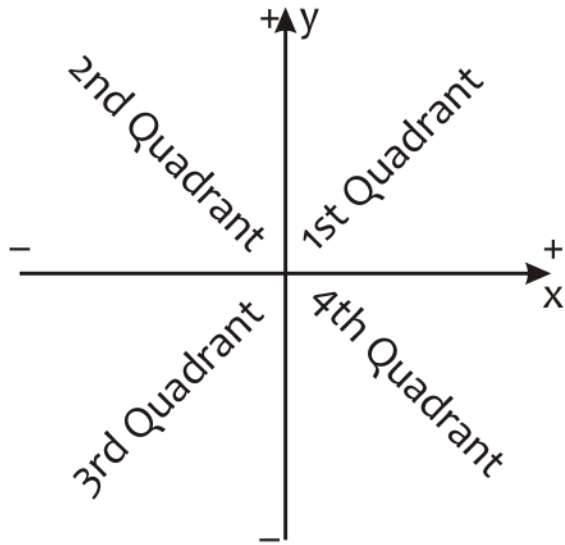
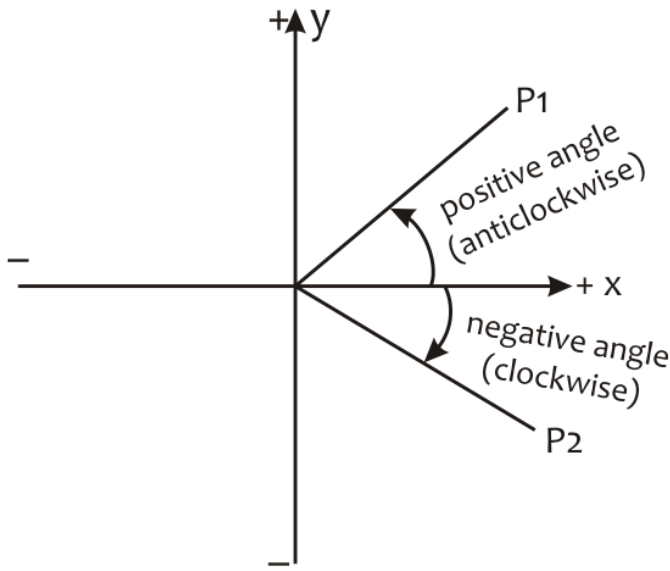
QUADRANTS IN TRIGONOMETRY

The Cartesian axes *x* and *y* divide the plane into 4 quadrants:



For trigonometric purposes, an angle is defined as a measure of the rotation of a line OP about the origin O, starting from the direction of Ox. The angle may be positive or negative depending on

whether the rotation is anticlockwise or clockwise respectively.



Angular Rotation as a Modular Arithmetic

Angular rotation is typical example of modular arithmetic. It operates at modulus 360, thus, $0 = 360 = 720$.

Using modular arithmetic we would understand that $+60^{o}$ is equal -300^{o}; also, that 100^{o}, 460^{o} and -260^{o} are equivalent.

Example:

1. Find the value of -260 in mod 360.

   Solving

$$0 - 260\ (mod\ 360) \rightarrow 360 - 260$$
$$= 100\ (mod\ 360)$$

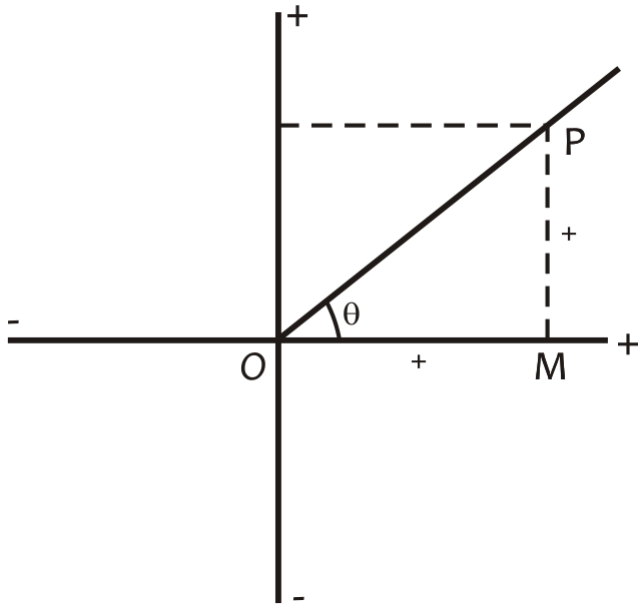
2. Find the value of 460 in mod 360.

   Solving

$$460 - 0\ (mod\ 360) \rightarrow 460 - 360$$
$$= 100\ (mod\ 360)$$

Trigonometric Ratios in the First Quadrant

The first quadrant starts from 0^o to 90^o. It occurs in the *positive y* and *positive x* axes, thus the diagram below:

