

Precalc

### 1g Trig Ratios Using Reference Angles

**DEGREES**

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	$\sin \theta$	$\cos \theta$	$\tan \theta$
$0^\circ$	0		0	1	0
$30^\circ$	$\pi/6$		$1/2$	$\sqrt{3}/2$	$1/\sqrt{3}$
$45^\circ$	$\pi/4$		$\sqrt{2}/2$	$\sqrt{2}/2$	1
$60^\circ$	$\pi/3$		$\sqrt{3}/2$	$1/2$	$\sqrt{3}$
$90^\circ$	$\pi/2$		1	0	U

$\sin(135^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\sin(45^\circ)$

Solution:  $\sqrt{2}/2$

$\tan(315^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\tan(45^\circ)$

Solution:  $-1$

$\cos(300^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\cos(60^\circ)$

Solution:  $1/2$

$\sin(240^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\sin(60^\circ)$

Solution:  $-\sqrt{3}/2$

$\cos(330^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\cos(30^\circ)$

Solution:  $\sqrt{3}/2$

$\sin(300^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\sin(60^\circ)$

Solution:  $-\sqrt{3}/2$

$\tan(120^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\tan(60^\circ)$

Solution:  $-\sqrt{3}$

$\cos(225^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\cos(45^\circ)$

Solution:  $-\sqrt{2}/2$

$\sin(315^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\sin(45^\circ)$

Solution:  $-\sqrt{2}/2$

$\cos(120^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\cos(60^\circ)$

Solution:  $-1/2$

$\sin(225^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\sin(45^\circ)$

Solution:  $-\sqrt{2}/2$

$\tan(225^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\tan(45^\circ)$

Solution:  $1$

Precalc

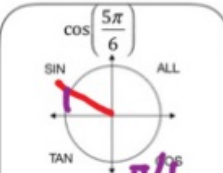
19 Trig Ratios Using Reference Angles

**RADIANS**

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	$\sin \theta$	$\cos \theta$	$\tan \theta$
$0^\circ$	$0$		$0$	$1$	$0$
$30^\circ$	$\pi/6$		$1/2$	$\sqrt{3}/2$	$1/\sqrt{3}$
$45^\circ$	$\pi/4$		$\sqrt{2}/2$	$\sqrt{2}/2$	$1$
$60^\circ$	$\pi/3$		$\sqrt{3}/2$	$1/2$	$\sqrt{3}$
$90^\circ$	$\pi/2$		$1$	$0$	$\text{undefined}$

