

Properties of logarithms

$$1a) \log_4(xz) ; \log_4 x + \log_4 z$$

$$1b) \log_4(y/k) ; \log_4 y - \log_4 k$$

$$1c) \log_4 \sqrt[3]{z} ; \frac{1}{3} \log_4 z$$

$$\begin{aligned} 3) \log_a \frac{x^3 w}{y^2 z^4} & ; \log_a x^3 w - \log_a y^2 z^4 \\ & \log_a x^3 + \log_a w - [\log_a y^2 + \log_a z^4] \\ & \log_a x^3 + \log_a w - \log_a y^2 - \log_a z^4 \\ & 3\log_a x + \log_a w - 2\log_a y - 4\log_a z \end{aligned}$$

$$\begin{aligned} 7) \ln \sqrt[4]{\frac{x^7}{y^5 z}} & ; \ln \left(\frac{x^7}{y^5 z} \right)^{\frac{1}{4}} ; \frac{1}{4} \ln \frac{x^7}{y^5 z} ; \frac{1}{4} [\ln x^7 - \ln y^5 - \ln z] \\ & ; \frac{1}{4} [7 \ln x - 5 \ln y - \ln z] \\ & ; \frac{7}{4} \ln x - \frac{5}{4} \ln y - \frac{1}{4} \ln z \end{aligned}$$

$$9a) \log_3 x + \log_3(5y) ; \log_3(5xy)$$

$$9b) \log_3(2z) - \log_3 x ; \log_3 \left(\frac{2z}{x} \right)$$

$$9c) 5 \log_3 y ; \log_3 y^5$$

$$13) \log(x^3 y^2) - 2 \log x^2 y - 3 \log(x/y)$$

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

$$\log \frac{x^3 y^2}{(x y^{\frac{1}{3}})^2 (x/y)^3} ; \log \left[\frac{x^3 y^2}{y^{\frac{2}{3}} x^2} \cdot \frac{y^3}{x^3} \right] ; \log \frac{y^5}{x^2 y^{\frac{2}{3}}} ; \boxed{\log \frac{y^{13/3}}{x^2}}$$