Graphing Logs the Easy Way:

1) Find two points.

Remember that $\log_a 1 = 0$

$\log_a a = 1$

2) Find vert asymptote.

$x =$ horz shift

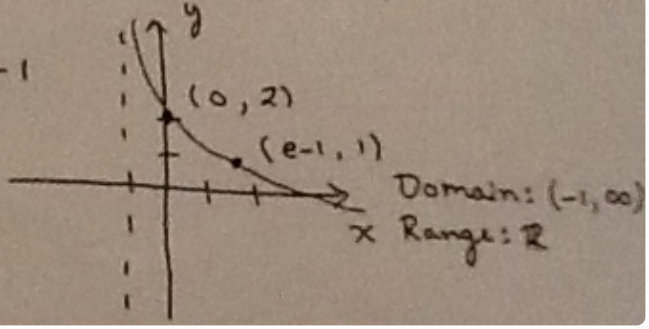
3) Sketch the log shape.

Ex: Sketch a graph of $f(x) = -\ln(x+1) + 2$

1) Two Points:

x	$f(x)$
0	$-\ln(1) + 2 = 2$
$e-1$	$-\ln(e) + 2 = -1 + 2 = 1$

2) Vert Asymptote: $x = -1$

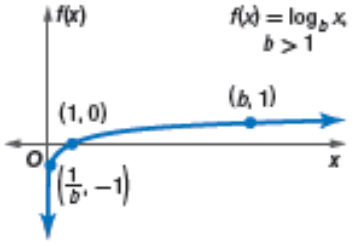


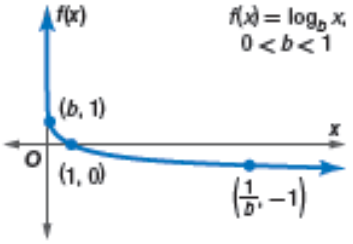
2 Graphing Logarithmic Functions

The function $y = \log_b x$, where $b \neq 1$, is called a **logarithmic function**. The graph of $f(x) = \log_b x$ represents a parent graph of the logarithmic functions.

KeyConcept Parent Function of Logarithmic Functions

Parent function:	$f(x) = \log_b x$	Type of graph:	continuous, one-to-one
Domain:	all positive real numbers	Range:	all real numbers
Asymptote:	$f(x)$-axis	Intercept:	(1, 0)





Graph each function.

a. $f(x) = \log_5 x$

Step 1 Identify the base.

$b = 5$

Step 2 Determine points on the graph.

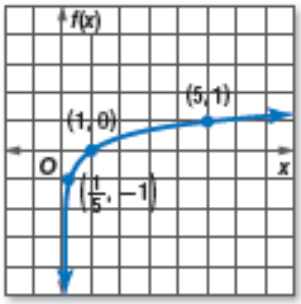
Because $5 > 1$, use the points $\left(\frac{1}{b}, -1\right)$, (1, 0), and $(b, 1)$.

Step 3 Plot the points and sketch the graph.

$\left(\frac{1}{b}, -1\right) \rightarrow \left(\frac{1}{5}, -1\right)$

(1, 0)

$(b, 1) \rightarrow (5, 1)$

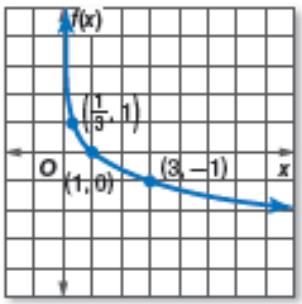


b. $f(x) = \log_{\frac{1}{3}} x$

Step 1 $b = \frac{1}{3}$

Step 2 $0 < \frac{1}{3} < 1$, so use the points $\left(\frac{1}{3}, 1\right)$, (1, 0) and (3, −1).

Step 3 Sketch the graph.



KeyConcept Transformations of Logarithmic Functions

$$f(x) = a \log_b (x - h) + k$$

h – Horizontal Translation	k – Vertical Translation
h units right if h is positive $\lvert h \rvert$ units left if h is negative	k units up if k is positive $\lvert k \rvert$ units down if k is negative

a – Orientation and Shape

If $a < 0$, the graph is reflected across the x-axis.

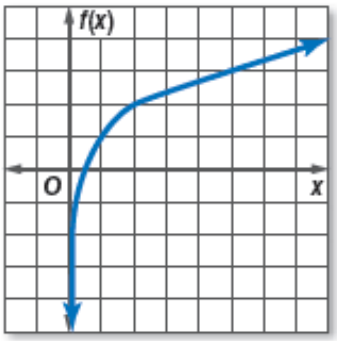
If $\lvert a \rvert > 1$, the graph is stretched vertically.
If $0 < \lvert a \rvert < 1$, the graph is compressed vertically.

Graph each function.

a. $f(x) = 3 \log_{10} x + 1$

This represents a transformation of the graph of $f(x) = \log_{10} x$.

