**Exploring the Graph of**

**Section 1: Reviewing the Linear Function**

Earlier in the course we explored the linear function family, defined by the equation

**.** We studied the roles of the parameters *m* and *b*. We found that regardless of the numbers used to replace *m* or *b*, our graphs were always straight lines.

1. Before summarizing the roles of *m* and *b* below, refresh your memory by graphing

 *y* = 0.5*x* + 1, *y* = 2*x* + 1, and *y* = 4*x* + 1 and on your calculator. If *m* > 0, what can you say about the graph of the equation *y* = *mx* + *b*?

1. As *m* increases, what happens to the graphs? Be specific.
2. Now graph *y* = – 0.5*x* + 1, *y* =­ –2*x* + 1, and *y* = – 4*x* + 1 on your calculator. If *m* < 0, what can you say about the graph of the equation *y* = *mx* + *b*?
3. As *m* decreases, what happens to the graphs? Be specific.
4. Now let *m* = 0 and graph *y* = 0*x* + 1. How does this graph differ from the graphs in questions 1 and 3?
5. Now consider the graphs of *y* = 2*x* + 3, *y* = 2*x* + 4 and *y* = 2*x* – 5. How are these graphs alike?
6. How do the graphs in question 6 differ?
7. Now summarize the roles of the parameters *m* and *b* in the equation
8. Without graphing, what can you say about the graph of *y* = 5*x* + 4?

In the next section, we wish to explore an equation that is very different from the linear equation . We now want to study the family of exponential functions modeled by the equation . Parameter *a* is the “coefficient,” while parameter *b* is the “base.” We will use our calculators to explore the roles of parameters *a* and *b*.

**Section 2: Exploring Parameter *b***

First we will select a number to replace parameter *a*, and then keep that number constant. Then, we will vary parameter *b* until we can explain the role of *b* on the graph of

.

Case 1: *a* = 1 and *b* > 1

1. Let *a* = 1 and *b* = 2 and type the resulting equation into Y1 on your calculator. (You are graphing ) Use the window settings –4.7 ≤ *x* ≤ 4.7 and –2 ≤ *y* ≤ 10 with an

*x*-scale and *y*-scale of 1. As a check, your equation and window should look as follows:

 

And, your graph should look like this:



1. Leave in Y1 and now place in Y2 and in Y3. **Sketch the resulting images of Y2 and Y3 on the graph above.**
2. What point do all three graphs have in common? ­­­­
3. Focus on the portion of the graphs in the first quadrant (to the right of the *y*-axis). Based on this investigation where *a* = 1 and *b* > 1, how does the graph change as *b* gets larger?

**Section 2: Exploring Parameter *b*, continued**

Case 2: *a* = 1 and 0 < *b* < 1

1. We continue to let *a* = 1. Clear the equations from the case 1 investigation. Now replace *b* with 0.75 and type into Y1. Adjust the window to settings to –4.7 ≤ *x* ≤ 4.7 and –1 ≤ *y* ≤ 3 with scales of 1. As a check, the equation and window should look as follows:

And, your graph should look like this:



1. What is the same about this graph compared to those in the case 1 investigation above?
2. What is different?
3. Leave in Y1 and now place in Y2 and in Y3. **Sketch the images of Y2 and Y3 on the graph above.**
4. Focus on the portion of the graphs in the first quadrant (to the right of the *y*-axis). Based on this investigation where *a* = 1 and 0 < *b* < 1, how does the graph change as *b* gets smaller?

**Section 3: Exploring Parameter *a***

Now that we have a good idea of how parameter *b* impacts the graph of , we may explore the role of parameter *a*. So, we will keep *b* constant and then vary parameter *a* until we can explain its impact.

Case 1: *b* = 2 and *a* > 0

1. Let *b* = 2 and *a* = 0.5 and type the resulting equation into Y1 on your calculator. (You are graphing ) Use the window settings –4.7 ≤ *x* ≤ 4.7 and –1 ≤ *y* ≤ 5 with an *x*-scale and *y*-scale of 1. As a check, your equation and window should look as follows:





And, your graph should look as follows:



1. Leave in Y1 and now let *a* = 1 by placing in Y2. **Sketch the resulting image on the graph above.** Repeat for *a* = 2 and *a* = 3.
2. Identify the *y*-intercepts on each graph.
3. How is the *y*-intercept related to parameter *a*?
4. Based on this investigation where *b* = 2 and *a* > 0, how does the graph change as parameter *a* gets larger? Remember to use good mathematical vocabulary.

**Section 4: Summary**

If one were asked to summarize the role of parameter *b* in the equation where parameter *a* is held as a positive constant, here is what a response might look like:

“When *b* is greater than 1, the graph of increases as we move from left to right. As we make *b* larger, the graph becomes steeper and rises more quickly.”

1. Continue with this response, but now summarize the role of parameter *b* when its value is between 0 and 1.
2. Summarize what you have learned about the role of parameter *a* in the equation. Include in your response the relationship between the *y-*intercept and the parameter *a*, if any.