

## Unit Circle

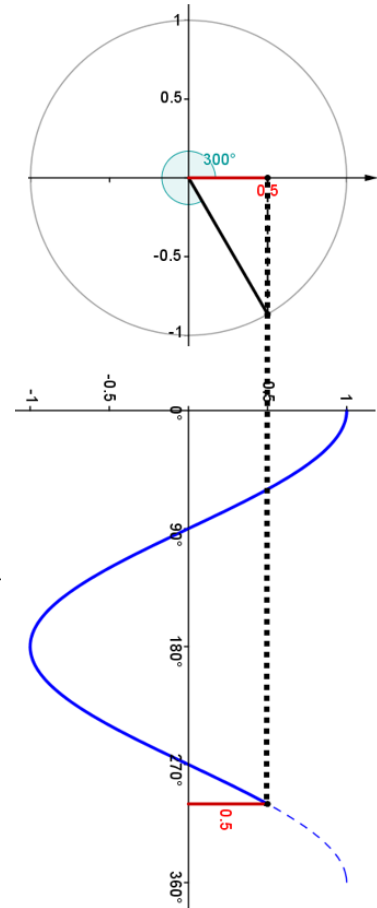
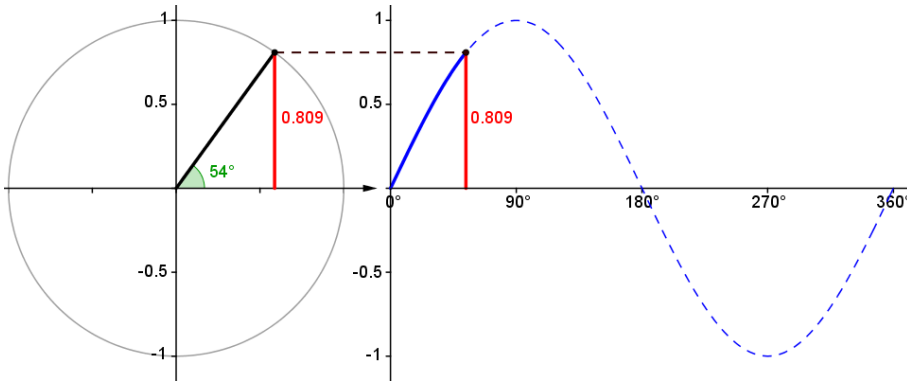
If we consider a unit circle (a circle of radius 1), then

