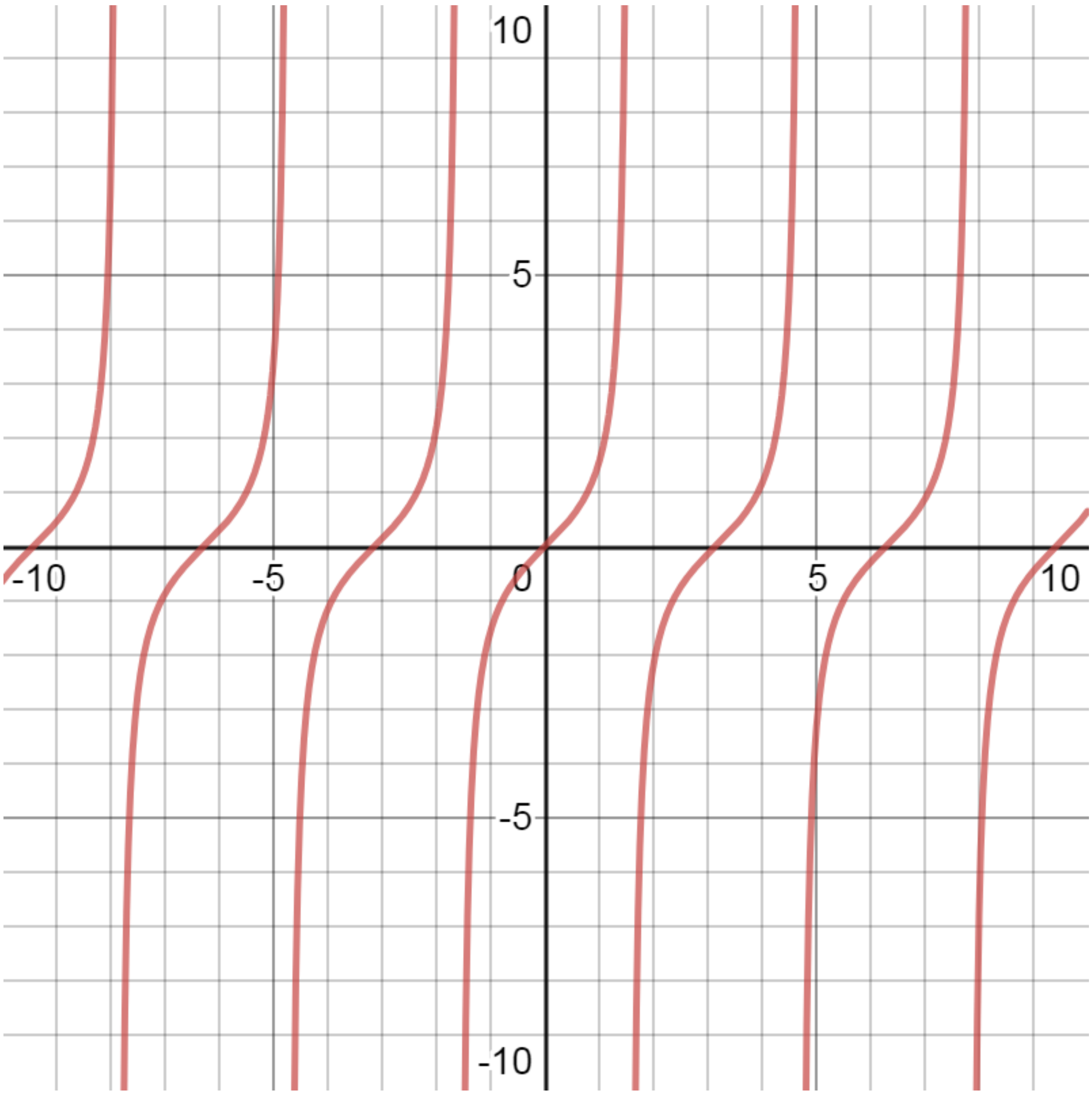
The graph of the tangent function

The tangent function has a very different graph than sine and cosine:



In this case, it really doesn’t make sense to think about **amplitude** . . .

. . . because the function has no maximum or minimum!

However, this is a periodic function and so it does have a **period**.

