

PROPERTIES OF LOGARITHMS

In the list that follows, a, b, M, N and r are real numbers.

Also, $a > 0, a \neq 1, b > 0, b \neq 1, M > 0,$ and $N > 0$

- Definition:

$$y = \log_a x \leftrightarrow x = a^y$$

" \leftrightarrow " means the statements are equivalent. The log base a of x is the power that a needs to be raised to, to get x .

- Properties of Logarithms:

$\log_a 1 = 0$
$\log_a a = 1; \ln e = 1$
$a^{\log_a M} = M; \log_a a^r = r$
$\log_a(MN) = \log_a M + \log_a N$
$\log_a \frac{M}{N} = \log_a M - \log_a N$
$\log_a M^r = r \log_a M$
If $M = N$, then $\log_a M = \log_a N$
If $\log_a M = \log_a N$, then $M = N$

- Change-of-base Formula:

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

For a more detailed discussion of logarithms, including practice problems, click [here](#).