

2.4 - Derivatives of Trigonometric Functions

2.4a

Derivatives of Trigonometric Functions

$$\frac{d}{dx}(\sin x) = \cos x$$

$$\frac{d}{dx}(\cos x) = -\sin x$$

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

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

$$\frac{d}{dx}(\sec x) = \sec x \tan x$$

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

Exercises:

Differentiate.

$$y = x^2 \sin x$$

$$y = \frac{\sin t}{t + \tan t}$$

2.4b

$$y = x^2 \sin x \tan x$$

Find the equation of the tangent line to the curve at the given point.

$$y = x + \tan x, (\pi, \pi)$$

Find the points on the curve at which the tangent is horizontal.

$$y = \frac{\cos x}{2 + \sin x}$$

2.4c

Trigonometric limits

$$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1 \text{ (with proof)}$$

$$\lim_{x \rightarrow 0} \frac{\cos x - 1}{x} = 0$$

2.4d

Proof:

$$\lim_{x \rightarrow 0} \frac{\cos x - 1}{x} = 0$$

Exercise:

Find the limit.

$$\lim_{x \rightarrow 0} \frac{\sin 3x \sin 5x}{x^2}$$

2.4e

Proofs:

The differentiation formula for the sine function

The differentiation formula for the tangent function