Learning Goal: I will be write and interpret logarithmic equations.

Minds On: Zombie Apocalypse and Population Growth

Action: Logarithmic Investigation

Consolidation: Evaluating Logs

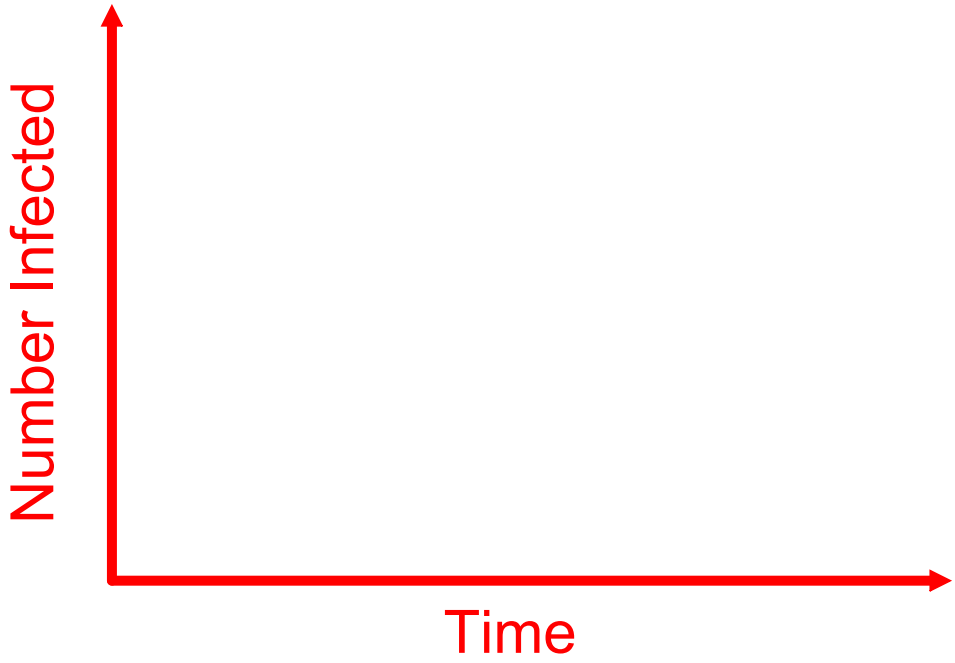
Unit 7

Exponential and Logarithmic Functions

Minds On

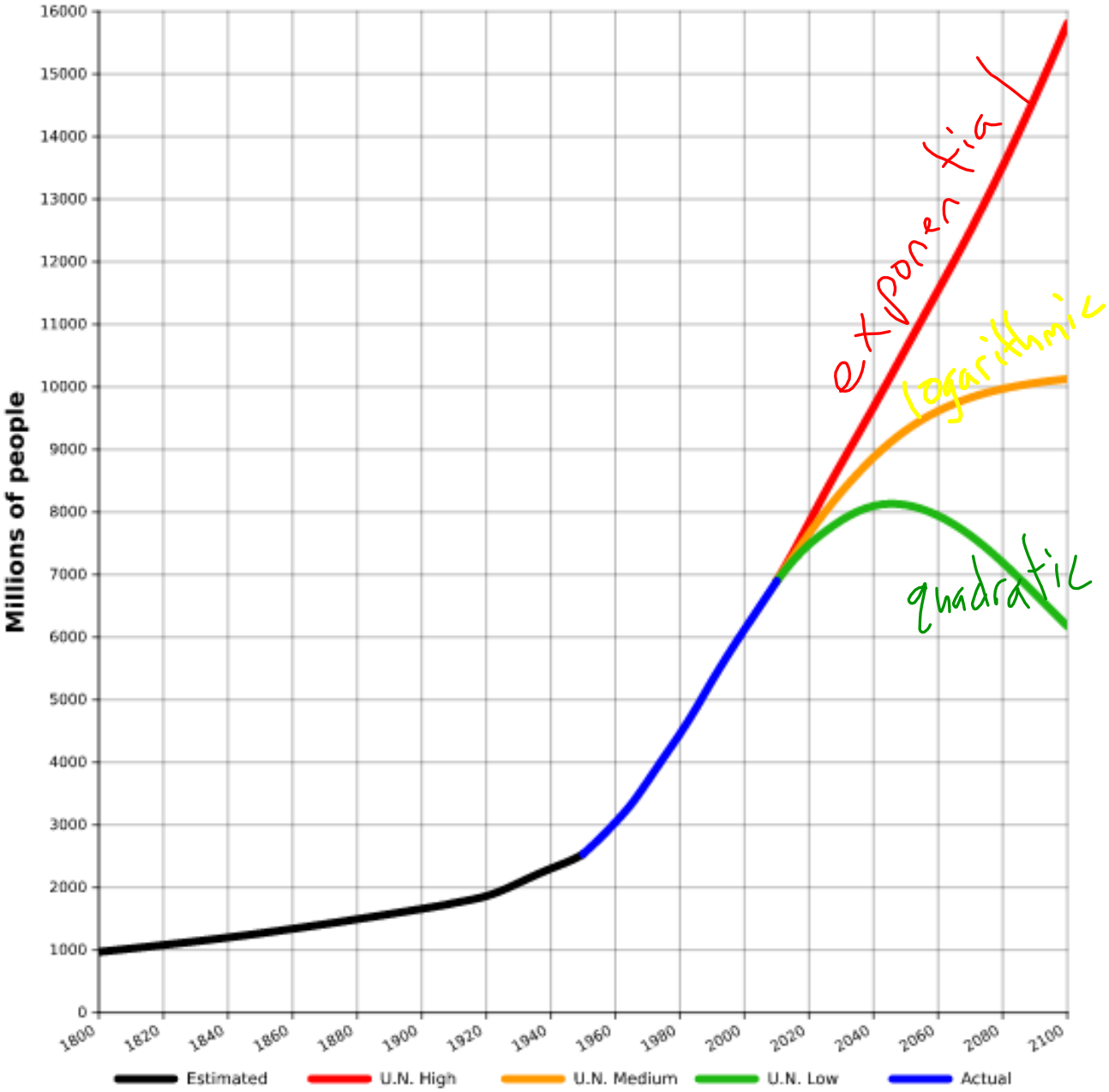
Zombie Apocalypse

On a whiteboard, draw a rough sketch of what you think the spread of a zombie infection might look like over time.



Minds On

World Population



Action

What's the Inverse?

Determine the inverse of each equation, then graph the original function and the inverse.

1. $y = 3x + 1$

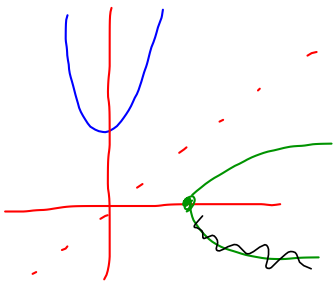
$x = 3y + 1$ switch x and y

$y = \frac{x-1}{3}$ or $y = \frac{1}{3}x - \frac{1}{3}$ solve for y

2. $y = x^2 + 6$

$x = y^2 + 6$

$y = \sqrt{x-6}$



3. $y = 2^x$

$x = 2^y$

Action

Properties of Inverse Functions

The Equations

- switch x & y
- solve for y

The Graphs

- Reflect the graph across $y=x$

The Tables

(x,y) becomes (y,x)

switch x and y values

Action

Desmos Investigation

Desmos Investigation

Graph the function $f(x) = 2^x$ in Desmos.

Complete the table of values below:

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

1. What is the domain of this function?

$\{x \in \mathbb{R}\}$

2. What is the range of this function?

$\{y \in \mathbb{R} \mid y > 0\}$

Interchange x and y in the equation of f to get the equation of the inverse equation $f^{-1}(x)$.
Graph the inverse equation on the same axes.
How do the two graphs compare?

$x = 2^y$ is $y = 2^x$ reflected across $x = y$ / $y = x$

Create a table of values for this inverse function, using "nice" values. You may need to move around to find nice points.

x	y
1	0
2	1
4	2
8	3
16	4

