

Properties of Logarithms Class Work

Objective: You will be able to simplify and expand logarithms.

★ When the bases of logarithms are identical, the following properties hold...

* $\log_b M + \log_b N = \log_b (M \cdot N)$

Example: $\log_3 (8x) + \log_3 (2x) = \log_3 (16x^2)$

* $\log_b M - \log_b N = \log_b \left(\frac{M}{N}\right)$

Example: $\log_2 (20x^5) - \log_2 (4x) = \log_2 (5x^4)$

* $\log_b M^a = a \log_b (M)$

Example: $\log_4 (x^3) = 3 \log_4 (x)$
 b/c $\log_4 (x \cdot x \cdot x) = \log_4 x + \log_4 x + \log_4 x = 3 \log_4 x$

★ Can you create a rule for the following logarithms, for any given values x and y?

* $\log_x x = 1$
 $x^? = x$

* $\log_y 1 = 0$
 $y^? = 1$

Practice: Write an equivalent expression to condense each logarithm.

1. $\log_3 2x + \log_3 (x-4)$

$\log_3 (2x \cdot (x-4))$
 $\log_3 (2x^2 - 8x)$

3. $\log_2 4^x$

$x \log_2 (4)$

5. $\log(p) + \log(q) = \log(r)$

$\log\left(\frac{pq}{r}\right)$

7. $\log_7 b - 5 \log_7 c + 5 \log_7 (3d)$

$\log_7 \frac{b}{c^5 (3d)^5}$
 $\log_7 \left(\frac{b}{243c^5 d^5}\right)$

9. $\ln(4x^2) + \ln(2) = \ln(x)$

$\ln\left(\frac{16x^2 \cdot 2}{x}\right)$
 $\ln(32x)$

"log" once

2. $\log_2 17 - \log_2 (2x + 5)$
 $\log_2 \left(\frac{17}{2x+5}\right)$

exponents first

4. $\log_2 (xy^3z^4) = \log_2 y$
 $\log_2 (x^3 y^4 z^3)$

6. $\log(xy) = \log(y) = \log(x)$

$\log\left(\frac{x^4 y^4 x}{y^6}\right)$
 $= \log\left(\frac{x^5}{y^2}\right)$

8. $\ln(6x^2) = \ln(2x)$

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

10. $\log(3w) - 2 \log(v) + \log(2^3)$

$\log(3w) - (6 \log v + 2 \log 8)$
 $\log\left(\frac{3w}{v^6 (3c)^2}\right)$
 $\log\left(\frac{3w}{9v^6 c^2}\right)$
 $\log\left(\frac{w}{3v^6 c^2}\right)$

11. $\log_9 \frac{1}{3} + \log_9 3^4$

$$\log_9 \left(\frac{1}{3} \cdot 3^4 \right)$$

$$\log_9 \left(\frac{81}{3} \right) = \log_9 (27)$$

12. $\log_{16} \left(\frac{1}{4} \right) + 3 \log_{16} 4$

$$\log_{16} \left(\frac{1}{4} \cdot 4^3 \right)$$

$$= \log_{16} (4^2)$$

$$= \log_{16} (16)$$

13. $4 \log_2 + \log_7 - \log_4$

$$\log \left(\frac{2^4 \cdot 7}{4} \right) = \log \left(\frac{16 \cdot 7}{4} \right)$$

$$= \log (28)$$

14. $\ln 8 - 3 \ln 2$

$$\ln \left(\frac{8}{2^3} \right) = \ln \left(\frac{8}{8} \right)$$

$$= \ln (1)$$

Practice: Write an equivalent expression to expand each logarithm.

15. $\log_4 (3\sqrt{x})$

16. $\log_3 (8^3(3x-1)^2)$

17. $\log_8 (2^*(4y + 5)^7)$

18. $\log_{11} (4\sqrt{5})$

19. $\log_t \sqrt{\frac{3w}{z}}$

20. $\log_8 \sqrt{\frac{s}{6r}}$

Exit Slip: Write an equivalent expression to condense each logarithm.

1. $\log_2 2x + \log_2 x - \log_2 8$

2. $4 \log 3x - \log 9$

Write an equivalent expression to expand each logarithm.

3. $\log_5 (3^*(2x + 1)^2)$

4. $\ln (4x * y^2)$

Homework: pages 449-451

∞ **Condensing:** #11-18, 33, 37, 38, 41, 58, 60, 69, 73, 74, 77, 92, 93, and the extra problem below...

Extra Problem (Required): Condense $\log(9h) - 3(2 \log(f) + \log(3h))$

∞ **Expanding:** #19-29 odds only, 43, 71, 79, 81, and the extra problem below...

Extra Problem (Required): Expand $\log \left(y^3 \sqrt{\frac{w}{4z}} \right)$

∞ **Throwback:** p. 444 #100, 103, 104, and 105