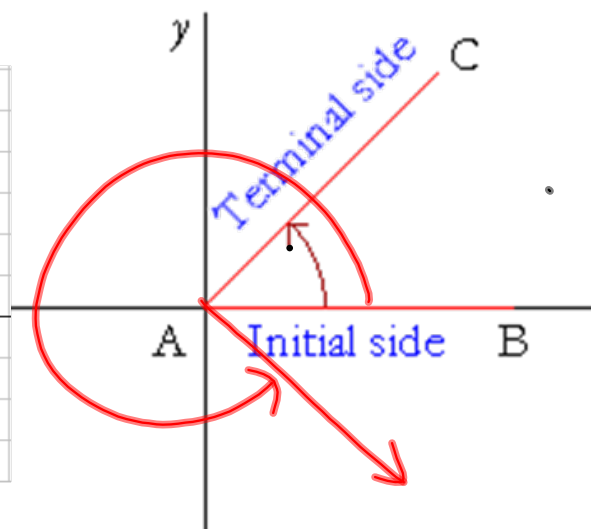
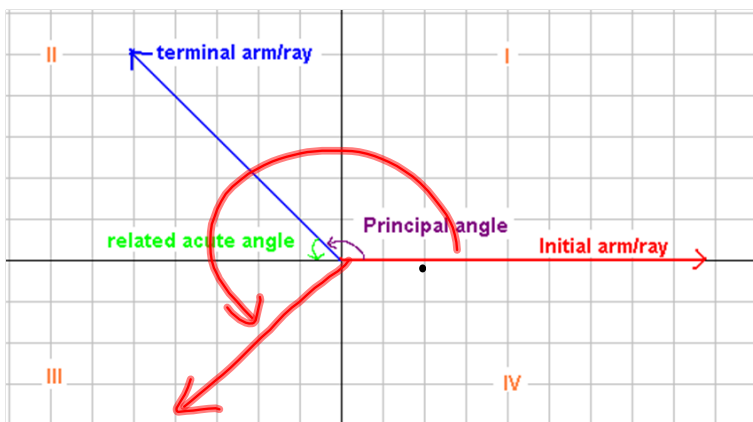
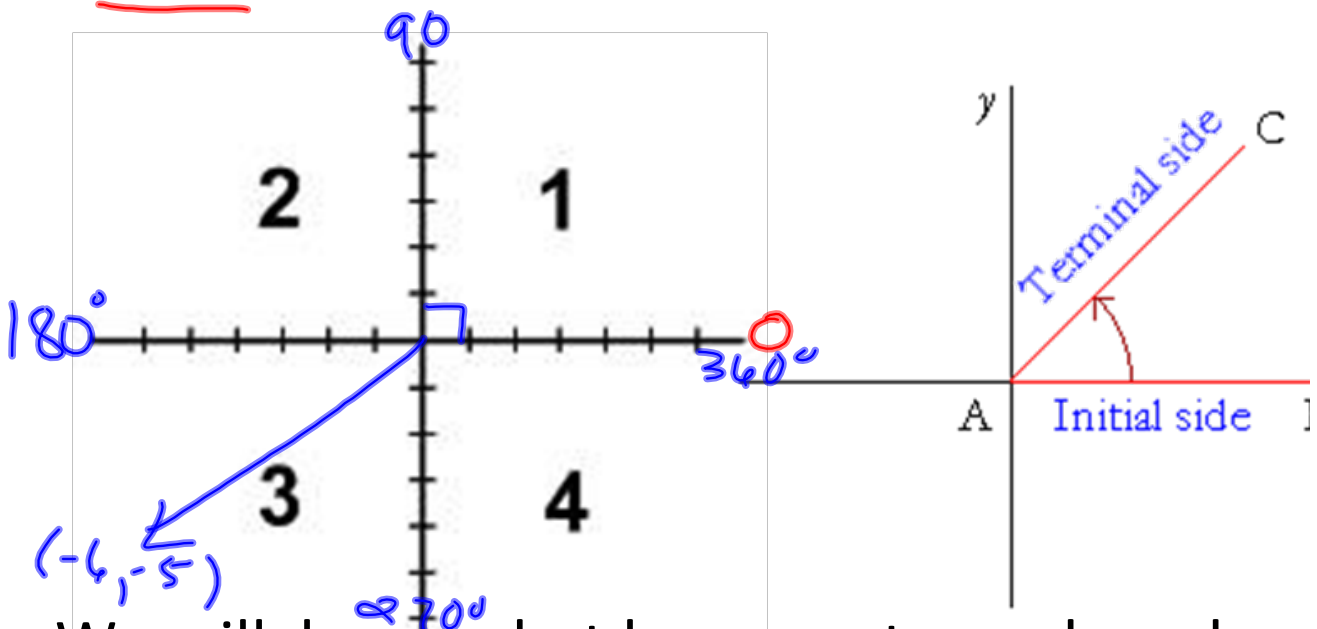


