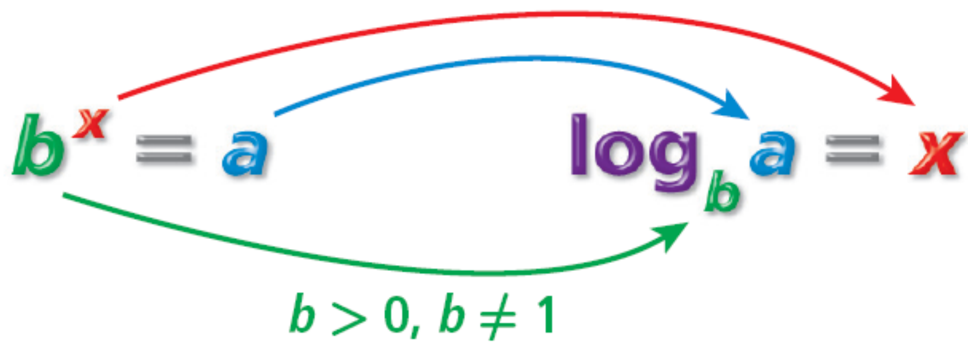
Logarithms

A **logarithm** is the inverse operation that undoes raising a base to an exponent equation



Read $\log_b a = x$, as "the log base *b* of *a* is *x*."

- Notice that the log is equal the exponent of the exponential form.

Example #1: **Rewrite as a logarithm.**

$6^3 = 216$

$4^6 = 4096$

You try: $10^5 = 100000$

Example #2: **Rewrite as an exponential.**

$log_7 x = 2$

$log_x 27 = 3$

You try: $log_{10} x = 7$

Example #3: Simplify each expression.

$log_4 64$

$log_2 64$

$log_3 81$

A logarithm with base 10 is called a **common logarithm**. If no base is written for a logarithm, the base is assumed to be 10.

Example #3:
log 100,000

Example #4: **Solve $\boldsymbol{log x = 3}$.**

You try: **Solve $\boldsymbol{log x = -1}$.**

- Does $log_0 5$ exist? Explain.
- Does log(-3) exist?
- What is log1?

Properties of Logarithms

Property	Definition	Example
Product	$\log_b mn = \log_b m + \log_b n$	$\log_3 9x = \log_3 9 + \log_3 x$
Quotient	$\log_b \frac{m}{n} = \log_b m - \log_b n$	$\log_{\frac{1}{4}} \frac{4}{5} = \log_{\frac{1}{4}} 4 - \log_{\frac{1}{4}} 5$
Power	$\log_b m^p = p \cdot \log_b m$	$\log_2 8^x = x \cdot \log_2 8$

Example #1: **Expand** $\log(abc)$

Example #2: **Expand** $\log(x^3)$

Example #3: **Expand** $log\left(\frac{3x}{4m}\right)$

You try: **Expand** $\log(4xy)$

Expand $log\left(\frac{w}{2x}\right)$

Example #4: **Rewrite as a single logarithm.**

log2 + log3 – log8

Example #5:

$3logx - \log(x)$

You try: **Rewrite as a single logarithm:** 4logw + log5

Exponent Properties:

$log_b b^x = x$ $\quad$ $b^{log_b x} = x$

$log 10^x = x$ $\quad$ $10^{log x} = x$

Example #6: **Simplify** $log_3 3^4$

Simplify: $3log_5 5$

Example #7: **Solve for x:** $\log_7(7^{3x}) = 9$

You try: **Simplify** $log_2 2^9$

Simplify: log3 + logx – log7

Lesson 22-2 and 23-2

Relating to Inverses:

Solve for the inverse of $f(x) = 2^x$

Solve for the inverse of $f(x) = 4 \cdot 2^x + 2$