Name: ______________________________________ Date: ___________________

GRAPHS OF LOGARITHMS
COMMON CORE ALGEBRA II

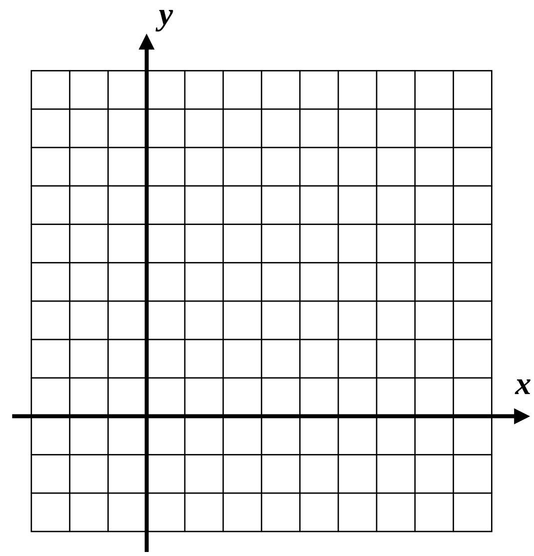
The vast majority of logarithms that are used in the real world have bases greater than one; the pH scale that we saw on the last homework assignment is a good example. In this lesson we will further explore graphs of these logarithms, including their construction, transformations, and domains and ranges.

***Exercise* #1:** Consider the logarithmic function $y = \log_3 x$ and its inverse $y = 3^x$.

(a) Construct a table of values for $y = 3^x$ and then use this to construct a table of values for the function $y = \log_3 x$.

x	-2	-1	0	1	2
$y = 3^x$					

x					
$y = \log_3 x$					



(b) Graph $y = 3^x$ and $y = \log_3 x$ on the grid given. Label with equations.

(c) State the natural domain and range of $y = 3^x$ and $y = \log_3 x$.

$y = 3^x$

Domain:

Range:

$y = \log_3 x$

Domain:

Range:

***Exercise* #2:** Using your calculator, sketch the graph of $y = \log_{10} x$ on the axes below. Label the x-intercept. State the domain and range of $y = \log_{10} x$.

Domain:

Range:

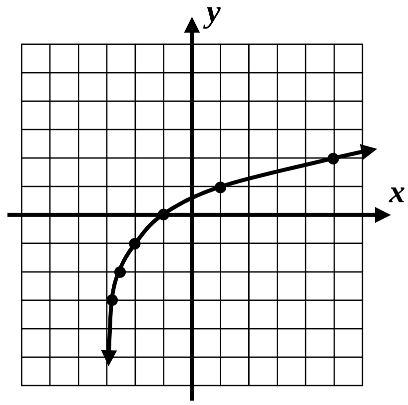
***Exercise* #3:** Which of the following equations describes the graph shown below? Show or explain how you made your choice.

(1) $y = \log_3(x+2) - 1$

(2) $y = \log_2(x-3) + 1$

(3) $y = \log_2(x+3) - 1$

(4) $y = \log_3(x+3) - 1$

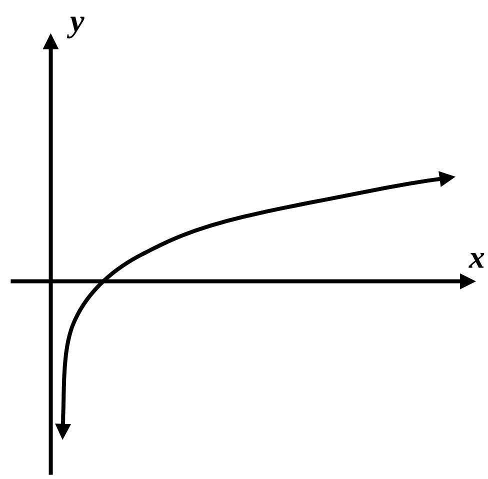


The fact that finding the logarithm of a non-positive number (negative or zero) is not possible in the real number system allows us to find the domains of a variety of logarithmic functions.

***Exercise* #4:** Determine the domain of the function $y = \log_2(3x-4)$. State your answer in set-builder notation.

All logarithms with bases larger than 1 are **always increasing**. This increasing nature can be seen by calculating their **average rate of change**.

