Sec 8-3: Logarithms
(the inverse of exponential functions)

Exponential Function

$$y = b^x$$

The base of the Exponential Function

The exponent

Logarithmic Function

$$\log_b y = x$$

The base of the Logarithmic Function

Exponential Function:

How do you say this?

$$y = b^x$$

"y equals b to the power of x"

Logarithmic Function:

How do you say this?

$$\log_b y = x$$

"Log base b of y equals x"

Exponential Function:

$$y = b^x$$

Logarithmic Function:

$$\log_b y = x$$

"the base is the base"

The exponent is the answer

Exponential Equation

Range: Pos #'s

Domain: Any real number

$$y = b^x$$

$b>0,\ b\neq 1$

Logarithmic Equation

$$\log_b y = x$$

Range: Any real number

Domain: Pos #'s

b: $b>0,\ b\neq 1$

You can get any real number out of a logarithm

You can't have a negative # or zero as the base. You'll get an error message on the calculator.

You can't take the log of a negative # or zero. You'll get an error message on the calculator.

Get a whiteboard, marker, and rag

Rewrite each into logarithmic form.

the exponent is the answe

1. $12^x = 100$ $\qquad \log_{12} 100 = x$

the base is the base

2. $6^2 = x$

$\log_6 x = 2$

3. $x^5 = 20$

$\log_x 20 = 5$

Rewrite each into exponential form.

1. $LOG_5 8 = x$ $\qquad 5^x = 8$

2. $LOG_3 x = 12$ $\qquad 3^{12} = x$

3. $LOG_x 15 = 30$ $\qquad x^{30} = 15$

Write in Logarithmic Form: $\qquad 10^x = 125$

$\log_{10} 125 = x$

$LOG_{10}125$ → "LOG base 10 of 125" → LOG125

LOG_{10} is called the Common Logarithm and is written without the 10.

The button on the calculator $\boxed{\text{LOG}}$ is for Common Logarithms LOG_{10}

Evaluate each without a calculator:

(hint: think of each as an exponential)

1. $\log_4 1$

$4^? = 1$

$? = 1$

2. $\log_3 9$

$3^? = 9$

$? = 2$

3. $\log_7(7)$

$7^? = 7$

$? = 1$

4. $\log_{25} 5$

$25^? = 5$

$\sqrt{25} = 5$

$25^{1/2} = 5$

$? = 1/2$

5. $\log_6(6^4)$

$6^? = 6^4$

$? = 4$

6. $\log_2(0.5)$

$2^? = 0.5 \rightarrow 1/2$

$2^? = \frac{1}{2^1}$

$? = -1$

Using the graphing calculator to do logarithms

If it's $\log_{10}$ just use the $\boxed{\text{log}}$ button

log75 = $\boxed{\text{log}}\ \boxed{7}\ \boxed{5}\ \boxed{=}$ 1.875

This answer represents the power of 10 that will equal 75. In other words, the logarithm represents the following exponential: $10^x = 75$

$10^1 = 10$ and $10^2 = 100$. Since 75 is between these two values you should expect the exponent to be between 1 and 2.

If it's a base other than 10 such as: $\text{Log}_3 8$

Method 1:

Press $\boxed{\text{MATH}}$ then

arrow key down to A↓ logBASE(Or $\boxed{\text{MATH}}$ alpha $\boxed{\text{MATH}}$

Method 2:

Press alpha then $\boxed{\text{window}}$

choose 5: logBASE(

$\rightarrow \log_{\square}\square$

Find each to the nearest hundredth.

1. $\log_9 5$ = 0.73

2. $\log_2 20$ = 4.32

3. log300 = 2.48

Solve each equation. Round to the nearest tenth.

1. $10^x = 1500$

$\log 1500 = x$

$x = 3.2$

2. $\frac{4(10)^x}{4} = \frac{570}{4}$

$10^x = 142.5$

$\log 142.5 = x$

$x = 2.2$

3. $4^x = 44$

$\log_4 44 = x$

$x = 2.7$

4. $12^x = 3$

$\log_{12} 3 = x$

$x = 0.4$

What if your calculator only has common logarithm button LOG?

Property	**Change of Base Formula**
For any positive numbers, M, b, and c, with $b \neq 1$ and $c \neq 1$, $\log_b M = \frac{\log_c M}{\log_c b}$	Most of the time we'll use Common Log (base=10)

$$\log_5 30 = \frac{\log 30}{\log 5} = 2.11$$

Find each to the nearest hundredth using only common logarithms.

1. $\log_5 16 =$

$= \frac{\log 16}{\log 5}$

$= 1.72$

2. $\log_8 100 =$

$= \frac{\log 100}{\log 8}$

$= 2.21$

The value of a house has been decreasing 7.5% each year. The house was worth \$180,000 in 2001.

In how many years will the value fall to \$45,000? Round to the nearest hundredth.

$100 - 7.5$
$= 92.5\%$
$b = 0.925$

$$\frac{45{,}000}{180{,}000} = \frac{180{,}000(0.925)^x}{180{,}000}$$

$$0.25 = 0.925^x$$

$$x = \log_{0.925}(0.25) = 17.78 \text{ yrs}$$