

# TRIGONOMETRY

## Right Triangle Definitions

$$\begin{aligned}\sin \theta &= \frac{\text{opp}}{\text{hyp}} & \cos \theta &= \frac{\text{adj}}{\text{hyp}} \\ \tan \theta &= \frac{\text{opp}}{\text{adj}} & \cot \theta &= \frac{\text{adj}}{\text{opp}} \\ \sec \theta &= \frac{\text{hyp}}{\text{adj}} & \csc \theta &= \frac{\text{hyp}}{\text{opp}}\end{aligned}$$

## Circular Definitions

$$\begin{aligned}\sin \theta &= \frac{y}{r} & \cos \theta &= \frac{x}{r} \\ \tan \theta &= \frac{y}{x} & \cot \theta &= \frac{x}{y} \\ \sec \theta &= \frac{r}{x} & \csc \theta &= \frac{r}{y}\end{aligned}$$

## Other Identities

$$\begin{aligned}\tan x &= \frac{\sin x}{\cos x} & \cot x &= \frac{\cos x}{\sin x} \\ \sec x &= \frac{1}{\cos x} & \csc x &= \frac{1}{\sin x}\end{aligned}$$

## Reduction Formulas

$$\begin{aligned}\sin(-x) &= -\sin(x) & \cos(-x) &= \cos(x) \\ \tan(-x) &= -\tan(x) & \cot(-x) &= -\cot(x) \\ \sec(-x) &= \sec(x) & \csc(-x) &= -\csc(x)\end{aligned}$$

## Sum and Difference Formulas

$$\begin{aligned}\cos(u \pm v) &= \cos u \cdot \cos v \mp \sin u \cdot \sin v \\ \sin(u \pm v) &= \sin u \cdot \cos v \pm \cos u \cdot \sin v \\ \tan(u \pm v) &= \frac{\tan u \pm \tan v}{1 \mp \tan u \cdot \tan v}\end{aligned}$$

## Pythagorean Identities

$$\begin{aligned}\sin^2 \theta + \cos^2 \theta &= 1 \\ 1 + \tan^2 \theta &= \sec^2 \theta \\ 1 + \cot^2 \theta &= \csc^2 \theta\end{aligned}$$

## Double Angle Formulas

$$\begin{aligned}\sin(2u) &= 2 \sin u \cos u \\ \cos(2u) &= \cos^2 u - \sin^2 u \\ \cos(2u) &= 2 \cos^2 u - 1 \\ \cos(2u) &= 1 - 2 \sin^2 u \\ \tan(2u) &= \frac{2 \tan u}{1 - \tan^2 u}\end{aligned}$$

## Power Reducing Formulas

$$\begin{aligned}\sin^2 u &= \frac{1 - \cos(2u)}{2} \\ \cos^2 u &= \frac{1 + \cos(2u)}{2} \\ \tan^2 u &= \frac{1 - \cos(2u)}{1 + \cos(2u)}\end{aligned}$$

## Cofunction Identities

$$\begin{aligned}\sin\left(\frac{\pi}{2} - x\right) &= \cos x & \cos\left(\frac{\pi}{2} - x\right) &= \sin x \\ \tan\left(\frac{\pi}{2} - x\right) &= \cot x & \cot\left(\frac{\pi}{2} - x\right) &= \tan x \\ \sec\left(\frac{\pi}{2} - x\right) &= \csc x & \csc\left(\frac{\pi}{2} - x\right) &= \sec x\end{aligned}$$

## Product to Sum Formulas

$$\begin{aligned}\sin u \sin v &= 0.5[\cos(u - v) - \cos(u + v)] \\ \cos u \cos v &= 0.5[\cos(u - v) + \cos(u + v)] \\ \sin u \cos v &= 0.5[\sin(u + v) + \sin(u - v)] \\ \cos u \sin v &= 0.5[\sin(u + v) - \sin(u - v)]\end{aligned}$$

## Special Angles

$$\begin{array}{lllll}\cos 0 = 1 & \cos \frac{\pi}{6} = \frac{\sqrt{3}}{2} & \cos \frac{\pi}{4} = \frac{\sqrt{2}}{2} & \cos \frac{\pi}{3} = \frac{1}{2} & \cos \frac{\pi}{2} = 0 \\ \sin 0 = 0 & \sin \frac{\pi}{6} = \frac{1}{2} & \sin \frac{\pi}{4} = \frac{\sqrt{2}}{2} & \sin \frac{\pi}{3} = \frac{\sqrt{3}}{2} & \sin \frac{\pi}{2} = 1\end{array}$$

## Derivative Rules

$$\begin{aligned}\frac{d}{dx} \sin x &= \cos x & \frac{d}{dx} \cos x &= -\sin x \\ \frac{d}{dx} \tan x &= \sec^2 x & \frac{d}{dx} \cot x &= -\csc^2 x \\ \frac{d}{dx} \sec x &= \sec x \tan x & \frac{d}{dx} \csc x &= -\csc x \cot x\end{aligned}$$

$$\begin{aligned}\frac{d}{dx} \arcsin x &= \frac{1}{\sqrt{1-x^2}} \\ \frac{d}{dx} \arctan x &= \frac{1}{x^2+1} \\ \frac{d}{dx} \operatorname{arcsec} x &= \frac{1}{x\sqrt{x^2-1}}\end{aligned}$$

$$\begin{aligned}\frac{d}{dx} \ln x &= \frac{1}{x} & \frac{d}{dx} a^x &= \ln a \cdot a^x \\ \frac{d}{dx} \cosh x &= \sinh x & \frac{d}{dx} x^n &= n \cdot x^{n-1} \\ \frac{d}{dx} \sinh x &= \cosh x & \frac{d}{dx}\end{aligned}$$