H S II Year Commerce - 2020

SUBJECT: C M S

R G Baruah College

Date: 9^{th} August to 10^{th} August,

CHAPTER III - Logarithm

Rules or Laws of Logarithms

In this lesson, we will discuss the common rules of logarithms, also known as the “log rules”. These seven (7) log rules are useful in expanding logarithms, condensing logarithms, and solving logarithmic equations. In addition, since the inverse of a logarithmic function is an exponential function, I would also recommend that you go over and master the exponent rules. Believe me, they always go hand in hand.

Rules of Logarithms

Rule 1: $\log_b(M \cdot N) = \log_b M + \log_b N$

Rule 2: $\log_b\left(\dfrac{M}{N}\right) = \log_b M - \log_b N$

Rule 3: $\log_b\left(M^k\right) = k \cdot \log_b M$

Rule 4: $\log_b(1) = 0$

Rule 5: $\log_b(b) = 1$

Rule 6: $\log_b\left(b^k\right) = k$

Rule 7: $b^{\log_b(k)} = k$

Where:

$b > 0$ but $b \neq 1$, and M, N, and k are real numbers but M and N must be positive!

Descriptions of Logarithm Rules

Rule 1: Product Rule

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

The logarithm of the product is the sum of the logarithms of the factors.

Rule 2: Quotient Rule

$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

The logarithm of the ratio of two quantities is the logarithm of the numerator minus the logarithm of the denominator.

Rule 3: Power Rule

$$\log_b\left(M^k\right) = k \cdot \log_b M$$

The logarithm of an exponential number is the exponent times the logarithm of the base.

Rule 4: Zero Rule

$$\log_b(1) = 0$$

The logarithm of 11 such that b > 0*b*>0 but b≠1 equals zero.

Rule 5: Identity Rule

$$\log_b(b) = 1$$

The logarithm of the argument (inside the parenthesis) wherein the argument is the same as the base is equal to 11. Since the argument is equal to the base, b*b* must be greater than 00 but it cannot equal to 11.

Rule 6: Log of Exponent Rule (Logarithm of a Base to a Power Rule)

$$\log_b\left(b^k\right) = k$$

The logarithm of an exponential number where its base is the same as the base of the log is equal to the exponent.

Rule 7: Exponent of Log Rule (A Base to a Logarithmic Power Rule)

$$b^{\log_b(k)} = k$$

Raising the logarithm of a number to its base is equal to the number.

Example 1:
Evaluate the expression below using Log Rules.

$\mathrm{Log}_2 8 + \log_2 4$

$$\begin{aligned} \log_2 8 + \log_2 4 &= \log_2 2^3 + \log_2 2^2 \\ &= 3\log_2 2 + 2\log_2 2 \\ &= 3(1) + 2(1) \\ &= 3 + 2 \end{aligned}$$

$$\log_2 8 + \log_2 4 = 5$$

ANSWER: 5

Example 2: Evaluate the expression below using Log Rules.

$\log_3 162 - \log_3 2$

$$\begin{aligned}\log_3 162 - \log_3 2 &= \log_3\left(\frac{162}{2}\right)\\ &= \log_3(81)\\ &= \log_3 3^4\\ &= 4\log_3 3\\ &= 4(1)\end{aligned}$$

$$\log_3 162 - \log_3 2 = 4$$

Answer : 4

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Example 3: Evaluate the expression below.

$$\log_5 500 - 2\log_5 2 + \log_4 32 + \log_4 8$$

$$\log_5 500 - 2\log_5 2 + \log_4 32 + \log_4 8 = \log_5 500 - \log_5 2^2 + \log_4 32 + \mathrm{l}$$

$$= \log_5 500 - \log_5 4 + \log_4 32 + \mathrm{lo}$$

$$= \log_5\left(\frac{500}{4}\right) + \log_4(32 \cdot 8)$$

$$= \log_5(125) + \log_4(256)$$

$$= \log_5\left(5^3\right) + \log_4\left(4^4\right)$$

$$= 3 \cdot \log_5 5 + 4 \cdot \log_4(4)$$

$$= 3(1) + 4(1)$$

$$= 3 + 4$$

$$= 7$$

ANSWER: 7

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Example 4: Expand the logarithmic expression below.

$$\log_3\left(27x^2y^5\right) = \log_3(27) + \log_3\left(x^2\right) + \log_3\left(y^5\right)$$

$$= \log_3\left(3^3\right) + \log_3\left(x^2\right) + \log_3\left(y^5\right)$$

$$= 3\log_3(3) + 2\log_3(x) + 5\log_3(y)$$

$$= 3(1) + 2\log_3(x) + 5\log_3(y)$$

$$\log_3\left(27x^2y^5\right) = 3 + 2\log_3(x) + 5\log_3(y)$$

ANSWER: [3+2Log$_3$(x) +5 Log$_3$(y)]

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