Name _____ Notes: Lesson 4 Date _____

Properties of Logs

Exponent Rule	Property	Example
$a^m \cdot a^n = a^{m+n}$	Product Property $\log_b M + \log_b N = \log_b MN$	$\log_3 2 + \log_3 x = \log_3 2x$
$\frac{a^m}{a^n} = a^{m-n}$	Quotient Property $\log_b M - \log_b N = \log_b \frac{M}{N}$	$\log_4 x - \log_4 y = \log_4 \frac{x}{y}$
$(a^m)^n = a^{m \cdot n}$	Power Property $\log_b M^a = a \log_b M$	$\log_5 x^2 = 2\log_5 x$

Example 1... **Write each logarithmic expression as a single logarithm (condense).**

a. $\log 7 + \log 2$

$\log(7)(2) = \log 14$

b. $\log_2 12 - \log_2 3$

$\log_2 \frac{12}{3} = \log_2 4$

c. $\log_3 8 - 2\log_3 6 + \log_3 3$

$\log_3 8 - \log_3 6^2 + \log_3 3$

$\log_3 \frac{8}{36} + \log_3 3$

$\log_3 (\frac{2}{9})(3) = \log_3 \frac{2}{3}$

d. $\ln 5 - x\ln 2$

$\ln 5 - \ln 2^x$

$\ln \frac{5}{2^x}$

Example 2... **Expand each logarithm.**

a. $\log_8 x^3y^5$

$\log_8 x^3 + \log_8 y^5$

$3\log_8 x + 5\log_8 y$

b. $\log 8\sqrt{x}$

$\log 8 + \log \sqrt{x}$

$\log 8 + \log x^{1/2}$

$\log 8 + \frac{1}{2}\log x$

c. $\ln (7x)^3$

$\ln 7^3 x^3$

$\ln 343 + \ln x^3$ or $\ln 7^3 + \ln x^3$

$\ln 343 + 3\ln x$ $3\ln 7 + 3\ln x$

d. $\log_m 25x^4$

$\log_m 25 + \log_m x^4$

$\log_m 25 + 4\log_m x$

Example 3... Use the properties of logs to evaluate each expression.

a. $3\log_2 2 - \log_2 4$

$\log_2 2^3 - \log_2 4$

$\log_2 \frac{8}{4} = \log_2 2$

Evaluate: $\log_2 2 = x$

$2^x = 2 \quad x = 1$

b. $\log_3 3 + 5\log_3 3$

$\log_3 3 + \log_3 3^5$

$\log_3 (3)(243)$

$\log_3 729$

Evaluate: $\log_3 729 = x$

$3^x = 729 \quad x = 6$

c. $6\ln e$

$\ln e^6$

Evaluate: $\ln e^6 = x$

$\log_e e^6 = x$

$e^x = e^6 \quad x = 6$

Example 4... Assume that $\log 3 \approx 0.4771$, $\log 4 \approx 0.6021$, $\log 5 \approx 0.6990$. Use the properties of logarithms to evaluate each expression. Do NOT use a calculator.

a. $\log 15$

$\log (3)(5)$

$\log 3 + \log 5$

$.4771 + .6990$

1.1761

b. $\log 16$

$\log (4)(4)$ or $\log 4^2$

$\log 4 + \log 4$ $\quad 2 \log 4$

$.6021 + .6021$ $\quad 2(.6021)$

1.2042 $\quad 1.2042$

c. $\log \frac{4}{3}$

$\log 4 - \log 3$

$.6021 - .4771$

$.125$