Inspiring Greatness

ISD

INDEPENDENCE SCHOOL DISTRICT

Math Virtual Learning

Algebra IIB

Logarithmic Transformations

April 10, 2020

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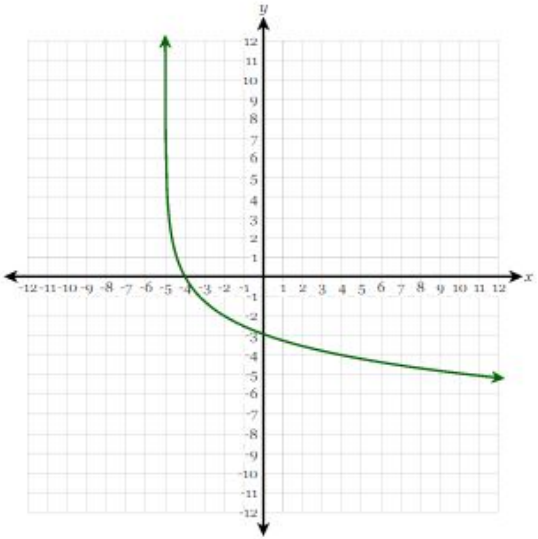
Lesson: April 10, 2020

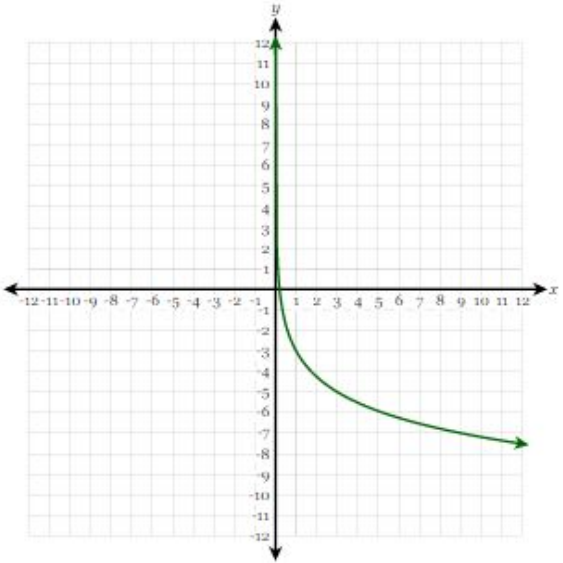
Objective/Learning Target: Students will identify transformations of a logarithmic function compared to the parent function or other log function.

Let's Get Started:

What are the features of the function $f(x) = -2\log_3(x+5)$ graphed below?



What are the features of the function $f(x) = -2\log_3 x - 3$ graphed below?

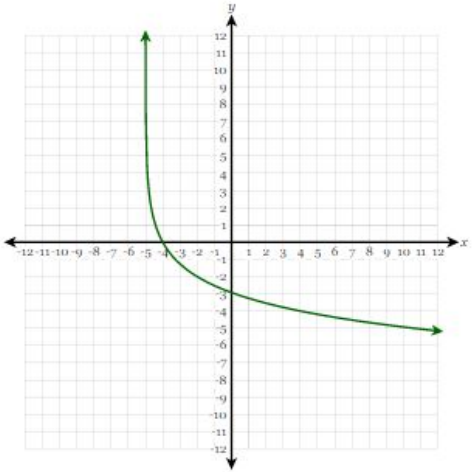


Yesterday you practiced identifying key features of logarithmic graphs. Today we are going to be comparing graphs to the parent function and other log functions. Go to www.desmos.com and graph $y=-2\log_3(x)$.

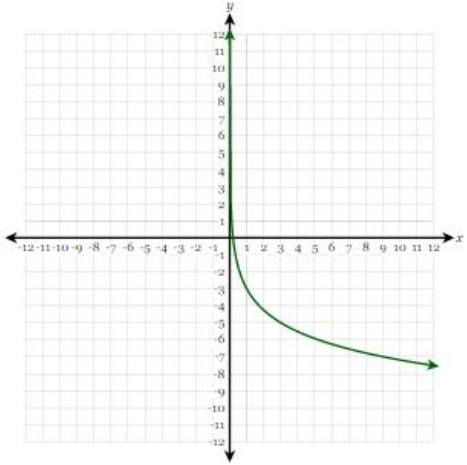
1. How do the graphs above CHANGE compared to the one in desmos?
2. What part of the equation on the graph on right make it move down instead of right?

