Limit of Sin(*x*)/*x*

Name _____

Class _____

In this activity you will be exploring $y = \frac{\sin(x)}{x}$. When the value of a function is $\frac{0}{0}$, the function at that point is said to be *indeterminate*.

Problem 1 – Graphical Limit

1. Graph the function $f(x) = \frac{\sin(x)}{x}$. Go to the Y= screen and type **sin(x)/x** next to y1.

2. Press F2 and select **ZoomTrig** to view the graph.

- Graphically, approximately what value does *y*1(*x*) appear to equal as *x* approaches 0?

3. Remove the axes by pressing F1 and selecting **Format**. Arrow down to 'Axes' and arrow right to select **OFF**. Press ENTER to save.

4. Press F3 (Trace). Examine points in the neighborhood of *x* = 0.

- Type 0.1 ENTER. Then type 0.01 ENTER. What does the *y*-value equal as you move the point from the right toward *x* = 0?

- Repeat for –0.1, –0.01, etc. What does the *y*-value equal as you move the point from the left toward *x* = 0?

- What happens when you type 0 ENTER? Why?

Problem 2 – Numerical Limit

4. Press ◆ F4 to change tblStart to –0.1 and Δtbl to 0.01. Press ENTER to save.

5. Press ◆ F5 to view the table. Arrow down to observe what is happening to *y*1 as *x* approaches 0. To see more decimal places for *y*1 arrow over to the *y*1 column and continue to arrow down and up.

- Is *y*1 defined when *x* = 0? Explain.

- Does *y*1 appear to approach the same value from both sides of zero?

Problem 3 – Algebraic Limit

6. Press [HOME]. To find the limit from the left hand side, press [F3] and choose **limit(**. Then type **y1(x),x,0,–1)** in the entry line and press [ENTER].

The –1 at the end the expression causes it to be a left-hand limit. Remove the negative to make it a right-hand limit.

- $\lim_{x\to 0^-} y1(x) =$

- $\lim_{x\to 0^+} y1(x) =$

7. When the left-hand limit equals the right-hand limit, the limit exists. Enter **limit(y1(x),x,0)** to determine the limit.

- $\lim_{x\to 0} y1(x) =$

Practice Problems

Use a graph and a spreadsheet to determine the limit of the following problems.

1. $\lim_{x\to 1} \frac{x-1}{x^3-1}$ **2.** $\lim_{x\to 0} \frac{1-\cos(x)}{x^2}$ **3.** $\lim_{x\to 0} (1+x)^{\frac{1}{x}}$