SM3-A HANDOUT 7-7 (The Logarithm Function)

Find the Inverse: exchange the locations of 'x' and 'y' in the equation then solve for 'y'.

$f(x) = (x-2)^2$

Domain: The input values (that have corresponding outputs)

Range: The output values (that have corresponding inputs)

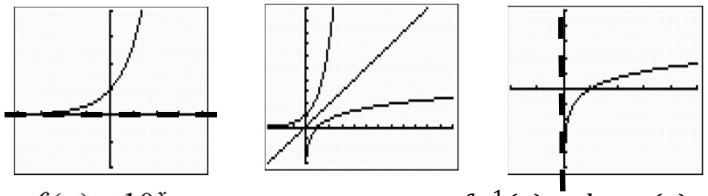
Inverse of a Function: A function resulting from an "exchange" of the inputs and outputs.

$f(x): Domain, Range$

$f^{-1}(x):$ Domain = range of f(x)

Range = domain of f(x)

Exponential Function | Inverse Functions | Logarithm Function



$f(x) = 10^x$ $f^{-1}(x) = log_{10}(x)$

Domain = ?

Range = ?

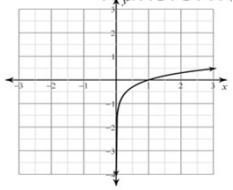
asymptote = ?

Domain = ?

Range = ?

asymptote = ?

Transformations of the Log Function



$f(x) = \log x$

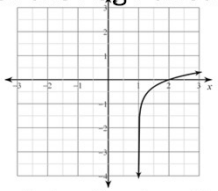
Domain = ? (0, ∞)

Range = ? (-∞, ∞)

vertical asymptote = ? x = 0

X-intercept = ? x = 1

Where increasing = ? (0, ∞)



$g(x) = \log(x-1)$

Right 1 shift

Domain = ?

Range = ?

asymptote = ?

Logarand

$g(x) = 3\log(2x-1)+5$

Logarand

Vertical Asymptote: The value of 'x' that makes the logarand equal to zero.

Vertical asymptote = ? $2x - 1 = 0$

$x = ½$

Evaluating Logs on your calculator

$\log 8 = ?$

Push buttons:

log | 8) | = | _____

$\log 0 = ?$ | error | Why? _____

$\ln 10 = ?$

Push buttons:

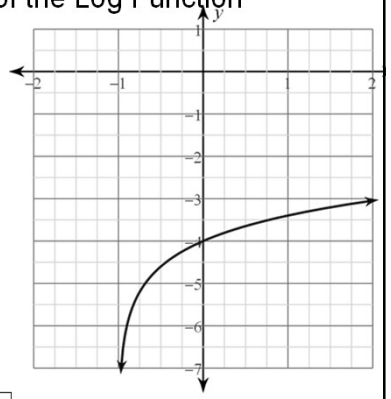
ln | 10) | = | _____

$\log(-3) = ?$ | error | Why? _____

Transformations of the Log Function

$f(x) = \log x$

$g(x) = 2\log(x+1) - 3$



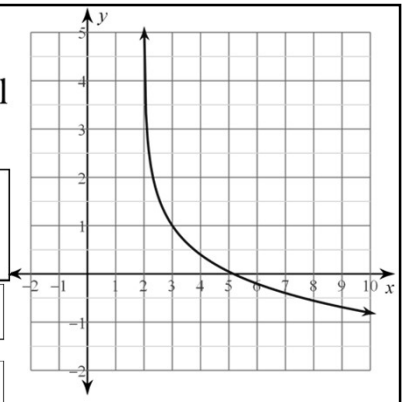
Domain = ? _____

Range = ? _____

Asymptote = ? _____

$f(x) = \log x$

$g(x) = -3\log(x-2) + 1$



Domain = ? _____

Range = ? _____

Asymptote = ? _____

NOT exponential (has a vertical asymptote, does NOT have a horizontal asymptote.

What is a logarithm?

A logarithm is another way of writing an exponent.

$2^x = 8$ — x is the exponent

$\log_2 8 = x$ — Log = exponent

Both of these equations are saying the same thing:

"2 raised to what power is 8?"

Exponential Form	Logarithm Form
$2^3 = 8$ (base)	Log$_{\square}$ $\square$ = $\square$ $\quad \log_2 8 = 3$ (base)
"base 2 raised to the 3rd is 8"	"log base 2 of 8 is 3"
$3^x = 9$	$\log_3 9 = x$
What exponent of 3 equals 9?	What exponent of 3 equals 9?

x = 2

Convert to logarithm form Log$_{\square}$ $\square$ = $\square$

What is the solution?

