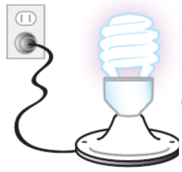
Model Electric Power

The electricity coming from power plants into your house is alternating current (AC). This means that the direction of current flowing in a circuit is constantly switching back and forth. In Canada, the current makes 60 complete cycles each second.



The voltage can be modelled as a function of time using the sine function $V = 170 \sin(120\pi t)$.

a) What is the period of the current in Canada?

b) Graph the voltage function over two cycles. Explain what the scales on the axes represent.

c) Suppose you want to switch on a heat lamp for an outdoor patio. If the heat lamp requires 110 V to start up, determine the time required for the voltage to first reach 110 V.

> **Did You Know?**
>
> The number of cycles per second of a periodic phenomenon is called the frequency. The hertz (Hz) is the SI unit of frequency. In Canada, the frequency standard for AC is 60 Hz.
>
> Voltages are expressed as root mean square (RMS) voltage. RMS is the square root of the mean of the squares of the values. The RMS voltage is given by $\frac{\text{peak voltage}}{\sqrt{2}}$. What is the RMS voltage for Canada?

a) Period $= \frac{2\pi}{k}$

$= \frac{2\pi}{120\pi}$

$= \frac{1}{60}$ sec

oscilloscope

c) $110 = 170\sin(120\pi t)$

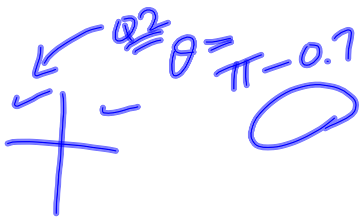
$\frac{110}{170} = \sin(120\pi t)$

$\sin^{-1}\left(\frac{110}{170}\right) = 120\pi t$

ref $0.70 = 120\pi t$

$t = \frac{0.70}{120\pi}$

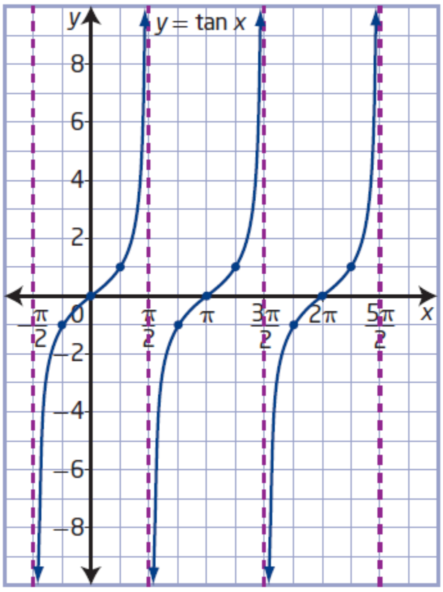
$t = 0.0019$ sec



Key Ideas

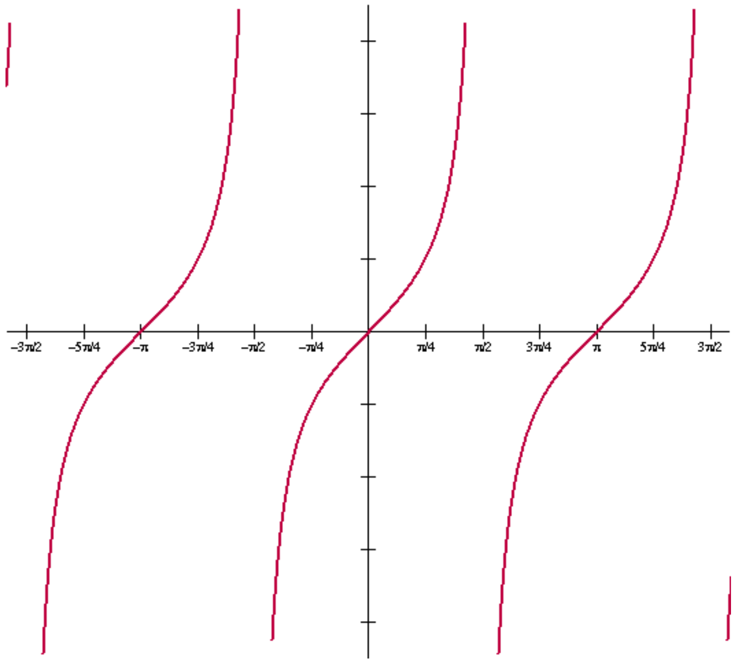
- You can use asymptotes and three points to sketch one cycle of a tangent function. To graph $y = \tan x$, draw one asymptote; draw the points where $y = -1$, $y = 0$, and $y = 1$; and then draw another asymptote.

How can you determine the location of the asymptotes for the function $y = \tan x$?



