Math Virtual Learning

Precalculus
Graphing Secant and Cosecant

April 17, 2020

Precalculus
Lesson: April 17th, 2020

Objective/Learning Target:
Students will be able to graph secant and cosecant functions with amplitude changes and vertical shifts. Included will be determining the domain, range, and amplitude.

Let's Get Started:

## What does the Secant and Cosecant graph look like?

Watch the video below to see what the graphs of the secant and cosecant functions look like and how to graph them.

Stop the video at 3:04.

Video: How to Graph Secant and Cosecant Functions

	Secant $y = \sec(x)$	**Cosecant** $y = \csc(x)$
Domain	$\left\{ x \mid x \neq \frac{\pi}{2} + \pi \cdot n, \text{ where } n \text{ is any integer} \right\}$	$\{ x \mid x \neq \pi \cdot n, \text{ where } n \text{ is any integer} \}$
Range	$\{ y \mid y \leq -1 \text{ and } y \geq 1 \}$ Or $(-\infty, -1] \cup [1, \infty)$	$\{ y \mid y \leq -1 \text{ and } y \geq 1 \}$ Or $(-\infty, -1] \cup [1, \infty)$
Asymptote	$x = \frac{\pi}{2} + n\pi$ (where n can be any integer)	$x = n\pi$ (where n can be any integer)
Period	The **period** (length required to complete 1 cycle) of the secant function is the same as the cosine function, therefore it is 2π.	The **period** (length required to complete 1 cycle) of the cosecant function is the same as the sine function, therefore it is 2π.
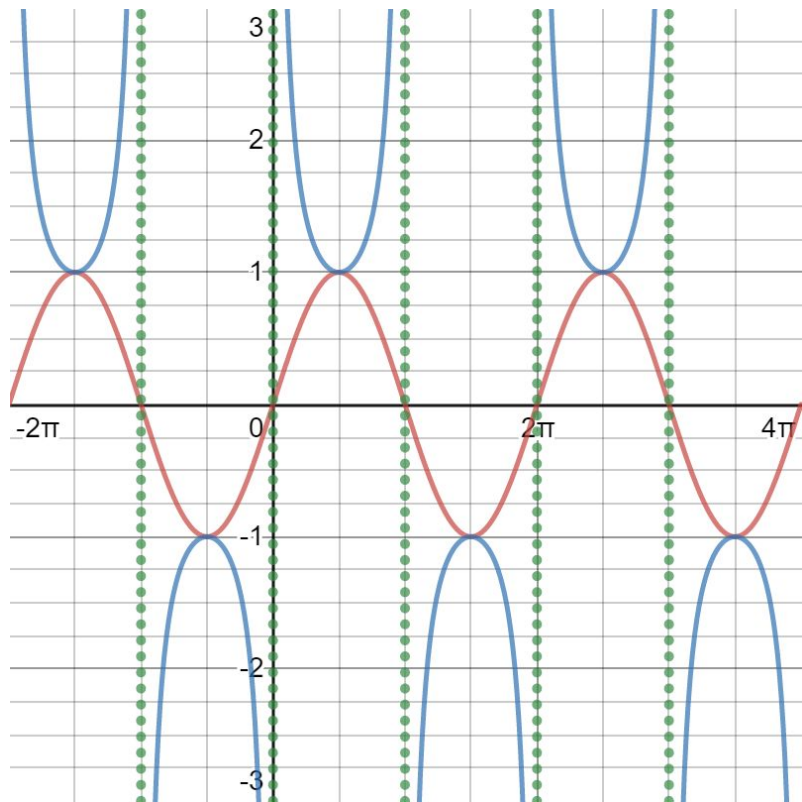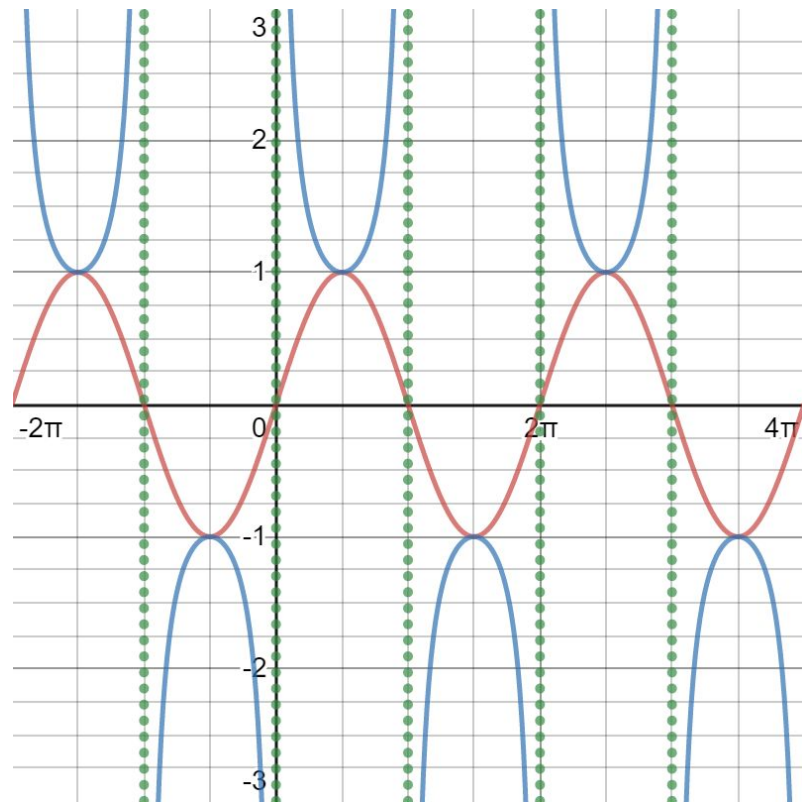
Secant