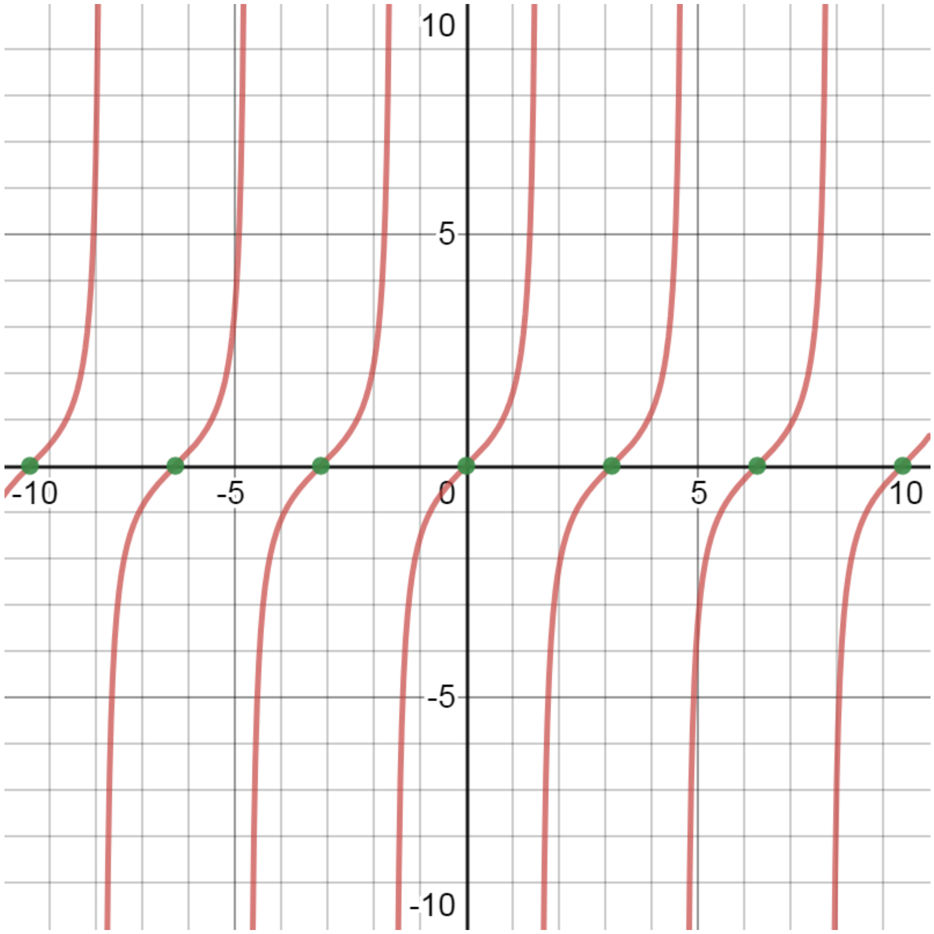
But the period of the tangent function is different than that of sine and cosine!

Let’s look at the graph again and try to see what it is.

First, we can distinguish between the different periods . . .

. . . by noting that each cycle . . .

. . . has one x-intercept!



