Name _____

Date _____

Functions Lab
Calculus BC

In this activity you will review what you know about transformations of functions. Please complete all work on separate paper. Where you are asked to graph multiple functions on the same coordinate plane, please use different colors to indicate each graph. Write all your answers in complete sentences where appropriate. You may use a graphing calculator to help you graph or draw conclusions, but all functions need to be shown on paper.

Part I

A. Let $f(x) = x^2$. Graph the $f(x)$ function on a coordinate plane. On the same coordinate plane, graph $3f(x)$ and $\frac{1}{8}f(x)$. What conclusions can you make about the effect the *a* in $af(x)$ has on the parent function?

Complete these steps again for $f(x) = \sin x$, $f(x) = \sqrt{x}$, and $f(x) = \frac{1}{x}$. Are the conclusions you drew for each function the same or different? Explain why you think that is.

B. Let $f(x) = x^2$. Graph the $f(x)$ function on a coordinate plane. On the same coordinate plane, graph $f(x+3)$ and $f(x)+3$. What conclusions can you make about the effect the *a* in $f(x+a)$ and $f(x)+a$ has on the parent function?

Complete these steps again for $f(x) = \sin x$, $f(x) = \sqrt{x}$, and $f(x) = \frac{1}{x}$. Are the conclusions you drew for each function the same or different? Explain why you think that is.

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Part II

A. Define a function $f(x)$ for which the graph has the following features:

at least one vertical asymptote
more than one *x*-intercept
a *y*-intercept
a horizontal asymptote
symmetric to the *y*-axis

B. Graph the function you defined and completely describe it using correct mathematical terminology.

C. Graph $|f(x)|$ on a separate coordinate plane. How does the absolute value function affect the graph?

D. Graph $f(|x|)$ on a separate coordinate plane. How does the absolute value of the *x* affect the graph?

E. Repeat steps B, C, and D for the function $f(x) = x^3 - 5x + 2$. Do the conclusions from the function you created match those of the one given in this step. Explain why or why not.

Part III

Consider the quadratic function $kx^2 + (k+1)x - (k+2),$ where *k* is a constant.

A. Graph the parabolas where *k* = 1, 2, 3, and 4 on the same coordinate plane. Compare the vertices and general shape of these parabolas. What happens as *k* increases? Justify your answer.

B. Notice that all of the parabolas cross the *x*-axis at two points. Let s_k be the larger of the two solutions of $kx^2 + (k+1)x - (k+2) = 0.$ Using your calculator, determine the values of $s_1, s_2, s_3,$ and s_4.

C. Predict the behavior of s_k as *k* gets very large. Provide some support for your hypothesis.

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