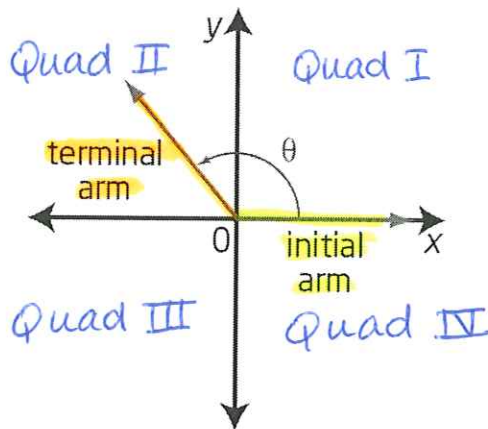## 2.1 Angles in Standard Position

In this chapter, we will investigate **trigonometry**.

Up to this point, our encounters with trigonometry have been limited to investigating triangles.

We will now extend trigonometry to angles that are not necessarily contained within a triangle.

To do so, we need to examine the concept of an **angle in standard position**.

An angle is in **standard position** when its vertex is at the origin of a coordinate grid and its initial arm coincides with the positive x-axis.
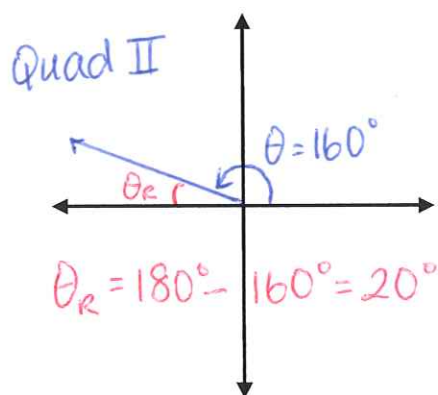

Each angle in standard position has a corresponding **reference angle**: the acute angle formed between the terminal arm and the x-axis.

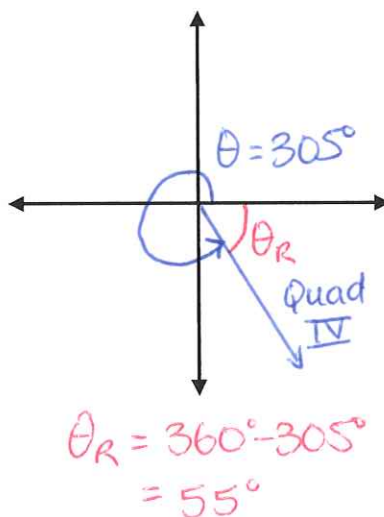The reference angle, θ_R, is always positive and is between $0°$ and $90°$.
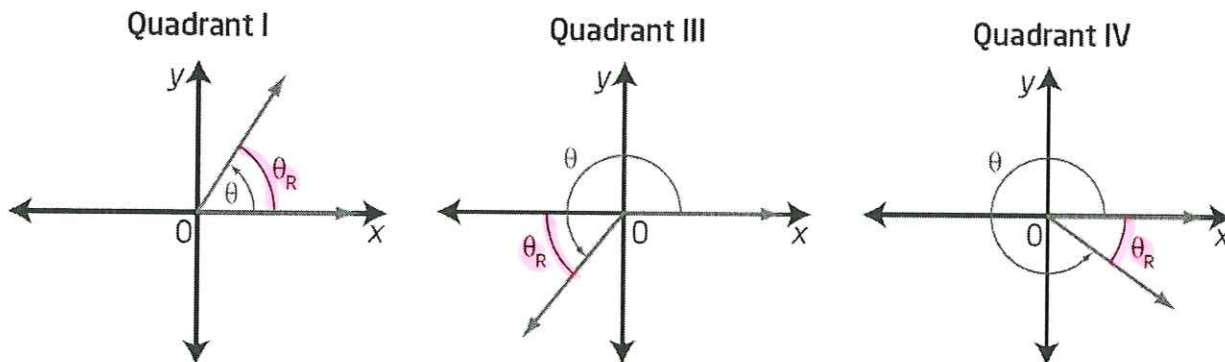
Example: Sketch each angle in standard position.
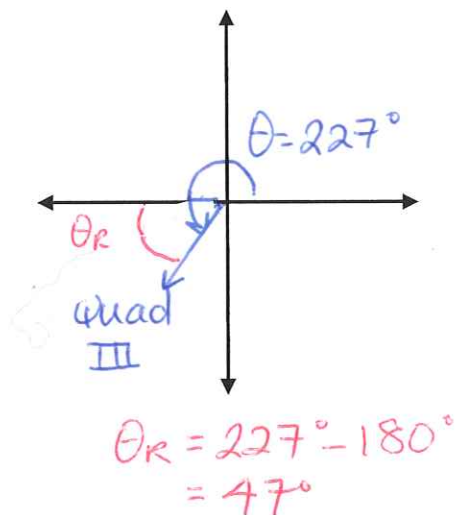State the quadrant it is in and its reference angle.
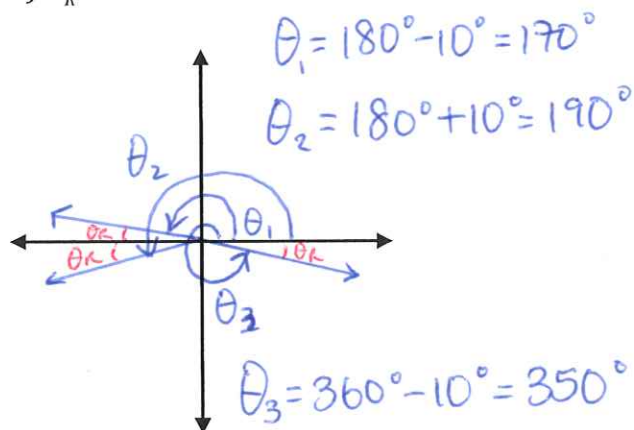
$\theta = 160°$

