Learning Target(s): I am able to evaluate logarithms and graph logarithmic functions.

Notes: 7.4 Evaluate Logarithms and Graph Logarithmic Functions

Logarithm of y with base b – a logarithm is denoted by $\log_b y$ and defined as $\log_b y = x$

"log base b of y" if and only if $b^x = y$ given that b and y are positive numbers and $b \neq 1$.

Common Logarithm - (log) base 10 $\log_{10} x = \log x$

Natural Logarithm – (ln) base e $\log_e x = \ln x$

Ex 1: Rewrite the logarithmic equation in exponential form.

	Logarithmic Form	Exponential Form
a.	$\log_2 32 = 5$	$2^5 = 32$
b.	$\log_7 1 = 0$	$7^0 = 1$
c.	$\log_{13} 13 = 1$	$13^1 = 13$
d.	$\log_{\frac{1}{2}} 2 = -1$	$\frac{1}{2}^{-1} = 2$

Log is BAE

Try it!
Rewrite the logarithmic equation in exponential form.

1. $\log_{18} 1 = 0$ → $18^0 = 1$

2. $\log_2 64 = 6$ → $2^6 = 64$

Ex 2: Evaluate the logarithm **without** a calculator.

a. $\log_3 81 = 4$ → $3^4 = 81$

b. $\log_4 0.25$ → $\frac{1}{4}$ → $4^{-1} = .25$

c. $\log_{\frac{1}{4}} 256$ → $\frac{1}{4}^{-4} = 256$

Try it!
Evaluate the logarithm **without** a calculator.

3. $\log_{49} 7$ → $49^{\frac{1}{2}} = 7$

4. $\log_{\frac{1}{3}} 9$ → $\frac{1}{3}^{-2} = 9$

5. $\log_{16} 4$ → $16^{\frac{1}{2}} = 4$

Ex 3: Simplify the expression.

a. $10^{\log 6.7}$

$10^{\log_{10} 6.7} = 6.7$

b. $\log_2 16^x$

$16 = 2^4$

$\log_2 2^{4x} = 4x$

Rule for part a: $b^{\log_b x} = x$

Rule for part b: $\log_b b^x = x$

Try it!
Simplify the expression.

6. $10^{\log 7x}$

$10^{\log_{10} 7x} = 7x$

7. $\log_3 27^x$

$27 = 3^3$

$\log_3 3^{3x} = 3x$

Ex 4: Find the inverse of the function.

$y = \ln(x - 4)$

$x = \ln(y - 4)$

$e^x = y - 4$

$+4 \quad +4$

$e^x + 4 = y$

Switch x and y.

Write in exponential form.

Solve for y.

Try it!
Find the inverse of the function.

8. $y = 7^{2x}$

$x = 7^{2y}$

$\log_7 x = 2y$

$\frac{\log_7 x}{2} = y$

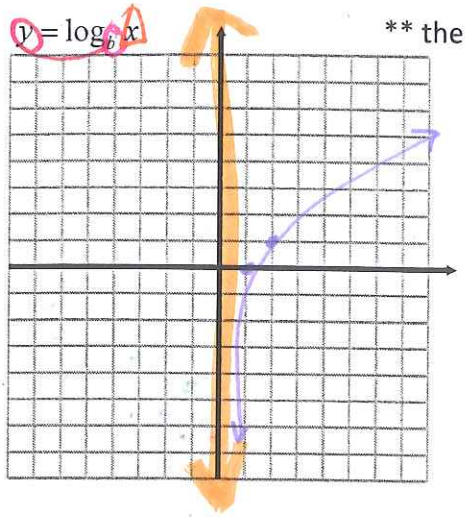
9. $y = \log_{\frac{3}{2}} x$

$x = \log_{\frac{3}{2}} y$

$\frac{3}{2}^x = y$

Parent Graph for Logarithmic Functions

$y = \log_b x$



** the logarithmic function is the inverse of the exponential graph.

$b^y = x$

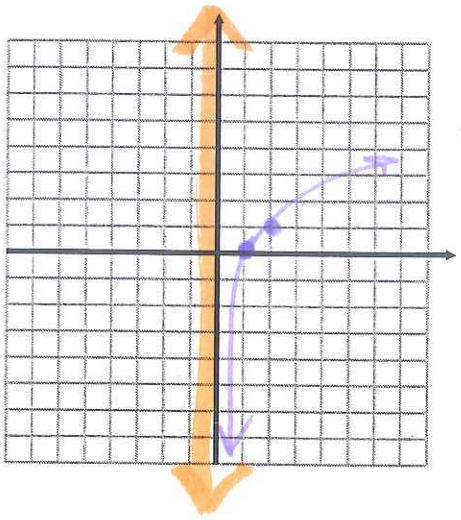
x	y
1	0
b	1

Domain: $x > 0$

Range: $\mathbb{R}$

Ex 5: Graph

a. $y = \log_2 x$



Step 1: Write in exponential form.

$1 \cdot 2^y = x$

Step 2: Make a table (pick y's and find x's)

x	y
1	0
2	1

Step 3: State the domain and the range.

D: $x > 0$

R: $\mathbb{R}$

$$y = \log_b(x - h) + k$$

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

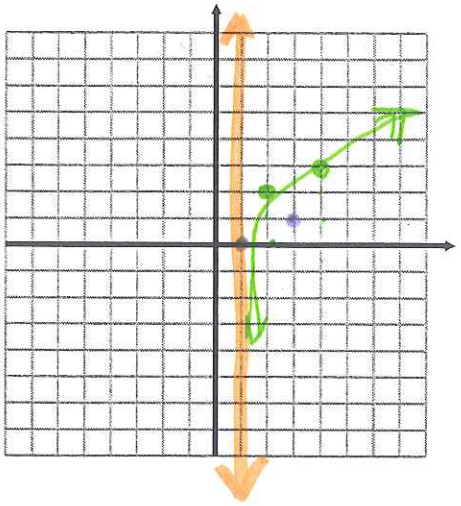
Step 1: Write in exponential form and solve for x. ***Note: must move the vertical shift over first if there is one**

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

$3^{y-2} = x-1$

$+1 \quad +1$

$1 \cdot 3^{y-2} + 1 = x$



Step 2: Make a table (pick y's and find x's)

h → shift right 1

k → up 2

x	y
1	0
3	1

Step 3: State the domain and the range.

D: $x > 1$

R: $\mathbb{R}$

Try it!

Graph the function. State the domain and range.

9. $y = \log_{\frac{1}{2}} x - 3$

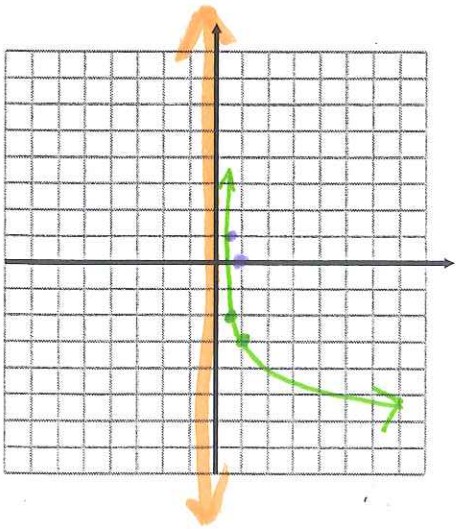
$y+3 = \log_{1/2} x$

$1 \cdot \left(\frac{1}{2}\right)^{y+3} = x$

h: 0

k: down 3

x	y
1	0
$\frac{1}{2}$	1



D: $x > 0$

R: $\mathbb{R}$