

7-4 Properties of Logarithms**Objective:**

Use properties to simplify logarithmic expressions.

Translate between logarithms in any base.

The logarithmic function for pH that you saw in the previous lessons, $\text{pH} = -\log[\text{H}^+]$, can also be expressed in exponential form, as $10^{-\text{pH}} = [\text{H}^+]$.

Because logarithms are exponents, you can derive the properties of logarithms from the properties of exponents

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Remember that to *multiply* powers with the same base, you *add* exponents. $b^m b^n = b^{m+n}$

Product Property of Logarithms

For any positive numbers m , n , and b ($b \neq 1$),

WORDS	NUMBERS	ALGEBRA
The logarithm of a product is equal to the sum of the logarithms of its factors.	$\log_3 1000 = \log_3(10 \cdot 100)$ $= \log_3 10 + \log_3 100$	$\log_b mn = \log_b m + \log_b n$

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Express $\log_6 4 + \log_6 9$ as a single logarithm. Simplify.

To add the logarithms, multiply the numbers.

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Express as a single logarithm: $\log_5 25 + \log_5 5$

Remember that to *divide* powers with the same base, you *subtract* exponents $\frac{b^m}{b^n} = b^{m-n}$

Quotient Property of Logarithms

For any positive numbers m , n , and b ($b \neq 1$),

WORDS	NUMBERS	ALGEBRA
The logarithm of a quotient is the logarithm of the dividend minus the logarithm of the divisor.	$\log_5 \left(\frac{16}{2}\right) = \log_5 16 - \log_5 2$	$\log_b \frac{m}{n} = \log_b m - \log_b n$

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Express $\log_5 100 - \log_5 4$ as a single logarithm. Simplify, if possible.

To subtract the logarithms, divide the numbers

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Express $\log_7 343 - \log_7 7$ as a single logarithm. Simplify, if possible

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Because you can multiply logarithms, you can also take powers of logarithms.

Power Property of Logarithms

For any real number p and positive numbers a and b ($b \neq 1$),

WORDS	NUMBERS	ALGEBRA
The logarithm of a power is the product of the exponent and the logarithm of the base.	$\log 10^3$ $\log(10 \cdot 10 \cdot 10)$ $\log 10 + \log 10 + \log 10$ $3 \log 10$	$\log_b a^p = p \log_b a$

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Express as a product. Simplify, if possible.

A. $\log_2 32^6$

B. $\log_8 4^{20}$

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Express as a product. Simplify, if possibly.

a. $\log 10^4$

b. $\log_5 25^3$

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End of Part 1

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