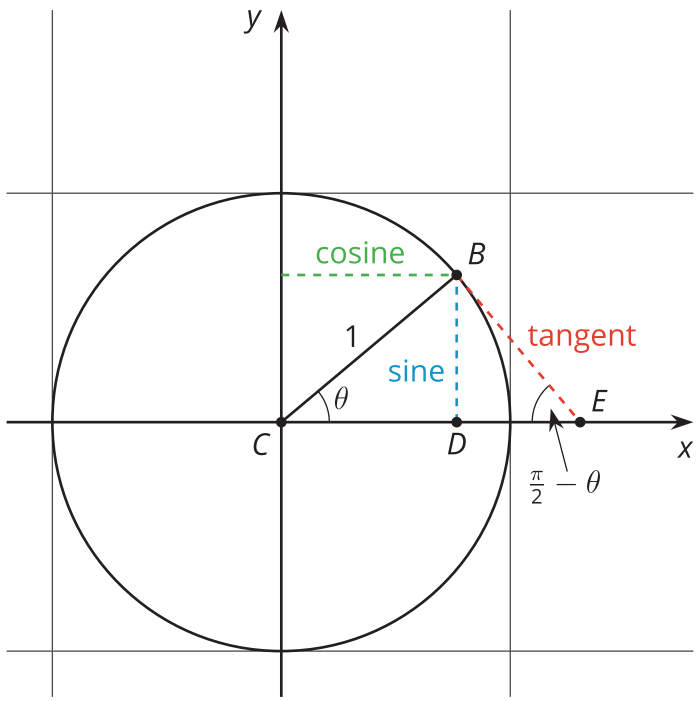
Unit 6, Lesson 13

Some New Ratios

Let's explore graphs of some more trigonometric functions.

13.1 Notice and Wonder: Angles and Lines

What do you notice? What do you wonder?



13.2 Some Additional Lines

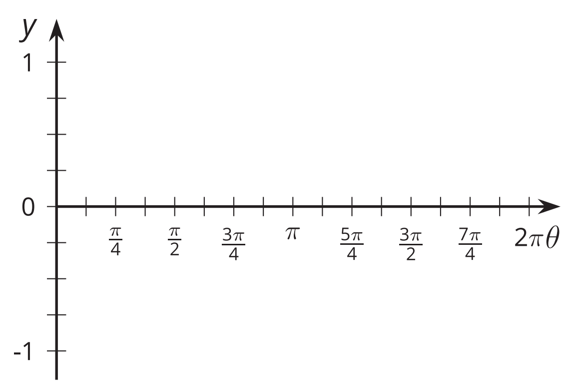
Your teacher will assign you a function—either secant, or cotangent, where $f(\theta) = \sec(\theta)$, $g(\theta) = \csc(\theta)$, and $h(\theta) = \cot(\theta)$.

1. Complete the table of values for your function from 0 to 2π.

θ	
0	
$\frac{\pi}{6}$	
$\frac{\pi}{4}$	
$\frac{\pi}{3}$	
$\frac{\pi}{2}$	
$\frac{2\pi}{3}$	
$\frac{3\pi}{4}$	
$\frac{5\pi}{6}$	
π	

θ	
$\frac{7\pi}{6}$	
$\frac{5\pi}{4}$	
$\frac{4\pi}{3}$	
$\frac{3\pi}{2}$	
$\frac{5\pi}{3}$	
$\frac{7\pi}{4}$	
$\frac{11\pi}{6}$	
2π	

2. Graph your function from 0 to 2π.



3. Create a display that includes your function name, the graph, the trigonometric ratio, and the reciprocal identity.

Are you ready for more?

The “co” in “cosine,” “cotangent,” and “cosecant” refers to the complement of the angle. The complement of θ is $\frac{\pi}{2} - \theta$.

