

Stick Quiz T7-2

$$x = \frac{1}{2}$$

1. Solve $4^{2x} = 16^{3x-1}$ 2. Solve $8^{x-1} = 2^{x+9}$ $x = 6$

3. $\left(\frac{1}{9}\right)^{x-2} = 6561$

$12000\left(1 + \frac{.053}{4}\right)^{4t}$ $x = -2$

4. A money market account pays 5.3% interest compounded quarterly. What will the balance in the account be after 5 years if \$12,000 is invested? Round your answers to the hundredth. \$15,613.98

LESSON 7-3 Logarithms and Logarithmic Functions

I can describe transformations, graph and determine domain and range of exponential and logarithmic functions.

Today: Logarithmic Functions

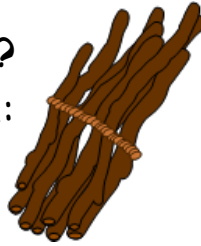
(actually they are inverses of exponential functions)

7.3 Logarithmic Functions

(more affectionately known as logarithms)

Q: What are logarithms?

A:



Logs that can dance

Ren & Stimpy
What is log???



Definition of Logarithms

For $a > 0$ and $b > 0$, $a = b^x$ is equivalent to $\log_b a = x$

$$\begin{array}{c}
 a = b^x \\
 \updownarrow \\
 \log_b a = x
 \end{array}
 \quad b^x = a$$

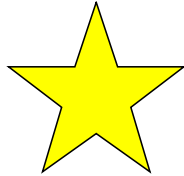
The diagram shows the relationship between the exponential form $a = b^x$ and the logarithmic form $\log_b a = x$. A vertical double-headed arrow connects the two equations. A blue circle is drawn around the a in the logarithmic equation and the x in the exponential equation, with arrows indicating their correspondence. To the right, the equation $b^x = a$ is written in blue.

There is a special exponential that has a special inverse...

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

it turns up so much in biology, chemistry, geology, sound engineering and more, it's called the **common log.**

(it even has it's own button on the calculator!)



Because it's the most commonly used, the powers that be made the 10 invisible!



famous
invisibles

$$\begin{aligned} 1x &= x \\ \sqrt{x} &= \sqrt{x} \\ -1(x+2) &= -(x+2) \\ y = \log_{10} x &= \log x \end{aligned}$$

Write in log form....

$$a = b^x$$

$$3^x = 102$$

$$5^x = 125$$

$$9^x = 500$$

$$b^x = a$$

$$\log_b a = x$$

$$\log_3 102 = x$$

— .

Write in exponential form.

$$\log_{10} 100 = x \quad 10^x = 100 \quad x = 2$$

$$\log_5 125 = x \quad 5^x = 125 \quad x = 3$$

1 $\log_2 64$

2 $\log_7 49$

3 $\log_3 27$

4 $\log_{\frac{1}{64}}$

Rewrite each in exponential form:

$$\log_{10} x = 10$$

$$10^{10} = x$$

$$\log_x 625 = 4$$

$$(x^4) = (625)^{\frac{1}{4}}$$

$$x = 5$$

$$\log_x 64 = 6$$

$$\log_2 x = y$$

$2^y = x$	<u>inverse</u>	$y = 2^x$
$\log_2 x = y$		

Introduction to Graphing Logs

(Inverse of exponential)

Graph: $y = 2^x$

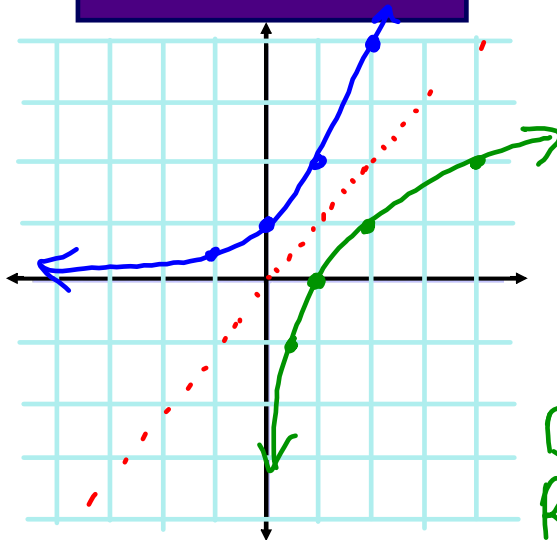
$x = 2^y$

x	y
-1	$\frac{1}{2}$
0	1
1	2
2	4

D: \mathbb{R}
R: $y > 0$

How to find an inverse
Switch x and y

$\log_2 x = y$



x	y
$\frac{1}{2}$	-1
1	0
2	1
4	2

D: $x > 0$
R: \mathbb{R}

Logarithmic Parent Function Pg 468

KeyConcept Parent Function of Logarithmic Functions

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

$f(x) = \log_b x, 0 < b < 1$

You can Memorize...