Cosecant


*** Please Note: The graphs of secant and cosecant are blue, asymptotes are green, and the cosine and sine functions are red.
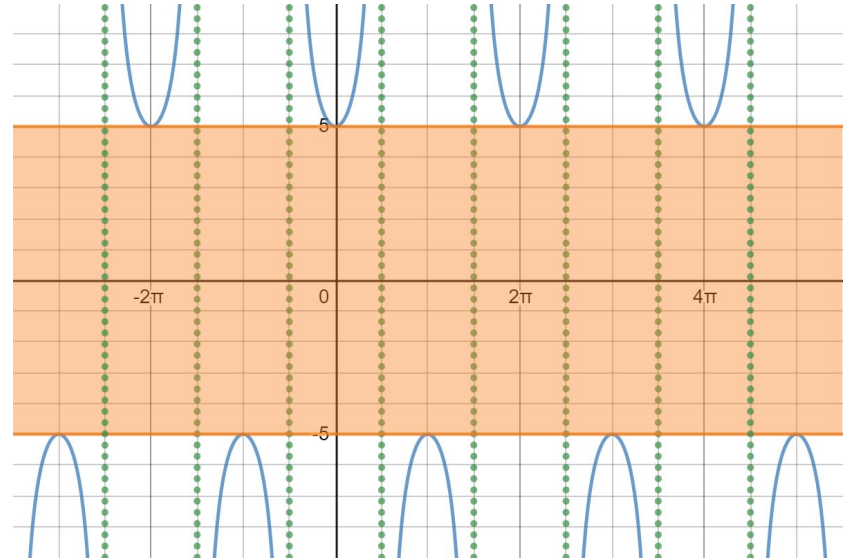
Amplitude Changes