Explain for each of the function pairs how you know that the statements are true:

1. $\cos(\theta) = \sin(\frac{\pi}{2} - \theta)$
2. $\cot(\theta) = \tan(\frac{\pi}{2} - \theta)$

3. $\csc(\theta) = \sec\left(\frac{\pi}{2} - \theta\right)$

13.3 Card Sort: Periodic Functions

Your teacher will give you a set of cards. Take turns with your partner to match a graph with a function name, ratio, and identity.

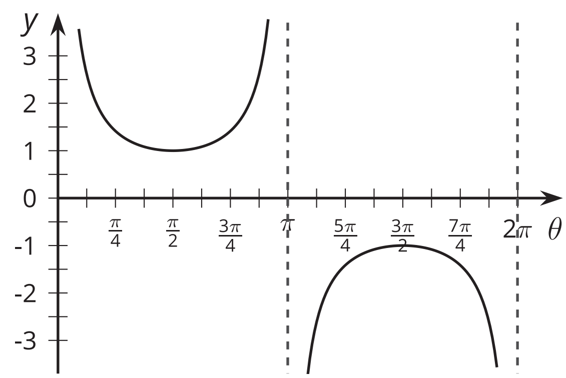
1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to the explanation. If you disagree, discuss your thinking, and work to reach an agreement.

Lesson 13 Summary

We can use the sine, cosine, and tangent functions to talk about some new trigonometric functions: cosecant, secant, and cotangent.

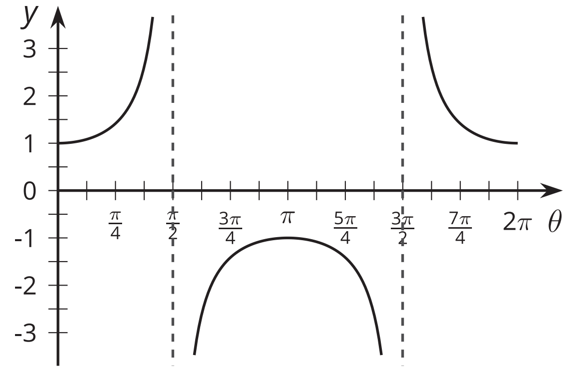
Cosecant is the reciprocal function of sine. This means that $\csc(\theta) = \frac{1}{\sin(\theta)}$. On a right triangle, we can identify the trigonometric ratio $\csc(\theta) = \frac{\text{hypotenuse}}{\text{opposite}}$. We can use this information to create a graph of $y = \csc(\theta)$. The graph will have an asymptote any time $\sin(\theta) = 0$. We also know that $y = 1$ any time $\sin(\theta) = 1$, $y = \text{-}1$ any time $\sin(\theta) = \text{-}1$, and has the same period as $\sin(\theta)$. Here is the graph of $y = \csc(\theta)$:

$y = \csc(\theta)$



Secant is the reciprocal function of cosine. This means that $\sec(\theta) = \frac{1}{\cos(\theta)}$. On a right triangle, we can identify the trigonometric ratio $\sec(\theta) = \frac{\text{hypotenuse}}{\text{adjacent}}$. We can use this information to create a graph of $y = \sec(\theta)$. The graph will have an asymptote any time $\cos(\theta) = 0$. We also know that $y = 1$ any time $\cos(\theta) = 1$, $y = \text{-}1$ any time $\cos(\theta) = \text{-}1$, and has the same period as $\cos(\theta)$. Here is the graph of $y = \sec(\theta)$:

$y = \sec(\theta)$



Cotangent is the reciprocal function of tangent. This means that $\cot(\theta) = \frac{1}{\tan(\theta)}$. On a right triangle, we can identify the trigonometric ratio $\cot(\theta) = \frac{\text{adjacent}}{\text{opposite}}$. We can use this information to create a graph of $y = \cot(\theta)$. The the graph will have an asymptote any time $\tan(\theta) = 0$, and it will have a value of 0 any time $\tan(\theta)$ has an asymptote. We also know that $y = 1$ any time $\tan(\theta) = 1$, $y = \text{-}1$ any time $\tan(\theta) = \text{-}1$, and has the same period as $\tan(\theta)$. Here is the graph of $y = \cot(\theta)$:

$y = \cot(\theta)$