

Name Answer key

DUE ON: _____

Calc I H - Properties of Logarithm Review

Period _____

You can use the following to help you remember Properties of Logs (as necessary)

Google Search → *Algebra 2: Lesson 7-4 Properties of Logarithms* (14 min 53 sec)

<https://www.youtube.com/watch?v=-Hh464rjZ50>

Name	Rule	Common Errors
Product Property	$\log_b uv = \log_b u + \log_b v$	$\log_b (u + v) \neq \log_b u + \log_b v$ $\log_b (u + v) \neq \log_b uv$
Quotient Property	$\log_b \frac{u}{v} = \log_b u - \log_b v$	$\log_b (u - v) \neq \log_b u - \log_b v$ $\log_b (u - v) \neq \log_b \frac{u}{v}$
Power Property	$\log_b u^n = n \log_b u$	$(\log_b u)^n \neq n \log_b u$

Condensing Logarithms using properties:

To **condense** a sum or difference of logarithms, you want to get all the logs into a single log with a coefficient of 1 in front of that log, if possible.

(Use the Product Property, Quotient Property and Power Property.)

Examples: Write as a single logarithm.

<p>a. $\log_4 3 + 5 \log_4 x$</p> $\log_4 3 + 5 \log_4 x = \log_4 3 + \log_4 x^5$ $= \log_4 (3x^5)$	<p>b. $\log 3 - 5 \log x$</p> $\log 3 - 5 \log x = \log 3 - \log x^5$ $= \log \left(\frac{3}{x^5} \right)$
<p>c. $\ln 2 + 4 \ln x - 3 \ln y - \ln 8$</p> $\ln 2 + 4 \ln x - 3 \ln y - \ln 8 = \ln 2 + \ln x^4 - (\ln y^3 + \ln 8)$ $= \ln (2x^4) - \ln (8y^3)$ $= \ln \left(\frac{2x^4}{8y^3} \right)$ $= \ln \left(\frac{x^4}{4y^3} \right)$	<p>d. $2 \ln 4 - \frac{1}{2} \ln x + \ln y - 3 \ln 2$</p> $2 \ln 4 - \frac{1}{2} \ln x + \ln y - 3 \ln 2 = \ln (4^2 y) - \ln (2^3 x^{1/2})$ $= \ln \left(\frac{16y}{8\sqrt{x}} \right)$ $= \ln \left(\frac{2y}{\sqrt{x}} \right)$

Expanding Logarithms using the properties:

To **expand** a logarithm, you want to write it in terms of sums and differences of logarithms with no exponent inside a log, if possible. (Use the Product Property, Quotient Property and Power Property.)

Examples: Expand each logarithm.

<p>a. $\log_7 \frac{5x}{y^4}$</p> $\log_7 \frac{5x}{y^4} = \log_7(5x) - \log_7 y^4$ $= \log_7 5 + \log_7 x - 4 \log_7 y$	<p>b. $\log \frac{x^3}{9y^2}$</p> $\log \frac{x^3}{9y^2} = \log x^3 - \log(9y^2)$ $= 3 \log x - \log 9 - 2 \log y$
<p>c. $\ln 27 \sqrt[4]{a}$</p> $\ln 27 \sqrt[4]{a} = \ln 27 + \ln a^{1/4}$ $= \ln 27 + \frac{1}{4} \ln a$	<p>d. $\ln \frac{3x^2+1}{2x^3-3x^2}$</p> $\ln \frac{3x^2+1}{2x^3-3x^2} = \ln(3x^2+1) - \ln(2x^3-3x^2)$

And Don't Forget!

$\ln(1) = 0$

$\ln e = 1$

$\ln e^x = x$

$b^{\log_b y} = y$

Simplify. When possible, show work.

1. $\ln \sqrt[5]{e^3 x} = \frac{1}{5} \ln(e^3 x)$
 $= \frac{1}{5} (3 \ln e + \ln x)$
 $= \frac{3}{5} + \frac{1}{5} \ln x$

2. $\ln 5e^3 = \ln 5 + \ln e^3$
 $= \ln 5 + 3 \ln e$
 $= \ln 5 + 3$

3. $b^{\log_b x} = \boxed{\times}$

Expand each logarithmic expression. When possible, show work.

4. $\ln \frac{12}{5} = \ln 12 - \ln 5$

5. $\ln \frac{5y}{x^2} = \ln 5y - \ln x^2$
 $= \ln 5 + \ln y - 2 \ln x$

6. $\ln x^3 y^5 = \ln x^3 + \ln y^5$
 $= 3 \ln x + 5 \ln y$

7. $\ln \frac{y^3+4}{x\sqrt{y^3+2}}$
 $= \ln(y^3+4) - \ln x (y^3+2)^{1/2}$
 $= \ln(y^3+4) - \ln x - \frac{1}{2} \ln(y^3+2)$

8. $\ln \frac{1}{x^4} = \ln 1 - 4 \ln x$
 $= -4 \ln x$
 OR $\ln x^{-4} = -4 \ln x$

9. $\ln \frac{1-x^2}{x^3}$
 $= \ln(1-x^2) - \ln x^3$
 $= \ln(1-x^2) - 3 \ln x$

Condense each logarithmic expression.

10. $2 \ln x + \ln(x+1)$
 $= \ln x^2 (x+1)$

11. $\ln(x^2-1) - \ln(x+1)$
 $= \ln \frac{x^2-1}{x+1} = \ln \frac{(x+1)(x-1)}{(x+1)}$
 $= \ln(x-1)$

12. $-2 \ln x + \ln(x+1)$
 $= \ln x^{-2} + \ln(x+1)$
 $= \ln x^{-2}(x+1)$
 $= \ln \left(\frac{x+1}{x^2} \right)$