$\cos\left(\frac{5\pi}{6}\right)$

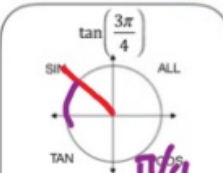


Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $-\sqrt{3}/2$

$\tan\left(\frac{3\pi}{4}\right)$

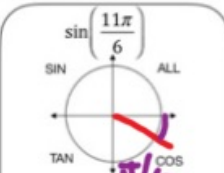


Reference Angle:  $\pi/4$

Rewrite:  $\tan(\pi/4)$

Solution:  $-1$

$\sin\left(\frac{11\pi}{6}\right)$

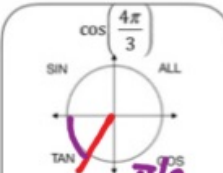


Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $-1/2$

$\cos\left(\frac{4\pi}{3}\right)$

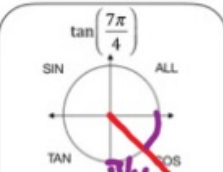


Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $-1/2$

$\tan\left(\frac{7\pi}{4}\right)$

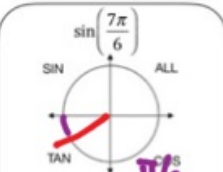


Reference Angle:  $\pi/4$

Rewrite:  $\tan(\pi/4)$

Solution:  $-1$

$\sin\left(\frac{7\pi}{6}\right)$

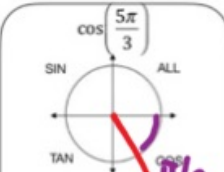


Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $-1/2$

$\cos\left(\frac{5\pi}{3}\right)$

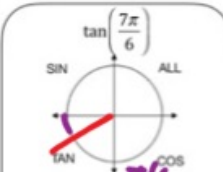


Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $1/2$

$\tan\left(\frac{7\pi}{6}\right)$

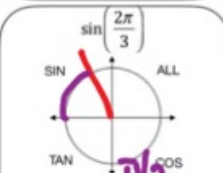


Reference Angle:  $\pi/6$

Rewrite:  $\tan(\pi/6)$

Solution:  $\sqrt{3}/3$

$\sin\left(\frac{2\pi}{3}\right)$

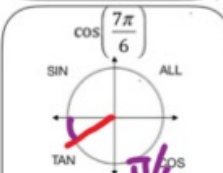


Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $\sqrt{3}/2$

$\cos\left(\frac{7\pi}{6}\right)$

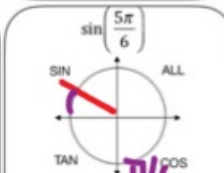


Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $-\sqrt{3}/2$

$\sin\left(\frac{5\pi}{6}\right)$

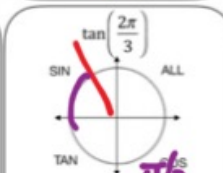


Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $1/2$

$\tan\left(\frac{2\pi}{3}\right)$



Reference Angle:  $\pi/3$

Rewrite:  $\tan(\pi/3)$

Solution:  $\sqrt{3}$

Precalc  
1g Trig Ratios Using Reference Angles

### Negative Degrees and Radians

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	$\sin \theta$	$\cos \theta$	$\tan \theta$
$0^\circ$			0	1	0
$30^\circ$	$\pi/6$		$1/2$	$\sqrt{3}/2$	$\sqrt{3}/3$
$45^\circ$	$\pi/4$		$\sqrt{2}/2$	$\sqrt{2}/2$	1
$60^\circ$	$\pi/3$		$\sqrt{3}/2$	$1/2$	$\sqrt{3}$
$90^\circ$	$\pi/2$		1	0	

$\cos(-45^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\cos(45^\circ)$

Solution:  $\sqrt{2}/2$

$\tan\left(-\frac{3\pi}{4}\right)$

Reference Angle:  $\pi/4$

Rewrite:  $\tan(\pi/4)$

Solution: 1

$\sin(-210^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\sin(30^\circ)$

Solution:  $1/2$

$\cos\left(-\frac{\pi}{3}\right)$

Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $1/2$

$\tan(-300^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\tan(60^\circ)$

Solution:  $\sqrt{3}$

$\sin\left(-\frac{2\pi}{3}\right)$

Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $-\sqrt{3}/2$

$\cos\left(-\frac{\pi}{6}\right)$

Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $\sqrt{3}/2$

$\tan(-150^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\tan(30^\circ)$

Solution:  $\sqrt{3}/3$

$\sin\left(-\frac{4\pi}{3}\right)$

Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $\sqrt{3}/2$

$\cos(-135^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\cos(45^\circ)$

Solution:  $-\sqrt{2}/2$

$\sin\left(-\frac{5\pi}{6}\right)$

Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $-1/2$

$\tan(-120^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\tan(60^\circ)$

Solution:  $-\sqrt{3}$

Trig Ratios Using Reference Angles

**Angles on the Axis**

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

<p><math>\sin\left(\frac{3\pi}{2}\right) \rightarrow y = -1</math></p>	<p><math>\cos(180^\circ) \rightarrow x \rightarrow -1</math></p>	<p><math>\tan(0^\circ) \rightarrow \frac{y}{x} \rightarrow \frac{0}{1} \rightarrow 0</math></p>
<p><math>\sec(270^\circ) \rightarrow \frac{1}{x} \rightarrow \frac{1}{0} \rightarrow U</math></p>	<p><math>\csc(\pi) \rightarrow \frac{1}{y} \rightarrow \frac{1}{0} \rightarrow U</math></p>	<p><math>\cot(-\pi) \rightarrow \frac{x}{y} \rightarrow \frac{1}{0} \rightarrow U</math></p>
<p><math>\sin(90^\circ) \rightarrow y \rightarrow 1</math></p>	<p><math>\cos(-270^\circ) \rightarrow x \rightarrow 0</math></p>	<p><math>\tan\left(-\frac{\pi}{2}\right) \rightarrow \frac{y}{x} \rightarrow \frac{1}{0} \rightarrow U</math></p>



Precalc

# DEGREES reciprocal functions

## 19 Trig Ratios Using Reference Angles

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	csc $\theta$	sec $\theta$	cot $\theta$
$0^\circ$	0		U	1	U
$30^\circ$	$\pi/6$		2	$2\sqrt{3}/3$	$\sqrt{3}$
$45^\circ$	$\pi/4$		$\sqrt{2}$	$\sqrt{2}$	1
$60^\circ$	$\pi/3$		$2\sqrt{3}/3$	2	$\sqrt{3}/3$
$90^\circ$	$\pi/2$		U	U	0

