

# RADIAN AND DEGREE MEASURE

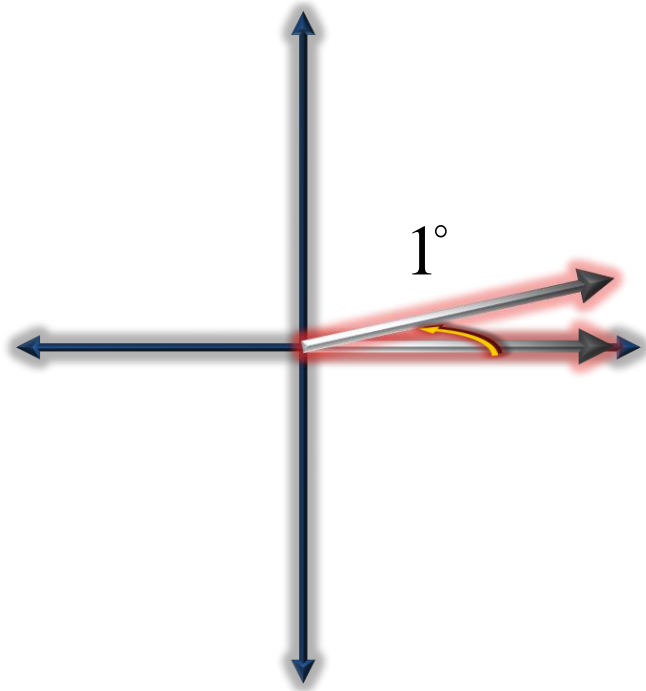
## Section 4.1

Precalculus PreAP/Dual, Revised ©2017

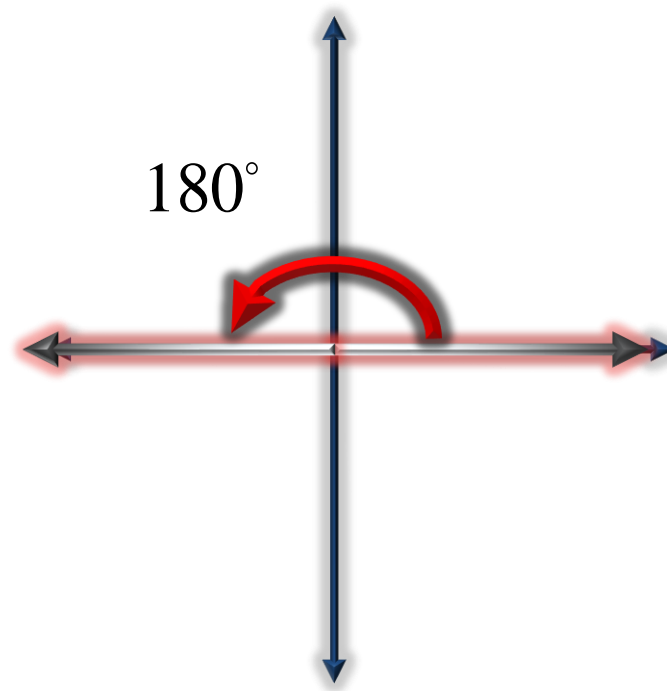
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# WHAT IS A DEGREE AND RADIAN MEASURE?

