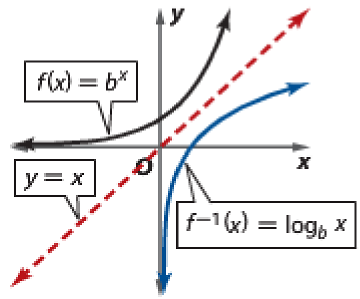
Name: ______________________________________ Date: _________________ Period_____________

Section 3.2– Logarithmic Functions

LOGARTIHMIC FUNCTIONS

Objective: Evaluate expressions involving logarithms

LOGARITHMIC FUNCTION	
Definition:	
Relating Logarithmic and Exponential Functions	

EXAMPLE 1: Evaluate Logarithms

Evaluate each logarithm.

a) $\log_3 81$

b) $\log_7 \frac{1}{49}$

c) $\log_5 \sqrt{5}$

d) $\log_2 2$

e) $\log_8 512$

f) $\log_4 4^{3.2}$

g) $\log_2 \frac{1}{32}$

h) $\log_{16} \sqrt{2}$

Basic Properties of Logs			
If $b > 0$, $b \neq 1$, and x is a real number, then the following statements are true:			

EXAMPLE 2: Apply Properties of Logarithms

Evaluate each expression.

a) $\log_5 125$ b) $12^{\log_{12} 4.7}$ c) $\log_9 81$ d) $3^{\log_3 1}$

Common Logarithm

Basic Properties of Common Logs			
If *x* is a real number, then the following statements are true:			

EXAMPLE 3: Common Logarithms

Evaluate each expression.

a) $\log 0.001$ b) $10^{\log 5}$ c) $\log 26$ d) $\log(-5)$

e) $\log 10,000$ f) $\log 0.081$ g) $\log -0$ h) $10^{\log 3}$

Natural Logarithm

Basic Properties of Natural Logs			
If *x* is a real number, then the following statements are true:			

EXAMPLE 4: Natural Logarithms

Evaluate each expression.

a) $\ln e^{0.73}$ b) $\ln(-5)$ c) $e^{\ln 6}$ d) $\ln 4$

e) $\ln 32$ f) $e^{\ln 4}$ g) $\ln\left(\frac{1}{e^3}\right)$ h) $-\ln 9$

GRAPHS OF LOGARTIHMIC FUNCTIONS

Objective: Sketch and analyze graphs of logarithmic functions

EXAMPLE 5: Graphs of Logarithmic Functions

Sketch and analyze the graph of each function. Describe its domain, range, intercepts, asymptotes, end behavior, and where the function is increasing or decreasing.

a) $f(x) = \log_3 x$

What is $f^{-1}(x)$?

Construct a table for $f^{-1}(x)$

x	*-4*	*-2*	*-1*	*0*	*1*	*2*
$f^{-1}(x)$						

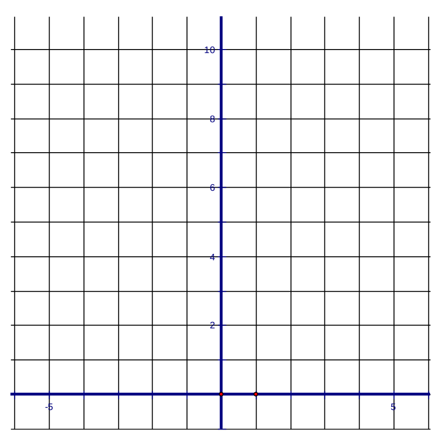
$f^{-1}(x)$						
x						

Domain: Range:

y-intercept: Asymptote:

end behavior:

increasing: decreasing:



b) $f(x) = \log_{\frac{1}{2}} x$

Domain: Range:

y-intercept: Asymptote:

end behavior:

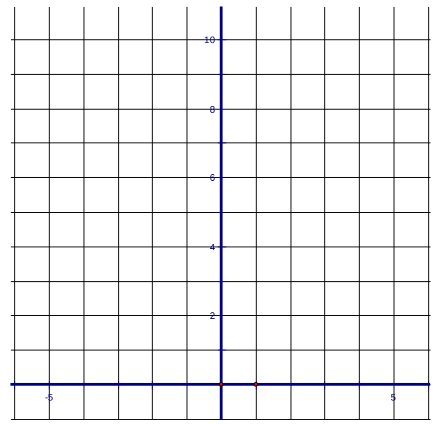
increasing: decreasing:

What is $f^{-1}(x)$?

Construct a table for $f^{-1}(x)$

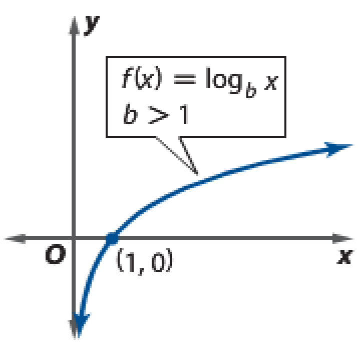
x	-4	-2	-1	0	1	2
$f^{-1}(x)$						

$f^{-1}(x)$						
x						



PROPERTIES OF LOGARITHMIC FUNCTIONS	
Logarithmic Growth	**Logarithmic Decay**

Logarithmic Growth



Domain: Range:

