

## Unit 6a

### 7.1 - 7.4: Exponential Growth & Decay

## Exponential Growth & Decay

$$y = a \cdot b^x$$

$b > 1$  is growth

$0 < b < 1$  is decay

$a$  = Vertical stretch of  $y = b^x$

$b$  = growth factor: multiple by which  $y$  values are increasing

asymptote - imaginary line that the function approaches but never reaches

## Exponential Growth & Decay

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

$$y = a \cdot b^x$$

$$y = 2^x$$

$$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$$

$$2^{-1} = \frac{1}{2^1} = \frac{1}{2}$$

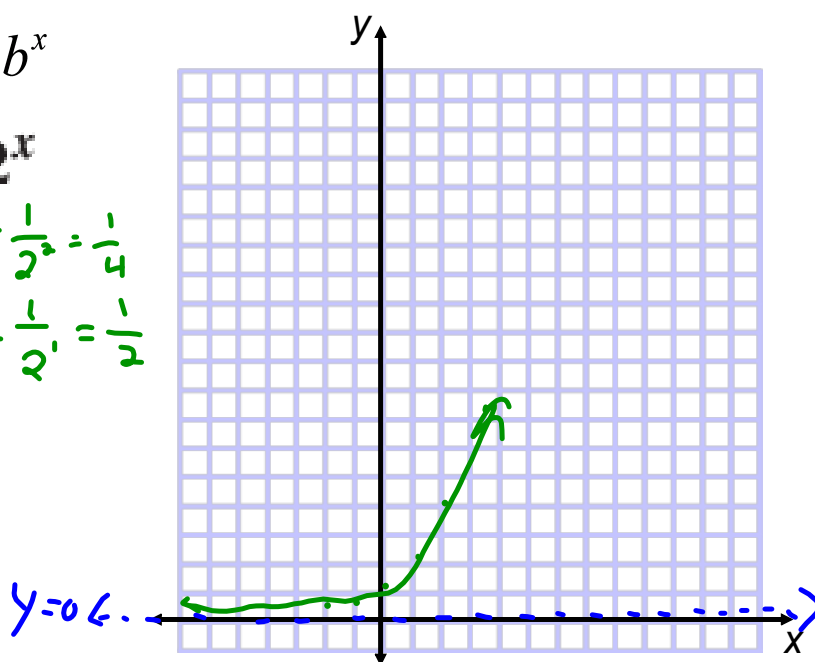
$$a = 1 \quad b = 2$$

$$\text{Asymptote: } y = 0$$

$$\text{y-intercept: } (0, 1)$$

$$\text{Parent Function } y = 2^x$$

$$\text{Domain } (-\infty, +\infty)$$



$$\text{Range } (0, +\infty) \quad \text{Growth or Decay}$$

## Exponential Growth & Decay

x	y
-2	4
-1	2
0	1
1	1/2
2	1/4

$$y = a \cdot b^x$$

