7.3 Laws of Logarithms

Multiplication Law

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

previous example

$\log_2 16 + \log_2 2$

$2^y = 16$
$2^y = 2^4$
$y = 4$

$2^y = 2$
$2^y = 2^1$
$y = 1$

$4 + 1 = 5$

By property

$\log_2 (16)(2)$

$\log_2 32 = y$

$2^y = 32$

$y = 5$

Division Law

$$\log_b \frac{M}{N} = \log_b M - \log_b N$$

$\log_2 48 - \log_2 3$

$\log_2 \frac{48}{3}$

$\log_2 16$

$\log_2 16 = y$

$2^y = 16$
$2^y = 2^4$
$y = 4$

$\log_b N = e$

$b^e = N$

Power Rule

$A \log_b X \Rightarrow \log_b X^A$

↑ any number

ex. 1 $\quad 2\log_3\left(\frac{1}{9}\right)$

evaluate

$2(\quad)$

$\log_3\left(\frac{1}{9}\right) = y$

$3^y = \frac{1}{9}$

$3^y = 3^{-2}$

$y = -2$

$2(-2) = -4$

use property first

$\log_3\left(\frac{1}{9}\right)^2$

$\log_3\left(\frac{1}{81}\right) = y$

$3^y = \frac{1}{81}$

$3^y = 3^{-4}$

$y = -4$

More examples:

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a) $\log_3 18 + \log_3\left(\frac{3}{2}\right)$

+ → multiplication

$\log_3(18)\left(\frac{3}{2}\right)$

$\left(\frac{18}{1}\right)\left(\frac{3}{2}\right) = \frac{54}{2}$

$= 27$

$\log_3 27 = y$

$3^y = 27$

$\cancel{3}^y = \cancel{3}^3$

$y = 3$

b) $\log_5 40 - 3\log_5 2$

$\log_5 40 - \log_5 2^3$

$\log_5 40 - \log_5 8$

$\log_5 \frac{40}{8}$

$\log_5 5$

$\log_5 5 = y$

$5^y = 5$

$y = 1$

c) $\log_2\left(\frac{1}{16}\right) + \log_3 81$

* you cannot apply the laws of logs because the bases are different.

Evaluate separately

$\log_2\left(\frac{1}{16}\right) = y$

$2^y = \frac{1}{16}$

$2^y = 2^{-4}$

$y = -4$

$\log_3 81 = y$

$3^y = 81$

$3^y = 3^4$

$y = 4$

Then solve: $-4 + 4 = 0$