Basic Trigonometric Identities

Reciprocals

$$\sin(x) = \frac{1}{\csc(x)} \qquad \csc(x) = \frac{1}{\sin(x)}$$
$$\cos(x) = \frac{1}{\sec(x)} \qquad \sec(x) = \frac{1}{\cos(x)}$$
$$\tan(x) = \frac{1}{\cot(x)} \qquad \cot(x) = \frac{1}{\tan(x)}$$

Pythagorean

$$\sin^2(\mathrm{x}) + \cos^2(\mathrm{x}) = 1 \qquad 1 + \tan^2(\mathrm{x}) = \sec^2(\mathrm{x}) \qquad \cot^2(\mathrm{x}) + 1 = \csc^2(\mathrm{x})$$

Negative Angles

$$\sin(-x) = -\sin(x) \qquad \cos(-x) = \cos(x) \qquad \tan(-x) = -\tan(x)$$

Quotient Identities

$$\tan(x) = \frac{\sin(x)}{\cos(x)} \qquad \cot(x) = \frac{\cos(x)}{\sin(x)}$$

Sum and Difference Formulas

$$\sin(t+u) = \sin(t)\cos(u) + \sin(u)\cos(t) \qquad \sin(t-u) = \sin(t)\cos(u) - \sin(u)\cos(t)$$

$$\cos(t+u) = \cos(\mathrm{t})\cos(\mathrm{u}) - \sin(\mathrm{t})\sin(\mathrm{u}) \qquad \cos(t-u) = \cos(\mathrm{t})\cos(\mathrm{u}) + \sin(\mathrm{t})\sin(\mathrm{u})$$

$$\tan(t+u) = \frac{\tan(t)+\tan(u)}{1-\tan(t)\tan(u)} \qquad \tan(t-u) = \frac{\tan(t)-\tan(u)}{1+\tan(t)\tan(u)}$$

Double Angles

$$\sin(2\mathrm{t}) = 2\sin(\mathrm{t})\cos(\mathrm{t}) \qquad \cos(2\mathrm{t}) = \cos^2(\mathrm{t}) - \sin^2(\mathrm{t}) \qquad \tan(2t) = \frac{2\tan(t)}{1-tan^2(t)}$$

$$= 2\cos^2(\mathrm{t}) - 1$$

$$= 1 - 2\sin^2(\mathrm{t})$$

-over-

Cofunction Identities

$\cos(90° - \theta) = \sin(\theta)$ $\quad \sin(90° - \theta) = \cos(\theta)$ $\quad \tan(90° - \theta) = \cot(\theta)$

$\cot(90° - \theta) = \tan(\theta)$ $\quad \sec(90° - \theta) = \csc(\theta)$ $\quad \csc(90° - \theta) = \sec(\theta)$

Half Angles

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

$= \frac{1-\cos(t)}{\sin(t)}$

$= \frac{sin(t)}{1+cos(t)}$

Product-to-Sum

$\sin(t)\cos(u) = \frac{1}{2}[\sin(t+u) + \sin(t-u)]$ $\quad \cos(t)\cos(u) = \frac{1}{2}[\cos(t+u) + \cos(t-u)]$

$\cos(t)\sin(u) = \frac{1}{2}[\sin(t+u) - \sin(t-u)]$ $\quad \sin(t)\sin(u) = \frac{1}{2}[\cos(t-u) - \cos(t+u)]$

Sum-to-Product

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

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

Law of Sines

$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$

Laws of Cosines

$a^2 = b^2 + c^2 - 2bc\cos(A)$

$b^2 = a^2 + c^2 - 2ac\cos(B)$

$c^2 = a^2 + b^2 - 2ab\cos(C)$