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

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

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

Asymptote:  $y = 0$

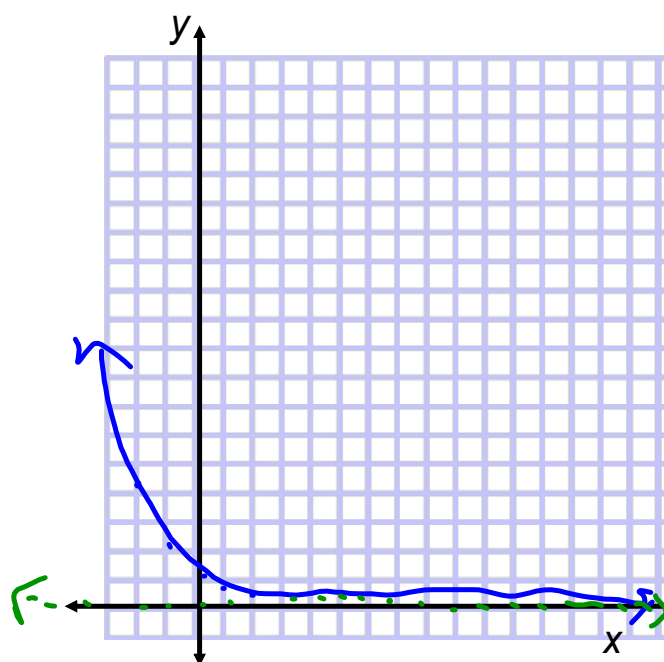
y-intercept:  $(0, 1)$

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

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

Range  $(0, +\infty)$

Growth or Decay



## Exponential Growth & Decay

x	y
-2	$\frac{4}{9}$
-1	$\frac{4}{3}$
0	4
1	12
2	36

$$y = a \cdot b^x$$

$$y = 4 \cdot 3^x$$

$$4 \cdot 3^{-2}$$

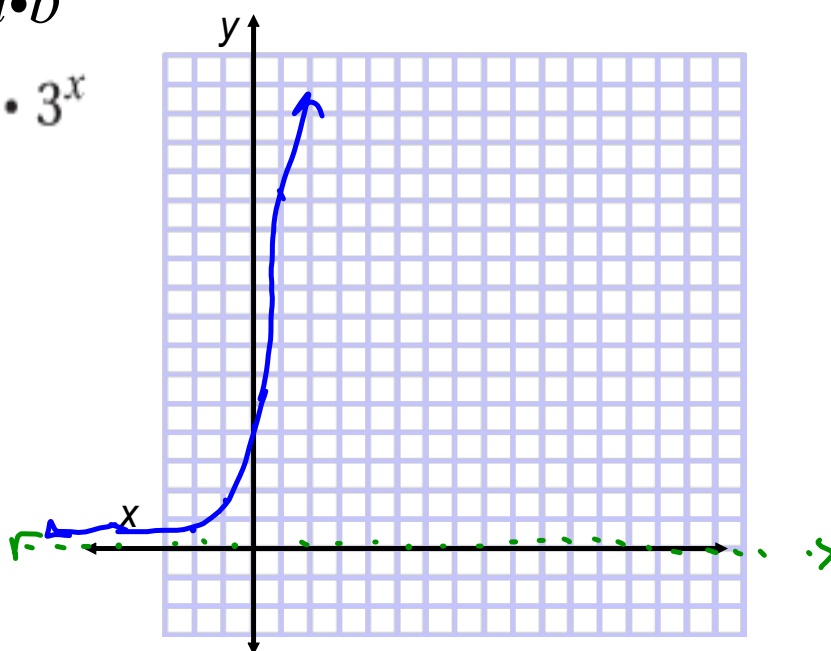
$$4 \left(\frac{1}{3^2}\right)$$

$$4 \left(\frac{1}{3^1}\right)$$

$$a = 4 \quad b = 3$$

$$\text{Asymptote: } y = 0$$

$$\text{y-intercept: } (0, 4)$$



## Exponential Growth & Decay

x	y
-2	$\frac{1}{9}$
-1	$\frac{1}{3}$
0	1
1	3
2	9

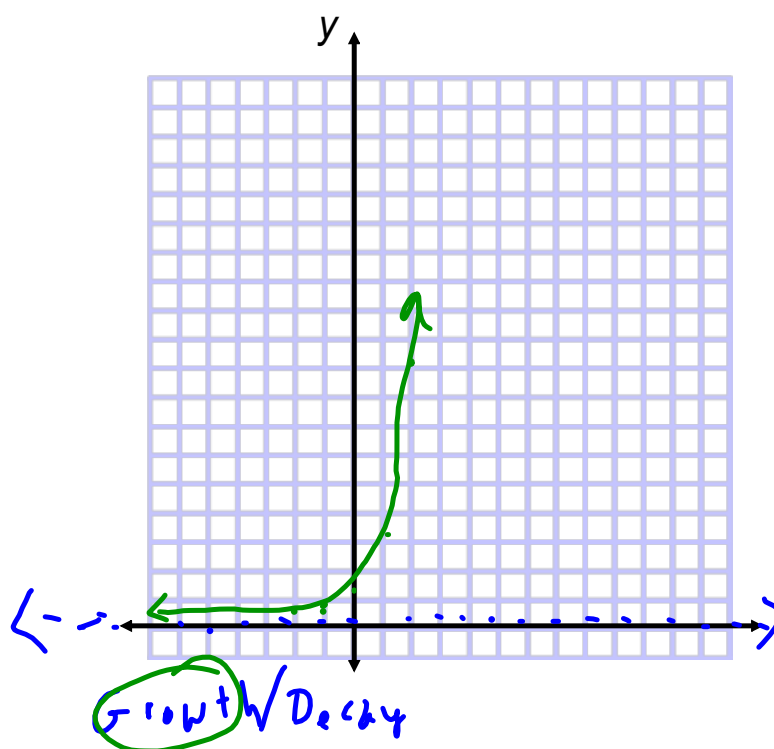
$$y = 3^x$$

$$a = 1 \quad b = 3$$

Asymptote:  $y = 0$

y-intercept:

Domain Range  
 $(-\infty, +\infty)$   $(0, +\infty)$



Transformations:  $y = ab^{x-h} + k$

$$y = 2^{x-2} + 4$$

$b > 1$  is growth  
 $0 < b < 1$  is decay

$b$  = growth factor

$h$  = horizontal shift

$k$  = vertical shift

Parent Function

$$y = 2^x$$

Asymptote  $y = k$

$$y = 4$$

Domain

$$(-\infty, +\infty)$$

Range  $(k, +\infty)$

$$(4, +\infty)$$

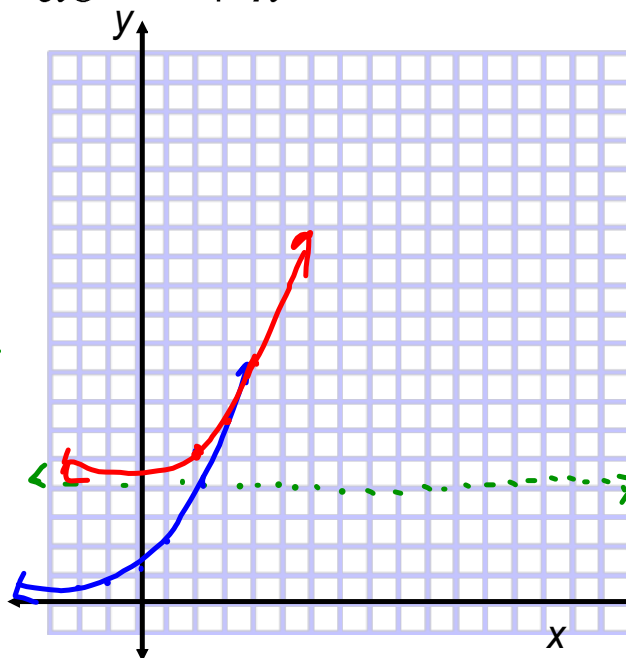
Horizontal Shift

$h$  Right 2

Vertical Shift

$k$  Up 4

Growth or Decay



$$y = (4)2^{x-1} - 3$$

Parent Function  $y = 2^x$

Asymptote  $y = -3$

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

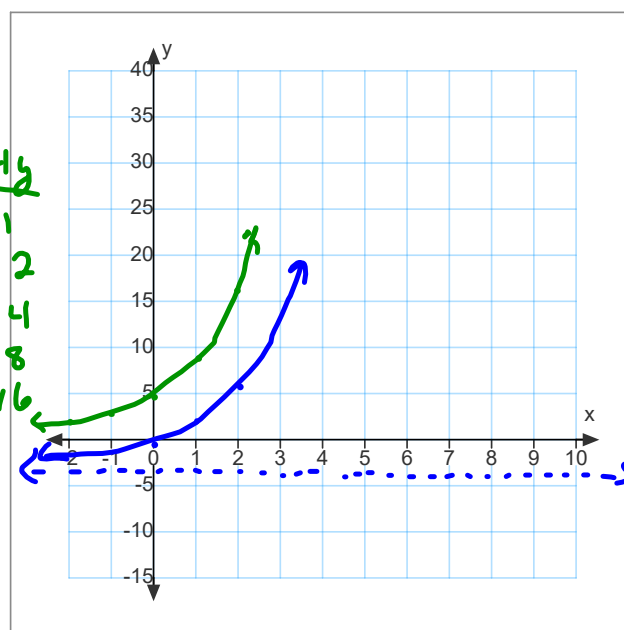
Range  $(-3, +\infty)$

Horizontal Shift Right +1

Vertical Shift Down 3

Growth or Decay

x	y
-2	1/4
-1	1/2
0	1
1	2
2	4





$$y = (2)^{\frac{1}{3}x+2} + 1$$

Parent Function

Asymptote

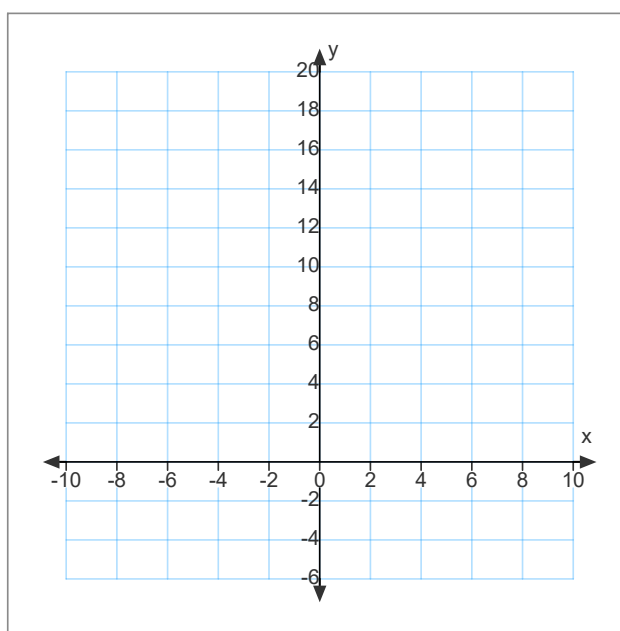
Domain

Range

Horizontal Shift

Vertical Shift

Growth or Decay



How can you tell the difference between an exponential growth or a decay?

$$f(x) = 3 \left( \frac{1}{4} \right)^{x-6} + 7$$

$$f(x) = 3(2)^{x+4} - 5$$

Parent Function

Asymptote

Domain

Range

Horizontal Shift

Vertical Shift

Growth or Decay

