Name: Mrs. Dunphy Period: _____

Unit Circle Activity: Symmetry Groups

Today, you will be using the milepost angles from the first quadrant of the unit circle to develop the "symmetry groups" which form the basis of our understanding of the other three quadrants. On the separate page you received, you will see three circles. Each circle will be used to develop one of the three symmetry groups. The steps below will walk you through the process of creating the symmetry groups. (Make sure that you staple the separate sheet to this packet before submitting it.)

Circle #1:

1. Label the following angles: 0 rad, $\frac{\pi}{6}$ rad, $\frac{\pi}{2}$ rad, π rad, and $\frac{3\pi}{2}$ rad.
2. Remembering that the top half of the circle accounts for π radians, and noticing that the top half is split into six equal parts, determine the radian measures of the other angles in the top half of the circle. ✓
3. You should see a pattern in the top half of the circle. Continue this pattern through the bottom half of the circle to determine the radian measures of the angles in the bottom half of the circle. ✓
4. Draw the right triangle which corresponds to the angle $\frac{\pi}{6}$ radians by putting an altitude from that angle down to the x-axis. ✓
5. Write the ordered pair for $\frac{\pi}{6}$ radians on the outside of the circle, by that angle. ✓
6. Think about reflecting that point across the x-axis, across the y-axis, and across the origin. Draw the three triangles which would result from these reflections. Shade them in to form a bowtie shape. ✓
7. The angles in the $\frac{\pi}{6}$ symmetry group are:

   $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

8. Use the ordered pair for $\frac{\pi}{6}$ to determine the ordered pairs for the other angles in the $\frac{\pi}{6}$ symmetry group. Write the correct ordered pairs next to the angles. Remember that x is negative in QII, both x and y are negative in QIII, and y is negative in QIV.
9. Complete the table below:

$\pi/6$ symmetry group			
Angle (in radians)	Quadrant	Sine	Cosine
$\frac{\pi}{6}$	I	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
$\frac{5\pi}{6}$	II	$\frac{1}{2}$	$\frac{-\sqrt{3}}{2}$
$\frac{7\pi}{6}$	III	$-\frac{1}{2}$	$\frac{-\sqrt{3}}{2}$
$\frac{11\pi}{6}$	IV	$-\frac{1}{2}$	$\frac{\sqrt{3}}{2}$

Circle #2:

1. Label the following angles: 0 rad, $\frac{\pi}{4}$ rad, $\frac{\pi}{2}$ rad, π rad, and $\frac{3\pi}{2}$ rad. ✓
2. Remembering that the top half of the circle accounts π radians, and noticing that the top half is split into four equal parts, determine the radian measures of the other angles in the top half of the circle. ✓
3. You should see a pattern in the top half of the circle. Continue this pattern through the bottom half of the circle to determine the radian measures of the angles in the bottom half of the circle. ✓
4. Draw the right triangle which corresponds to the angle $\frac{\pi}{4}$ radians by putting an altitude from that angle down to the x-axis. ✓
5. Write the ordered pair for $\frac{\pi}{4}$ radians on the outside of the circle, by that angle. ✓
6. Think about reflecting that point across the x-axis, across the y-axis, and across the origin. Draw the three triangles which would result from these reflections. Shade them in to form a bowtie shape. ✓
7. The angles in the $\frac{\pi}{4}$ symmetry group are:

   $\frac{\pi}{4}$, $\frac{3\pi}{4}$, $\frac{5\pi}{4}$, $\frac{7\pi}{4}$

8. Use the ordered pair for $\frac{\pi}{4}$ to determine the ordered pairs for the other angles in the $\frac{\pi}{4}$ symmetry group. ✓ Write the correct ordered pairs next to the angles. Remember that x is negative in QII, both x and y are negative in QIII, and y is negative in QIV. ✓
9. Complete the table below:

$\pi/4$ symmetry group			
Angle (in radians)	Quadrant	Sine	Cosine
$\frac{\pi}{4}$	I	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
$\frac{3\pi}{4}$	II	$\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$
$\frac{5\pi}{4}$	III	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$
$\frac{7\pi}{4}$	IV	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$