The amplitude is basically the height or distance from the midline. As the amplitude gets bigger, the vertical gap between the curves (shown below in orange) of the secant and cosecant function gets bigger. Below are a couple examples of the secant function.
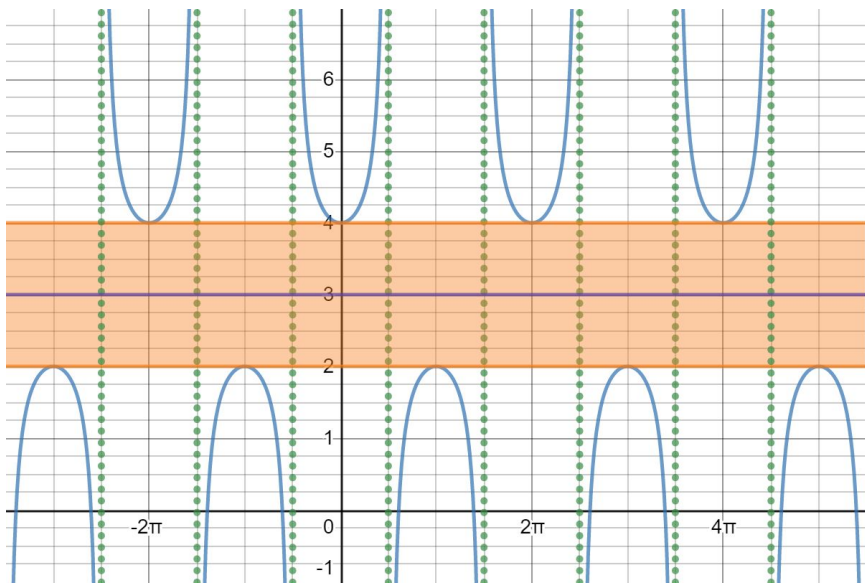
y = 2 sec(x)
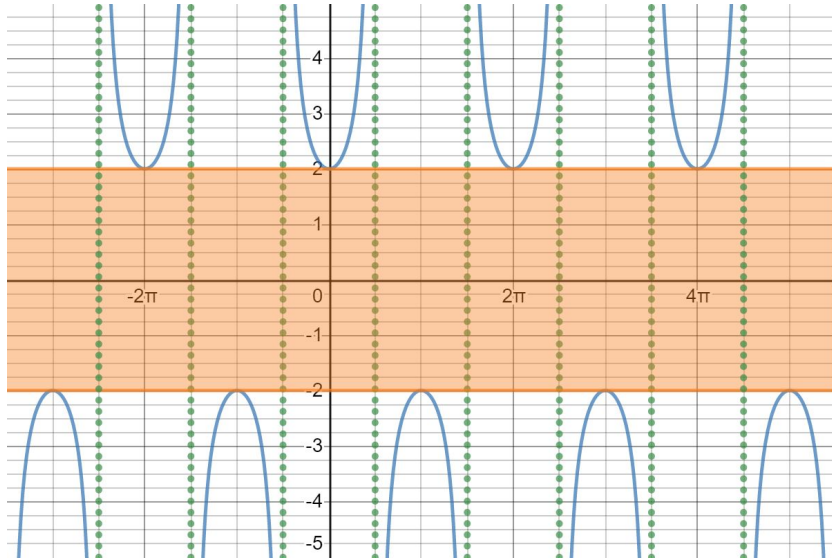
y = 5 sec(x)

Vertical Shift

$$y = \sec(x) + k \qquad\qquad y = \csc(x) + k$$

The value of k shifts the graph up or down.
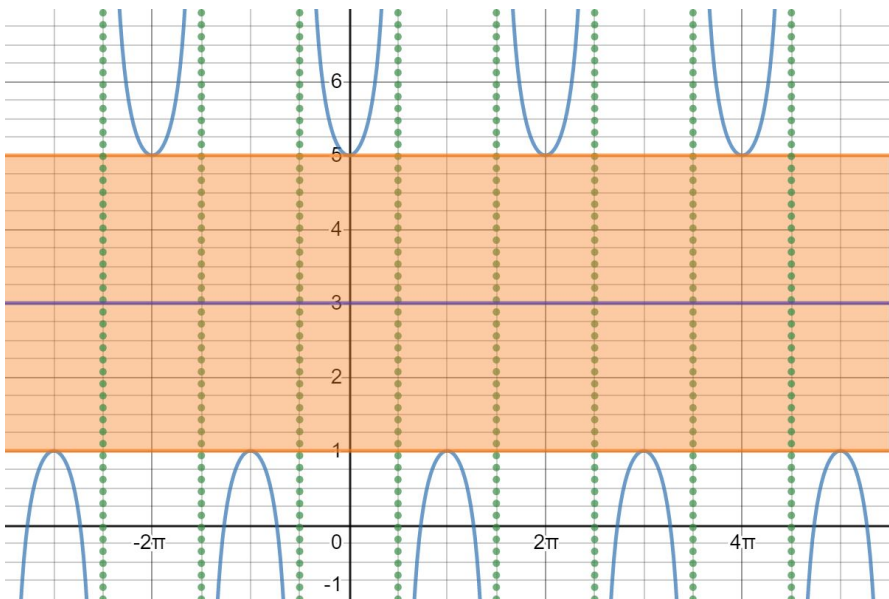
Up if k is positive and down if k is negative.

Example: y = sec(x) + 3

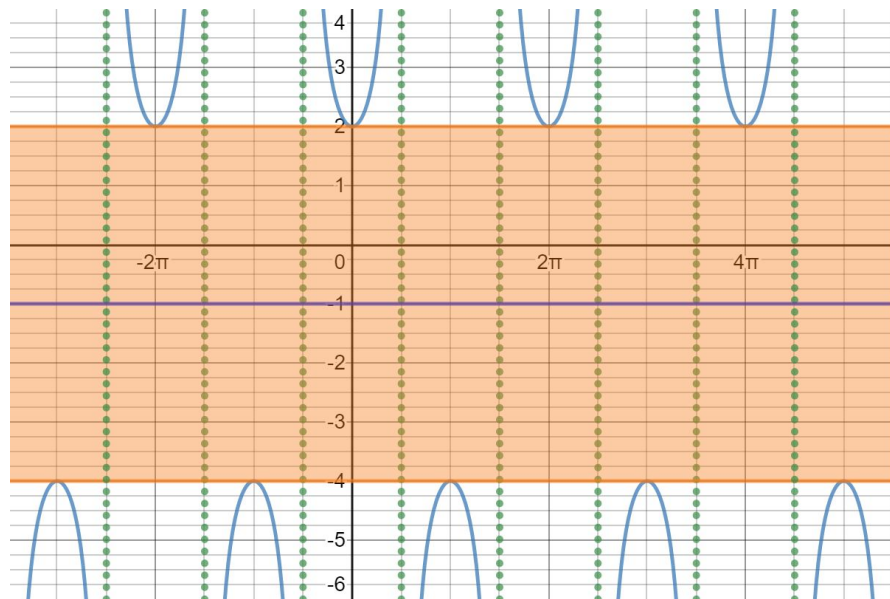Notice how the midline (marked in purple) is now at y = 3 instead of on the x-axis.

Additional Secant Examples

y = 2 sec(x) + 3

y = 3 sec(x) - 1

Notice that the edges of the graph are either 2 above or 2 below the midline and the **amplitude is 2**. Also notice that the midline is at **y = 3** which is the same as the k value.