1. What is the domain of this inverse function?

$\{x \in \mathbb{R} \mid x > 0\}$

2. What is the range of this inverse function?

$\{y \in \mathbb{R}\}$

3. How do the points of $f(x)$ seem to relate to those of $f^{-1}(x)$?

x & y are switched

4. Now graph the function $g(x) = log_2 x$. What do you notice?

Same as $x = 2^y$

5. Using each point you found in your last table of values, replace the x and y in the statement $y = log_2 x$ with the x and y values from your points.

$0 = \log_2 1$ $2 = \log_2 4$ $4 = \log_2 16$
$1 = \log_2 2$ $3 = \log_2 8$

6. Based on what you did in #5, what meaning does the expression $log_a x$ have?

$\log_a x$ = the exponent that must be applied to base a to get the value of x

$y = a^x$
inverse
$x = a^y \rightarrow y = \log_a x$

7. Remove all other graphs. Now graph $y = a^x$ and $y = log_a x$.
Set a slider for a between 0 and 10 with a step of 0.1.
Complete the table below to describe the behaviour of $y = a^x$ and $y = log_a x$.

	$y = a^x$	$y = log_a x$
$a > 1$	increasing	increasing
$0 < a < 1$	decreasing	decreasing
Domain	$\{x \in R\}$	$\{x \in R \mid x > 0\}$
Range	$\{y \in R \mid y > 0\}$	$\{y \in R\}$
Asymptotes	horizontal: $y = 0$	vertical: $x = 0$
Intercepts	y-intercept: $y = 1$	x-intercept: $x = 1$

Consolidation

Evaluating Logs

$\log_a x$ is the exponent on base a to get x

Evaluate each logarithm below:

$\log_3 9 = 2$ $\log_2 32 = 5$ $\log_2 1 = 0$

$x^{-1} = \frac{1}{x}$

$\log_6 \frac{1}{6} = -1$ $\log_4 \frac{1}{16} = -2$ $\log_{25} 5 = \frac{1}{2}$

$\sqrt{x} = x^{\frac{1}{2}}$ | $\sqrt[3]{x} = x^{\frac{1}{3}}$ | $\sqrt{x^3} = x^{\frac{3}{2}}$ | $\sqrt[n]{x^m} = x^{\frac{m}{n}}$

$\log_{16} 2 = \frac{1}{4}$ $\log_7 \sqrt{7} = \frac{1}{2}$ $\log_2(-4)$ D.N.E.

Consolidation

Practice

Pg. 451

4 - 6, 9 - 11