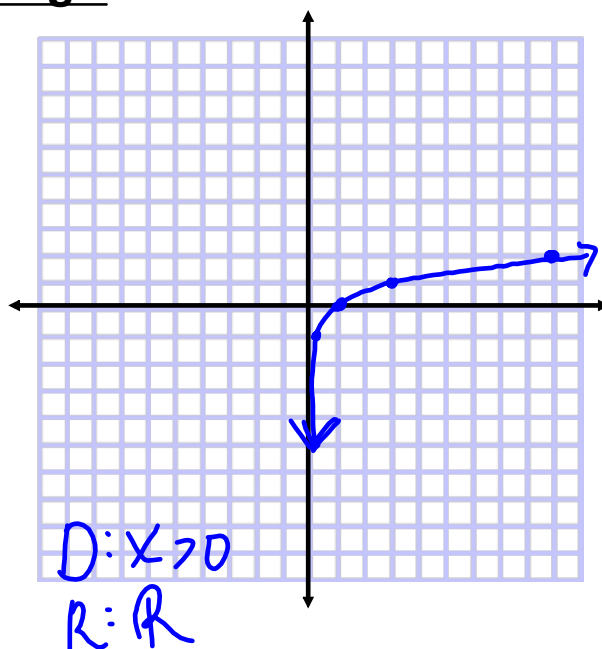
Graph. Note domain and range.

1. $y = \log_3 x$

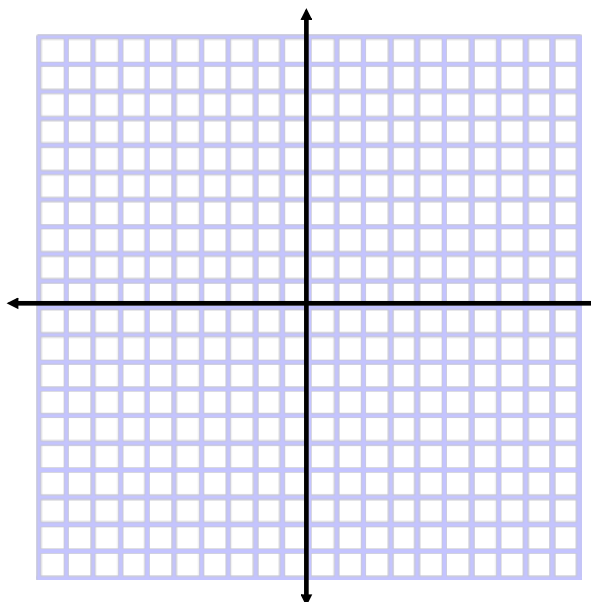
$3^y = x \leftarrow \text{graph}$

$y = 3^x$	
-1	$\frac{1}{3}$
0	1
1	3
2	9

$3^y = x$	
$\frac{1}{3}$	-1
1	0
3	1
9	2

Graph. Note domain and range.**You Try**

2. $y = \log_6 x$



Graph. Note domain and range.