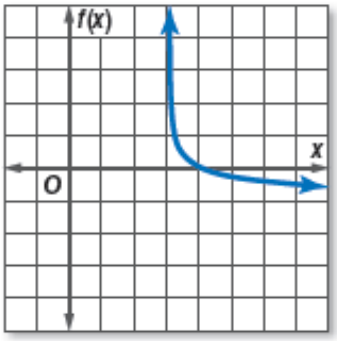
- $\lvert a \rvert = 3$: The graph stretches vertically
- $h = 0$: There is no horizontal shift.
- $k = 1$: The graph is translated 1 unit up.



b. $f(x) = \frac{1}{2} \log_{\frac{1}{4}} (x - 3)$

This is a transformation of the graph of $f(x) = \log_{\frac{1}{4}} x$.

- $\lvert a \rvert = \frac{1}{2}$: The graph is compressed vertically.
- $h = 3$: The graph is translated 3 units to the right.
- $k = 0$: There is no vertical shift.

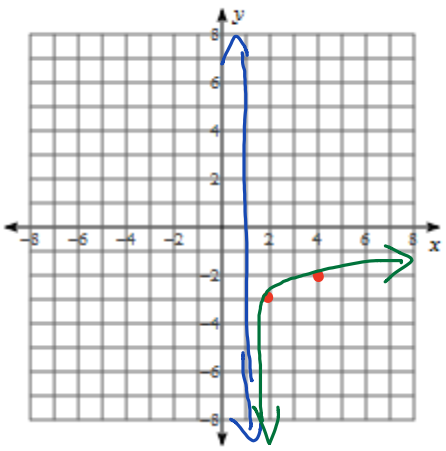


Example

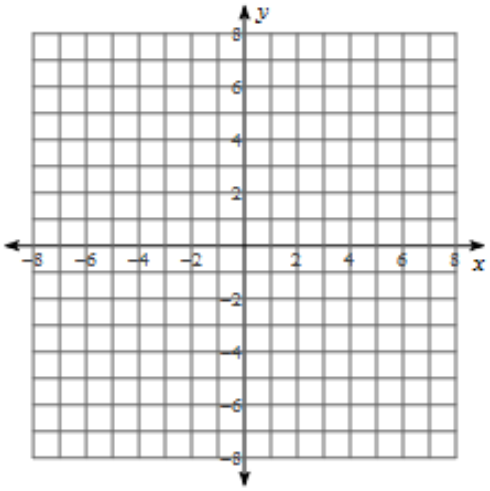
1) $y = \log_3 (x - 1) - 3$

$\log_3 x$	$\log_3 (x-1)$ shift 1 right	$\log_3 (x-1) - 3$ shift down 3
$(1, 0)$	$(2, 0)$	$(2, -3)$
$(3, 1)$	$(4, 1)$	$(4, -2)$

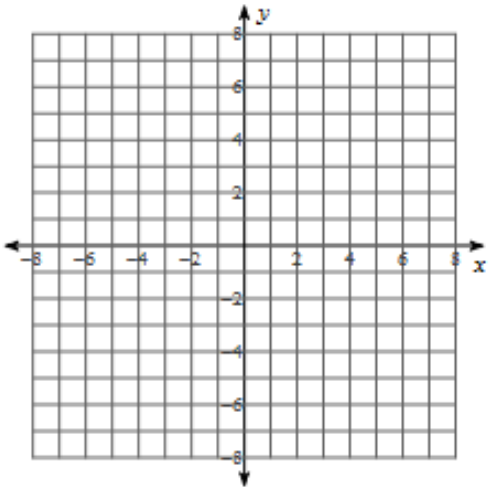
Vert asymtote = Vertical shift
$x = 1$



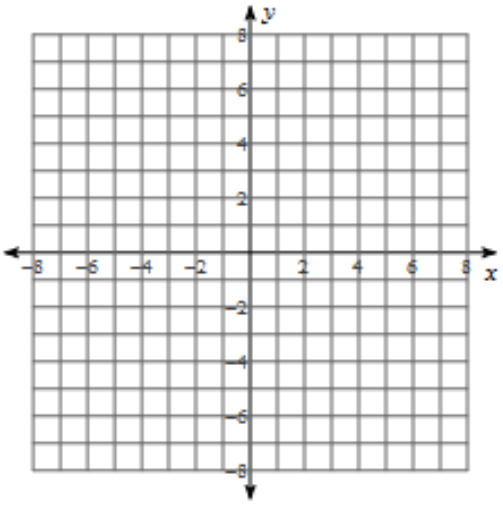
1) $y = \log_5 (x - 1) + 5$



2) $y = \log (x - 1) - 3$



3) $y = \log (x - 1) - 4$



4) $y = \log_6 (x - 1) - 3$