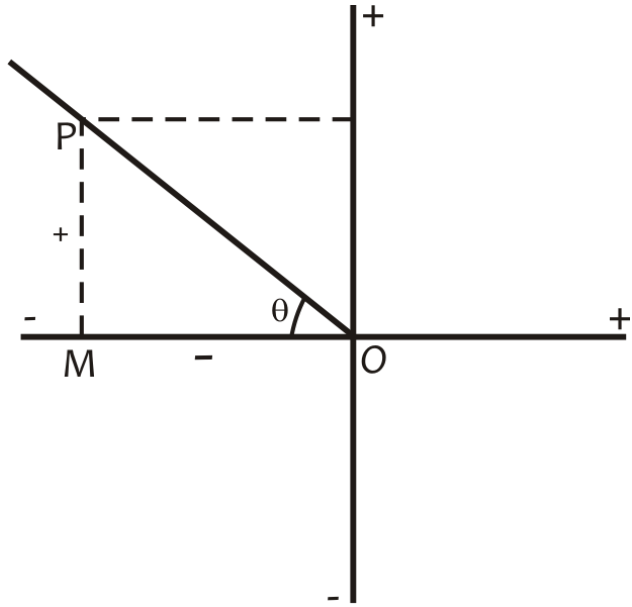


From the diagram,

$$sin\theta = \frac{PM}{PO}; cos\theta = \frac{MO}{PO}; tan\theta = \frac{PM}{OM}$$

Thus, sinϴ, cosϴ and tanϴ are all positive.

Trigonometric Ratios in the Second Quadrant



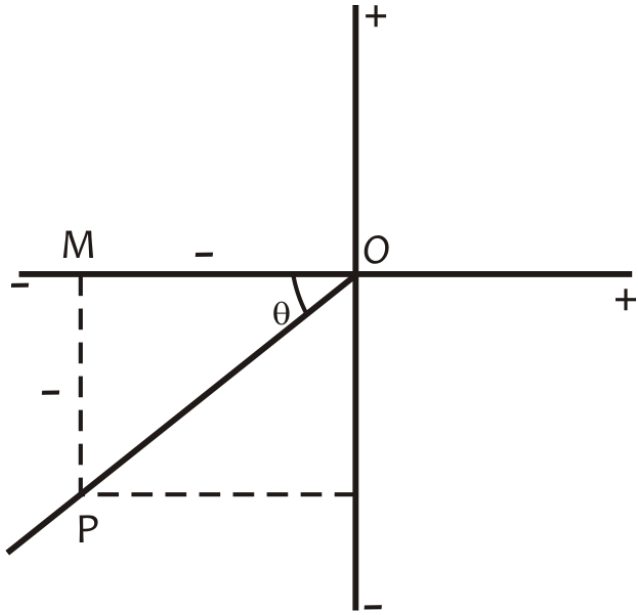
Θ = 180 - Θ (mod 360)

From the diagram above,

$$sin\ \theta = \frac{PM}{PO};\ cos\theta = -\frac{MO}{PO};\ tan\theta = -\frac{PM}{OM}$$

Thus, only sinΘ is positive.

Trigonometric Ratios in the Third Quadrant



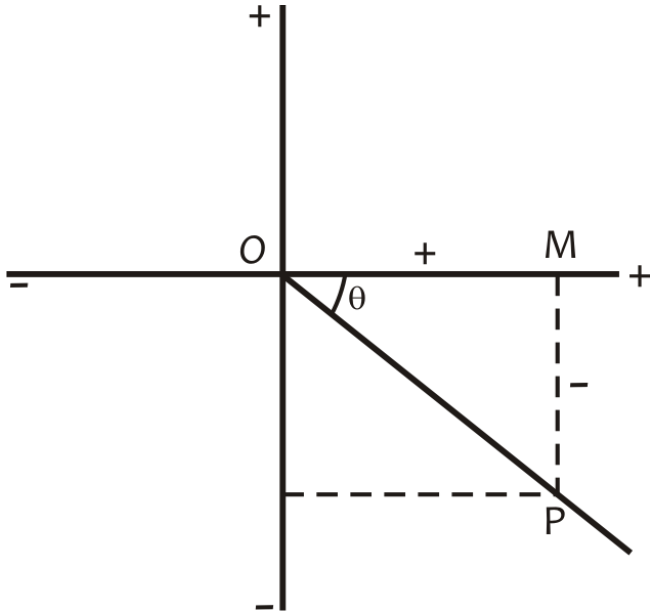
Θ = Θ – 180 (mod 360)

From the diagram above,

$$sin\ \theta = -\frac{PM}{PO};\ cos\theta = -\frac{MO}{PO};\ tan\theta = \frac{PM}{OM}$$

Thus, only tanΘ is positive.

Trigonometric Ratios in the Fourth Quadrant



Θ = 360 - Θ (mod 360)

From the diagram above,

$$sin\ \theta = -\frac{PM}{PO};\ cos\theta = \frac{MO}{PO};\ tan\theta = \frac{PM}{OM}$$

Thus, only cosΘ is positive.

Example: Express the sine, cosine, tangent of

a. 60^o, b. 120^o, c. 240^o, d. 300^o, as either a positive or negative trigonometric ratio of an acute angle.

Solving

a. sin60 = +sin60 first quadrant
cos60 = +cos60 first quadrant
tan60 = +tan60 first quadrant

b. 120 = 180 – 120 = 60
sin60 = +sin60 second quadrant
cos60= -cos60 second quadrant
tan60= -tan60 second quadrant

c. 240 = 240 – 180 = 60
sin60 = -sin60 third quadrant
cos60= -cos60 third quadrant
tan60= +tan60 third quadrant

d. $300 = 360 - 300 = 60$

$\sin 60 = -\sin 60$	fourth quadrant
$\cos 60 = +\cos 60$	fourth quadrant
$\tan 60 = -\tan 60$	fourth quadrant