

## Exponential Functions 5 - Intro to Logarithmic Functions

Standards: F-LE.4, F-BF.5

### Learning Targets:

What is a logarithmic function?

How do you rewrite it in exponential form?

10HW: Exp 5 #1-9 (odds), 10-14, 15, 17

$$2^2 = 4$$

$$2^3 = 8$$

so if  $2^x = 6$  what is  $x$ ?

$$2^{2.5} = 5.7$$

$$2^{2.6} = 6.06$$

$$2^{2.55} = 5.85$$

$$2^2 < 6 < 2^3 \quad \text{so} \quad 2 < x < 3$$

but what is it exactly?

(erase to show)

**Logarithm with Base b**Let  $b$  &  $y$  be positive numbers,  $b \neq 1$ 

The logarithm of  $y$  with base  $b$  is denoted by  $\log_b y$   
and defined as follows:

"log base  $b$  of  $y$ "

$$\log_b y = x \quad \text{iff} \quad b^x = y$$

logarithmic form                  exponential form  
are equivalent

**Ex1: Rewrite into exponential form.**  $\log_b y = x \rightarrow b^x = y$

a)  $\log_3 9 = 2$       $3^2 = 9$

\*b)  $\log_8 1 = 0$       $8^0 = 1$

c)  $\log_5 \left( \frac{1}{25} \right) = -2$       $5^{-2} = \frac{1}{25}$

\*d)  $\log_{10} 10 = 1$       $10^1 = 10$

e)  $\log_{1/2} 2 = -1$       $\left( \frac{1}{2} \right)^{-1} = 2$

**\*Special Logarithm Values**

Logarithm of 1 -----  $\log_b 1 = 0$

Logarithm of base b ----  $\log_b b = 1$

**Ex2:** Find the equivalent value missing in the table for either the Exponential or Log form:

Note: the first row has been completed for you.

Exponential Form	Log Form
$2^5 = 32$	$\log_2 32 = 5$
$4^3 = 64$	$\log_4 64 = 3$
$7^{1/2} = \sqrt{7}$	$\log_7 \sqrt{7} = 1/2$
$9^{3/2} = 27$	$\log_9 27 = \frac{3}{2}$
$3^{-4} = \frac{1}{81}$	$\log_3 (1/81) = -4$
$16^{-3/4} = 1/8$	$\log_{16} (\frac{1}{8}) = -\frac{3}{4}$

**Ex3: Evaluate**

$$\log_5 125 = 3 \quad \rightarrow \log_5 125 = x \rightarrow 5^x = 125$$

$$a) \log_5 125 = 3$$

$$\rightarrow 2^x = \frac{1}{8}$$

• whole #  $\leftrightarrow$  fraction  
- negative exp

$$b) \log_2 \frac{1}{8} = -3$$

$$\rightarrow \left(\frac{1}{4}\right)^x = 256$$

$$c) \log_{1/4} 256 = -4$$

• large whole #  
→ small whole #

$$\rightarrow 32^x = 2$$

$$d) \log_{32} 2 = \frac{1}{5}$$

- fraction exp

(erase to show)

**Common Logarithm**Logarithm with base 10

$$\log_{10} x = \underline{\log x}$$

**Natural Logarithm**Logarithm with base e

$$\log_e x = \underline{\ln x}$$

**Ex.4**

You can do these on the calculator

a)  $\log 7$   
 $= 0.84509\dots$

b)  $\ln 0.25$   
 $= -1.386294\dots$

Raise your hand if you can't do this.