Section 3.1 | Exponential Functions

Objective: Given an exponential function students will be able to graph and describe the function.

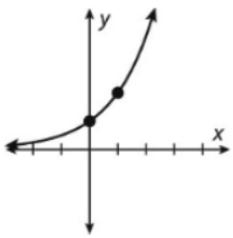
Study Problems

Part 1-Page 225 #1-41 EOO

Part 2 - Page 225 #63,67,69,73

Exponential Growth Functions

$f(x) = b^x,\ b > 1$



Horizontal Asymptote

$y = 0 \longrightarrow y = k$

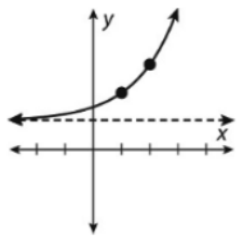
Reference Point

$(0, 1) \longrightarrow (h, a + k)$

Reference Point

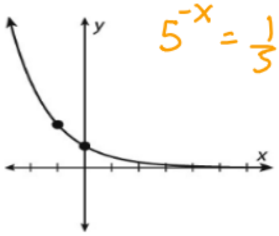
$(1, b) \longrightarrow (1 + h, ab + k)$

$g(x) = ab^{x-h} + k$



Exponential Decay Functions

$f(x) = b^x,\ 0 < b < 1$



$5^{-x} = \frac{1}{3}^{x}$

Horizontal Asymptote

$y = 0 \longrightarrow y = k$

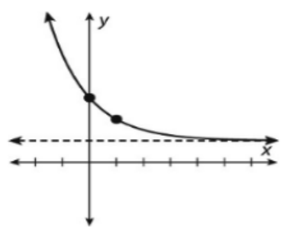
Reference Point

$(0, 1) \longrightarrow (h, a + k)$

Reference Point

$\left(-1, \frac{1}{b}\right) \longrightarrow \left(h - 1, \frac{a}{b} + k\right)$

$g(x) = ab^{x-h} + k$



	Transformed Functions	
	Decay $g(x) = ab^{x-h} + k$, where $0 < b < 1$	$g(x) = ab^{x-h} + k$, where $b > 1$ growth
Parent Functions	$f(x) = (b)^x$	$f(x) = b^x$
Reflection	$a < 0$ = across the x-axis	$a < 0$ = across the x-axis
Translation	$+h$ = right h units $-h$ = left h units $+k$ = up k units $-k$ = down k units	$+h$ = right h units $-h$ = left h units $+k$ = up k units $-k$ = down k units
Dilation	$\|a\| < 1$ = vertical compression; factor of a $\|a\| > 1$ = vertical stretch; factor of a	$\|a\| < 1$ = vertical compression; factor of a $\|a\| > 1$ = vertical stretch; factor of a
Asymptote	$y = k$	$y = k$
Reference Points	$(0, 1) \to (h, a + k)$ $(-1, \frac{1}{b}) \to (h - 1, \frac{a}{b} + k)$	$(0, 1) \to (h, a + k)$ $(1, b) \to (1 + h, ab + k)$
Domain	$\{x \mid -\infty < x < \infty\}$	$\{x \mid -\infty < x < \infty\}$
Range	$\{y \mid y > k\}$	$\{y \mid y > k\}$

$g(x) = ab^{x-h} + k$

State the domain and range of the function. Then identify the new values of the reference points and the asymptote. Use these values to graph the function.

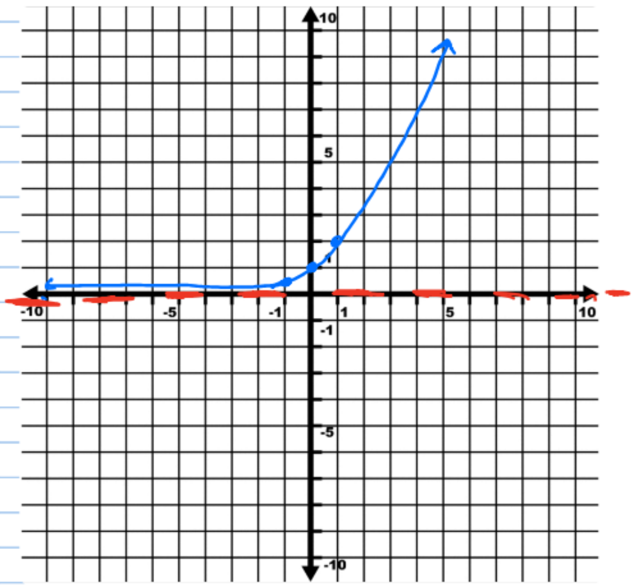
$y = 2^x + 0 \Rightarrow$ growth $b > 1$

x	y
-1	$2^{-1} = \frac{1}{2}$
0	$2^0 = 1$
1	$2^1 = 2$

Assy : $y = 0$

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

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



State the domain and range of the function. Then identify the new values of the reference points and the asymptote. Use these values to graph the function.