**sine** of an angle is given by the **opposite side**, or the **y coordinate** on the unit circle

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{\text{opposite}}{1}$$

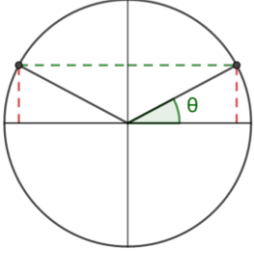
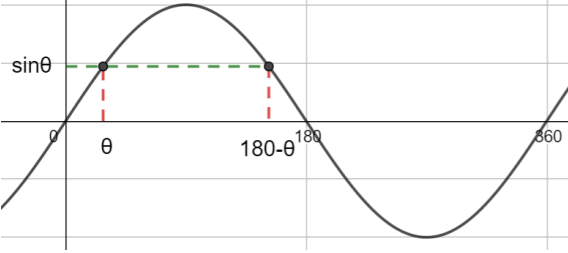
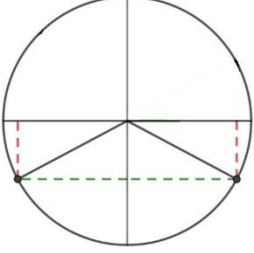
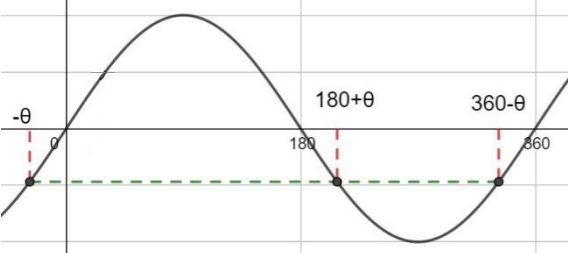
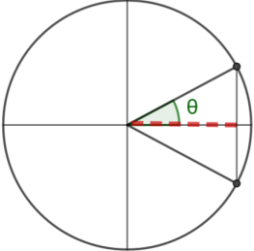
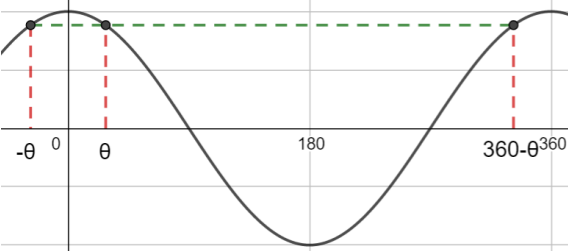
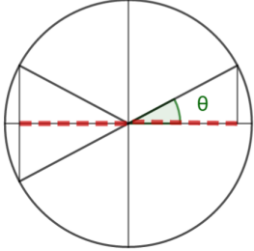
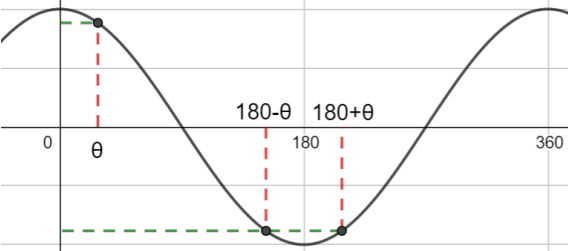
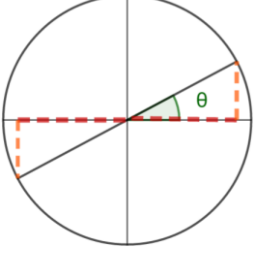
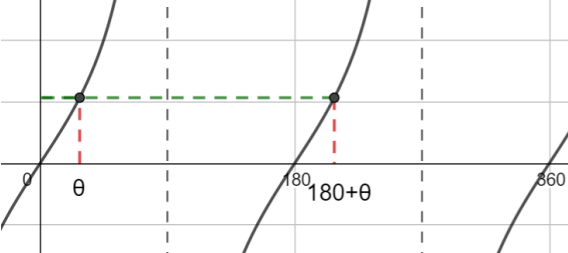
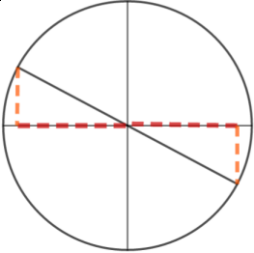
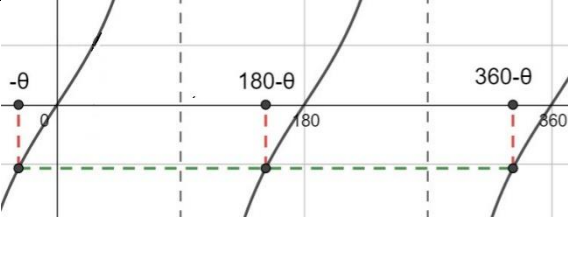
**cosine** of an angle is given by the **adjacent side**, or the **x coordinate** on the unit circle

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{\text{adjacent}}{1}$$



**tangent** of an angle  $\tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{\sin\theta}{\cos\theta}$

There are many properties of the sin, cos and tan functions. However, all of these can be derived and remembered from either the unit circle or the graphs of the functions:

$\sin\theta$ $= \sin(180^\circ - \theta)$		
$\sin(180^\circ + \theta)$ $= \sin(360^\circ - \theta)$ $= \sin(-\theta)$		
$\cos\theta$ $= \cos(360^\circ - \theta)$ $= \cos(-\theta)$		
$\cos(180 - \theta)$ $= \cos(180 + \theta)$ $= -\cos(\theta)$		
$\tan\theta$ $= \tan(180 + \theta)$		
$\tan(180 - \theta)$ $= \tan(360 - \theta)$ $= \tan(-\theta)$		

There are three reciprocal trigonometric functions that you need to know about:

$$\operatorname{cosec}\theta = \frac{1}{\sin\theta} = \frac{\text{hypotenuse}}{\text{opposite}}$$

$$\sec\theta = \frac{1}{\cos\theta} = \frac{\text{hypotenuse}}{\text{adjacent}}$$

$$\cot\theta = \frac{1}{\tan\theta} = \frac{\cos\theta}{\sin\theta} = \frac{\text{adjacent}}{\text{opposite}}$$

There are exact values for certain angles that should be learnt (they are not provided in the formula booklet). Remember that **180° = π radians**

$\theta$ in degrees	0	30	45	60	90
$\theta$ in radians	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
$\sin\theta$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	undefined

The table is easier to remember if you recognise the pattern  $\frac{\sqrt{0}}{2}, \frac{\sqrt{1}}{2}, \frac{\sqrt{2}}{2}, \frac{\sqrt{3}}{2}, \frac{\sqrt{4}}{2}$  in the first two rows