Transformations of Logarithmic Functions

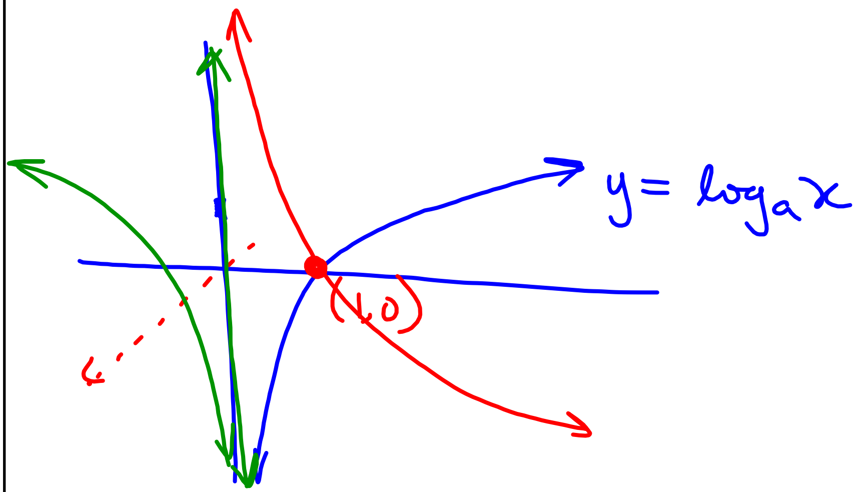
Nov. 28/2014

In general: $y = af[k(x-p)] + q$

For the logarithmic function, $y = \log_b x$, this becomes:

$$y = a\log_b[k(x-p)] + q$$

(note the base can be represented as 'b' to avoid confusion with the scale factor 'a')



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Transformation Strategies:

(1) Transform asymptote, x = 0, by horizontal shift p.

(2) Transform key points (1,0) and (b,1) using

$$(x, y) \to \left(\frac{x}{k} + p, ay + q\right)$$

Note: A third point may be required. $(b^2, 2)$

(3) The domain depends on the asymptote and any horizontal reflections.

$y = \log_b x$ $\quad x = 1 \longrightarrow y = 0$
$\quad x = b \longrightarrow y = 1$

$y = \log_2 x$ $\quad x = 1:$ $y = \log_2 1$
$2^y = 1$
$2^y = 2^0$
$y = 0$ ✓

$x = 2:$ $y = \log_2 2$
$2^y = 2^1$
$y = 1$ ✓

$y = \log_{10} x$ $\quad x = 10:$ $y = \log_{10} 10$
$10^y = 10^1$
$y = 1$

$x = 100:$ $y = \log_{10} 100$
$10^y = 100$
$10^y = 10^2$
$y = 2$

$\log_b(b^2) = 2$

$\log_{b^2}(b^4) = \log_a a^2 = 2$

let $b^2 = a$

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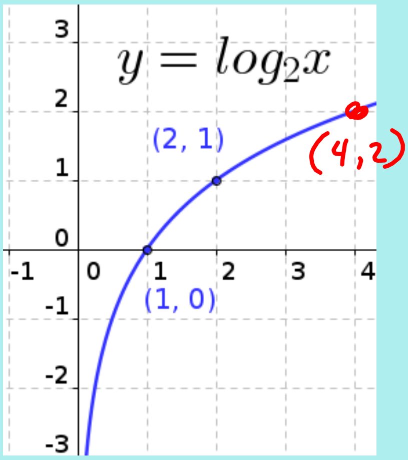
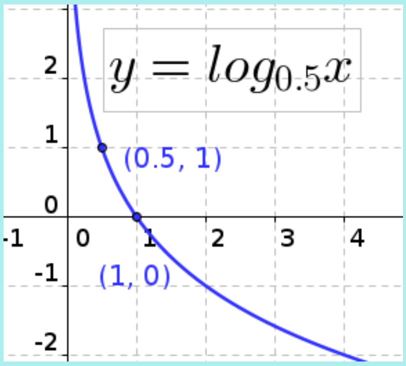
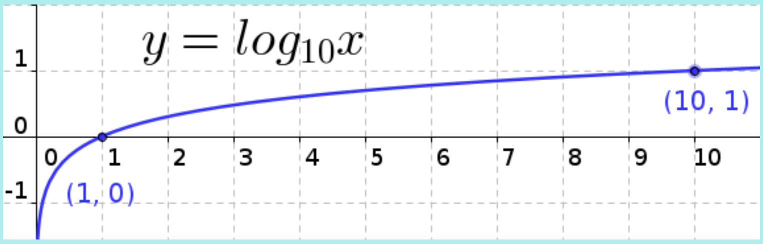
The parent logarithmic function $y = \log_b x$ will have convenient key points at $(1, 0)$ and $(b, 1)$







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Assigned Work:

p.456 # 1 - 3, 4, 5, 8, 9, 11

8. $f(x) = \log_{10} x$ $P(10, 1)$

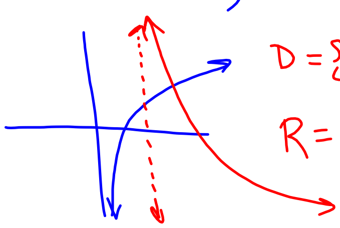
(a) $y = -3f\left[\frac{1}{2}(x-5)\right] + 2$

$y = -3\log_{10}\left[\frac{1}{2}(x-5)\right] + 2$

$(x, y) \rightarrow \left(\frac{x}{k} + p, ay + q\right)$

(b) $(10, 1) \rightarrow (25, -1)$

(c)



$D = \{x \in \mathbb{R} \mid x > 5\}$

$R = \{y \in \mathbb{R}\}$

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11. $f(x) = \dfrac{-2}{\log_2(x+2)}$

$= \dfrac{1}{\dfrac{\log_2(x+2)}{-2}}$

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

① graph $y = \log_2 x$

② graph $y = \underbrace{-\frac{1}{2}\log_2(x+2)}_{\text{zeroes}}$

③ $\frac{1}{y}$ for ②

zeroes → VA!

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