

Laws of Logarithms

Common Logarithms	Natural Logarithms
1. $\log_a(uw) = \log_a u + \log_a w$	1. $\ln(uw) = \ln u + \ln w$
2. $\log_a\left(\frac{u}{w}\right) = \log_a u - \log_a w$	2. $\ln\left(\frac{u}{w}\right) = \ln u - \ln w$
3. $\log_a(u^c) = c \log_a u$	3. $\ln(u^c) = c \ln u$

Use the properties of logarithms to write the expression as a sum, difference, and/or constant multiple of logarithms.

1. $\log 5x$

2. $\log_3\left(\frac{x}{4}\right)$

3. $\log_8 t^{-3}$

4. $\ln \sqrt[3]{d}$

5. $\ln abc$

6. $\ln \frac{xy}{z}$

7. $\ln\left(\frac{x^2-1}{x^3}\right)$

8. $\ln z(z-1)^2$

9. $\ln \sqrt{\frac{x^2}{y^3}}$

10. $\ln \sqrt[3]{\frac{x}{y}}$

11. $\ln \frac{x^4 \sqrt{y}}{z^5}$

12. $\ln \frac{x}{\sqrt{x^2+1}}$

13. $\log_5 \frac{x^5}{y^2 z^3}$

14. $\log_7 \frac{\sqrt{xy^5}}{z^2}$

Write the expression as one logarithm.

1. $\log_3 x + \log_3 (5y)$

2. $\log_3 (2z) - \log_3 x$

3. $\frac{1}{3} \log_3 5x$

4. $3 \ln x + 2 \ln y - 4 \ln z$

5. $2 \log_a x + \frac{1}{3} \log_a (x-2) - 5 \log_a (2x+3)$

6. $\ln x - 2[\ln(x+2) + \ln(x-2)]$

7. $4[\ln x + \ln(x+5)] - 2 \ln(x-5)$

8. $\frac{1}{3}[2 \ln(x+3) + \ln x - \ln(x^2-1)]$

9. $2[\ln x - \ln(x+1) - \ln(x-1)]$

10. $\frac{1}{3}[\ln y + 2 \ln(y+4) - \ln(y-1)]$

11. $2 \ln 3 - \frac{1}{2} \ln(x^2+1)$

12. $\frac{3}{2} \ln 5t^6 - \frac{3}{4} \ln t^4$

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Use the properties of logarithms to write the expression as a sum, difference, and/or constant multiple of logarithms.

1. $\log 5 + \log x$

2. $\log_3 x - \log_3 4$

3. $-3 \log_8 t$

4. $\frac{1}{3} \ln d$

5. $\ln a + \ln b + \ln c$

6. $\ln x + \ln y - \ln z$

7. $\ln(x^2 - 1) - 3 \ln x$

8. $\ln z + 2 \ln(z - 1)$

9. $\ln x - \frac{3}{2} \ln y$

10. $\frac{1}{3}[\ln x - \ln y]$

11. $4 \ln x + \frac{1}{2} \ln y - 5 \ln z$

12. $\ln x - \frac{1}{2} \ln(x^2 + 1)$

13. $5 \log_5 x - 2 \log_5 y - 3 \log_5 z$

14. $\frac{1}{2} \log_7 x + 5 \log_7 y - 2 \log_7 z$

Write the expression as one logarithm.

1. $\log_3 5xy$

2. $\log_3 \left(\frac{2z}{x} \right)$

3. $\log_3 \sqrt[3]{5x}$

4. $\ln \frac{x^3 y^2}{z^4}$

5. $\log_a \frac{x^2 \sqrt[3]{x-2}}{(2x+3)^5}$

6. $\ln \frac{x}{[(x-2)(x+2)]^2}$ or $\ln \frac{x}{(x^2-4)^2}$

7. $\ln \frac{x^4 (x+5)^4}{(x-5)^2}$ or $\ln \frac{(x^2+5x)^4}{(x-5)^2}$

8. $\ln \sqrt[3]{\frac{x(x+3)^2}{x^2-1}}$

9. $\ln \left(\frac{x}{x^2-1} \right)^2$

10. $\ln \sqrt[3]{\frac{y(y+4)^2}{y-1}}$

11. $\ln \frac{9}{\sqrt{x^2+1}}$

12. $\ln 5t^6 \sqrt{5}$