The Graphs of $y = \tan(x)$, $y = \sec(x)$, $y = \csc(x)$, $y = \cot(x)$

Graphs of trigonometric functions can be produced in degrees or in radians. The graphs appearing here will be done in radians.

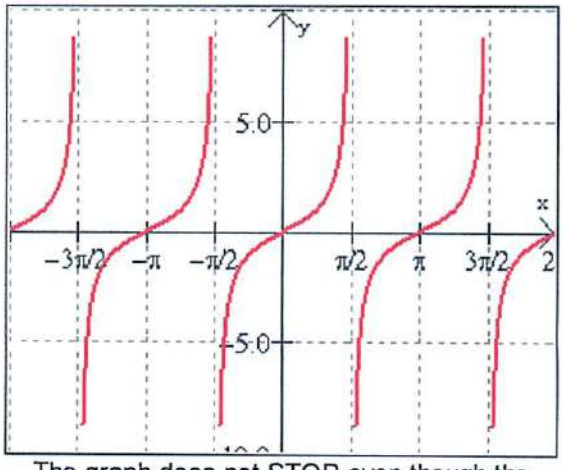
Hint: When hand-drawing the graphs of sine and cosine, draw vertical dotted lines at $\frac{\pi}{2}$ intervals to remind you of the connection to the quadrants from the unit circle and to keep your graphs accurate. (Such dotted lines will resemble the dashed vertical grid lines in the graphs below.)

Tangent Function: $y = \tan(x)$

- One cycle occurs between $-\frac{\pi}{2}$ and $\frac{\pi}{2}$.
- There are vertical asymptotes at each end of the cycle. The asymptote that occurs at $\frac{\pi}{2}$ repeats every π units.
- period: π
- amplitude: none, graphs go on forever in vertical directions.

Note: a graphing utility, such as the one used to produce these graphs, may not show the function approaching infinity (going on forever upward or downward). The graphs,
however, DO tend toward positive and negative infinity and do not STOP.

$y = \tan(x)$



The graph does not STOP even though the plot may "appear" as if the graph stops as the y-values increase/decrease.

Cotangent Function: $y = \cot(x)$

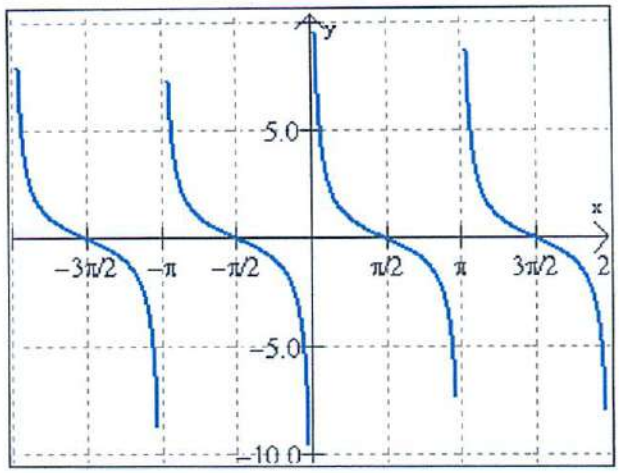
$y = \cot(x)$

- One cycle occurs between 0 and π.
- There are vertical asymptotes at each end of the

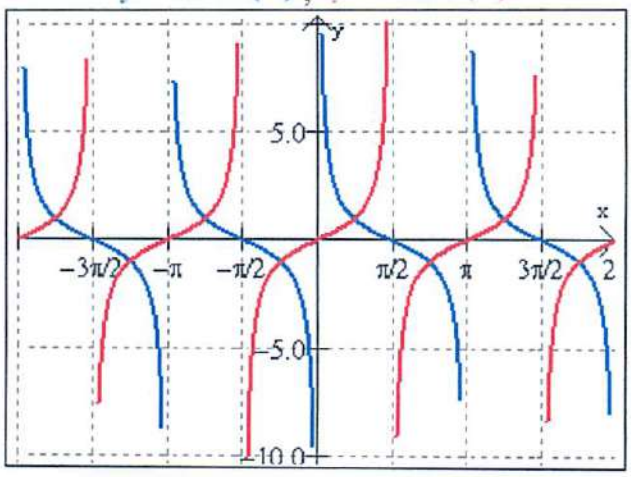
cycle. The asymptote that occurs at π repeats every π units.

- period: π
- amplitude: none, graphs go on forever in vertical directions
- The x-intercepts of the graph of $y = \tan(x)$ are the asymptotes of the graph of $y = \cot(x)$.
- The asymptotes of the graph of $y = \tan(x)$ are the x-intercepts of the graph of $y = \cot(x)$.
- The graphs of $y = \tan(x)$ and $y = \cot(x)$ have the same x-values for y-values of 1 and -1.

