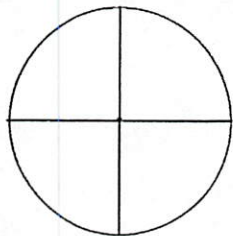


### 11.3 Trig Functions of General Angles

✓ Given any point on the coordinate plane, I can find the six trig functions.



$$\sin\theta = - \quad \csc\theta = -$$

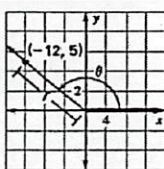
$$\cos\theta = - \quad \sec\theta = -$$

$$\tan\theta = - \quad \cot\theta = -$$

The terminal side of  $\theta$  in standard position contains each point. Find the exact values of the six trigonometric functions of  $\theta$ .

**Example 1** Evaluate trigonometric functions given a point

Let  $(-12, 5)$  be a point on the terminal side of an angle  $\theta$  in standard position. Evaluate the six trigonometric functions of  $\theta$ .



Use the Pythagorean theorem to find the value of  $r$ .

$$r = \sqrt{x^2 + y^2} = \sqrt{(\quad)^2 + \quad^2} = \sqrt{\quad} = \quad$$

Using  $x = -12$ ,  $y = 5$ , and  $r = \quad$ , you can write:

$$\sin\theta = \frac{\quad}{r} = \quad$$

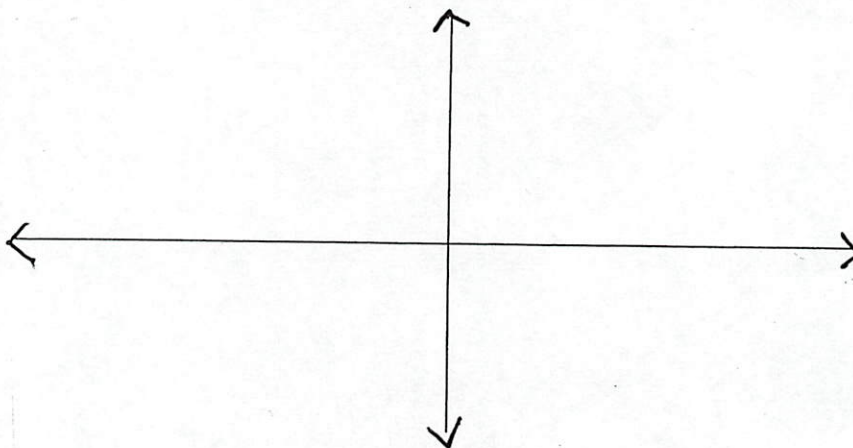
$$\csc\theta = \frac{\quad}{y} = \quad$$

$$\cos\theta = \frac{x}{\quad} = \quad$$

$$\sec\theta = \frac{\quad}{x} = \quad$$

$$\tan\theta = \frac{\quad}{x} = \quad$$

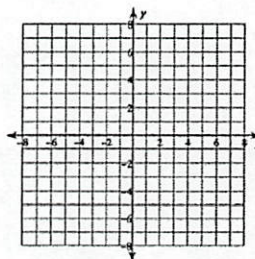
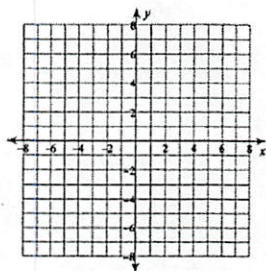
$$\cot\theta = \frac{\quad}{y} = \quad$$



Given the point, find the 6 trig functions of the reference angle.

1)  $(-3, 6)$

2)  $(5, -12)$



✓ I can draw positive and negative angles in standard position.

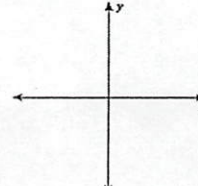
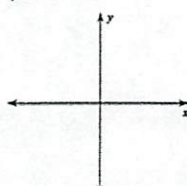
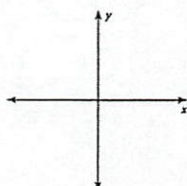
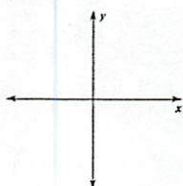
Draw an angle with the given measure in standard position.

