

Trigonometric Identities

Basic identities

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

Trig functions in terms of their complements

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

Negative angles of trig functions

$$\begin{aligned}\sin(-t) &= -\sin(t) \\ \cos(-t) &= \cos(t) \\ \tan(-t) &= -\tan(t)\end{aligned}$$

Pythagorean Theorem for trig functions

$$\begin{aligned}\sin^2(t) + \cos^2(t) &= 1 \\ \sec^2(t) &= 1 + \tan^2(t)\end{aligned}$$

Sum and difference formulas for trig functions

$$\begin{aligned}\sin(s + t) &= \sin(s) \cdot \cos(t) + \cos(s) \cdot \sin(t) & \sin(s - t) &= \sin(s) \cdot \cos(t) - \cos(s) \cdot \sin(t) \\ \cos(s + t) &= \cos(s) \cdot \cos(t) - \sin(s) \cdot \sin(t) & \cos(s - t) &= \cos(s) \cdot \cos(t) + \sin(s) \cdot \sin(t) \\ \tan(s + t) &= \frac{\tan(s) + \tan(t)}{1 - \tan(s) \cdot \tan(t)} & \tan(s - t) &= \frac{\tan(s) - \tan(t)}{1 + \tan(s) \cdot \tan(t)}\end{aligned}$$

Double angle formulas

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

Triple angle formulas

$$\begin{aligned}\sin(3t) &= 3 \cdot \sin(t) - 4 \cdot \sin^3(t) \\ \cos(3t) &= 4 \cdot \cos^3(t) - 3 \cdot \cos(t) \\ \tan(3t) &= \frac{3 \tan(t) - \tan^3(t)}{1 - 3 \tan^2(t)}\end{aligned}$$

Half angle formulas

$$\sin\left(\frac{1}{2}t\right) = \pm \sqrt{\frac{1 - \cos(t)}{2}}$$

$$\cos\left(\frac{1}{2}t\right) = \pm \sqrt{\frac{1 + \cos(t)}{2}}$$

$$\tan\left(\frac{1}{2}t\right) = \frac{\sin(t)}{1 + \cos(t)} = \frac{1 - \cos(t)}{\sin(t)}$$

Product sum identities

$$\sin(s) + \sin(t) = 2 \cdot \sin\left(\frac{s+t}{2}\right) \cdot \cos\left(\frac{s-t}{2}\right) \qquad \cos(s) + \cos(t) = 2 \cdot \cos\left(\frac{s+t}{2}\right) \cdot \cos\left(\frac{s-t}{2}\right)$$

$$\sin(s) - \sin(t) = 2 \cdot \sin\left(\frac{s-t}{2}\right) \cdot \cos\left(\frac{s+t}{2}\right) \qquad \cos(s) - \cos(t) = -2 \cdot \sin\left(\frac{s+t}{2}\right) \cdot \sin\left(\frac{s-t}{2}\right)$$

Product identities

$$\sin(s) \cdot \sin(t) = \frac{\cos(s-t) \cdot \cos(s+t)}{2}$$

$$\cos(s) \cdot \cos(t) = \frac{\cos(s+t) \cdot \cos(s-t)}{2}$$

$$\sin(s) \cdot \cos(t) = \frac{\sin(s+t) \cdot \sin(s-t)}{2}$$