3.1 Exponential Functions

Wednesday, November 14, 2018 2:06 PM

- Let a & b be real constants
- Exponential Function can be written in the form $f(x) = a \cdot b^x$ where $a \neq 0$

  $b > 0$ & $b \neq 1$. Domain: $(-\infty, \infty)$

  $f(0) = a \cdot b^0 = a$

- initial value $(0, a)$

  $b =$ base

Which of the following are exponential functions?

$f(x) = a \cdot b^x$

a. $y = 3 \cdot 2^x$
yes $b = 2$
$3 \cdot 2^x \neq 6^x$

b. $y = x^x$
not exp.

c. $y = 2^{-x} = \left(\frac{1}{2}\right)^x$
yes
$b = 1/2$

d. $y = 6^{\sqrt{x}}$
not

e. $y = 5\left(\frac{1}{2}\right)^{2x} = 5\left(\frac{1}{4}\right)^x$
yes
$b = 1/4$

f. $y = e^x$
yes
$b = e$

Exponential Functions have an add-multiply property.

	x	$f(x)$	
	-2	$4/9$	
$+1$	-1	$4/3$	$\times 3$
$+1$	0	4	$\times 3$
$+1$	1	12	$\times 3$
	2	36	

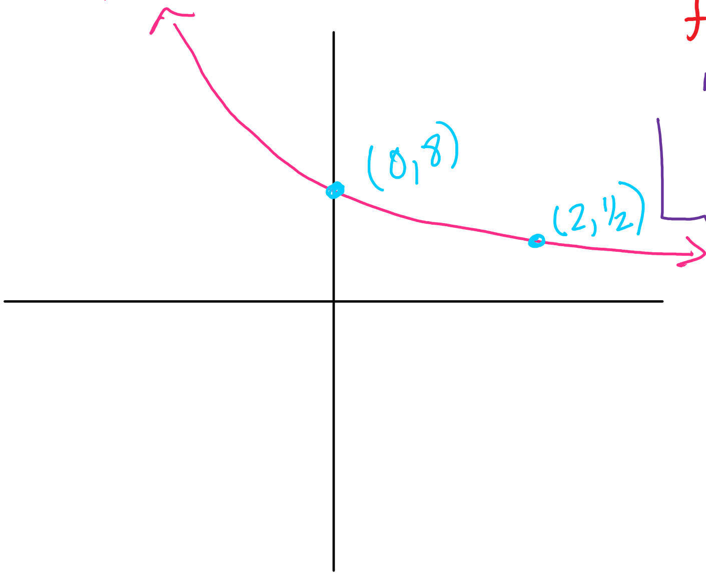
$f(x) = 4b^x$

$12 = 4b^1$

$3 = b$

$f(x) = 4 \cdot 3^x$

Write the equation of the exponential function graphed below.



$f(x) = 8b^x$

$\frac{1}{2} = 8b^2$

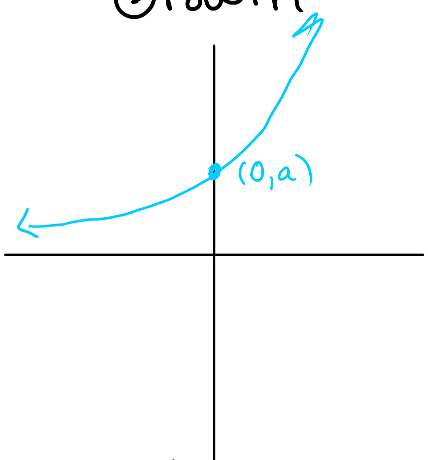
$\frac{1}{16} = b^2$

$b = \pm\sqrt{1/16}$

$b = 1/4$

$f(x) = 8 \cdot \left(\frac{1}{4}\right)^x$

Growth



$b > 1$

Increasing $(-\infty, \infty)$

$\lim_{x \to \infty} f(x) = \infty$

$\lim_{x \to -\infty} f(x) = 0$

Domain

$(-\infty, \infty)$

Range

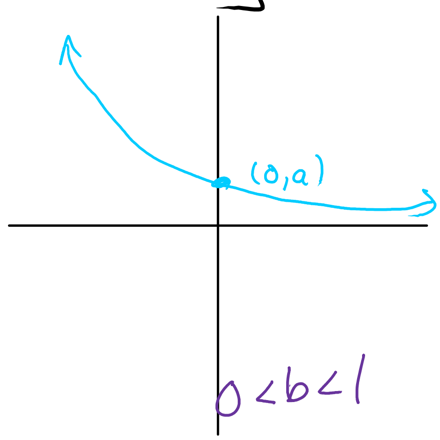
$(0, \infty)$

$(0, a)$

Bounded Below

$a > 0$

Decay



$0 < b < 1$

Decreasing $(-\infty, \infty)$

$\lim_{x \to \infty} f(x) = 0$

$\lim_{x \to -\infty} f(x) = \infty$

Parent Function $f(x) = 2^x$

Parent Function $f(x) = 2^{x}$

state the transformations performed on $f(x)$ to get $g(x)$.

a. $g(x) = 1 - 3 \cdot 2^{x-1}$

H	V
1. Right 1	1. Reflect over the x-axis
	2. stretch bafo 3
	3. up 1

b. $g(x) = 5 + 2^{-3x+1}$

H	V
1. Left 1	1. up 5
2. shrink bafo $1/3$	
3. reflect over the y-axis	

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given $f(x) = \left(1 + \frac{1}{x}\right)^{x}$

$$\lim_{x \to \infty} f(x) = e \approx 2.718$$

Logistic Growth Functions

Let a, b, c, and k be positive constants with $b < 1$. A logistic growth function is in the form:

c

$$f(x) = \frac{C}{1 + a \cdot b^x} \quad \text{or} \quad f(x) = \frac{C}{1 + ae^{-kx}}$$

☆ If $b > 1$ or $k < 0$ these formulas yield logistic decay.

☆☆ where C is the limit to growth.

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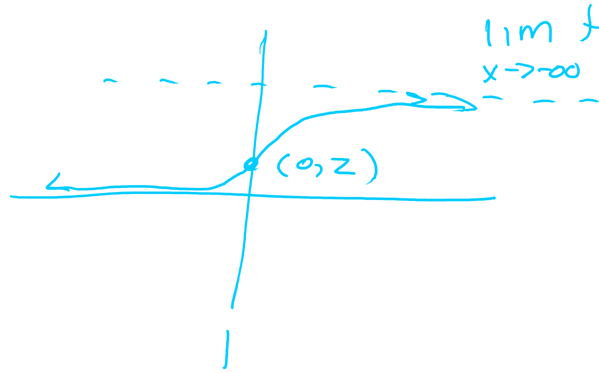
example $f(x) = \dfrac{8}{1 + 3(.7)^x}$ → limit to growth

$\lim\limits_{x \to \infty} f(x) = 8$

y int: $\left(0, \frac{8}{1+3}\right)$

$(0, 2)$

$\lim\limits_{x \to -\infty} f(x) = 0$



$y = 8$