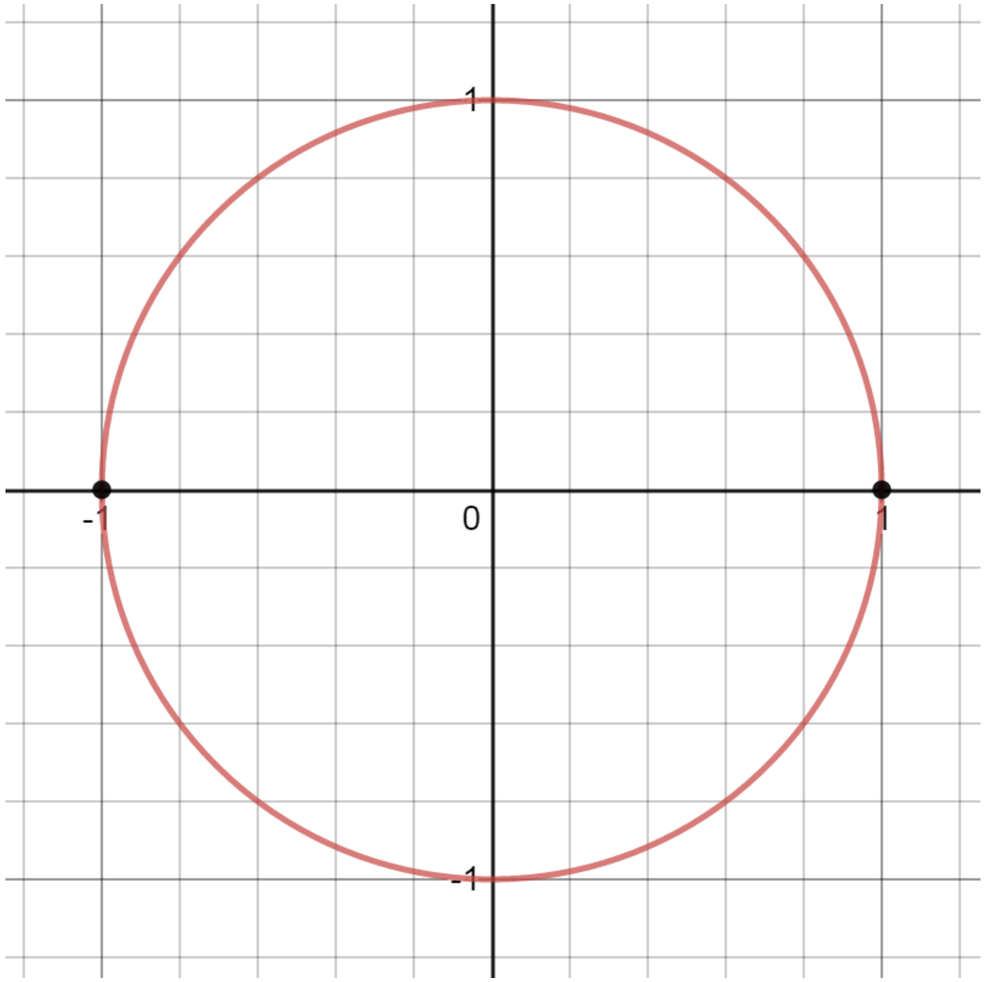
Those happen whenever the tangent of an angle is **zero**.

Remember, that

$$\tan(\theta) = \frac{y}{x}$$

Which means that these x-intercepts happen when

$$y = 0$$



Which happens at $0° \ and \ 180°$

or, in radian angle measures,

$0 \ and \ \pi$

This means that the tangent function completes a full period in π radians …

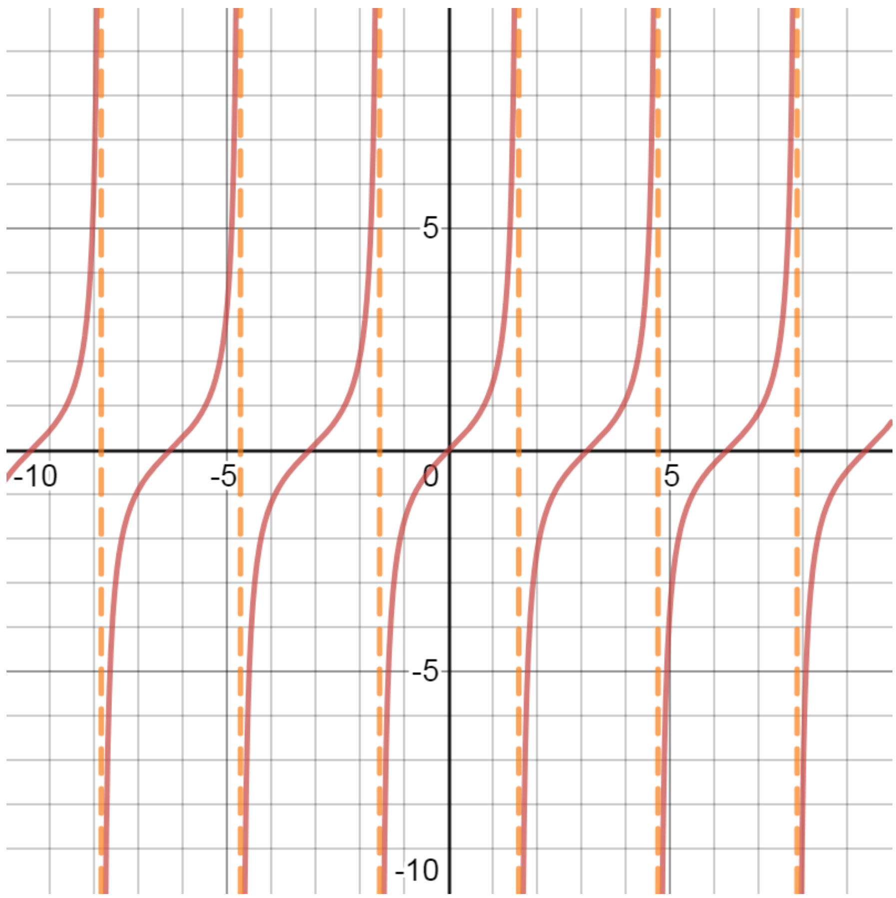
… which is half of the angle that the sine and cosine complete their cycle.

