Algebra II **Section 7.4**
Auch **Date:**

Objectives

- Use properties to simplify logarithmic expressions.
- Translate between logarithms in any base.

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.	$\log_3 1000 = \log_3(10 \cdot 100)$ $= \log_3 10 + \log_3 100$	$\log_b mn = \log_b m + \log_b n$

Example 1

Express as a single logarithm. Simplify if possible.

$\log_4 2 + \log_4 32$

Try it!

Express as a single logarithm. Simplify if possible.

a) $\log_5 625 + \log_5 25$

b) $\log_{\frac{1}{3}} 27 + \log_{\frac{1}{3}} \frac{1}{9}$

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 dividendt minus the logarithm of the divisor.	$\log_5\left(\frac{16}{2}\right) = \log_5 16 - \log_5 2$	$\log_b \frac{m}{n} = \log_b m - \log_b n$

Example 2

Express as a single logarithm. Simplify if possible.

$\log_2 32 - \log_2 4$

Try it!

Express as a single logarithm. Simplify if possible.

a) $\log_7 49 - \log_7 7$

Power Property of Logarithms		
For any positive numbers *m, n,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.	$\log 10$ $\log(10 \cdot 10 \cdot 10)$ $\log 10 + \log 10 + \log 10$ $3\log 10$	$\log_b a^p = p \log_b a$

Example 3

Express as a single logarithm. Simplify if possible.

$\log_3 81^2$

Try it!

Express as a single logarithm. Simplify if possible.

a) $\log 10^4$

b) $\log_5 25^2$

c) $\log_2 \left(\frac{1}{2}\right)^5$

Inverse Properties of Logarithms and Exponents	
For any base b such that $b>0$ and $b \neq 1$,	
Algebra	**Example**
$\log_b b^x = x$	$\log_b b^x = x$
$b^{\log_b x} = x$	$10^{\log_{10} 2} = 2$

Example 4

Express as a single logarithm. Simplify if possible.

a) $\log_8 8^{3x+1}$ b) $\log_5 125$ c) $2^{\log_2 27}$

Try it!

Express as a single logarithm. Simplify if possible.

a) $\log 10^{0.9}$

b) $2^{\log_2(8x)}$

Change of Base Formula	
For $a>0$ and $a \neq 1$, and any base b such that $b>0$ and $b \neq 1$,	
Algebra	**Example**
$\log_b x = \frac{\log_a x}{\log_a b}$	$\log_4 8 = \frac{\log_2 8}{\log_2 4}$

Example 5

Evaluate $\log_4 8$

a) Method 1 Change to base 10

b) Method 1 Change to base 2,
because both 4 and 8 are powers of 2.

Try it!

a) Evaluate $\log_9 27$

b) Evaluate $\log_8 16$

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