Observations:

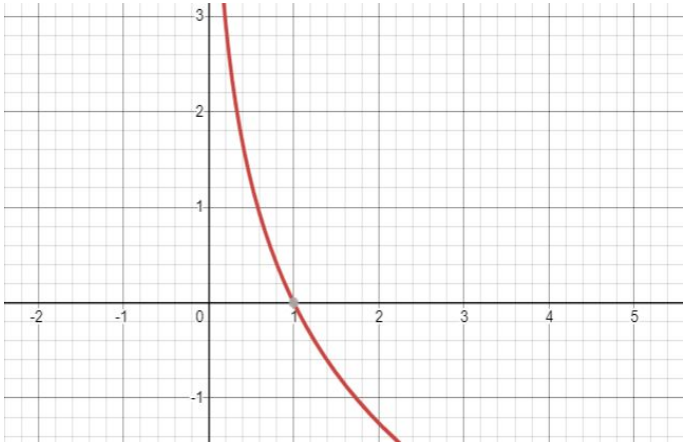
What are the features of the function $f(x) = -2\log_3(x+5)$ graphed below?



What are the features of the function $f(x) = -2\log_3 x - 3$ graphed below?



$y=-2\log_3(x)$.



1. How do the graphs above CHANGE compared to the one in desmos? The first graph moved to the left and the second graph moved down.
2. What part of the equation on the graph on right make it move down instead of right? The equation on the right does not have parentheses.

Introduction to logarithmic transformations

Watch Video: Transformation of Logarithmic Functions

Logarithmic Transformations

General form: $f(x) = a\log_b(x + h) + k$

a: A vertical stretch or compress. If it is negative it reflects over the x axis.

b: The base. b>1 is growth, 0<b<1 is decay. It can't be negative.

h: If it is negative the graph moves right. It it is positive the graph moves left. It is always inside parentheses. It is also the vertical asymptote.

k: If it is negative the graph moves down. If it is positive the graph moves up.

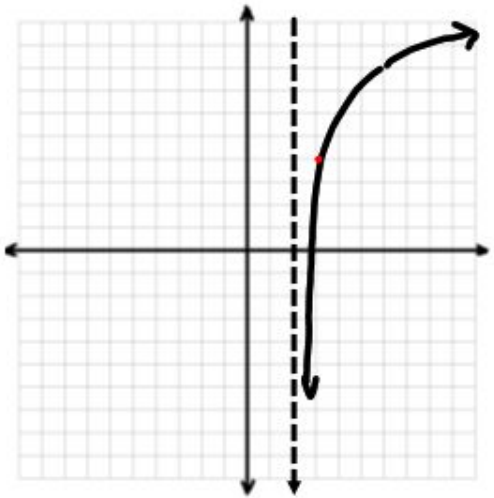
Example: $\log_5(x - 2) + 4$

b=5 so this is a growth function.

h= -2 so the asymptote is x=2. The graph is moving to the right 2.

k=4 so the graph is moving up 4

*all parent graphs go through the point (1,0) so move that point right 2 and up 4.



Comparing a log function to a different log function

When you compare 2 different log functions, you need to explain how the a,h and k have changed. Usually you only compare equations with the same base.

Example: Describe the transformations from $f(x)=3\log_4(x-2)+7$ to $g(x)=\log_4 x+1$

a: The a went from 3 to 1 so there is a vertical compression.

h: The h went from -2 to 0 so it started at +2 and went left 2 spaces to end up at 0.

k: The k went from +7 to +1 so it started at +7 and went down 6 spaces to end up at +1.

Verify your answer by graphing both equations at www.desmos.com

PRACTICE

For each given function, explain the effects of the transformations on the graph of the parent function.

1. $y = \log_2(x-1)+3$
2. $y = 4\log_2(x-1)$
3. $y = -2\log_2 x + 3$
4. $y = \log_2(x+5)+9$
5. $y = -\log_{10}(x-6)$
6. $y = 0.5\log_{10} x - 12$

MORE PRACTICE:

A. Describe the transformations between equation 1 and equation 2.
B. Describe the transformations between equation 3 and equation 4.
C. Describe the transformations between equation 5 and equation 6.

Answers:

1. Move right 1 and up 3
2. Move right 1 and a vertical stretch by a factor of 4
3. Move up 3, reflect vertically over the x-axis and vertical stretch by a factor of 2
4. Move left 5 and up 9
5. Move right 6 and reflect vertically over the x-axis
6. Move down 12 and compress by a factor of 0.5

A. Stretch vertically by a factor of 4, move down 3

B. Compress vertically by a factor of 2, reflect vertically over the x-axis, move left 2, and up 6

C. Compress vertically by a factor of 0.5, move right 6 and down 12

Additional Resources

https://courses.lumenlearning.com/ivytech-collegealgebra/chapter/graphing-transformations-of-logarithmic-functions/