$$g(x) = \frac{1}{3}^{x} + \overset{k}{0}$$

$\frac{1}{3} \to 3^{-x}$

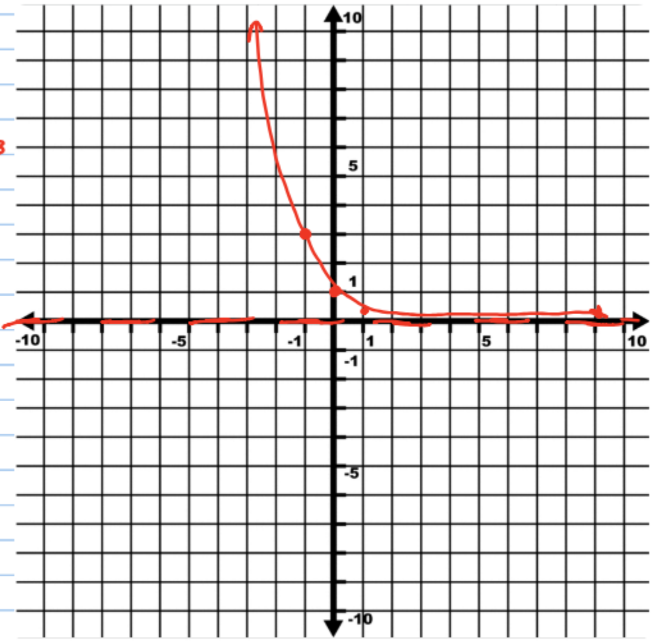
x	y
-1	$\frac{1}{3}^{-1} = 3$
0	$\frac{1}{3}^{0} = 1$
1	$\frac{1}{3}^{1} = \frac{1}{3}$

Decay $0 < b < 1$

Assy : $y = 0$

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

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



State the domain and range of the function. Then identify the new values of the reference points and the asymptote. Use these values to graph the function.

$$f(x) = 2(5)^{x} + 0$$

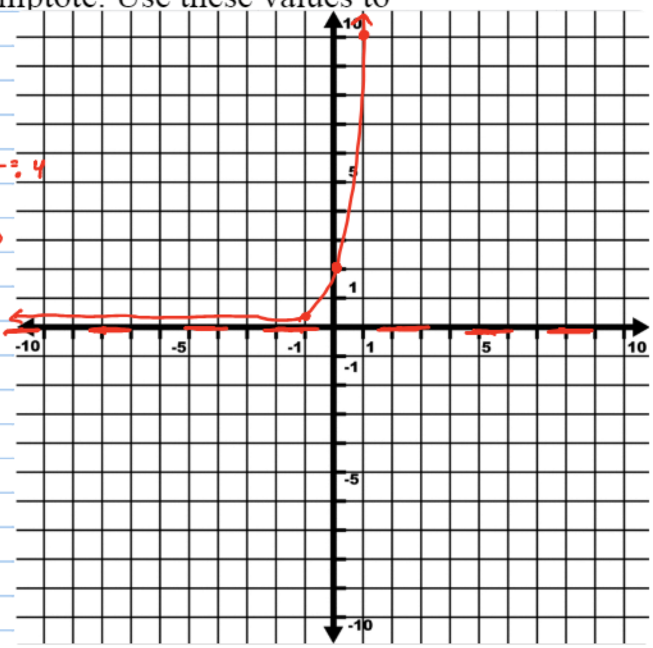
x	y
-1	$2(5)^{-1} = \frac{2}{5} = .4$
0	$2(5)^{0} = 2$
1	$2(5)^{1} = 10$

Asym: $y = 0$

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

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

Incre. (growth)



State the domain and range of the function. Then identify the new values of the reference points and the asymptote. Use these values to graph the function.

$$g(x) = \overset{a}{4}\left(\overset{b}{\frac{1}{2}}\right)^{x-\overset{h}{3}} \overset{k}{-\,2}$$

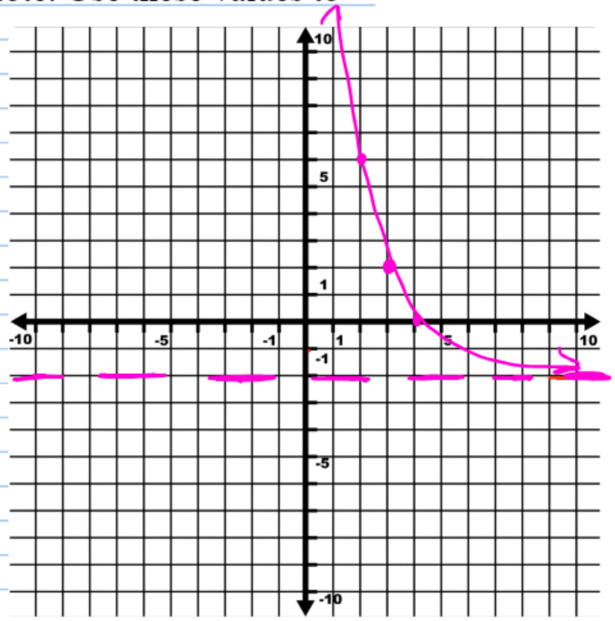
x	y
3	2
2	6
4	0

Asy: $y=-2$

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

R $\{y \in \mathbb{R} \mid y > -2\}$

Decay (decreasing b/c $b = 1/2$)



State the domain and range of the function. Then identify the new values of the reference points and the asymptote. Use these values to graph the function.

$$f(x) = 4\left(2^{x-3}\right) - 1$$

x	y

a= 4
b= 2
h= -3
K= -1

Assy: $y=-1$

Ref. Pt. $(-3, 3)$, $(-2, 7)$

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

R: $\{y \in \mathbb{R} \mid y > -1\}$