Notice that the edges of the graph are either 3 above or 3 below the midline and the **amplitude is 3**. Also notice that the midline is at **y = -1** which is the same as the k value.
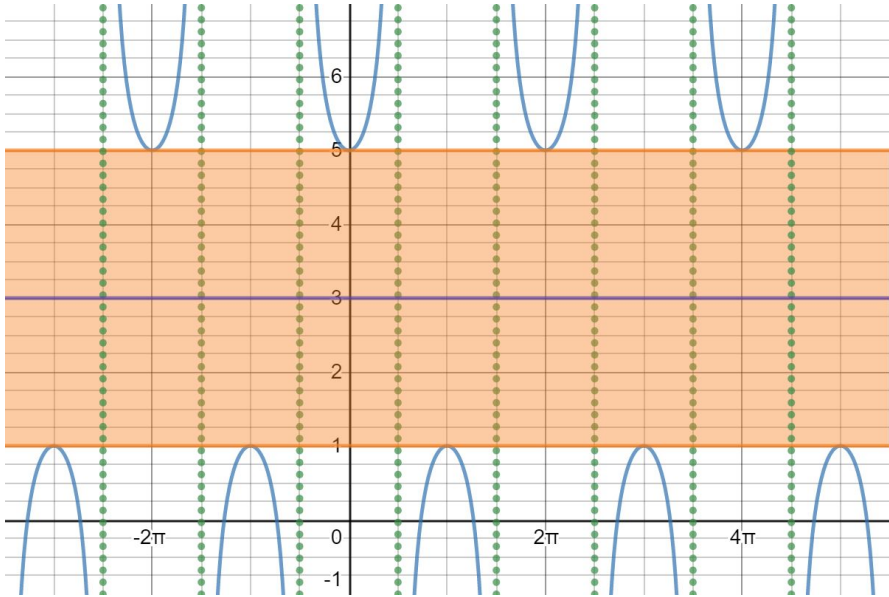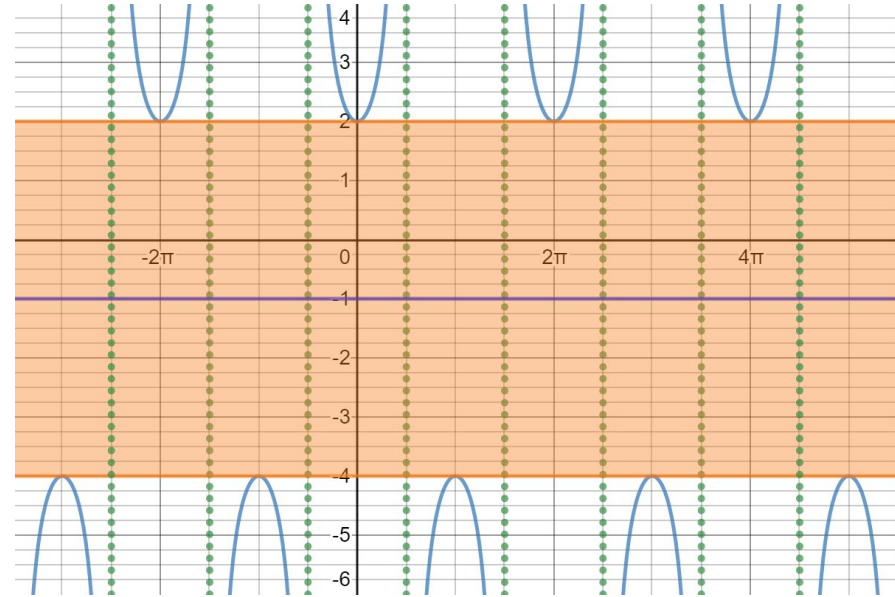
Additional Secant Examples (Cont.)

$y = 2\ \text{sec}(x) + 3$

$y = 3\ \text{sec}(x) - 1$

Domain: $\left\{ x \mid x \neq \dfrac{\pi}{2} + \pi \cdot n,\ \text{where } n \text{ is any integer} \right\}$

Range: $\{ y \mid y \leq 1 \text{ and } y \geq 5 \}$ Or $(-\infty, 1] \cup [5, \infty)$
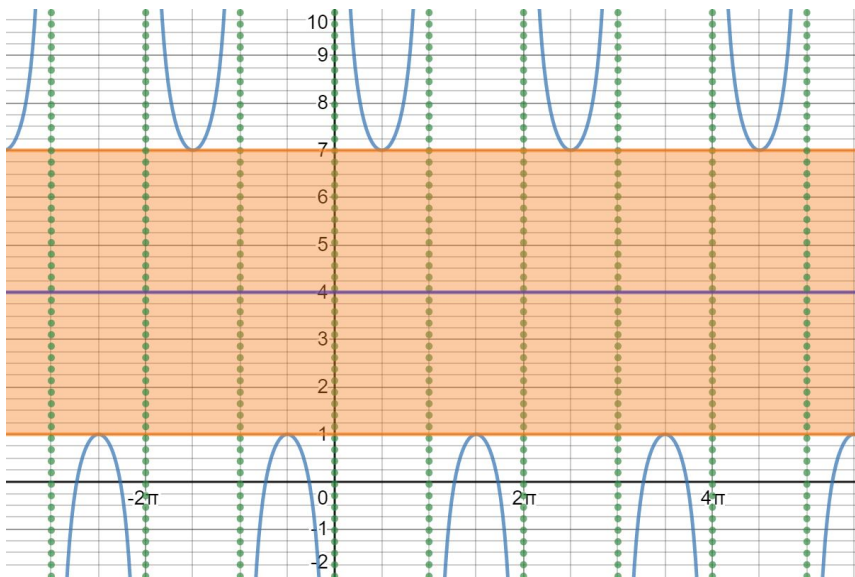