so the period of tangent is . . .

$$\pi$$

We can see this on the graph:

$f(\theta) = \tan(\theta)$



Note that here I drew the dotted lines that separate cycles as asymptotes.

The function becomes undefined wherever the x in

$$\tan(\theta) = \frac{y}{x}$$

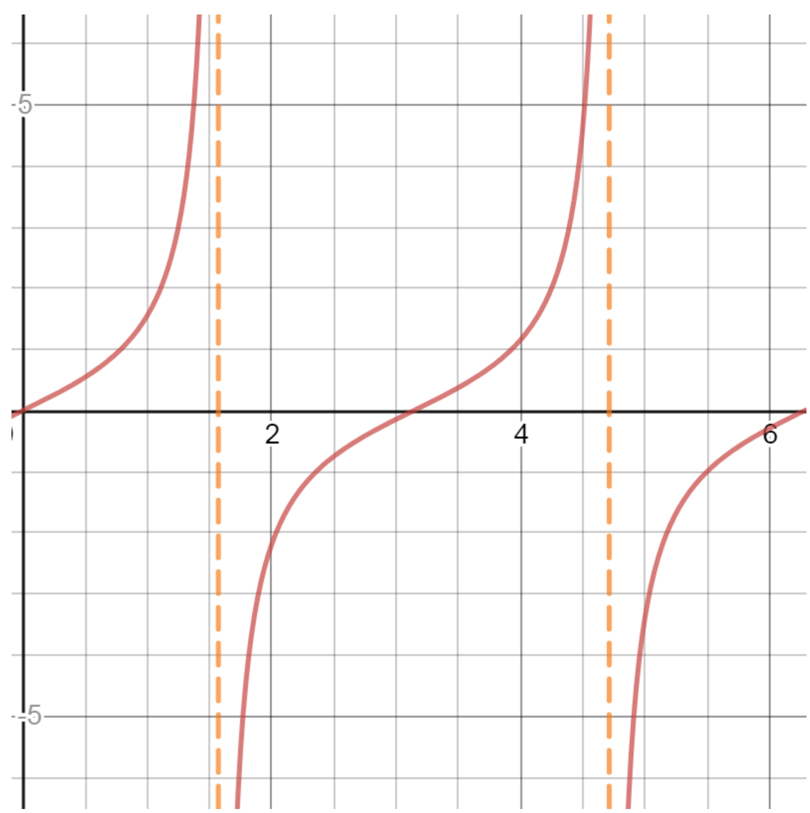
becomes zero, which happens at

$\theta = \frac{\pi}{2}, \ \ \theta = \frac{3\pi}{2}$, etc.

So if you were asked to **graph** only **two periods** of the tangent function . . .

. . . you would only need to graph from 0 to 2π:

