

# 7-3

## Logarithmic Functions as Inverses

### Content Standards

**F.BF.4.a** Solve an equation of the form  $f(x) = c$  for a simple function  $f$  that has an inverse and write ... the inverse.

**F.IF.7.e** Graph exponential ... functions, showing intercepts and end behavior ...

Also **A.SSE.1.b**, **F.IF.8**, **F.IF.9**

**Objectives** To write and evaluate logarithmic expressions  
To graph logarithmic functions

*log is an exponent*

Example:  $2^3 = 8$      $\log_2 8 = 3$   
 $2^x = 10$      $\log_2 10 = 3.3$   
 $2^4 = 16$      $\log_2 16 = 4$

Exponential Form	VS	Logarithmic Form
$2^3 = 8$		$\log_2 8 = 3$

For any positive base  $b$ , where  $b \neq 1$ :  $b^x = y$  if and only if  $x = \log_b y$

### Examples

Write each equation in logarithmic form.

1.  $5^3 = 125$      $\log_5 125 = 3$

2.  $\left(\frac{1}{2}\right)^{-3} = 8$      $\log_{\frac{1}{2}} 8 = -3$

Write each equation in exponential form.

3.  $\log_3 81 = 4$      $3^4 = 81$

4.  $\log_4 \frac{1}{16} = -2$      $4^{-2} = \frac{1}{16}$

You can evaluate logarithms with a base of 10 by using the log key on your calculator.

Solve each equation for  $x$ . Round your answers to the nearest hundredth.

5.  $10^x = 85$      $\log_{10} 85 = x$   
1.929

6.  $10^x = \frac{1}{109}$      $\log_{10} \frac{1}{109} = x$   
-2.04

*log<sub>10</sub> 100 = 2*  
*10<sup>2</sup> = 100*

**One-to One Property of Exponent**  
 If  $b^x = b^y$  then  $x = y$

Find the value of  $y$  in each equation. **DO NOT USE A CALCULATOR!!!!**

7.  $4 = \log_3 v$   
 $3^4 = v$   
 $v = 81$

8.  $5 = \log_v 32$   
 $v^5 = 32$   
 $v = 2$

9.  $\frac{1}{2} = \log_9 v$   
 $9^{1/2} = v$   
 $\sqrt{9} = v$   
 $v = 3$

10.  $-2 = \log_6 v$   
 $6^{-2} = v$   
 $\frac{1}{36} = v$

11.  $\log_v 4 = \frac{1}{2}$   
 $v^{1/2} = 4$   
 $v = 16$

12.  $v = \log_{125} 5$   
 $125^v = 5$   
 $\sqrt[3]{125} = 5$   
 $v = \frac{1}{3}$

13.  $\log_{10} 0.001 = v$   
 $10^v = .001$   
 $v = -3$

14.  $\log_4 \sqrt{2} = v$   
 $4^v = \sqrt{2}$   
 $2^{2v} = 2^{1/2}$   
 $v = \frac{1}{4}$



# Practice and Problem-Solving Exercises



Practice

Write each equation in logarithmic form.

See Problem 1.

12.  $49 = 7^2$

13.  $10^3 = 1000$

14.  $625 = 5^4$

15.  $\frac{1}{10} = 10^{-1}$

16.  $8^2 = 64$

17.  $4 = \left(\frac{1}{2}\right)^{-2}$

18.  $\left(\frac{1}{3}\right)^3 = \frac{1}{27}$

19.  $10^{-2} = 0.01$

Evaluate each logarithm.

See Problem 2.

20.  $\log_2 16 = x$

21.  $\log_4 2$

22.  $\log_8 8$

23.  $\log_4 8$

$2^x = 16$   
 $x = 4$

24.  $\log_2 8$

25.  $\log_{49} 7$

26.  $\log_5 (-25)$

27.  $\log_3 9$

NO SOL.

28.  $\log_2 2^5$

29.  $\log_{\frac{1}{3}} \frac{1}{2}$

30.  $\log 10,000$

31.  $\log_5 125$

Write each equation in exponential form.

46.  $\log_2 128 = 7$

47.  $\log 0.0001 = -4$

48.  $\log_6 6 = 1$

49.  $\log_4 1 = 0$

50.  $\log_7 16,807 = 5$

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

52.  $\log_3 \frac{1}{9} = -2$

53.  $\log 10 = 1$