Expanding and Condensing

Laws of Logarithms

Product	Quotient	Power
$\log_a(AB) = \log_a(A) + \log_a(B)$	$\log_a\left(\frac{A}{B}\right) = \log_a(A) - \log_a(B)$	$\log_a(A^C) = C \bullet \log_a(A)$

* Expanding Logarithms

- Apply the laws of logs to rewrite a single logarithmic term as an expression of logarithmic terms.
- Each term will have the same base.
- The number of factors in the original expression will be the number of terms in the expanded expression.

Examples: Expand each logarithm.

1. $\log_2(6x)$

$\log_2 6 + \log_2 x$

2. $\log_7(3xy^5)$

$\log_7 3 + \log_7 x + \log_7 y^5$

$\log_7 3 + \log_7 x + 5\log_7 y$

3. $\log_7 \sqrt{5}$

$\log_7 5^{1/2} = \frac{1}{2}\log_7 5$

4. $\log_3\left(\frac{5x}{7}\right)$

$\log_3 5x - \log_3 7$

$\log_3 5 + \log_3 x - \log_3 7$

5. $\log_5\left(\frac{5x^2}{7y}\right)$

$\log_5 5x^2 - \log_5 7y$

$\log_5 5 + \log_5 x^2 - (\log_5 7 + \log_5 y)$

$\log_5 5 + 2\log_5 x - \log_5 7 - \log_5 y$

6. $\ln\left(\frac{3xy^2}{2}\right)$

$\ln 3 + \ln x + 2\ln y - \ln 2$

Condensing Logarithms

- Apply the laws of logs to rewrite a logarithmic expression as a single logarithmic term.
- The number of terms in the log expression represents the number of factors in the single log term.
- You can ONLY condense log terms that have the same base!!!

Examples: Condense each logarithmic expression into a single logarithm.

1. $\log_4 2 + \log_4 32$

$\log_4(2 \cdot 32) = \log_4 64 = 3$

2. $\log(4x) - \log(7)$

$\log\left(\frac{4x}{7}\right)$

3. $3\log(7x + 6)$

$\log(7x+6)^3$

4. $2\log(x) + \log(x - 1)$

$\log x^2 + \log(x-1)$

$\log(x^2(x-1))$

5. $3(\log_2 x + \log_2 y - \log_2 5)$

$\log_2\left(\frac{x \cdot y}{5}\right)^3 = \log_2 \frac{x^3y^3}{5^3}$

6. $\frac{1}{2}[\ln 5 + 2\ln x - \ln(x^2 + 5)]$

$\ln\left(\frac{5x^2}{x^2+5}\right)^{1/2} = \ln\sqrt{\frac{5x^2}{x^2+5}}$

Change of Base Formula Name: ________________

Change of Base Formula	a: new base (what you want to change to)
$\log_b M = \frac{\log_a M}{\log_a b}$	b: original base (what you start with)
	To evaluate, change to base 10

Examples: Use Change of Base Formula to rewrite the following. Then use your calculator to solve to four decimal places.

Change these into log base 10.	Change these into log base e (natural log).
1. $\log_5 140$ $\frac{\log_{10} 140}{\log_{10} 5} \approx 3.070$	4. $\log_5 140$ $\frac{\ln 140}{\ln 5} \approx 3.070$
2. $\log_7 2506$ $\frac{\log 2506}{\log 7} \approx 4.022$	5. $\log_7 2506$ $\frac{\ln 2506}{\ln 7}$
3. $\log_3 412$ $\frac{\log 412}{\log 3}$	6. $\log_3 412$ $\frac{\ln 412}{\ln 3}$

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CW #2:

1. $\log_5 x - \log_5 2$

2. $\ln \pi + \ln x$

3. $\frac{1}{4}\log_6 17$

4. $10(\log_2 x + \log_2 y)$
or
$10\log_2 x + 10\log_2 y$

5. $2\log_a x - (\log_a y + 3\log_a z)$
or
$2\log_a x - \log_a y - 3\log_a z$

6. $\frac{1}{3}(\ln 3 + 2\ln r + \ln s)$
or
$\frac{1}{3}\ln 3 + \frac{2}{3}\ln r + \frac{1}{3}\ln s$

7. $2\log a - (4\log b + \frac{1}{2}\log c)$
or
$2\log a - 4\log b - \frac{1}{2}\log c$

8. $\frac{1}{2}[\log_5(x-1) - \log_5(x+1)]$

9. $\ln 3 + 2\ln x - 10\ln(x+1)$

10. $\log x - \frac{1}{3}\log(1-x)$

CW#2

1. $\log \frac{12\sqrt{7}}{2} = \log 6\sqrt{7}$ 2. $\log_5\left(\frac{x}{y^2}\right)$

3. $\ln\left(\frac{a^3}{b^2c^4}\right)$ 4. $\log_5\left(\frac{xy^2}{z^3}\right)^2$

1. $\log_5 25 + 2\log_2 4$
$2 + 2(2) = 6$

5. $\log_5 1 + \log_5 125 = 0 + 3 = 3$

6. $\log_3 243 - 2\log_3 9$
$5 - 2(2) = 1$

CW #3

1. 2.807355
2. 2.523658
3. 4.165458
4. .430677
5. .655407
6. .368742

7. 2.182658
8. 3.503061

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