Lesson 2.3 - The Basics of Logarithms

Learning Objective: SWBAT:

1. Describe the relationship between an Exponential function and a Logarithmic Function
2. Convert an exponential equation into logarithmic form and vice versa.

What is a Logarithm?

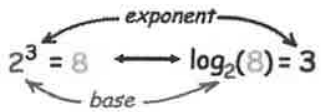
- A logarithm is the INVERSE of an exponential function
- A logarithm answers the question:
  - > "What power would we raise a given base to in order to equal another given number?"
  - > As an example, for the equation $3^x = 15$ logarithms will help us determine the power needed to raise the base 3 so that it equals 15.
- The "parent" equation of logarithmic functions is $f(x) = \log_b x$ where "b" the base of the corresponding exponential equation inverse.
- **Logarithms create a way for us to solve for an exponent**
- We will explore graphs and transformations of logarithms in 2.4

Exponential and Logarithmic Form

- The example below, outlines the relationship between the standard forms of exponential and logarithmic equations

Example 1 - Rewrite the exponential expression $2^3 = 8$ in Logarithmic form:

a logarithm answers a question like this: $2^? = 8$



In this way $2^3 = 8$ → **exponential form**

$\log_2(8) = 3$ → **logarithmic form**

Your Turn #1: Rewrite the following expressions in Logarithmic form:

1. $3^4 = 81$ — $\log_3 81 = 4$
2. $2^6 = 64$ — $\log_2 64 = 6$
3. $5^{-2} = \frac{1}{25}$ — $\log_5 \frac{1}{25} = -2$
4. $8^{\frac{1}{3}} = 2$ — $\log_8 2 = \frac{1}{3}$

Your Turn #2: Re-write the following expressions in Exponential form:

7. $\log_7 49 = 2$ — $7^2 = 49$
8. $\log_{10} 10{,}000 = 4$ — $10^4 = 10{,}000$
9. $\log_2 32 = 5$ — $2^5 = 32$
10. $\log_{25} 5 = \frac{1}{2}$ — $25^{1/2} = 5$

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Practice

Rewrite each equation in exponential form.

1) $\log_6 36 = 2$

$6^2 = 36$

2) $\log_{289} 17 = \frac{1}{2}$

$289^{1/2} = 17$

3) $\log_{14} \frac{1}{196} = -2$

$14^{-2} = 196$

4) $\log_3 81 = 4$

$3^4 = 81$

Rewrite each equation in logarithmic form.

5) $64^{\frac{1}{2}} = 8$

$\log_{64} 8 = \frac{1}{2}$

6) $12^2 = 144$

$\log_{12} 144 = 2$

7) $9^{-2} = \frac{1}{81}$ $\log_9 81 = -2$

8) $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$ $\log_{\frac{1}{2}} \frac{1}{144} = 2$

Rewrite each equation in exponential form.

9) $\log_u \frac{15}{16} = v$

$u^v = \frac{15}{16}$

10) $\log_v u = 4$

$v^4 = u$

11) $\log_{\frac{7}{4}} x = y$

$\left(\frac{7}{4}\right)^y = x$

12) $\log_2 v = u$

$2^u = v$

13) $\log_u v = -16$

$u^{-16} = v$

14) $\log_y x = -8$

$y^{-8} = x$

Rewrite each equation in logarithmic form.

15) $u^{-14} = v$ $\log_u v = -14$

16) $8^b = a$ $\log_8 a = b$

19) $9^y = x$

$\log_9 x = y$

20) $b^a = 123$

$\log_b 123 = a$