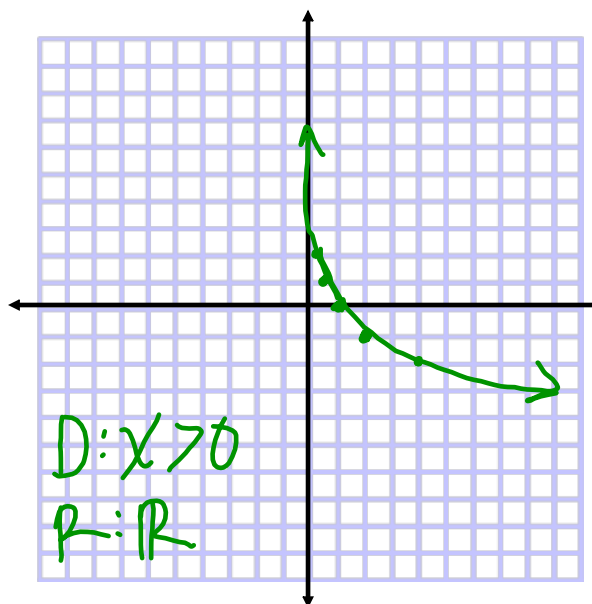
3. $y = \log_{1/2} x$

$$y = \left(\frac{1}{2}\right)^x$$

-2	1/4
-1	1/2
0	1
1	2
2	4

$$\left(\frac{1}{2}\right)^y = x$$

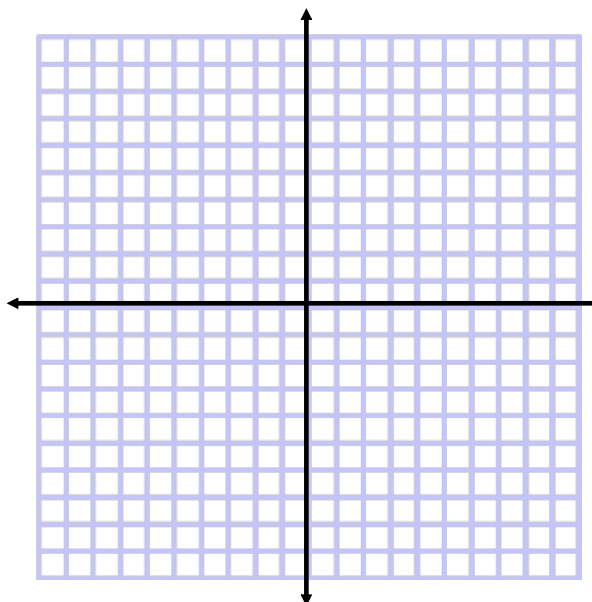
-2	4
-1	2
0	1
1	1/2
2	1/4



Graph. Note domain and range.

You Try

4. $y = \log_{1/3} x$



Transformations

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

IF NOT IN
() ITS
NOT h!

$f(x) = \log_b x$ Parent function

h - Horizontal translation

k - Vertical translation

a - Orientation/Shape

Don't forget! A negative out front just flips the graph

5. Describe the transformations.

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

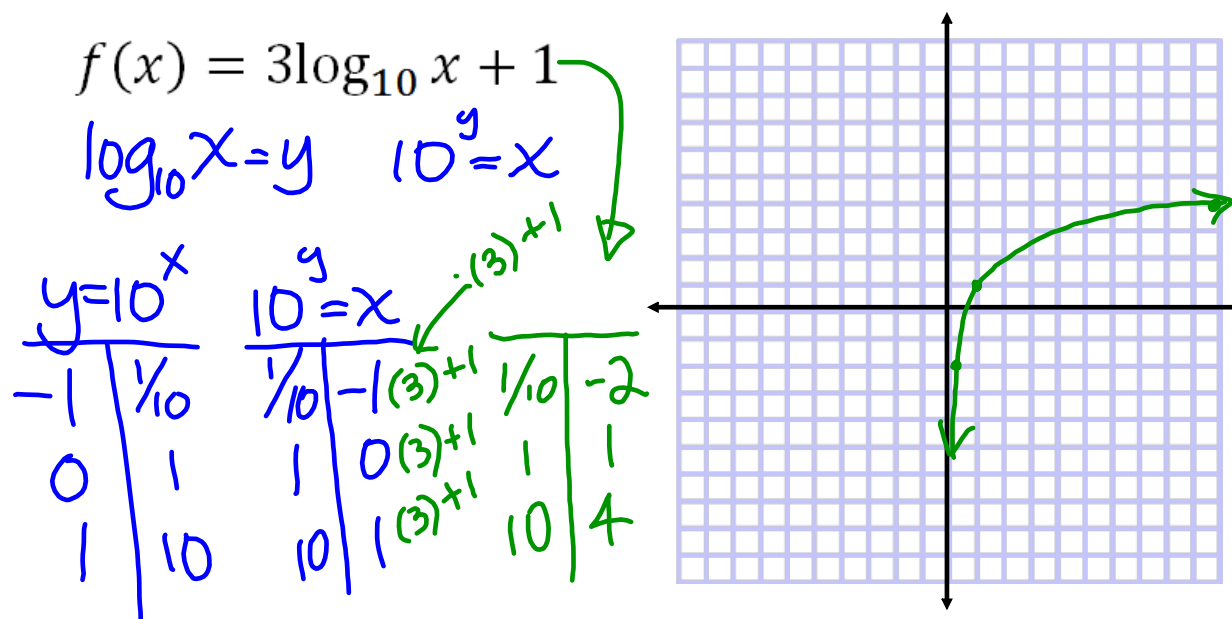
The parent function is: $y = \log_{10} x$

