Logarithmic Functions

Notes #
Omega 4

Exponential Function: A function of the form $y = a^x$, where a is a positive real number.

Logarithm: The inverse of $y = a^x$ is $x = a^y$. In the function $x = a^y$, *y* is called the logarithm. It is usually written $y = \log_a x$ and is read *y* equals the log, base *a*, of *x*.

Logarithmic Function: A function in the form $y = \log_a x$.

Definition of Logarithmic Function:
The logarithmic function $y = \log_a x$, where $a > 0$ and $a \neq 1$, is the inverse of the exponential function $y = a^x$. Therefore, $y = \log_a x$ iff $x = a^y$.

Properties of Logarithms:
Suppose m and n are positive numbers, b is a positive number other than 1, and p is any real number. Then the following properties are true.

Product Property: $\log_b mn = \log_b m + \log_b n$

Quotient Property: $\log_b \frac{m}{n} = \log_b m - \log_b n$.

Power Property: $\log_b m^p = p \bullet \log_b m$

Property of Equality: If $\log_b m = \log_b n$, then $m = n$.

Log Identity 1: $\log_a a^x = x$

Log Identity 2: $a^{\log_a x} = x$

Ex A: Write each equation in logarithmic form.

#1) $4^3 = 64$	#2) $6^{-2} = \frac{1}{36}$	#3) $49^{\frac{1}{2}} = 7$
#1	#2	#3

Ex B: Write each equation in exponential form.

#1) $\log_{27} 3 = \frac{1}{3}$	#2) $\log_{16} 4 = ½$	#3) $\log_9 27 = \frac{3}{2}$
#1	#2	#3

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Ex C: Evaluate each expression.

#1) $\log_2 32$

#1

#2) $\log_{10} 1000$

#2

#3) $\log_7 \frac{1}{343}$

#3

#4) $\log_{10} 0.0001$

#4

#5) $\log_2 \frac{1}{32}$

#5

#6) $5^{3\log_5 2}$

#6

Ex D: Solve each equation.

#1) $\log_6 x + \log_6 9 = \log_6 54$

#1

#2) $\log_7 n = \frac{2}{3}\log_7 8$

#2

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Ex D: Solve each equation.

#3) $4 \log_2 x + \log_2 5 = \log_2 405$

#3

#4) $\log_8 48 - \log_8 w = \log_8 4$

#4

#5) $\log_{10} \sqrt[3]{10} = x$

#5

#6) $3 \log_7 4 + 4 \log_7 3 = \log_7 x$

#6

Ex E: Word problems.

#1) If the population of 100 bacteria doubles every fifteen minutes, how long will it take for the population to reach 12,800?

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Ex F: Graph each equation or inequality.

#1) $y = \log_3 (x + 1)$

#1) Change to exponential form.

#2) Solve your equation for x instead of y.

#3) When doing your table substitute numbers into y instead of x.

Recall that exponential graphs have a horizontal asymptote. Therefore logarithmic graphs (inverse of exponential) have a vertical asymptote.

#2) $y < \log_2 x$