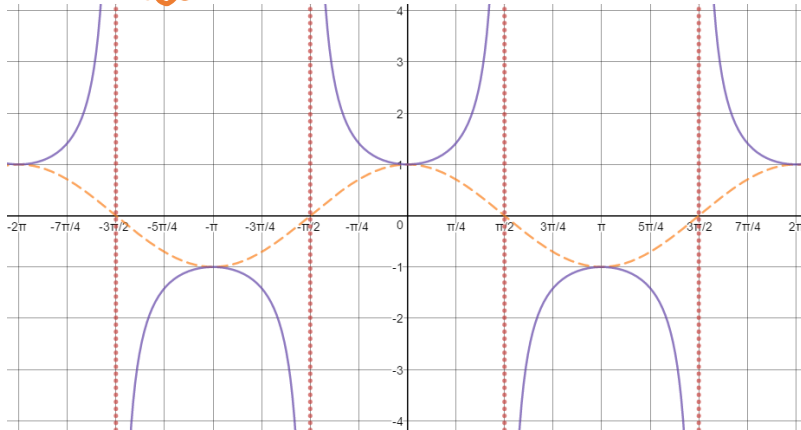


4.5 Graphs of Tangent, Cotangent, Secant, Cosecant

Target 5C: Rigid and non-rigid transformations of sinusoids

$y = \sec x$

$\frac{1}{\cos x}$ ☺



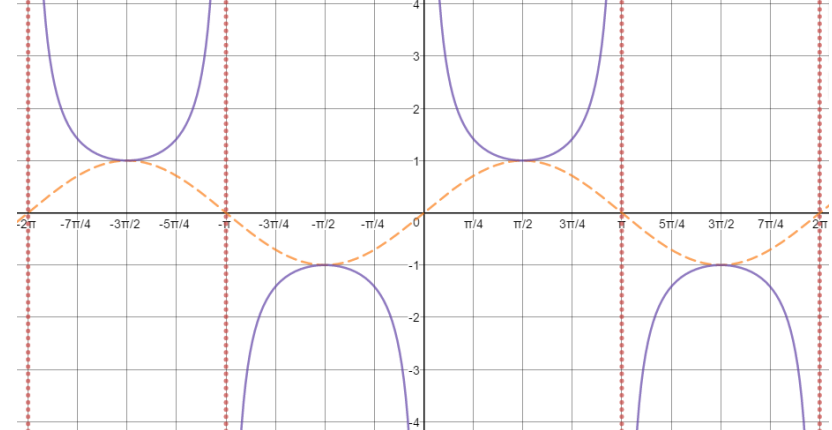
Period: 2π

Asymptotes: $x = \pm\frac{\pi}{2}, \pm\frac{3\pi}{2}, \dots, \pm\frac{(2k+1)\pi}{2}$ where k is an integer