$f(\theta) = \tan(\theta)$



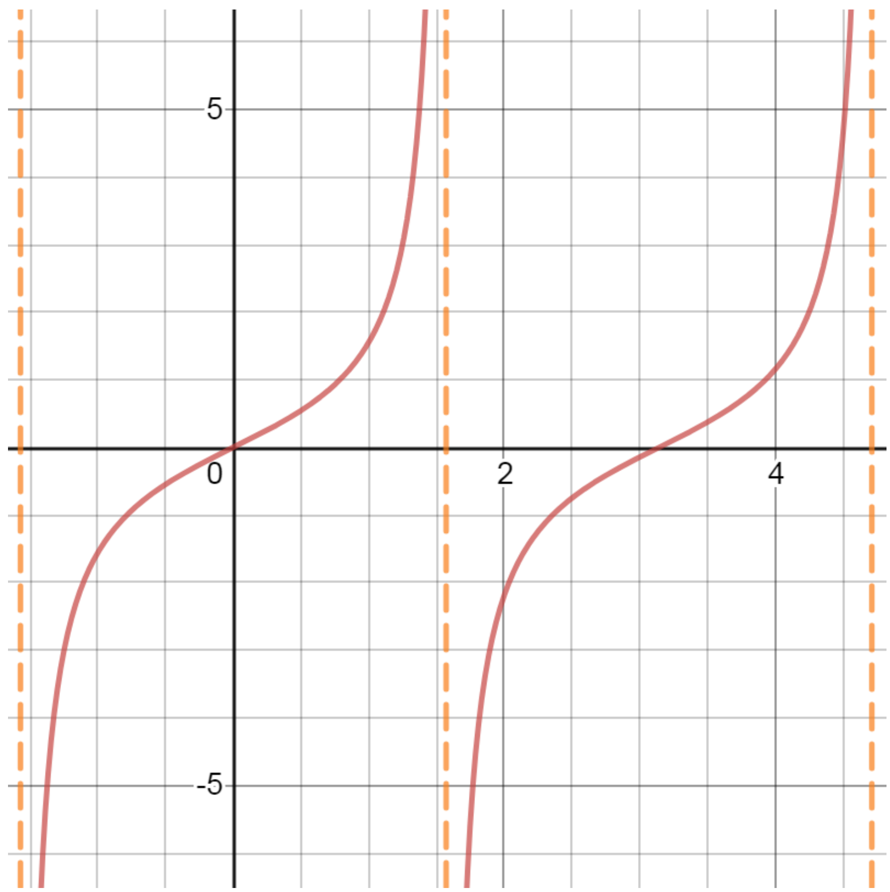
Alternatively you could choose to graph the function from

