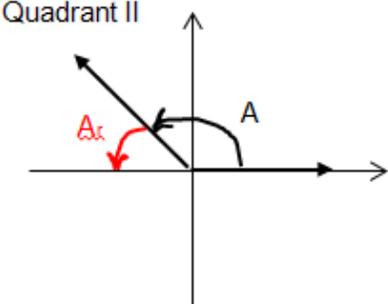
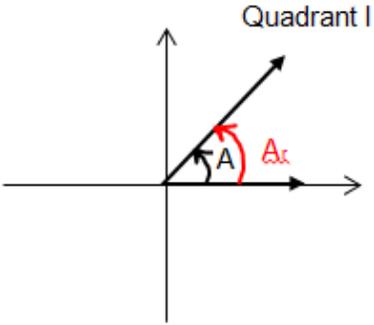
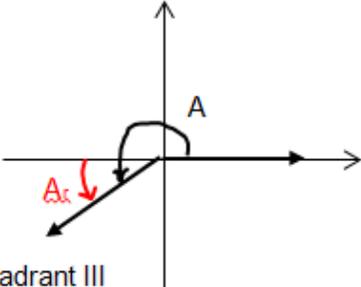
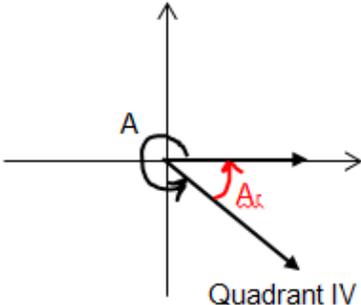


Reference Angle

If A is an angle in standard position, its **reference angle**, A_r , is the **acute angle formed by the x-axis and the terminal side of angle A** .

<p>If angle A is in quadrant II then the reference angle</p> $A_r = 180^\circ - A$ <p>(if A is given degrees) or</p> $A_r = \pi - A$ <p>(if A is given in radians).</p> 	<p>If angle A is in quadrant I then the reference angle</p> $A_r = A.$ 
<p>If angle A is in quadrant III then the reference angle</p> $A_r = A - 180^\circ$ <p>(if A is given degrees) or</p> $A_r = A - \pi$ <p>(if A is given in radians)</p> 	<p>If angle A is in quadrant IV then the reference angle</p> $A_r = 360^\circ - A$ <p>(if A is given degrees) or</p> $A_r = 2\pi - A$ <p>(if A is given in radians)</p> 

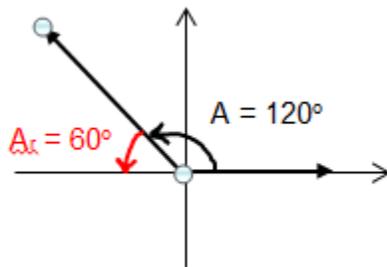
Examples

1. Find the reference angle for each of the following angles.

- a) $A = 120^\circ$
- b) $A = -15\pi/4$
- c) $A = -30^\circ$

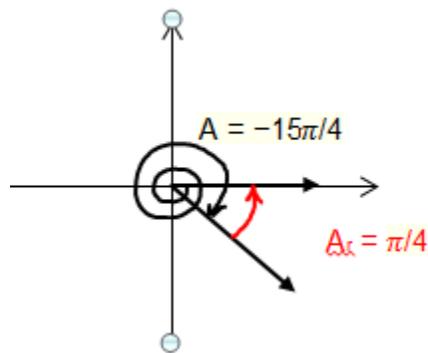
Solutions

a) Since angle A is in quadrant II, the reference angle, $A_r = 180^\circ - 120^\circ = 60^\circ$



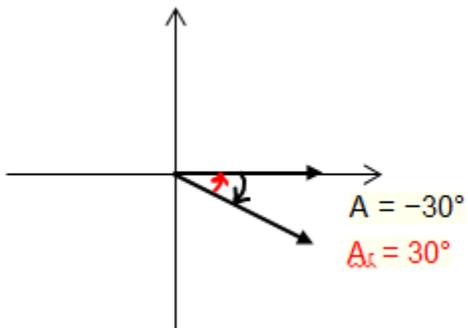
b) The given angle is not positive and less than 2π . We can use the positive and less than 2π coterminal A_c to angle A .

$$A_c = -15\pi/4 + 2(2\pi) = \pi/4$$



c) Angle A is negative, in quadrant IV and its absolute value is less than 90° . Hence

$$A_r = |-30^\circ| = 30^\circ$$



Practice

Find the reference angle for each of the following angles.

- a) $A = 1620^\circ$
- b) $A = -29\pi/7$
- c) $A = -\pi/7$

Answers

- a) $A_r = 25^\circ$
- b) $A_r = \pi/6$
- c) $A_r = \pi/7$