

Section 5.6
Laws of Logarithms

Given M and N are positive real numbers, $b > 0$ and $b \neq 1$

- 1) $\log_b MN = \log_b M + \log_b N$
- 2) $\log_b (M/N) = \log_b M - \log_b N$
- 3) $\log_b M = \log_b N$ if $M = N$ (drop the logs)
- 4) $\log_b M^k = k \log_b M$ (power goes to the front)

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Examples

Express in terms of $\log M$ and $\log N$.

1) $\log M^3$

$3 \log M$

2) $\log(3MN)$

$\log 3 + \log M + \log N$

3) $\log \sqrt{MN}$

$\log (MN)^{1/2}$
 $\frac{1}{2} \log(MN)$

$\frac{1}{2} \log M + \frac{1}{2} \log N$

Express as a single logarithm or a rational number.

4) $\log_5 2 + \log_5 7$

$\log_5 14$

5) $\ln e^5 = 5$

$5 \ln e = 5 \cdot 1 = 5$

6) $\log_6 12 + \log_6 3$

$\log_6 36 = \log_6 6^2 = 2$

7) $\log C - 3 \log W$

$\log C - \log W^3$
 $\log \left(\frac{C}{W^3} \right)$

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Examples

Express y in terms of x.

8) $\log y = 3 \log x$

$$\log y = \log x^3$$

$$y = x^3$$

Solve.

9) $\ln y = \frac{1}{3}(\ln 7 + \ln x)$

$$\ln y = \frac{1}{3} \ln(7x)$$

$$\ln y = \ln(7x)^{1/3}$$

$$y = \sqrt[3]{7x}$$

10) $\log_2(x+3) + \log_2 6 = 4$

$$\log_2(6x+18) = 4$$

$$2^4 = 6x+18$$

$$\frac{16}{6} = \frac{6x+18}{6}$$

$$\frac{-2}{6} = \frac{6x}{6}$$

$$x = -\frac{1}{3}$$

$$x = 4$$

~~$$x = 2$$~~

11) $\log_2 x + \log_2(x-2) = 3$

$$\log_2(x^2-2x) = 3$$

$$2^3 = x^2-2x$$

$$8 = x^2-2x$$

$$0 = x^2-2x-8$$

$$0 = (x-4)(x+2)$$

x cannot be -2 because if you check the answer you get a negative value within the parentheses

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Examples

Solve the following logarithms.

12) $\log_2 8 = x$

$$2^x = 8$$

$$x = 3$$

Change of base

$$\frac{\log 8}{\log 2} = 3$$

13) $\log_2 7 = x$

$$2^x = 7$$

$$\frac{\log 7}{\log 2} = 2.807$$

Jan 5-7:12 AM

Homework

p200 #1-23 odd
#29, 31, 43, 45

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