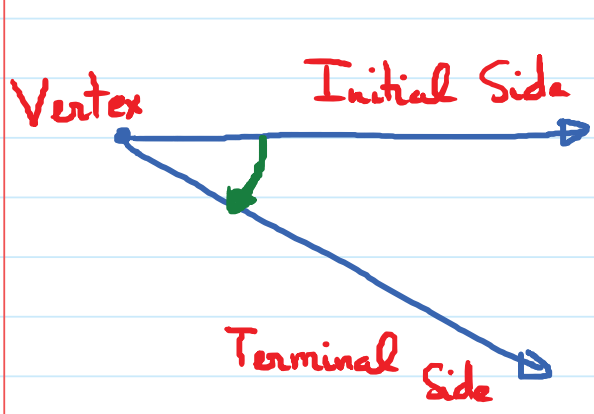
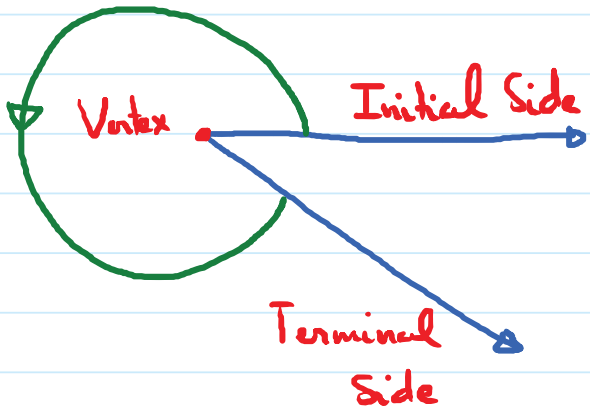
# 1.1. Angles

Thursday, January 17, 2019 8:01 AM



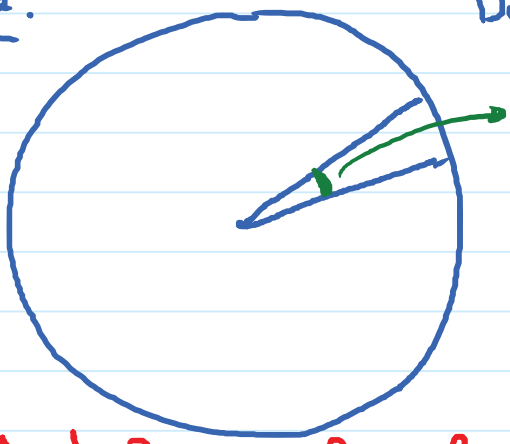

Negative angle (clockwise)

Positive angle (counterclockwise)

Degree:

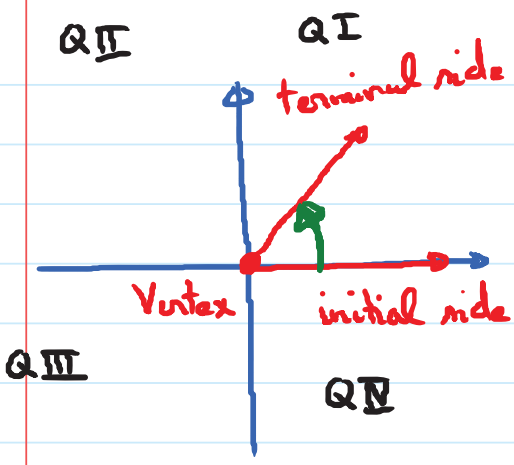
Divide into 360 equal pieces

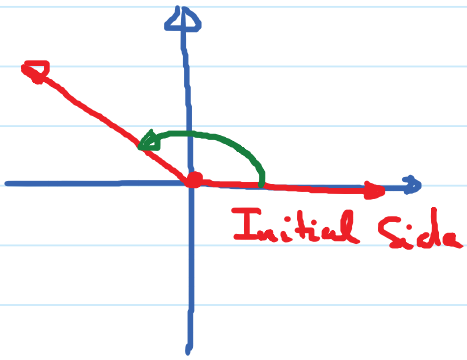
this is a $1^\circ$ angle

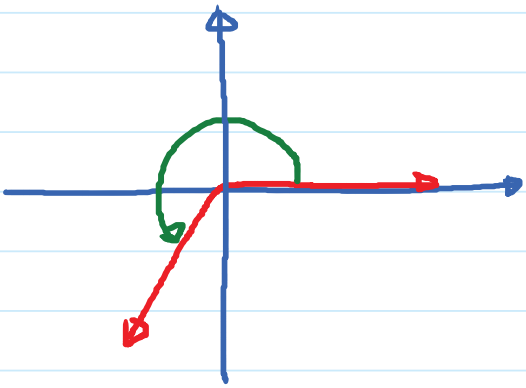


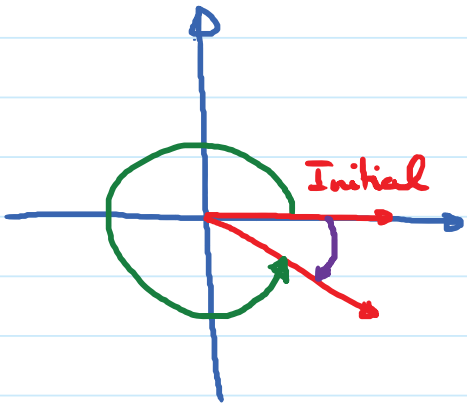
## Standard Position of angle

Def: An angle is in standard position if its vertex is at the origin and its initial side is the positive part of the x-axis



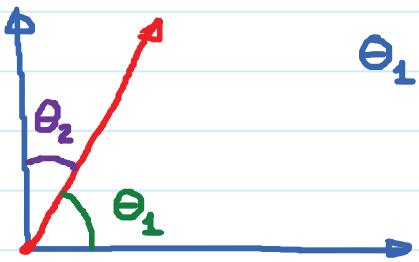



Angle : between $0°$ and $90°$ → acute

exactly $90°$ → right

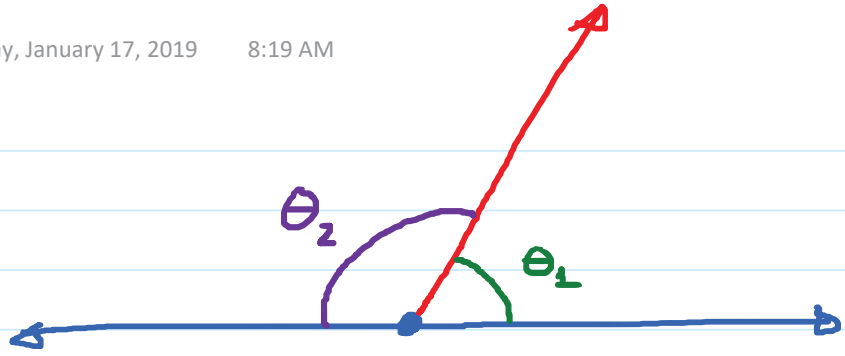
between $90°$ and $180°$ → obtuse

exactly $180°$ → straight




$\theta_1 + \theta_2 = 90°$

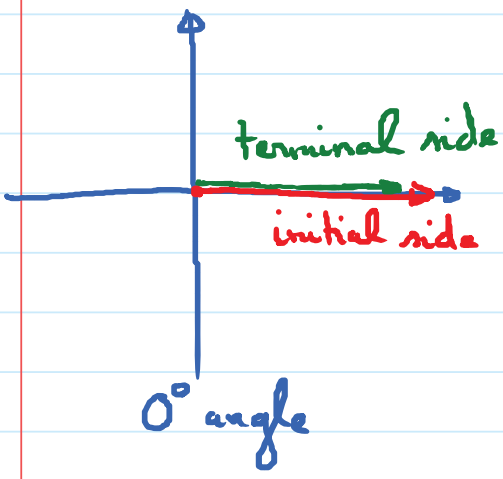
$\theta_1$ and $\theta_2$ are called complementary angles.



