Derivatives of Trigonometric Functions Date:

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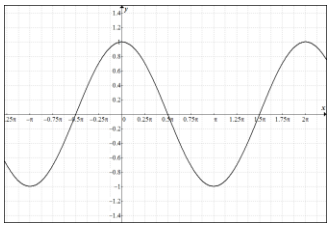
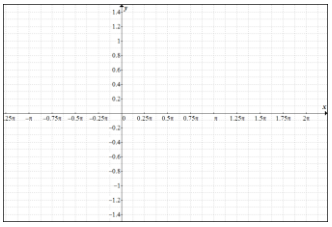
$$\frac{d(\sin x)}{dx} = \cos x \qquad \frac{d(\tan x)}{dx} = \sec^2 x \qquad \frac{d(\sec x)}{dx} = \sec x \tan x$$

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

Example 1: Derivative of *cos x* using the first principle of derivative

Verify $\frac{d(\cos x)}{dx} = -\sin x$ using the first principle of derivatives.





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

For $f(x) = \cos x$

Example 2: Derivative of Sine and Cosine functions

Differentiate

a) $y = \sin 4x$ b) $y = \cos(5x^2 + 6)$ c) $f(x) = \sin^2(4x - 3\pi)$

Example 3: Derivative of Sine and Cosine functions using the derivative rules

Differentiate

a) $y = \cos(\sin 3x)$ b) $y = 3x^2 \cos 4x$ c) $y = \frac{\sin 2x}{\cos 3x}$

Example 4: Derivative of Sine and Cosine functions using the derivative rules

Find $\frac{dy}{dx}$ if $f(x)=\cos^2(\cos x)+\sin^2(\cos x)$

Try: $f(x)=\cos^2(\cos x)+3\sin^2(\cos x)$
Hint:

Example 5: Equation of tangent line

Find the equation of the tangent line to $y=\frac{\sin x}{\cos 2x}$ at the point where $x=\frac{\pi}{6}$.

Example 6: Deriving the derivative of *tan x* and *csc x*

a) Verify $\frac{d(\tan x)}{dx}=\sec^2 x$.

b) Verify $\frac{d(\csc x)}{dx}=-\csc x\cot x$.

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Example 7: Derivative of trigonometric functions

Differentiate

a) $f(x) = \tan(4x^2 - 3x)$

b) $f(x) = \dfrac{2\sin(3x-1)}{\cos(3x-1)}$

c) $y = (\cos x - \tan x)^3$

Example 8: Derivative of other trigonometric functions

Differentiate

a) $y = 2\csc^3(3x^2)$

b) $f(x) = \sec^2(\cot x)$

c) $y = \dfrac{x^2 \tan x}{\sec x}$

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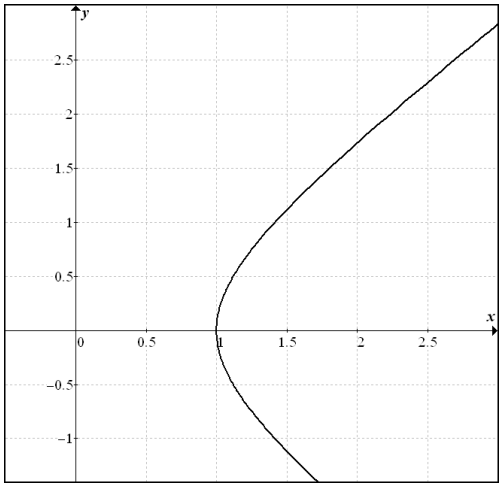
Example 9: Differentiating with a Parameter

Find the line tangent to the right-hand hyperbola branch defined parametrically by $x = \sec t, y = \tan t, \frac{-\pi}{2} < t < \frac{\pi}{2}$ at the point $\left(\sqrt{2}, 1\right)$ where $t = \frac{\pi}{4}$



Example 10: Applications of Derivative of Trigonometric functions

Find the slope of the tangent line to $y = \tan(\csc x)$ when $\sin x = \frac{1}{\pi}, x$ in the interval $\left(0, \frac{\pi}{2}\right)$.

Homework:
P. 146 #1-36, 42,43
P. 153 #1-32
Cal & Vectors (Optional)
P. 256 #1 - 5, 14
P. 260 #1 - 5, 8, 10, 11