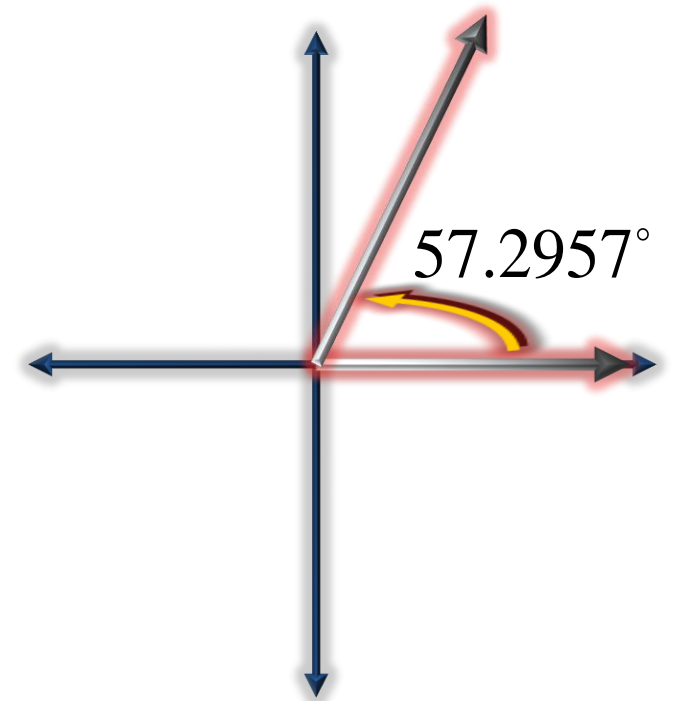
A.  $1^\circ$



B.  $\pi$  Radian



C. 1 Radian



# WHAT IS A RADIAN?

<https://www.geogebra.org/m/KGTQjfvw>

# CONVERSIONS

A.  $180^\circ = \pi$  Radian

B.  $1^\circ = \frac{\pi}{180}$  Radian

C.  $\frac{180}{\pi} = 1$  Radian

D. Conversions between Degrees and Radians:

1. Rewrite degrees as radians, multiply  $\frac{\pi}{180}$
2. Rewrite radians as degrees, multiply  $\frac{180}{\pi}$

# EXAMPLE 1

Convert  $240^\circ$  to radian measure

$$240^\circ = \frac{\overset{4}{\cancel{240^\circ}}}{1} \cdot \frac{\pi}{\cancel{180^\circ} \underset{3}{}}$$

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

## EXAMPLE 2

Convert  $\frac{9\pi}{2}$  to degree measure

$$\frac{9\pi}{2} = \frac{\cancel{9\pi} \cdot \cancel{180}^{\mathbf{90}}}{\mathbf{1} \cdot \cancel{2} \cdot \cancel{\pi}}$$

