

3.3 | Properties of Logarithms

A Few Essential Facts:

$$\log_a 1 = 0$$

$$\log_a a = 1$$

$$\ln e = 1$$

$$a^{\log_a m} = m$$

$$\log_a a^m = m$$

The "Big THREE" Properties of Logs:

$$\log_a (mn) = \log_a m + \log_a n$$

$$\log_a \left(\frac{m}{n} \right) = \log_a m - \log_a n$$

$$\log_a m^r = r \log_a m$$

Find the exact value of each without a calculator:

Ex. 1 $9 \ln e^3 + 4 \ln e^5$

Ex. 2 $\log_2 \sqrt[5]{32}$

Ex. 3 $36 \ln e^{0.5} - 4 \ln e^5$

Ex. 1

Write $\log_a \left(x\sqrt{x^2 + 1} \right)$ in expanded form:

$$\begin{aligned}\log_a \left(x\sqrt{x^2 + 1} \right) &= \log_a x + \log_a \left(\sqrt{x^2 + 1} \right) \\ &= \log_a x + \frac{1}{2} \log_a \left(x^2 + 1 \right)\end{aligned}$$

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$$\text{Ex. 2} \quad \ln \frac{x^7}{\sqrt[3]{x+2}}$$

$$\text{Ex. 3} \quad \log_7 h^2 j^{11} k^{-5}$$

Ex. 1

Write the following as a single logarithm:

$$2\log_a x + \log_a 9 + \log_a (x+1) - \log_a 5$$

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$$\text{Ex. 2} \quad 5 \log_7 (2x) - \frac{1}{3} \log_7 (5x + 1)$$

$$\text{Ex. 3} \quad 4 \ln (x + 3) - \frac{1}{5} \ln (4x + 7)$$

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$$\boxed{\text{Ex. 4}} \quad \ln 13 + 7 \ln a - 11 \ln b + \ln c$$

Change of Base Formula

$$\log_a m = \frac{\log m}{\log a}$$

Ex. 1 $\log_5 89 = \frac{\log 89}{\log 5} = 2.7889$

Use your calculator to approximate each value:

Ex. 2 $\log_{15} 33$

Ex. 3 $\log_{\frac{1}{3}} 10$

Assignment:

W.S. 3.3 (1-33)