

**Pythagorean identities :**

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

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

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

**Reciprocal identities :**

$$\csc x = \frac{1}{\sin x}$$

$$\sec x = \frac{1}{\cos x}$$

$$\cot x = \frac{1}{\tan x}$$

**Even - odd identities :**

$$\sin(-x) = -\sin x$$

$$\cos(-x) = \cos x$$

$$\tan(-x) = -\tan x$$

**Product to sum formulas :**

$$\sin x \cdot \sin y = \frac{1}{2} [\cos(x - y) - \cos(x + y)]$$

$$\cos x \cdot \cos y = \frac{1}{2} [\cos(x - y) + \cos(x + y)]$$

$$\sin x \cdot \cos y = \frac{1}{2} [\sin(x + y) + \sin(x - y)]$$

$$\cos x \cdot \sin y = \frac{1}{2} [\sin(x + y) - \sin(x - y)]$$

**Sum to product :**

$$\sin x \pm \sin y = 2 \sin\left(\frac{x \pm y}{2}\right) \cos\left(\frac{x \mp y}{2}\right)$$

$$\cos x + \cos y = 2 \cos\left(\frac{x + y}{2}\right) \cos\left(\frac{x - y}{2}\right)$$

$$\cos x - \cos y = -2 \sin\left(\frac{x + y}{2}\right) \sin\left(\frac{x - y}{2}\right)$$

**Double - angle formulas :**

$$\sin 2\theta = 2 \cdot \sin \theta \cos \theta$$

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

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

**Co - function identities :**

$$\cos\left(\frac{\pi}{2} - x\right) = \sin x$$

$$\sin\left(\frac{\pi}{2} - x\right) = \cos x$$

$$\tan\left(\frac{\pi}{2} - x\right) = \cot x$$

$$\cot\left(\frac{\pi}{2} - x\right) = \tan x$$

$$\csc\left(\frac{\pi}{2} - x\right) = \sec x$$

$$\sec\left(\frac{\pi}{2} - x\right) = \csc x$$

**Periodicity identities :**

$$\sin(x \pm 2\pi) = \sin x$$

$$\cos(x \pm 2\pi) = \cos x$$

$$\tan(x \pm \pi) = \tan x$$

$$\cot(x \pm \pi) = \cot x$$

$$\sec(x \pm 2\pi) = \sec x$$

$$\csc(x \pm 2\pi) = \csc x$$

**Sum and difference formulas :**

$$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$$

$$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y$$

$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$$

**Half - angle formulas :**

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

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

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

**Law of sines :**

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

**Law of cosines :**

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

$$A = \cos^{-1}\left(\frac{b^2 + c^2 - a^2}{2bc}\right)$$

**Area of triangle :**

$$\frac{1}{2} ab \sin C$$

$$\sqrt{s(s-a)(s-b)(s-c)},$$

$$\text{where } s = \frac{1}{2}(a + b + c)$$