Lesson 8-4 Properties of Logarithms
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Last section we saw that $pH = -log\ [H+]$ can also be expressed in exponential form: $10^{-pH} = [H^+]$. Since logarithms are inverses of exponents, you can derive the properties of logarithms from the properties of exponents:

Operation	**Logarithms** ***NEW***	***Example***
product	$log_b(m \cdot n) = log_b m + log_b n$	
quotient	$log_b {}^{m}/_{n} = log_b m - log_b n$	
power	$log_b m^x = x log_b m$	

Example: express as a single logarithm

$log7 + log2$	$log_2 12 - log_2 3$
$log_3 8 - 2log_3 6 + log_3 3$	$ln5 - xln2$

We can write as single logarithms and we can expand into multiple logarithms:

$log_8 x^3 y^5$	$log8\sqrt{x}$
$ln(7x)^3$	$log_m 25x^4$

Properties of logarithms may be applied and then the single logarithm may be evaluated:

Simplify: $3log_2 2 - log_2 4$	1. apply product rule or 2. quotient rule 3. simplify 4. evaluate: ____ $= x$ *You must read and understand the directions. Depending on what is required, you will either stop at this point or continue on to evaluate, that is x=….*
$log_3 3 + 5log_3 3$	$6lne$

Logarithms are uses to model sound. The intensity of a sound is the measure of the energy carried by the sound wave. The greater the intensity of a sound, the louder it seems. Loudness is measured in decibels with the formula: $\boldsymbol{L = 10log\frac{I}{I_o}}$. (I is the intensity of the sound in watts per square meter and I_o is the lowest intensity sound that the average human can hear.)

Earplugs are advertised to block a certain amount of noise. One earplug brand claims to block the sound of noise as loud as 22 dB. A second brand claims to block 8 times that amount. If this claim is true, how many more decibels are blocked?

First off this is a subtraction problem as we are looking at "how many more." So let L_2= brand 2 loudness and

L_1= brand 1 loudness. Identify the relationship between the two brands: $I_2 = 8I_1$, so using our equation for loudness: