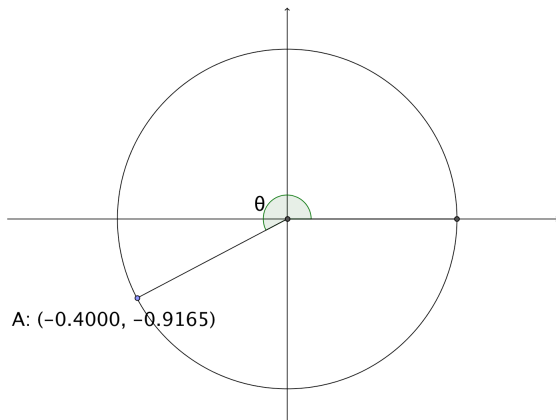


**Directions:** You may NOT use Right Triangle Trigonometry for any of these problems! Use your unit circle knowledge to solve these problems. No SOHCAHTOA allowed! If you see the symbol  $\text{Ⓜ}$ , you may use your calculator for that problem. Otherwise, no scientific calculator allowed.

**Part 1:** If the point  $(1,0)$  is rotated  $\theta^\circ$  counterclockwise around the origin, its image is  $(\cos\theta, \sin\theta)$ .


- Let angle  $\theta$  be  $125^\circ$ . For questions a-d, only use angles from 0 to 360 degrees.
  - State the measure of another angle that has the same sine as angle  $\theta$ . \_\_\_\_\_
  - State the measure of another angle that has the same cosine as angle  $\theta$ . \_\_\_\_\_
  - State the measures of two angles that have the opposite sine as angle  $\theta$ . \_\_\_\_\_
  - State the measures of two angles that have the opposite cosine as angle  $\theta$ . \_\_\_\_\_
- The point  $(1, 0)$  is rotated  $x^\circ$  counterclockwise about the origin. The coordinates of its image are as follows:  $(-0.7986, 0.6018)$ .
  - What is  $\sin x$ ? \_\_\_\_\_
  - What is  $\cos x$ ? \_\_\_\_\_
- Using the diagram below find the values of  $\sin\theta$  and  $\cos\theta$ .



$\sin\theta =$  \_\_\_\_\_

$\cos\theta =$  \_\_\_\_\_

- The point  $(1, 0)$  is rotated  $30^\circ$  counterclockwise about the origin. What are the EXACT (no trig expressions) coordinates of the image?
- The point  $(1, 0)$  is rotated  $240^\circ$  counterclockwise about the origin. What are the EXACT (no trig expressions) coordinates of the image?
- The point  $(1, 0)$  is rotated  $135^\circ$  counterclockwise about the origin. What are the EXACT (no trig expressions) coordinates of the image?

7.  The point  $(1, 0)$  is rotated  $320^\circ$  counterclockwise about the origin. What are the approximate coordinates of the image? Round to 4 decimal places.
8. Arrange the following in ascending order:  $\sin 60^\circ$ ,  $\sin 100^\circ$ ,  $\sin 140^\circ$ ,  $\sin 180^\circ$ ,  $\sin 220^\circ$
9. Arrange the following in descending order:  $\cos 70^\circ$ ,  $\cos 140^\circ$ ,  $\cos 210^\circ$ ,  $\cos 280^\circ$ ,  $\cos 350^\circ$
10. The point  $(1, 0)$  is rotated  $435^\circ$  **clockwise** about the origin. What are the EXACT coordinates of the image?

**Part 2:** For any point  $P(x, y)$  in the coordinate plane,  $x = r\cos\theta$ ,  $y = r\sin\theta$ , and  $x^2 + y^2 = r^2$  where  $r$  is the distance between  $P$  and the origin  $O(0, 0)$  and  $\theta$  is the counterclockwise angle of rotation from the positive  $x$ -axis to the terminal side,  $\overline{OP}$ .

1. When the point  $(7, 0)$  is rotated counterclockwise about the origin by  $117^\circ$  it lands on point R. State the EXACT coordinates of point R.

**R** ( \_\_\_\_\_ , \_\_\_\_\_ )

2. When the point  $(2, 0)$  is rotated counterclockwise about the origin by  $60^\circ$  it lands on point S. State the EXACT coordinates of point S.

**S** ( \_\_\_\_\_ , \_\_\_\_\_ )

3. When the point  $(10, 0)$  is rotated counterclockwise about the origin by  $315^\circ$  it lands on point T. State the EXACT coordinates of point T.






**T** ( \_\_\_\_\_ , \_\_\_\_\_ )

4. When the point  $(0.75, 0)$  is rotated counterclockwise about the origin by  $270^\circ$  it lands on point W. State the EXACT coordinates of point W.




**W** ( \_\_\_\_\_ , \_\_\_\_\_ )

5. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are (5, 12). Find EXACT values of  $\sin\theta$  and  $\cos\theta$ .
  
6. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are (24, -7). Find EXACT values of  $\sin\theta$  and  $\cos\theta$ .
  
7. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are  $(-1, \sqrt{3})$ . Find EXACT values of  $\sin\theta$  and  $\cos\theta$ . What's  $\theta$ ?
  
8. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are (1, 2). Find EXACT values of  $\sin\theta$  and  $\cos\theta$ . Simplify all radicals and rationalize all denominators.
  
9. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are (-3, 5). Find EXACT values of  $\sin\theta$  and  $\cos\theta$ . Simplify all radicals and rationalize all denominators.
  
10. A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and lands on point P. The coordinates of point P are (-4, -6). Find EXACT values of  $\sin\theta$  and  $\cos\theta$ . Simplify all radicals and rationalize all denominators.

**Part 3:** Find  $\theta$ . Remember that when using the inverse trig functions, the calculator will only give you a value within a specific range. You may have to carry out an extra step or two to find the correct  $\theta$ .

1.  The point  $(17, 0)$  is rotated  $\theta^\circ$  counterclockwise about the origin and its image is  $(15, 8)$ . Find  $\theta$  to the nearest hundredth of a degree.  $0 \leq \theta < 360^\circ$ .
2.  A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and its image is  $(-7, 9)$ . Find  $\theta$  to the nearest hundredth of a degree.  $0 \leq \theta < 360^\circ$ .
3.  A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and its image is  $(-3, 8)$ . Find  $\theta$  to the nearest hundredth of a degree.
4.  A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and its image is  $(7, -6)$ . Find  $\theta$  to the nearest hundredth of a degree.  $0 \leq \theta < 360^\circ$ .
5.  A point on the positive  $x$ -axis is rotated  $\theta^\circ$  counterclockwise about the origin and its image is  $(-5, 0)$ . Find  $\theta$  to the nearest hundredth of a degree.  $0 \leq \theta < 360^\circ$ .

**Part 4:** Challenge! A picture can be very helpful!

1. The point  $(-9, 0)$  is rotated  $45^\circ$  counterclockwise about the origin. Find the EXACT coordinates of its image.
2. The point  $(0, 2)$  is rotated  $120^\circ$  counterclockwise about the origin. Find the EXACT coordinates of its image.
3.  The point  $(-4, 0)$  is rotated  $50^\circ$  **clock**wise about the origin. Find the approximate coordinates of its image. Round to the nearest hundredth.
4.  The point  $(5, 5)$  is rotated  $60^\circ$  counterclockwise about the origin. Find the approximate coordinates of its image. Round to the nearest hundredth.
5.  The point  $(-7, 24)$  is rotated  $98^\circ$  counterclockwise about the origin. Find the approximate coordinates of its image. Round to the nearest hundredth.