

Properties of Logarithms

Nov 15-12:39 PM

4.4 Properties of Logarithms

PreCalc  
Unit 4 Day 5

Product Property:  $\log_b mn = \log_b m + \log_b n$  Quotient Property:  $\log_b \frac{m}{n} = \log_b m - \log_b n$

Power Property:  $\log_b m^p = p \log_b m$  Root Property:  $\log_b \sqrt[p]{m} = \log_b (m)^{\frac{1}{p}} = \frac{1}{p} \log_b m$

Remember:  $\log_e m = \ln m$   
 $\log_{10} m = \log m$   $\log_e n = \ln n$

Nov 14-5:38 PM

Express in terms of sums and differences of logs: **Expand**

1.  $\ln x^3 \sqrt{y}$   
 $\ln(x^3 \cdot y^{\frac{1}{2}}) = \ln x^3 + \ln y^{\frac{1}{2}}$   
 $\ln x^3 + \frac{1}{2} \ln y$   
 $3 \ln x + \frac{1}{2} \ln y$

2.  $\log \sqrt{\frac{x^2 y}{z}}$   
 $\log \left( \frac{x^2 y}{z} \right)^{\frac{1}{2}} = \frac{1}{2} \log \left( \frac{x^2 y}{z} \right)$   
 $\frac{1}{2} (\log x^2 + \log y - \log z)$   
 $\frac{1}{2} (2 \log x + \log y - \log z)$   
 $\frac{1}{2} (2 \log x + \log y - \log z)$   
 $\log x + \frac{1}{2} \log y - \frac{1}{2} \log z$

3.  $\log \left( \frac{a^2}{3b} \right)^3$   
 $3 \log a^2 - 3(\log 3 + \log b)$   
 $6 \log a - 3 \log 3 - 3 \log b$

4.  $\ln \frac{xy}{z}$   
 $\ln x + \ln y - \ln z$

Nov 14-5:40 PM

Write as a single log:

1.  $\log(2x+7) + \log(x-1)$   
 $\log((2x+7)(x-1))$   
 $\log(2x^2 + 5x - 7)$

2.  $2 \ln(x-3) - \ln(x^2 - 9)$   
 $\ln \frac{(x-3)^2}{x^2 - 9}$   
 $\ln \frac{(x-3)(x-3)}{(x+3)(x-3)} = \ln \frac{x-3}{x+3}$

3.  $\log a + \frac{1}{2}(\log b - \log c)$   
 $\log a \sqrt{\frac{b}{c}}$

4.  $2 - \log(10x)$   
 $2 - (\log 10 + \log x)$   
 $2 - 1 - \log x$   
 $1 - \log x$

Nov 14-5:41 PM

5.  $2 \ln(x-5) + \ln x$

6.  $\ln e^{5x}$

Nov 14-5:41 PM

7. Graph  $y = \ln x$ . Find domain, range and intercepts.

|   |      |     |      |      |
|---|------|-----|------|------|
| 1 | 2    | 3   | 4    | 5    |
| 0 | 0.69 | 1.1 | 1.39 | 1.61 |

D:  $(0, \infty)$

R:  $(-\infty, \infty)$

x-intercept(s):  $(1, 0)$

y-intercept(s): **NONE**

Nov 14-5:42 PM

8. Graph  $y = \ln(x+1)$ . Find domain, range, and intercepts.

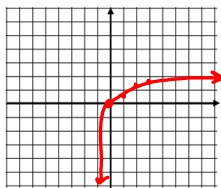
|   |   |     |     |                |
|---|---|-----|-----|----------------|
| x | 0 | 1   | 2   | $-\frac{1}{2}$ |
| y | 0 | .69 | 1.1 | -.69           |

D:  $(-1, \infty)$

R:  $(-\infty, \infty)$

x-intercept(s):  $(0, 0)$

y-intercept(s):  $(0, 0)$



Nov 14-5:42 PM

9. Name the transformation that takes place from  $y = \ln x$  to

a.  $y = \ln(x+3)$   
up 3

b.  $y = \ln(x-3)$   
left 3

c.  $y = \ln(-x)$   
reflect y-axis

Nov 14-5:42 PM

10. Let  $a = \ln x$ ,  $b = \ln y$  and  $c = \ln 2$ . Find each of the following in terms of  $a$ ,  $b$ , &  $c$ :

a.  $\ln\left(\frac{x^2y^2}{2}\right)$  Expand this

$\ln x^2 + \ln y^2 - \ln 2$   
 $2 \ln x + 2 \ln y - \ln 2$   
 $2a + 2b - c$

b.  $\ln(\sqrt[3]{xy}) = \ln(xy)^{\frac{1}{3}}$   
 $\frac{1}{3}(\ln(xy))$   
 $\frac{1}{3}(\ln x + \ln y)$   
 $\frac{1}{3} \ln x + \frac{1}{3} \ln y$   
 $\frac{1}{3}a + \frac{1}{3}b$

Nov 14-5:42 PM

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6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_ 9. \_\_\_\_\_ 10. \_\_\_\_\_



Nov 14-5:42 PM

Nov 15-12:41 PM