Notes: 4.4 Laws of Logarithms

$Evaluate:$

$\log 10$ **= 1**

$\log_2 2$ **= 1**

$\ln e$ **= 1**

$\log_5 5$ **= 1**

$\log_{10} 10 = x$

$so \quad 10^x = 10^1$

$x = 1$

$\ln_e e = x$

$so \quad e^x = e^1$

$x = 1$

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

one term = one term

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

then m = n

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

Example 1:

Write the given expression as a single logarithm:

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

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

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

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

Important! Show your thinking process by listing all steps.

Example 2:

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

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

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

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

$$8 = x$$

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

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

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

9. $\log 50 + \log 200 = x$ (sum)

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**