AGS 3 Name: ______________________ Period: _____ Date: __________

Notes 2.3 – Intro to Properties of Logarithms

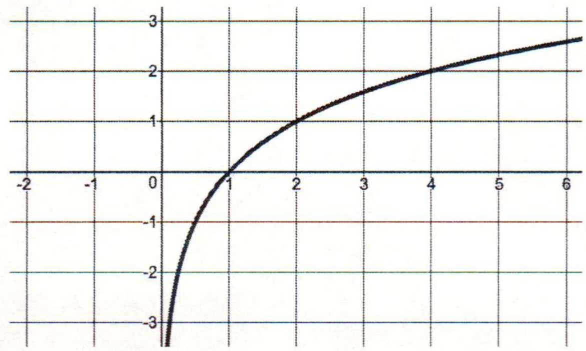
Warmup – Find the value for each logarithm.

1. $\log_5 625 =$ 4

2. $\log_5 0.2 =$ -1

3. $\log_x x^7 =$ 7

Answer the questions about each graph.



4. What is the value of x when $f(x) = 0$?

$x = 1$

What is the value of x when $f(x) = 1$

$x = 2$

What is the value of $f(x)$ when $x = 2$?

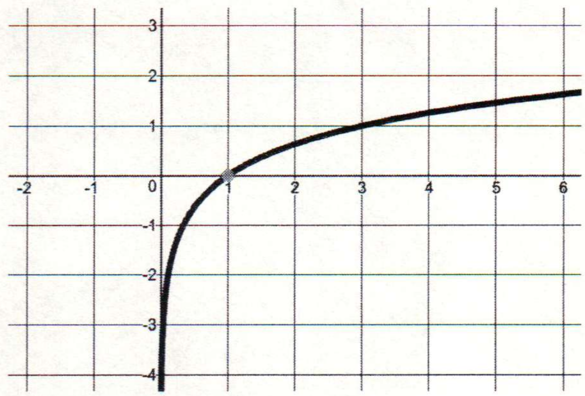
$y = 1$

What will be the value of x when $f(x) = 4$?

$x = 16$

What is the equation of the graph?

$f(x) = \log_2 x$



5. What is the value of x when $f(x) = 0$?

$x = 1$

What is the value of x when $f(x) = 1$

$x = 3$

What is the value of $f(x)$ when $x = 9$?

$y = 2$

What will be the value of x when $f(x) = 4$?

$x = 81$

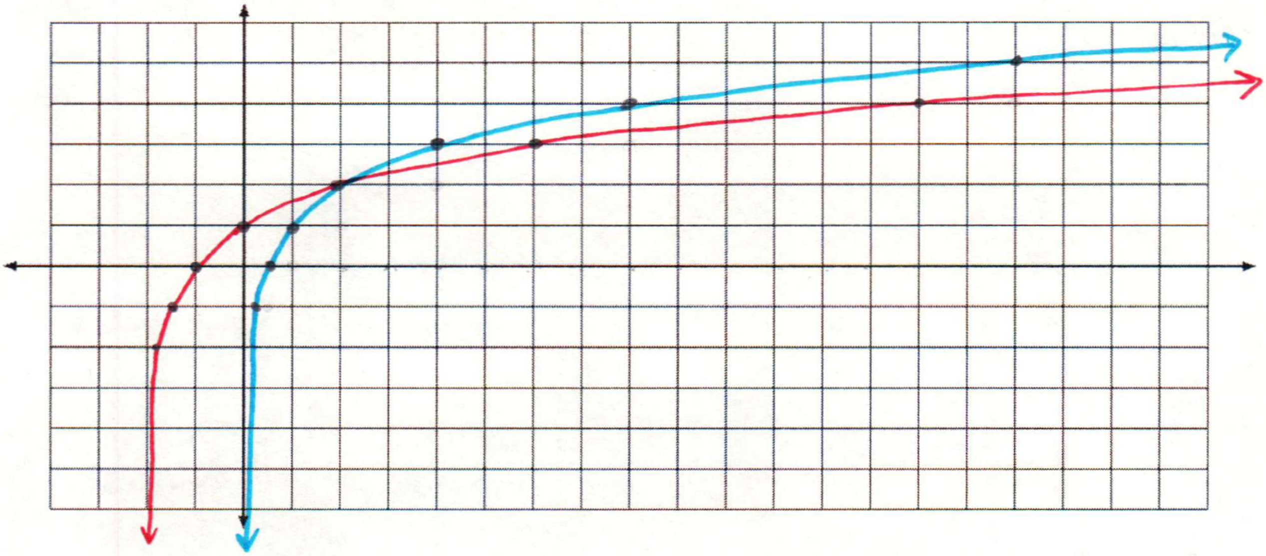
What is the equation of the graph?

