

**Properties of Logarithms**

Textbook 8.3

Logarithms are the inverse of exponential functions. The expression  $\log_b x$  is read "log base  $b$  of  $x$ ".  $b$  is the base of the log, and it has the restrictions:  $b > 0$  and  $b \neq 1$ .  $x$  is called the argument of the log.

$y = \log_b x$  means  $b^y = x$

Logs can have any base, but frequently-used bases are 10 and  $e$ . Common log has base 10. If the log has no specified base, then it is assumed to be a common log, i.e.  $\log x = \log_{10} x$ . Natural Log has base  $e$ . The notation  $\ln$  is used for natural log, i.e.  $\ln x = \log_e x$ .

$y = \log x$  means  $10^y = x$

$y = \ln x$  means  $e^y = x$

Examples: Write the log equations in exponential form.

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

B.  $\log_6 \left(\frac{1}{36}\right) = -2$

C.  $\ln 5 = 1.609$        $e^{1.609} = 5$

D.  $\log 10,000 = 4$

$10^4 = 10,000$

You Try:

E.  $\log_2 32 = 5$        $2^5 = 32$

F.  $\ln 20.085 = 3$        $e^3 = 20.085$

Examples: Write the exponential equations in log form.

G.  $7^3 = 343$        $\log_7 343 = 3$

H.  $3^{-4} = \frac{1}{81}$        $\log_3 \frac{1}{81} = -4$

I.  $e^3 = 20.086$        $\ln 20.086 = 3$

J.  $10^6 = 1,000,000$        $\log 1,000,000 = 6$

You Try:

K.  $3^5 = 243$        $\log_3 243 = 5$

L.  $10^3 = 1,000$        $\log 1,000 = 3$

You can evaluate logarithms mentally by asking the question, "The base to what power equals the argument?"

Examples: Evaluate without a calculator.

M.  $\log_6 216 = 3$

N.  $\log_8 \left(\frac{1}{8}\right) = -3$

O.  $\log_{25} 5 = \frac{1}{2}$

Name: \_\_\_\_\_

**Properties of Logarithms**

Write the log equations in exponential form.

1.  $\log_7 64 = 3$

2.  $\log_7 \left(\frac{1}{49}\right) = -2$

3.  $\ln 18 = 0 = \frac{1}{2}$

4.  $\ln 20.086 = 3$

5.  $\log_5 81 = 4$

6.  $\ln 18 = 2 = \frac{1}{2}$

7.  $\ln 1 = 0$

8.  $\log 10 = 1$

9.  $\ln \left(\frac{1}{1000}\right) = -3$

Write the exponential equations in log form.

10.  $5^3 = 125$

11.  $8^2 = 64$

12.  $e^7 = 1096.633$

13.  $81^{\frac{1}{2}} = 3$

14.  $w^w = w$

15.  $e^x = 4$

Evaluate without a calculator.

16.  $\log_5 36$

17.  $\log_5 16$

18.  $\log \left(\frac{1}{100}\right)$

19.  $\log_3 3$

20.  $\log_8 2$

21.  $\log_5 1$

22.  $\ln e^2$

23.  $\log_9 81$

24.  $\log_3 3^2$

Evaluate using a calculator. Round to 3 decimal places.

25.  $\log_{10} 345$

26.  $\log \left(\frac{4}{5}\right)$

27.  $\ln 32$

28.  $\log 12.5$

29.  $\ln 18.42$

30.  $\log_{10} 145$