**810°**

# YOUR TURN

Convert  $-2^\circ$  to radian measure

$$\frac{\pi}{90}$$

# EXAMPLE 3

Convert 1 radian to degree measure

1 radian is not  $\pi$   
radian

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

$$\approx 57.2957^\circ$$



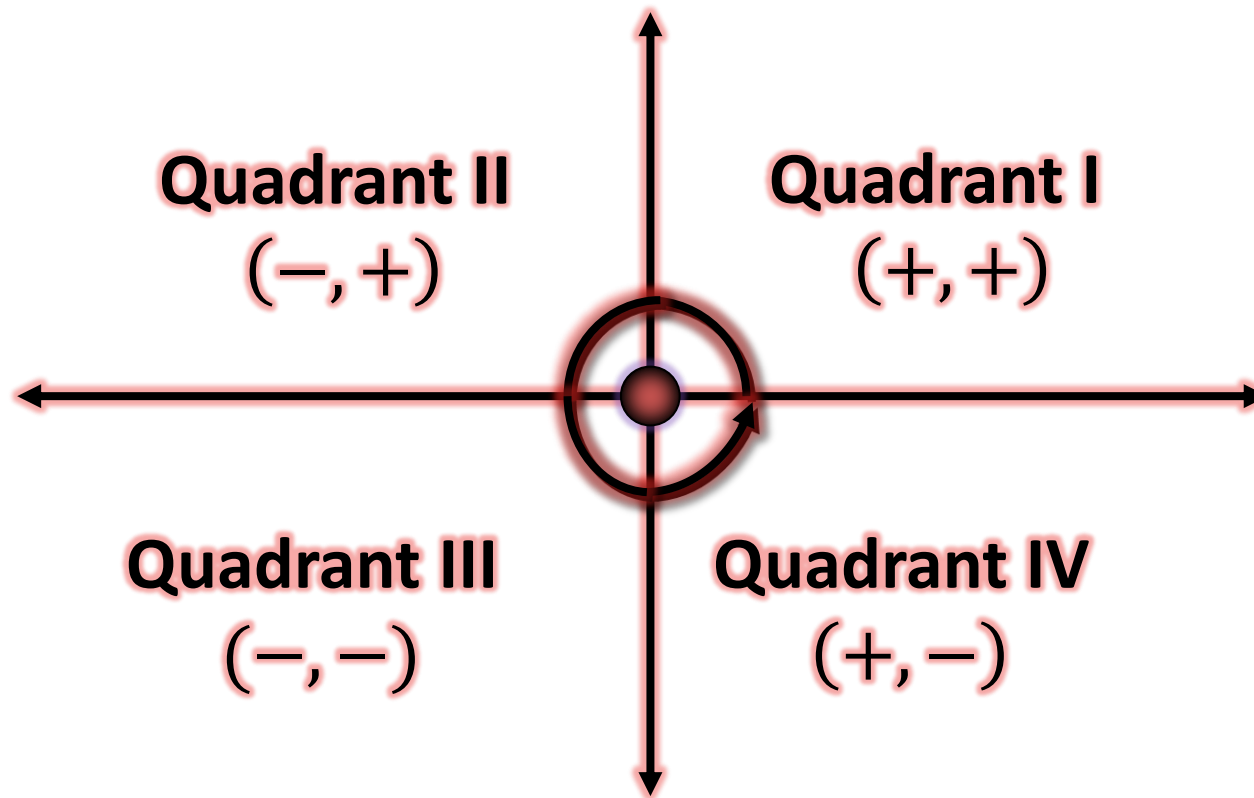
# YOUR TURN

Convert  $\frac{1}{4}$  radian to degree measure

$$\approx 14.3239^\circ$$

# QUADRANTS

For  $\theta$  be an angle in standard position with any point  $(x, y)$  :

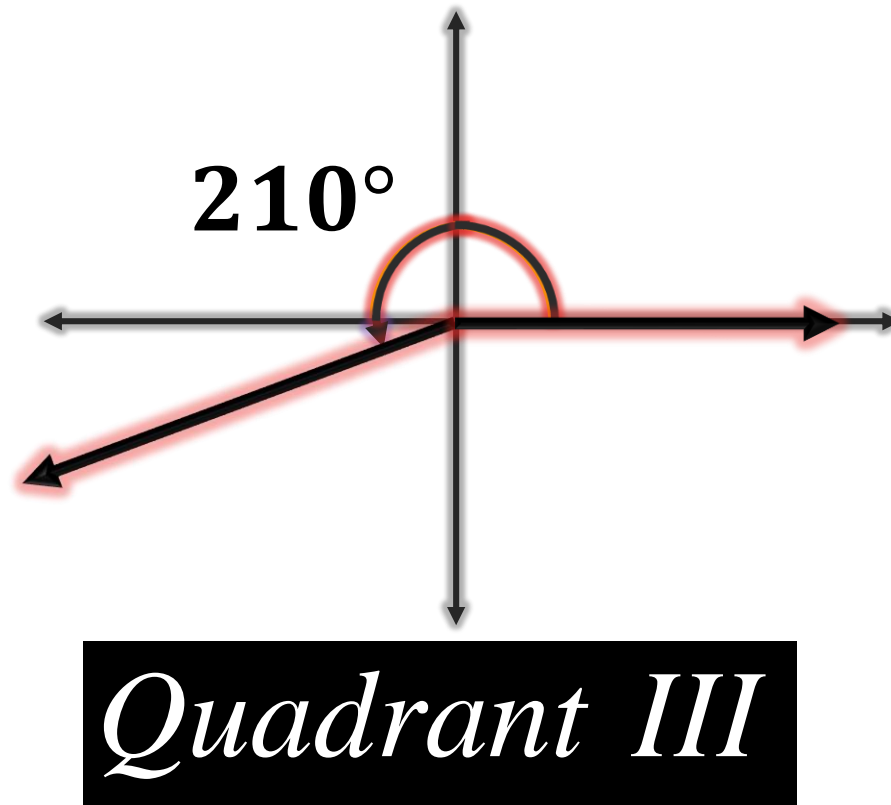


# ANGLE OF ROTATION

- A. Angle of rotation is formed by two rays with a common endpoint (called the vertex).
- B. One ray is called the initial side.
- C. The other ray is called the terminal side.
- D. The measure of the angle is determined by the amount and direction of rotation from the initial side to the terminal side.