a = 3, which means v. stretch by 3 ←

h = 0, which means no left/right ← ~~D: X > 0~~

k = 1, which means up 1 ← R: R

5. Graph parent function and transformed function.
State Domain and Range.



6. Describe the transformations.

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

The parent function is: $y = \log_{\frac{1}{4}} x$

$a = \frac{1}{2}$, which means shrink of 2

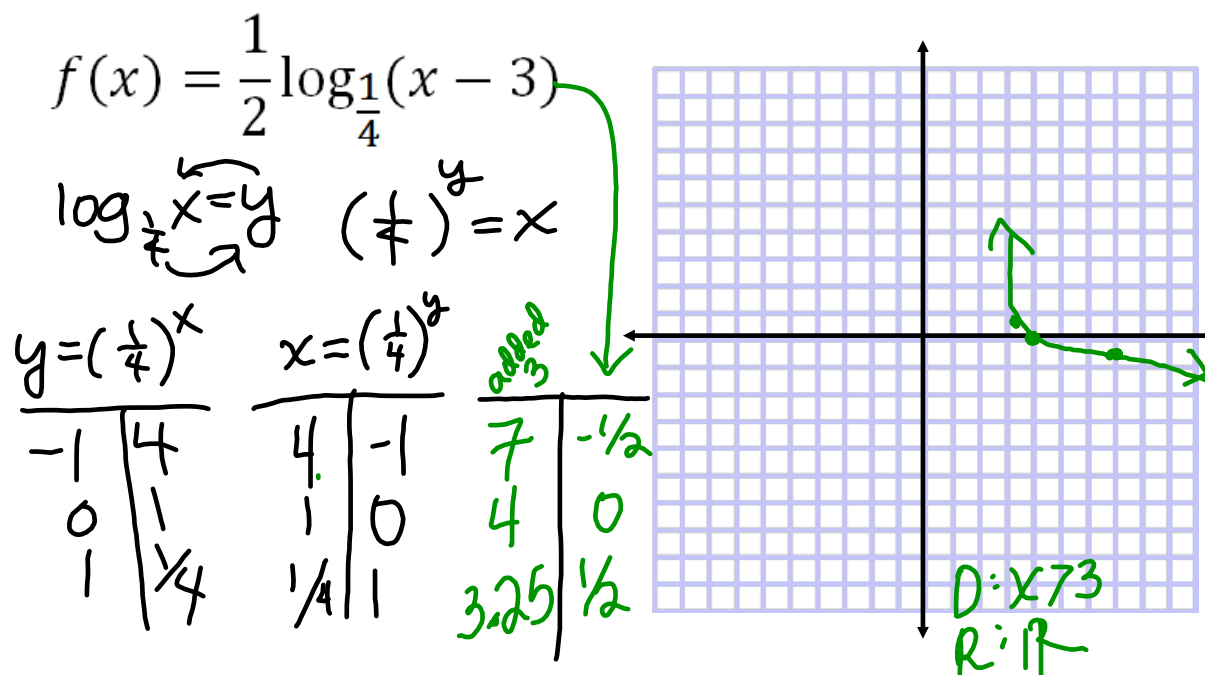
$h = 3$, which means right 3 $D: x > 3$

$k = 0$, which means no up/down

*multiply
y values by 1/2
or - by 2*

*+3
to mt
x values*

6. Graph the parent function and this function on same graph. State Domain and Range.



You Try

7. Describe the transformations.

$$f(x) = 2 \log_3(x - 2)$$

The parent function is: _____

a= _____, which means _____

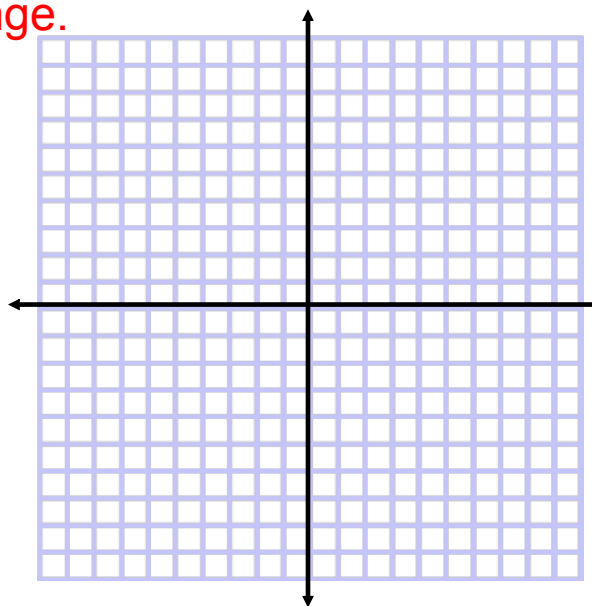
h= _____, which means _____

k= _____, which means _____

You Try

7. Graph the parent function and this function on same graph. State Domain and Range.

$$f(x) = 2\log_3(x - 2)$$



Homework 7.3

7.3 Pg472 #13-35o, 37-47o, 50

For 37-47o In addition to the books instructions:
State the parent function and all transformations.