LOGARITHMIC FUNCTIONS PART 2

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Product Law of Logarithms:

- states that log of product is equal to the sum of logs of the factors.
  - $\log_b(mn) = \log_b(m) + \log_b(n)$

$\log_{10}(5)$ → $\log(5)$

$\log_b(10) = \log_b(5) + \log_b(2)$

$\log(10) + \log_b(1)$

$\log(5)$ → $\log_{10}(5)$

Quotient law of Logarithms

- states that log of quotient is equal to the log of the numerator minus the log of the denominator.
  - $\log_b\left(\frac{m}{n}\right) = \log_b(m) - \log_b(n)$ → 10 → $\log_{10}(m) - \log_{10}(n)$

Examples:

(1) $\log_{10}(6) + \log_2(8) - \log_{12}(16)$

Step (1) Apply product rule: $\log_1(6) + \log_1(8) \rightarrow \log_1(48)$ (m = 6, n = 8)

$\log_b(m) + \log_b(n) = \log_b(mn)$

$\log_b(mn)$

Step (2) Apply quotient law: $\log_1(48) - \log_1(16) \rightarrow \log_1\left(\frac{48}{16}\right)$

$\log_1(3)$ ✓

(2) $\log(x) + \log(y) + \log(3x) - \log(y)$ → $\log_{10}$, $\log_2$, $\log_3$, $\log_{n\to\infty}$

Step (1) Apply Product / quotient laws based on like terms

$\log(x) + \log(3x)$	$\log(y) - \log(y)$
$\log(x \cdot 3x)$	$\log(y/y)$
$\log(3x^2)$	$\log(1) = 0$

$x = m$, $3x = n$; $y = n$

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

$\log_b(1) = 0$

$\log_{10}(10) = 1$

$\log_2(2) = 1$

$\log_3(3) = 1$

Product rule

$\log(3x^2) + \log(1)$; $M = 3x^2$, $n = 1$

$\log(3x^2)$

$2 \cdot \log(3x)$

$2\log(3x)$

Practice:

(1) $\log(12) - 3\log(2) + 2\log(2)$

(2) $\log(1000)$

(1) $\log(12) - 3\log(2) + 2\log(2)$

$\log(12) - \log(2^3)$; $3\log(2) = \log(2^3)$

$\log(12 / 2^3)$

$\log(12/8)$

$\log(3/2) + \log(2^2)$

$\log(3/2(4)$

$\log_{10}(6) = ?$

$\frac{m}{n} = \frac{12}{2^3}$; $m = 12$, $n = 2^3$

$2 \times 2 \times 2 = 8$

$12 \rightarrow 3$

$8 \rightarrow 2$

$2\log(2) \rightarrow \log(2^2)$

$\log_b(m) + \log_b(n) = \log_b(mn)$

$m = 3/2$, $n = 2^2 = 4$

$m \cdot n$

$\frac{3}{2} \times 2^2 \rightarrow \frac{3}{2} \times 4^2 = 6$

$\log_b(m) + \log_b(n)$

$2\log_b(m)$

(2) $\log(1000) = \log(100) + \log(10)$ → n

$= \log(10^2) + \log(10)$

$= 2\log(10) + \log(10)$

$= 3\log_b(10) = ?$

$\log(mn) \rightarrow \log(m) + \log(n)$

$\log(100)$ → $x \cdot y$

$m = 100$

$n = 10$

10^2

$\log(10^2)$

$2\log(10)$