Domain: $\left\{ x \mid x \neq \dfrac{\pi}{2} + \pi \cdot n,\ \text{where } n \text{ is any integer} \right\}$

Range: $\{ y \mid y \leq -4 \text{ and } y \geq 2 \}$ Or $(-\infty, -4] \cup [2, \infty)$
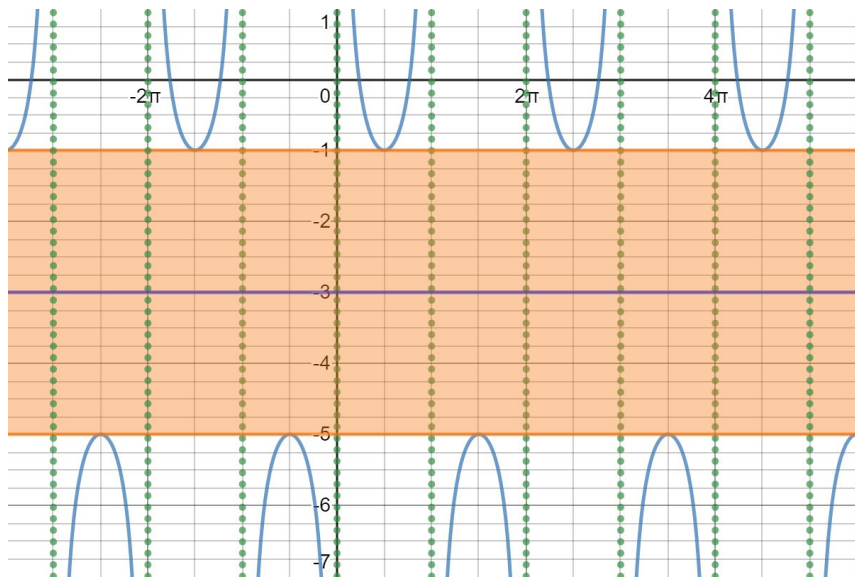
Additional Cosecant Examples

y = 3 csc(x) + 4

y = 2 csc(x) - 3

Notice that the edges of the graph are either 3 above or 3 below the midline and the **amplitude is 3**. Also notice that the midline is at **y = 4** which is the same as the k value.

Notice that the edges of the graph are either 2 above or 2 below the midline and the **amplitude is 2**. Also notice that the midline is at **y = -3** which is the same as the k value.
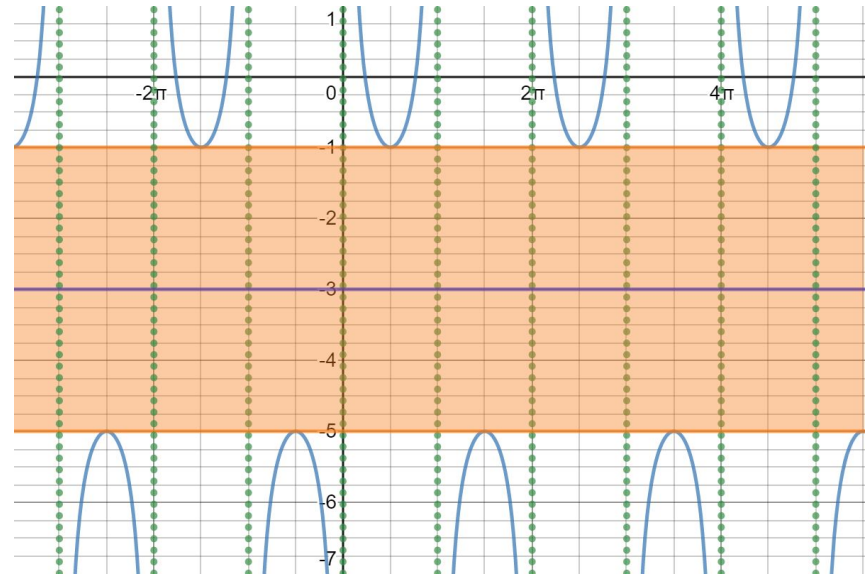
Additional Cosecant Examples (Cont.)