# Exploring Trig Ratios for Angles Greater than $90^\circ$

**Standard position:** an angle in the Cartesian plane whose vertex lies at the origin and whose initial arm (the arm that is fixed) lies on the positive  $x$ -axis. Angle  $\theta$  is measured from the initial arm to the terminal arm (the arm that rotates).



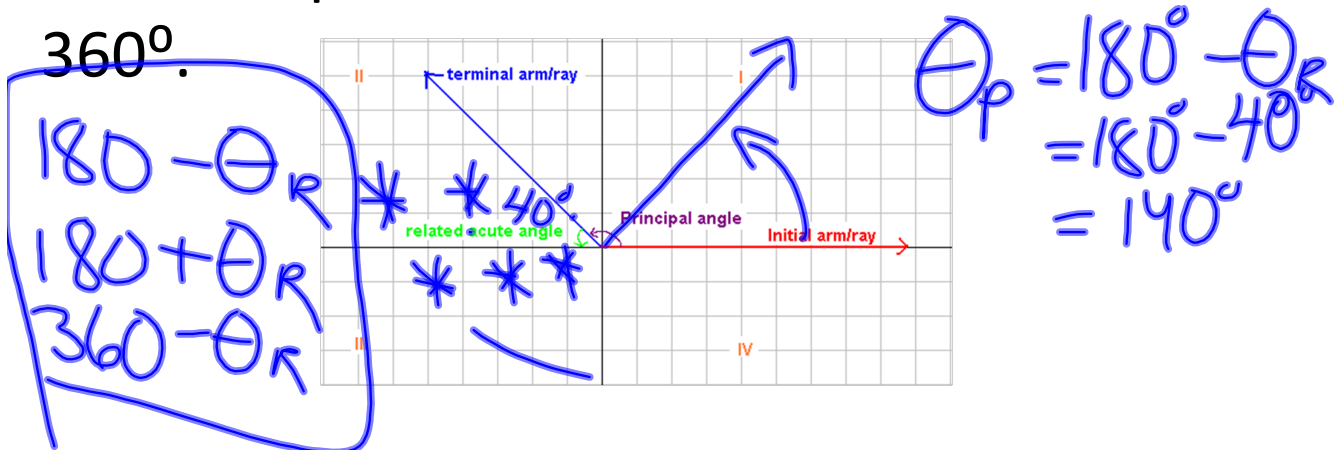
There are four quadrants in the Cartesian Plane *x-y plane*



We will learn what happens to angles whose terminal arm lands in different quadrants.

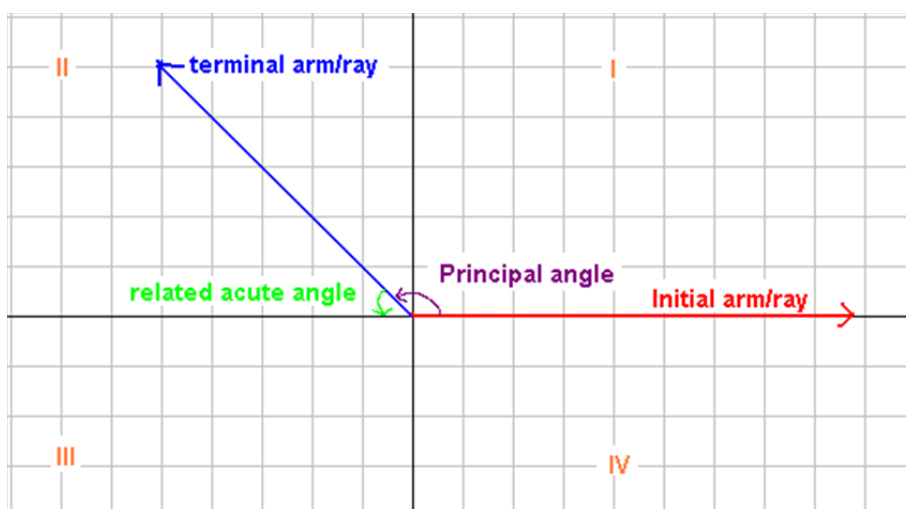
# The Principal Angle

- The counterclockwise angle between the initial arm and the terminal arm of an angle in standard position. Its value is between  $0^\circ$  and  $360^\circ$ .

