

4.2 Logarithmic Functions

- **Change from logarithmic to exponential form**
- **Change from exponential to logarithmic form**
- **Evaluate logarithms**
- **Use basic logarithmic properties**



Definition of the Logarithmic Function:

$y = \log_b x$ is equivalent to $b^y = x$

so a log is really just an **EXPONENT**

Logarithmic Form	Exponential Form
$y = \log_b x$	$b^y = x$

LT: Change from logarithmic to exponential form

Example 1:

Write each equation in its equivalent exponential form:

a. $2 = \log_5 x$

$$x = 5^2$$

b. $3 = \log_b 64$

$$64 = b^3$$

c. $\log_3 7 = y$

$$7 = 3^y$$

LT: Change from exponential to logarithmic form

Example 2:

Write each equation in its equivalent logarithmic form:

$$a. 12^2 = x$$

$$2 = \log_{12} x$$

$$b. b^3 = 8$$

$$3 = \log_b 8$$

$$c. e^y = 9$$

$$y = \log_e 9$$

$$y = \ln 9$$

LT: Evaluate logarithms

Example 3:
Evaluate

a. $\log_2 16$

$$16 = 2^?$$

$$16 = 2^4$$

4

b. $\log_3 9$

$$9 = 3^?$$

$$9 = 3^2$$

2

c. $\log_{25} 5$

$$5 = 25^?$$

$$5 = 25^{\frac{1}{2}}$$

$\frac{1}{2}$

LT: Use basic logarithmic properties

$$\log_b b = 1$$

$$\log_b 1 = 0$$

$$\log_b b^x = x \text{ or } b^{\log_b x} = x$$

Example 4:
Evaluate

$$\begin{aligned} a. \log_7 7 &= 1 \\ 7 &= 7^1 \end{aligned}$$

$$\begin{aligned} b. \log_5 1 &= 0 \\ 1 &= 5^0 \end{aligned}$$

Example 5:
Evaluate

$$a. \log_4 4^5 = 5$$

$$b. 6^{\log_6 9} = 9$$

Logs with base 10 are called **common logarithms**, see the log button on a calculator.

Practice entering these in a calculator:

Logarithm	Calculator Keystrokes	Display
a. $\log 1000$	log 1000 ENTER	3
b. $\log \frac{5}{2}$	log 5 ÷ 2 ENTER	.3979400087
c. $\frac{\log 5}{\log 2}$	log 5) ÷ log 2 ENTER	2.321928095
d. $\log(-3)$	log - 3 ENTER	ERROR

Logs with base e are called **natural logarithms**, see the LN key on a calculator.

The basic properties applied to both common and natural logs:

General Properties	Common Logarithms	Natural Logarithms
$\log_b b = 1$	$\log 10 = 1$	$\ln e = 1$
$\log_b 1 = 0$	$\log 1 = 0$	$\ln 1 = 0$
$\log_b b^x = x$	$\log 10^x = x$	$\ln e^x = x$
$b^{\log_b x} = x$	$10^{\log x} = x$	$e^{\ln x} = x$