

3.3 Properties of Logarithms.

Product Property

$$b^x \cdot b^y = b^{x+y} \longrightarrow \log_b xy = \log_b x + \log_b y$$

Quotient Property

$$\frac{b^x}{b^y} = b^{x-y} \longrightarrow \log_b \left(\frac{x}{y}\right) = \log_b x - \log_b y$$

Power Property

$$(b^x)^y = b^{xy} \longrightarrow \log_b x^p = p \log_b x$$

Example 1 Simplify

$$\log_4 \sqrt[5]{64}$$

$$\log_4 64^{\frac{1}{5}}$$
$$\log_4 4^{\frac{3}{5}} = \frac{3}{5}$$

$$\frac{1}{5} \log_4 64$$
$$\frac{1}{5} (\log_4 4)^3 = \frac{3}{5}$$

Practice: pg 185: 19-23

19. $\log_5 \sqrt[4]{25}$

20. $8 \ln e^2 - \ln e^{12}$

21. $9 \ln e^3 + 4 \ln e^5$

23. $2 \log_3 \sqrt[2]{27}$

22. $\log_2 \sqrt[5]{32}$

Example 2 Expand Logarithms

$$\log 12x^5y^{-2}$$

$$\log(12 \cdot x^5 \cdot y^{-2})$$

$$\log 12 + \log x^5 + \log y^{-2}$$

$$\boxed{\log 12 + 5\log x - 2\log y}$$

goal - separate
part mult. div. part.

Practice pg 185: ¹⁹⁻²³ 29-33 69, 71, 118

29. $\log_9 6x^3y^5z$

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

31. $\log_3 \frac{p^2q}{\sqrt[5]{3q^{-1}}}$

32. $\ln \frac{4df^5}{\sqrt[8]{1-3d}}$

33. $\log_{11} ab^{-4}c^{12}d^7$

69. $\ln \sqrt[5]{x^3(x+3)^7}$

71. $\log_{14} \frac{11}{\sqrt[4]{x^5(8x-1)}}$

118. See book