

## 3-4 Graphing Logarithmic Functions

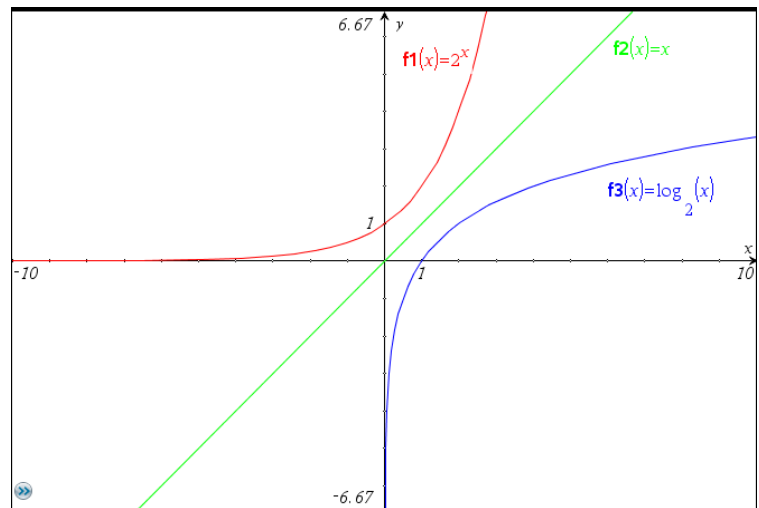
### Logarithms & Exponentials

$f(x) = 2^x$  &  $f(x) = \log_2 x$  are inverses

$x = 2^y$  to find inverse:

$y = \log_2 x$

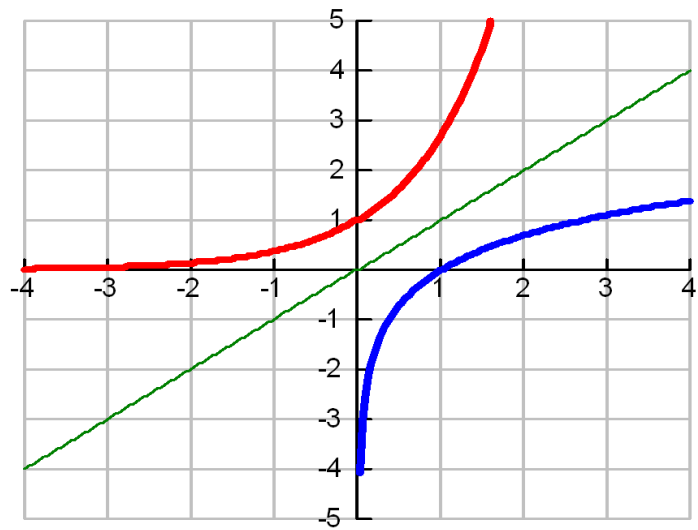
1. switch x&y
2. solve for y



natural log

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

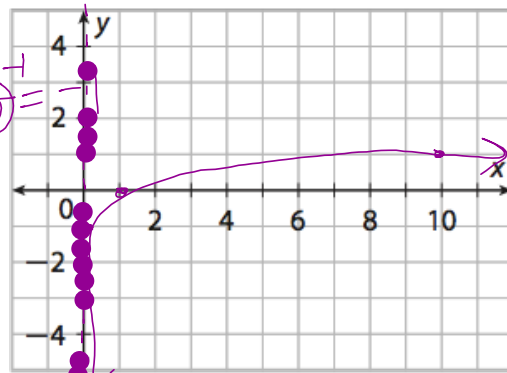
$$f(x) = e^x$$



Complete the table for the function  $f(x) = \log x$

Then plot the points on the graph and connect the dots.

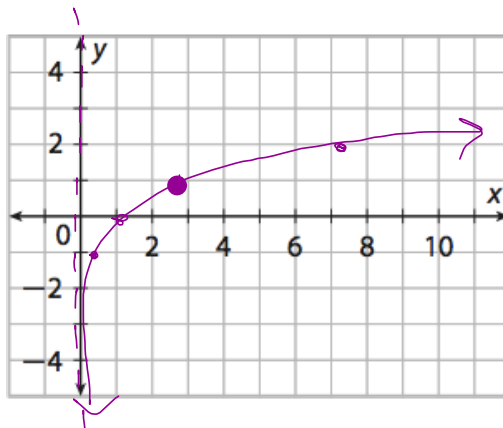
x	$f(x) = \log x$
0.1	$\log 0.1 = \log \frac{1}{10} = \log(10)^{-1} = -1$
1	$\log 1 = 0$
10	$\log 10 = 1$



