8.4 Properties of Logarithms

Since logarithm is an exponent, the properties for operations with logarithms are similar to the properties with exponents

Product Property $\log_b MN = \log_b M + \log_b N$

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

Power Property $\log_b M^x = x\log_b M$

Note: The properties for logarithms do not apply unless the bases are the same!

You can use the properties of logarithms to rewrite the logarithmic expression

State the property or properties used to rewrite each expression.

$\log_5 2 + \log_5 6 = \log_5 12$

product property

$3\log_b 4 - 3\log_b 2 = \log_b 8$

$\log_b \left(\frac{4}{2}\right)^3$

Quotient & Power

Write each logarithmic expression as a single logarithm.

$\log_4 64 - \log_4 16 = \log_4 \frac{64}{16} = \log_4 4 = 1$

$4^1 = 4$

$6\log_5 x + \log_5 y = \log_5 (x^6 y)$

$3\log 2 + \log 4 - \log 16 = \log \frac{2^3 \cdot 4}{16} = \log \frac{8 \cdot 4}{16} = \log \frac{32}{16}$

$= \log 2$

$3\log_2 9 - \log_6 9$ can't be done different bases

You can write a single logarithm as a sum or difference of two or more logarithms. Expand each logarithm.

$\log_2 7b$

$\log_2 7 + \log_2 b$

$\log\left(\frac{y}{3}\right)^2$

$2\log y - 2\log 3$

$\log_7 a^3 b^4$

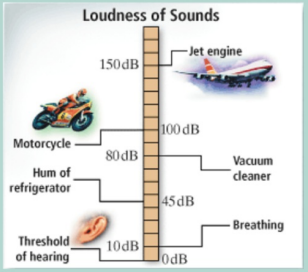
$3\log_7 a + 4\log_7 b$

$\log \frac{4p^3}{y}$ $\log 4 + 3\log p - \log y$

Logarithms are used to model sound. The intensity of a sound is a measure of the energy carried by the sound wave. The greater the intensity of a sound, the louder it seems. This apparent loudness, L, is measured in decibels.

Use the formula $L = 10\log\frac{I}{I_0}$

Where I is the intensity of the sound in watts per square meter I_0 is the lowest intensity sound that the average human ear can detect.



Manufacturers of a vacuum cleaner want to reduce its sound intensity 40% of the original intensity. By how many decibels would the loudness be reduced?

I_1 = initial I_2 = reduced $(.4\ I_1)$

L_1 = initial L_2 = reduced

$L_1 = 10\log\frac{I_1}{I_0}$ $L_2 = 10\log\frac{I_2}{I_0}$

$L_1 - L_2 = 10\log\frac{I_1}{I_0} - 10\log\frac{I_2}{I_0}$

$= 10\log\frac{I_1}{I_0} - 10\log\frac{.4\,I_1}{I_0}$

$10\log\frac{I_1}{I_0} - 10\log(.4 + \frac{I_1}{I_0})$ $-10\log .4$

$= 3.97 \approx 4\text{dB}$

homework:

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