

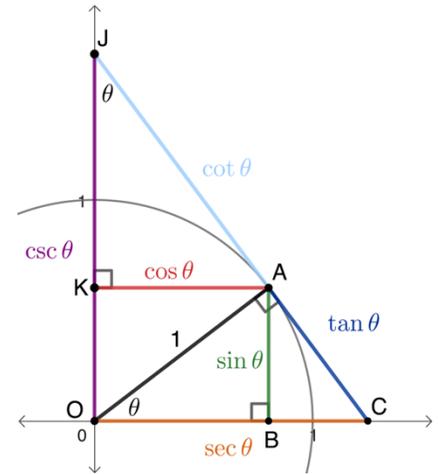


# Is There More to Explore?



So far we've talked about the sine, cosine, and tangent functions. But did you know there are other trigonometric functions? They are called secant, cosecant, and cotangent!

1. The diagram shows an angle,  $\theta$ , in standard position, a circle of radius 1, and a line tangent to the circle at Point A. The six trigonometric functions can all be represented by certain segments in this diagram. What do you notice? What do you wonder?



2. Imagine moving Point A so that  $\theta$  increases slightly.  
 a. Which values in the diagram would increase?

b. Which values in the diagram would decrease?

3. Go to <https://tinyurl.com/calcmedicapc2>. Move around Point A and watch how the values of the 6 trig functions change. What is the relationship between  $\sin \theta$ ,  $\cos \theta$ , and  $\tan \theta$  and  $\csc \theta$ ,  $\sec \theta$ , and  $\cot \theta$ ?

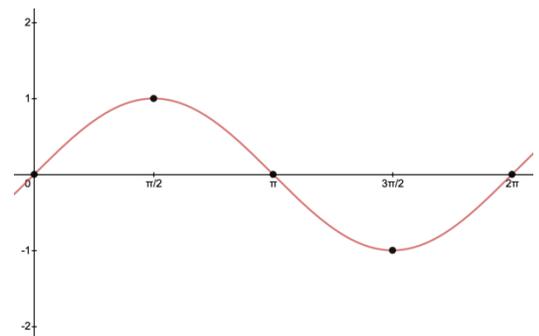
4. Explore the outputs of  $\sin \theta$  and  $\csc \theta$  for various values of  $\theta$ .

a. What do you notice about the values of  $\csc \theta$ ? Are there minimum or maximum values?

b. For which values of  $\theta$  is  $\csc \theta$  undefined? How do you know?

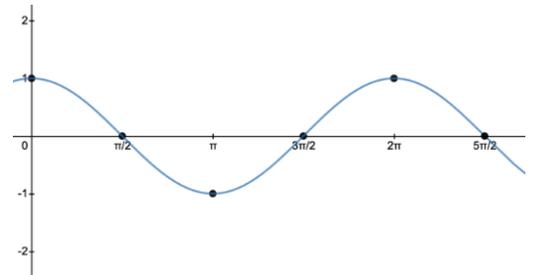
c. For which values of  $\theta$  do  $\sin \theta$  and  $\csc \theta$  have the same output? Why does this happen?

5. The graph of  $y = \sin \theta$  is shown. Sketch the cosecant curve on the same set of axes. Be sure to include any relevant asymptotes.



6. Now explore the outputs of  $\cos \theta$  and  $\sec \theta$  as  $\theta$  changes.
  - a. What do you notice about the values of  $\sec \theta$ ? Are there minimum or maximum values?
  - b. For which values of  $\theta$  is  $\sec \theta$  undefined? How do you know?
  - c. For which values of  $\theta$  do  $\cos \theta$  and  $\sec \theta$  have the same output?

7. The graph of  $y = \cos \theta$  is shown. Sketch the secant curve on the same set of axes. Be sure to include any relevant asymptotes.



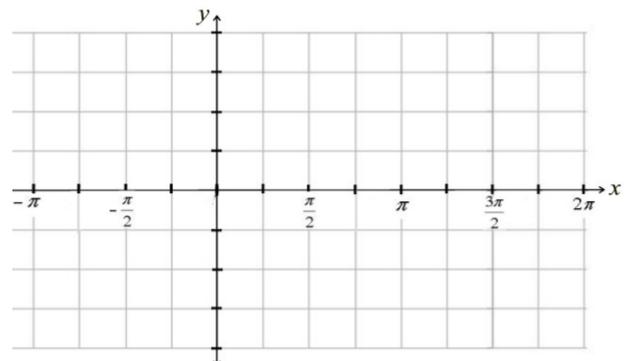
8. What is the period of  $y = \csc \theta$  and  $y = \sec \theta$ ?

9. Explore the outputs of  $\tan \theta$  and  $\cot \theta$  for various values of  $\theta$ .
  - a. How is the cotangent ratio related to the values of  $\sin \theta$  and  $\cos \theta$ ?
  - b. For which values of  $\theta$  is  $\cot \theta$  undefined? How do you know?
  - c. For which values of  $\theta$  is  $\cot \theta = 0$ ? How do you know?
  - d. How long does it take until the values of  $\cot \theta$  repeat?

- e. For  $0^\circ < \theta < 180^\circ$ , is  $\cot \theta$  increasing or decreasing?

10. Sketch a graph of  $y = \cot \theta$ .  
Be sure to include any relevant asymptotes.

11. How is the graph of  $y = \cot \theta$  similar and different from the graph of  $y = \tan \theta$ ?



## Lesson 7.4 – The Secant, Cosecant, and Cotangent Functions

QuickNotes

### Check Your Understanding

1. Find exact values for each of the following:

$$\cot\left(\frac{3\pi}{4}\right)$$

$$\sec\left(\frac{5\pi}{3}\right)$$

$$\csc\left(\frac{7\pi}{6}\right)$$

2. Let  $f(\theta) = \cos \theta$  and  $g(\theta) = \sec \theta$ . If  $f(a) = 0.235$ , find  $g(a)$ .
3. The parent function  $y = \csc \theta$  is stretched by a factor of 2 and shifted up 5 units.
- Write an equation for this new function.
  - Determine the range of this new function.
4. Which of the following is equivalent to  $y = \cot x$ ?
- $y = -\tan x$
  - $y = -\tan\left(x - \frac{\pi}{2}\right)$
  - $y = \tan\left(x - \frac{\pi}{2}\right)$
  - $y = \tan(-x)$
5. Which of the following equations has no solution?
- $5 \csc x + 2 = 4$
  - $-3 \tan x = 5$
  - $-1 + \sec x = -5$
  - $2 \cot x = 0$