

Exploring Trigonometric Ratios for Angles Greater than 90° on the iPads

*Using two fingers, center the y-axis and line up your file so "Principal angle = ..." is at the top of the screen.

Note: All angles are in **standard position** (vertex at the origin, initial arm on positive x-axis)

Part 1

Touch and move the point at the end of the terminal arm.

Watch the values of the '**principal angle**' and the '**related acute angle**' as you move this point.

1. Describe the relationship between the principal angle and the related acute angle when the end of the terminal arm is in

- a. Quadrant I

They are the same!! (both $0 < \theta < 90$)

- b. Quadrant II

They sum to 180 (principal: $90 < \theta < 180$)
(related acute: $0 < \theta < 90$)

- c. Quadrant III

Principal $180 < \theta < 270$
Related acute $0 < \theta < 90$

- d. Quadrant IV

Principal $270 < \theta < 360$
Related acute $0 < \theta < 90$

2. How is the principal angle determined? Where is it measured from?

The counter clockwise angle between the initial and terminal arms of an angle in standard position. The angle is between 0° and 360°

3. How is the related acute angle determined? Where is it measured from?

The acute angle between the terminal arm of an angle in standard position and the x-axis when the terminal arm is in Quadrants II, III and IV

Part 2

Click the "Show Sine Measurements" button and, again, move the point at the end of the terminal arm.

1. What do you notice about the sine of the principal angle and the sine of the related acute angle?

They are the same in I & II
In III & IV the principal is negative.

2. In what quadrant(s) is the sine of the principal angle

a. Positive? I and II

- b. Negative?

III and IV

Click the "Show Cosine Measurements" button and, again, move the point at the end of the terminal arm.

1. What do you notice about the cosine of the principal angle and the cosine of the related acute angle?

They are the same, but in II & III
the principal is \ominus

2. In what quadrant(s) is the cosine of the principal angle

a. Positive? I & IV

- b. Negative?

II & III

Click the "Show Tangent Measurements" button and, again, move the point at the end of the terminal arm.

1. What do you notice about the tangent of the principal angle and the tangent of the related acute angle?

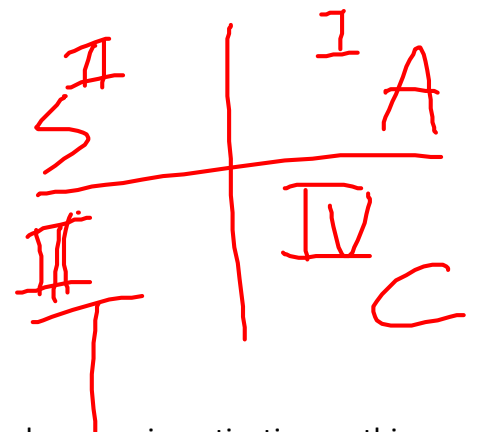
They are the same, but in II & IV
the principal is \ominus

2. In what quadrant(s) is the tangent of the principal angle

a. Positive? I & III

- b. Negative?

II & IV



There is a rule / mnemonic in trigonometry known as **The CAST Rule**. Based on your investigation on this page, what do you think the rule is used for?

Telling us where each trig ratio is \oplus or \ominus

Part 3

Click the "Show Negative Angles" button and, again, move the point at the end of the terminal arm.

1. How is the value of a negative angle determined? Where is it measured from?

It's measured from the x-axis
in QI, clockwise
*always \ominus

Part 4

Complete the table below assuming that θ is an acute angle in standard position.

Terminal arm in Quadrant I
Principal angles are between: 0° and 90°
The principal angle can be expressed as
θ A
$\sin \theta = \sin \theta$
$\cos \theta = \cos \theta$
$\tan \theta = \tan \theta$

Terminal arm in Quadrant II
Principal angles are between: 90° and 180°
The principal angle can be expressed as
$180^\circ - \theta$ S
$\sin(180^\circ - \theta) = \sin \theta$
$\cos(180^\circ - \theta) = -\cos \theta$
$\tan(180^\circ - \theta) = -\tan \theta$

Terminal arm in Quadrant III
Principal angles are between: 180° and 270°
The principal angle can be expressed as
$180^\circ + \theta$ T
$\sin(180^\circ + \theta) = -\sin \theta$
$\cos(180^\circ + \theta) = -\cos \theta$
$\tan(180^\circ + \theta) = \tan \theta$

Terminal arm in Quadrant IV
Principal angles are between: 270° and 360°
The principal angle can be expressed as
$360^\circ - \theta$ C
$\sin(360^\circ - \theta) = -\sin \theta$
$\cos(360^\circ - \theta) = \cos \theta$
$\tan(360^\circ - \theta) = -\tan \theta$