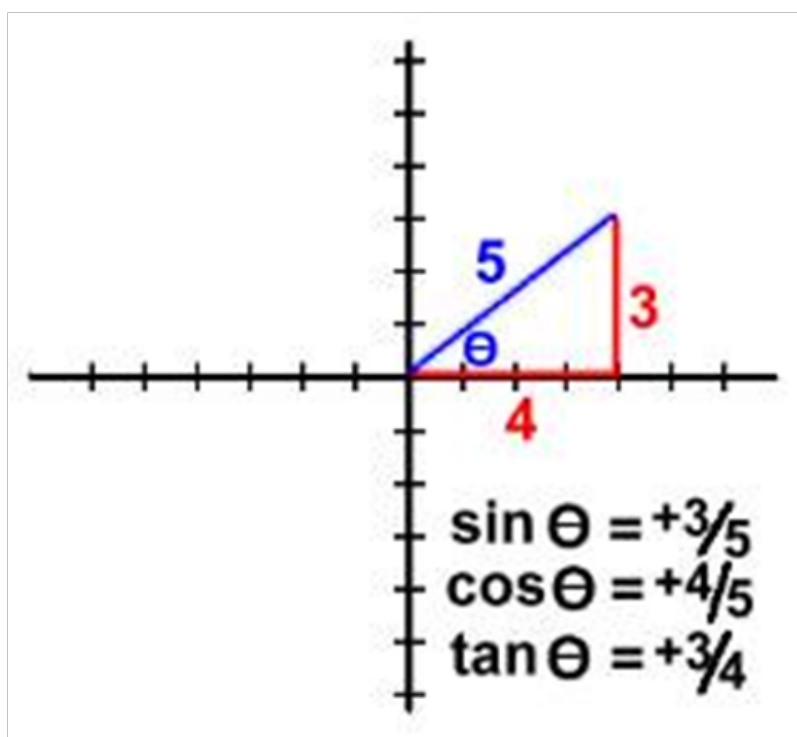


## The Related Acute Angle

The acute angle between the terminal arm of an angle in standard position and the x-axis when the terminal arm lies in quadrant 2, 3, or 4.



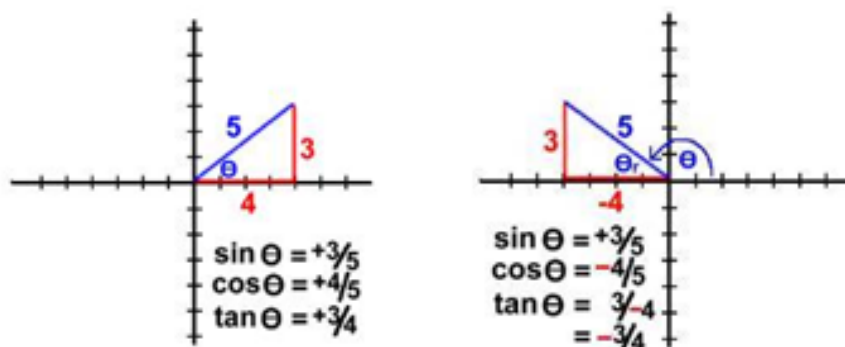
When the terminal arm lies in Q1.



Find the value of  $\theta$ .

When the terminal arm lies in Q2.

Now reflect the triangle in the y-axis.

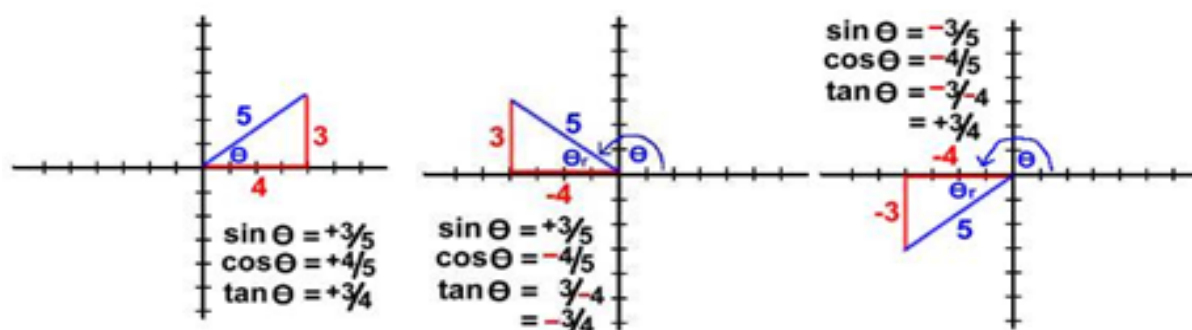


The trig ratios of the new angle can be found by looking at the related acute angle

Find  $\theta$

## When the terminal arm lies in Q3.

Now reflect the triangle in the x-axis.



