Warm-up

Evaluate with-out using a calculator (Switch forms)

1. $\log_5 25 = x \rightsquigarrow 5^x = 25$ $\boxed{x=2}$

2. $\log_4 64 = x \rightsquigarrow 4^x = 64$ $\boxed{x=3}$

3. $\log_2 2 = x \rightsquigarrow 2^x = 2^1$ $\boxed{x=1}$

4. $\ln 1 = x \rightsquigarrow e^x = 1$ $\boxed{x=0}$

Agenda:

1) **Warm-up (check with your elbow partner when done)**
2) **Homework questions???**
3) **New lesson on the Properties of Logarithms**
4) **In-class Activity (elbow partners)**
5) **Homework!!!**

6.5 Properties of Logarithms:

Learning Targets:

1) Use the properties of logarithms to evaluate logs
2) Use the properties of logs to expand and condense logs
3) Use the change-of-base formula to evaluate logs

***our calculators can only evaluate common logs (base 10) and natural logs (base e)**
So...we need to convert other base logs to base 10 or e if we want to use a calculator.

Change of Base:

$$\log_b x \rightarrow \frac{\log_{10} x}{\log_{10} b} \quad or \quad \frac{\ln x}{\ln b}$$

Examples:

1. $\log_3 7 =$ $\frac{\log_{10} 7}{\log_{10} 3} = 1.77$ or $\frac{\ln 7}{\ln 3} = 1.77$

2. $\log_4 8 =$ $\frac{\log_{10} 8}{\log_{10} 4}$ or $\frac{\ln 8}{\ln 4} = 1.5$

Try: (both ways!)

1. $\log_2 3 =$ $\frac{\log 3}{\log 2}$ or $\frac{\ln 3}{\ln 2} = 1.58$

2. $\log_6 15 =$ $\frac{\log 15}{\log 6}$ or $\frac{\ln 15}{\ln 6} = 1.51$

Properties of logs:

1. Product Rule: $\log_b(x \cdot y) = \log_b x + \log_b y$

Examples: (also called expanding...make bigger!)

1. $\log_4(2x) =$ $\log_4 2 + \log_4 x$

2. $\log_2(2xy) =$ $\log_2 2 + \log_2 x + \log_2 y$

3. $\log_5(21) =$ $\log_5(7 \cdot 3) = \log_5 7 + \log_5 3$

Rule #2: Quotient Rule $\log_b\left(\frac{x}{y}\right) \rightarrow \log_b x - \log_b y$

Examples: (expanding)

1. $\log_5\left(\frac{3}{7}\right) = \log_5 3 - \log_5 7$

2. $\log_5\left(\frac{5}{4}\right) = \log_5 5 - \log_5 4$

Rule #3: Power Rule $\log_b x^y = y \log_b x$

Examples:

1. $\log_5 3^2$ = $2 \cdot \log_5 3$

2. $\log_5 49$ $\log_5(7^2) \rightarrow 2 \cdot \log_5 7$

1st homework section

Try: Use the fact that $\log_9 5 = .73$ *and* $\log_9 11 = 1.09$

1. $\log_9\left(\frac{5}{11}\right) =$ $\log_9 5 - \log_9 11$ $(.73) - (1.09)$ $\rightarrow$ $-.36$

2. $\log_9(55) =$ $\log_9(5 \cdot 11) \rightarrow \log_9 5 + \log_9 11$ $1.09 + .73 \rightarrow 1.82$

3. $\log_9(25) =$ $\log_9(5^2) \rightarrow 2\log_9 5$ $2[.73] = 1.46$

Expand: (use the log rules to make the log as big as possible)

Ex: $\log_2\left(\frac{7x^3}{y}\right) =$ $\log_2(7x^3) - \log_2 y$

$\log_2 7 + \log_2 x^3 - \log_2 y$

$\log_2 7 + 3\log_2 x - \log_2 y$

* Division 1st −
* Multiplication 2nd +
* exponents

Try:

1) $\log_5\left(\frac{2x^6}{3}\right) =$ $\log_5(2x^6) - \log_5 3$

$\log_5 2 + \log_5 x^6 - \log_5 3$

$\log_5 2 + 6\log_5 x - \log_5 3$

2) $\log_7\left(\frac{y}{3x^2}\right) =$

$\log_7 y - \log_7(3x^2)$

$\log_7 y - [\log_7 3 + \log_7 x^2]$

$\log_7 y - \log_7 3 - 2\log_7 x$

Condense (use log rules to make smaller)

EX: $\log 6 + 2\log 2 - \log 3$

$\log 6 + \log 4 - \log 3$

$\log 24 - \log 3$

$\log(8)$

Try:

1. $2\log_3 7 - 5\log_3 x$

$\log_3 49 - \log_3 x^5$

$\log_3 \frac{49}{x^5}$

2. $2\log_8 x - \log_8 5 - 3\log_8 y$

$\log_8 x^2 - \log_8 5 - \log_8 y^3$

$\log_8 \frac{x^2}{5} - \log_8 y^3$

$\log_8 \frac{x^2}{5y^3}$

Homework: Pg. 331 (3-6, 13-19, 23-29, 33-37)