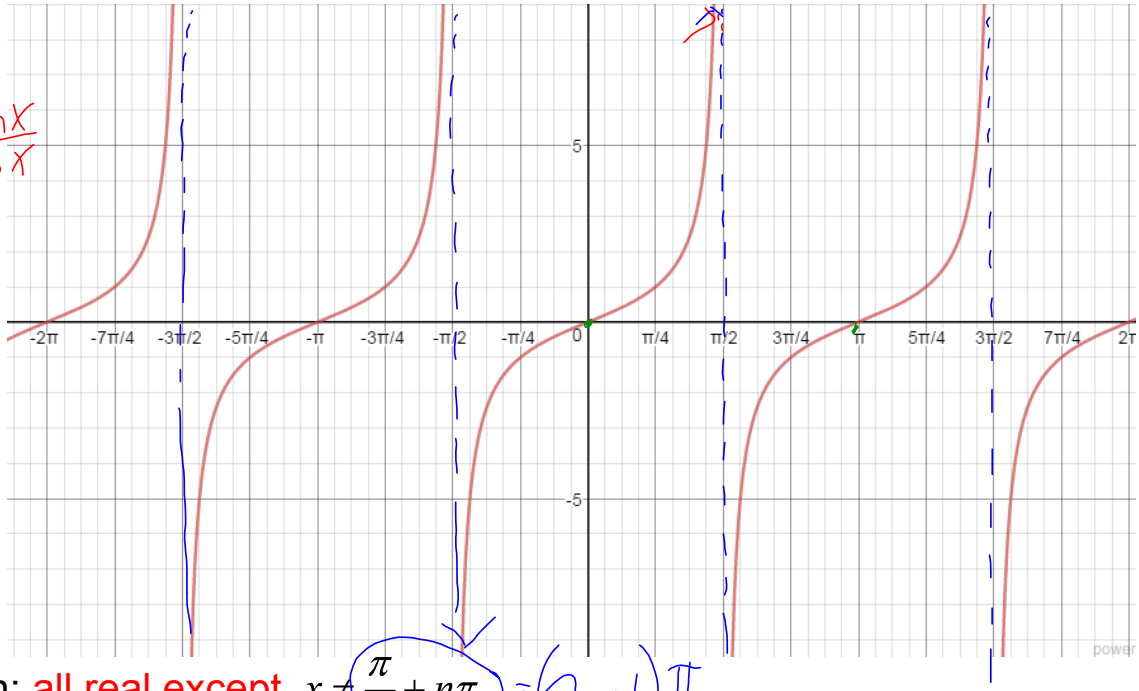
Sec. 4.6
Graphs of Other Trig. Functions

In this section we use the graphs of sine and cosine to analyze the other four trigonometric functions.