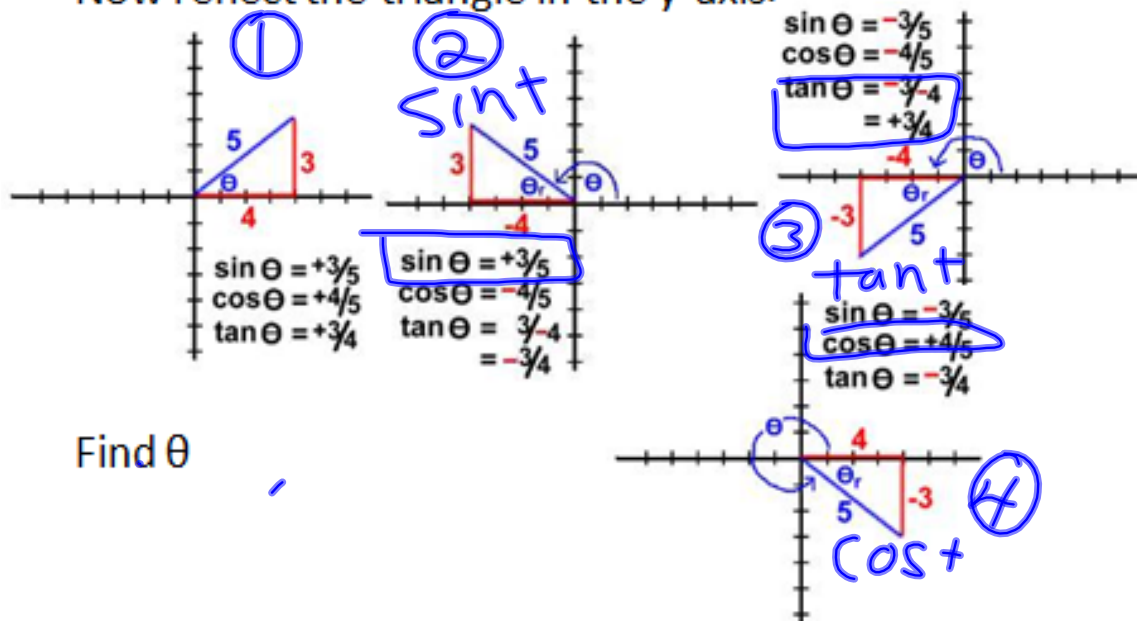
The trig ratios of the new angle can be found by looking at the related acute angle

Find  $\theta$

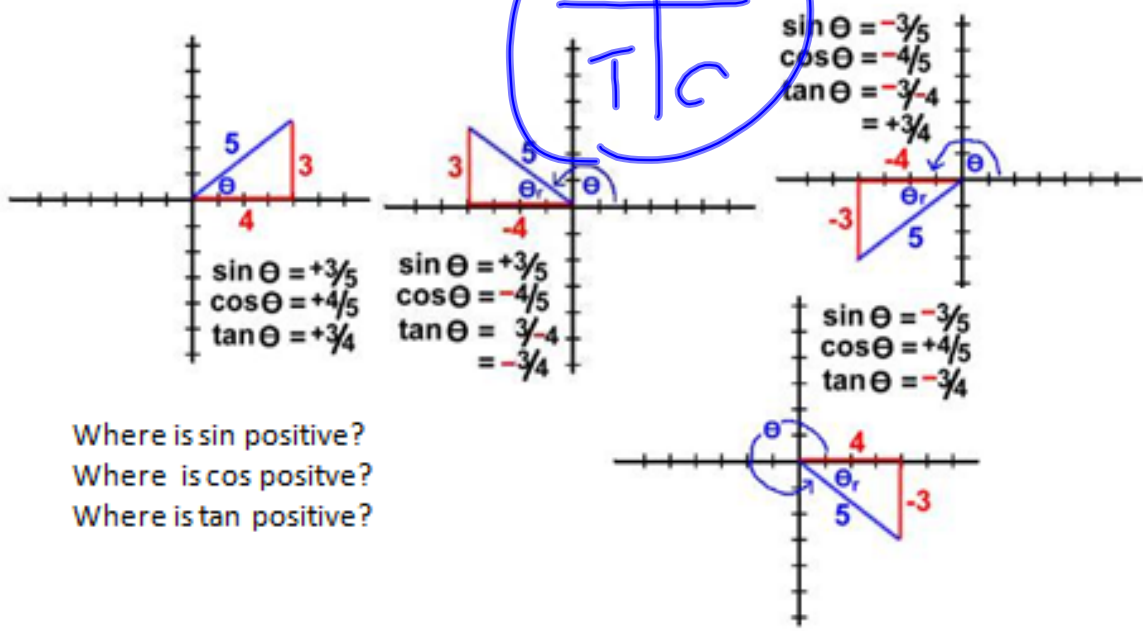
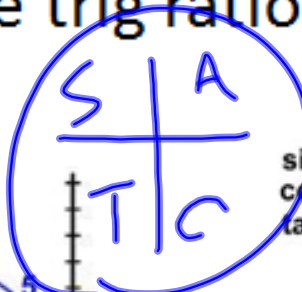


