

**Pythagorean Identities:**

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

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

**Co-function identities:**

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

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

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

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

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

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

**Even/Odd identities:**

$$\sin(-u) = -\sin u$$

$$\tan(-u) = -\tan u$$

$$\sec(-u) = \sec u$$

$$\cos(-u) = \cos u$$

$$\csc(-u) = -\csc u$$

$$\cot(-u) = -\cot u$$

**Sum/Difference Formulas:**

$$\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v \quad \cos(u \pm v) = \cos u \cos v \mp \sin u \sin v \quad \tan(u \pm v) = \frac{\tan u \pm \tan v}{1 \mp \tan u \tan v}$$

**Double Angle formulas:**

$$\sin 2u = 2 \sin u \cos u$$

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

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

$$= 1 - 2 \sin^2 u$$

$$= 2 \cos^2 u - 1$$

**Power Reducing formulas:**

$$\sin^2 u = \frac{1 - \cos 2u}{2}$$

$$\cos^2 u = \frac{1 + \cos 2u}{2}$$

$$\tan^2 u = \frac{1 - \cos 2u}{1 + \cos 2u}$$

**Half Angle Formulas:**

$$\sin \frac{u}{2} = \pm \sqrt{\frac{1 - \cos u}{2}}$$

$$\cos \frac{u}{2} = \pm \sqrt{\frac{1 + \cos u}{2}}$$

$$\tan \frac{u}{2} = \frac{1 - \cos u}{\sin u} = \frac{\sin u}{1 + \cos u}$$

The sign of  $\sin \frac{u}{2}$  and  $\cos \frac{u}{2}$  depends on the quadrant in which  $\frac{u}{2}$  lies.

**Product to Sum formulas:**

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

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

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

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

**Sum to Product formulas:**

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

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

$$\cos u + \cos v = 2 \cos\left(\frac{u+v}{2}\right) \cos\left(\frac{u-v}{2}\right)$$

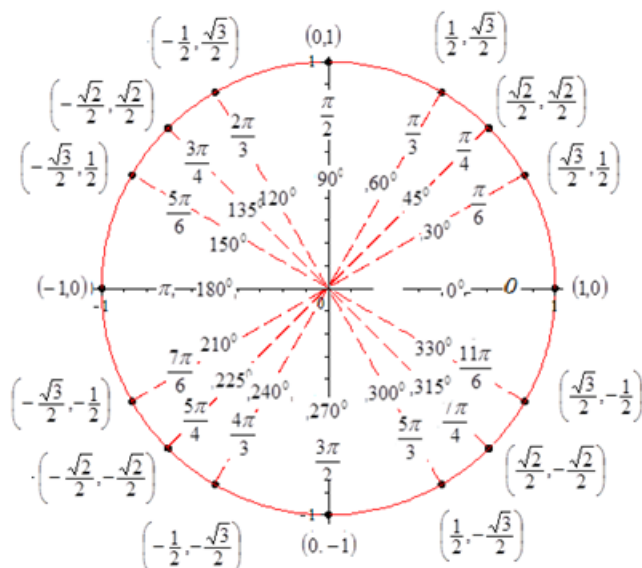
$$\cos u - \cos v = -2 \sin\left(\frac{u+v}{2}\right) \sin\left(\frac{u-v}{2}\right)$$

**Law of Sines:**

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

**Law of Cosines:**

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad b^2 = a^2 + c^2 - 2ac \cdot \cos B \quad c^2 = a^2 + b^2 - 2ab \cdot \cos C$$



Unit Circle