

## 3.5 Derivatives of Trigonometric Functions

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### Trigonometric Derivatives

$$D_x \sin x = \cos x$$

$$D_x \cos x = -\sin x$$

$$D_x \tan x = \sec^2 x$$

$$D_x \cot x = -\csc^2 x$$

$$D_x \sec x = \sec x \tan x$$

$$D_x \csc x = -\csc x \cot x$$

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### Jerk

If a body's position at time  $t$  is  $s(t)$ , the body's jerk at time  $t$  is  $j(t) = \frac{da}{dt} = \frac{d^3 s}{dt^3}$

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For problems 1–4, find the derivative.

1.  $f(x) = 5x \csc x$

2.  $f(x) = \frac{1 - \cos x}{1 + \cos x}$

3.  $f(x) = \sec x \tan x$

4.  $f(x) = 3x^2 \cot x - x^3 \sin x$

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5. Find the equation of the normal line to the graph of  $y = \tan x$  at the point  $\left(\frac{\pi}{4}, 1\right)$ .

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6. Find the equation of the tangent line to the graph of  $y = x + \sin x$  at the point  $\left(\frac{\pi}{2}, \frac{\pi}{2} + 1\right)$ .

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7. For the function  $f(x) = 2\sec x - \tan x$ , find where the tangent line is horizontal on the interval  $\left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$ .

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8. A body is moving in simple harmonic motion with position  $s(t) = 3 + 3\cos t$ , where  $t$  is measured in seconds and  $s$  is measured in meters. Find the body's velocity, speed, acceleration, and jerk at time  $t = \frac{2\pi}{3}$  seconds.

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9. Find  $y''$  if  $y = \cot x$