By the end of the lesson, we will be able to:

- Convert Degrees to Radians
- Convert Radians to Degrees
- Understand and use the terms: Initial Side, Terminal Side, Standard Position, and Coterminal Side

In most real-world applications, angles are measured in degrees. However, in upper-level math classes, angles are measured in **radians**. Radians are usually written in terms of π

Relationships between Radians and Degrees:

$$2\pi \text{ radians} = 360°$$

$$1 \text{ radian} = \frac{180°}{\pi} \approx 57.3° \qquad 1° = \frac{\pi \text{ radians}}{180} \approx 0.017 \text{ radians}$$

To convert between radians and degrees, you multiply by a **conversion factor**:

Convert Radians to Degrees → $\frac{180°}{\pi}$ or $\frac{\pi}{180°}$ ← Convert Degrees to Radians

CAUTION: An angle measure without a degree symbol means radians. If you want degrees, you must use °.

Mult by $\frac{180}{\pi}$

Examples:

A. Convert $\frac{3\pi}{4}$ radians to degrees.

$$\frac{3\pi}{4} \cdot \frac{180}{\pi} = \frac{3(45)}{1} = 135^\circ$$

$45 \times 3 = 135$

B. Convert $\frac{20\pi}{3}$ radians to degrees.

$$\frac{20\pi}{3} \cdot \frac{180}{\pi} = \frac{20(60)}{1} = 1200^\circ$$

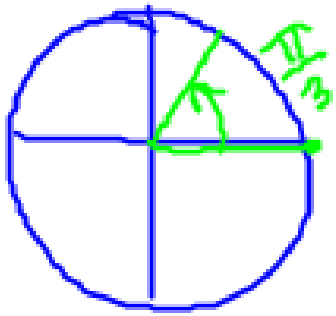
CAUTION: An angle measure without a degree symbol means radians. If you want degrees, you must use °.

Examples:

$* \quad \frac{\pi}{180^\circ}$

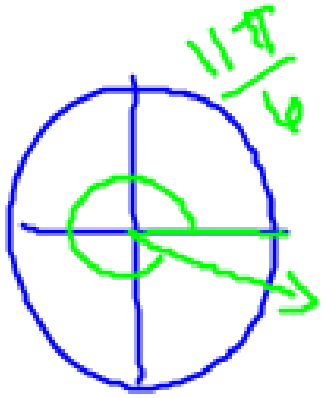
C. Convert 60° to radians.

$$\frac{60}{1} \cdot \frac{\pi}{180} = \frac{\pi}{3}$$



D. Convert 330° to radians.

$$\frac{330}{1} \cdot \frac{\pi}{180} = \frac{11\pi}{6}$$



CAUTION: An angle measure without a degree symbol means radians. If you want degrees, you must use °.

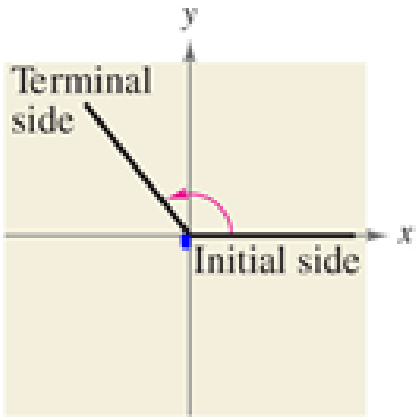
The UNIT CIRCLE is a circle with radius of 1 unit, centered at the origin of a coordinate plane.

~ Angles in STANDARD POSITION on the unit circle have their vertex at the origin.

~ One side of the angle, called the INITIAL SIDE, is on the positive x-axis.

~ The other side, called the TERMINAL SIDE, determines the measure of the angle, and is measured counterclockwise.

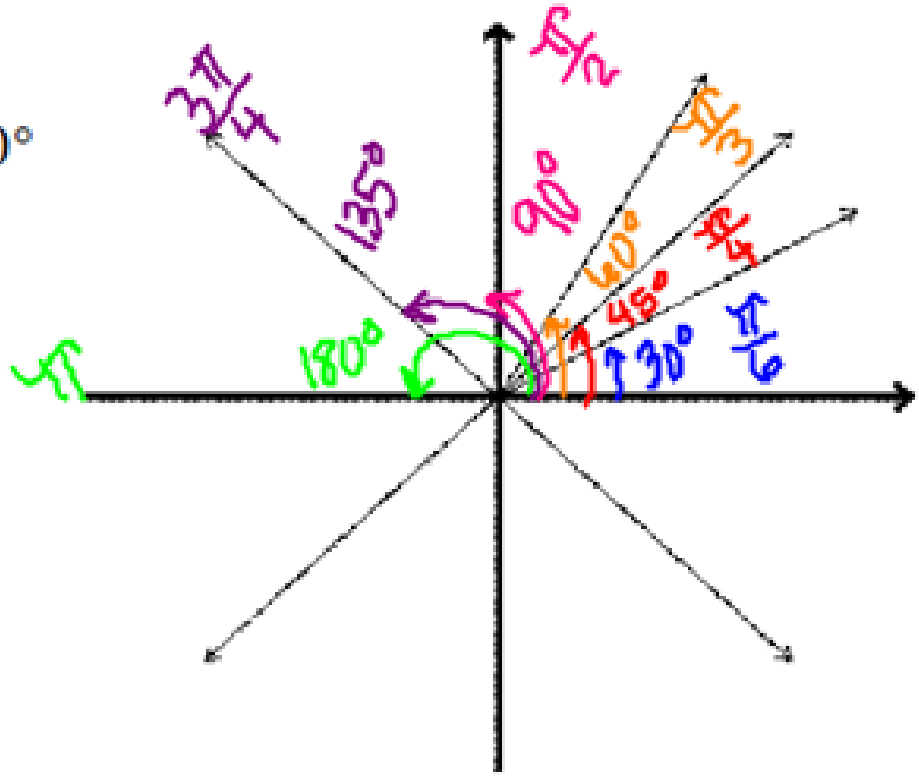
Since there is a starting direction, angles can have any measure, positive or negative. The variable for angles is usually a Greek letter, commonly θ (theta).



