PROPERTIES OF LOGARITHMS

There are five properties of logs you need to solve any exponential or logarithmic equation. The first two we have already covered.

The first rule we covered was converting a logarithm form logarithmic form to exponential form and vice-a-versa.

Logarithmic Form	Exponential Form
$\log_a b = c$	$a^c = b$

The second rule we covered was the base change formula.

$$\text{Base Change Formula: } \log_a b = \frac{\log b}{\log a}$$

This formula must be used to evaluate logs using a calculator if the base is a number other than 10. You must also use this if you are using a calculator to graph logarithm functions.

The function $f(x) = \log_3(x-4)+2$ must be entered as $y = \dfrac{\log(x-4)}{\log 3} + 2$.

The final three properties of logs allow you to write a single logarithmic statement as the sum or difference of logs; or condense the sum or difference of logs to a single statement.

PROPERTIES OF LOGS

1) $\log_a uv = \log_a u + \log_a v$ or $\ln uv = \ln u + \ln v$

2) $\log_a \frac{u}{v} = \log_a u - \log_a v$ or $\ln \frac{u}{v} = \ln u - \ln v$

3) $\log_a u^v = v \log_a u$ or $\ln u^v = v \ln u$

Examples

Express the following as the sum or difference of logs.

1) $\log_3 5x^2y^4z$

2) $\log_4 \left(9x^2y^3z^5\right)^2$

3) $\ln \dfrac{4\sqrt{x}}{yz^3}$

4) $\log \sqrt[3]{\dfrac{12x^2y^5}{z^2}}$

5) $\ln \dfrac{\sqrt[3]{x(x-3)^2}}{(x+2)^3}$

Properties of Logarithms Continued

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Condense, write the following using a single log statement.

1) $\log_4 10 - \log_4 3 + \log_4 7$

2) $\log 4 - (\log 3 + \log 5)$

3) $\log_3 5 - 2\log_3 a + 4\log_3 b - 7\log_3 c + \frac{1}{3}\log_3 d$

4) $\frac{3}{5}\log_5 2+\frac{4}{5}\log_5 x-\frac{2}{5}\log_5 y+\frac{1}{5}\log_5 z$

5) $2\ln 12-2\ln x+\frac{3}{5}\ln y-\frac{1}{3}\ln z$

6) $\log_3 2-4\log_3 x+6\log_3 y+4$

7) $\log_5 3+\log_5 x-\log_5 y+5\log_3 z$