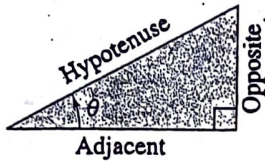


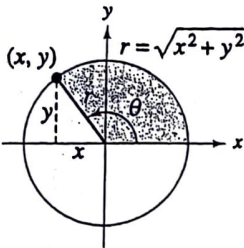
## Definition of the Six Trigonometric Functions

Right triangle definitions, where  $0 < \theta < \pi/2$ .

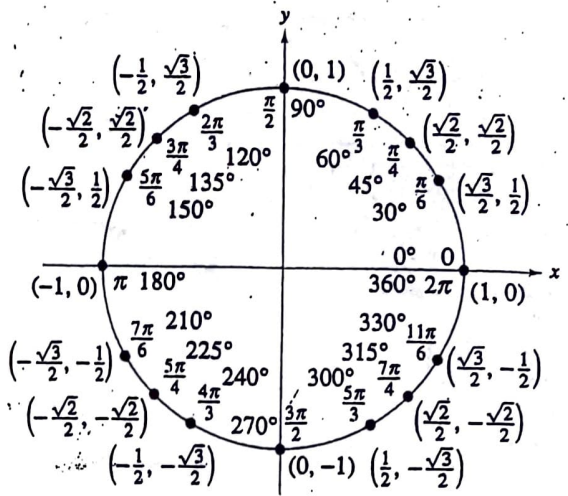


$$\begin{aligned} \sin \theta &= \frac{\text{opp.}}{\text{hyp.}} & \csc \theta &= \frac{\text{hyp.}}{\text{opp.}} \\ \cos \theta &= \frac{\text{adj.}}{\text{hyp.}} & \sec \theta &= \frac{\text{hyp.}}{\text{adj.}} \\ \tan \theta &= \frac{\text{opp.}}{\text{adj.}} & \cot \theta &= \frac{\text{adj.}}{\text{opp.}}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

Circular function definitions, where  $\theta$  is any angle.



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



## Reciprocal Identities

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

## Quotient Identities

$$\tan u = \frac{\sin u}{\cos u} \quad \cot u = \frac{\cos u}{\sin u}$$

## Pythagorean Identities

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

## Cofunction Identities

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

## Negative Identities

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

## Sector Formulas

$$\begin{aligned} s &= r\theta \\ K &= \frac{1}{2}rs \text{ or } K = \frac{1}{2}r^2\theta \end{aligned}$$

$s$  = arc length  
 $r$  = radius  
 $\theta$  = central angle in radians  
 $K$  = area

## Area of a Triangle

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

$$K = \sqrt{s(s-a)(s-b)(s-c)}, \text{ where } s = \frac{a+b+c}{2}$$

## Conversion Formula

$$\frac{\text{radians}}{\pi} = \frac{\text{degrees}}{180^\circ}$$

## Sum and Difference Identities

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

## Double-Angle Identities

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

## Half-Angle Identities

$$\begin{aligned} \sin \frac{u}{2} &= \pm \sqrt{\frac{1 - \cos u}{2}} \\ \cos \frac{u}{2} &= \pm \sqrt{\frac{1 + \cos u}{2}} \\ \tan \frac{u}{2} &= \pm \sqrt{\frac{1 - \cos u}{1 + \cos u}} = \frac{\sin u}{1 + \cos u} = \frac{1 - \cos u}{\sin u} \end{aligned}$$

## Law of Sines

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

## Law of Cosines

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos A \\ b^2 &= a^2 + c^2 - 2ac \cos B \\ c^2 &= a^2 + b^2 - 2ab \cos C \end{aligned} \quad \text{or} \quad \begin{aligned} \cos A &= \frac{b^2 + c^2 - a^2}{2bc} \\ \cos B &= \frac{a^2 + c^2 - b^2}{2ac} \\ \cos C &= \frac{a^2 + b^2 - c^2}{2ab} \end{aligned}$$