

What is a Radian? Learning Task:

On a separate sheet of blank paper, use a compass to draw a circle of any size. Make sure the center of the circle is clearly marked. Use a straightedge to draw a radius of the circle.

Take a piece of string and “measure” the radius of the circle. Cut the string to exactly the length of the radius.

1. Beginning at the end of the radius, wrap the cut string around the edge of the circle. Mark where the string ends on the circle. Move the string to this new point and wrap it to the circle again. Continue this process until you have gone completely around the circle. How many radius lengths did it take to complete the distance around the circle? What geometric concept does this reflect?

2. Remember from your study of circles in Mathematics 2 that arcs can be measured in degrees or by length. In Trigonometry, we can measure arcs by degrees or radians. Based on your process in #1, what do you think a radian is?

3. Let’s consider the unit circle. We know the radius is equal to 1 unit, thus the circumference is 2π . How does this value relate to the work you did in #1?

4. So far, we know that the complete circle measures 2π radians and 360° . Can we simplify this relationship?

5. Let’s convert several common angles from degrees to radians:
 - a. 180° is half of a circle, so it is how many radians?
 - b. 90° is a quarter of a circle, so it is how many radians?
 - c. 270° is three-quarters of a circle, so it is how many radians?
 - d. 45° is _____ of a circle, so it is _____ radians.

e. 120° is _____ of a circle so it is _____ radians.

6. Other angles can also be converted using the relationship between the degree measure of the angle and the associated arc length, or radian measure.

Degrees to Radians

Radians to Degrees

a. $32^\circ =$ _____

f. $\frac{7\pi}{8} =$ _____

b. $200^\circ =$ _____

g. $\frac{3\pi}{4} =$ _____

c. $140^\circ =$ _____

h. $8\pi =$ _____

d. $920^\circ =$ _____

i. $-\frac{12\pi}{5} =$ _____

e. $-40^\circ =$ _____

j. $2 =$ _____

7. Just as you have found the values of the six trigonometric functions for specific degree measures, you will also need to find the values of these functions for radian measures. Use your knowledge of the unit circle to determine each of the following values.

a. $\sin \frac{\pi}{4} =$ _____

d. $\csc \frac{7\pi}{3} =$ _____

b. $\cos \frac{2\pi}{3} =$ _____

e. $\sec \frac{7\pi}{4} =$ _____

c. $\tan 2\pi =$ _____

f. $\cot \frac{7\pi}{6} =$ _____

8. The values of the trigonometric functions are not readily found from the unit circle. For these values, you will use a scientific or graphing calculator. Be sure your calculator is in radian mode before proceeding.

a. $\csc \frac{\pi}{5} =$ _____

c. $\cot \frac{13\pi}{12} =$ _____

b. $\sec \frac{8\pi}{9} =$ _____

d. $\cos \frac{19\pi}{10} =$ _____