	$5^x = 25$	
	$4^x = 64$	
x = ???	$b^x = y$	
	$9^x = 81$	
	$10^x = 1000$	

Convert to exponential form Log$_{\square}$ $\square$ = $\square$

What is the solution?

	$\log_{10} 100 = x$	
	$\log_3 27 = x$	
	$\log_9 1 = x$	
	$\log_4 x = 2$	
	$\log_2 x = 5$	

Common Logarithm: has a base of 10.

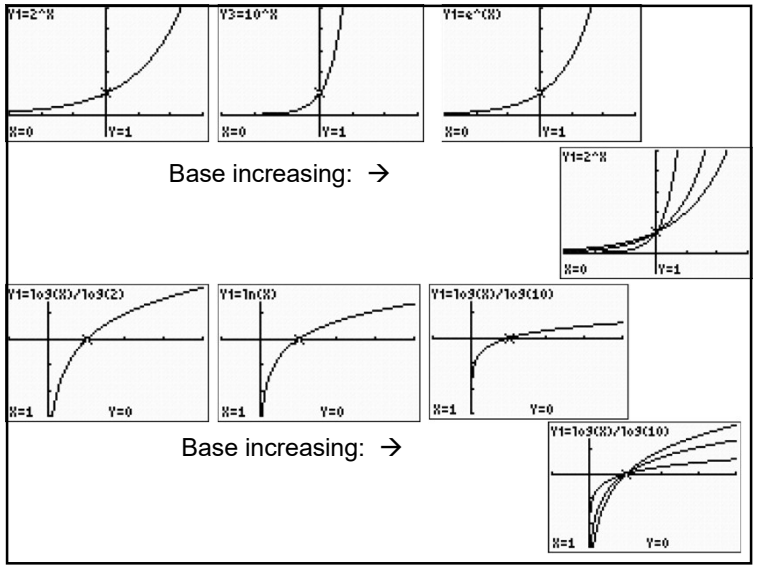
$\log_{10} 100 = x$

We usually write it in this form: $\log 100 = x$

Natural Logarithm: has a base of e.

$\log_e 2.718 = 1$

We always write it in this form: $\ln 2.718 = 1$



What is the base?

$\log_2 8 = x$ $\quad \ln 5 = x$ $\quad \log 20 = x$

What is the Solution?

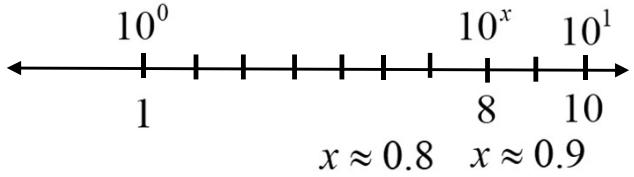
$\frac{1}{100} = log_{10}(x)$

$x = log_2\sqrt{2}$

$x = log_5 \frac{1}{\sqrt[3]{5}}$

Estimate the value of the log: $log(8)$

$\log 8 = x \qquad 10^x = 8$

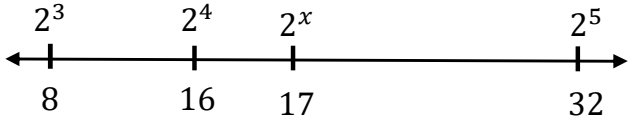


$x \approx 0.8 \quad x \approx 0.9$

Find $\log 8$ on your calculator. $\log 8 = 0.903$

Estimate the value of the log: $\log_2 17$

$\log_2 17 = x \quad \rightarrow 2^x = 17$



$x \approx 4.1$?

Find $\log_2 17$ on your calculator. $\log_2 17 = 4.09$

Estimate the value of the log (without using your calculator)

$log_3 30$ $\quad log_5 30$ $\quad log_6 30$

Finding the Inverse $f^{-1}(x) = ?$

$f(x) = 3^x$ Shift 'x' and 'y'

$x = 3^y$ "Undo the Exponential" (Convert it to a log)

"A log is an exponent"

$y = \log_3 x$ $\boxed{f^{-1}(x) = \log_3 x}$

Finding the Inverse $f^{-1}(x) = ?$

$f(x) = (3)^{x-1} + 2$

Finding the Inverse $f^{-1}(x) = ?$

$f(x) = (3)^{x-1} + 2$ $f^{-1}(x) = \log_3(x-2) + 1$

Right 1 → up 2 Right 2 → up 1

Finding the Inverse $f^{-1}(x) = ?$

$f(x) = 2\log_2(x+1)$