$\text{csc}(135^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\frac{1}{\sin(45^\circ)}$

Solution:  $\frac{1}{\sqrt{2}/2} \rightarrow \sqrt{2}$

$\text{sec}(240^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\frac{1}{\cos(60^\circ)}$

Solution:  $-\frac{1}{1/2} \rightarrow -2$

$\text{cot}(150^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\frac{\cos(30^\circ)}{\sin(30^\circ)}$

Solution:  $-\frac{\sqrt{3}/2}{1/2} \rightarrow -\sqrt{3}$

$\text{sec}(300^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\frac{1}{\cos(60^\circ)}$

Solution:  $\frac{1}{1/2} \rightarrow 2$

$\text{cot}(210^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\frac{\cos(30^\circ)}{\sin(30^\circ)}$

Solution:  $\frac{\sqrt{3}/2}{1/2} \rightarrow \sqrt{3}$

$\text{csc}(210^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\frac{1}{\sin(30^\circ)}$

Solution:  $-\frac{1}{1/2} \rightarrow -2$

$\text{sec}(330^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\frac{1}{\cos(30^\circ)}$

Solution:  $\frac{1}{\sqrt{3}/2} \rightarrow \frac{2\sqrt{3}}{3}$

$\text{cot}(315^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\frac{\cos(45^\circ)}{\sin(45^\circ)}$

Solution:  $-\frac{1}{1} \rightarrow -1$

$\text{csc}(120^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\frac{1}{\sin(60^\circ)}$

Solution:  $\frac{1}{\sqrt{3}/2} \rightarrow \frac{2\sqrt{3}}{3}$

$\text{sec}(225^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\frac{1}{\cos(45^\circ)}$

Solution:  $-\frac{1}{\sqrt{2}/2} \rightarrow -\sqrt{2}$

$\text{cot}(225^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\frac{\cos(45^\circ)}{\sin(45^\circ)}$

Solution:  $1 \rightarrow 1$

$\text{csc}(330^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\frac{1}{\sin(30^\circ)}$

Solution:  $\frac{1}{1/2} \rightarrow 2$

Precalc

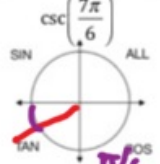
# Radians reciprocal functions

19 Trig Ratios Using Reference Angles

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	$\csc \theta$	$\sec \theta$	$\cot \theta$
$0^\circ$	0		U	1	U
$30^\circ$	$\pi/6$		2	$2\sqrt{3}/3$	$\sqrt{3}$
$45^\circ$	$\pi/4$		$\sqrt{2}$	$\sqrt{2}$	1
$60^\circ$	$\pi/3$		$2\sqrt{3}/3$	2	$\sqrt{3}/3$
$90^\circ$	$\pi/2$		1	U	0

$\csc\left(\frac{7\pi}{6}\right)$

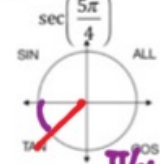


Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $-1/2 \rightarrow -2$

$\sec\left(\frac{5\pi}{4}\right)$

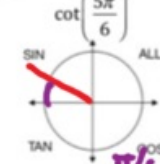


Reference Angle:  $\pi/4$

Rewrite:  $\cos(\pi/4)$

Solution:  $-\frac{\sqrt{2}}{2} \rightarrow -\sqrt{2}$

$\cot\left(\frac{5\pi}{6}\right)$

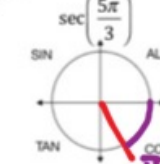


Reference Angle:  $\pi/6$

Rewrite:  $\tan(\pi/6)$

Solution:  $-\frac{\sqrt{3}}{3} \rightarrow -\sqrt{3}$

$\sec\left(\frac{5\pi}{3}\right)$

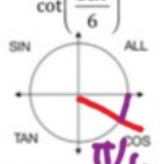


Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $1/2 \rightarrow 2$

$\cot\left(\frac{11\pi}{6}\right)$

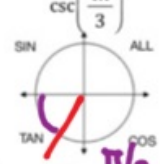


Reference Angle:  $\pi/6$

Rewrite:  $\tan(\pi/6)$

Solution:  $-\frac{\sqrt{3}}{3} \rightarrow -\sqrt{3}$

$\csc\left(\frac{4\pi}{3}\right)$

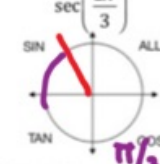


Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $-\frac{\sqrt{3}}{2} \rightarrow -\frac{2\sqrt{3}}{3}$

