Warm Up

Graph the function and its inverse without a graphing calculator.

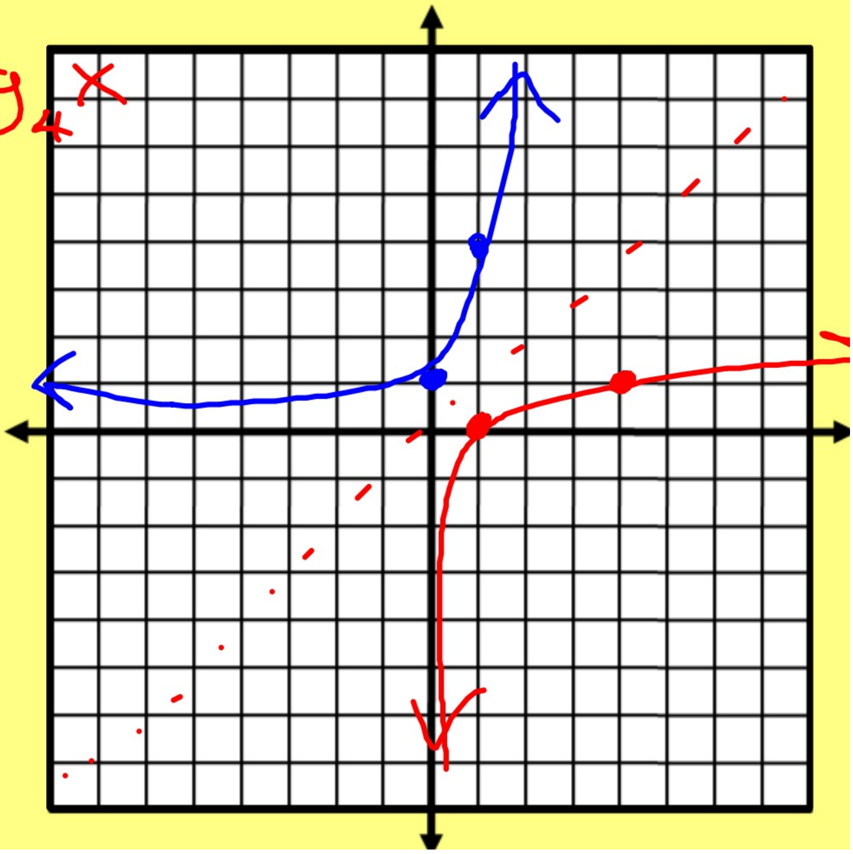
$y = 4^x$ $\quad y^{-1} = \log_4 x$

x	y

x	y

$x = 4^y$

$y = \log_4 x$



$y = 3^{x-1} + 2$

Graph the function and its inverse without a graphing calculator.

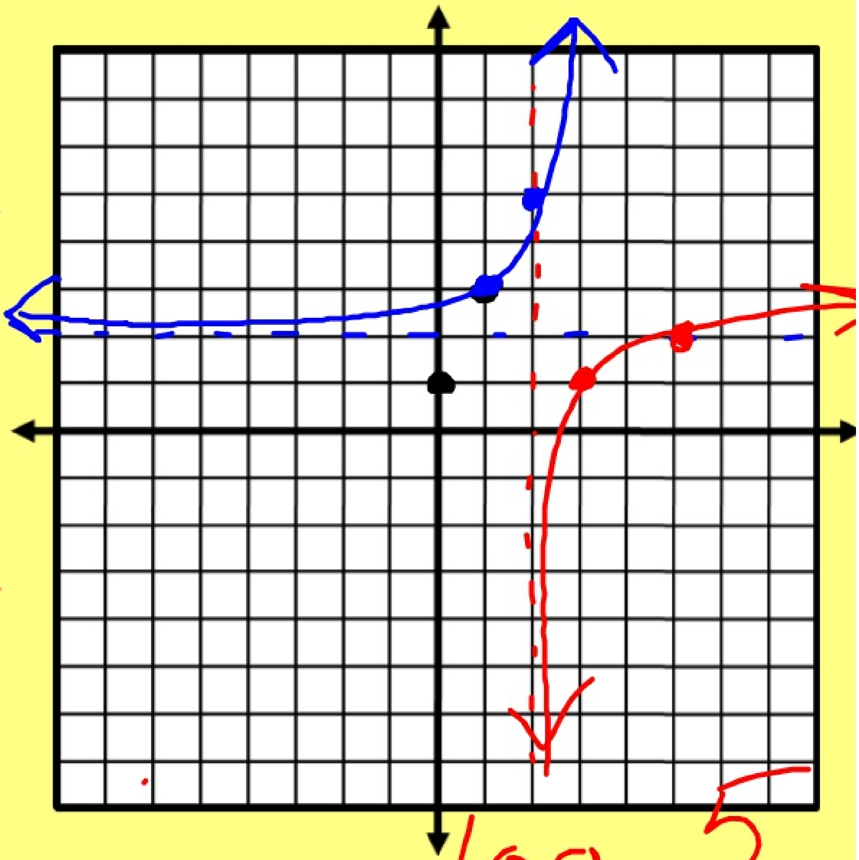
$y^{-1} =$ ___

x	y
1	3
2	5

x	y
3	1
5	2

H.A. at $y=2$

V.A. at $x=2$



$\log_3 5$

$y = 3^{x-1} + 2$

$x = 3^{y-1} + 2$

$x - 2 = 3^{y-1}$

$\log_3 x - 2 = y - 1$

$+1 \qquad +1$

$y = \log_3 (x-2) + 1$

SECTION 8.5: Properties of Logarithms

Most calculators only have two types of log keys:

1.) Common Logarithms (base 10) LOG
2.) Natural Logarithms (base e) LN

To evaluate logarithms to other bases we need to use the

CHANGE-OF-BASE FORUMLA

$\log_a x$ can be converted to a different base as follows:

BASE b	BASE 10	BASE e
$\log_a x = \dfrac{\log_b x}{\log_b a}$	$\log_a x = \dfrac{\log x}{\log a}$	$\log_a x = \dfrac{\ln x}{\ln a}$

Changing Bases Using Common & Natural Logarithms

	10 Common Log	e Natural Log
$\log_4 25$	$\frac{\log_{10} 25}{\log_{10} 4} = 2.32$	$\frac{\ln 25}{\ln 4} = 2.32$
$\log_2 12$	3.58	
$\log_3 16$	2.52	
$\log_5 22$	1.92	

More Logarithm Properties

Property #1 - Product Property

$$\log_a(cd) = \log_a c + \log_a d$$

Expanding Examples:

$\log_5(125x)$

$\log_5 125 + \log_5 x$

$\ln(xyz)$

$\ln x + \ln y + \ln z$

More Logarithm Properties

Property #1 - Product Property

$$\log_a(cd) = \log_a c + \log_a d$$

Condensing Examples:

$$\log_7 x + \log_7 11$$

$\log_7(11x)$

$$\ln r + \ln 5 + \ln s$$

$\ln r5s$

$\boxed{\ln(5rs)}$

More Logarithm Properties

Property #2 - Quotient Property $\log_a \frac{c}{d} = \log_a c - \log_a d$

Expanding Examples:

$\log_4\left(\frac{1}{64}\right)$

Expanded:

$\log_4 1 - \log_4 64$

Simplified:

$0 - 3 = \boxed{-3}$

$\log\left(\frac{xy}{zw}\right)$

$\log(xy) - \log(zw)$

$(\log x + \log y) - (\log z + \log w)$

$\log x + \log y - \log z - \log w$

More Logarithm Properties

Property #2 -
Quotient Property

Condensing Examples:

$\log_2 5 - \log_2 11$

$\log_2\left(\frac{5}{11}\right)$

$\log 12 - \log 5$

$\log\left(\frac{12}{5}\right)$

More Logarithm Properties

Property #3 - Power Property

$$\log_a c^w = w\log_a c$$

Examples:

$\log_5 7^{12}$

$12 \log_5 7$

$\log_7 \sqrt[4]{7}$

Expanded

$\log_7 7^{1/4}$

$\frac{1}{4}\log_7 7 = \frac{1}{4}$

simplif

$\log_4 4^{10}$

$10 \log_4 4$

10

$\ln 5^6$

$6 \ln 5$

More Logarithm Properties

Property #3 - Power Property

Examples:

$$15\log_3 a + 5\log_3 b$$

$\log_3 a^{15} + \log_3 b^5$

$\log_3 a^{15} b^5$

$$8\log x + 2\log y$$

$\log x^8 + \log y^2$

$\log(x^8 y^2)$

$$6\log_4 x - 12\log_4 y$$

$\log_4\left(\frac{x^6}{y^{12}}\right)$

$$2\log_9 w + \frac{\log_9 u}{2}$$

$2\log_9 w + \frac{1}{2}\log_9 u$

$\log_9 w^2 + \log_9 u^{1/2}$

$\boxed{\log_9\left(w^2\sqrt{u}\right)}$

Simplify each expression.

$\log_5 75 - \log_5 3$

$\log_5\left(\frac{75}{3}\right)$

$\log_5 25$

$5^b = 25$

$\boxed{2}$

$\ln\left(\frac{e^6}{e^2}\right)$

$\ln e^6 - \ln e^2$

$6 \ln e - 2 \ln e$

$6 - 2$

$\boxed{4}$

$\log_4 2 + \log_4 32$

$\log_4 64$

$4^b = 64$

$\boxed{3}$

Condense each expression into one logarithm.

$\frac{1}{2}\log x + 3\log(x+1)$

$\log x^{1/2} + \log(x+1)^3$

$\log\left(x^{1/2}\cdot(x+1)^3\right)$

$\boxed{\log\left(\sqrt{x}\cdot(x+1)^3\right)}$

$2\ln(x + 2) - \ln x$

$\ln(x+2)^2 - \ln x$

$\boxed{\ln\left(\frac{(x+2)^2}{x}\right)}$

$\log_3(x + 2) - \log_3(x) - 2\log_3(x)$

$\log_3(x+2) - \log_3(x) - \log_3 x^2$

$\log_3\left(\frac{x+2}{x}\right) - \log_3 x^2$

$\log_3\left(\frac{\frac{x+2}{x}}{x^2}\right)$

$\log_3\left(x^2+2x\right)$

Expand each expression.

$\log_4 5x^3y$

$\ln\left(\frac{\sqrt{3x-5}}{7}\right)$

$\log(4x^3y5z^2)$

Condense each expression.

$\log_2 5 - 3$

$\dfrac{\log_9 12}{2}$

$6\log_4 11 + 6\log_4 3 + 36\log_4 10$

Log Properties -

How well do you actually know them?

$$\log_3 3 = \_\_\_\_\_\_$$

Log Properties -

How well do you actually know them?

$$\log_7 1 = \underline{\hspace{4cm}}$$

Log Properties -

How well do you <u>actually</u> know them?

$$\ln e = \_\_\_\_\_\_$$

Log Properties -

How well do you actually know them?

$$\log 10^4 = \_\_\_\_\_\_$$

Log Properties -
How well do you <u>actually</u> know them?

$$\ln e^2 = \underline{\hspace{3cm}}$$