$f(x) = \log_3 x$

Investigation

x	$-1\frac{1}{2}$	-1	0	2	6	14
y	-1	0	1	2	3	4

Graph the function $f(x) = \log_2(x+2)$



Can we distribute the logarithm across the parenthesis to be $\boxed{f(x) = \log_2 x + \log_2 2}$? How can we check if that works?

- make tables
- graph both

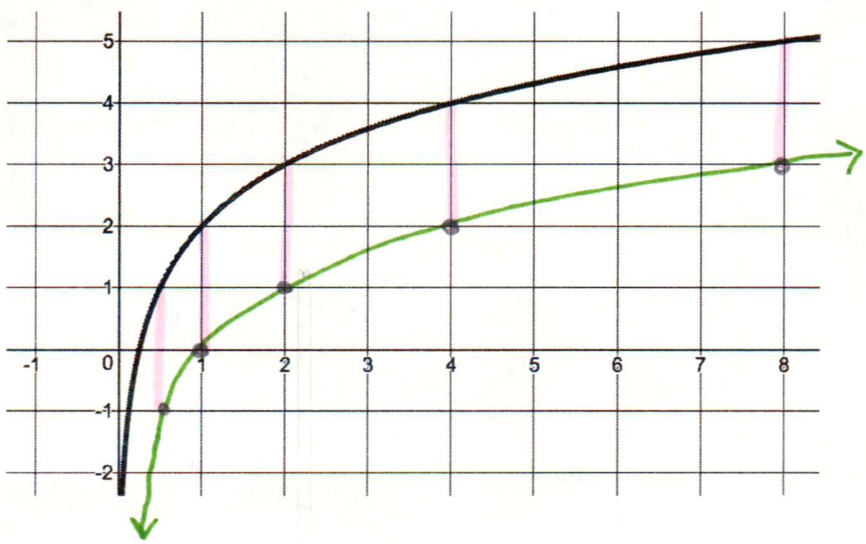
then compare

x	$\frac{1}{2}$	1	2	4	8	16
y	0	1	2	3	4	5

They are not the same thing.

The graph below is the function $f(x) = \log_2(4x)$. Draw the graph of $\boxed{f(x) = \log_2 x}$ on the same graph. What do you notice?

The graph is a vertical shift up of 2.