When the terminal arm lies in Q4.

Now reflect the triangle in the y-axis.

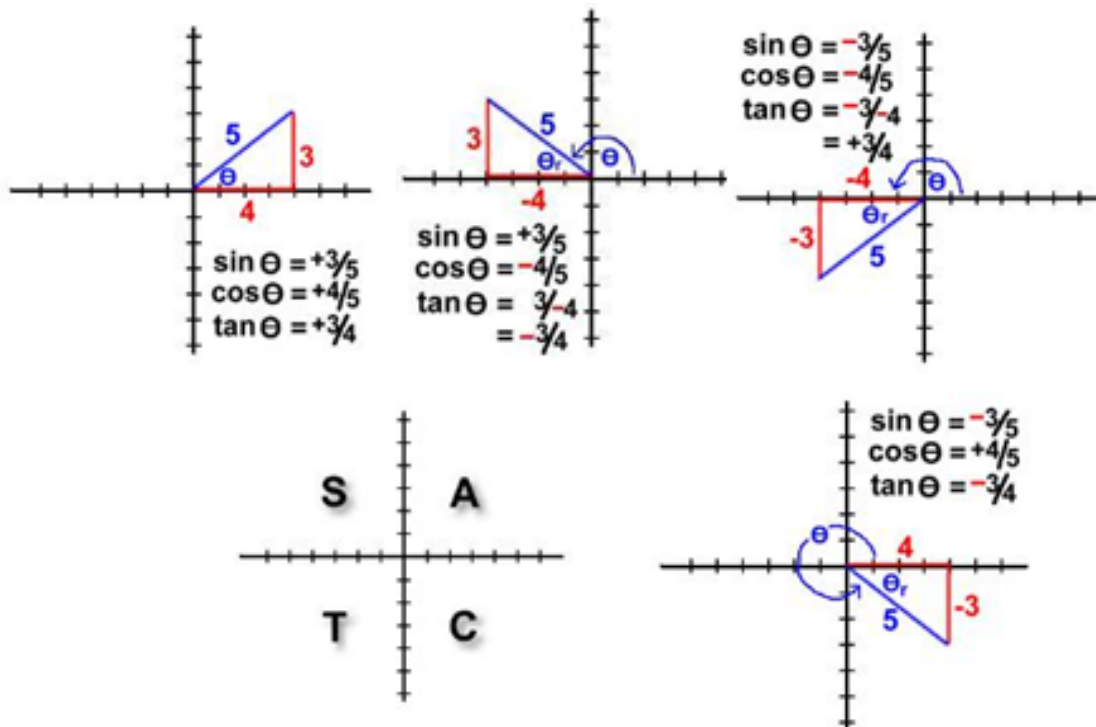


Where are the trig ratios positive?

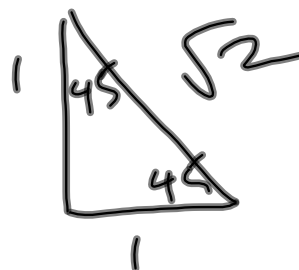
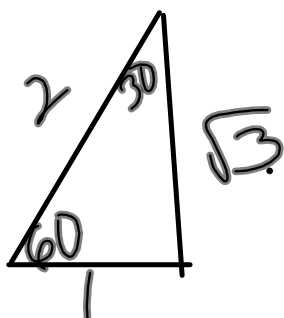


Where is sin positive?  
 Where is cos positive?  
 Where is tan positive?

