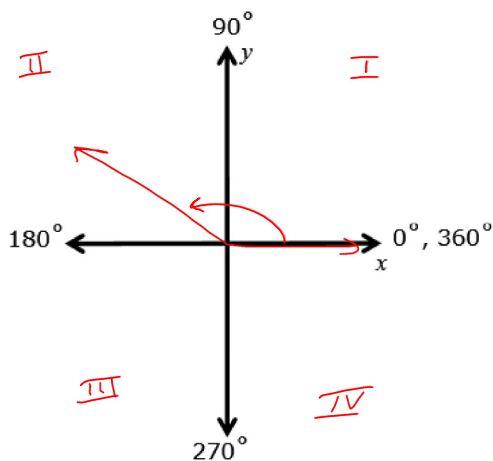


Pre-Calculus 12 Angles in Standard Position

An *angle in standard position* has its vertex at the origin, its initial arm along the positive x -axis and the terminal arm rotates counterclockwise. (ccw)

Negative angle – angles obtained from rotating the terminal arm clockwise (cw)



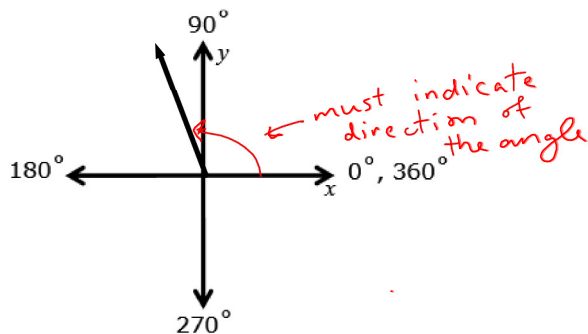
Angles in standard position with the same terminal arm, less than 0° or greater than 360° are called *coterminal angles*.

General Solution – the formula that gives all possible coterminal angles.

Ex. 1) Sketch 100° in standard position; state a positive and negative coterminal angle.

$$\begin{aligned}\theta_c &= 100^\circ + 360^\circ \\ &= 460^\circ\end{aligned}$$

$$\begin{aligned}\theta_c &= 100^\circ - 360^\circ \\ &= -260^\circ\end{aligned}$$



If asked in general form

$$100^\circ \pm 360^\circ k, \quad k \in \mathbb{Z} \leftarrow \text{integers}$$

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Ex. 2) Determine the measures of all angles in standard position between -800° and 800° that are coterminal with the following angles:

a) 85°

$$85^\circ + 360^\circ = \boxed{445^\circ}$$

$$445^\circ + 360^\circ = \cancel{805^\circ} \text{ too big}$$

$$85^\circ - 360^\circ = \boxed{-275^\circ}$$

$$-275^\circ - 360^\circ = \boxed{-635^\circ}$$

Write an expression for all angles coterminal with 85° .

another way of asking for general solution

$$85^\circ \pm 360^\circ k, k \in \mathbb{Z}$$

k revolutions

k is an element of the set of Integers

b) -150°

$$-150^\circ + 360^\circ = \boxed{210^\circ}$$

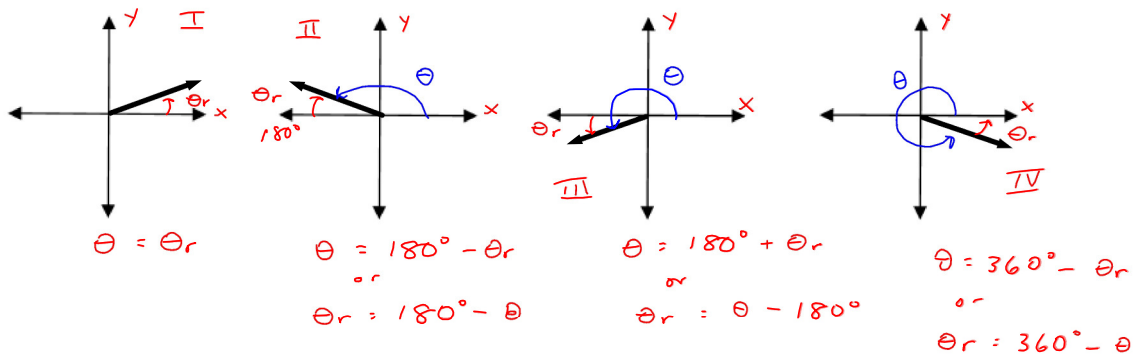
$$210^\circ + 360^\circ = \boxed{570^\circ}$$

$$-150^\circ - 360^\circ = \boxed{-510^\circ}$$

Write an expression for all angles coterminal with -150° .

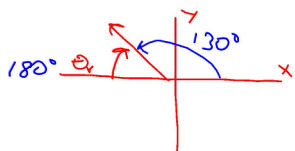
$$-150^\circ + 360k, k \in \mathbb{Z} \quad \text{or} \quad \left. \begin{array}{l} 210^\circ \pm 360^\circ k, k \in \mathbb{Z} \\ \uparrow \\ \text{principal angle} \\ \text{(between } 0^\circ \text{ and } 360^\circ) \end{array} \right\}$$

Recall: Reference Angles: measured from the x-axis to the terminal arm. (an acute angle between 0° and 90°)



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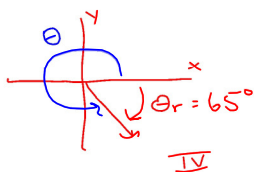
Ex. 3) Determine the reference angle for 130° .



in Q II

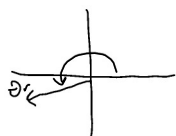
$$\begin{aligned}\theta_r &= 180^\circ - \theta \\ &= 180^\circ - 130^\circ \\ &= 50^\circ\end{aligned}$$

Ex. 4) An angle θ in standard position terminates in quadrant IV. If the reference angle is 65° determine a possible measurement for θ .



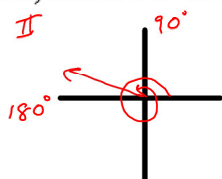
$$\begin{aligned}\theta &= 360^\circ - \theta_r \\ &= 360^\circ - 65^\circ \\ &= 295^\circ\end{aligned}$$

If
Try $\theta = 195^\circ$, determine θ_r



$$\begin{aligned}\theta_r &= 195^\circ - 180^\circ \\ &= 15^\circ\end{aligned}$$

Ex. 5) Sketch 520° in standard position and then identify the reference angle.



$$520^\circ - 360^\circ = 160^\circ$$

coterminal principal angle

520° is coterminal w/ 160°

$$\begin{aligned}\theta_r &= 180^\circ - 160^\circ \\ &= 20^\circ\end{aligned}$$