

5.2 Transformations of Logarithmic Functions

Day 1: Do investigation on p. 452-453 using graphing calculators

Day 2 **Summary of transformations:** **Gizmos Demo**

$$y = a \log_b(k(x-d)) + c$$

$|a| > 1$ - vertical stretch

a - $0 < |a| < 1$ - vertical compression
if a is negative - reflection over x-axis

b - base of the inverse of exponential form

$|k| > 1$ - horizontal compression
 k - $0 < |k| < 1$ - horizontal stretch
if k is negative - reflection over y-axis

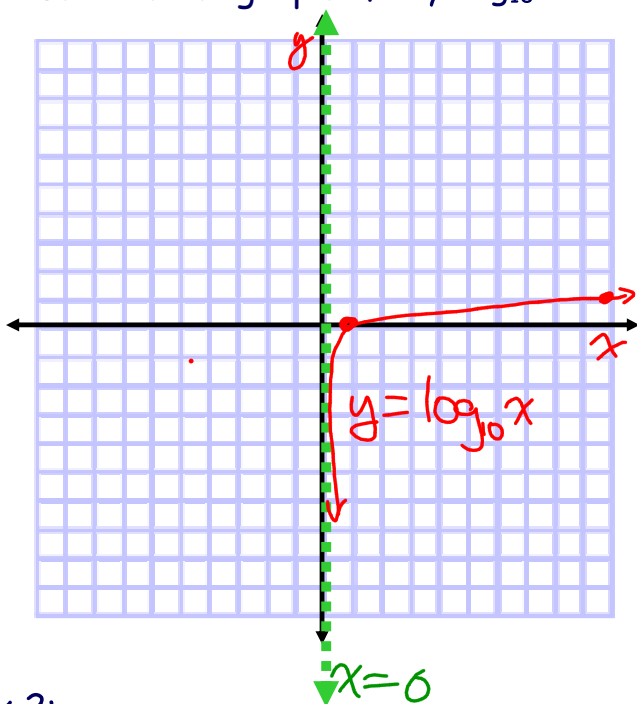
horizontal translation

d - $d > 0$ right
 $d < 0$ left

vertical translation

c - $c > 0$ up
 $c < 0$ down

Ex 1 Sketch the graph of $y = \log_{10} x$



Steps to graph:

- 1) graph the inverse of the exponential function "base"
- 2) apply stretches / compressions / reflection
- 3) then apply the translations

$y = 10^x$

x	y
-2	$\frac{1}{100}$
-1	$\frac{1}{10}$
0	1
1	10
2	100

Ex 2:

i) Describe the transformations that must be applied to $y = \log_{10} x$ to obtain:

ii) Write the mapping notation

a) $y = \log_{10}(-2x+6)$

$= \log_{10}(-2(x-3))$ $(x, y) \rightarrow \left(-\frac{x}{2} + 3, y\right)$

b) $y = -\log_{10}(x) + 2$

$(x, y) \rightarrow (x, -y + 2)$

c) $y = \frac{1}{2} \log_{10}(x) - 1$

$(x, y) \rightarrow \left(x, \frac{1}{2}y - 1\right)$

Ex 3 State the inverse equation of the following functions.

a) $y = -2(5)^x - 3$

$$x = -2(5)^y - 3$$

$$\frac{x+3}{-2} = 5^y$$

$$-\frac{x+3}{2} = 5^y$$

← Interchange x & y

← Isolate the power before you write it as a log (or vice versa)

$$y = \log_5 \left[\frac{-(x+3)}{2} \right]$$

$$y = a^x \Leftrightarrow x = \log_a y$$

b) $y = 3\log_2(x-5) + 4$

$$x = 3\log_2(y-5) + 4$$

$$\frac{x-4}{3} = \log_2(y-5)$$

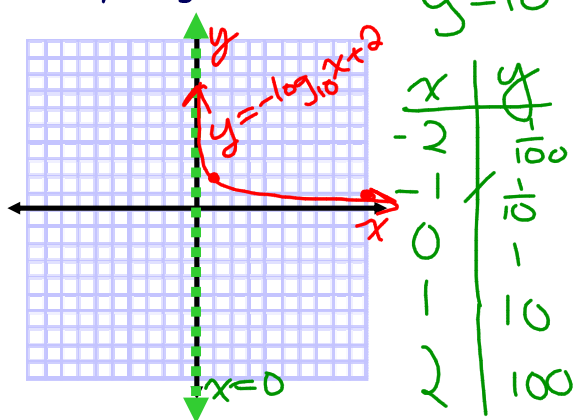
$$y-5 = 2^{\frac{x-4}{3}}$$

$$y = 2^{\frac{x-4}{3}} + 5$$

$$\therefore f^{-1} = 2^{\frac{x-4}{3}} + 5$$

Ex 4 Sketch the graphs of the following logarithmic functions

a) $y = -\log_{10}x + 2$

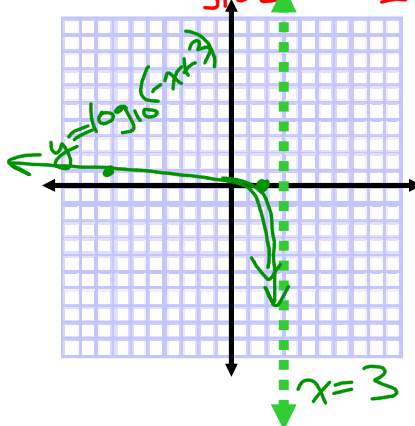


$(x, y) \rightarrow (x, -y + 2)$

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

$(10, 1) \rightarrow (10, 1)$

b) $y = \log_{10}(-x + 3)$ VA? $x = 3$
 $= \log_{10}[-(x - 3)]$

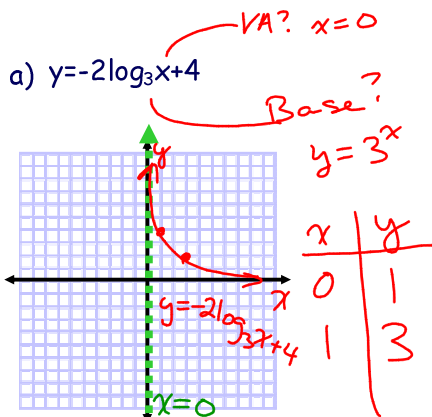


$(x, y) \rightarrow (-x + 3, y)$

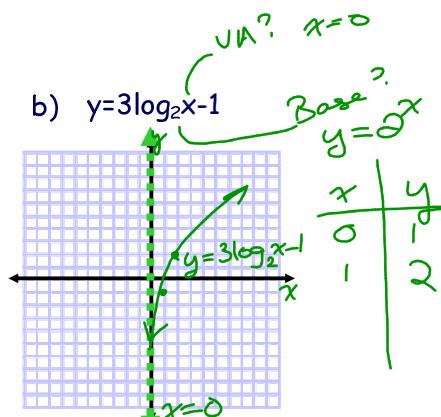
$(1, 0) \rightarrow (2, 0)$

$(10, 1) \rightarrow (-7, 1)$

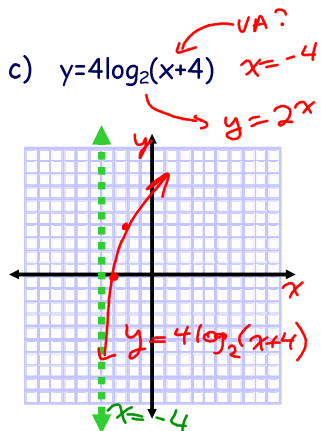
Ex 5 Sketch the graphs of the following logarithmic functions.



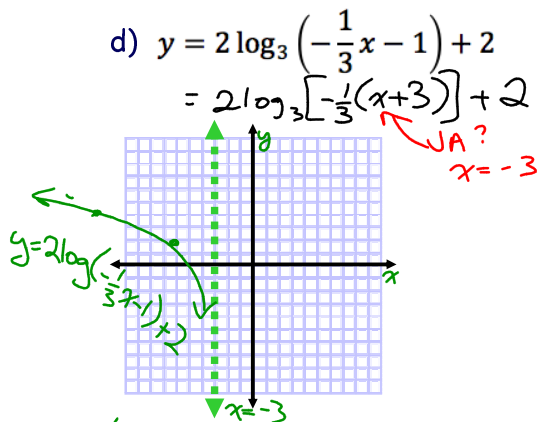
$(x,y) \rightarrow (x, -2y+4)$
 $(1,0) \rightarrow (1, 4)$
 $(3,1) \rightarrow (3, 2)$



$(x,y) \rightarrow (x, 3y-1)$
 $(1,0) \rightarrow (1, -1)$
 $(2,1) \rightarrow (2, 2)$



$(x,y) \rightarrow (x-4, 4y)$
 $(1,0) \rightarrow (-3, 0)$
 $(2,1) \rightarrow (-2, 4)$



$(x,y) \rightarrow (-3x-3, 2y+2)$
 $(1,0) \rightarrow (-6, 2)$
 $(3,1) \rightarrow (-12, 4)$

Homework 5.2:
p. 457 # 1,3,5,6,8-10

