3.1 Intro to Logarithms

SWBAT simplify and solve simple logarithm equations.

A logarithm is just a special way to ask a specific question.

"log base b of a equals x"

$$\log_b a = x$$

THE QUESTION: What **exponent** is required to go from a **base "b"** to reach a value of **"a"**?

Note: is a log has no base written, it is implied that the base is 10.

Exponential Form	Logarithmic Form
$(\text{Base})^{\text{exponent}} = \text{Answer}$	$\log_{\text{Base}} \text{Answer} = \text{exponent}$
Example: $2^3 = 8$	Example: $\log_2 8 = 3$

SWOOSH Method

Used to convert between exponential form and logarithmic form (and vice versa)!

Logarithmic Form:	$\log_4 64 = y$	$\log_{343} 7 = x$	$\log_u \frac{15}{16} = v$	$\log_{\frac{1}{5}} y = x$	$\log_{\frac{7}{4}} x = y$	$\log_b 123 = a$
Exponential Form:	$4^y = 64$	$343^x = 7$	$u^v = \frac{15}{16}$	$\left(\frac{1}{5}\right)^x = y$	$\frac{7}{4}^y = x$	$b^a = 123$

Evaluating Logarithms

Used when evaluating a logarithm that is not already in base 10. Be sure to write each out, and then evaluate using your calculator and the LOG button!

$$\log_b a = \frac{\log a}{\log b}$$

Example:	$\log_4 64$	$\log_3 \frac{1}{243}$	$\log_2 4$	$\log_2 16$	$\log_6 \frac{1}{216}$	$\log_5 125$
Solution:	3	-5	2	4	-3	3

Solving using Simple Logarithms

SWOOSH Method		Evaluating	Log = Log
$\text{Log}_{\#}(x) = \#$	$b^x = \#$	$\text{Log}_{\#}(\#) = x$	$\text{Log}(x) = \text{Log}(x)$
Use when a variable is attached to the logarithm.	Use when a base is raised to an unknown and equals a number.	Use when a constant is attached to the logarithm	Use when <u>one</u> log is = to <u>one</u> other log. Logs must have the same base in order to cancel.

Example 1: Solve each of the following for x.

a) $\text{Log}_2(2x + 1) = 4$

$2^4 = 2x+1$

$16 = 2x+1$

$15 = 2x$

$x = 7.5$

b) $\text{Log}_5 125 = x^2 - 2x$

$3 = x^2 - 2x$

$x^2 - 2x - 3 = 0$

$(x-3)(x+1) = 0$

$x = 3 \quad x = -1$

c) $5^{x-2} = 32$

$\log_5 32 = x - 2$

$2.15 = x - 2$

$x = 4.15$

d) $\text{Log}_4(17x - 4) = 3$

$4^3 = 17x - 4$

$64 = 17x - 4$

$68 = 17x$

$x = 4$

e) $3^{x+6} = 12$

$\log_3 12 = x + 6$

$2.26 = x + 6$

$x = -3.74$

f) $\text{Log}_2 16 = x^2$

$4 = x^2$

$x = \pm 2$

g) $2(4)^x = 14$

$4^x = 7$

$\log_4 7 = x$

$x = 1.4$

h) $\text{Log}(2x - 5) = 2$

$10^2 = 2x - 5$

$100 = 2x - 5$

$105 = 2x$

$x = 52.5$

i) $\text{Log}_5 10 = x + 6$

$1.43 = x + 6$

$x = -4.57$

Example 2: Solve by canceling the logs!

a) $\log_4(3x-1) = \log_4(2x+3)$

$3x - 1 = 2x + 3$

$x - 1 = 3$

$x = 4$

b) $\log_2(x-6) = \log_2(2x+2)$

$x - 6 = 2x + 2$

$-1x - 6 = 2$

$-1x = 8$

$x = -8$ Answer makes log negative!

No Solution.