y = 3 csc(x) + 4

y = 2 csc(x) - 3
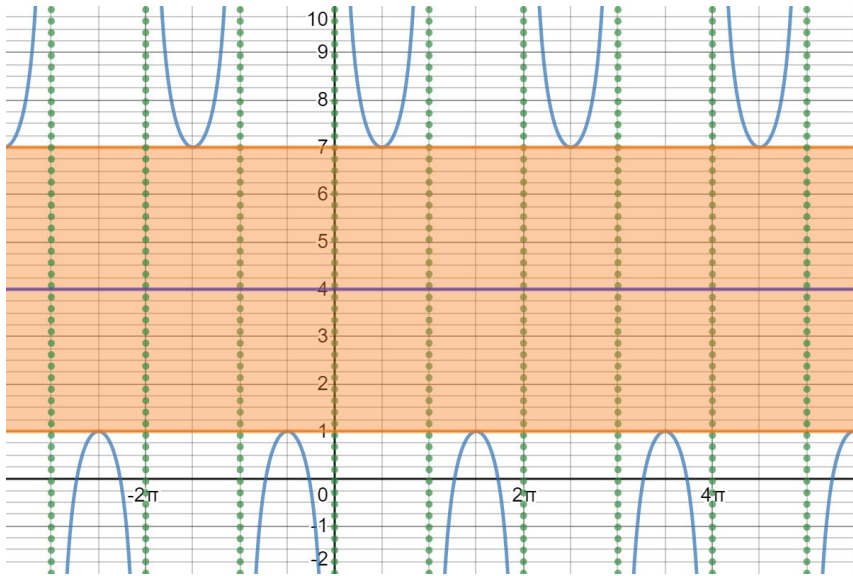
Domain: $\{\, x \mid x \neq \pi \cdot n, \ where \ n \ is \ any \ integer \,\}$

Range: $\{\, y \mid y \leq 1 \ and \ y \geq 7 \,\}$ Or $(-\infty, 1] \cup [7, \infty)$

Domain: $\{\, x \mid x \neq \pi \cdot n, \ where \ n \ is \ any \ integer \,\}$

Range: $\{\, y \mid y \leq -5 \ and \ y \geq -1 \,\}$ Or $(-\infty, -5] \cup [-1, \infty)$

Graphing Secant and Cosecant Practice:

On a sheet of paper, sketch the graph. Then determine the domain and range for each. Once you are finished, check your answers on the following page.
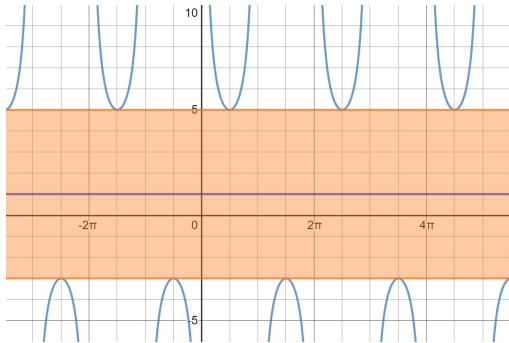
1. $y = 4 \sec(x) + 1$