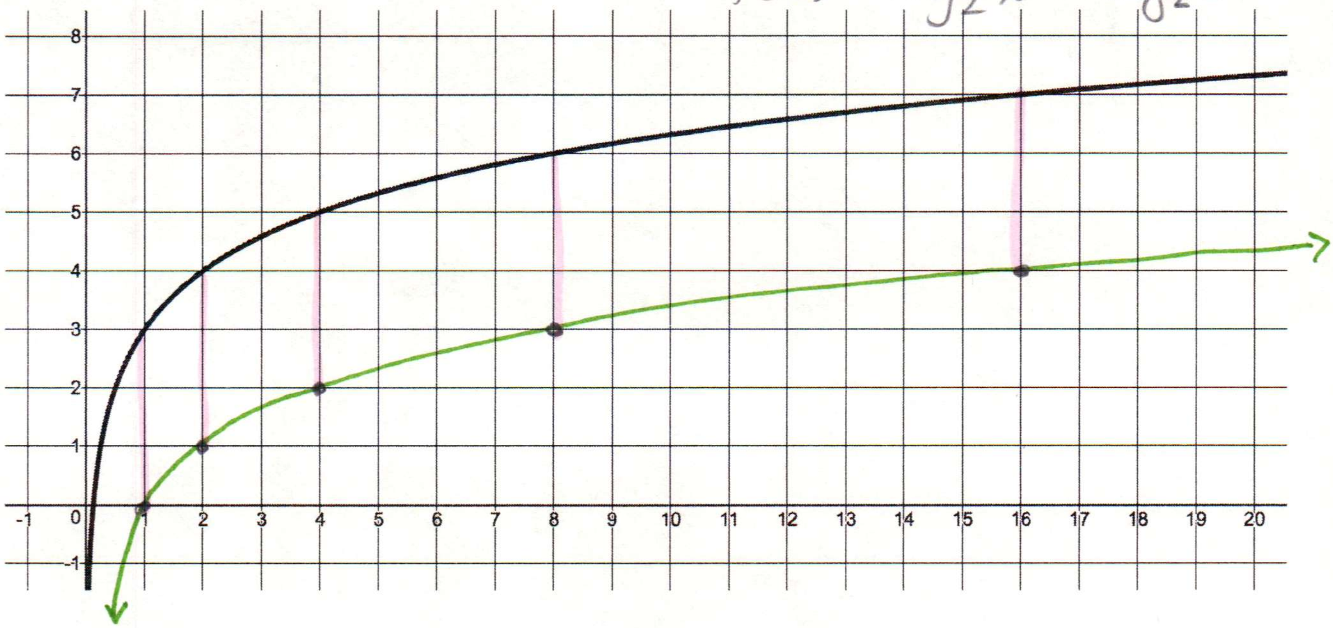


$f(x) = \log_2 x + 2$ gives the same graph.

$\boxed{\text{or}}$ $f(x) = \log_2 x + \log_2 4$

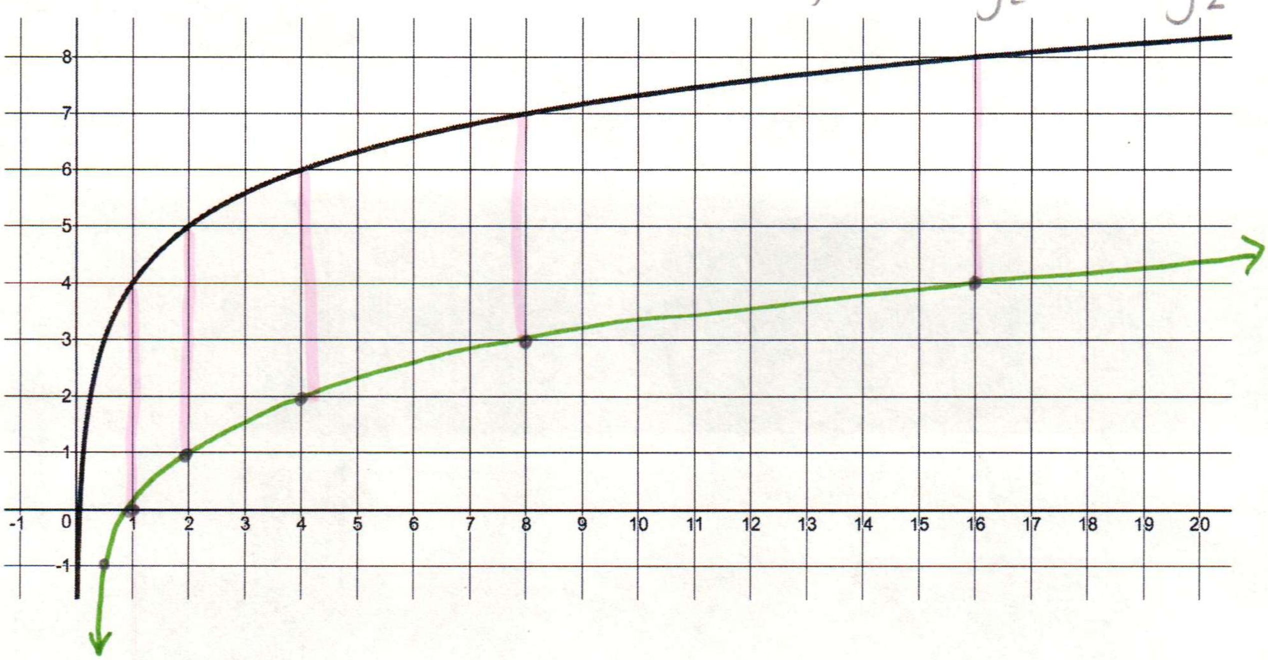
$f(x) = \log_2(8x)$ is below. Equivalent equation: $f(x) = \log_2 x + 3$

