solid lines, and draw the appropriate vertical asymptotes with dashed lines. Be able to label the scale on the $x-$ and $y-$axes for the $y-$intercept, the asymptotes, and the local extrema.