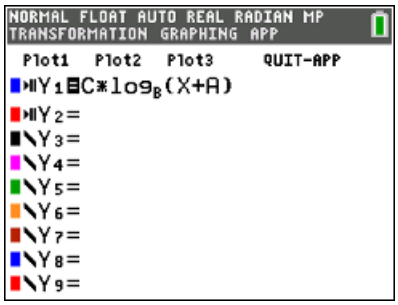
Transformations of Logarithmic Functions

Student Activity

Name _____

Class _____

In this activity, you will examine the family of logarithmic functions of the form $f(x) = c\log_b(x+a)$ where $a, b,$ and c are parameters. You will turn on the **Transformation App** on your handheld to manipulate these parameters.



The parameter b is the base of the logarithmic 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. At the end of this activity, you can use your graphs from the handheld to match each function with its corresponding graph.

Question 1

1. Graph the following function into Y_1: $Y_1 = \log_B x$. Press the arrows to change the value of B, and observe the changes in the graph of Y_1.
   a. Explain why for every value of B the graph of Y_1 passes through the point $(1,0)$.

   b. For $B > 1$, describe the graph of $Y_1 = \log_B x$.

   c. For $0 < B < 1$, describe the graph of $Y_1 = \log_B x$.

   d. Find the domain and range of function $Y_1 = \log_B x$ for all possible values of B.

   e. Describe the behavior of the graph of $Y_1 = \log_B x$ near the y-axis in words and by writing it in limit notation.

Question 2

2. Graph the following function into Y_2: $Y_2 = \log_B(x + A)$. For various (fixed) values of B, click the arrows to change the value of A, and observe the changes in the graph of Y_1. Describe the effect of the parameter A on the graph of $Y_2 = \log_B(x + A)$.

Question 3

3. Graph the following function into Y_2: $Y_2 = C \cdot \log_B(x + A)$. For various (fixed) 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 $Y_2 = C \cdot \log_B(x + A)$.

Questions 4

4. Consider a logarithmic function of the form $Y_1 = \log_B(Dx)$ where D is a constant. 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 $Y_1 = \log_4(x)$ and $Y_2 = \log_4(16x)$.
      (i) How is the graph of Y_2 related to the graph of Y_1?

      (ii) Using the properties of logarithms, rewrite the function Y_2 in terms of Y_1 to justify your answer.

      (iii) Describe the two equivalent transformations that $Y_2 = \log_4(16x)$ performs on the parent function $Y_1 = \log_4(x)$.

   b. Display the graphs of $Y_1 = \log_3(x)$ and $Y_2 = \log_4\left(\frac{x}{27}\right)$.
      (i) How is the graph of Y_2 related to the graph of Y_1?

      (ii) Using the properties of logarithms, rewrite the function Y_2 in terms of Y_1 to justify your answer.

(iii) Describe the two equivalent transformations that $Y_2 = \log_3\left(\frac{x}{27}\right)$ performs on the parent function $Y_1 = \log_3 x$.

Question 5

5. Without using your calculator, match each equation with its corresponding graph below. **Note that these screenshots are from a TI-Nspire CX handheld, but it is not relevant. Focus on the graphs.*

(a) $f(x) = \log_3(x+4)$

(b) $f(x) = \log_{1/4}(x)$

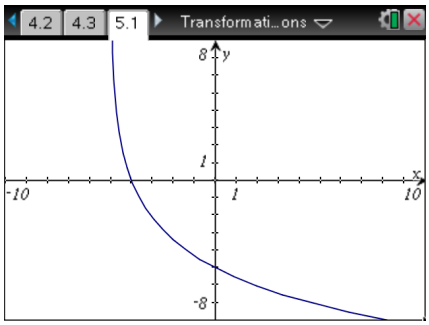
(c) $f(x) = -\log_4(x-2)$

(d) $f(x) = -3\log_{1/2}(x+1)$

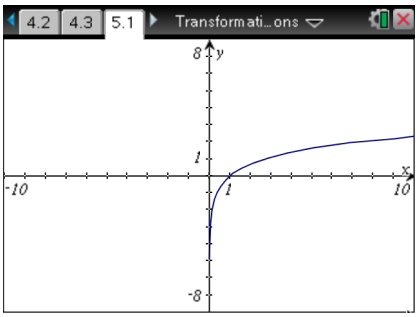
(e) $f(x) = \log_e(x) = \ln x$

(f) $f(x) = 5\log_{1/5}(x+5)$

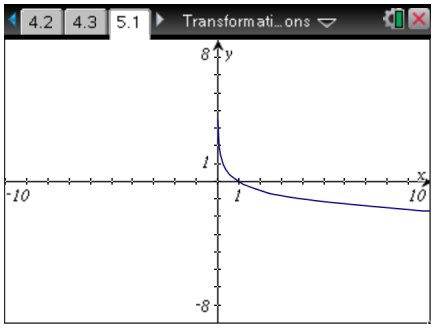
(i)



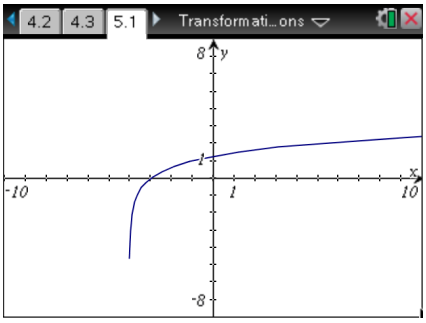
(ii)



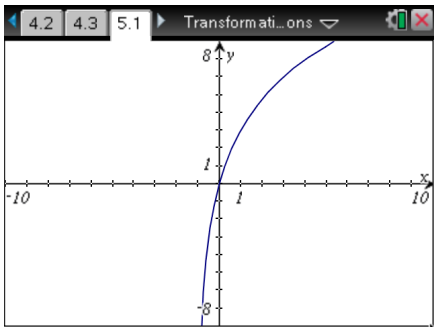
(iii)



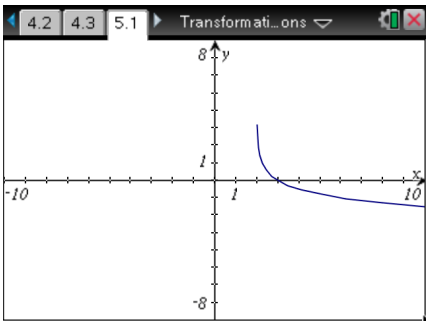
(iv)



(v)


4.2 4.3 5.1 Transformati...ons
8
y
1
x
-10
1
10
-8

(vi)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y
1
x
-10
1
10
-8