$f(x) = \log_2 x + \log_2 8$



$f(x) = \log_2(16x)$ is below. Equivalent equation: $f(x) = \log_2 x + 4$

$f(x) = \log_2 x + \log_2 16$

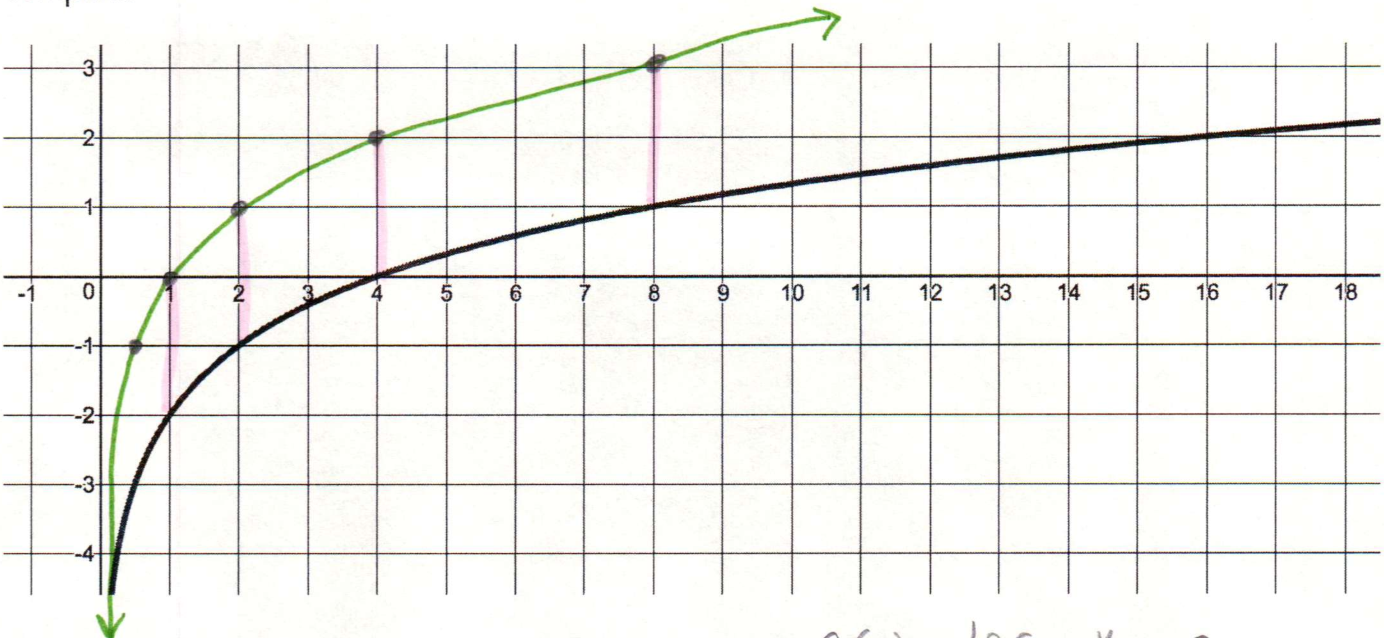


How can we write a log in the form $f(x) = \log_b(mn)$ as the sum of two logs?

$f(x) = \log_b(mn)$ becomes $\boxed{f(x) = \log_b m + \log_b n}$

Do you think that dividing inside a log would have a similar relationship?

