~~P9~~

P 10 ~~3.2~~ Logarithmic Functions

A Logarithmic Function is an inverse function to an Exponential Function, therefore logarithms are exponents

Relating Logarithms to exponents

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

Example 1 Evaluating Logarithms

a. $\log_3 81 = x$

$3^x = 81$ $x = 4$

b. $\log_5 \sqrt{5}$

$5^x = \sqrt{5}$ $x = \frac{1}{2}$

c. $\log_7 \frac{1}{49}$

$7^x = \frac{1}{49}$ $x = -2$

d. $\log_2 2$

$2^x = 1$ $x = 0$

Basic Logarithmic Properties $b > 0, b \neq 1$

$\log_b 1 = 0$ $\log_b b = 1$ $\log_b b^x = x$ $b^{\log_b x} = x, x > 0$

Example 2 Applying Logarithmic Properties

a. $\log_5 125$

$\log_5 5^3 = 3$

b. $12^{\log_{12} 4.7} = 4.7$

c. $\log_9 81$

$\log_9 9^2 = 2$

d. $3^{\log_3 1} = 1$

Common Logarithms logarithms with a base of 10

$\log 1 = 0$ $\log 10 = 1$ $\log 10^x = x$ $10^{\log x} = x, x > 0$

Example 3 Evaluating Common Logarithms

a. $\log 0.001$

-3

b. $10^{\log 5}$

5

c. $\log 26$ $= 1.415$ d. $\log(-5)$ not real

Natural Logarithms logarithms with a base of e $e = 2.71828\ldots$
(natural logarithms are written as ln)

Basic Properties of natural logarithms

$\ln 1 = 0$ $\ln e = 1$ $\ln e^x = x$ $e^{\ln x} = x, x > 0$

Example 4 Evaluating Natural Logarithms

a. $\ln e^{0.73}$ $= 0.73$ b. $\ln(-5)$ not real

c. $e^{\ln 6}$ $= 6$ d. $\ln 4$ $= 1.386$

Evaluate each expression. (Examples 1–4)

1. $\log_2 8$
2. $\log_{10} 10$
3. $\log_6 \frac{1}{36}$
4. $4^{\log_4 1}$
5. $\log_{11} 121$
6. $\log_2 2^3$
7. $\log_{\sqrt{9}} 81$
8. $\log 0.01$
9. $\log 42$
10. $\log_x x^2$
11. $\log 5275$
12. $\ln e^{-14}$
13. $3 \ln e^4$
14. $\ln(5 - \sqrt{6})$
15. $\log_{36} \sqrt[5]{6}$
16. $4 \ln(7 - \sqrt{2})$
17. $\log 635$
18. $\frac{\ln 2}{\ln 7}$
19. $\ln(-6)$
20. $\ln\left(\frac{1}{e^{12}}\right)$
21. $\ln 8$
22. $\log_{\sqrt{4}} 64$
23. $\frac{7}{\ln e}$
24. $\log 1000$