Circle #3:

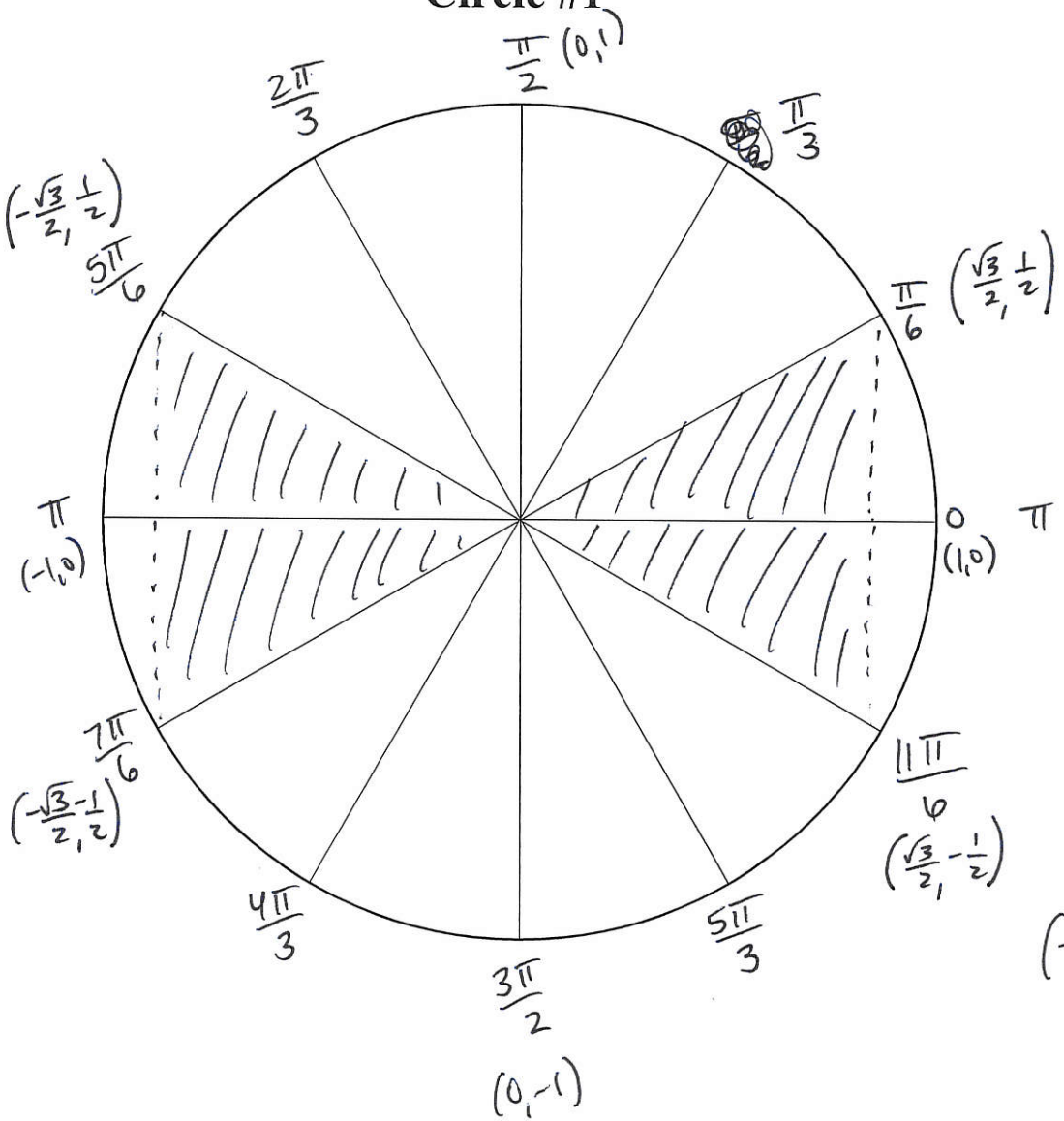
1. Label the following angles, in both radians and degrees: 0 rad, $\frac{\pi}{3}$ rad, and π rad.
2. Remembering that the top half of the circle accounts for π radians, and noticing that the top half is split into three equal parts, determine the radian measures of the other angles in the top half of the circle. (The vertical line is only present so that you can visualize where the y-axis is located.)
3. You should see a pattern in the top half of the circle. Continue this pattern through the bottom half of the circle to determine the radian measures of the angles in the bottom half of the circle.
4. Draw the right triangle which corresponds to the angle $\frac{\pi}{3}$ radians by putting an altitude from that angle down to the x-axis.
5. Write the ordered pair for $\frac{\pi}{3}$ radians on the outside of the circle, by that angle.
6. Think about reflecting that point across the x-axis, across the y-axis, and across the origin. Draw the three triangles which would result from these reflections. Shade them in to form a bowtie shape.
7. The angles in the $\frac{\pi}{3}$ symmetry group are:

   $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

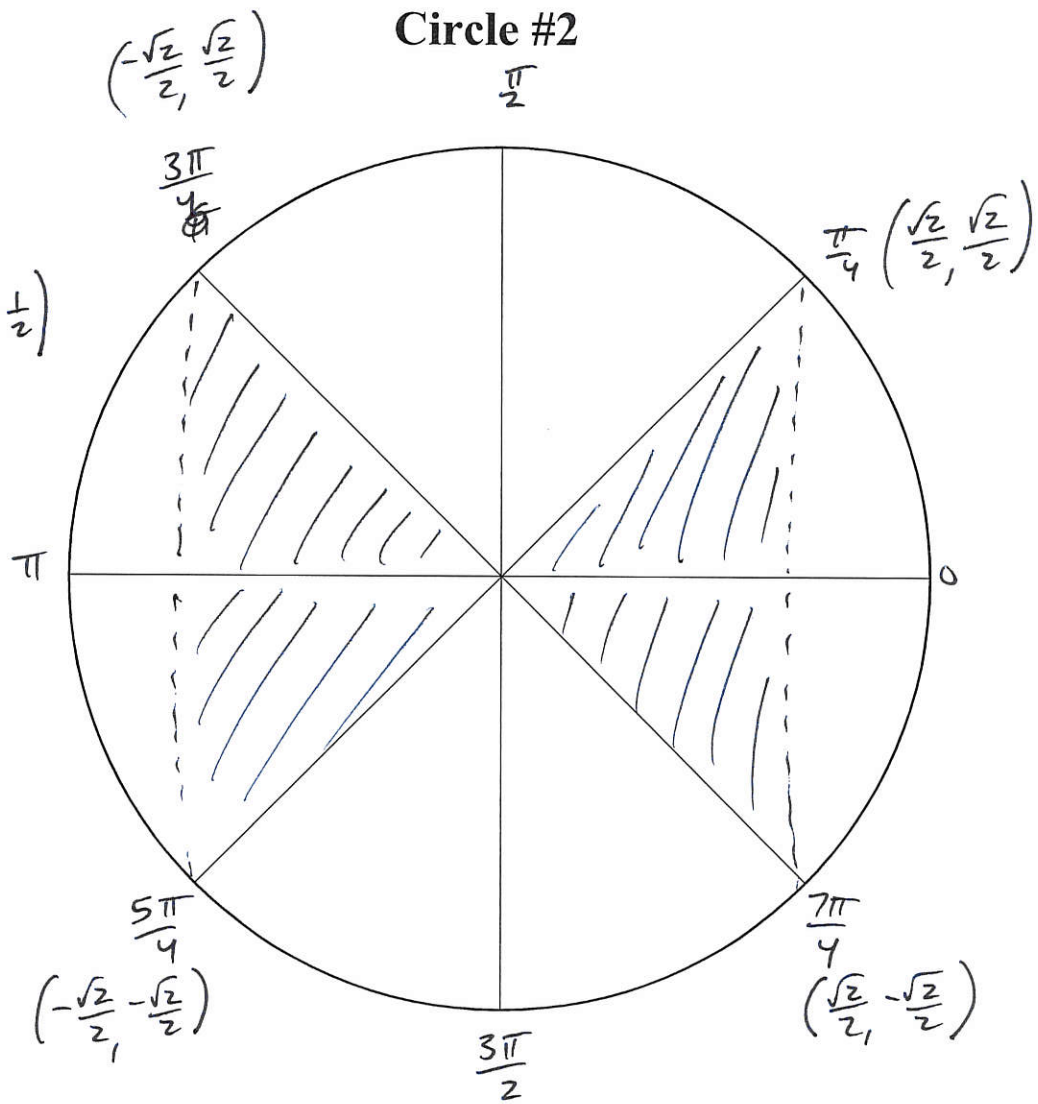
8. Use the ordered pair for $\frac{\pi}{3}$ to determine the ordered pairs for the other angles in the $\frac{\pi}{3}$ symmetry group. Write the correct ordered pairs next to the angles. Remember that x is negative in QII, both x and y are negative in QIII, and y is negative in QIV.
9. Complete the table below:

$\pi/3$ symmetry group			
Angle (in radians)	Quadrant	Sine	Cosine
$\frac{\pi}{3}$	I	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$
$\frac{2\pi}{3}$	II	$\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$
$\frac{4\pi}{3}$	III	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$
$\frac{5\pi}{3}$	IV	$-\frac{\sqrt{3}}{2}$	$\frac{1}{2}$

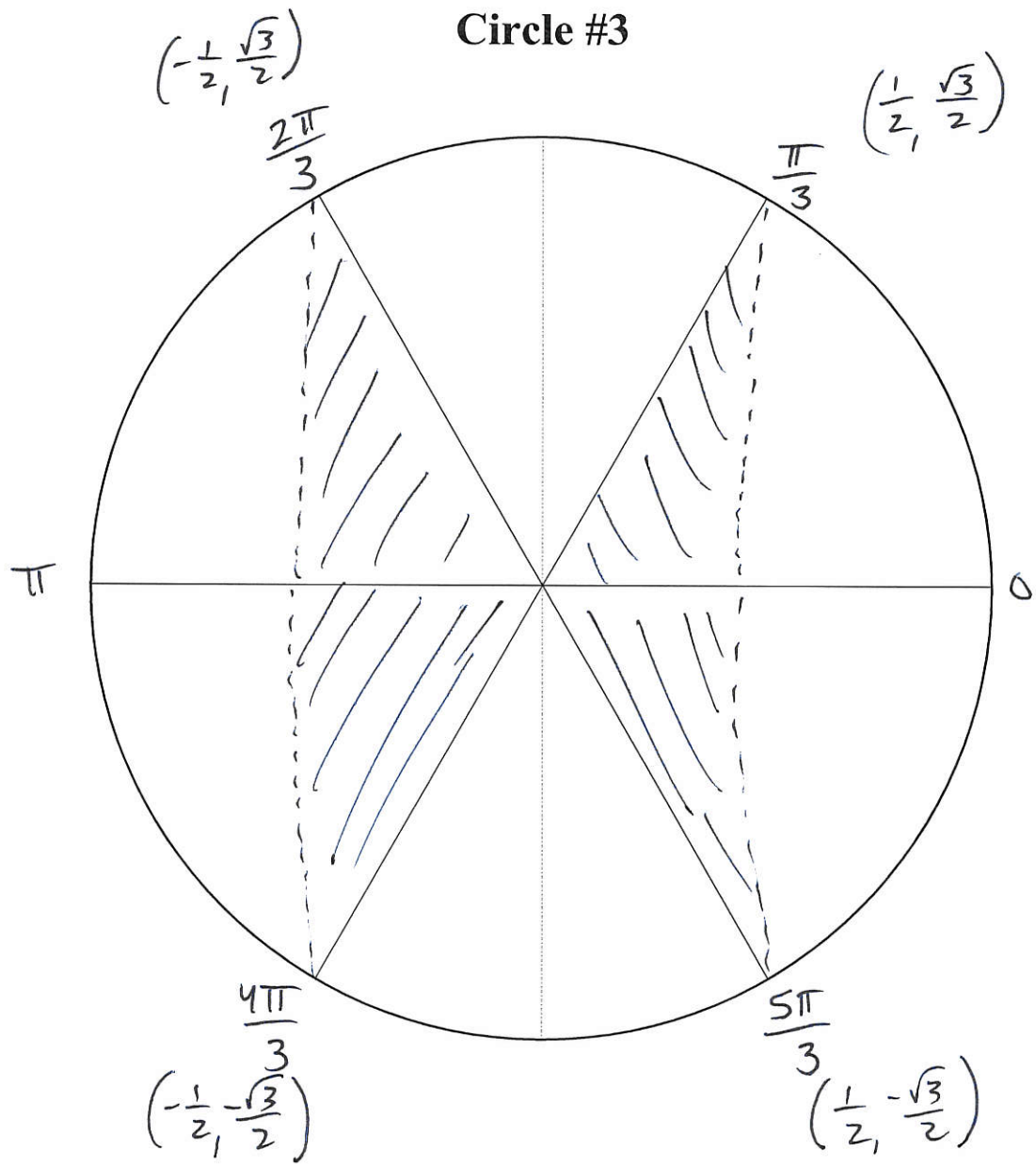
Circle #1



Circle #2



Circle #3


$\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$
$\frac{2\pi}{3}$
$\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$
$\frac{\pi}{3}$
π
0
$\frac{4\pi}{3}$
$\left(-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$
$\frac{5\pi}{3}$
$\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$

Ms. Murphy

Period: _____

Symmetry Groups Homework

1) Using the *Symmetry Groups* activity you completed during class today, fill in the table below. You will need to calculate the value of tangent; please show your work in the table.

	Angle (radians)	Angle (degrees)	Sine	Cosine	Tangent = $\frac{\sin}{\cos}$
	0	0	0	1	$\frac{0}{1} = 0$
1	$\pi/6$	30	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2} \cdot \frac{2}{\sqrt{3}} = \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}}$ $\frac{\sqrt{3}}{3}$
2	$\pi/4$	45	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2} \div \frac{\sqrt{2}}{2} = 1$