- The tangent function $y = \tan x$ has the following characteristics:
  - The period is π.
  - The graph has no maximum or minimum values.
  - The range is $\{y \mid y \in \mathrm{R}\}$.
  - Vertical asymptotes occur at $x = \frac{\pi}{2} + n\pi$, $n \in \mathrm{I}$.
  - The domain is $\left\{x \mid x \neq \frac{\pi}{2} + n\pi, x \in \mathrm{R}, n \in \mathrm{I}\right\}$.
  - The x-intercepts occur at $x = n\pi$, $n \in \mathrm{I}$.
  - The y-intercept is 0.

y = tan θ



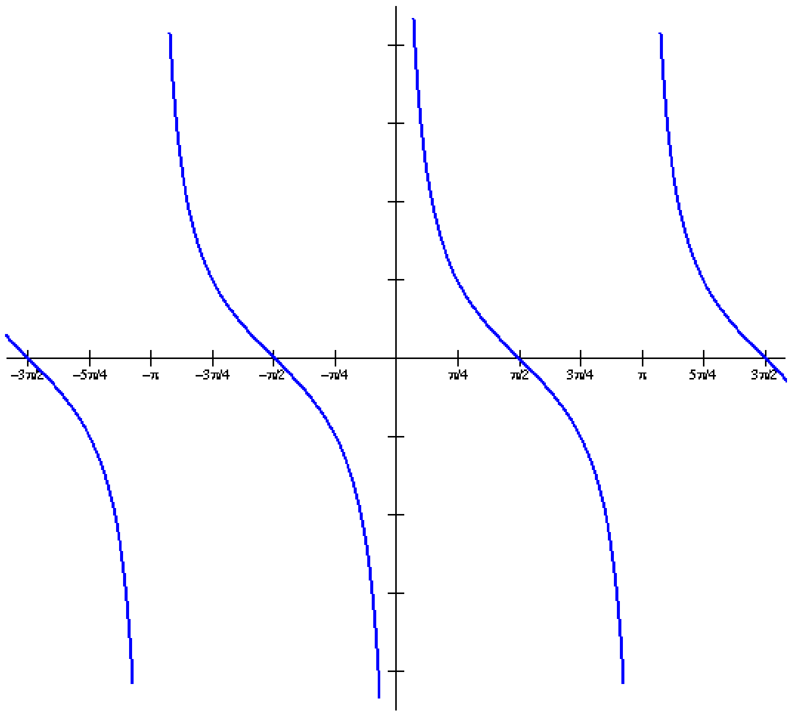
What would the graph of **cot θ** look like?

REMEMBER:

$$\tan x = \frac{1}{\cot x}$$

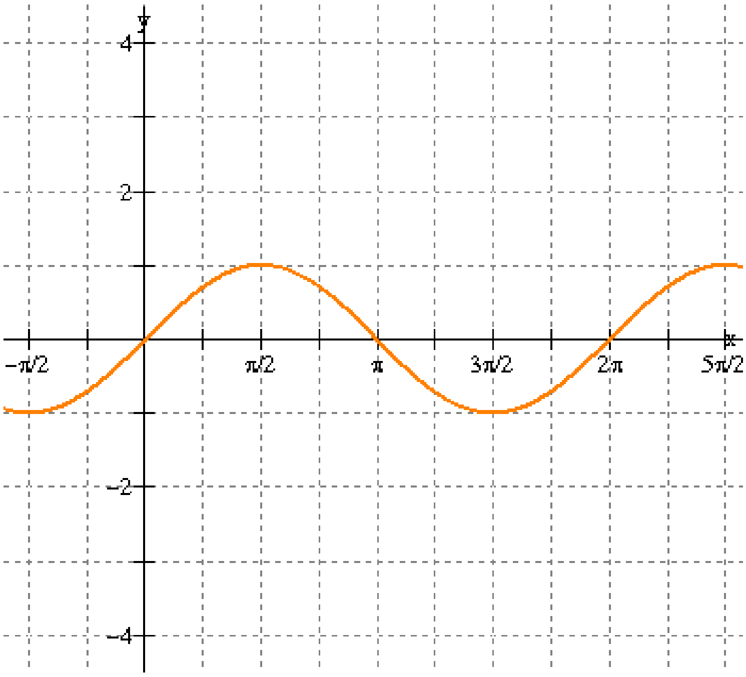
where tan x = 0,
cot x is undefined

y = cot θ



Graphs of Other Trigonometric Functions

$y = \sin \theta$



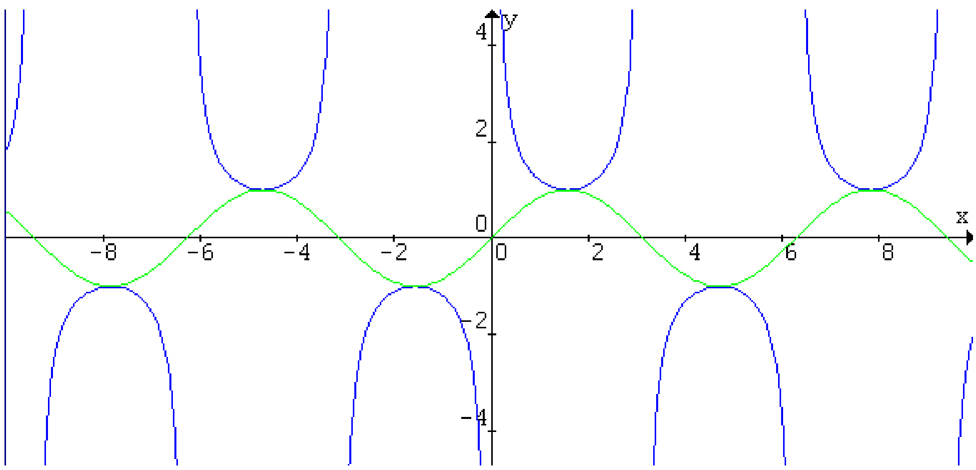
What would the graph of **csc θ** look like?

REMEMBER:

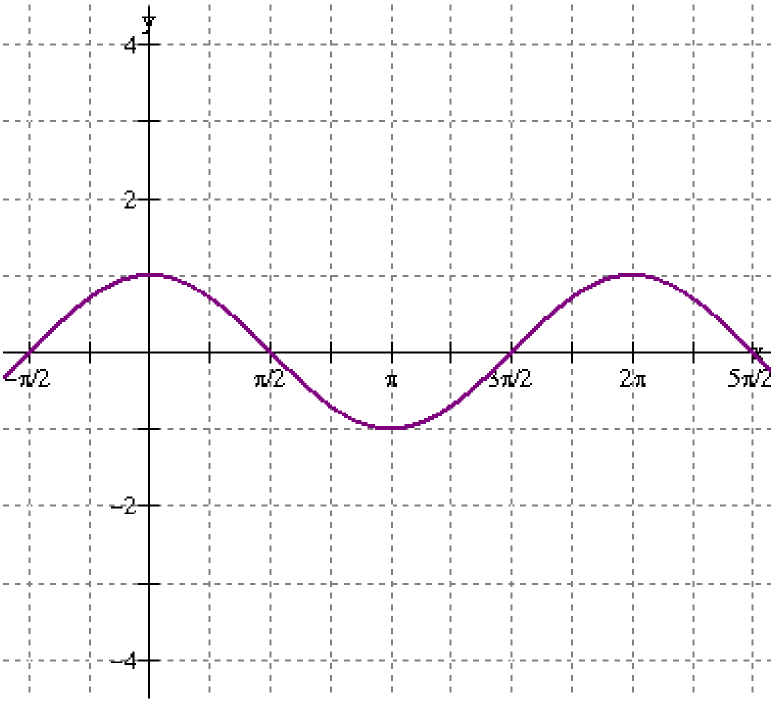
$$\csc\theta = \frac{1}{\sin\theta}$$

where sin x = 0,
csc x is undefined

$y = \sin x$ $y = \csc x$



y = cos θ



What would the graph of **sec θ** look like?

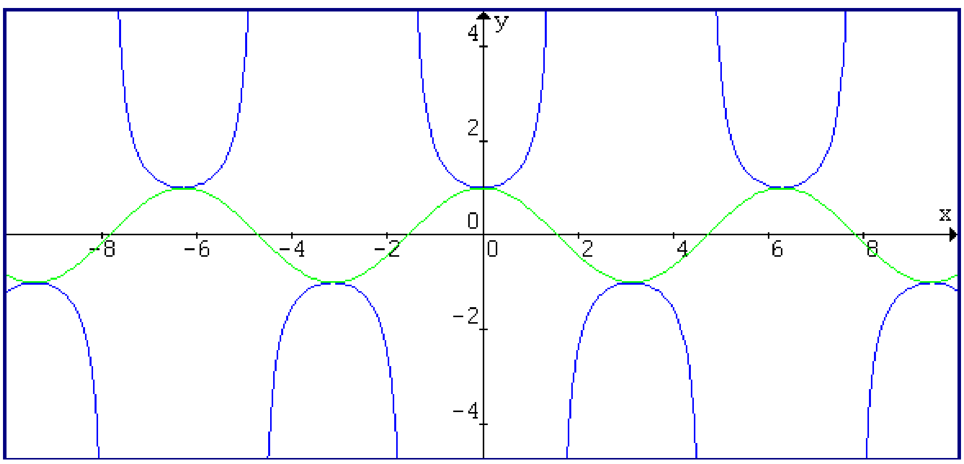
REMEMBER:

$$\sec\theta = \frac{1}{\cos\theta}$$

where cos x = 0,
sec x is undefined

y = cos x

y = sec x



REVIEW - Sketching Trigonometric Functions

- sinusoidal functions
  - properties: domain/range, amplitude, period, phase shift, vertical translation, eq'n of sinusoidal axis, mapping notation.
  - sketching equation in standard form.
- finding the function (both a sine/cosine) given a graph
- solving trigonometric equations where period is not 360
- applications of sinusoidal functions.
  - sketch
  - develop a function
  - use function to answer question
- sketches of all SIX trigonometric ratios