9-4 Graphing Logarithmic Functions

Objectives:

1. I can identify the transformations performed on a logarithmic function.

2. I can graph a logarithmic function by hand.

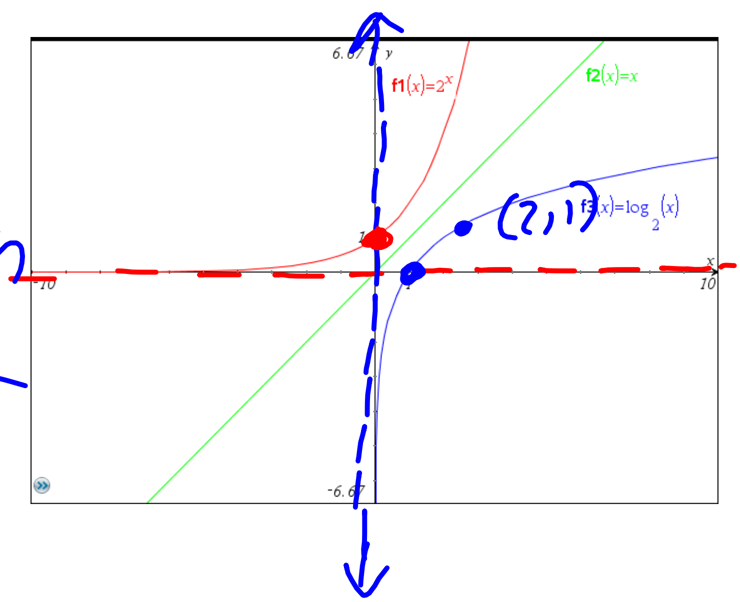
3. I can identify the asymptote of a logarithmic function.

Logarithms & Exponentials

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

to find inverse:

1. switch x&y
2. solve for y



log graph

- $x = 0$
- $(1, 0)$
- $(b, 1)$

Describe the transformations on each graph:

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

left 2

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

V. STRETCH 3 down 4

~~Reflect over y~~

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

Reflect over X

V. ST 2

~~H. ST 2~~

UP 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	$(b, 1)$	$(b+h, a+k)$

List the transformations, then graph.

$g(x) = 2\log(x+2) + 4$

V. ST 2, Left 2, UP 4

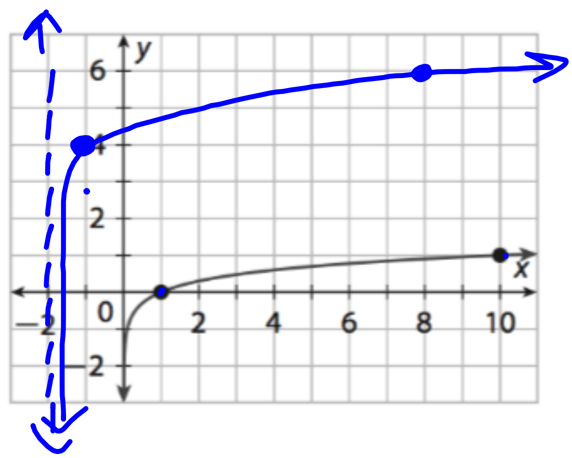
$x = 0 \rightarrow x = -2$

x, y

$(1, 0) \cdot 2 \; (1, 0) \rightarrow (-1, 4)$

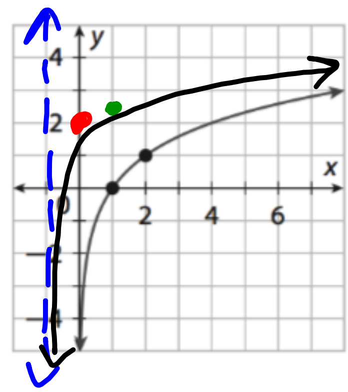
x, y

$(10, 1) \cdot 2 \; (10, 2) \; (8, 6)$



Identify the transformations of the graph of $f(x) = \log_b x$ that produce the graph of the given function $g(x)$. Then graph $g(x)$ on the same coordinate plane as the graph of $f(x)$ by applying the transformations to the asymptote $x = 0$ and to the reference points $(1, 0)$ and $(b, 1)$. Also state the domain and range of $g(x)$ using set notation.

