Contents

Derivatives of inverse functions

Derivatives of inverse trigonometric functions

Derivative of inverse sine

- The function $y = \sin^{-1}(x)$.

$$\begin{aligned} x &= \sin(y) \\ \frac{dx}{dx} &= \frac{d\sin(y)}{dy}\frac{dy}{dx} \\ \frac{dy}{dx} &= \frac{1}{\cos y} \\ \frac{dy}{dx} &= \frac{1}{\text{derivative of sine function} y} \end{aligned}$$

General expression for derivative of inverse sine trigonometric functions

The general expression for derivative of inverse sine trigonometric function is

- $$\frac{d\sin^{-1}(x)}{dx} = \frac{1}{\sqrt{1-x^2}}$$

General expression for derivative of any inverse of any function

- A function is taken $f(x)$.
- A function is taken $f(y)$.

Condition for application The condition for application of the general expression in inverse of any function is

- The derivative of function $f(x)$ be equal to $g(x)$.
- $$\frac{d}{dx}f(x) = g(x)$$

General expression for inverse

- The function $y = f^{-1}(x)$ is taken.
- The general expression for inverse of a function y is expressed as
- $$\frac{d}{dx} f^{-1}(x) = \frac{1}{g(y)}$$

Formulae for derivative of standard trigonometric functions

Inverse sine

The expression for derivative of inverse sine is

- $$\frac{d}{dx} \sin^{-1}(x) = \frac{1}{\sqrt{1-x^2}}$$

Inverse cosine

The expression for derivative of inverse sine is

- $$\frac{d}{dx} \cos^{-1}(x) = \frac{-1}{\sqrt{1-x^2}}$$

Inverse tangent

The expression for derivative of inverse tangent is

- $$\frac{d}{dx} \tan^{-1}(x) = \frac{1}{1+x^2}$$

Inverse cotangent

The expression for derivative of inverse cotangent is

- $$\frac{d}{dx} \cot^{-1}(x) = \frac{-1}{1+x^2}$$

Inverse secant

The expression for derivative of inverse secant is

- $$\frac{d}{dx}\sec^{-1}(x) = \frac{1}{x\sqrt{1-x^2}}$$

Inverse cscant

The expression for derivative of inverse cscant is

- $$\frac{d}{dx}\csc^{-1}(x) = \frac{-1}{x\sqrt{1-x^2}}$$

Euler’s number

Expression for euler’s number in terms of $x \to 0$

The expression for euler’s number in terms of $x \to 0$ is

- $$e = \lim_{x \to 0} = (1+x)^{\frac{1}{x}}$$

Expression for euler’s number in terms of $n \to \infty$

The expression for euler’s number in terms of $n \to \infty$ is

- $$e = \lim_{h \to \infty} = (1+\frac{1}{x})^n$$

Expression for euler’s number in terms of binomial expansion

The expression for euler’s number in terms of binomial expansion is

- $$e = 1 + \frac{1}{1!} + \frac{2}{2!} + \frac{1}{3!} + ... + \infty$$

Identities in euler's number

Expression for hyperbolic sine

The expression for hyperbolic sine is

- $$sinh(x) = \frac{e^x - e^{-x}}{2}$$

Expression for hyperbolic cosine

The expression for hyperbolic cosine is

- $$cosh(x) = \frac{e^x + e^{-x}}{2}$$

Expression for hyperbolic tangent

The expression tangent hyperbolic is

- $$tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

Expression for hyperbolic cotangent

The expression for hyperbolic cotangent is

- $$coth(x) = \frac{e^x + e^{-x}}{e^x - e^{-x}}$$

Expression for hyperbolic secant

The expression for hyperbolic secant is

- $$sech(x) = \frac{2}{e^x + e^{-x}}$$

Expression for hyperbolic cscant

The expression for hyperbolic cscant is

- $$csch(x) = \frac{2}{e^x - e^{-x}}$$

General relation of trigonometric identities and hyperbolic identities

- The sign of operators is interchanged.
- The sign of operators is interchanged among trigonometric and hyperbolic identites
- A expression of $a\cos(x) + b\sin(x)$ in hyperbolic functions is reverted to
- $$acosh(x) - bsinh(x)$$