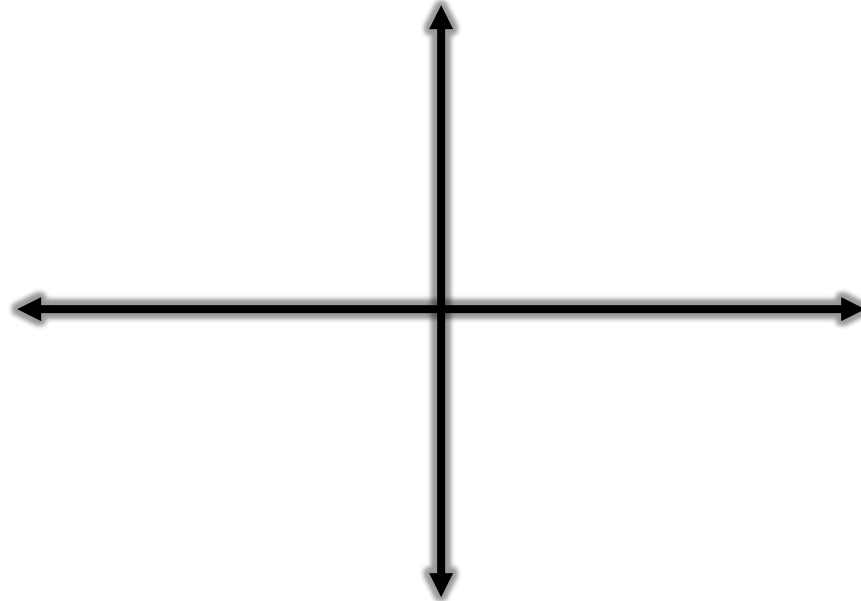
# EXAMPLE 4

Draw  $210^\circ$  with the given measure in standard position. Then determine in which quadrant the terminal side lies.



## EXAMPLE 5

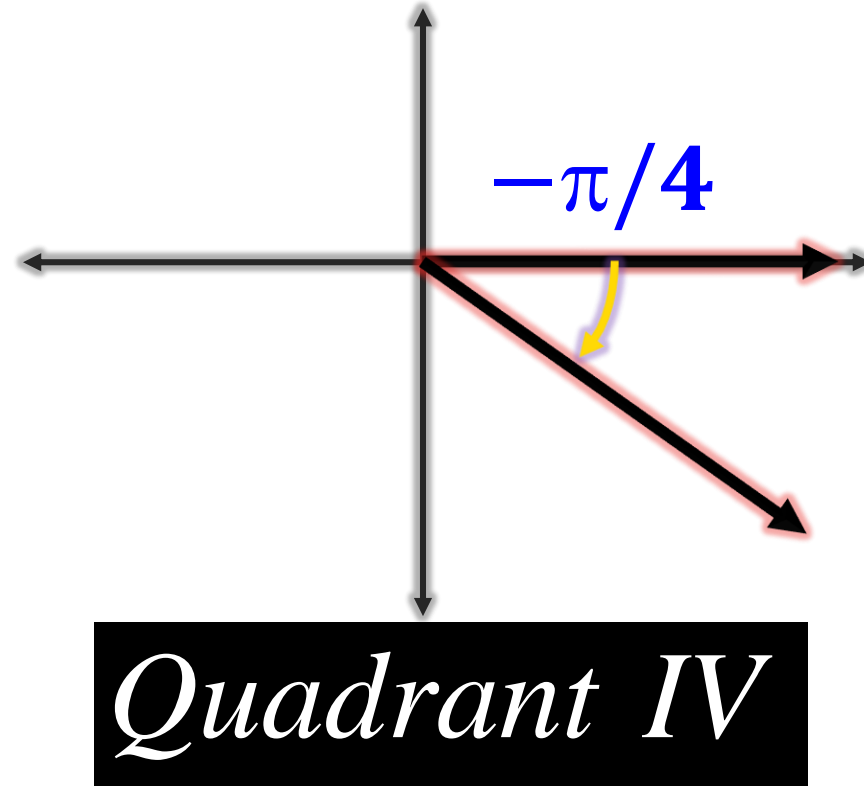
Draw  $\frac{9\pi}{5}$  with the given measure in standard position. Then determine in which quadrant the terminal side lies.



*Quadrant IV*

# YOUR TURN

Draw  $-\frac{\pi}{4}$  with the given measure in standard position. Then determine in which quadrant the terminal side lies.