3	$\pi/3$	60	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2} \cdot \frac{2}{1} = \sqrt{3}$
	$\pi/2$	90	1	0	$\frac{1}{0} = \emptyset$ und.
3	$2\pi/3$	120	$\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$\frac{\sqrt{3}}{2} \cdot \frac{-2}{1} = -\sqrt{3}$
2	$3\pi/4$	135	$\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2} \cdot \frac{-2}{\sqrt{2}} = -1$
1	$5\pi/6$	150	$\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$\frac{1}{2} \cdot \frac{2}{-\sqrt{3}} = \frac{-1}{\sqrt{3}} = \frac{-\sqrt{3}}{3}$
	π	180	0	-1	$\frac{0}{-1} = 0$
1	$7\pi/6$	210	$-\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2} \cdot \frac{-2}{\sqrt{3}} = \frac{+1}{\sqrt{3}}$ $\frac{\sqrt{3}}{3}$
2	$5\pi/4$	225	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2} \cdot \frac{-2}{\sqrt{2}} = 1$
3	$4\pi/3$	240	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$-\frac{\sqrt{3}}{2} \cdot \frac{-2}{1} = \sqrt{3}$
	$3\pi/2$	270	-1	0	$\frac{-1}{0} = \emptyset$ und.
3	$5\pi/3$	300	$-\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$-\frac{\sqrt{3}}{2} \cdot \frac{2}{1} = -\sqrt{3}$
2	$7\pi/4$	315	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2} \cdot \frac{2}{\sqrt{2}} = -1$
1	$11\pi/6$	330	$-\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$-\frac{1}{2} \cdot \frac{2}{\sqrt{3}} = \frac{-1 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}}$ $-\frac{\sqrt{3}}{3}$
	2π	360	0	1	$\frac{0}{1} = 0$