Trigonometric Functions and the Unit Circle

Deg	**Rad**	$Sin\theta \frac{Opp}{Hyp}$ $Sin\theta(y)$ $\frac{b}{c}, \frac{y}{r}$	$Cos\theta \frac{Adj}{Hyp}$ $Cos\theta(x)$ $\frac{a}{c}, \frac{x}{r}$	$Tan\theta \frac{Opp}{Adj}$ $Tan\theta = \frac{Sin\theta(y)}{Cos\theta(x)}$ $\frac{b}{a}, \frac{y}{x}$	$Cot\theta \frac{Adj}{Opp}$ $\frac{1}{Tan\theta}$ $\frac{a}{b}, \frac{x}{y}$	$Sec\theta \frac{Hyp}{Adj}$ $\frac{1}{Cos\theta}$ $\frac{c}{a}, \frac{r}{x}$	$Csc\theta \frac{Hyp}{Opp}$ $\frac{1}{Sin\theta}$ $\frac{c}{b}, \frac{r}{y}$	**Quadrant** $r = \sqrt{x^2 + y^2} \neq 0$
0	**0**	**0**	**1**	**0**	**Undefined**	**1**	**Undefined**	**x-y coordinates (1,0)**
30	$\frac{\pi}{6}$ (.542)	$\frac{1}{2}$(.5)	$\frac{\sqrt{3}}{2}$(.866)	$\frac{\sqrt{3}}{3}$(.577)	$\frac{3\sqrt{3}}{3}$	$\frac{2\sqrt{3}}{3}$	2	I - $Sin\theta+, Cos\theta+, Tan\theta+, Cot\theta+, Sec\theta+, Csc\theta+$
45	$\frac{\pi}{4}$ (.785)	$\frac{\sqrt{2}}{2}$(.707)	$\frac{\sqrt{2}}{2}$(.707)	1	1	$\sqrt{2}$	$\sqrt{2}$	I - $Sin\theta+, Cos\theta+, Tan\theta+, Cot\theta+, Sec\theta+, Csc\theta+$
60	$\frac{\pi}{3}$(1.04)	$\frac{\sqrt{3}}{2}$(.866)	$\frac{1}{2}$(.5)	$\sqrt{3}$(1.73)	$\frac{\sqrt{3}}{3}$	2	$\frac{2\sqrt{3}}{3}$	I - $Sin\theta+, Cos\theta+, Tan\theta+, Cot\theta+, Sec\theta+, Csc\theta+$
90	$\frac{\pi}{2}$(1.57)	**1**	**0**	**Undefined**	**0**	**Undefined**	**1**	**x-y coordinates (0,1)**
120	$\frac{2\pi}{3}$(2.1)	$\frac{\sqrt{3}}{2}$(.866)	$-\frac{1}{2}$(-.5)	$-\sqrt{3}$(-1.73)	$-\frac{\sqrt{3}}{3}$	-2	$\frac{2\sqrt{3}}{3}$	II - $Sin\theta+, Cos\theta-, Tan\theta-, Cot\theta-, Sec\theta-, Csc\theta+$
135	$\frac{3\pi}{4}$(2.35)	$\frac{\sqrt{2}}{2}$(.707)	$-\frac{\sqrt{2}}{2}$	-1	-1	$-\sqrt{2}$	$\sqrt{2}$	II - $Sin\theta+, Cos\theta-, Tan\theta-, Cot\theta-, Sec\theta-, Csc\theta+$
150	$\frac{5\pi}{6}$(2.61)	$\frac{1}{2}$(.5)	$-\frac{\sqrt{3}}{2}$	$-\sqrt{3}$(-1.73)	$-\sqrt{3}$	$-\frac{2\sqrt{3}}{3}$	2	II - $Sin\theta+, Cos\theta-, Tan\theta-, Cot\theta-, Sec\theta-, Csc\theta+$
180	π (3.14)	**0**	**-1**	**0**	**Undefined**	**-1**	**Undefined**	**x-y coordinates (-1,0)**

210	$\frac{7\pi}{6}$ (3.66)	$-\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$	$\sqrt{3}$	$-\frac{2\sqrt{3}}{3}$	-2	III - $Sin\theta-, Cos\theta-, Tan\theta+, Cot\theta+, Sec\theta-, Csc\theta-$
225	$\frac{5\pi}{4}$ (3.92)	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$	1	1	$-\sqrt{2}$	$-\sqrt{2}$	III - $Sin\theta-, Cos\theta-, Tan\theta+, Cot\theta+, Sec\theta-, Csc\theta-$
240	$\frac{4\pi}{3}$ (4.18)	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$\sqrt{3}$	$\frac{\sqrt{3}}{3}$	-2	$-\frac{2\sqrt{3}}{3}$	III - $Sin\theta-, Cos\theta-, Tan\theta+, Cot\theta+, Sec\theta-, Csc\theta-$
270	$\frac{3\pi}{2}$ (4.71)	**-1**	**0**	**Undefined**	**0**	**Undefined**	**-1**	**x-y coordinates (0,-1)**
300	$\frac{5\pi}{3}$ (5.23)	$-\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$-\frac{\sqrt{3}}{3}$	$-\sqrt{3}$	2	$-\frac{2\sqrt{3}}{3}$	IV - $Sin\theta-, Cos\theta+, Tan\theta-, Cot\theta-, Sec\theta+, Csc\theta-$
315	$\frac{7\pi}{4}$ (5.49)	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	-1	-1	$\sqrt{2}$	$-\sqrt{2}$	IV - $Sin\theta-, Cos\theta+, Tan\theta-, Cot\theta-, Sec\theta+, Csc\theta-$
330	$\frac{11\pi}{6}$ (5.75)	$-\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{3}}{3}$	$-\sqrt{3}$	$\frac{2\sqrt{3}}{3}$	-2	IV - $Sin\theta-, Cos\theta+, Tan\theta-, Cot\theta-, Sec\theta+, Csc\theta-$
360	2π (6.28)	**0**	**1**	**0**	**Undefined**	**1**	**Undefined**	**x-y coordinates (1,0)**

Commonly Used Formulas

Radian Measure

The radian measure of a central angle subtending an arc length *s* in a circle of radius *r* is $\theta = s / r$. Radian and degree measure are related as follows, where θ_d is the measure of the angle in degrees and θ_r is the measure of the angle in radians.

$$\frac{\theta_d}{180^\circ} = \frac{\theta_r}{\pi}$$

Radians to degrees

$$\theta_d = \frac{\theta_r 180}{\pi}$$

Degrees to radians

$$\theta_r = \frac{\pi \theta_d}{180}$$

1 radian = $\frac{180^\circ}{\pi} = 57^\circ 17' 45''$

1 degree = $\frac{\pi}{180^\circ} = .01745$ radians

Arc length (*s*)

Radian Measure	Degree Measure
$s = r\theta$	$s = \frac{\pi}{180} r\theta$

Proportion relating central angles and arcs

$\frac{\theta}{360^\circ} = \frac{s}{C}$, where *s* is equal to the arc length and *C* is the circumference ($C = 2\pi r$)

Linear velocity (**V**) – arc length per unit time

$$V = \frac{s}{t}$$

Where s is arc length and t is time

Linear velocity is equal to the radius times the angular velocity ω

$$V = r\omega$$

Angular velocity – central angle swept out in radians per unit time

$$\omega = \frac{\theta}{t}$$

Area of a Sector

Radian Measure

$$A = \frac{1}{2} r^2 \theta$$

Degree Measure

$$A = \frac{\pi}{360} r^2 \theta$$

Where r is the radius