**Activity 5.4.2 Transformations Using**

In the last activity, you determined the effect of parameters on the function . The transformations are the same transformations that you saw in previous units.

* vertically shifts the graph of
* vertically stretches or compresses the graph of
* horizontally stretches or compresses the graph of

One transformation that you did not see in the last activity is . From previous units, you learned that horizontally shifts the graph of .

**Investigating**

1. Graph and on the same coordinate system.
2. Sketch the graphs here.



1. For what x-value does ?
2. For what x-value does ?
3. How does the graph of compare to the graph of ?
4. Graph and on the same coordinate system.
5. Sketch the graphs here.



1. How does the graph of compare to the graph of ?
2. Let’s see why this is happening. Start with the function .
   * 1. Use the product rule of exponents to write as a product.
     2. One of these factors is an exponential function to the power . The other factor is a constant. Approximate the value of the constant to 4 decimal places. Rewrite the function using the approximation of the constant.
     3. *This example shows that the function can be written as a* product . Write an expression for in terms of .

**Which Numbers Can Be Written as a Power of ?**

1. Sketch the graph of .



1. On the same coordinate system, graph:
2. Does the graph of the line intersect the graph of ?
3. Does the graph of the line intersect the graph of ?
4. For what values of will the graph of the line intersect the graph of ?

**Finding x-values**

You now have a set of b-values for which the equation has a solution.

1. Go back to the example . Rewrite this exponential equation in logarithmic form to find the exact value of .
2. For what value of is
3. Choose three values for (not 5 or ) and for each , find the value of so that .
4. Now solve the equation without substituting in values. For what value of does ?

**Forms of Exponential Functions**

All exponential functions can be written in multiple forms including and . The equations and are equivalent. Let’s figure out why and determine an expression for .

1. Start with . What restrictions are there on , the base of an exponential function?
2. Explain why can be written as a power of .
3. Since b can be written as a power of e, this means for some value r. Substitute into the equation . Don’t forget the parentheses around .
4. Explain how this becomes .

1. Now figure out an expression for in terms of . Solve the equation for .
2. Substitute this expression for in to the equation . This is another equation equivalent to the initial two equations!

**Compound Interest**

1. Julia is opening a savings account with an initial deposit of $250. The account offers a 3.6% APR compounded quarterly.
   1. Assuming she makes no other deposits or withdrawals, write a function giving the amount in the account after years.
   2. Rewrite the function from part a with base .
2. Joachim is open a savings account with an initial deposit of $250. The account offers a 3.5% APR compounded continuously. Assuming he makes no other deposits or withdrawals, write a function giving the amount in the account after years.
3. Compare the functions for Joachim and Julia (function from part b). Just by comparing the functions, can you tell which person is getting a better deal from the bank? Explain.
4. Verify your answer for question 3 by comparing graphs or a table of values. After 10 years, how much money will Julia have in the bank? How much will Joachim have?

**Population Change**

The number of tri-color bats in Connecticut is decreasing at the rate of 49% per year. Your environmental studies class has counted 194 bats in the area.

1. Write an exponential function (base ) modeling the population of tri-color bats after years.
2. What part of the function in part a shows that the population is decreasing?
3. Write an exponential function using base modeling the population of tri-color bats after years.
4. What part of the function in 3 above shows that the population is decreasing?
5. In how many years will the tri-color bat population be below 5 bats?