Trigonometric identities

Expression for sine and cosine in terms of their square

The expression for sine and cosine in terms of their square is

- $$\cos^2\theta + \sin^2\theta = 1$$

Expression for tangent in terms of secant

The expression for tangent in terms of secant is

$$1 + \tan^2\theta = \sec^2\theta$$

Expression for cotangent in terms of cscant

The expression for cotangent in terms of cscant is

$$\cot^2\theta + 1 = \csc^2\theta$$

Expression for $\cos 2\theta$ in terms of $\sin$ and $\cos$

The expression for $\cos 2\theta$ in terms of $\sin$ and $\cos$ is

$$\cos 2\theta = \cos^2 - \sin^2$$

Expression for $\sin 2\theta$ in terms of $\sin$ and $\cos$

The expression for $\sin 2\theta$ in terms of $\sin$ and $\cos$ is

$$\sin 2\theta = 2\sin(\theta)\cos(\theta)$$

Expression for $\cos 2\theta$ in terms of $\tan$

The expression for $\cos 2\theta$ in terms of $\tan$ is

$$\cos(2\theta) = \frac{1 - \tan^2\theta}{1 + \tan^2\theta}$$

Expression for $\sin 2\theta$ in terms of $\tan$

The expression for $\sin 2\theta$ in terms of $\tan$ is

$$\sin(2\theta) = \frac{2\tan\theta}{1 + \tan^2\theta}$$

Expression for $\tan 2\theta$ in terms of $\tan$

The expression for $\tan 2\theta$ in terms of $\tan$ is

$$\tan(2\theta) = \frac{2\tan(\theta)}{1 - \tan^2\theta}$$

Hyperbolic identities

Expression for hyperbolic sine and hyperbolic cosine in terms of their square

The expression for hyperbolic sine and hyperbolic cosine in terms of their square is

$$cosh^2(x) - sinh^2(x) = 1$$

Expression for hyperbolic tangent in terms of secant

The expression for hyperbolic tangent in terms of secant is

$$1 - tanh^2 x = sech^2(x)$$

Expression for hyperbolic cotangent in terms of cscant

The expression for hyperbolic cotangent in terms of cscant is

$$coth^2(x) - 1 = csch^2(x)$$

Expression for $cosh(2x)$ in terms of $cosh(x)$ and $sinh(x)$

The expression for $cosh(2x)$ in terms of $cosh$ and $sinh$ is

$$cosh(2x) = cosh^2(x) + sinh^2(x)$$

Expression for $sinh(2x)$ in terms of $cosh(x)$ and $sinh(x)$

The expression for $sinh(2x)$ in terms of $cosh$ and $sinh$ is

$$sinh(2x) = 2sinh(x)cosh(x)$$

Expression for $cosh(2x)$ in terms of $tanh(x)$

The expression for $cosh(2x)$ in terms of $tanh(x)$ is

$$cosh(2x) = \frac{1 + tanh^2 x}{1 - tanh^2 x}$$

Expression for $sinh(2x)$ in term of $tanh(x)$

The expression for $sinh(2x)$ in terms of $tanh(X)$ is

$$sinh(2x) = \frac{2tanh(x)}{1 + tanh^2(x)}$$

Expression for $tanh(2x)$ in terms of $tanh(x)$

The expression for $tanh(2x)$ in terms of $tanh(X)$ is

$$tanh(2x) = \frac{2tanh(x)}{1 + tanh^2(x)}$$

Expression for cosh(x + y) in hyperbolic functions

$$cosh(x + y) = coshxcoshy + sinhxsinhy$$

Expression for sinh(x + y) in hyperbolic functions

$$sinh(x + y) = sinhxcoshy + coshxsinhy$$

Expression for sinh(-x) in hyperbolic functions

$$sinh(-x) = -sinhx$$

Expression for cosh(-x) in hyperbolic functions

$$cosh(-x) = coshx$$