Odd #s
 $2k+1=1$
 $2(1)+1=3$

$y = \csc x$

$\frac{1}{\sin x}$ ☺

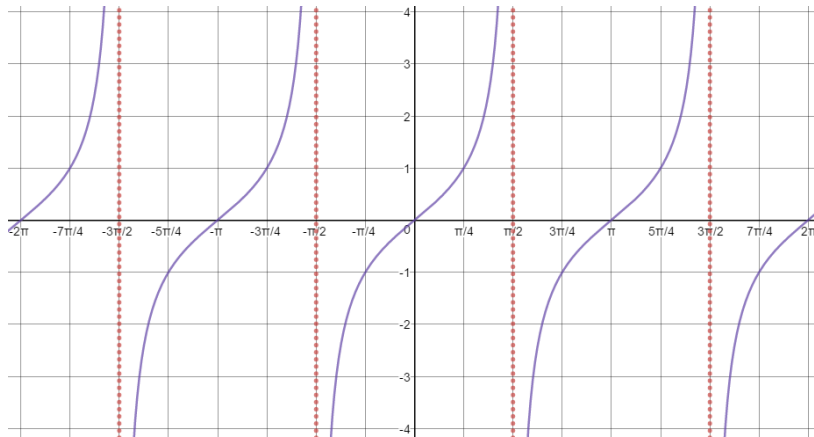


Period: 2π

Asymptotes: $x = 0, \pm\pi, \pm2\pi, \dots, 2k\pi$ where k is an integer

Even #s
 $2k=0$
 $2(1)=2$

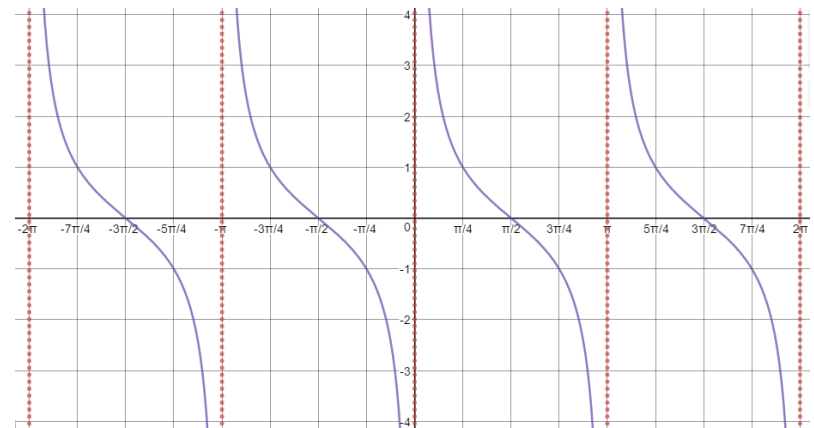
$y = \tan x$



Period: π

Asymptotes: $x = \pm\frac{\pi}{2}, \pm\frac{3\pi}{2}, \dots, \pm\frac{(2k+1)\pi}{2}$ where k is an integer

$y = \cot x$



Period: π

Asymptotes: $x = 0, \pm\pi, \pm2\pi, \dots, 2k\pi$ where k is an integer

Write an equation for each graph and identify the vertical asymptotes.

1. Tangent

period = 3π

$$\frac{\pi}{b} = 3\pi$$

$$\pi = 3\pi b$$

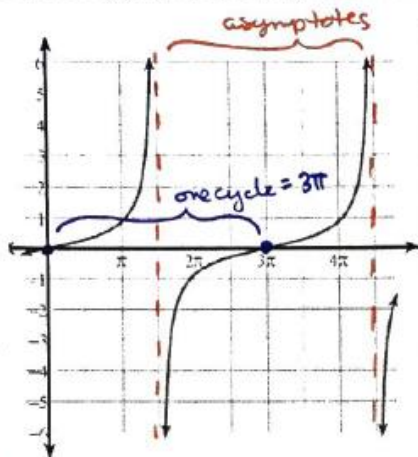
$$\frac{1}{3} = b$$

$$y = \tan\left(\frac{1}{3}x\right)$$

V.A. @ $x = \frac{3\pi}{2}, \frac{9\pi}{2}, \frac{15\pi}{2}, \dots$

$$x = \frac{3\pi}{2} + 3\pi k$$

(where k is an integer)



2. Cotangent

period = $\frac{\pi}{2}$

$$\frac{\pi}{b} = \frac{\pi}{2}$$

$$2\pi = \pi b$$

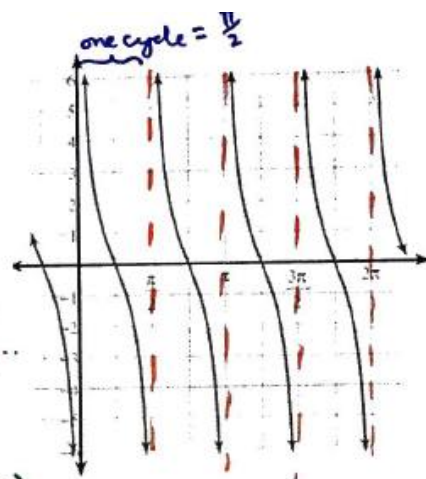
$$2 = b$$

$$y = \cot(2x)$$

V.A. @ $x = \frac{\pi}{2}, \pi, \frac{3\pi}{2}, \dots$

$$x = \frac{\pi}{2}k$$

(where k is an integer)