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

to

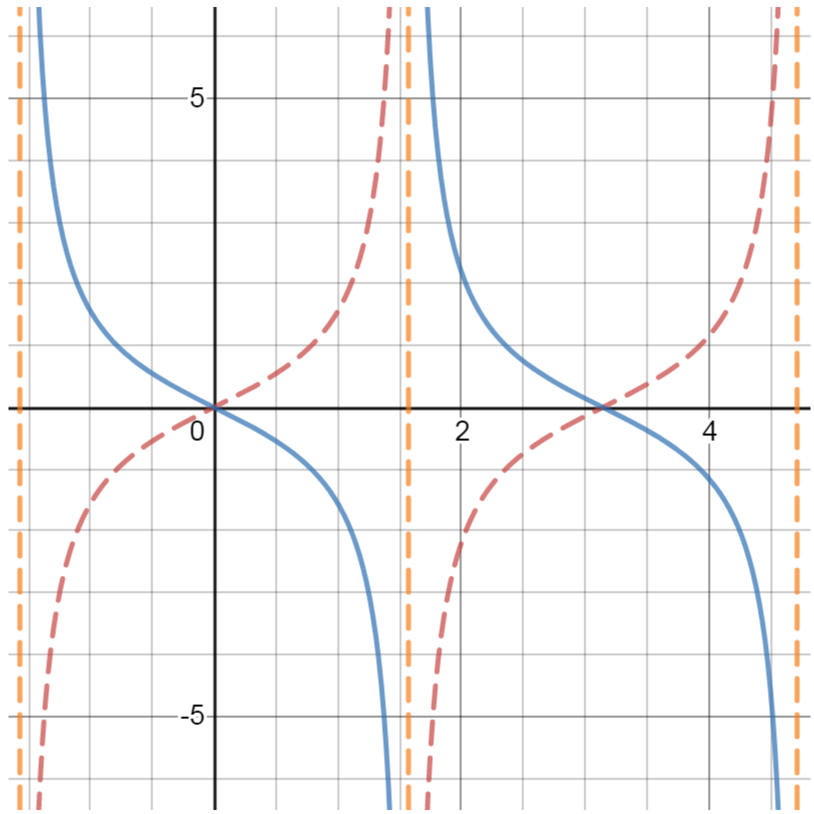
$$\theta = \frac{3\pi}{2}$$

$f(\theta) = \tan(\theta)$



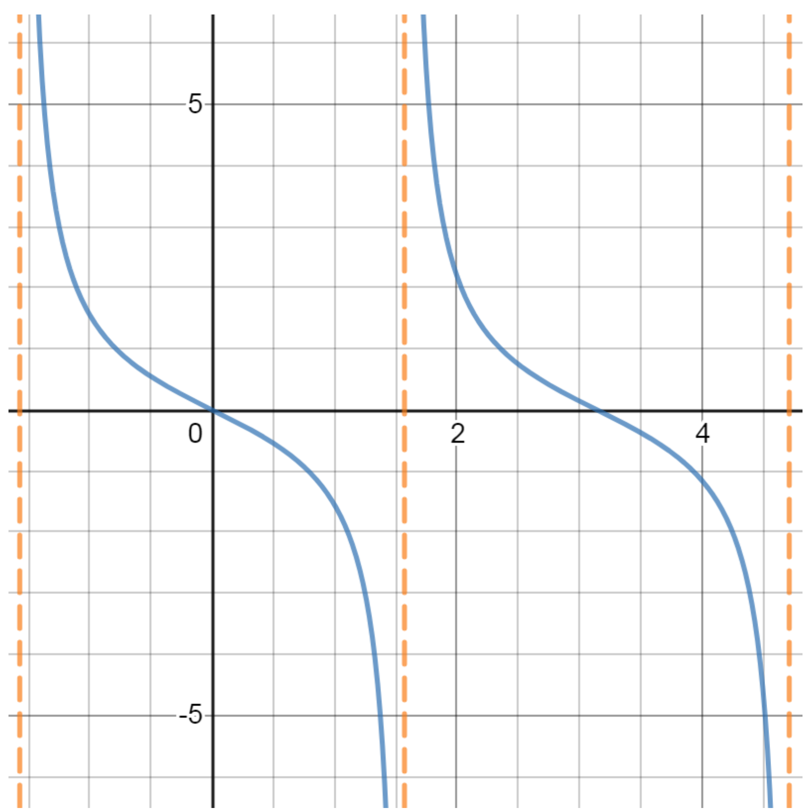
The only variations on the tangent function are those involving a . . .

. . . ***vertical reflection***:



which results in a graph that decreases rather than increases:

$f(\theta) = -\tan(\theta)$



or you might have to graph a tangent function with an altered period:

$$g(\theta) = \tan(4\pi\theta)$$

and here, since the period of the basic tangent function is π . . .

our formula for a tangent function undergoing a horizontal stretch (shrink):

$$h(\theta) = \tan\,(B * \theta)$$

is going to be

$$\textbf{period} = \frac{\pi}{B}$$

Let's do a problem asking us to graph a tangent function.

Graph two full periods of the function

$$p(\theta) = -\tan(2\theta)$$

First let's figure out the period:

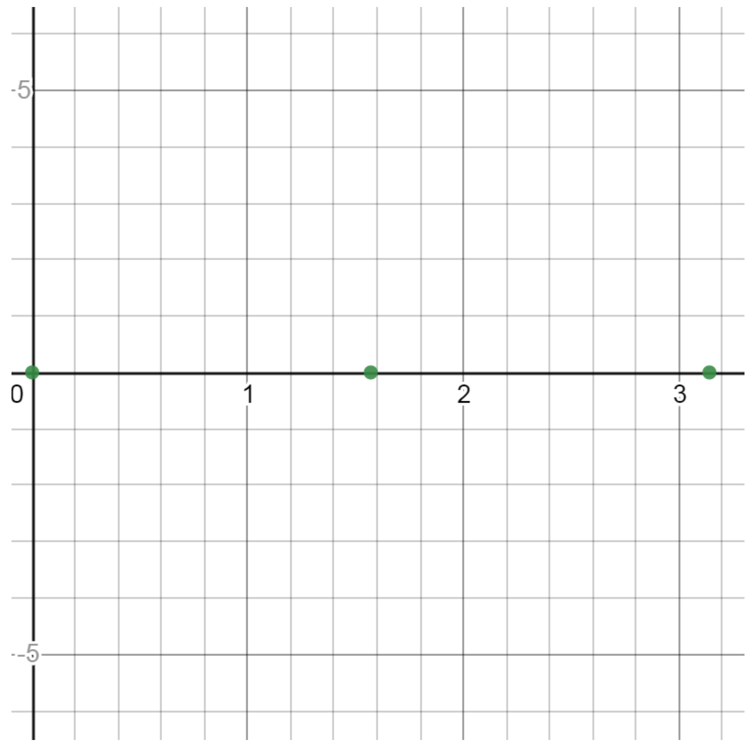
$$period = \frac{\pi}{2}$$

Remember that our basic tangent function has an x-intercept at the origin.

