8.3 Part 1 New

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8.3 Laws of Logarithms Part 1

Product Law for Logs	$\log_c MN = \log_c M + \log_c N$
Quotient Law for Logs	$\log_c \frac{M}{N} = \log_c M - \log_c N$
Power Law for Logs	$\log_c M^P = P \log_c M$

Ex. #1: Prove the product law for logs

let $\log_c M = x$ $\quad \log_c N = y$

$c^x = M$ $\quad c^y = N$

$M \cdot N = c^x \cdot c^y$

$MN = c^{x+y}$

$\log_c MN = x + y$

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

Ex. #2: Use log laws to expand into individual logs

a) $\log_3 \frac{x^2 n^4}{y}$

$= \log_3 (x^2 n^4) - \log_3 y$

$= \log_3 x^2 + \log_3 n^4 - \log_3 y$

$= 2\log_3 x + 4\log_3 n - \log_3 y$

b) $\log \frac{a}{b\sqrt[3]{c}}$

$= \log a - \log(bc^{1/3})$

$= \log a - (\log b + \log c^{1/3})$

$= \log a - \log b - \log c^{1/3}$

$= \log a - \log b - \frac{1}{3}\log c$

Ex. #3: Use log laws to evaluate. (do not use a calculator)

a) $\log_{12} 18 + \log_{12} 8$

$= \log_{12}(18 \cdot 8)$

$= \log_{12} 144$

$= \log_{12} 12^2$

$= 2$

$$\begin{array}{r} 18 \\ \times\ 8 \\ \hline 144 \end{array}$$

$\log_c c^x = x$

b) $2\log_3 6 - \frac{1}{2}\log_3 64 + \log_3 2$

$= \log_3 6^2 - \log_3 64^{1/2} + \log_3 2$

$= \log_3 36 - \log_3 8 + \log_3 2$

$= \log_3 \frac{36(2)}{8}$

$= \log_3 9$

$= \log_3 3^2$

$= 2$

$\log_3 \frac{36}{8} + \log_3 2$

$\log_3 \frac{36}{8}(2)$

Ex. #4: If $\log_8 3 = x$ and $\log_8 7 = y$ find an expression for $\log_8 441$

441
3 147
3 49
7 7

$\log_8 441$

$= \log_8 (3^2 \cdot 7^2)$

$= \log_8 3^2 + \log_8 7^2$

$= 2\log_8 3 + 2\log_8 7$

$= 2x + 2y$

$2x + 2y$

Ex. #5: If $\log_2 5 = x$ and $\log_2 7 = y$ find an expression for $\log_2 \frac{\sqrt[3]{5}}{28}$

$\log_2 \sqrt[3]{5} - \log_2 28$

$\log_2 5^{1/3} - \log_2 (7 \cdot 4)$

$\log_2 5^{1/3} - (\log_2 7 + \log_2 4)$

$\log_2 5^{1/3} - (\log_2 7 + \log_2 2^2)$

$\frac{1}{3}\log_2 5 - (\log_2 7 + 2\log_2 2)$

$\frac{1}{3}\log_2 5 - \log_2 7 - 2\log_2 2$

$\frac{1}{3}x - y - 2(1)$

$\frac{1}{3}x - y - 2$