# CAST RULE

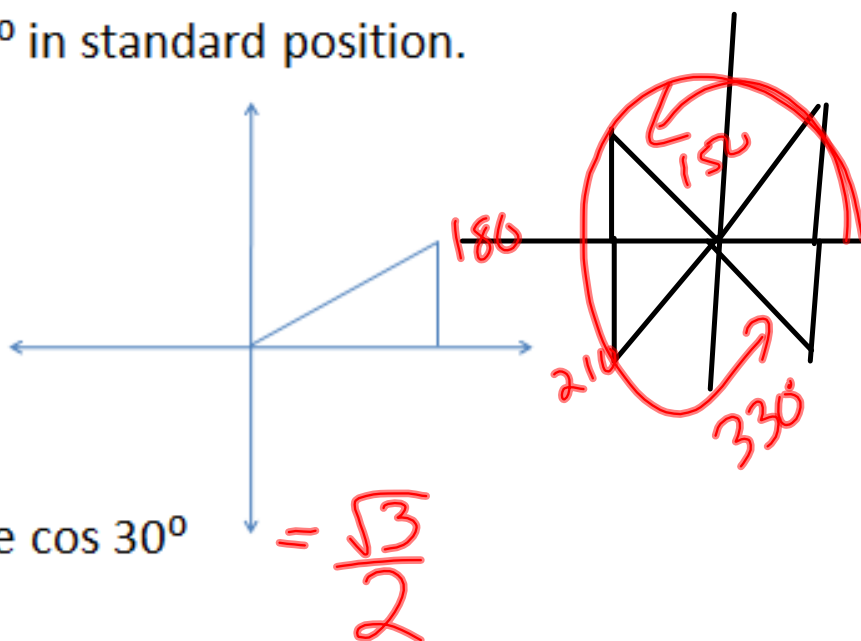


	30	60	45
sin	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$ $\frac{1}{\sqrt{2}}$
cos	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$
tan	$\frac{1}{\sqrt{3}}$ $\frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$	$\frac{\sqrt{3}}{1}$	$\frac{1}{1}$



Caculating  
cos 30, cos 150, cos210 and cos 330

a) Sketch  $30^\circ$  in standard position.



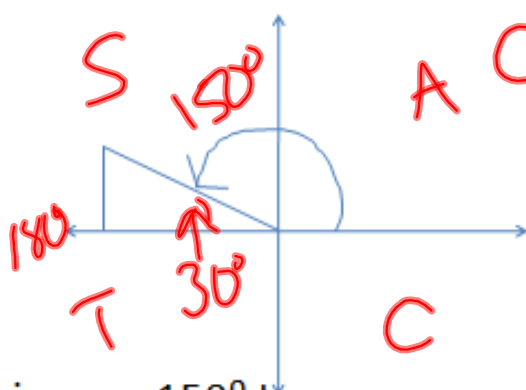
b) Determine  $\cos 30^\circ$

$$= \frac{\sqrt{3}}{2}$$

$$\cos \theta_P = \cos \theta_R$$

$$\cos 150$$

a) Sketch  $150^\circ$  in standard position.



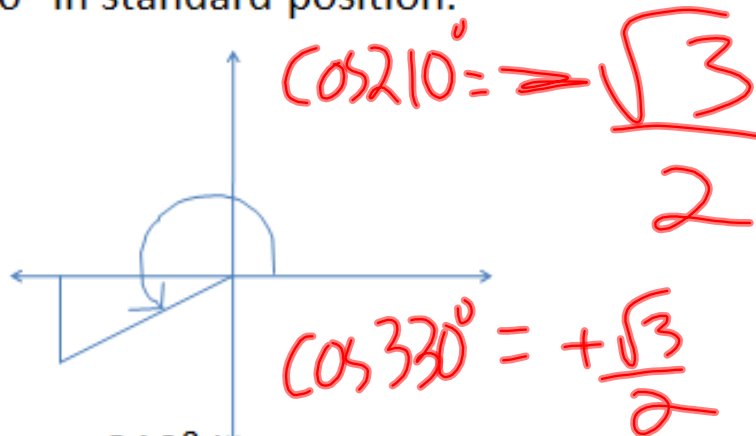
$$\cos 150^\circ = \cos 30^\circ$$

$$= -\frac{\sqrt{3}}{2}$$

a) Determine  $\cos 150^\circ$  two ways.

