AFM Name Key

Unit 4 Day 1 Notes – Exponential Functions Date _____

Exponential Function is a function in the form $y = ab^x$, where $a \neq 0, b > 0, b \neq 1$. b is referred to as the base.

Important Notes about Exponential Functions:

1. Variable is in the exponent.
2. Graph is continuous. Domain: $(-\infty, \infty)$; Range will change with transformations.
3. When $b > 1$ (and a is positive), the graph is increasing (exponential growth).
4. When $0 < b < 1$ (and a is positive), the graph is decreasing (exponential decay).
   Note: if a is negative it is neither exponential growth nor exponential decay
5. Graphs will have a horizontal asymptote at y=k. (All parent exponential functions have HA at y=0.)
6. (0, a) is the y-intercept.

Graphing Exponential Functions

Complete the tables of ordered pairs below for each of the following parent graphs, then use the points to sketch each graph on the coordinate plane below in the given colors.

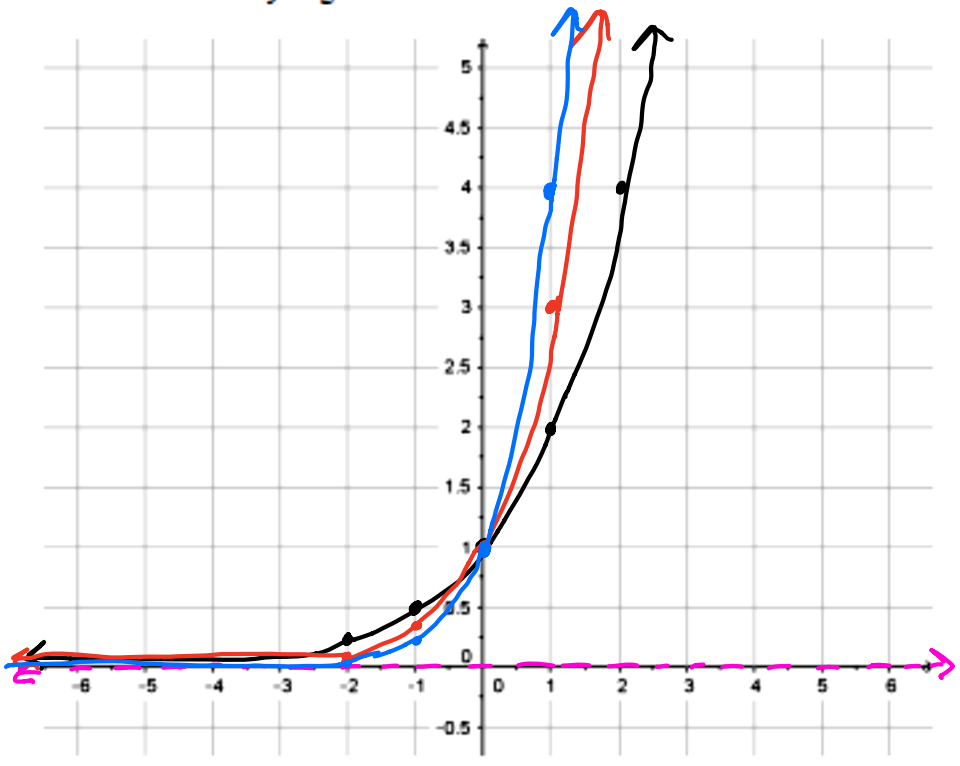
$y = 2^x$ (BLACK)	
-2	.25
-1	.5
0	1
1	2
2	4
3	8

$y = 3^x$ (RED)	
-2	$.\overline{1}$
-1	$.\overline{3}$
0	1
1	3
2	9
3	27

$y = 4^x$ (BLUE)	
-2	.0625
-1	.25
0	1
1	4
2	16
3	64

Is there ever any value of x that will make $y = 0$? None

Is there ever any value of x that will make y negative? No



Find the domain and range for each parent graph.