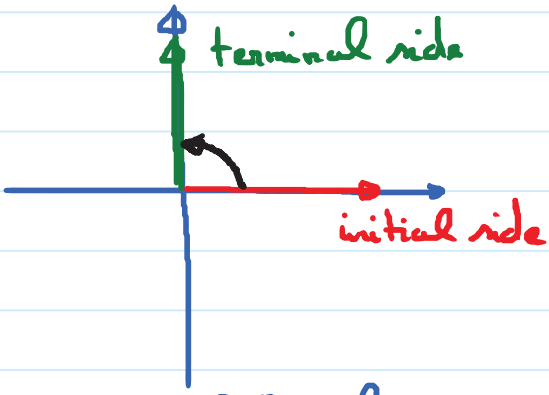

$\theta_1 + \theta_2 = 180°$

$\theta_1$ and $\theta_2$ are called supplementary angles.

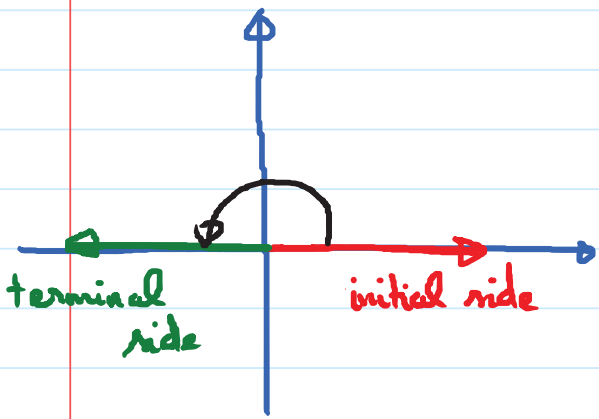
**Quadrantal Angles:** an angle whose terminal side lies on either the x-axis or the y-axis.