Angle in Standard Position

It is helpful to have some benchmark angles on the unit circle to help sketch angles.

$\frac{\pi}{6} = 30°$ $\frac{\pi}{4} = 45°$ $\frac{\pi}{3} = 60°$ $\frac{\pi}{2} = 90°$

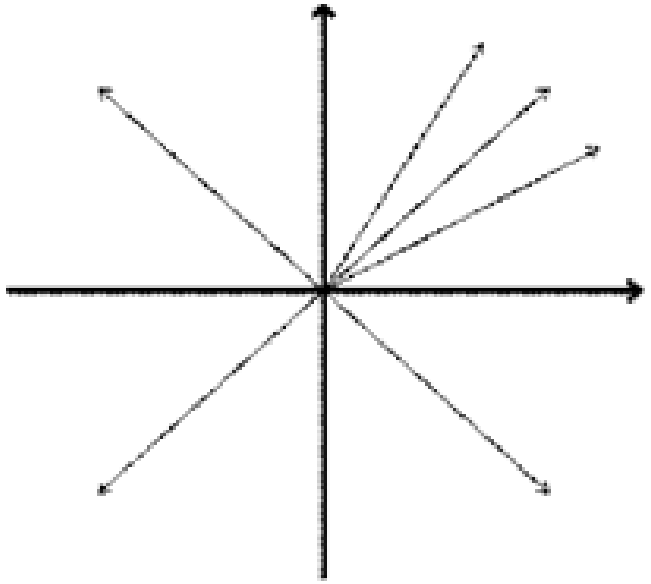


It is helpful to have some benchmark angles on the unit circle to help sketch angles.

$\frac{\pi}{6} = 30°$ $\frac{\pi}{4} = 45°$ $\frac{\pi}{3} = 60°$ $\frac{\pi}{2} = 90°$

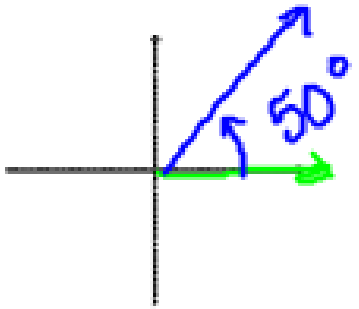
$\frac{3\pi}{4} = 135°$ $\pi = 180°$ $\frac{5\pi}{4} = 225°$

$\frac{3\pi}{2} = 270°$ $\frac{7\pi}{4} = 315°$ $2\pi = 360°$

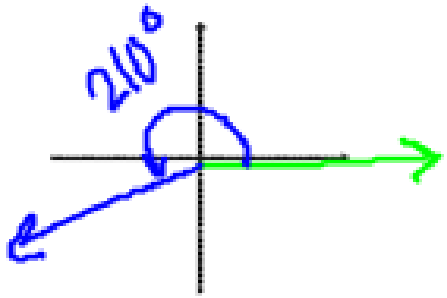


Examples: Sketch each angle in standard position.