$y = 2^x$ (BLACK)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = 3^x$ (RED)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = 4^x$ (BLUE)

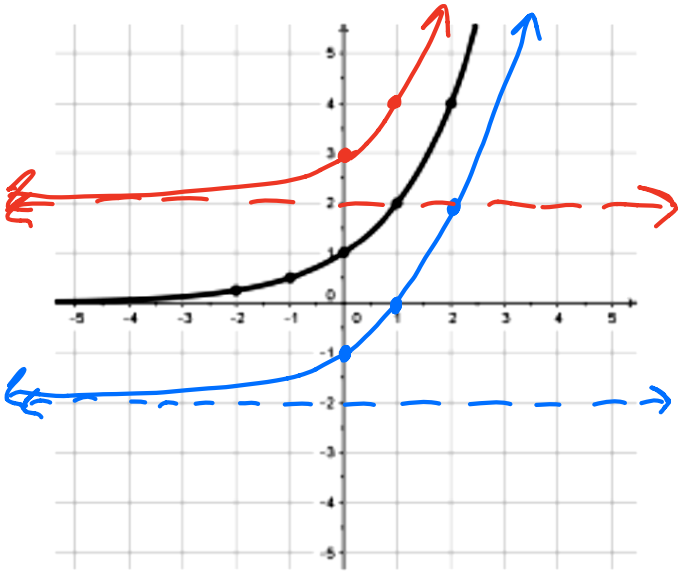
Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

Transformations of Exponential Functions

Use a graphing calculator to view the graph of each function and the table of ordered pairs to neatly sketch them on the graph below in the given colors. Then find the domain, range, and asymptote for each.



What affect does adding or subtracting a value "outside" the x have on the graph of the exponential function?

shifts it up or down

Does this change impact the domain, range, or asymptotes? No

yes

$y = 2^x$ (GIVEN)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = 2^x + 2$ (RED)

Domain: $(-\infty, \infty)$

Range: $(2, \infty)$

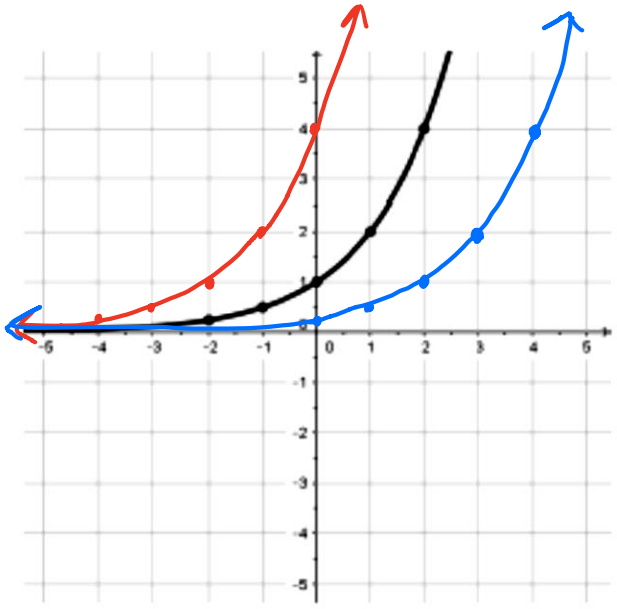
Horizontal Asymptote at: $y = 2$

$y = 2^x - 2$ (BLUE)

Domain: $(-\infty, \infty)$

Range: $(-2, \infty)$

Horizontal Asymptote at: $y = -2$



What affect does adding or subtracting a value "inside" from the x have on the graph of the exponential function?

shifts left or right
(+) (−)

Does this change impact the domain, range, or asymptotes? No

$y = 2^x$ (GIVEN)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = 2^{x+2}$ (RED)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

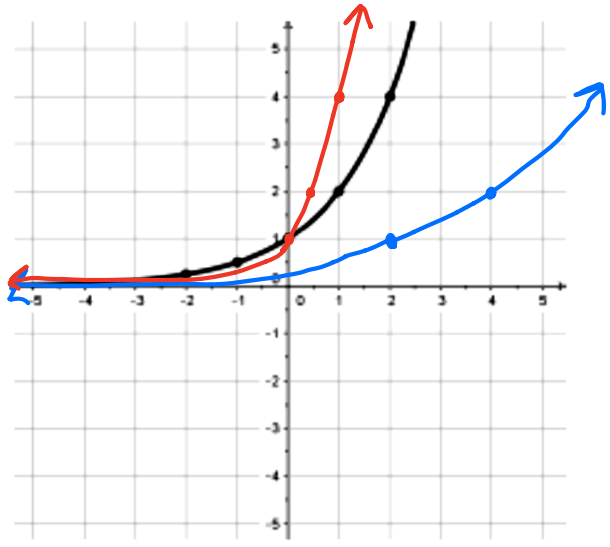
Horizontal Asymptote at: $y = 0$

$y = 2^{x-2}$ (BLUE)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$



What affect does multiplying x by a value have on the graph of the exponential function?