3)  $110^\circ$

4)  $670^\circ$

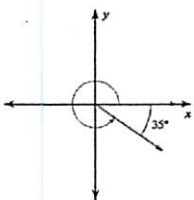
5)  $370^\circ$

6)  $-355^\circ$

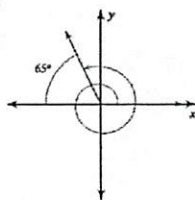


Find the measure of each angle.

7)



8)



✓ Given any angle, I can find a coterminal angle.

**Example 2** Find coterminal angles

Find one positive angle and one negative angle that are coterminal with  $210^\circ$ .

There are many such angles, depending on what multiple of  $360^\circ$  is added or subtracted.

$210^\circ + 360^\circ = \underline{\hspace{2cm}}$        $210^\circ - 360^\circ = \underline{\hspace{2cm}}$

Find one positive and one negative coterminal angles with the given angles.

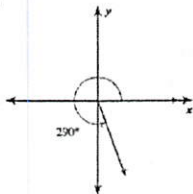
9)  $485^\circ$

10)  $-290^\circ$

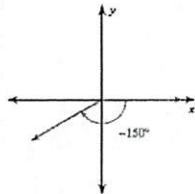
✓ Given any angle, I can find its reference angle.

Find the reference angle.

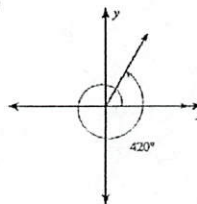
11)



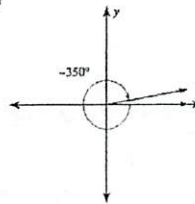
12)



13)



14)



✓ I can find the exact value of a trig function using the reference angle and quadrant.

Steps to evaluate a trigonometric function for any angle  $\theta$ .

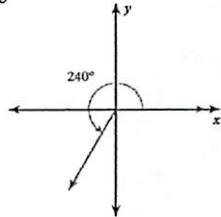
Step 1:

Step 2:

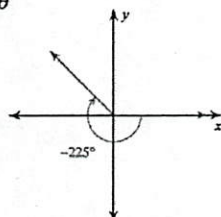
Step 3:

Find the exact value of each trig function:

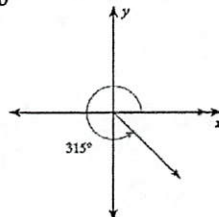
15)  $\sin \theta$



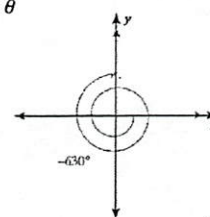
16)  $\sin \theta$



17)  $\cos \theta$



18)  $\cos \theta$



19)  $\sin 30^\circ$

20)  $\cos 180^\circ$

21)  $\tan -210^\circ$

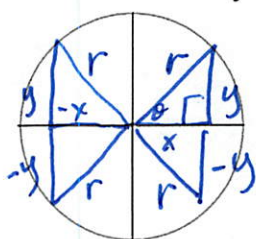
22)  $\sin 225^\circ$

23)  $\cos 60^\circ$

24)  $\tan 90^\circ$

### 11.3 Trig Functions of General Angles

✓ Given any point on the coordinate plane, I can find the six trig functions.



$$x^2 + y^2 = r^2$$

$$\sin \theta = \frac{y}{r}$$

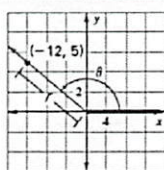
$$\cos \theta = \frac{x}{r}$$

$$\tan \theta = \frac{y}{x}$$

The terminal side of  $\theta$  in standard position contains each point. Find the exact values of the six trigonometric functions of  $\theta$ .