Note: The graphs of $y = \tan(x)$ and $y = \cot(x)$ "face" in opposite directions.



$y = \cot(x)$; $y = \tan(x)$

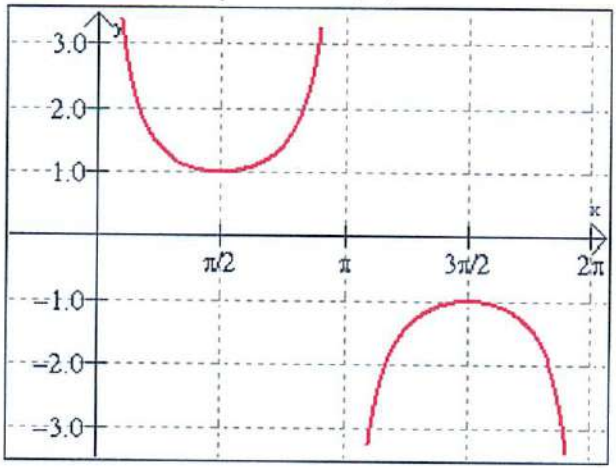


Cosecant Function: $y = \csc(x)$

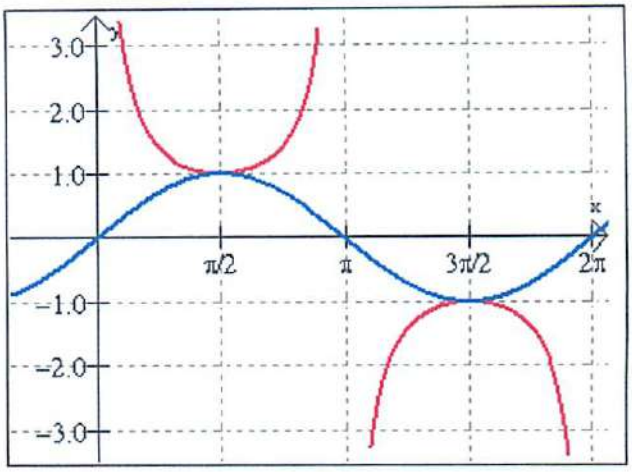
- There are vertical asymptotes. The asymptote that occurs at π repeats every π units.
- period: 2π
- amplitude: none, graphs go on forever in vertical directions.
- The maximum values of $y = \sin x$ are minimum values of the positive sections of $y = \csc x$. The minimum values of $y = \sin x$ are the maximum values of the negative sections of $y = \csc x$.
- The x-intercepts of $y = \sin x$ are the asymptotes for $y = \csc x$.

Note: the U shapes of the cosecant graph are tangent to its reciprocal function, sine, at sine's max and min locations.

$y = \csc(x)$



$y = \csc(x)$ $y = \sin(x)$

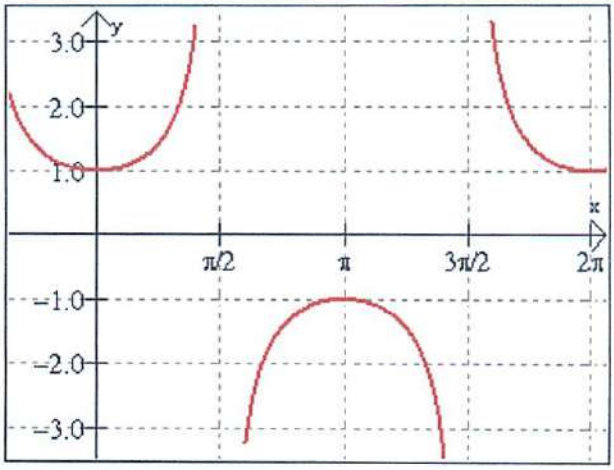


Secant Function: $y = \sec(x)$

- There are vertical asymptotes. The asymptote that occurs at $\frac{\pi}{2}$ repeats every π units.
- period: 2π
- amplitude: none, graphs go on forever in vertical directions.
- The maximum values of y = cos *x* are minimum values of the positive sections of y = sec *x*. The minimum values of y = cos *x* are the maximum values of the negative sections of y = sec *x*.
- The *x*-intercepts of y = cos *x* are the asymptotes for y = sec *x*.

Note: the U shapes of the secant graph are tangent to its reciprocal function, cosine, at cosine's max and min locations.

$y = \sec(x)$



$y = \sec(x)$ $y = \cos(x)$