## Discovering the Unit Circle

MATERIALS NEEDED: protractor, measuring sticks (unmarked strips of paper), and graphing calculator.

1. Using any method you want to find the center of the circle. Your center needs to be precise or this experiment will not work.
2. Draw the diameter of your circle.
3. Construct another diameter for you circle perpendicular to the one you drew in \#2. These diameters will intersect at the center of the circle.
4. Extend the two diameters that you drew beyond the circle. In effect, you have constructed two coordinate axes. Label one of them the x -axis and the other one the y-axis. Lightly label each of the four quadrants (I, II, III, and IV) on your paper.
5. Make a measuring system of your own. Create your own measuring stick (be sure that it is longer than the radius of your circle). Make it as accurate as possible. Make up a name for your units. For example, let one unit be one gum wrapper. Now, you will be measuring in lengths of gum wrappers instead of inches or centimeters. What is the radius of your circle in terms of your new unit? $\qquad$
What is the equation of your circle in terms of your new unit? $\qquad$ (Note: The equation of a circle centered at the origin is $x^{2}+y^{2}=r^{2}$ )
6. Decide on a method that will divide the circumference of your circle into 24 equally spaced segments (arcs). You may use a protractor and your new measuring stick to do this. What is the measure of each of the central angles, which have been formed by these arcs? $\qquad$ Mark each of these dividing points.
7. Enter the angles $(0,15,30,45 \ldots 345)$ into L1 in your calculator. (STAT...EDIT....L1)

Why was 360 not entered into the list? $\qquad$
8. Using your new units, determine the $x$ and $y$-coordinates of each of the points that you marked in \#6. This may take a while, and can be quite tedious, but be as accurate as you can, as this is one of the most crucial aspects of this activity. Record the $x$ coordinates in L2 and the y-coordinates in L3. (NOTE: These coordinates must correspond to the angle measures you typed into L1).
9. The number of elements in each list is called the dimension of the list. Check to see that each list (L1, L2, and L3) all have the same dimensions.
10. Record the values you have for L1, L2 and L3 in the tables provided.
11. What is the radius of your circle (in your new units)?
$\qquad$ This is the same value you listed in $\# 5$.
12. In your calculator, highlight L 4 and enter $\mathrm{L} 2 / \mathrm{R}$ (that is, press $2^{\text {nd }} \# 2$ to get L 2 to show up and then divide by your actual radius). You should see a new set of numbers show up in L4.
13. Now highlight L5 and enter L3/R. You should see a new set of numbers.
14. What do you think the numbers in L4 represent?
15. What do you think the numbers in L5 represent?
16. Please record the values you have for L4 and L5 in the table provided.

| L1 | L2 | L3 | L4 | L5 |
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17. You are now ready to construct a scatter plot of your data. In the Stat Plot menu, turn on Plot 1 and select the first type of scatter plot that is given. In the x -list, enter L1 and in the y -list enter L2. Choose the dot at the mark.
18. Set a window appropriate to your data. (Hint: ZoomStat \#9)
19. Press GRAPH to view your scatter plot. Sketch a graph on "Connections between graph and circle."
20. Repeat procedures in \#'s $17-19$, using L3 in place of L2.
21. Repeat procedures in \#'s $17-19$, using L4 in place of L2.
22. Repeat procedures in \#'s $17-19$, using L5 in place of L2.

Conjectures about the data of L1 vs. L4:

Conjectures about the data of L1 vs. L5:

Compare your graphs of L1 vs. L4 and L1 vs. L5 with 2 other students. What similarities/differences do you notice? Please note any here:

