

## **Exponential Functions 2 - Exponential Decay**

**Standards:** F.IF.7e - Graph exponential functions  
F.LE.1 - Distinguish...situations that can be modeled...with exp. functions

### **Learning Targets:**

-How do you tell the difference between an exp. growth & exp. decay function equation & graph?

Exponential Decay Function

(erase to show)

$$f(x) = ab^x$$

when  $a > 0$  and  $0 < b < 1$ (remember, GROWTH is when  $b > 1$ )**Example 1:**

State whether it is an exponential growth or decay function.

a)  $f(x) = 4\left(\frac{5}{8}\right)^x$

$$a=4 \quad b=\frac{5}{8}$$

exp. decay

b)  $f(x) = 8\left(\frac{3}{2}\right)^x$

$$a=8 \quad b=\frac{3}{2}=1.5$$

exp. growth

c)  $f(x) = \frac{1}{3}(2)^{-x}$

$$a^{-n} = \left(\frac{1}{a}\right)^n$$

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

$$a=\frac{1}{3} \quad b=\frac{1}{2}$$

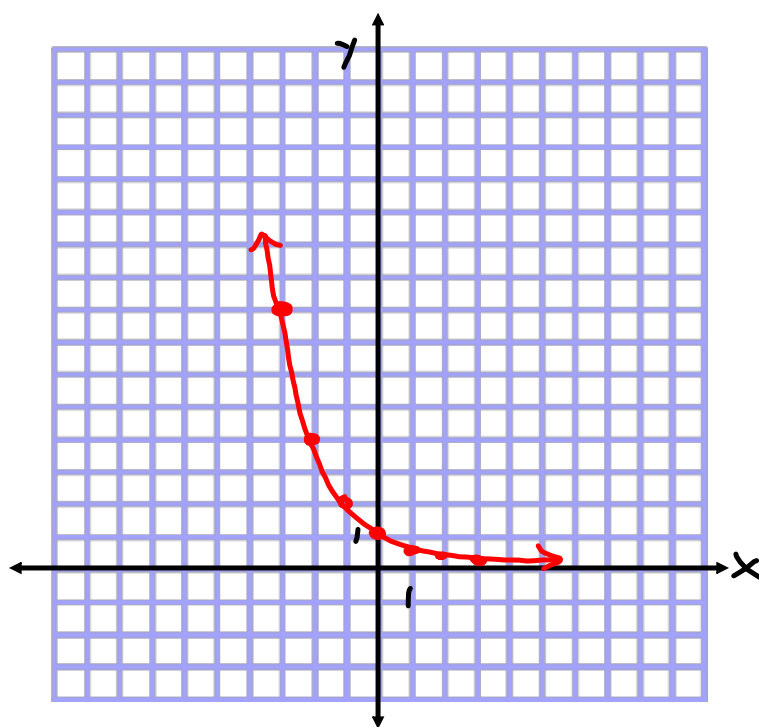
exp. decay

**Example:**

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

$a = 1$   
 $b = \frac{1}{2}$  exp. decay

$x$	$f(x)$
-3	8
-2	4
-1	2
0	1
1	0.5
2	0.25
3	0.125



So it's just like Exponential Growth...

(erase to show)

- The graph goes through the point (0, a)
- The x-axis is the asymptote  $y=0$
- Domain = all real numbers
- Range is  $y > 0$  if  $a > 0$
- $y < 0$  if  $a < 0$

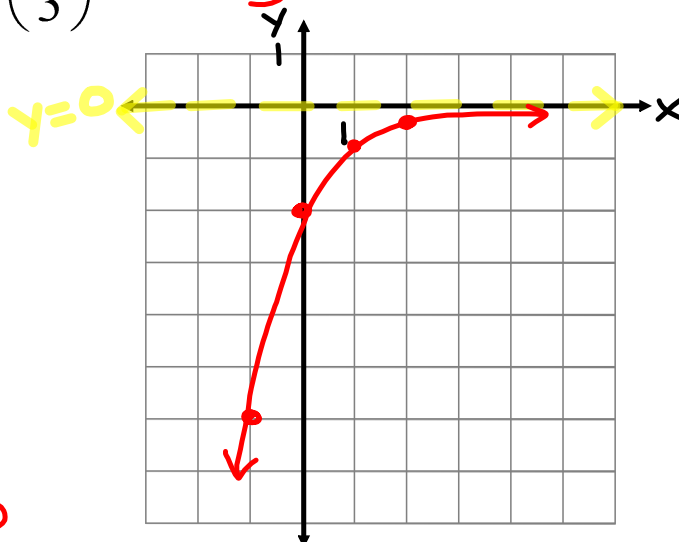
**Example 2**

Graph.