## cos 210

a) Sketch  $210^\circ$  in standard position.



b) Determine  $\cos 210^\circ$  two ways.

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$\cos 150^\circ = -\frac{\sqrt{3}}{2}$$

$$\cos 210^\circ = -\frac{\sqrt{3}}{2}$$

$$\cos 330^\circ = \frac{\sqrt{3}}{2}$$

Find  $\theta$  if  $\cos \theta = -\frac{\sqrt{3}}{2}$

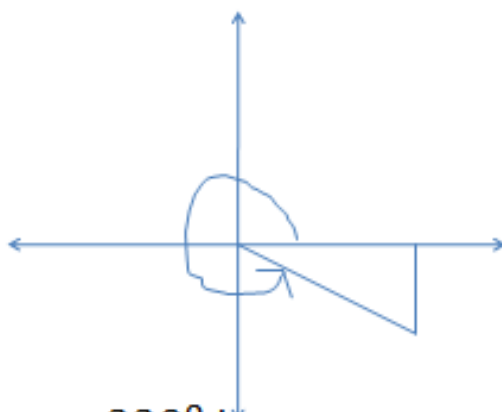
$$\theta = 150^\circ \text{ or } 210^\circ$$

Find  $\theta$  if  $\cos \theta = \frac{\sqrt{3}}{2}$

$$\theta = 30^\circ \text{ or } 330^\circ$$

cos 330

a) Sketch  $330^\circ$  in standard position.



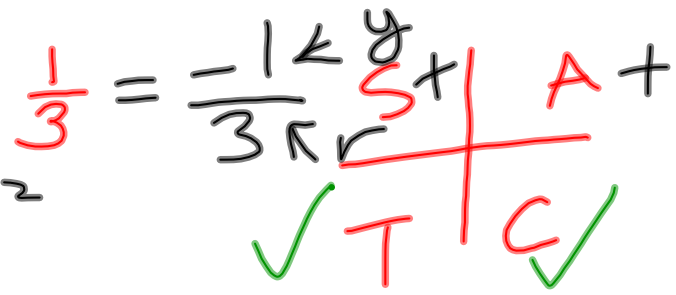
b) Determine  $\cos 330^\circ$  two ways.

$$\begin{aligned}\cos \theta &= 0.866025 \\ \theta &= \cos^{-1}(0.866025) \\ &= 30^\circ\end{aligned}$$



LIKE Pg 300 #6  $\sin \theta = \frac{y}{r}$

Angle  $\theta$  is in Q3 and  $\sin \theta = -\frac{1}{3}$



- ✓ a) Determine the value of x, y, and r.
- ✓ b) Sketch angle  $\theta$  in standard position.

c) Determine the other 2 primary trig ratios for  $\theta$

✓ d) Determine the principal angle  $\theta$  and the related acute angle to the nearest degree.

e) Find another positive angle that has the same sine ratio.

f) Find a negative angle that has the same ratio.

$$\cos \theta = \frac{x}{r} = \frac{-2\sqrt{2}}{3}$$

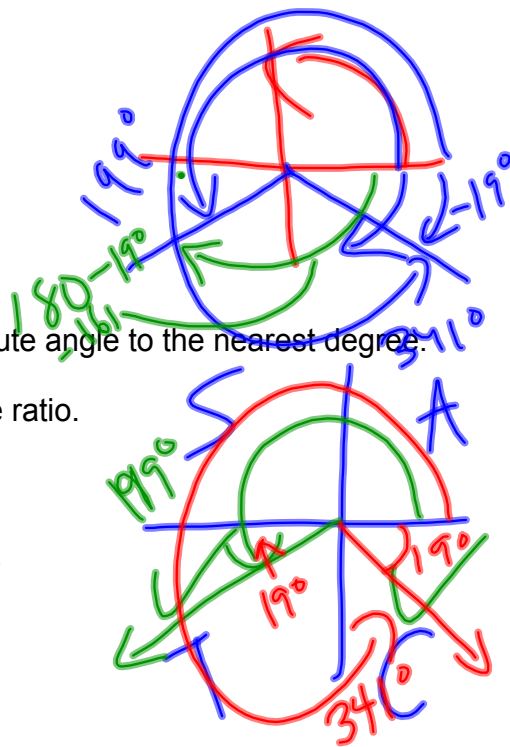
$$\tan \theta = \frac{y}{x} = \frac{-1}{-2\sqrt{2}} = \frac{1}{2\sqrt{2}}$$