2. $g(x) = \frac{1}{2}\log_2(x+1) + 2$



$\frac{1}{2}\log_2(x+1)+2$

V. ST 1/2

Left 1, up 2

$x = 0 \rightarrow x = -1$

$(1, 0)\cdot\frac{1}{2}$ $(1, 0) \rightarrow (0, 2)$

$(2, 1)\cdot\frac{1}{2}$ $(2, \frac{1}{2}) \rightarrow (1, 2.5)$

Graph and analyze the following functions:

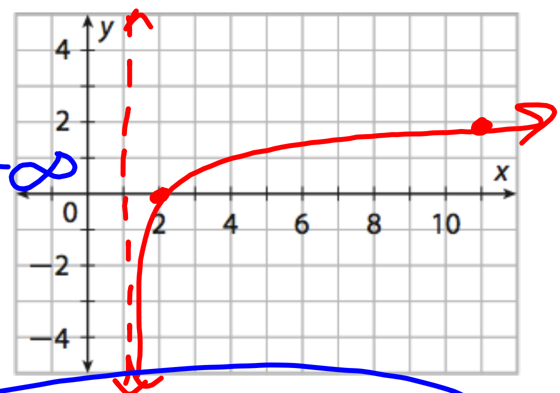
$f(x) = 2 \cdot \log(x-1)$ ST2, R1

Domain: $(1, \infty)$

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

End behavior:

$\lim_{x \to \infty} f(x) = \infty$ $\lim_{x \to -\infty} f(x) = -\infty$



Vertical Asymptote: $x = 1$

Increasing: $(1, \infty)$

Decreasing: dne

~~**Intercepts:**~~

$x = 0$ $x = 1$

$(1, 0) \cdot 2$ $(1, 0)$

$(10, 1) \cdot 2$ $(10, 2)$

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

Domain: $(-1, \infty)$

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

End behavior:

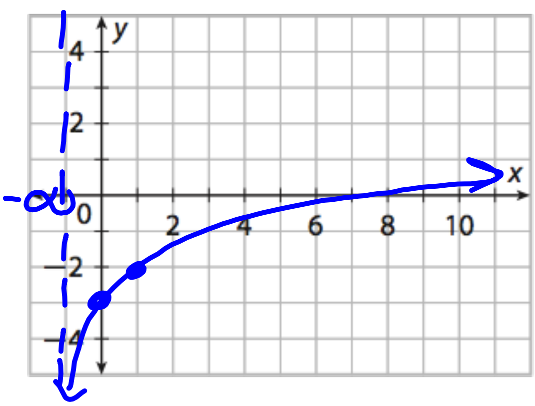
$\lim_{x \to \infty} f(x) = \infty$ $\quad \lim_{x \to -\infty} f(x) = -\infty$

Vertical Asymptote: $x = -1$

Increasing: $(-1, \infty)$

Decreasing: dne

~~**Intercepts:**~~



$X = 0 \rightarrow x = -1$

$(1, 0) \rightarrow (0, -3)$

$(2, 1) \rightarrow (1, -2)$

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

Domain: $(0, \infty)$

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

End behavior:

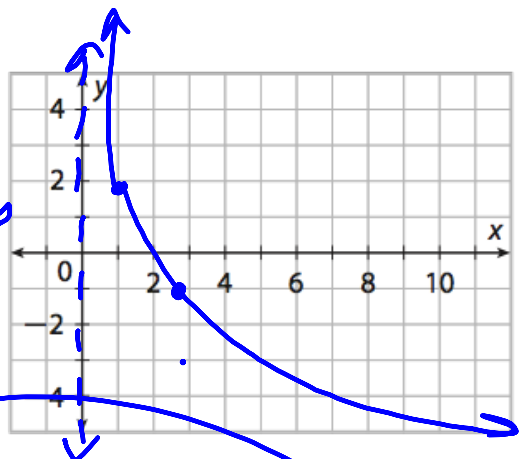
$\lim_{x \to \infty} f(x) = -\infty$ $\qquad \lim_{x \to -\infty} f(x) = \infty$

Vertical Asymptote: $x = 0$

Increasing: dne

Decreasing: $(0, \infty)$

~~**Intercepts:**~~



ST by -3

UP 2

$x = 0 \rightarrow x = 0$

$(1, 0) \rightarrow (1, 2)$

$(2.7, 1) \cdot -3 \rightarrow (2.7, -1)$ $+2$