Below is the graph of $f(x) = \log_2\left(\frac{x}{4}\right)$, draw the graph of $f(x) = \log_2 x$ on the same graph and compare.



What do you notice?

The graph shifts down instead of up

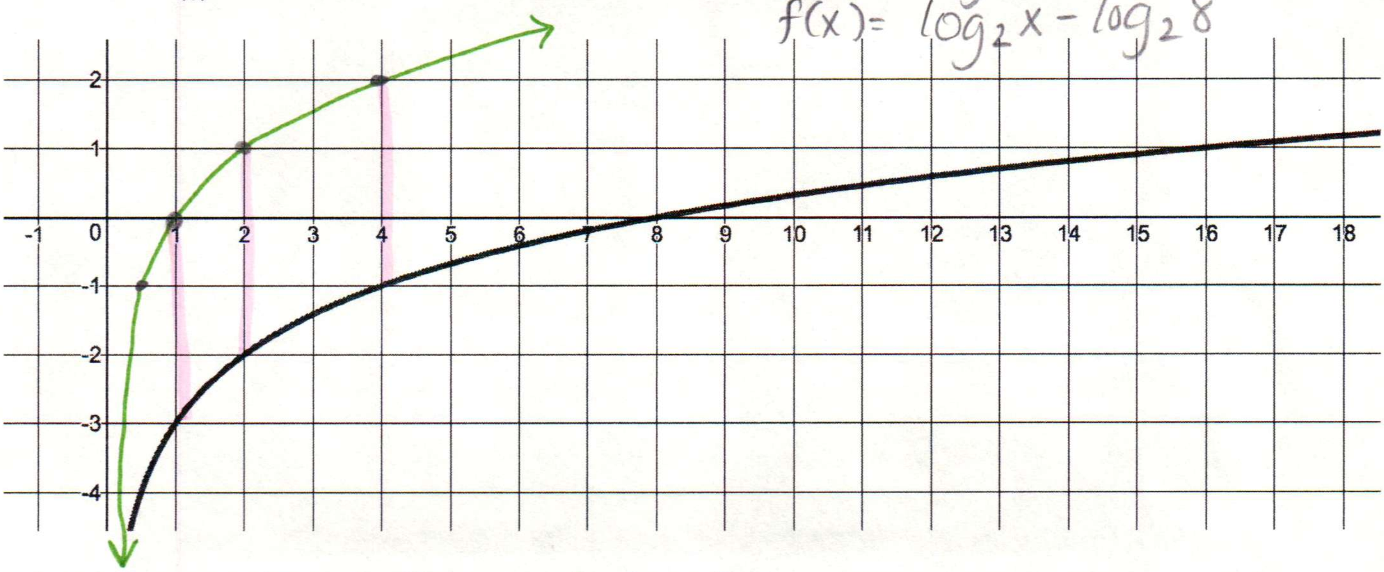
$f(x) = \log_2 x - 2$

$f(x) = \log_2 x - \log_2 4$

$f(x) = \log_2\left(\frac{x}{8}\right)$ is below.

Equivalent equation: $f(x) = \log_2 x - 3$

$f(x) = \log_2 x - \log_2 8$



What is the general form for division inside a logarithm?

$f(x) = \log_b\left(\frac{m}{n}\right)$ becomes $\boxed{f(x) = \log_b m - \log_b n}$

Using what we learned about multiplying within a logarithm, how can you rewrite this logarithm?

$f(x) = \log_2(x^3)$ → $f(x) = \log_2(x \cdot x \cdot x)$

→ $f(x) = \log_2 x + \log_2 x + \log_2 x$

→ $\boxed{f(x) = 3 \cdot \log_2 x}$

Logarithm Properties

Property	Rule
Log of a Product	$\log_b(mn) = \log_b m + \log_b n$
Log of a Quotient	$\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$
Log of a Power	$\log_b(m^n) = n \cdot \log_b m$

How are log properties similar to the rules for exponents?

when multiplying with a common base, add the exponents
when dividing with a common base, subtract the exponents
when raising to a power, multiply the exponents