Wrapping Functions

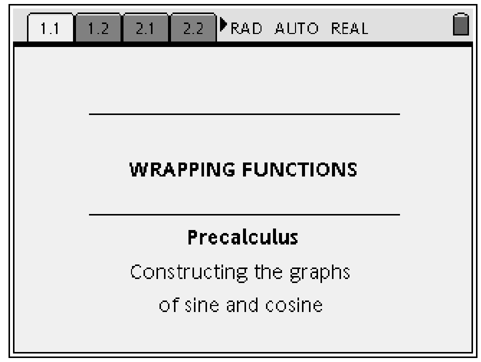
ID: 8257

Name ______________________

Class ______________________

In this activity, you will:

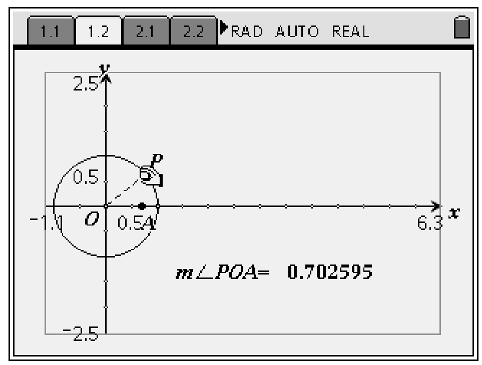
- *capture and display different measures of circular functions*
- *investigate the graphs of the sine and cosine functions*



Open the file *PreCalcAct1_WrappingFxns_EN.tns* on your handheld and work by yourself or with a partner to complete the activity. Use this document as a reference and to record your answers.

Problem 1

On page 1.2, you will find a unit circle centered at the origin, and a point *P* (represented by an open circle) that can be dragged around the circle. Point *A* is on the *x*-axis, and the measure of ∠*POA*, in radians, is displayed on the screen. At all times, this measure is equal to the *x*-coordinate of point *A*. Grab point *P* and drag it counterclockwise around the circle, observing the location of point *A* as you do so. Then answer these questions.



1. As you move point *P* counterclockwise, in what direction does point *A* move? Does the *x*-coordinate of point *A* increase or decrease?

2. Where is point *P* approximately located when the measure of the angle changes from about 1.5 radians to about 1.6 radians?

3.1 to 3.2?

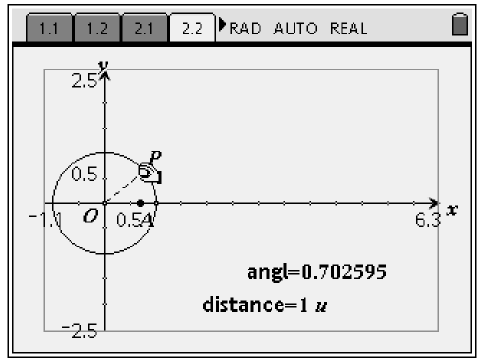
4.7 to 4.8?

3. What happens when you drag *P* completely around the circle? What is greatest measure that ∠*POA* can have?

4. Try dragging point *P* clockwise around the circle. What happens to point *A* as you do so? Explain.

Problem 2

In this problem, you will record some data as point *P* is moved around the circle. Advance to the graph on page 2.2. For a specified location of point *P*, the value of the angle and the distance from point *P* to the origin will be captured into the spreadsheet on page 2.1.



Before dragging point *P*, think about what the graph of angle measures v. distances might look like.

Now, drag point *P* counterclockwise around the circle, pressing ctrl + . every few moments to capture different values. As you do so, the scatter plot (angle measures, distances) appears. Use the scatter plot to answer the questions below.

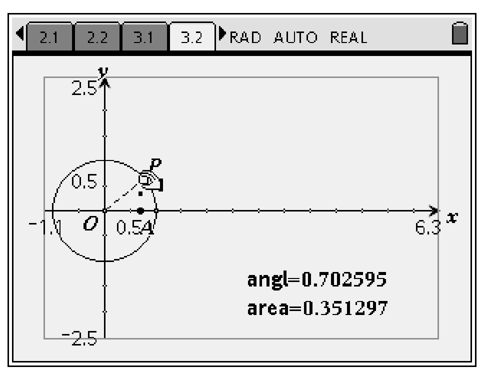
1. Why do the points of the scatter plot lie on a horizontal line? What is the equation of this line?

2. Return to page 2.1 and place the cursor on the gray formula cell for Column A. Press enter twice to clear out the data from the column. Repeat this procedure to clear out the data in Column B. Return to page 2.2, and suppose you were to change the radius of the circle from 1 unit to 2 units. How would the scatter plot (angle measures, distances) be affected? Explain. Then drag the point at (1, 0) to (2, 0) and recapture values using ctrl + . to test your prediction.

Before moving on to Problem 3, clear the data from page 2.1 as described above.

Problem 3

Now you will graph a more interesting function of $\angle POA$—the area of the sector of the circle swept out by $\overline{PO}$. This time, the values are captured and displayed *automatically* as point *P* moves around the circle. On page 3.2, drag point *P* counterclockwise one revolution and watch as the scatter plot appears.



