

Section 4.4 – Laws of Logarithms

- Laws of Logarithms قوانين اللوغاريتمات

$$\log_a A + \log_a B = \log_a (AB)$$

$$\ln A + \ln B = \ln(AB)$$

$$\log_a A - \log_a B = \log_a \left(\frac{A}{B}\right)$$

$$\ln A - \ln B = \ln \left(\frac{A}{B}\right)$$

$$\log_a (A^C) = C \log_a A$$

$$\ln(A^C) = C \ln A$$

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Common MISTAKES

$$1. \log_a (A + B) \neq \log_a A + \log_a B$$

$$2. \frac{\log_a A}{\log_a B} \neq \log_a \left(\frac{A}{B}\right)$$

$$3. (\log_a A)^C \neq C \log_a A$$



Example 1

Evaluate each expression.

(a) $\log_4 2 + \log_4 32$

(b) $\log_2 80 - \log_2 5$

(c) $\log_3 100 - \log_3 18 - \log_3 50$

Solution

$$(a) \log_4 (2 \cdot 32) = \log_4 64 = 3$$

$$(b) \log_2 \left(\frac{80}{5}\right) = \log_2 16 = 4$$

$$\begin{aligned} (c) \log_3 \left(\frac{100}{50}\right) - \log_3 18 &= \log_3 2 - \log_3 18 \\ &= \log_3 \left(\frac{2}{18}\right) = \log_3 \frac{1}{9} = -2 \end{aligned}$$

Problems

- Evaluate the expression

(a) $\frac{-1}{3} \log 8$

(b) $\log 50 + \log 200$

(c) $\log_2 60 - \log_2 15$

- Use the Laws of Logarithms to expand the expression.

(a) $\log_5(5x^3y^6)$

(b) $\ln\left(\frac{ab^2}{\sqrt[3]{c}}\right)$

(c) $\log \sqrt{\frac{x}{10(x^3-7)^2}}$

(d) $\ln \left(x \sqrt{\frac{y}{z}} \right)$

- Use the Laws of Logarithms to combine the expression.

(a) $1 + 3 \log x + \frac{1}{2} \log(x + 1)$

(b) $3 \ln s + \ln(t + 2) - \ln(t^2 + t - 2)$

(c) $\ln(a + b) + \ln(a - b) - 2 \ln c$

(d) $2 \log_3 x - 3(\log_3(y + 1) + \log_3 z)$