What is a logarithm?

An Exponent

What is the value of x?

$$2^x = 32$$

$2^5 = 32$

$\frac{\log(35)}{\log(2)}$

What do you do if it is does not have a whole number for a power?

$$2^x = 35$$

$\log_2 2^x = \log_2 35$

$x = 5.129$

This is why we need logarithms

Solve for x for each of the following

$3^x = 27$

$x = 3$

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

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

$x = -1$

$6^x = \frac{1}{36}$ $x = -2$

$7^x = 30$ $\log_7 30$

$x = 1.748$

Notes: Logarithms

Logarithms written as follows:

$$\log_b y = x$$

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

Converting between exponential form and logarithmic form.

Example: Convert into logarithmic form

$$2^3 = 8$$

$\log_2 8 = 3$

Converting between exponential form and logarithmic form.

Example: Convert into logarithmic form

$$5^2 = 25$$

$\log_5 25 = 2$

Converting between exponential form and logarithmic form.

Example: Convert into exponential form

$$\log_{19} 361 = 2$$

$19^2 = 361$

Converting between exponential form and logarithmic form.

Example: Convert into exponential form

$$\log_8 \frac{1}{64} = -2$$

$8^{-2} = \frac{1}{64}$

Essential Understandings:

1. A logarithm undoes a base, and a base undoes a logarithm.

2. Specific logarithms undo specific bases.

3. Logarithms help solve for exponents.

Evaluate each expression WITHOUT using a calculator.

$$\log_4 16$$

$4^x = 16$

$x = 2$

Evaluate each expression WITHOUT using a calculator.

$\log_7 \frac{1}{49}$ $= -2$

$\log_3 y = 3$ 3^3 $y = 27$

$\log_5 y = 2$ $y = 25$

$\log_x 9 = 2$ $x^2 = 9$ $3^2 = 9$

$\log_x 81 = 4$ $x^4 = 81$ $3^4 = 81$

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

Find the inverse of each function.

$$y = \log_4 x - 7$$

$x = \log_4 y - 7$

$x + 7 = \log_4 y$

$4^{x+7} = y$

$f^{-1}(x) = 4^{x+7}$

Find the inverse of each function.

$$y = \log_4 (x + 9)$$

$x = \log_4(y+9)$

$4^x = y + 9$

$4^x - 9 = f^{-1}(x)$

$$y = 8^x - 5$$

$x = 8^y - 5$

$x + 5 = 8^y$

$\log_8(x+5) = \log_8 8^y$

$\log_8(x+5) = y$

$\log_8(x+5) = f^{-1}(x)$

Find the inverse of each function.

$y = e^{x-2}$

$x = e^{y-2}$

$\ln x = \ln e^{y-2}$

$\ln x = y - 2$

$\ln x + 2 = f^{-1}(x)$

$y = \ln_e(x+4)$

$x = \ln_e(y+4)$

$e^x = y + 4$

$e^x - 4 = f^{-1}(x)$

Class Work / Homework:

EXPONENTIAL FORM **Rewrite the equation in exponential form.**

3. $\log_4 16 = 2$ **4.** $\log_7 343 = 3$ **5.** $\log_6 \frac{1}{36} = -2$ **6.** $\log_{64} 1 = 0$

7. ERROR ANALYSIS *Describe* and correct the error in rewriting the equation $2^{-3} = \frac{1}{8}$ in logarithmic form.

$\log_2 -3 = \frac{1}{8}$ ✗

EVALUATING LOGARITHMS **Evaluate the logarithm without using a calculator.**

8. $\log_{15} 15$ **9.** $\log_7 49$ **10.** $\log_6 216$ **11.** $\log_2 64$

12. $\log_9 1$ **13.** $\log_{1/2} 8$ **14.** $\log_3 \frac{1}{27}$ **15.** $\log_{16} \frac{1}{4}$

16. $\log_{1/4} 16$ **17.** $\log_8 512$ **18.** $\log_5 625$ **19.** $\log_{11} 121$

FINDING INVERSES **Find the inverse of the function.**

37. $y = \log_8 x$ **38.** $y = 7^x$ **39.** $y = (0.4)^x$ **40.** $y = \log_{1/2} x$

41. $y = e^{x+2}$ **42.** $y = 2^x - 3$ **43.** $y = \ln(x + 1)$ **44.** $y = 6 + \log x$

Summary

1. Rewrite the following equation in logarithmic form.

$$4^{1/2} = 2$$

2. Rewrite the following equation in exponential form.

$$\log_5 125 = 3$$

3. Evaluate without a calculator.

$$\log_{125} 5$$