

Laws of Logarithms

$$\textcircled{1} \log_a (A \cdot B) = \log_a (A) \oplus \log_a (B)$$

$$\textcircled{2} \log_a \left(\frac{A}{B} \right) = \log_a (A) \ominus \log_a (B)$$

$$\textcircled{3} \log_a A^{\underline{C}} = \underline{C} \cdot \log_a (A)$$

★ Change of Base

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

Examples:

→ Expanding Logarithms

$$\ln \left(\frac{ab}{\sqrt[3]{c}} \right) \quad \textcircled{1} \text{ division}$$

$$\ln(ab) - \ln(\sqrt[3]{c})$$

② rewrite radical

$$\ln(ab) - \ln(c^{1/3})$$

③ multiplication

$$\ln(a) + \ln(b) - \ln(c^{1/3})$$

④ exponent

$$\ln(a) + \ln(b) - \frac{1}{3} \ln(c)$$

→ Condensing logarithms

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

① exponents

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

② rewrite fraction exponent

$$\log(x^3) + \log(\sqrt{x+1})$$

③ multiplication

$$\log(x^3 \cdot \sqrt{x+1})$$

Expand logarithm

$$\log\left(\frac{z}{\sqrt{y} \cdot x^3}\right)$$

① division

$$\log(z) - \log(\sqrt{y} \cdot x^3)$$

② multiplication

$$\log(z) - (\log \sqrt{y} + \log x^3)$$

③ rewrite radical

$$\log(z) - (\log(y^{1/2}) + \log(x^3))$$

④ exponents

$$\log(z) - \left(\frac{1}{2}\log(y) + 3\log(x)\right)$$
$$\log(z) - \frac{1}{2}\log(y) - 3\log(x)$$