So the next x-intercept will happen at $\theta = \frac{\pi}{2}$

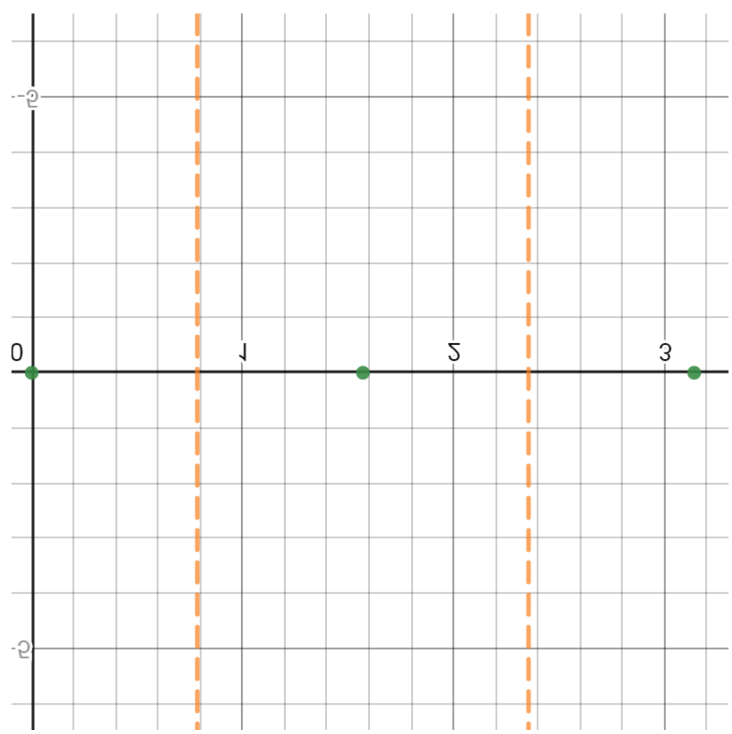
And the one after that will happen at $\theta = \pi$

Now let's scale our graph to include those points!



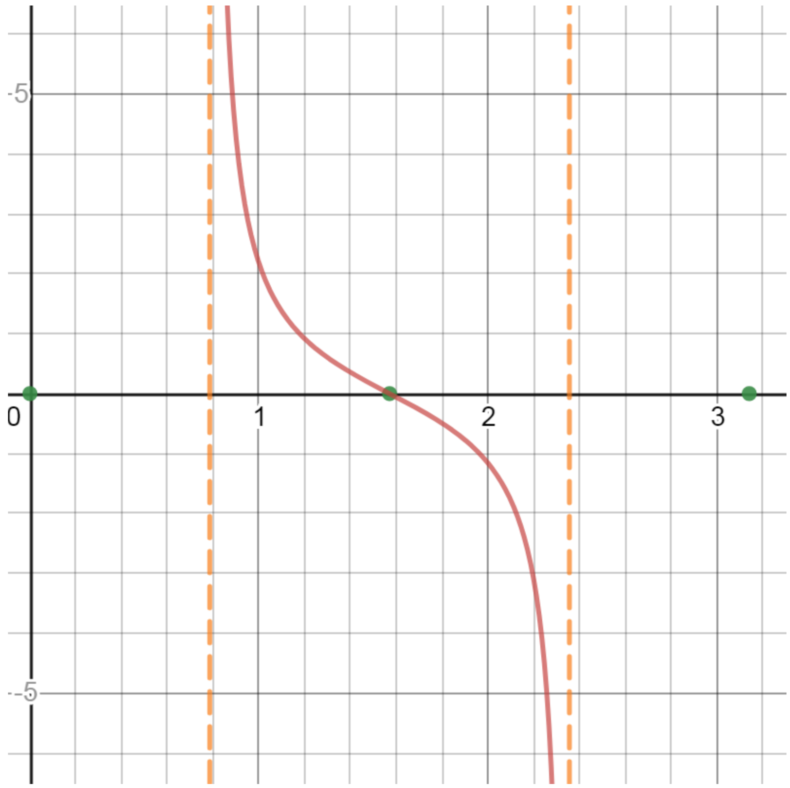
Next, we remember that the tangent function has vertical asymptotes . . .

. . . directly between the x-intercepts:



And finally, let's apply the vertical reflection to the area of the graph between the asymptotes. Remember, the vertically reflected tangent graph

decreases



Note: I only did the middle part because I wanted to make sure I got it right!

Now I will add the other parts of the graph:

$p(\theta) = -\tan(2\theta)$