

4.3 Laws of Logarithms

1. Write as a single logarithm.

(a) $3 \log 2 - 2 \log 3$ SOLUTION $\log \left(\frac{8}{9} \right)$.

(b) $\frac{1}{2} \ln(x+1) - 2 \ln(x-2) - 3 \ln(x+5)$ SOLUTION $\ln \left(\frac{\sqrt{x+1}}{(x-2)^2(x+5)^3} \right)$.

(c) $2 \ln x - 3 \ln(x+7) - 5 \ln z$ SOLUTION $\ln \left(\frac{x}{(x+7)^3 z^5} \right)$.

2. Write as a linear combination of $\ln x$, $\ln y$, and $\ln z$.

(a) $\ln 2xy$

(b) $\ln \frac{8x^5}{y^7}$ SOLUTION $\ln 8 + 5 \ln x - 7 \ln z$.

(c) $\ln \left(\frac{x^2 y^3}{z^5} \right)$ SOLUTION $2 \ln x + 3 \ln y - 5 \ln z$.

(d) $\ln \frac{x^7}{y^3 \sqrt{z}}$ SOLUTION $7 \ln x + 3 \ln y - \frac{1}{2} \ln z$.

(e) $\ln \left(\frac{\sqrt{x}}{y^5 z^7} \right)$ SOLUTION $\frac{1}{2} \ln x - 5 \ln y - 7 \ln z$.

3. Simplify.

(a) $\ln e^7$ SOLUTION 7.

(b) $e^{\ln 8}$ SOLUTION 8

(c) $e^{\ln \sqrt{y}}$ SOLUTION \sqrt{y}

(d) $10^{\log(3x+1)}$ SOLUTION $3x+1$

(e) $\ln e^{7t}$ SOLUTION $7t$

(f) $\ln 1$ SOLUTION 0

(g) $\ln e$ SOLUTION 1

4. Find a decimal approximation for the given expression by using the Change of Base Formula and writing the expression in terms of the natural log or common log. Round your answer to the fourth decimal place.

(a) $\log_2 11$ SOLUTION $= \frac{\ln 11}{\ln 2} = 3.4594$

(b) $\log_3 17$ SOLUTION $= \frac{\ln 17}{\ln 3} = 2.5789$

(c) $\log_2 21$ SOLUTION $= \frac{\ln 21}{\ln 2} = 4.3923$