$\theta = 305°$

$\theta = 227°$

Quad II

$\theta = 160°$

θ_R

$\theta_R = 180° - 160° = 20°$

$\theta = 305°$

θ_R

Quad IV

$\theta_R = 360° - 305°$
$= 55°$

$\theta = 227°$
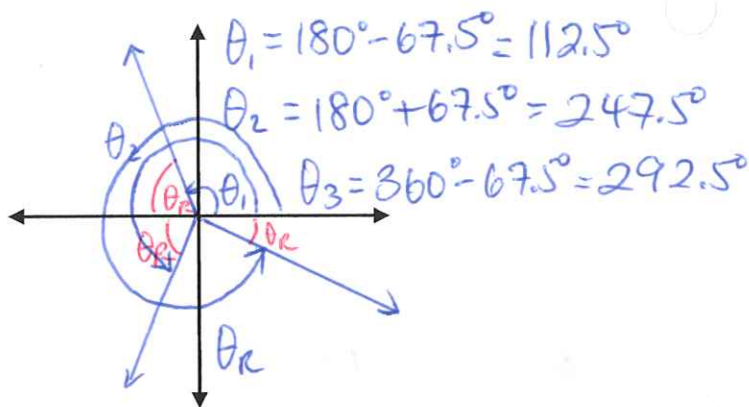
θ_R

quad III

$\theta_R = 227° - 180°$
$= 47°$

Example: Determine the measure of three other angles in standard position, $0 < \theta < 360°$, that have a reference angle of:

a) $\theta_R = 10°$

$\theta_1 = 180° - 10° = 170°$

$\theta_2 = 180° + 10° = 190°$

θ_2

θ_R

θ_1

θ_R

θ_3

$\theta_3 = 360° - 10° = 350°$

b) $\theta_R = 67.5°$

$\theta_1 = 180° - 67.5° = 112.5°$

$\theta_2 = 180° + 67.5° = 247.5°$

$\theta_3 = 360° - 67.5° = 292.5°$

θ_2

θ_R θ_1

θ_R

θ_R

θ_R

Example: Determine the angle in standard position given the following information.

a) $\theta_R = 58°$, θ is in quadrant III.

$\theta = 180° + 58° = 238°$

b) $\theta_R = 71°$, θ is in quadrant IV.

$\theta = 360° - 71° = 289°$