

## Notes: 4.4 Laws of Logarithms

*Evaluate :*

$$\log 10 = 1$$

$$\log_2 2 = 1$$

$$\ln e = 1$$

$$\log_5 5 = 1$$

$$\log_{10} 10 = x$$

$$\text{so } 10^x = 10^1$$

$$x = 1$$

$$\ln_e e = x$$

$$\text{so } e^x = e^1$$

$$x = 1$$

# Laws of Logarithms:

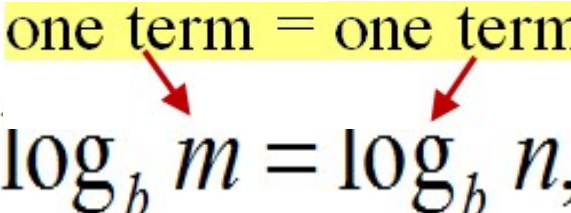
Product:  $\log_b mn = \log_b m + \log_b n$

Quotient:  $\log_b \frac{m}{n} = \log_b m - \log_b n$

Power:  $\log_b (m)^p = p \log_b m$

Power of Equality: if  $\log_b m = \log_b n$ ,  
then  $m = n$

one term = one term



Must have a  
one-to-one  
relationship to  
apply this law!

## Example 1:

Write the given expression as a single logarithm:

$$\ln 6 + 2 \ln 10 - \frac{1}{3} \ln 27$$

$$\ln 6 + \ln 10^2 - \ln 27^{\frac{1}{3}}$$

$$\ln 6(100) - \ln 3$$

$$\ln \frac{600}{3} = \boxed{\ln 200}$$

**Important!**  
**Show your**  
**thinking**  
**process by**  
**listing all steps.**

## Example 2:

Clearly show all steps...apply one property at a time!

$$2\log_6 4 - \frac{1}{4}\log_6 16 = \log_6 x$$

$$\log_6 4^2 - \log_6 16^{\frac{1}{4}} = \log_6 x$$

$$\log_6 \frac{16}{2} = \log_6 x$$

$$8 = x$$

**NOTE:** The logs will never drop out on the first step when you have more than two terms!!

← Like bases, so inside values are equal to each other by Power of Equality

Show work! Include a middle step(s) when possible.

Sum

$$9. \log 50 + \log 200 = x$$

product

$$\log_{10} 50(200) = x$$

$$10^x = 10,000$$

$$10^x = 10^4$$

$$x = 4$$

- Write given problem = x

- Combine

- Rewrite

- Use like bases to solve