

LAB: INTRODUCTION TO RADIAN MEASUREMENT

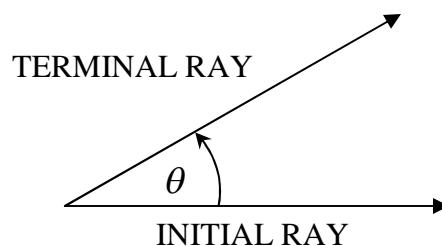
In trigonometry and calculus, it is sometimes more useful to use what is called **radian measurement** rather than degrees. In this investigation we will be studying the origins of radian measurement.

PRE-LAB: DEFINITIONS

Radian measurement is often used once it becomes necessary to study angles that are more than 90 degrees and trace out the path of an entire circle (or several circular rotations). When using such angles we must be aware of some terminology.

Ray: A geometric figure that has a starting point and moves in one direction to infinity.

Angle: An angle is formed by rotating a ray about its endpoint from its initial position to a new position so that it points in a new direction.

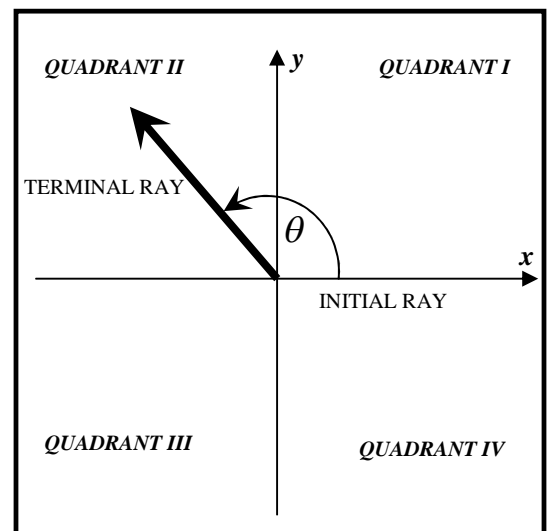


The **initial ray** shows the ray's original position and direction.

The **terminal ray** is the result of rotating the initial ray through an angle of θ .

Standard Position: An angle in standard position has the following characteristics...

- (1) The initial ray lies along the positive x -axis
- (2) A positive angle is formed by rotating the ray in a counterclockwise direction.



PART 1: BASICS

1. Open the web page entitled *CIRCLES & RADIAN MEASUREMENT* at the address below.

<http://atsorren.freewebsites.org/GENERAL/RADIANS/radian.html>

You will be using the slider located at the top of the java applet to adjust the angle of the terminal ray. The terminal ray intersects 3 circles. The RED circle has a radius of 1 unit. The BLUE circle has a radius of 2 units. The GREEN circle has a radius of 3 units.

2. Use the slider to create angles that will allow you to fill in the information in Table 1 below. Be sure that you choose 3 angles from each quadrant.

ANGLE (in degrees)	QUADRANT	RED ARC LENGTH	BLUE ARC LENGTH	GREEN ARC LENGTH
	I			
	I			
	I			
	II			
	II			
	II			
	III			
	III			
	III			
	IV			
	IV			
	IV			

TABLE 1

3. Use the results you obtained in Table 1 to complete Table 2 on the next page. [Note: Each of the Arc Lengths are being divided by the Radius of Rotation.]

ANGLE (in degrees)	QUADRANT	RED ARCLength	BLUE ARCLength	GREEN ARCLength
		1	2	3
	I			
	I			
	I			
	II			
	II			
	II			
	III			
	III			
	III			
	IV			
	IV			
	IV			

TABLE 2

FOLLOW-UP QUESTIONS:

- (1) For each angle, what did you notice about the calculations produced by dividing the arc length by the radius of rotation? [These are the calculations found in the last three columns of Table 2.]

- (2) The value you calculated in the last three columns of Table 2 was the radian measurement of the angle you chose. Based on knowing this, write a definition for radian measurement.

- (3) Based on your results, which circle [Red, Blue or Green] was the easiest to use to find the radian measurement of an angle?

- (4) The red circle in the applet is often called the **unit circle**. Give an explanation as to why it is given this name.

(5) FORMAL DEFINITION OF RADIAN MEASUREMENT

Complete the statement below.

The radian measurement of an angle is given by the measurement of the _____ that an angle traces along the _____ circle.

PART 2: CONVERSION FACTOR

1. Use the applet to find the radian measurement of an angle of 180° . _____
2. The number you wrote above is rounded to 5 decimal places. The number you found in #1 has a special name. What is the name given to that number? [Hint: It is an irrational number that has been given a Greek symbol for its name.]

3. Complete this statement:

$$180^\circ = \text{_____ radians}$$

This is the common conversion factor used for radians. This is used to convert degrees to radians and vice versa.

PART 3: RADIANS IN TERMS OF PI (π)

1. Use the applet to find the radian measurement of the angles listed in the table below. This will go into **column 2** of Table 3. [As you should have concluded in part 2, the easiest way to find the radian measurement is to simply use the arc length of the unit circle.]

ANGLE (in degrees)	RADIAN MEASUREMENT (from applet)	COLUMN 1 DIVIDED BY PI	RESULT FROM COLUMN 3 WRITTEN AS FRACTION	RADIAN MEASUREMENT IN TERMS OF PI
0°				
30°	0.5236	0.16̄	$\frac{1}{6}$	$\frac{\pi}{6}$
45°				
60°				
90°				
120°				
135°				
150°				
180°	3.14159	1	1	π
210°				
225°				
240°				
270°				
300°				
315°				
330°				
360°	*****	*****	*****	

TABLE 3

2. Now divide each of the values in column 2 by π . Use the numbers you obtain to fill in **column 3** of Table 3. One calculation has been done for you [see steps below].

$$\text{Angle} = 30^\circ \quad \frac{0.5236}{\pi} = 0.166667056$$

$$\text{Radians} = 0.5236 \quad \approx 0.1\bar{6}$$

