

## 8.3 Laws of Logarithms

### 1. Product Rule:

$$\log_c M + \log_c N = \log_c MN$$

### 2. Quotient Rule:

$$\log_c M - \log_c N = \log_c \frac{M}{N}$$

### 3. Power Rule:

$$\log_c M^P = P \log_c M$$

**\*\*The laws of logarithms go both directions**

**Example 1: Using Logs to Expand Expressions**

Write each expression in terms of individual logarithms of  $x$ ,  $y$  and  $z$

a.)  $\log_6 \frac{x}{y}$

b.)  $\log_3 xy^4$

c.)  $\log_5 \sqrt{xy}$

d.)  $\log_3 \frac{9}{\sqrt[3]{x^2}}$

e.)  $\log_7 \frac{x^4y}{\sqrt{z}}$

**Example 2: Use the Laws of Logarithms to Evaluate Expressions**

Simplify and evaluate:

a.)  $\log_6 8 + \log_6 9 - \log_6 2$

b.)  $\log_3 9\sqrt{3}$

c.)  $\log_5 1000 - \log_5 4 - \log_5 2$

d.)  $2 \log_3 6 - \frac{1}{2} \log_3 64 + \log_3 2$

**Example 3: Use the Laws of Logarithms to Simplify Expressions**

Write each as a single logarithm. **State the restrictions.**

a.)  $\log_7 x^2 + \log_7 x - \frac{5 \log_7 x}{2}$

b.)  $\log_2(x^2 - 9) - \log_2(x^2 - x - 6)$

**Change of Base:**

$$\log_c M = \frac{\log_d M}{\log_d c}$$

**Example 4:**

a.) Evaluate  $\log_3 7$  to 3 decimal places

b.) Graph  $y = 3\log_2 x - 5$  with a graphing calculator.