2. $y = 2 \csc(x) - 5$

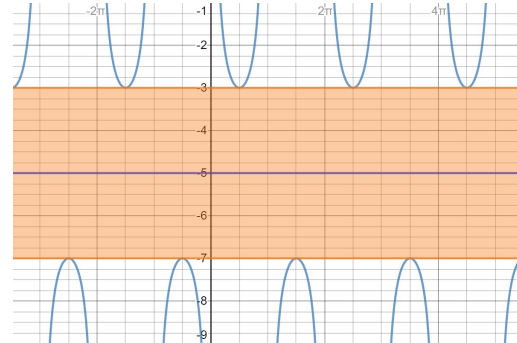3. $y = 2 \sec(x) - 6$

4. $y = 5 \csc(x) + 2$

ANSWERS - Graphing Secant and Cosecant Practice:

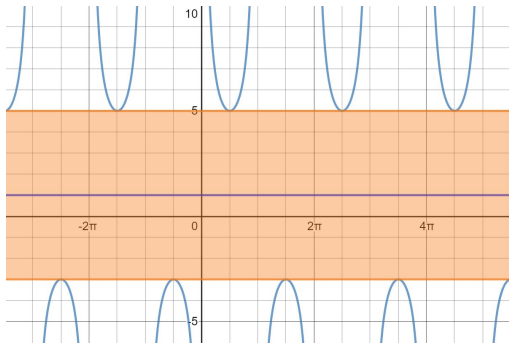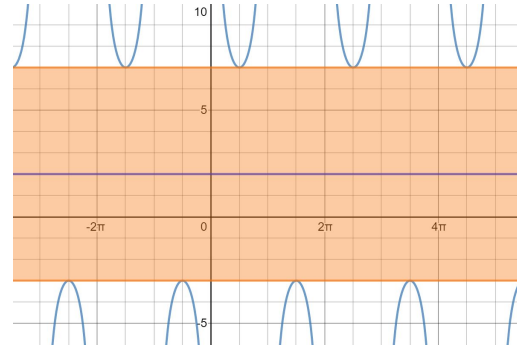Domain and Range answers are on the next page

1. y = 4 sec(x) + 1

2. y = 2 csc(x) - 5

3. y = 2 sec(x) - 6

4. y = 5 csc(x) + 2

ANSWERS - Graphing Secant and Cosecant Practice:

On a sheet of paper, sketch the graph. Then determine the domain and range for each. Once you are finished, check your answers on the following page.

1. $y = 4 \sec(x) + 1$

Domain: $\left\{ x \mid x \neq \frac{\pi}{2} + \pi \cdot n, \text{ where } n \text{ is any integer} \right\}$

Range: $\{ y \mid y \leq -3 \text{ and } y \geq 5 \}$ Or $(-\infty, -3] \cup [5, \infty)$

2. $y = 2 \csc(x) - 5$

Domain: $\{ x \mid x \neq \pi \cdot n, \text{ where } n \text{ is any integer} \}$

Range: $\{ y \mid y \leq -3 \text{ and } y \geq -1 \}$ Or $(-\infty, -3] \cup [-1, \infty)$

3. $y = 2 \sec(x) - 6$

Domain: $\left\{ x \mid x \neq \frac{\pi}{2} + \pi \cdot n, \text{ where } n \text{ is any integer} \right\}$

Range: $\{ y \mid y \leq -8 \text{ and } y \geq -4 \}$ Or $(-\infty, -8] \cup [-4, \infty)$

4. $y = 5 \csc(x) + 2$

Domain: $\{ x \mid x \neq \pi \cdot n, \text{ where } n \text{ is any integer} \}$

Range: $\{ y \mid y \leq -3 \text{ and } y \geq 7 \}$ Or $(-\infty, -3] \cup [7, \infty)$

Additional Resources:

Click on the links below to get additional helpful videos as well as additional practice to check your understanding.

Additional Practice

[Graphing Secant and Cosecant (with examples)](#)

[Graphs of Secant and Cosecant Functions (with answers)](#)

Helpful Videos

[How To Graph Secant and Cosecant Functions With Transformations](#)

(Now watch the rest of the video for transformations.)

[How to Graph Secant and Cosecant](#)