$\sec\left(\frac{2\pi}{3}\right)$

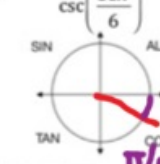


Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $-1/2 \rightarrow -2$

$\csc\left(\frac{11\pi}{6}\right)$

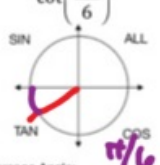


Reference Angle:  $\pi/6$

Rewrite:  $\sin(\pi/6)$

Solution:  $-1/2 \rightarrow -2$

$\cot\left(\frac{7\pi}{6}\right)$

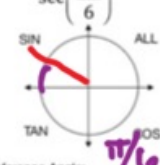


Reference Angle:  $\pi/6$

Rewrite:  $\tan(\pi/6)$

Solution:  $\frac{\sqrt{3}}{3} \rightarrow \sqrt{3}$

$\sec\left(\frac{5\pi}{6}\right)$

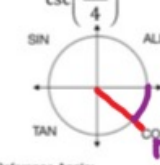


Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $-\frac{\sqrt{3}}{2} \rightarrow -\frac{2\sqrt{3}}{3}$

$\csc\left(\frac{7\pi}{4}\right)$

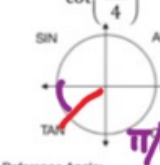


Reference Angle:  $\pi/4$

Rewrite:  $\sin(\pi/4)$

Solution:  $-\frac{\sqrt{2}}{2} \rightarrow -\sqrt{2}$

$\cot\left(\frac{5\pi}{4}\right)$



Reference Angle:  $\pi/4$

Rewrite:  $\tan(\pi/4)$

Solution:  $1 \rightarrow 1$

Precalc  
1g Trig Ratios Using Reference Angles

Negative Degrees and Radians reciprocal functions

$\theta$ (Deg)	$\theta$ (Rad)	Ref Angle	$\csc\theta$	$\sec\theta$	$\cot\theta$
$0^\circ$	0		U	1	U
$30^\circ$	$\pi/6$		2	$2\sqrt{3}/3$	$\sqrt{3}$
$45^\circ$	$\pi/4$		$\sqrt{2}$	$\sqrt{2}$	1
$60^\circ$	$\pi/3$		$2\sqrt{3}/3$	2	$\sqrt{3}/3$
$90^\circ$	$\pi/2$		1	U	0

$\cot(-45^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\tan(45^\circ)$

Solution:  $-1 \rightarrow -1$

$\csc(-\frac{3\pi}{4})$

Reference Angle:  $\pi/4$

Rewrite:  $\sin(\pi/4)$

Solution:  $-\frac{\sqrt{2}}{2} \rightarrow -\sqrt{2}$

$\cot(-210^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\tan(30^\circ)$

Solution:  $-\frac{\sqrt{3}}{3} \rightarrow -\sqrt{3}$

$\sec(-\frac{\pi}{3})$

Reference Angle:  $\pi/3$

Rewrite:  $\cos(\pi/3)$

Solution:  $1/2 \rightarrow 2$

$\sec(-300^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\cos(60^\circ)$

Solution:  $1/2 \rightarrow 2$

$\csc(-\frac{2\pi}{3})$

Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $-\frac{\sqrt{3}}{2} \rightarrow -\frac{2\sqrt{3}}{3}$

$\sec(-\frac{\pi}{6})$

Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $\frac{\sqrt{3}}{2} \rightarrow \frac{2\sqrt{3}}{3}$

$\cot(-150^\circ)$

Reference Angle:  $30^\circ$

Rewrite:  $\tan(30^\circ)$

Solution:  $\frac{\sqrt{3}}{3} \rightarrow \sqrt{3}$

$\csc(-\frac{4\pi}{3})$

Reference Angle:  $\pi/3$

Rewrite:  $\sin(\pi/3)$

Solution:  $\frac{\sqrt{3}}{2} \rightarrow \frac{2\sqrt{3}}{3}$

$\sec(-135^\circ)$

Reference Angle:  $45^\circ$

Rewrite:  $\cos(45^\circ)$

Solution:  $-\frac{\sqrt{2}}{2} \rightarrow -\sqrt{2}$

$\cot(-120^\circ)$

Reference Angle:  $60^\circ$

Rewrite:  $\tan(60^\circ)$

Solution:  $\sqrt{3} \rightarrow \sqrt{3}$

$\sec(-\frac{5\pi}{6})$

Reference Angle:  $\pi/6$

Rewrite:  $\cos(\pi/6)$

Solution:  $-\frac{\sqrt{3}}{2} \rightarrow -\frac{2\sqrt{3}}{3}$