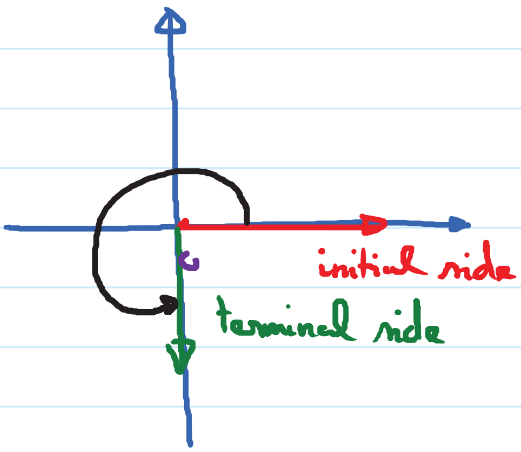

0° angle




90° angle

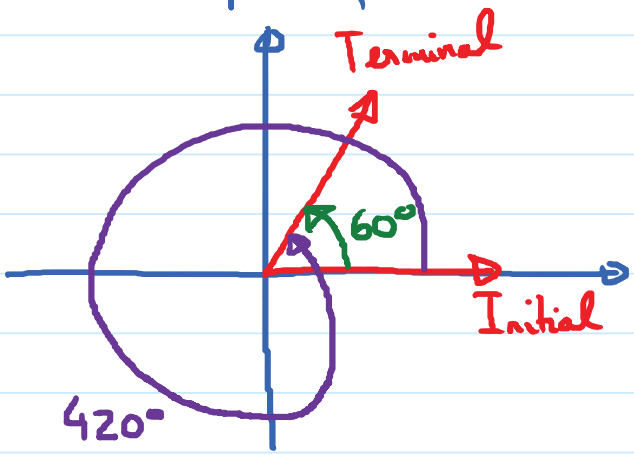



180° angle

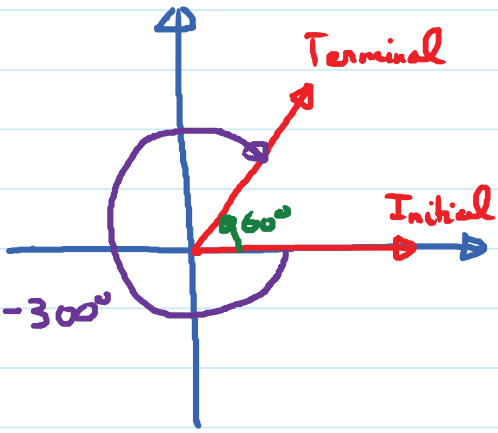



270° angle

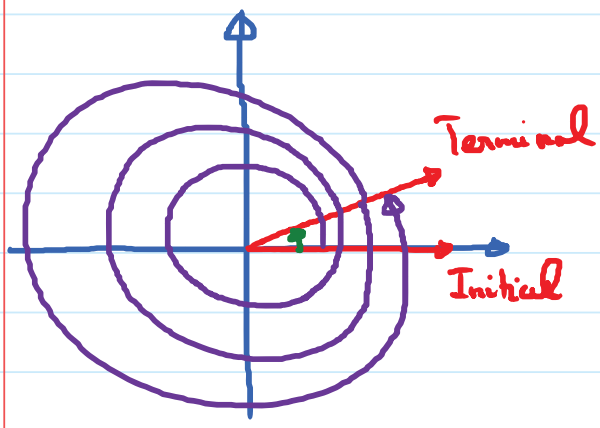
**Def:** Coterminal angles are angles that have the same initial side and terminal side but different amounts of rotation. Their measures differ by a multiple of 360°




60° and 420° are coterminal



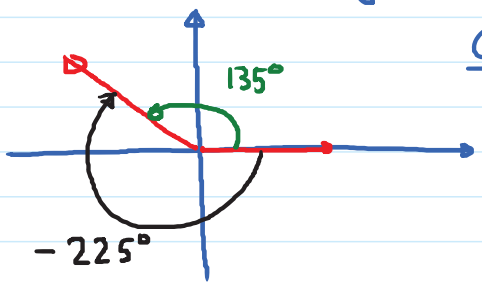

60° and −300° are coterminal




30° and 1110° are coterminal

$1110° - 30° = 1080°$
$= 3 \cdot 360°$ || difference = multiple of 360°

E.g. Given: 135° angle in standard position.




Q: Find the measure of a negative angle that is coterminal with this angle

Formula for generating all the angles that are coterminal with a given angle.

$\theta + n \cdot 360°$ where $n = \ldots, -3, -2, -1, 0, 1, 2, 3, \ldots$

theta

E.g. Find the angle of least positive measure that is coterminal with the given angle:

(a) 1106°

coterminal: $1106° + n \cdot 360°$

$n = -1$ : 746°

$n = -2$ : 386°

$n = -3$ : 26°

(b) $-603^\circ$

coterminal: $-603^\circ + n \cdot 360^\circ$

$n = 1$ : $-243^\circ$

$n = 2$ : $\boxed{117^\circ}$

Degrees, minutes, seconds

$1^\circ = 60$ minutes $\longrightarrow \boxed{1^\circ = 60'}$

1 minute $= 60$ seconds $\longrightarrow \boxed{1' = 60''}$

$1^\circ = 3600$ seconds $\longrightarrow \boxed{1^\circ = 3600''}$

1 minute $= \frac{1}{60}$ degrees $\longrightarrow \boxed{1' = \frac{1}{60}^\circ}$

1 second $= \frac{1}{60}$ minutes $\longrightarrow \boxed{1'' = \frac{1}{60}'}$

1 second $= \frac{1}{3600}$ degrees $\longrightarrow \boxed{1'' = \frac{1}{3600}^\circ}$

Calculations with degrees, minutes, seconds

(a) $28^\circ 35' + 63^\circ 52' = 91^\circ 87' = \boxed{92^\circ 27'}$

(b) $180^\circ - 117^\circ 29'$

$= 179^\circ 60' - 117^\circ 29' = \boxed{62^\circ 31'}$

(c) $73^\circ 23' - 47^\circ 48'$

$= 72^\circ 83' - 47^\circ 48' = \boxed{25^\circ 35'}$

Convert from degrees, minutes, seconds to decimals

E.g. $105^\circ 20' 32''$ → decimal

$$105^\circ + \frac{20^\circ}{60} + \frac{32^\circ}{3600} = 105.342^\circ$$

Decimal → degrees, minutes, seconds

E.g. $85.263^\circ$ → degrees, minutes, seconds

$85^\circ + \underbrace{(0.263^\circ)\cdot 60'}_{15.78'}$

$85^\circ$ and $15'$ and $\underbrace{(.78')\cdot 60''}_{46.8'' \to 47''}$

$85^\circ 15' 47''$