$$= \frac{\sqrt{2}}{2 \cdot 2} = \frac{\sqrt{2}}{4}$$

LIKE Pg 300 #6

Angle  $\theta$  is in Q3 and  $\sin\theta = -1/3$

- Determine the value of  $x$ ,  $y$ , and  $r$ .
- Sketch angle  $\theta$  in standard position.
- Determine the other 2 primary trig ratios for  $\theta$
- Determine the principal angle  $\theta$  and the related acute angle to the nearest degree.
- Find another positive angle that has the same sine ratio.
- Find a negative angle that has the same ratio.



$$\sin 199^\circ = \frac{1}{3}$$

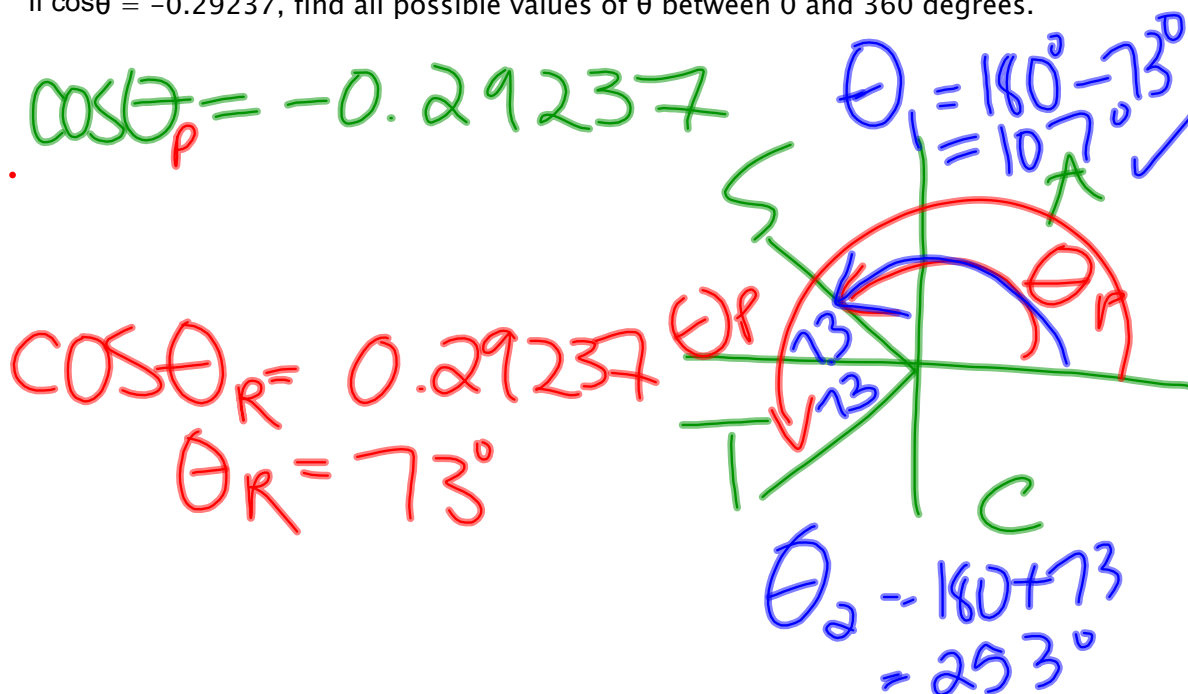
$$\sin 341^\circ = -\frac{1}{3}$$

$$\frac{1}{2} = -2\sqrt{2} \quad \tan\theta = \frac{-1}{-2\sqrt{2}}$$

$$= \frac{1}{2\sqrt{2}}$$

LIKE Pg 300 #8a

If  $\cos\theta = -0.29237$ , find all possible values of  $\theta$  between 0 and 360 degrees.



LIKE #12

$$\tan \theta = -\frac{9}{11}$$

Given  $\tan \theta = -0.8$ , where  $\theta$  is between 0 and 360 degrees.

a) Which quadrant could the terminal arm of  $\theta$  lie?

b) Determine all possible primary trig ratios for  $\theta$ .

c) Evaluate all possible values of  $\theta$  to the nearest degree.

$$\tan \theta_R = \frac{9}{11} = 39^\circ$$

