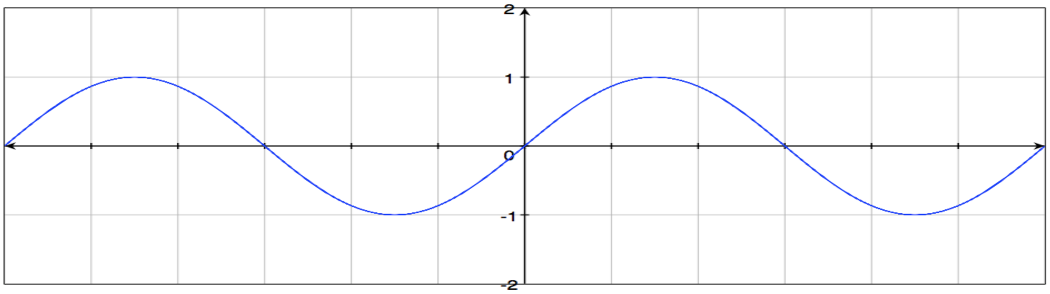
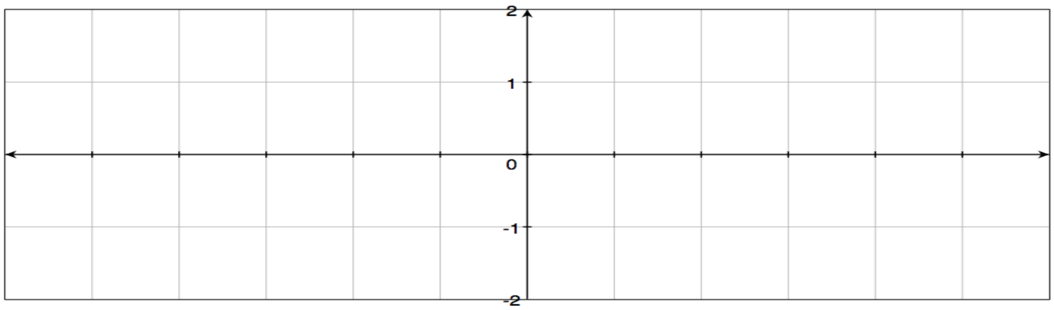
Below is the graph of $f(x)=\sin x$. Sketch the graph of $f\,'$

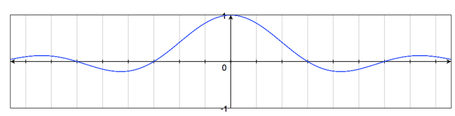




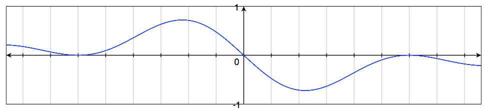
What does the derivative of $f\left(x\right)=\sin x$ look like?

Before proving that $\dfrac{d}{dx}\left(\sin x\right)=\cos x$, let's look at a couple of limits…

1. Use a table of values to show that $\boxed{\lim_{\theta\to 0}\dfrac{\sin\theta}{\theta}=1}$



2. Find $\boxed{\lim_{\theta \to 0} \frac{\cos\theta - 1}{\theta}}$



Note that the graph of $f(\theta) = \frac{\cos\theta - 1}{\theta}$ *has a hole in it at x=0*

So now we know that $\boxed{\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1}$ and $\boxed{\lim_{\theta \to 0} \frac{\cos\theta - 1}{\theta} = 0}$.

3. Use the definition of a derivative to prove that $\frac{d(\sin x)}{dx} = \cos x$

Recall that $\sin(x + y) = \sin x \cos y + \cos x \sin y$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$f'(x) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

Derivatives of Trigonometric Functions

$\frac{d}{dx}(\sin x) = \cos x$	$\frac{d}{dx}(\csc x) = -\csc x \cot x$
$\frac{d}{dx}(\cos x) = -\sin x$	$\frac{d}{dx}(\sec x) = \sec x \tan x$
$\frac{d}{dx}(\tan x) = \sec^2 x$	$\frac{d}{dx}(\cot x) = -\csc^2 x$

4. Use the quotient rule to show that $\frac{d}{dx}(\sec x) = \sec x \tan x$.

$\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$

5. Differentiate: $f(x) = \sqrt{x}\sin x$ $(fg)' = fg' + f'g$

6. Find an equation of the tangent line to the curve $y = e^x \cos x$ at the point $(0, 1)$.

7. Differentiate: $y = \dfrac{1 - \sec\theta}{\tan\theta}$

8. If $y = \csc x - x$ find f' and f''.

9. Find the x-values on the curve $y = \dfrac{\cos x}{2 + \sin x}$ at which the tangent line is horizontal.