Complete the table for the function  $f(x) = \ln x$

Then plot the points on the graph and connect the dots.

x	$f(x) = \ln x$
$\frac{1}{e} \approx 0.368$	$\ln \frac{1}{e} = \ln e^{-1} = -1$
1	$\ln 1 = 0$
$e \approx 2.72$	$\ln e = 1$
$e^2 \approx 7.39$	$\ln e^2 = 2$



**Analyze the graphs of:**

$$f(x) = \log x$$

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

**Domain:**

**Range:**

**End  
behavior:**

**VA/HA:**

**Increasing/  
Decreasing:**

**Intercepts:**

Describe the transformations on each graph:

$$f(x) = \log(x + 2)$$

$$f(x) = 3 \log(-x) - 4$$

$$f(x) = -2 \ln(2x) + 5$$

## Graphing Transformed Logarithmic Functions

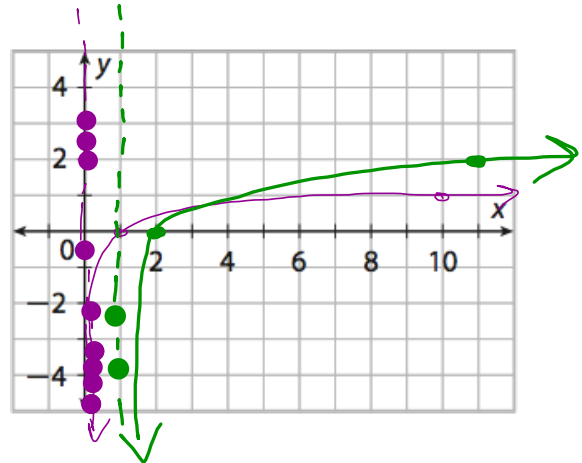
When graphing a transformed function, it is helpful to consider the following features of the graph: the vertical asymptote, and two reference points (1,0) and (b,1).

Function	$f(x) = \log_b x$	$g(x) = a \log_b (x - h) + k$
Asymptote	$x = 0$	$x = h$
Reference point	$(1, 0)$	$(1 + h, k)$
Reference point	$(b, 1)$	$(b + h, a + k)$

Graph and analyze the following functions:

•  $f(x) = 2 \cdot \log(x-1)$

↓ stretch of 2      right + 1  
parent:  $\log x$



**Domain:**  $(1, \infty)$

**Range:**  $(-\infty, \infty)$

**End behavior:**  $\lim_{x \rightarrow \infty} f(x) = \infty$        $\lim_{x \rightarrow 1} f(x) = -\infty$

**VA/HA:**  $x = 1$

**Increasing/**  $(1, \infty)$

**Decreasing:** n/a

**Intercepts:**  $(2, 0)$

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

$$\log_a 1 = 0$$

$$\log_a a = 1$$

**Domain:**  $\log_2(0+1) - 3$

$$\log_2 1 - 3$$

$$-3$$

**Range:**

$$\log_2(1+1) - 3$$

$$\log_2 2 - 3$$

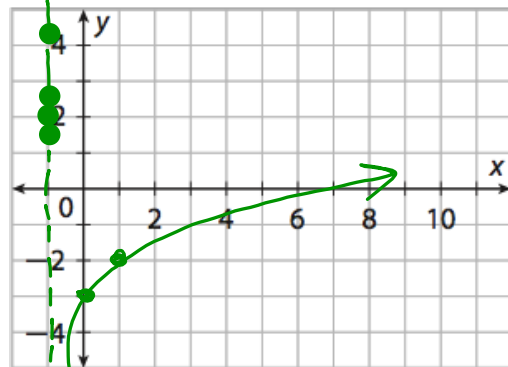
$$1 - 3$$

$$-2$$

**End**

**behavior:**

x	y
0	-3
1	-2



**VA/HA:**  $x = -1$

**Increasing/**

**Decreasing:**

**Intercepts:**

$$(0, -3) \quad (7, 0)$$

$$0 = \log_2(x+1) - 3$$

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

$$2^3 = x+1$$

$$8 = x+1$$

$$x = 7$$



$$f(x) = 3 \cdot \ln(x) + 2$$

$\log_e(x)$

**Domain:**

$$3 \cdot \ln 1 + 2$$

x	y
1	2
e	5

**Range:**

$$\frac{3(0) + 2}{2}$$

**End**

$$3 \cdot \ln e + 2$$

**behavior:**

$$3(1) + 2$$

5

**VA/HA:**

**Increasing/**

**Decreasing:**

**Intercepts:**

