3.3 Logarithmic Functions & their Graphs

Logarithmic Functions

Logs & exponentials are inverse functions (like add/sub are inverse operations), they "undo" each other and are very closely related.

"log base b of x"

$y = \log_b x$ iff $b^y = x$

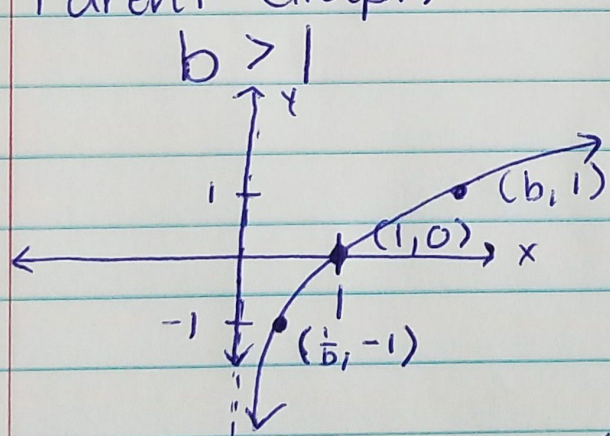
with $x > 0$, $b > 0$ and $b \neq 1$

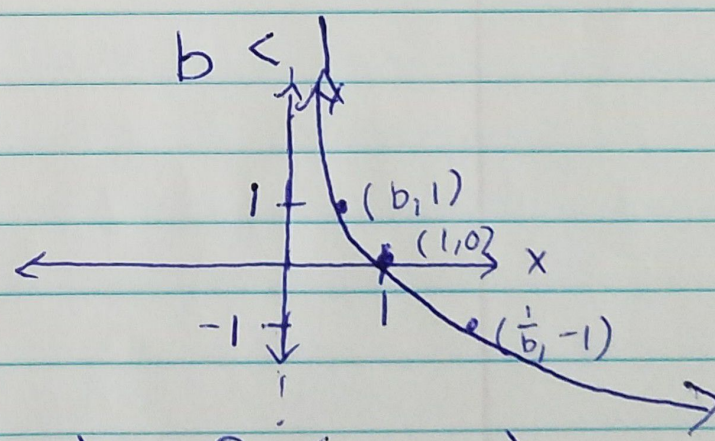
$\log_3 9 = y$ $\quad 3^y = 9$ $\quad y = 2$

$\log_2 \frac{1}{8} = y$ $\quad 2^y = \frac{1}{8}$ $\quad y = -3$

$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

Parent Graph





VA: $x = 0$ $\quad$ D: $(0, \infty)$ $\quad$ R: $(-\infty, \infty)$

unbounded $\quad$ x-int: (1, 0) $\quad$ no y-int $\quad$ no extrema

Transformations

$$f(x) = \pm a \log_b [\pm c (x - h)] + k$$

- $\pm$ on a: vertical reflection over the x-axis
- a: vertical stretch/shrink
- b: base
- $\pm$ on c: horizontal reflection over the y-axis
- c: horizontal stretch $c < 1$, shrink $c > 1$
- h: horizontal translation
- k: vertical translation

Common Logarithms

If $f(x) = \log_{10} x$, then you may simply write it as $f(x) = \log x$.

Base = 10

Natural Logarithms

If $f(x) = \log_e x$, then you may simply write it as $f(x) = \ln x$.

"ell-en" of x

ln x

~~apuesta~~