3-2 Properties of Logarithms

$$\log_a 1 = 0 \qquad \log_a a = 1$$

Evaluate

$\log_5 1$ $\qquad$ $\ln 1$

$\log_4 4$ $\qquad$ $\log 10$

Inverse Property of Logarithms
If b and M are positive real numbers, with $b \neq 0$, then

$$b^{\log_b M} = M$$

Evaluate

$12^{\log_{12}\sqrt{2}}$ $\qquad$ $10^{\log 0.2}$

Inverse Property of Logarithms
If b and r are positive real numbers, with $b \neq 0$, then

$$\log_a a^r = r$$

Evaluate

$\log_4 4^3$ $\qquad$ $\ln e^{-0.5}$ $\qquad$ $\log 10^{-4}$

Product Rule of Logarithms
If M, N and b are positive real numbers, with $b \neq 0$, then

$$\log_b(MN) = \log_b M + \log_b N$$

Write each of the following logarithms as the sum of logarithms.

$\log_2(5 \cdot 3)$ $\qquad$ $\ln(6z)$

Quotient Rule of Logarithms
If M, N and b are positive real numbers, with $b \neq 0$, then

$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

Write each of the following logarithms as the difference of logarithms.

$\log_2\left(\frac{5}{3}\right)$ $\qquad$ $\log\left(\frac{y}{5}\right)$

Power Rule of Logarithms
If M and b are positive real numbers, with $b \neq 0$, then

$$\log_b M^r = r\log_b M$$

Use the power Rule of Logarithms to express all powers as factors.

$\log_8 3^5$ $\qquad$ $\ln x^{\sqrt{3}}$

$3\log_2 5$ $\qquad$ $\frac{1}{2}\log 16$

Write the following as the sum or difference of logarithms.

$\log_3\left(\frac{4x}{y}\right)$ $\qquad$ $\log_2(x^2y^3)$

Expand the logarithm.

$\log\left(8xy^4\right)$ $\qquad$ $\log_3\left(\frac{9m^4}{\sqrt[3]{n}}\right)$

Write each of the following as a single logarithm.

$\log_6 3 + \log_6 12$ $\log(x-2) - \log x$

Write each of the following as a single logarithm.

$\ln x^5 - 2\ln(xy)$

$\log(x-1) + \log(x+1) - 3\log x$

Rewrite and express in terms of a and b given that a=ln3 and b=ln4

ln36 ln27

2ln4 $\frac{1}{2}\ln 144$

Change of Base Formula

If $a \neq 0$, $b \neq 0$, and M are positive real numbers, then

$$\log_a M = \frac{\log_b M}{\log_b a}$$

$$\log_a M = \frac{\log M}{\log a} = \frac{\ln M}{\ln a}$$

Rewrite the following as a natural log

$\log_4 45$ $\frac{\log 27}{3}$

Use your calculator to approximate the following:

$\log_4 45$ $\log_3 75$ $\log_6 40$

Summary of Properties

$\log_a a^r = r$ $b^{\log_b M} = M$

$$\log_b(MN) = \log_b M + \log_b N$$

$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

$$\log_b M^r = r\log_b M$$

$$\log_a M = \frac{\log_b M}{\log_b a}$$