1. What is the area of the sector when the angle is 0?

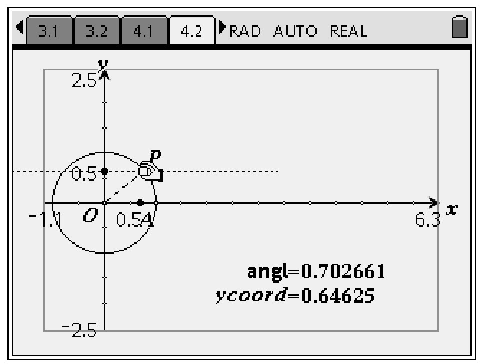
2. What happens to the area as the angle increases from 0 to about 1.5?

3. How many times higher on the graph is the point corresponding to an angle measure of about 3.14 radians than that for an angle measure of 1.57 radians?

   What about an angle measure of 4.71 compared to an angle measure of 1.57?

4. Return to page 3.1 and clear out the data from both columns. Suppose you were to again change the radius from 1 unit to 2 units. How would the scatter plot (angle measures, areas) be affected? Explain. Then drag the point at (1, 0) to (2, 0) and test your prediction. (Clear any re-captured data before proceeding to Problem 4.)

Problem 4



In this problem, you will begin to investigate another function of an angle: the *y*-coordinate of point *P*.

On page 4.2, grab point *P* and drag it around the circle once. As you do, observe the location and movement of the two points on the *x*- and *y*-axes.

Return to page 4.1 and examine the captured data values in the spreadsheet. Each row represents an angle measure/*y*-coordinate pair. Use these values (or carefully observe the movement of the point on the *y*-axis) to answer these questions. (Clear out the data from both columns before proceeding to Problem 5.)

1. What is the greatest value the *y*-coordinate of *P* obtains? What is the approximate measure of the angle when the *y*-coordinate obtains its maximum value?

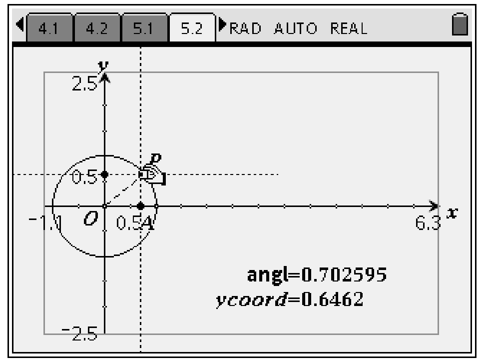
2. What is the least value the *y*-coordinate of *P* obtains? What is the approximate measure of the angle when the *y*-coordinate obtains its minimum value?

3. What is the approximate measure of the angle when the *y*-coordinate changes from a positive value to a negative value?

4. For what angle measures is the *y*-coordinate decreasing? increasing?

Problem 5

This problem again explores the relationship between the angle measures and *y*-coordinates. Here, you will again capture these values, but now you will also see the scatter plot emerge on page 5.2. The *x*-coordinate of each plotted point is an angle measure. The corresponding *y*-coordinate for each point is equal to the *y*-coordinate of point *P*. Think about what this graph might look like. Then drag point *P* as before, sketch the scatter plot to the right, and answer the following questions.



1. What are the approximate coordinates of this graph's highest point?

2. What are the approximate coordinates of this graph's lowest point?

3. What is the approximate *x*-intercept of this graph?

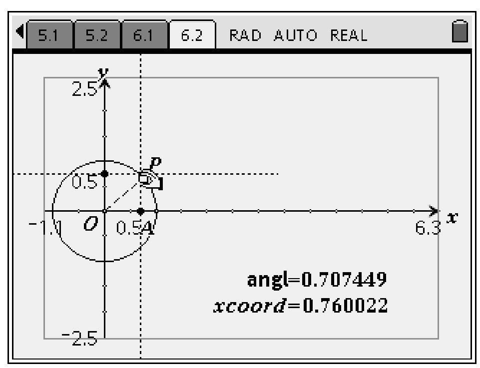
4. In what quadrant(s) is point *P* when the graph is decreasing? increasing?

Compare these answers to your answers from Problem 4. Do your answers match?
The curve formed by the points in your scatter plot is called the *sine function*. In the next problem, you will examine points that form the *cosine function*.

Before continuing to Problem 6, clear out the data from the spreadsheet once more.

Problem 6

This problem explores the relationship between the angle measures and corresponding *x*-coordinates of point *P*. Think about what this graph might look like, and drag point *P*, watching the scatter plot appear. Sketch the scatter plot here and answer the questions below.



1. What are the approximate coordinates of this graph's highest point(s)? its lowest point(s)?

2. What are the approximate *x*-intercepts of this graph?

3. In what quadrant(s) is point *P* when the graph is decreasing? increasing?

4. How does this graph of the cosine function compare with that of the sine function from Problem 5?

