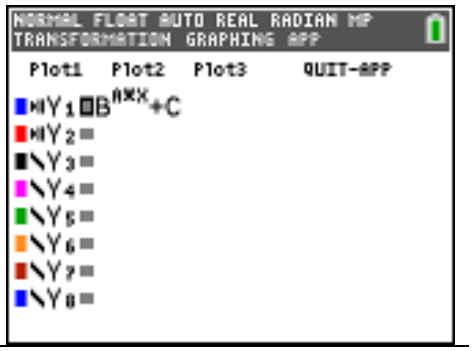
Transformations of Exponential Functions
Student Activity Part 2

Name _____

Class _____

In this activity, you will examine the family of exponential functions of the form $f(x) = b^{a \cdot x} + c$ where $a, b,$ and c are parameters. You will use the **Transformation App** (Transfrm) on your handheld to manipulate these parameters in Questions 1 - 3.



The parameter b is the base of the exponential function and $b > 0, b \neq 1$. Using the transformation app, change the value of a parameter by entering the equation for each question into Y_1 and Y_2, and pressing the arrow keys to manipulate each parameter of the function on the graph.

Question 1

Graph the following functions: $Y_1 = B^x$ and $Y_2 = B^x + C$. For specific values of B ($B \neq 1$), press the arrows to change the value of C, and observe the changes in the graph of Y_1.

a. Explain why for every value of B the graph of Y_2 passes through the point $(0, C+1)$.

b. Is it possible for the graph of $Y_2 = B^x + C$ to intersect the x-axis? Explain why or why not.

Question 2

Graph the following function: $Y_2 = B^{A \cdot x}$. For a specific value of B, click the arrows to change the value of A, and observe the changes in the graph of Y_1. Repeat this process for other values of B. Describe the effect of the parameter A on the graph of $Y_2 = B^{A \cdot x}$. Discuss the effects of both positive and negative values of A.

Question 3

Graph the following functions: $Y_1 = B^{A \cdot x}$ and $Y_2 = B^{A \cdot x} + C$. For specific values of A and B, click the arrows to change the value of C, and observe the changes in the graph of Y_1. Describe the effect of the parameter C on the graph of $Y_2 = B^{A \cdot x} + C$. Discuss the effects of both positive and negative values of C.

Question 4

Turn off the Transformation App by selecting Quit-App on the $y =$ screen. Graph each function given and answer the following questions.

a. Display the graphs of $Y_1 = 3^{2x}$ and $Y_2 = 9^x$.

(i) How is the graph of Y_2 related to the graph of Y_1?

(ii) Use the properties of exponents to justify your answer.

b. Display the graph of $Y_1 = 3^{-2x}$ and $Y_2 = \left(\frac{1}{9}\right) \cdot 3^x$.

(i) How is the graph of Y_2 related to the graph of Y_1?

(ii) Use the properties of exponents to justify your answer.

c. Use your answers to parts (a) and (b) to explain the relationship between a horizontal dilation of the graph of an exponential function and a change of base of the exponential function.

Question 5

5. Without using your calculator, match each equation with its corresponding graph.
Check your answers by graphing each function on your calculator.

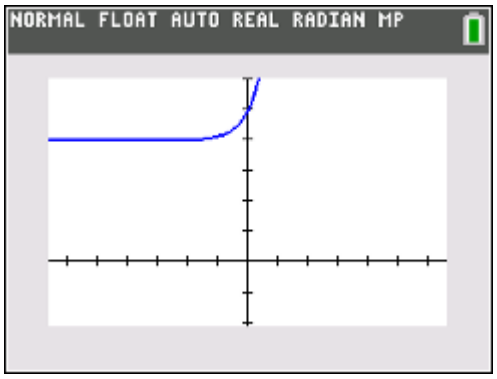
(a) $f(x) = 2^{3x}$ (b) $f(x) = -(2)^{3x}$

(c) $f(x) = 2^{-3x}$ (d) $f(x) = 2^{3x} + 4$

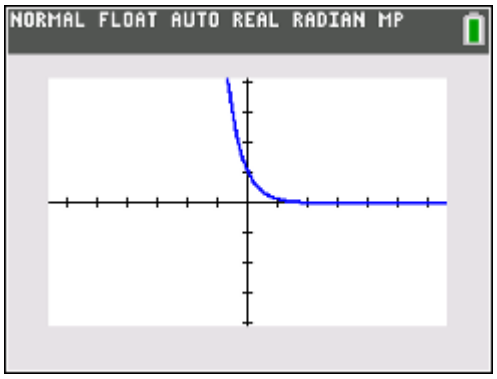
(e) $f(x) = e^{-x}$ (f) $f(x) = e^{x} - 3$

Note: The function in part (e) is the "natural" exponential function and involves the number $e \approx 2.71828...$

(i)



(ii)



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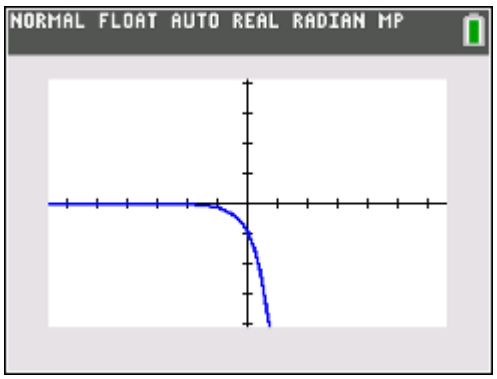

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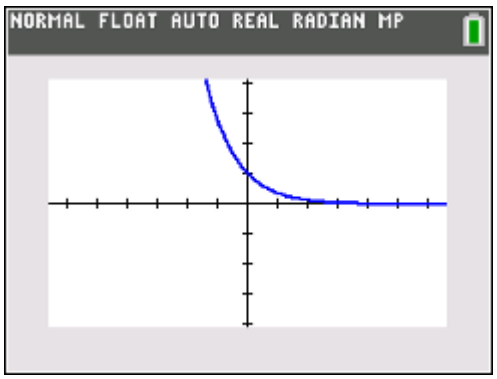

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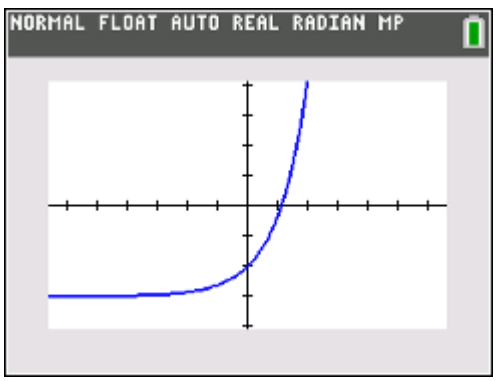

(vi)