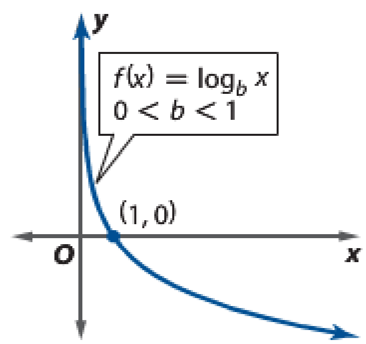
y-intercept: x- intercept:

end behavior:

increasing: decreasing:

asymptote: continuity:

Logarithmic Decay



Domain: Range:

y-intercept: x- intercept:

end behavior:

increasing: decreasing:

asymptote: continuity:

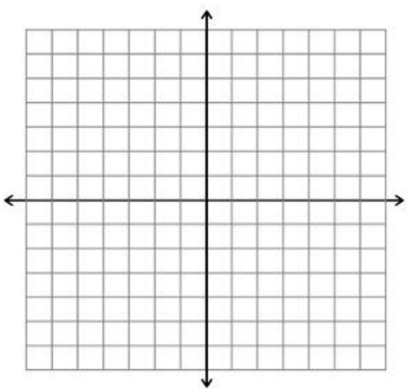
Transformations of functions

	Shift left 2	Shift right 2	Shift up 2	Shift down 2	Reflect over x-axis	Reflect over y-axis
Function Notation						
$f(x) = \log_3 x$						

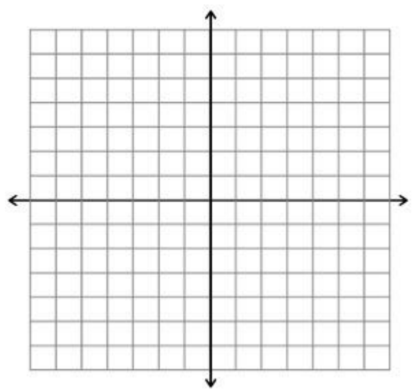
EXAMPLE 6: Graph Transformations of Logarithmic Functions

Use the graph of $f(x) = \log x$ to describe the transformation that results in each function. Then sketch the graph of the functions.

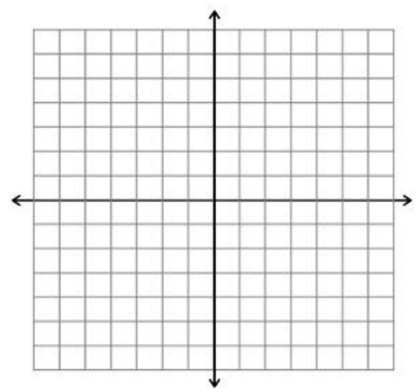
a) $f(x) = \log(x+4)$



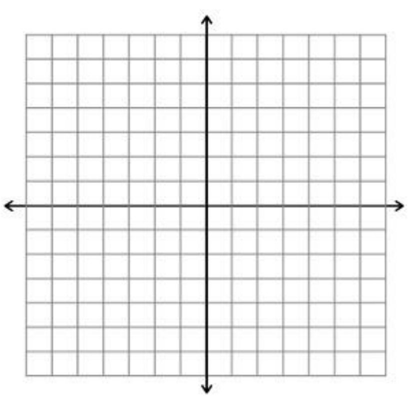
b) $f(x) = -\log x - 5$



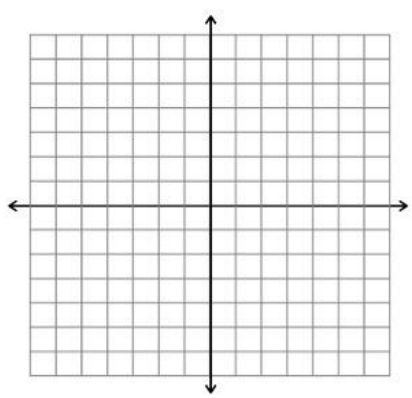
c) $f(x) = 3\log(x+2)$



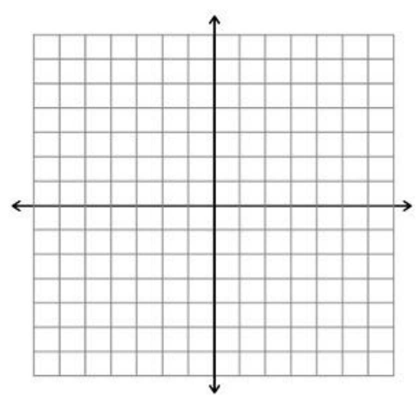
d) $f(x) = \ln(x-6)$



e) $f(x) = 0.5\ln x - 2$



f) $f(x) = \ln(x+4)+3$



EXAMPLE 7: Use Logarithmic Functions

a) The intensity level of a sound, measured in decibels, can be modeled by $d(w) = 10\log\frac{w}{w_0}$ where w is the intensity of the sound in watts per square meter and w_0 is the constant 1.0×10^{-12} watts per square meter.

i. If the intensity of the sound of a person talking loudly is 3.16×10^{-8} watts per square meter, what is the intensity level of a sound in decibels?

ii. If the threshold for hearing for a certain person with hearing loss is 5 decibels, will a sound with an intensity level 2.1×10^{-12} watts per square meter be audible to that person?

iii. Sounds in excess of 85 decibels can cause hearing damage. Determine the intensity of a sound with an intensity level of 85 decibels.

b) The number of machines infected by a specific computer virus can be modeled by $c(d) = 6.8 + 20.1\ln d$, where d is the number of days since the first machine was infected.

i. About how many machines were infected on day 12?

ii. How many more machines were infected on day 30 than on day 12?

iii. On about what day will the number of infected machines reach 75?