Tangent

$\tan X = \frac{\sin X}{\cos X}$



$\tan 2X$

Domain: all real except $x \neq \frac{\pi}{2} + n\pi = (2n+1)\frac{\pi}{2}$

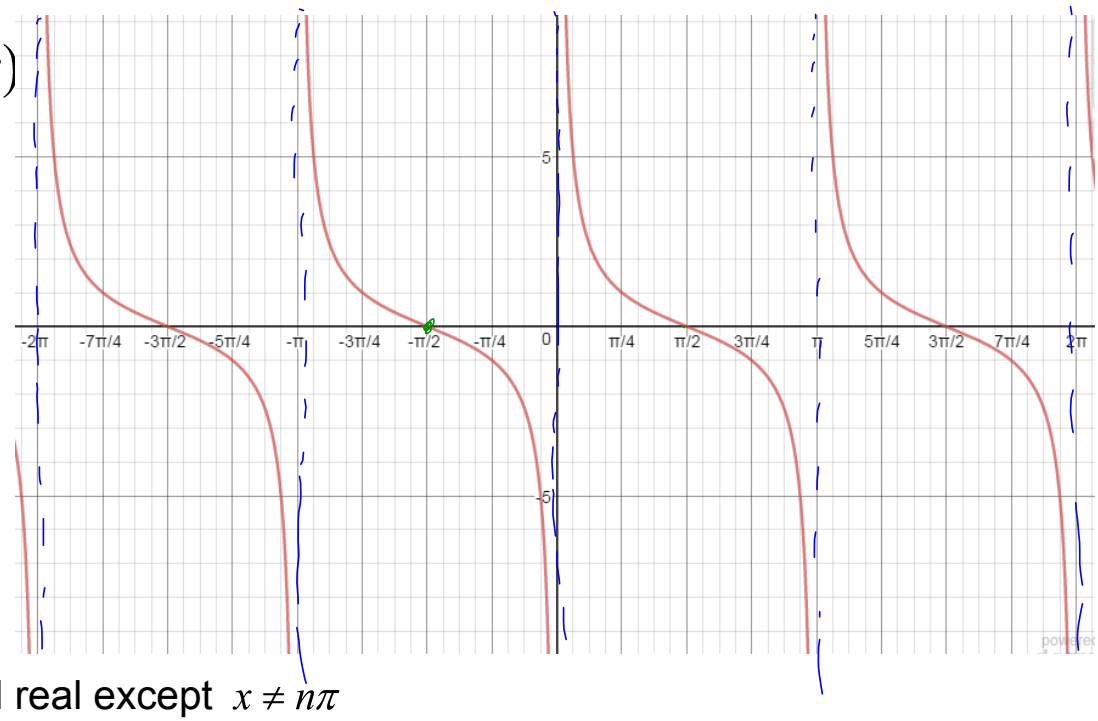
Range: all real

Period: π

Vertical Asymptotes: @ $x = \frac{\pi}{2} + n\pi$

$y = \cot(x)$

$\frac{\cos x}{\sin x}$



Domain: all real except $x \neq n\pi$

Range: all real

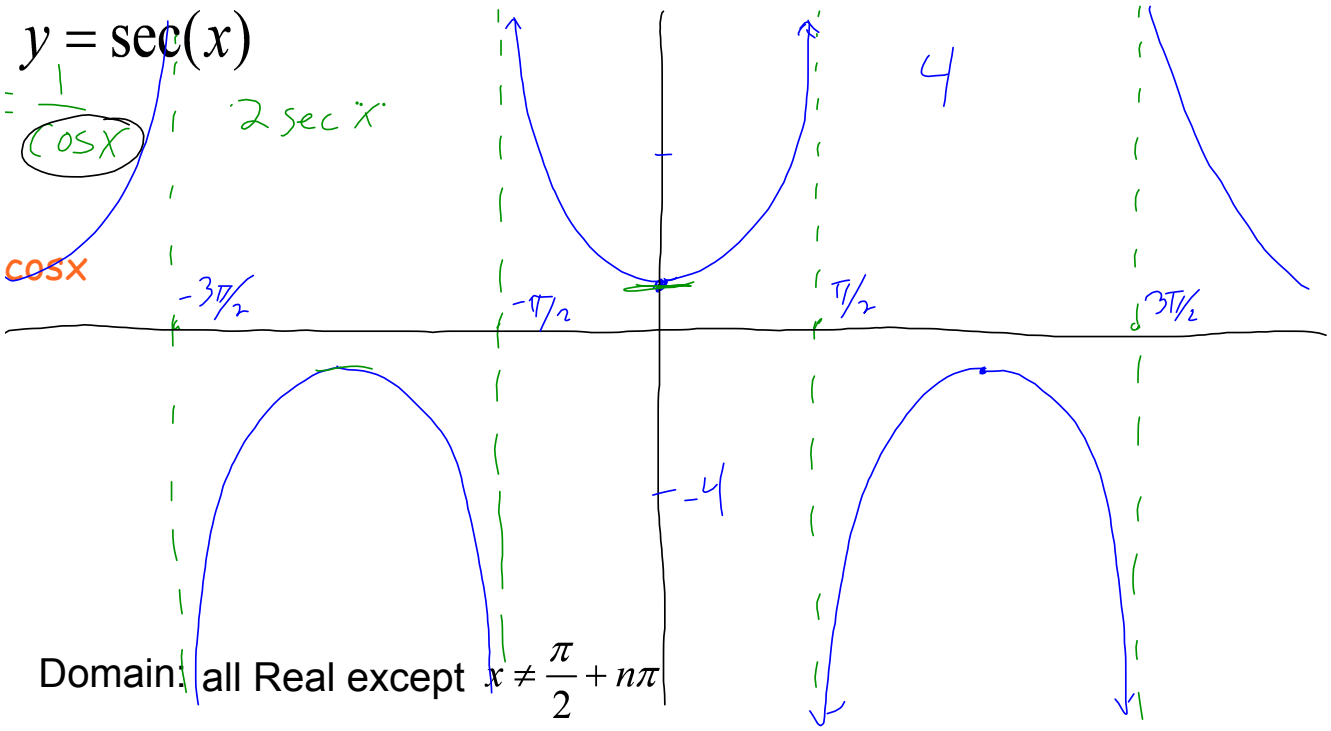
Period: π

Vertical Asymptote: @ $x = n\pi$

$y = \sec(x)$

$\frac{1}{\cos x}$ 2 sec x

cosx

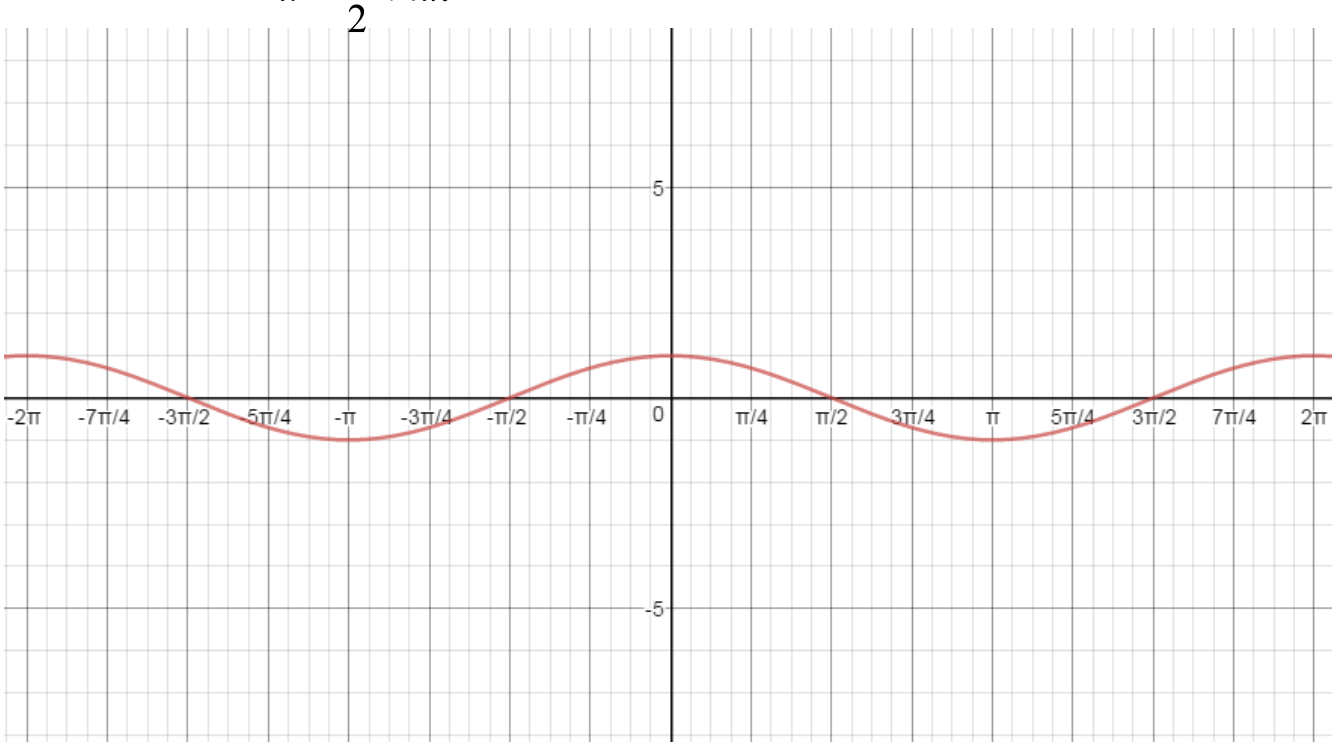


