

# Warmup:

Simplify. Your answer should contain only positive exponents.

$$\underbrace{(2ba^3)^{-3}} = 2^{-3} b^{-3} a^{-9}$$

$$(2a^{-4}b^3)^{-4} = 2^{-4} a^{16} b^{-12}$$

$$= \frac{1}{2^3 b^3 a^9} = \frac{1}{8b^3a^9}$$

$$= \frac{a^{16}}{2^4 b^{12}}$$

$$\frac{1}{(2ba^3)^3} = \frac{1}{2^3 b^3 a^9} = \frac{1}{8b^3a^9}$$

$$= \frac{a^{16}}{16b^{12}}$$

# What is a logarithm? How can I convert exponentials to logs?

$$y = 2x + 3$$

$$y = x^2 + 4x + 3$$

$$y = 2(3)^x$$

$$y = a \cdot b^x$$

$$y = 2^x$$

$$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$$

$$2^{-1} = \frac{1}{2^1} = \frac{1}{2}$$

$$2^0 = 1$$

$$2^1 = 2$$

$$2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

x	y
-3	$\frac{1}{1000}$
-2	$\frac{1}{4}$
-1	$\frac{1}{2}$
0	1
1	2
2	4
3	8
4	16

## Converting between Exponents & Logarithms

- ♦  $\text{BASE}^{\text{EXPONENT}} = \text{POWER}$
- ♦  $4^2 = 16$
- ♦ 4 is the base. 2 is the exponent.  
16 is the power.
- ♦ As a logarithm,  
 $\log_{\text{BASE}} \text{POWER} = \text{EXPONENT}$
- ♦  $\log_4 16 = 2$

$$a^b = x$$

exp

$$4^2 = 16$$

logarithm

$$\log_4 16 = 2$$

$$\log_7 49 = 2 \quad 7^2 = 49$$

$$10^2 = 100$$

$$\log_{10} 100 = 2$$

$$\log \text{ base } 10 \text{ of } 100 = 2$$

## What is a logarithm? How can I convert exponentials to logs?

### Writing Exponential form to Logarithmic form

First we must learn how to read logarithmic form:

The expression  $\log_b y$  is read as "log of base b of y"  
Examples:

$$\log_5 125$$

log of base 5 of 125

$$\log_6 36$$

log of base 6 of 36

$$\log_3 \frac{1}{5}$$

log of base 3 of 1/5

$$\begin{aligned} 5^1 &= 5 \\ 5^2 &= 25 \\ 5^3 &= 125 \end{aligned}$$

$$3^{\textcircled{?}} = 125$$

$$3^{?} = \frac{1}{5}$$

$$3^x = 3^{-2}$$

$x = -2$

# What is a logarithm? How can I convert exponentials to logs?

$$a^x = x$$

$$\log_a x = b$$

## Rewriting Logarithmic Equations

exp:

$$a^b = x$$

log:

$$\log_a x = b$$

Exponential Form

$$2^{-1} = \frac{1}{2}$$

$$2^4 = 16$$

$$5^x = 125$$

$$6^y = 36$$

$$3^x = \frac{1}{9}$$

$$3^2 = 9$$

$$3^{-2} = \frac{1}{3^2}$$

$$= \frac{1}{9}$$

Logarithmic Form

$$\log_2 \frac{1}{2} = -1$$

$$\log_2 16 = 4$$

$$\star \log_5 125 = x$$

$$\log_6 36 = y$$

$$\log_3 \frac{1}{9} = x$$

$$\log_a \frac{1}{a} = -1$$

$$x = 3$$

$$y = 2$$

$$x = -2$$



# What is a logarithm? How can I convert exponentials to logs?

## Simplifying Logarithmic Equations

Logarithmic Form	Exponential Form	Solution
$\log_4 16 = x$	$4^x = 16$	$x = 2$
$\log_3 1 = x$	$3^x = 1$	$x = 0$
$\log_2 \frac{1}{8} = x$	$2^x = \frac{1}{8}$	$x = -3$
$\log_4 \sqrt{2} = x$	$4^x = \sqrt{2}$	$x = \frac{1}{4}$ ☆
$\log_{27} \sqrt{3} = x$	$27^x = \sqrt{3}$	$x = \frac{1}{6}$



## What is a logarithm? How can I convert exponentials to logs?

### EXAMPLE 1 Evaluate logarithms

Evaluate (solve) the logarithm.

a.  $\log_4 64$

$$\log_4 64 = x \quad 4^x = 64$$

#### SOLUTION

To help you find the value of  $\log_b y$ , ask yourself what power of  $b$  gives you  $y$ .

a. 4 to what power gives 64?  $4^3 = 64$ , so  $\log_4 64 = 3$ .

b.  $\log_5 0.2$

$$\log_5 \frac{1}{5}$$

b. 5 to what power gives 0.2?  $5^{-1} = 0.2$ , so  $\log_5 0.2 = -1$ .

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

$$5^{-1} = \frac{1}{5}$$

$$5^0 = 1$$

$$5^1 = 5$$

$$5^2 = 25$$

$$5^3 = 125$$

# How can I evaluate a logarithm?

$$5^{-x} = 125$$

Evaluate (solve) the logarithm.

c.  $\log_{1/5} 125$        $\frac{1}{5}^x = 125$

## SOLUTION

To help you find the value of  $\log_b y$ , ask yourself what power of  $b$  gives you  $y$ .

c.  $\frac{1}{5}$  to what power gives 125?  $\left(\frac{1}{5}\right)^{-3} = 125$ , so  $\log_{1/5} 125 = -3$ .

d.  $\log_{36} 6$        $36^x = 6$

$$36^{1/2} = 6, \text{ so } \log_{36} 6 = \frac{1}{2}.$$



# Log Worksheet #1