Pg. 236 3.2 – Logarithmic Functions and Their Graphs

The inverse of the exponential function a^x is called the logarithmic function with base a.

$\log_a x$ is read as "log of x base a."

Logarithmic and exponential equations are interchangeable.

Logarithmic Form		**Exponential Form**
$y = \log_a x$	$\longleftrightarrow$	$x = a^y$

Important Note: Bases are the same both in logarithmic and exponential form.

You can NOT take the log of a negative number.
The most common logarithm has base 10. If there is no base for the logarithm, then it is 10.

Ex 1:
Convert to exponential form.

a) $\log_3 81 = 4$

b) $\log_{10} \frac{1}{1,000} = -3$

Ex 2:

Solve without a calculator.

a) $f(x) = \log_{16} x$ for x = 4

Solve with a calculator.

b) $f(x) = \log x$ for $x = \frac{1}{500}$

Ex 3:
Convert to logarithmic form.

a) $8^2 = 64$

b) $9^{3/2} = 27$

Natural Logarithm: $\ln x = \log_e x$

Ex 4:

Convert to exponential form.

a) $\ln \frac{2}{5} = -0.916...$

Convert to logarithmic form.

b) $e^2 = 7.3890...$

Properties of Logarithms	**Properties of Natural Logarithms**
$\log_a 1 = 0$ because $a^0 = 1$	$\ln 1 = 0$ because $e^0 = 1$
$\log_a a = 1$ because $a^1 = a$	$\ln e = 1$ because $e^1 = e$
$\log_a a^x = x$ and $a^{\log_a x} = x$	$\ln e^x = x$ and $e^{\ln x} = x$
If $\log_a x = \log_a y$, then $x = y$	If $\ln x = \ln y$, then $x = y$

Ex 5:

Simplify. **Note:** May help to set expression equal to x.

a) $\log_{1.5} 1$

b) $9^{\log_9 5}$

Ex 6:

Evaluate with a calculator.

a) $f(x) = 3\ln x$ for x = 0.32

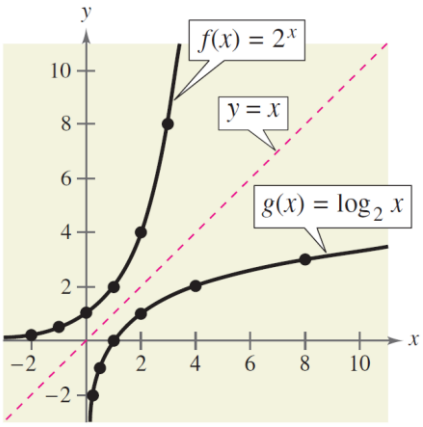
Solve without a calculator.

b) $f(x) = \ln x$ for $x = e^{-2}$

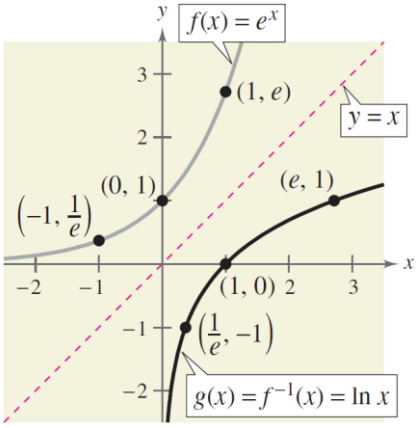
c) $\log_2 (x-3) = \log_2 9$

The inverse function of an exponential function with base a is a logarithmic function with base a.

Graph of Logarithm



Graph of Natural Logarithm



Parent Logarithmic Function

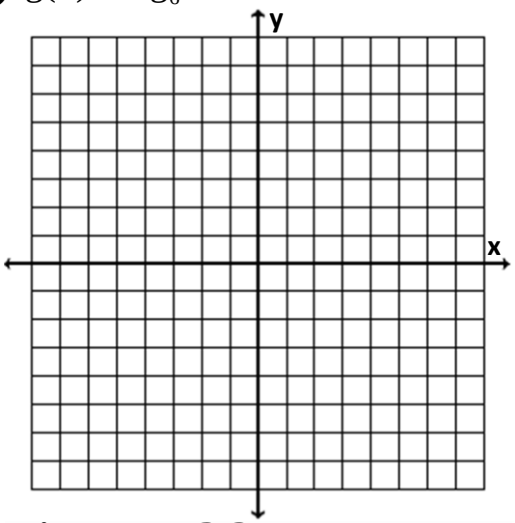
Domain: $(0,\infty)$

x-intercept (Starting Point): $(1,0)$

Vertical Asymptote: x = 0

Ex 7:
Find the domain, x-intercept, and vertical asymptote of the logarithmic function and sketch its graph.

a) $g(x)=\log_6 x$

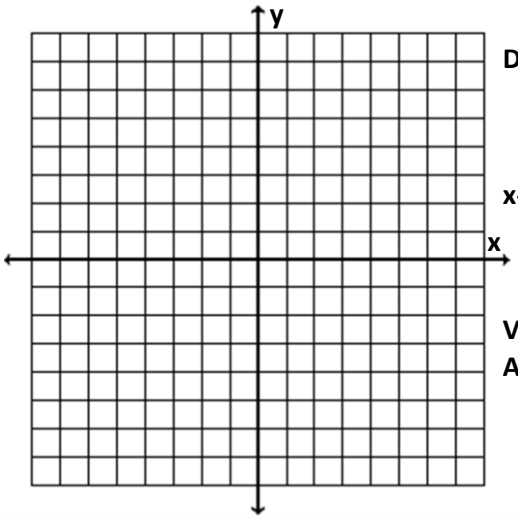


Domain:

x-intercept:

Vertical Asymptote:

b) $h(x)=\ln(x+1)$



Domain:

x-intercept:

Vertical Asymptote:

Assignment 3.2

Pg. 236 Vocab #'s 1-5

Problem Set #'s 1-85 ODD

<u>REQUIRED</u>: Vocab, 7, 13, 17, 23, 27, 31, 35, 39, 45, 55, 63, 65, 69, 75, 79, 85