Domain: all Real except $x \neq \frac{\pi}{2} + n\pi$

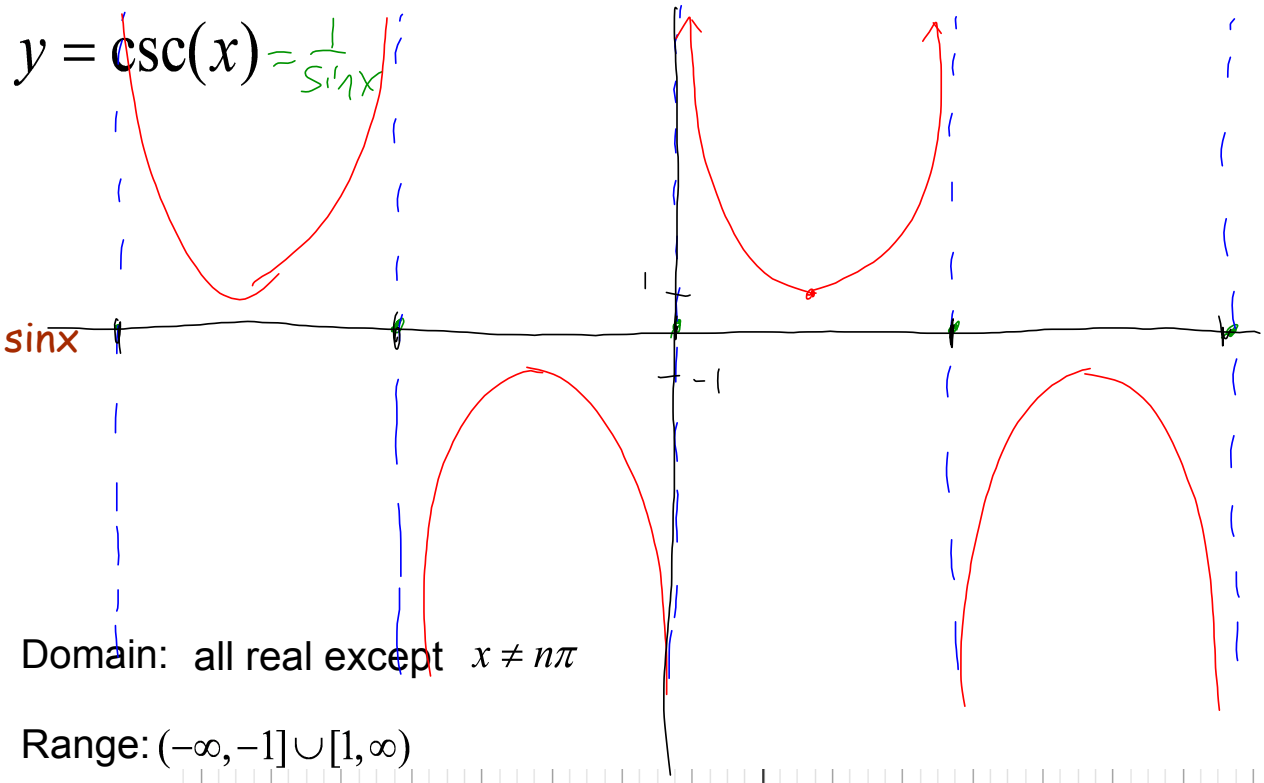
Range: $(-\infty, -1] \cup [1, \infty)$

Period: 2π

Vert. Asym.: $x = \frac{\pi}{2} + n\pi$



$y = \csc(x) = \frac{1}{\sin x}$

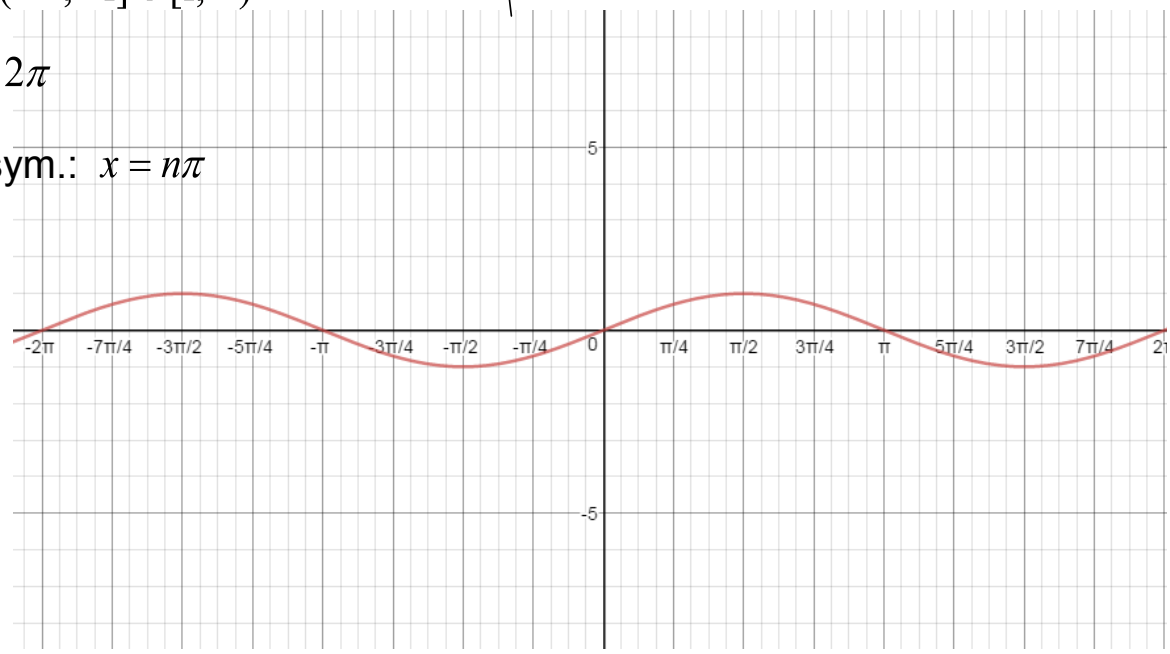


Domain: all real except $x \neq n\pi$

Range: $(-\infty, -1] \cup [1, \infty)$

Period: 2π

Vert. Asym.: $x = n\pi$



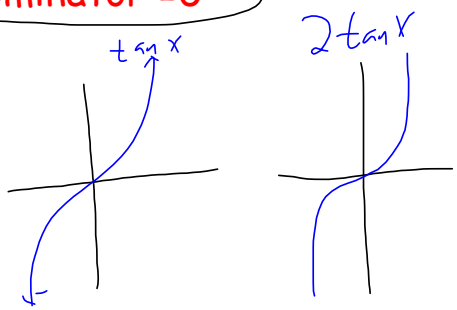
For these two functions $y = a\tan(bx - c)$ $y = a\cot(bx - c)$

the period is $\frac{\pi}{b}$ and the phase shift is $\frac{c}{b}$

V.A. or

