Properties of Logarithms

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If b is a positive real number then the following relationships exist:

1. $log_b 1 = 0$
2. $log_b b = 1$
3. $log_b b^x = x$
4. $b^{log_b x} = x$ for $x > 0$ (Why do we have the limitation $x > 0$?)

5. $log_b(MN) = log_b M + log_b N$ for $M > 0$ and $N > 0$
6. $log_b(\frac{M}{N}) = log_b M - log_b N$ for $M > 0$ and $N > 0$
7. $log_b(M^p) = p\, log_b M$ for $M > 0$

Simplify the following logarithmic expressions without using a calculator:

$log_2 8\sqrt{2}$

$log_5 \frac{\sqrt[3]{5}}{25}$

$log_9 3 + log_9 27$

$e^{-4\ln 2 + \ln 3}$

Use the properties of logarithms to write the following as a logarithm of a single quantity:

$4\,log_2\,(xy^2) + 2\,log_2\,\left(\frac{1}{x}\right) - 4\,log_2 y$

$ln\,7\, + 6\,ln\,x - 6\,ln\,y$

Expand the following logarithms:

$log_5(50x + 25y)$

$log_2(8x^2 + 80x + 200)$

$log\,(\,log\,(10000^{250x}\,))$

The Change of Base Formula:

If b, c, and x are positive real numbers then:

$log_b x = \frac{log_c x}{log_c b}$

Give a 4 decimal approximation for $log_3 20$.

Give a four decimal approximate for the number $log_{\frac{1}{7}}(0.719)$

On your calculator, graph the function $f(x) = 2 - log_3(x+1)$

The **pH** of a solution is defined to be $-log([H_3O^+])$, where $[H_3O^+]$ is the concentration of hydronium ions in moles/liter. Solutions with a pH less than 7 are said to be *acidic*, while those with a pH greater than 7 are *basic*.

Example:
If a sample of a solution has a $[H_3O^+]$ concentration of 7.49×10^{-6} moles/liter. What is the pH?

If I_0 is the minimum discernable intensity of an earthquake, then an earthquake with an intensity of I has a ***Richter Scale*** ranking of:
$R = log\left(\frac{I}{I_0}\right)$

If I_0 is the minimum discernable intensity of a sound, then a sound with an intensity of I has a **decibel level** of:
$D = 10\,log\left(\frac{I}{I_0}\right)$

Example:
Given that $I_0 = 10^{-12}$ watts/meter^2. What is the intensity of a sound for which the decibel level is 102?