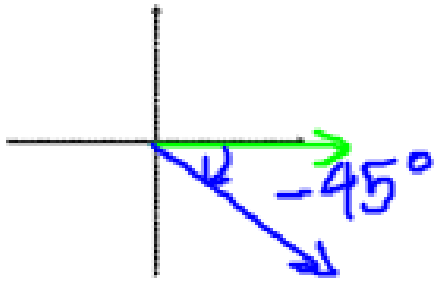
E. 50°



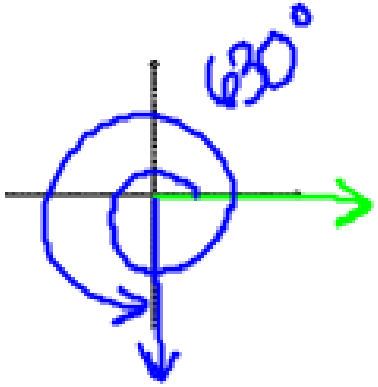
F. 210°



G. −45°



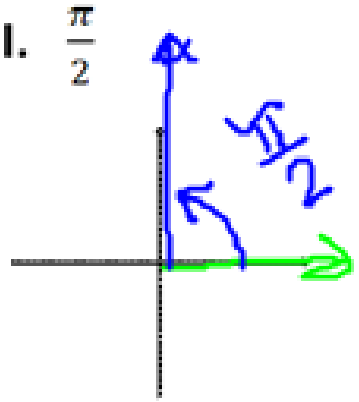
H. 630°



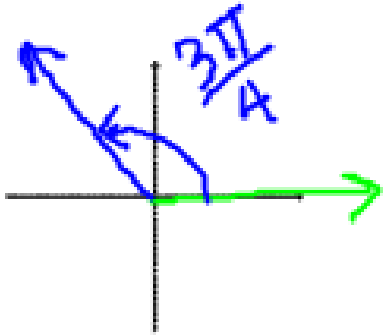
$$\begin{array}{r} 630 \\ -360 \\ \hline 270 \end{array}$$

Examples: Sketch each angle in standard position.

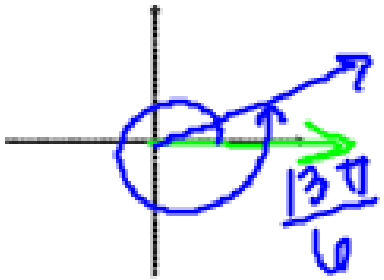
I. $\frac{\pi}{2}$



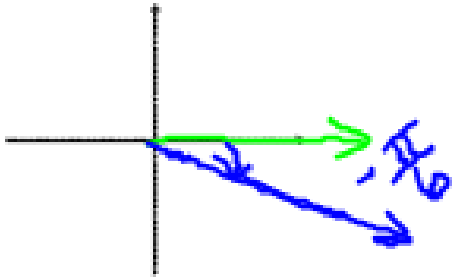
J. $\frac{3\pi}{4}$



K. $\frac{13\pi}{6} = \frac{12\pi}{6} + \frac{\pi}{6} = 2\pi + \frac{\pi}{6}$

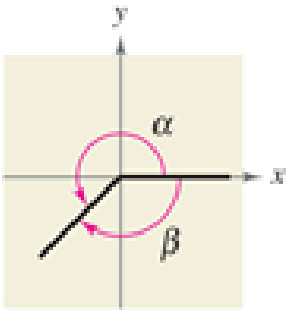


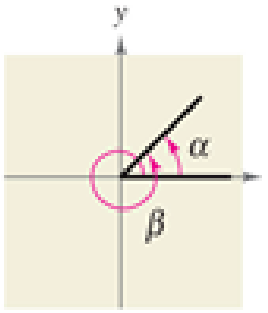
L. $-\frac{\pi}{6}$



Lesson 50: Degrees, Radians, & Coterminal Angles

Angles with the same terminal side are called **coterminal**. Coterminal angles are always 360° or 2π greater than or less than each other (or multiples of 360° and 2π). There are infinitely many coterminal angles for a given angle. Why?





Examples: Find one positive and one negative coterminal angle.

M. 30°

$30° + 360° = \boxed{390°}$

$30° - 360° = \boxed{-330°}$

N. −400°

$-400 + 360 = \boxed{-40°}$

$-400 - 360 = -760°$

$-400 + 360 + 360 =$

$-40 + 360 = \boxed{320°}$

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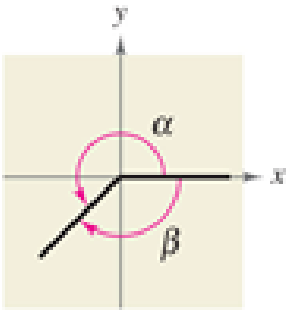

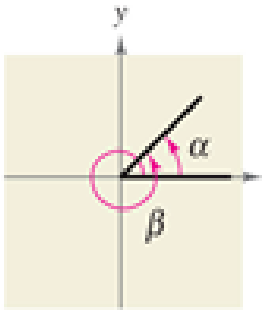

Examples: Find one positive and one negative coterminal angle.

O. $\frac{3\pi}{2}$

$\frac{3\pi}{2} + \frac{2\pi}{1} \cdot \frac{2}{2} = \frac{3\pi}{2} + \frac{4\pi}{2} = \boxed{\frac{7\pi}{2}}$

$\frac{3\pi}{2} - \frac{4\pi}{2} = \boxed{\frac{-\pi}{2}}$

P. $-\pi$

$-\pi - 2\pi = \boxed{-3\pi}$

$-\pi + 2\pi = \boxed{\pi}$

By the end of the lesson, we will be able to:

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- Understand and use the terms: Initial Side, Terminal Side, Standard Position, and Coterminal Side

Can you?

Homework:

Assignment 50

&

Test Review 12