***Exercise* #5:** Consider the common log, or log base 10, $f(x) = \log(x)$.



(a) Set up and evaluate an expression for the average rate of change of $f(x)$ over the interval $1 \le x \le 10$

(b) Set up and evaluate an expression for the average rate of change of $f(x)$ over the interval $1 \le x \le 100$.

(c) What do these two answers tell you about the changing slope of this function?

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GRAPHS OF LOGARITHMS
COMMON CORE ALGEBRA II HOMEWORK

FLUENCY

1. The domain of $y=\log_3(x+5)$ in the real numbers is

(1) $\{x \mid x>0\}$ (3) $\{x \mid x>5\}$

(2) $\{x \mid x>-5\}$ (4) $\{x \mid x\geq -4\}$

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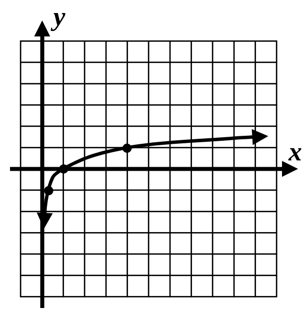
2. Which of the following equations describes the graph shown below?

(1) $y=\log_5 x$ (3) $y=\log_3 x$

(2) $y=\log_2 x$ (4) $y=\log_4 x$



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3. Which of the following represents the *y*-intercept of the function $y=\log_2(32-x)-1$?

(1) 8 (3) -1

(2) -4 (4) 4

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4. Which of the following values of *x* is *not* in the domain of $f(x)=\log_5(10-2x)$?

(1) -3 (3) 5

(2) 0 (4) 4

____

5. Which of the following is true about the function $y=\log_4(x+16)-1$?

(1) It has an *x*-intercept of 4 and a *y*-intercept of -1.

(2) It has *x*-intercept of -12 and a *y*-intercept of 1.

(3) It has an *x*-intercept of -16 and a *y*-intercept of 1.

(4) It has an *x*-intercept of -16 and a *y*-intercept of -1.

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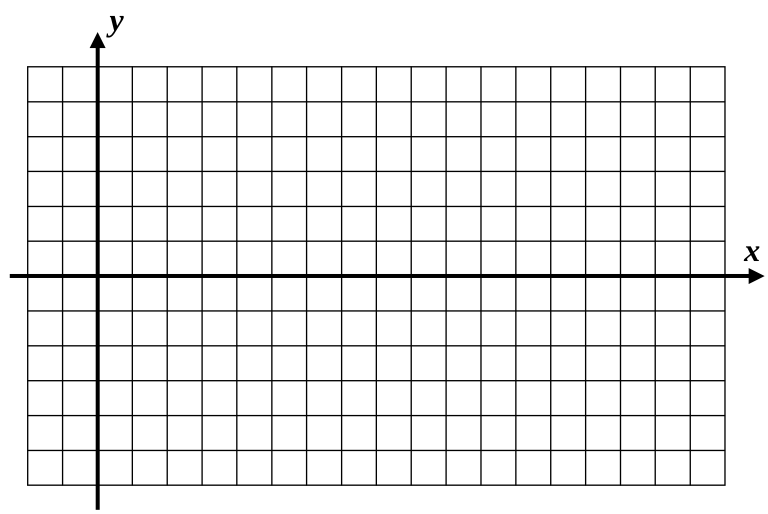
6. Determine the domains of each of the following logarithmic functions. State your answers using any accepted notation. Be sure to show the inequality that you are solving to find the domain and the work you use to solve the inequality.

(a) $y = \log_5(2x-1)$

(b) $y = \log(6-x)$

7. Graph the logarithmic function $y = \log_4 x$ on the graph paper given. For a method, see *Exercise* #1.



REASONING

8. Logarithmic functions whose bases are larger than 1 tend to increase **very slowly** as x increases. Let's investigate this for $f(x) = \log_2(x)$.

(a) Find the value of $f(1)$, $f(2)$, $f(4)$, and $f(8)$ without your calculator.

(b) For what value of x will $\log_2(x) = 10$? For what value of x will $\log_2(x) = 20$?