$a > 1$ horizontal shrink

$0 < a < 1$ horizontal stretch

Does this change impact the domain, range, or asymptotes? No

$y = 2^x$ (GIVEN)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = 2^{2x}$ (RED)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

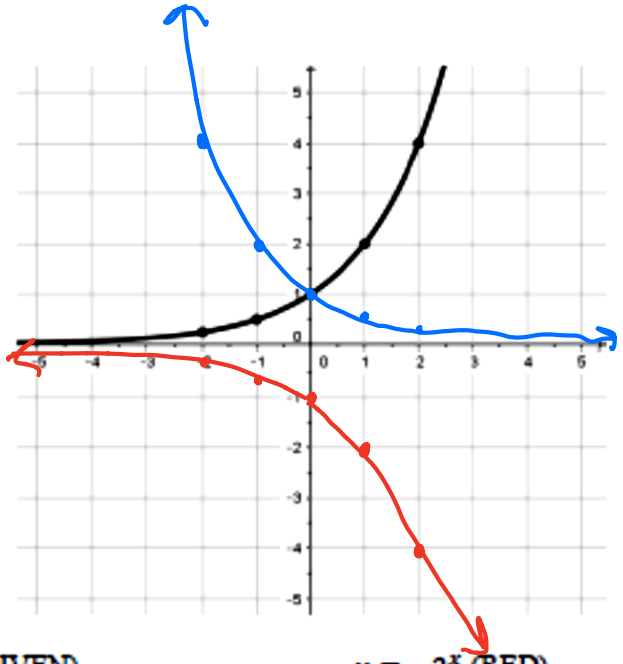
Horizontal Asymptote at: $y = 0$

$y = 2^{1/2x}$ (BLUE)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$



What affect does multiplying by a negative have on the graph of the exponential function?

$-ab^x$ reflects over the x-axis

ab^{-x} reflects over the y-axis

Does this change impact the domain, range, or asymptotes? No

$-ab^x$

$y = 2^x$ (GIVEN)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = -2^x$ (RED)

Domain: $(-\infty, \infty)$

Range: $(-\infty, 0)$

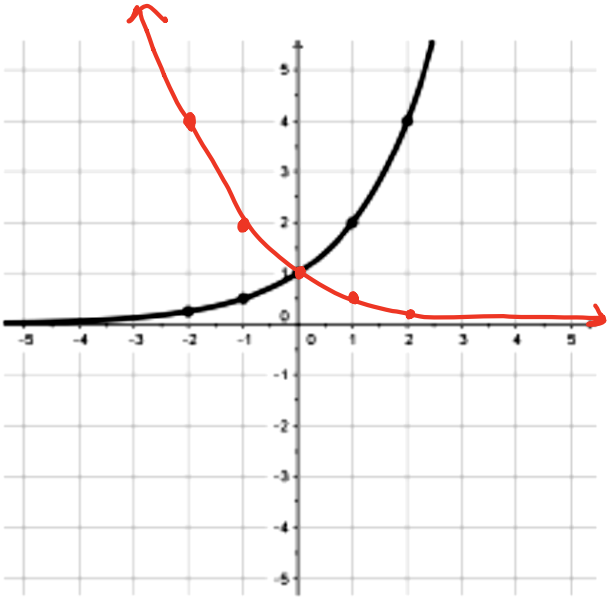
Horizontal Asymptote at: $y = 0$

$y = 2^{-x}$ (BLUE)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$



What effect does changing the base to a number between 0 and 1 have on the graph?

graph starts high and approaches zero.

What is another way to write this function so it has a base of 2?

$y = 2^{-x}$

$y = 2^x$ (GIVEN)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$

$y = \left(\frac{1}{2}\right)^x$ (RED)

Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

Horizontal Asymptote at: $y = 0$