**Example 1** Evaluate trigonometric functions given a point

Let  $(-12, 5)$  be a point on the terminal side of an angle  $\theta$  in standard position. Evaluate the six trigonometric functions of  $\theta$ .



Use the Pythagorean theorem to find the value of  $r$ .

$$r = \sqrt{x^2 + y^2} = \sqrt{(-12)^2 + 5^2} = \sqrt{169} = 13$$

Using  $x = -12$ ,  $y = 5$ , and  $r = 13$ , you can write:

$$\sin \theta = \frac{y}{r} = \frac{5}{13}$$

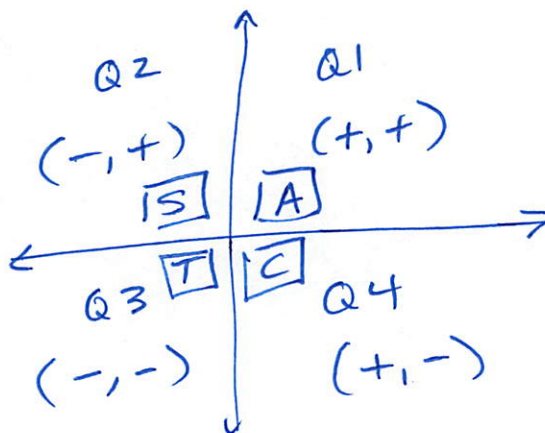
$$\csc \theta = \frac{r}{y} = \frac{13}{5}$$

$$\cos \theta = \frac{x}{r} = \frac{-12}{13}$$

$$\sec \theta = \frac{r}{x} = \frac{13}{-12}$$

$$\tan \theta = \frac{y}{x} = \frac{5}{-12}$$

$$\cot \theta = \frac{x}{y} = \frac{-12}{5}$$

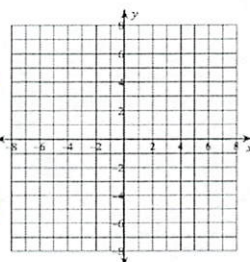
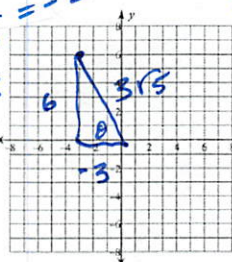


Given the point, find the 6 trig functions of the reference angle.

- 1)  $(-3, 6)$       2)  $(5, -12)$

$\tan \theta = \frac{6}{-3} = -2$   
 $\csc \theta = \frac{\sqrt{35}}{6}$   
 $\sec \theta = -\frac{\sqrt{35}}{3}$

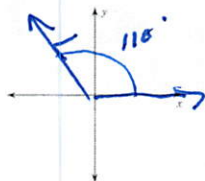
$\sin \theta = \frac{6}{\sqrt{35}}$   
 $\cos \theta = \frac{-3}{\sqrt{35}}$   
 $\csc \theta = \frac{\sqrt{35}}{6}$   
 $\sec \theta = -\frac{\sqrt{35}}{3}$



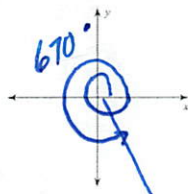
✓ I can draw positive and negative angles in standard position.

Draw an angle with the given measure in standard position.

- 3)  $110^\circ$

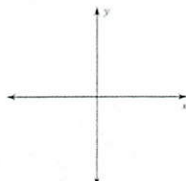


- 4)  $670^\circ$

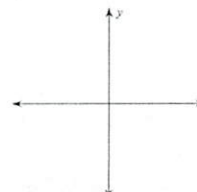


$$\begin{array}{r} 670 \\ -360 \\ \hline 310 \end{array}$$

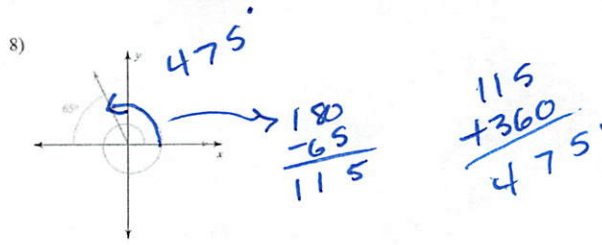
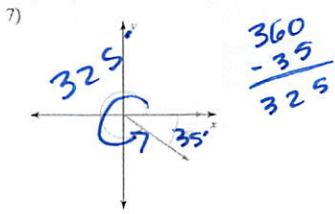
- 5)  $370^\circ$



- 6)  $-355^\circ$



Find the measure of each angle.



