

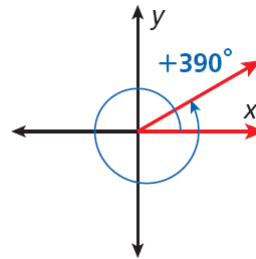
10-2 Angles of Rotation

So far, we have investigated trigonometric functions by using acute angles in right triangles. The trigonometric functions can also be evaluated for other types of angles.

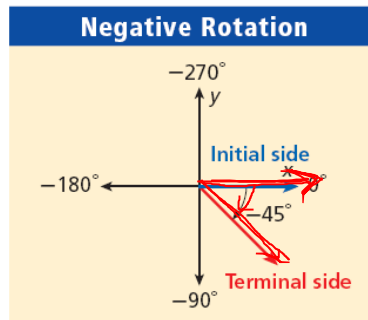
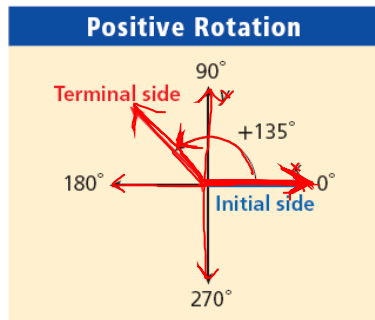
An angle is in **standard position** when its vertex is at the origin and one ray is on the positive x -axis. The **initial side** of the angle is the ray on the x -axis. The other ray is called the **terminal side** of the angle.

10-2 Angles of Rotation

An **angle of rotation** is formed by rotating the terminal side and keeping the initial side in place. If the terminal side is rotated counterclockwise, the angle of rotation is positive. If the terminal side is rotated clockwise, the angle of rotation is negative. The terminal side can be rotated more than 360° .



10-2 Angles of Rotation



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Remember!

A 360° rotation is a complete rotation. A 180° rotation is one-half of a complete rotation.

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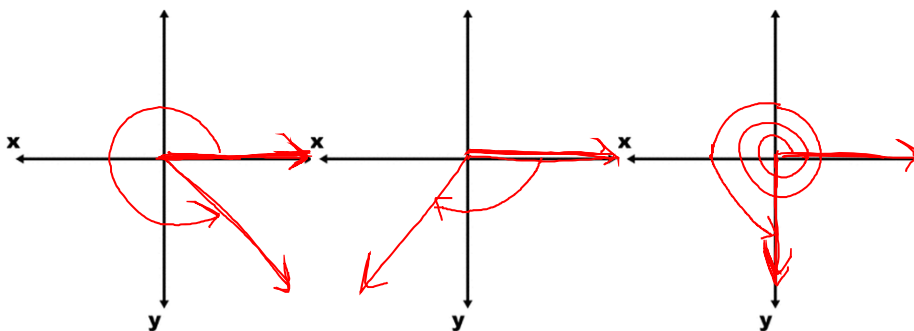
Example 1: Drawing Angles in Standard Position

Draw an angle with the given measure in standard position.

A. 320°

B. -110°

C. 990°

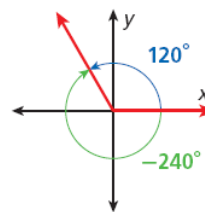


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10-2 Angles of Rotation

Coterminal angles are angles in standard position with the same terminal side. For example, angles measuring 120° and -240° are coterminal.



There are infinitely many coterminal angles. One way to find the measure of an angle that is coterminal with an angle θ is to add or subtract integer multiples of 360° .

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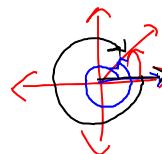
10-2 Angles of Rotation

Example 2: Finding Coterminal Angles

Find the measures of a positive angle and a negative angle that are coterminal with each given angle.

a. $\theta = 65^\circ$

425°
 -295°

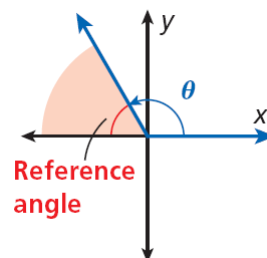


b. $\theta = 410^\circ$ 770° 50° -310°

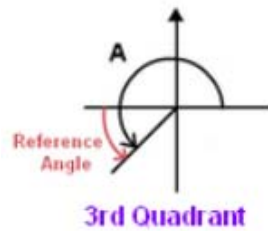
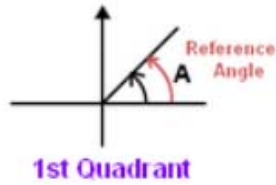
c. $\theta = -88^\circ$ 272°
 -448°

10-2 Angles of Rotation

For an angle θ in standard position, the **reference angle** is the positive acute angle formed by the terminal side of θ and the **x-axis**. We will learn how to use reference angles to find trigonometric values of angles measuring greater than 90° or less than 0° .



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10-2 Angles of Rotation

Example 3: Finding Reference Angles

Find the measure of the reference angle for each given angle.

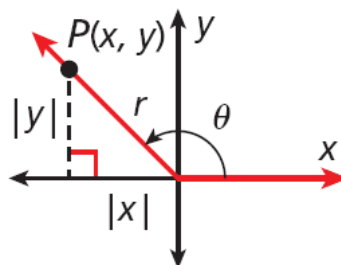
- A. $\theta = 135^\circ$ B. $\theta = -105^\circ$ C. $\theta = 325^\circ$

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10-2 Angles of Rotation

To determine the value of the trigonometric functions for an angle θ in standard position, begin by selecting a point P with coordinates (x, y) on the terminal side of the angle. The distance r from point P to the origin is given by $\sqrt{x^2 + y^2}$.



10-2 Angles of Rotation

Trigonometric Functions

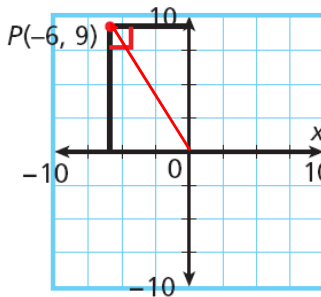
For a point $P(x, y)$ on the terminal side of θ in standard position and $r = \sqrt{x^2 + y^2}$,

SINE	COSINE	TANGENT
$\sin \theta = \frac{y}{r}$	$\cos \theta = \frac{x}{r}$	$\tan \theta = \frac{y}{x}, x \neq 0$

10-2 Angles of Rotation

Example 4: Finding Values of Trigonometric Functions

$P(-6, 9)$ is a point on the terminal side of θ in standard position. Find the exact value of the six trigonometric functions for θ .



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Helpful Hint

Because r is a distance, its value is always positive, regardless of the sign of x and y .

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Check It Out! Example 4

$P(-3, 6)$ is a point on the terminal side of θ in standard position. Find the exact value of the six trigonometric functions for θ .