AB Calculus (AP) - Ahlborn *Name*_____

Laboratory Assignment - 1 *Name*_____

*Date turned in*_____

Powers of Functions

Please be sure to read the sheet titled General Laboratory Instructions before beginning this laboratory exercise. Read it again before writing up the report.

In this laboratory assignment you will use the **Geometer Sketchpad** to study the changes in the graph of a function when it is taken to either integral or fractional powers. (Note we are not interested in negative powers for this assignment.) After studying several of the graphs you should be able to identify general patterns of change that will enable you make reasonable sketches by hand.

Start the Geometer Sketchpad and click on *File Open My Computer Local Drive (c:) Program Files Sketchpad Ahlborn-Sketchpad C-LAB-1*.

The line $y = x$ should be showing. It is being generated by the function $g(x) = x^n$ where $n = 1$. Notice the red button in the lower part of the screen that says "Reset *n*". Pressing that at any time will reset the value of n back to 1.

A. Begin by pulling the aqua slider n slowly to the *right*. (If it does not want to move to the right, reposition the mouse pointer closer to the right edge of the aqua ball on the slider and try again.) **Remember that decimal exponents are the same as fractional exponents**.

1. Notice that part of the graph disappears when applying some decimal exponents to the function. Why does this happen? (Think about the related fraction and how fractional exponents are calculated.)

2. At what values for n do all parts of the graph reappear?

3. Focusing on the part of the graph that is always present, how is it changing as n changes?

4. Focusing on the part of the graph that sometimes disappears, how does it change as n changes?

5. What recognizable shapes do you see when n takes on positive integer values?

6. Now move the slider n to the *left* moving it slowly through values between 1 and 0.

7. Again, when do parts of the graph disappear and why?

8. Focusing on the part of the graph that is always present, how is it changing as n changes from 1 to 0? In particular we are interested in the effect on the graph of the value $n = 0.5$ since it corresponds to a square root.

9. What happens when you let $n = 0$? Why?

B. Now click on the button the reads *Hide Line 1*. Next, click on the button that reads *Show Line 2*. Repeat the steps under part A. above. Try to give descriptions for the graph changes caused by n that fit both this function and the previous.

C. Click on the red button to reset n. Click on *Hide Line 2*. Click on *Show Cubic*. Slowly slide n to the right and then back to zero. Answer the same questions as in part A.

D. Make a sketch of the sine function by hand on a piece of paper. (This is not something you need to turn in.) Based on the patterns you saw in working with the line and the cubic on the computer, try to draw what you think the graph of the sine function would be with $n = 2$, $n = 3$, $n = 4$, $n = 1.5$, $n = 0.5$, $n = 0.6$, $n = 1.6$, and $n = 0$. After making your sketches, use the computer to check your work.

E. When you exit the program, **DO NOT SAVE THE LAB-1 FILE**.

F. Prepare a written report which includes each of the following:

1. This assignment paper as a cover to the report. Please fill in your name(s) and the due date. If you had a partner but are turning in separate reports, put the partner's name in parentheses.

2. An introductory paragraph about the nature and purpose of the assignment.

3. A description of the change in the graph of **any function** that is raised to a power, *with an explanation for why it happens.* Address in particular the powers of $n = 2$, $n = 3$, $n = 4$, $n = 1.5$, $n = 0.5$, $n = 0.6$, $n = 1.6$, and $n = 0$. Your comments should describe the relative steepness of the new graph compared to the original, the quadrants in which the new graph appears, where the new graph is undefined, how the parts of the new graph relate to the original, and how the intercepts of the new graph relate to the original.