

## 4.3 Properties of Logarithms

- Use the product rule
- Use the quotient rule
- Use the power rule
- Expand logarithmic expressions

## LT: Use the product rule

$$\log_b(MN) = \log_b M + \log_b N$$

Example 1:

Use the product rule to expand each logarithmic expression:

a.  $\log_4(7 \cdot 5)$

$$\log_4 7 + \log_4 5$$

b.  $\log 10x$

$$\log 10 + \log x$$

c.  $\ln(7x)$

$$\ln 7 + \ln x$$

## LT: Use the quotient rule

$$\log_b \left( \frac{M}{N} \right) = \log_b M - \log_b N$$

Example 2:

Use the quotient rule to expand each logarithmic expression:

a.  $\log_7 \left( \frac{19}{x} \right)$

$$\log_7 19 - \log_7 x$$

b.  $\log \frac{10}{x}$

$$\log 10 - \log x$$

$$1 - \log x$$

## LT: Use the power rule

$$\log_b M^p = p \log_b M$$

Example 3:

Use the power rule to expand each logarithmic expression:

a.  $\log_5 7^4$

$$4 \cdot \log_5 7$$

$$4 \log_5 7$$

b.  $\ln \sqrt{x}$

$$\ln x^{\frac{1}{2}}$$

$$\frac{1}{2} \cdot \ln x$$

$$\frac{1}{2} \ln x$$

c.  $\log(4x)^5$

$$5 \cdot \log 4x$$

$$5 \log 4x$$

$$5 \log 4 + 5 \log x$$

# LT: Expand logarithmic expressions

$\log_b(MN) = \log_b M + \log_b N$	<b>Product Rule</b>
$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$	<b>Quotient Rule</b>
$\log_b M^p = p \log_b M$	<b>Power Rule</b>

Example 4:

Use logarithmic properties to expand each expression as much as possible:

a.  $\log_b(x^2\sqrt{y})$

$$\log_b x^2 + \log_b \sqrt{y}$$

$$\log_b x^2 + \log_b y^{\frac{1}{2}}$$

$$2 \cdot \log_b x + \frac{1}{2} \cdot \log_b y$$

$$2 \log_b x + \frac{1}{2} \log_b y$$

b.  $\log_6\left(\frac{\sqrt[3]{x}}{36y^4}\right)$

$$\log_6 \sqrt[3]{x} - \log_6 36y^4$$

$$\log_6 \sqrt[3]{x} - (\log_6 36 + \log_6 y^4)$$

$$\log_6 x^{\frac{1}{3}} - \log_6 6^2 - \log_6 y^4$$

$$\frac{1}{3} \log_6 x - 2 \log_6 6 - 4 \log_6 y$$

$$\frac{1}{3} \log_6 x - 2 - 4 \log_6 y$$