# COMPLEMENTARY AND SUPPLEMENTARY

- A. Complementary angles are two angles that add up to  $90^\circ$
- B. Supplementary angles are two angles that add up to  $180^\circ$

## EXAMPLE 6

Determine the complementary and supplementary angles for  $\frac{\pi}{12}$

$$\frac{\pi}{12} \cdot \frac{180}{\pi} = 15^\circ$$

*Complementary :*

$$90^\circ - 15^\circ = 75^\circ$$

$$75^\circ \cdot \frac{\pi}{180} = \frac{5\pi}{12}$$

$$\text{Complementary : } \frac{5\pi}{12}$$

$$\text{Supplementary : } \frac{11\pi}{12}$$

*Supplementary :*

$$180^\circ - 15^\circ = 165^\circ$$

$$165^\circ \cdot \frac{\pi}{180} = \frac{11\pi}{12}$$



# EXAMPLE 7

**Determine the complementary and supplementary angles for 3 Radians**

*Complementary : Not Possible*  
*Supplementary :  $\pi - 3$*

# YOUR TURN

Determine the complementary and supplementary angles for  $\frac{\pi}{5}$

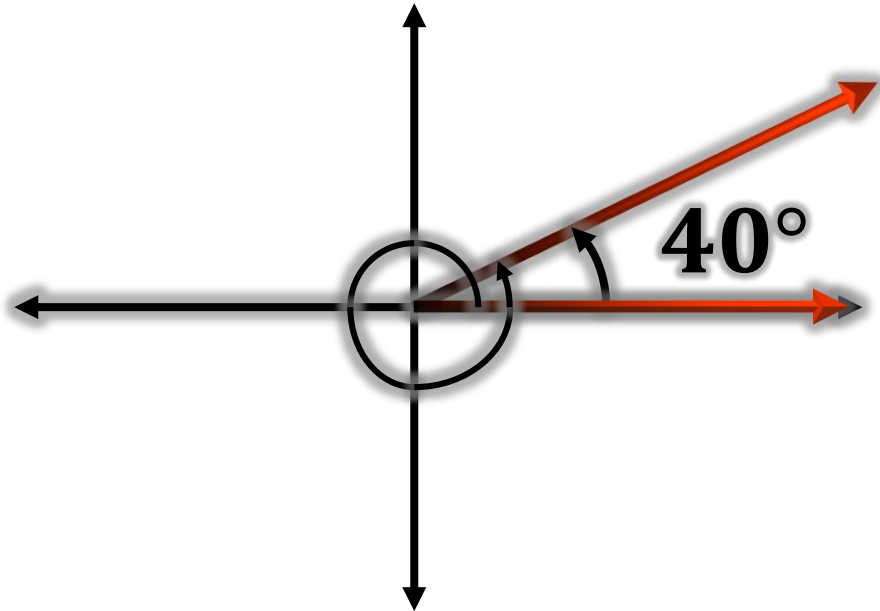
$$\begin{aligned} \text{Complementary: } & \frac{3\pi}{10} \\ \text{Supplementary: } & \frac{4\pi}{5} \end{aligned}$$

# COTERMINAL ANGLES

- A. Coterminal angles are angles in standard position with the same terminal side
- B. To determine the coterminal angles, add and/or subtract  $360^\circ$  by rotating counter clockwise for a positive rotation
- C. Coterminal Angles can also be negative

## EXAMPLE 8

Find two coterminal rays (1 positive and 1 negative) of  $40^\circ$



$$40^\circ + 360^\circ = 400^\circ$$

$$40^\circ - 360^\circ = -320^\circ$$

$$\theta = 400^\circ; \theta = -320^\circ$$

## EXAMPLE 9

Find one positive and one negative coterminal angle of  $\frac{7\pi}{3}$ .

$$\frac{7\pi}{3} + 2\pi$$

$$\frac{7\pi}{3} + \frac{6\pi}{3} = \frac{13\pi}{3}$$

$$\frac{7\pi}{3} - 2\pi$$

$$\frac{7\pi}{3} - \frac{6\pi}{3} = \frac{\pi}{3} - \frac{6\pi}{3} = -\frac{5\pi}{3}$$

$$\begin{array}{l} + : \frac{\pi}{3}, \frac{13\pi}{3} \\ - : -\frac{5\pi}{3} \end{array}$$

# YOUR TURN

Find one positive and one negative coterminal angle of  $-\frac{7\pi}{9}$

$$+ : \frac{11\pi}{9}, - : -\frac{25\pi}{9}$$

# ASSIGNMENT

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**11-45 odd (omit 21, 23)**