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

$a = -2$  exponential  
 $b = \frac{1}{3}$

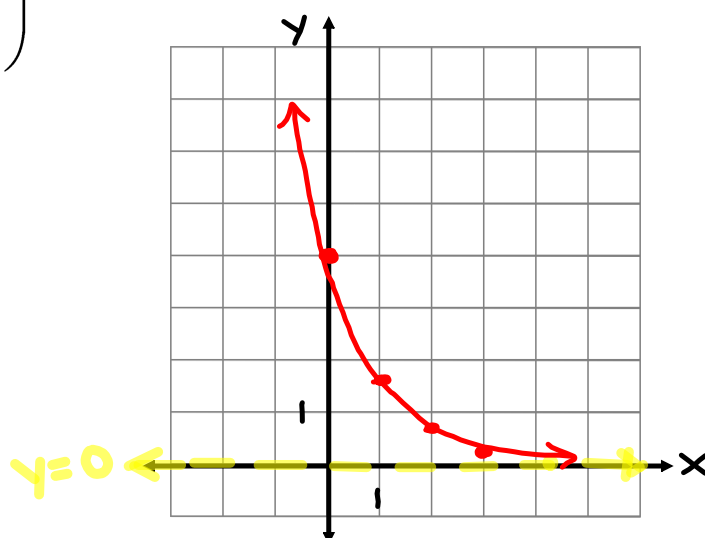
x	y
-1	-6
0	-2
1	-0.67
2	-0.22

asymptote:  $y=0$ domain:  $\mathbb{R}$ range:  $y < 0$ y-int:  $(0, -2)$

**Example 3****Graph.**

$$f(x) = 4\left(\frac{2}{5}\right)^x$$

x	y
-1	10
0	4
1	1.6
2	0.64
3	0.26

asymptote:  $y = 0$ domain:  $\mathbb{R}$ range:  $y > 0$ y-int:  $(0, 4)$

(erase to show)

**General Exponential Function:**

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

**h shifts it horizontally****k shifts it vertically**

**Example4:****Graph.**

$$f(x) = 5\left(\frac{1}{8}\right)^{x+1} - 2$$

$$f(x) = 5\left(\frac{1}{8}\right)^x \quad h = -1$$

$$k = -2$$

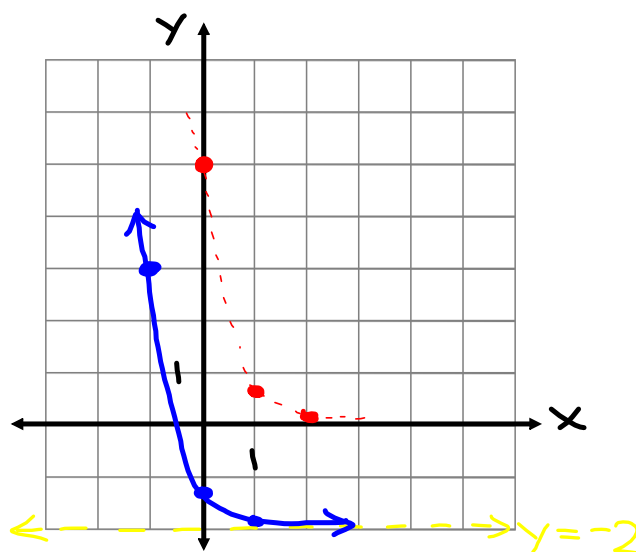
x	y
-1	40

$$0 \quad 5$$

$$1 \quad 0.625$$

$$2 \quad 0.08$$

(1 left  
2 down)



asymptote:  $y = -2$

domain:  $\mathbb{R}$

range:  $y > -2$

y-int:  $(0, -1.375)$

$$5\left(\frac{1}{8}\right)^{0+1} - 2$$



**Example 5****Graph.**

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

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

$$k = 1$$

(2 left)  
(1 up)

x	y
-1	-6
0	-3
1	-1.5
2	-0.75
3	-0.375

asymptote:  $y = 1$ domain:  $\mathbb{R}$ range:  $y < 1$ y-int:  $(0, 0.25)$ 

$$-3\left(\frac{1}{2}\right)^{0+2} + 1$$