✓ Given any angle, I can find a coterminal angle.

**Example 2** Find coterminal angles

Find one positive angle and one negative angle that are coterminal with  $210^\circ$ .

There are many such angles, depending on what multiple of  $360^\circ$  is added or subtracted.

$210^\circ + 360^\circ = 570^\circ$        $210^\circ - 360^\circ = -150^\circ$

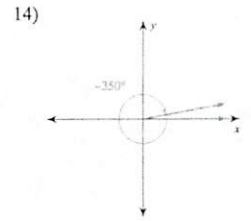
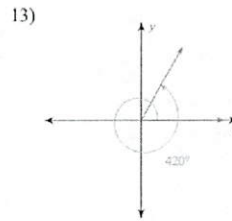
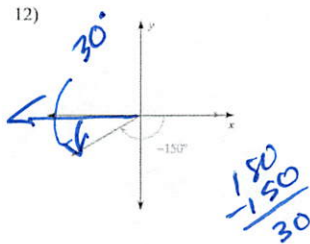
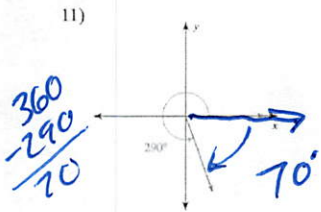
Find one positive and one negative coterminal angles with the given angles.

9)  $485^\circ$

10)  $-290^\circ$   
Handwritten calculation:  $-290 + 360 = 70$   
Handwritten calculation:  $70 + 360 = 430$

✓ Given any angle, I can find its reference angle.

Find the reference angle.



✓ I can find the exact value of a trig function using the reference angle and quadrant.

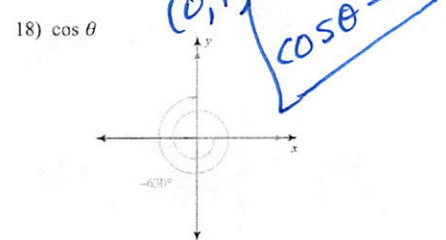
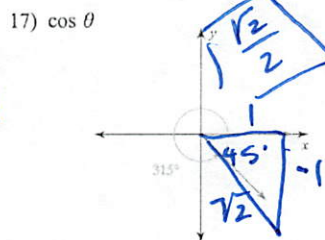
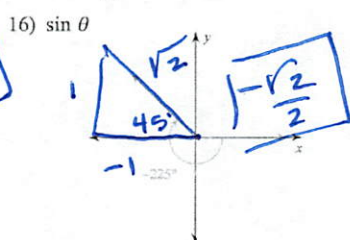
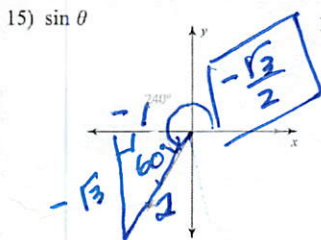
Steps to evaluate a trigonometric function for any angle  $\theta$ .

Step 1: Find the reference angle  $\theta'$

Step 2: Evaluate the trig function for  $\theta'$

Step 3: Determine the sign (+, -) of the trig function value from the quadrant in which  $\theta$  lies.

Find the exact value of each trig function:



19)  $\sin 30^\circ$

20)  $\cos 180^\circ$   
Handwritten calculation:  $\cos 180 = -1$

21)  $\tan -210^\circ$

22)  $\sin 225^\circ$

23)  $\cos 60^\circ$

24)  $\tan 90^\circ$

