TOPIC: INTRODUCTION TO LOGARITHMS

Logarithms Introduction

- The ______________ (inverse) operation of an exponential is taking the ***logarithm*** (log).
  - Logs and exponentials with the same **base** ________ each other.
  - A **log** gives us the **power** that some **base** must be raised to in order to equal a particular number.

Solving Polynomials	Solving Exponentials		
	(**A**)	(**B**)	
$x^3 = 216$	$2^x = 8$	$2^x = 216$	*(Exponential Form)*
$\sqrt[3]{x^3} = \sqrt[3]{216}$	$2 \times 2 \times 2 = 8$		
$x = \sqrt[3]{216}$	$x = 3$	$x = \log$	*(Logarithmic Form)* *"log base 2 of 216"*

- You will need to convert expressions between **exponential form** and **logarithmic form**.

Recall **Exponential Form**	New **Logarithmic Form**
Equals $3^x = 81$ *Log base of*	$\log_{\square} \square = \square$

Exponential Form	**Logarithmic Form**
$\square^{\square} = \square$	*Equals* $x = \log_4 64$ *To the power of*

EXAMPLE Write each log in exponential form & each exponential in log form.

(**A**)	(**B**)	(**C**)
$x = \log_5 800$	$\log_2 16 = 4$	$10^x = 4500$

- $\log_{10}$, known as the __________ log, can be written as just _____ and has its own calculator button: LOG

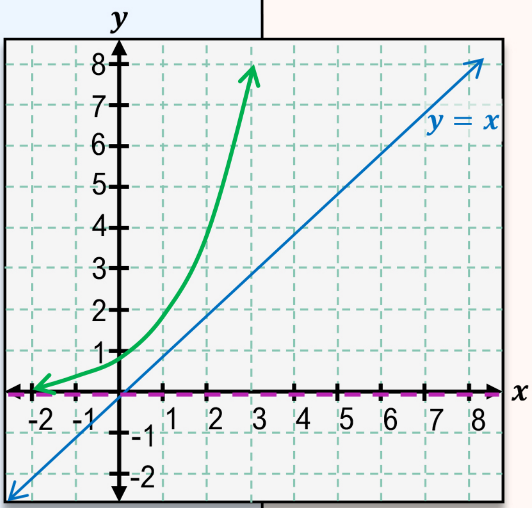
TOPIC: GRAPHING LOGARITHMIC FUNCTIONS

Graphs of Logarithmic Functions

- We can graph a logarithmic function using the fact that it is the ____________ of an exponential function.
  - $f(x) = \log_b x$ can be graphed by ______________ the graph of its inverse function, $y = b^x$ over ________.

Recall — **Exponential Functions**

x	$f(x) = 2^x$
-2	¼
-1	½
0	1
1	2
2	4
3	8



New — **Logarithmic Functions**

x	$f(x) = \log_2 x$
¼	
½	
1	
2	
4	
8	

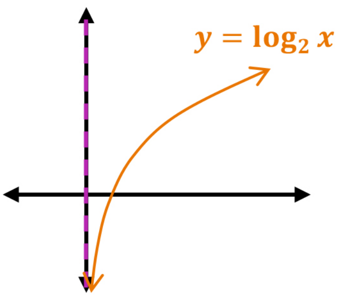
Domain: *always* $\mathbb{R}$ — Range: *always* ________

Range: depends on asymp.; $(0, \infty)$ — Domain: depends on __________; ________

Horizontal Asymptote at $y = 0$ → ____________ Asymptote at _______

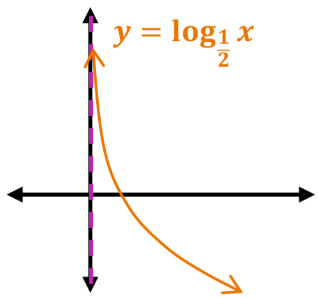
- Just like its inverse, the direction of the graph of $f(x) = \log_b x$ depends on ___.

$b > 1$



- Graph **[INCREASES | DECREASES]**

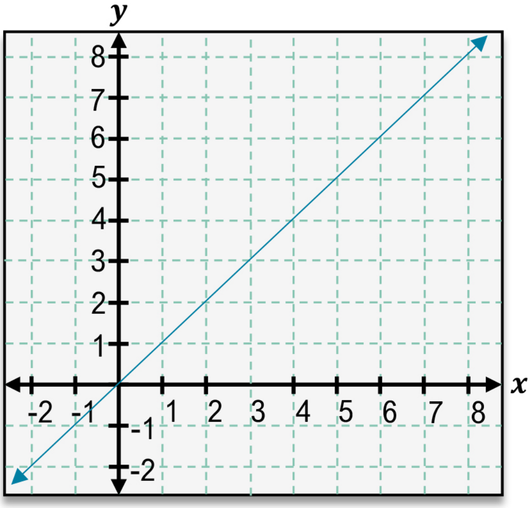
$0 < b < 1$



- Graph **[INCREASES | DECREASES]**

TOPIC: GRAPHING LOGARITHMIC FUNCTIONS

EXAMPLE: Graph $f(x) = 3^x$ and $g(x) = \log_3 x$ on the graph below. Determine the domain and range of each.



x	$f(x) = 3^x$
-2	
-1	
0	
1	
2	

Domain: __________

Range: __________

x	$g(x) = \log_3 x$

Domain: __________

Range: __________

TOPIC: INTRODUCTION TO LOGARITHMS

The Natural Log

- Besides the common log, ($\log_{10}$), another frequently occurring log is $\log$___, called the ______________ log.
  - The natural log is written as ______, and also has its own calculator button: LN

Equals

$b^x = M \Rightarrow \log_b M = x$

Log base of

$e^x = M \Rightarrow \log_{\square} M = x$

EXAMPLE Write each log in exponential form & each exponential in log form.

(***A***) $x = \ln 17$

(***B***) $e^x = 4$

TOPIC: INTRODUCTION TO LOGARITHMS

PRACTICE Convert the following logarithmic statement to its equivalent exponential form.

(***A***)

$$\log_4 x = 5$$

(***B***)

$$x = \log 9$$

PRACTICE Convert the following exponential statements to their equivalent logarithmic form.

(***A***)

$$3^x = 7$$

(***B***)

$$e^9 = x + 3$$