3. Secant

period = π

$$\frac{2\pi}{b} = \pi$$

$$2\pi = \pi b$$

$$2 = b$$

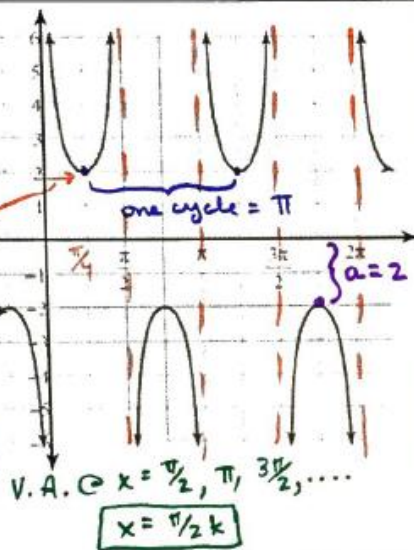
phase shift = $\frac{\pi}{4}$

$$\frac{c}{2} = \frac{\pi}{4}$$

$$c = \frac{\pi}{2}$$

$$a = 2$$

$$y = 2\sec\left(2x + \frac{\pi}{2}\right)$$



V.A. @ $x = \frac{\pi}{2}, \pi, \frac{3\pi}{2}, \dots$

$$x = \frac{\pi}{2}k$$

4. Cosecant

period = 2π

$$\frac{2\pi}{b} = 2\pi$$

$$b = 1$$

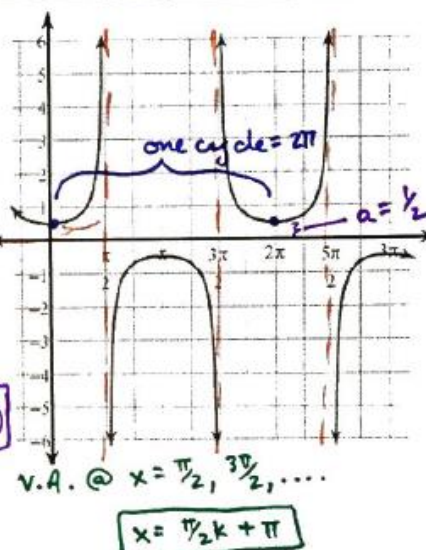
phase shift = $\frac{\pi}{2}$

$$\frac{c}{1} = \frac{\pi}{2}$$

$$c = \frac{\pi}{2}$$

$$a = \frac{1}{2}$$

$$y = \frac{1}{2}\csc\left(x + \frac{\pi}{2}\right)$$



V.A. @ $x = \frac{\pi}{2}, \frac{3\pi}{2}, \dots$

$$x = \frac{\pi}{2}k + \pi$$

Describe the transformation for the given function.

5. $y = \tan(5x) + 2$

$\frac{\pi}{b} \rightarrow$ period
period = $\frac{\pi}{5}$

Vertical shift = 2 (up)

6. $y = \cot\left(\frac{x}{3} - \pi\right)$

period = $\frac{\pi}{b} = \frac{\pi}{1/3} = 3\pi$

phase shift = $\frac{c}{b} = \frac{\pi}{1/3} = 3\pi$ (to the right)

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

reflects over x-axis

period = $\frac{2\pi}{b} = \frac{2\pi}{3}$

8. $y = \csc\left(2x + \frac{\pi}{2}\right)$

period = $\frac{2\pi}{b} = \frac{2\pi}{2} = \pi$

phase shift = $\frac{c}{b} = \frac{\pi/2}{2} = \frac{\pi}{4}$ (to the left)

More Practice

Graphs of Secant, Cosecant, Tangent, and Cotangent

<http://www.regentsprep.org/regents/math/algtrig/att7/othergraphs.htm>

<http://www.intmath.com/trigonometric-graphs/4-graphs-tangent-cotangent-secant-cosecant.php>

<http://www.purplemath.com/modules/triggrph3.htm>

https://www.youtube.com/watch?v=2m_qvTv1RgU

https://www.youtube.com/watch?v=srWI_jFm91w

https://www.youtube.com/watch?v=4Fnu3_mXaik

Homework Assignment

p.365 #3,5,9,13,17,19,25,29,32,33