domain: Set bx-c = Values that make denominator =0

(unit circle helps)



For these two functions, $y = a\sec(bx - c)$ $y = a\csc(bx - c)$

the period is $\frac{2\pi}{b}$ the phase shift is $\frac{c}{b}$ the "amplitude" is $|a|$

domain: Set bx-c = Values that make denominator =0

(unit circle helps)

Example Identify the domain, range, and vertical asymptotes (if any).

$y = 4\sec(2x)$ $= \frac{4}{\cos 2x}$

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

$x = -\frac{\pi}{4}$

$\frac{1}{\cos x}$

D: $\mathbb{R}$ $x \neq (2n+1)\frac{\pi}{4}$

R: $(-\infty, -4] \cup [4, \infty)$

$y \leq -4$ $y \geq 4$

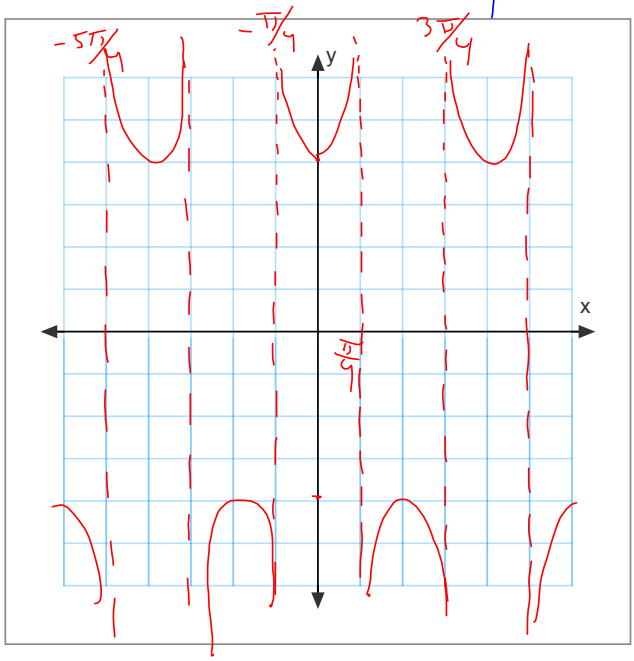
$\frac{2x}{2} = \frac{\pi}{2} \cdot \frac{1}{2}$

$x = \pi/4$

$2x = \frac{5\pi}{2}$

$x = \frac{5\pi}{4}$

V.A.: $x = (2n+1)\frac{\pi}{4}$



$\frac{2x}{2} = \frac{3\pi}{2} \rightarrow x = \frac{3\pi}{4}$

$y = 4 \cdot \sec(2x) = 4\left(\frac{1}{\cos(2x)}\right)$

to check on calculator

$y = \frac{4}{\cos(2x)}$

$y = \csc(3x - \pi)$

Identify the domain, range, and vertical asymptotes (if any).

Hint: take care of period change then the phase shift.