Sec. 4.4 Evaluate Logarithms

Let $b>0$, $y>0$, $b\neq 1$

The logarithm of y with base b is

$\log_b y = x$ if and only if $b^x = y$

LOG says "What is the exponent of b that produces y?"

Rewrite logarithmic equations

	Logarithmic form $\log_b y = x$	Exponential form $b^x = y$
a.	$\log_2 16 = 4$	$2^4 = 16$
b.	$\log_4 1 = 0$	$4^0 = 1$
c.	$\log_9 9^1 = 1$	$9^1 = 9$
d.	$\log_{\frac{1}{5}} 25 = -2$	$\left(\frac{1}{5}\right)^{-2} = 25$

Practice:

Rewrite in exponential form:

a. $\log_5 125 = 3$ $5^3 = 125$

b. $\log_{11} 11 = 1$ $11^1 = 11$

c. $\log_8 1 = 0$ $8^0 = 1$

d. $\log_{1/3} 27 = -3$ $\left(\frac{1}{3}\right)^{-3} = 27$

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Evaluate logarithms

a. $\log_3 81 = 4$

$9 \cdot 9$

$3 \cdot 3 \cdot 3 \cdot 3$

$\log_3 3^4 = 4$

b. $\log_4 0.25 = \log_4 \frac{1}{4} = \log_4 4^{-1} = -1$

c. $\log_{\frac{1}{6}} 36 = \log_{\frac{1}{6}} 6^2 = \log_{\frac{1}{6}} \left(\frac{1}{6}\right)^{-2} = -2$

$\log_{\frac{1}{6}} 36 = -2$

d. $\log_{27} 3$

$\log_{27} 3 = \frac{1}{3}$

Practice:

a. $\log_6 216 = 3$

b. $\log_5 \frac{1}{25} = -2$ $\log_5 \frac{1}{5^2} = \log_5 5^{-2} = -2$

c. $\log_{\frac{1}{2}} 64 = -6$ $\log_{\frac{1}{2}} 2^6 = \log_{\frac{1}{2}} \left(\frac{1}{2}\right)^{-6} = -6$

d. $\log_{32} 2 = \frac{1}{5}$

$\log_{32} 2 = \log_{32} \sqrt[5]{32} = \log_{32} 32^{\frac{1}{5}} = \frac{1}{5}$

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Use inverse properties $\log_3 9 = p = 2$ $3^p = 9$

$\log_a a^x = x$ $a^{\log_a x} = x$

$\log_3 3^2 = 2$ Ex: $3^{\log_3 9} = 9$

$\log_3 9 = 2$ $3^2 = 9$

* Note $\log \rightarrow \log_{10}$ common logarithm

$\ln \rightarrow \log_e$ natural logarithm

Examples:

Simplify

a. $10^{\log_{10} 9.6} = 9.6$

b. $\log_7 49^{2x} = \log_7 (7^2)^{2x}$

$= \log_7 7^{4x} = 4x$

c. $e^{\ln 4.5} = e^{\log_e 4.5} = 4.5$

d. $\ln e^{-2x} = -2x$

e. $\log_4 4^{7x} = 7x$

f. $10^{\log 3x} = 3x$

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Sec. 4.5 Properties of logarithms

Let b, m, and n be positive numbers such that $b \neq 1$.

Product Property: $\log_b mn = \log_b m + \log_b n$

$\log_2 8 \cdot 4 = \log_2 8 + \log_2 4$

$\log_2 32 = 5$ ← $3 + 2$

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Quotient Property: $\log_b \frac{m}{n} = \log_b m - \log_b n$

Power Property: $\log_b m^n = n \cdot \log_b m$

15. $\log_{16} \frac{1}{4} = \log_{16} 4^{-1} = \log_{16} \sqrt{16}^{-1}$

$\log_{16} 16^{-\frac{1}{2}} = -\frac{1}{2}$

16. $\log_{\frac{1}{4}} 16$

$\log_{\frac{1}{4}} 4^2 = \log_{\frac{1}{4}} \left(\frac{1}{4}\right)^{-2} = -2$

Jan 8-8:55 AM

57 $2000 4% CC

P .04 = r

t = 5 yrs

$$A = Pe^{rt}$$

$$A = 2000e^{0.04(5)}$$

$$A = \$2442.81$$

58. $1114.17

31.

$200 dec. 25% = r

$y = a(1-r)^t$

$y = 200(1-.25)^t$

$y = 200(.75)^t$

$y = 200(.75)^3$

$\approx \$84.38$

$\frac{100}{200} = \frac{200(.75)^t}{200}$

$\frac{1}{2} = .75^t$