6-1 Key Features of Exponential Functions

Essential Question: How do graphs and equations reveal key features of exponential growth and decay functions?

Learning Goal:

- Recognize the key features of exponential functions, such as asymptotes, end behavior, domain, range, and intercepts

Standard(s):
MAFS.912.F-IF.2.4: For a function that models a relationship between two quantities, interpret key features of graphs, interpret key features of graphs…and sketch graphs showing key features….intercepts; intervals where function is

- Get notes out from the lesson
- Get whiteboards ready

What is an exponential function?

X	Y
-2	1/4
-1	1/2
0	1
1	2
2	4
3	8

f(x) = 2^x

Exponential Growth

X	Y
-2	9
-1	3
0	1
1	1/3
2	1/9
3	1/27

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

Exponential Decay

Which of the following is considered an exponential function?

$a.\ f(x) = 3x^2$

$b.\ f(x) = \frac{1}{2} \cdot 4^{-x}$

$c.\ f(x) = 3x + 8$

$d.\ f(x) = x^3$

$e.\ f(x) = \frac{1}{x}$

$f.\ None\ of\ the\ above$

$y = a \cdot b^x$

$\frac{1}{2} \cdot \frac{1}{4}^x$

Which of the following is considered an exponential function?

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$c.\ f(x) = 3x + 8$

$d.\ f(x) = x^3$

$e.\ f(x) = \frac{1}{x}$

$f.\ None\ of\ the\ above$

Come up with 1 real world example of an exponential function

Example of an Exponential Function

$f(x) = \frac{1}{2} \cdot 4^{-x}$ y

Growth or decay? Decay

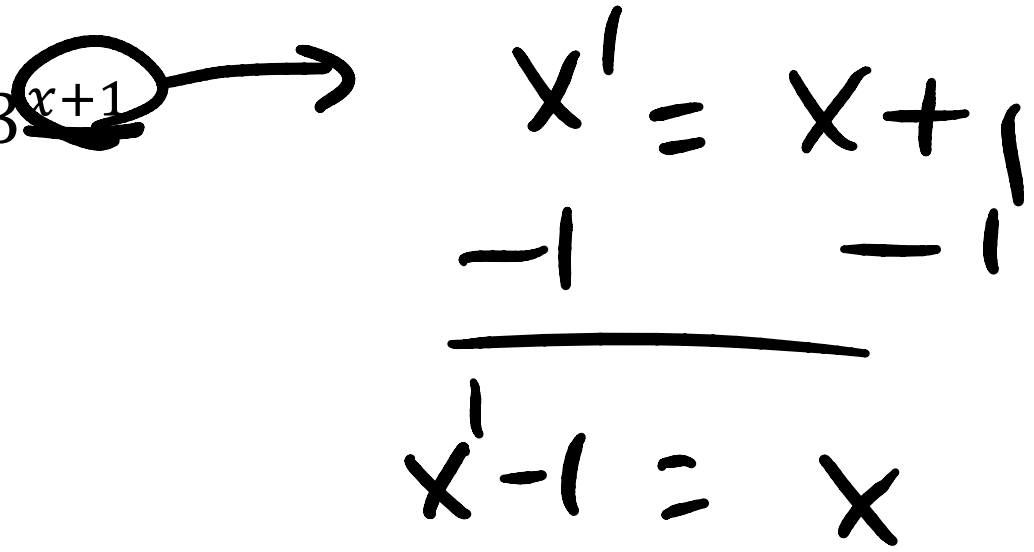
Parent function: $y = 4^x$

Transformations:

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

Find the parent function of

$f(x) = 4 \cdot 3^{x+1}$



Find the parent function of

$f(x) = 4 \cdot 3^{x+1}$

Solution: $f(x) = 3^x$

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Find the transformations of

$f(x) = 4 \cdot 3^{x+1}$ → y $\quad y' = 4y$

a. *Vertical ~~compression~~ by 4, shift left 1*
b. *Vertical stretch by 4, shift right 1*
c. *Shift up 4, Shift right 1*
d. *Shift up 4, Shift left 1*
e. *Vertical stretch by 4, horizontal stretch by 1*
f. *None of the above*

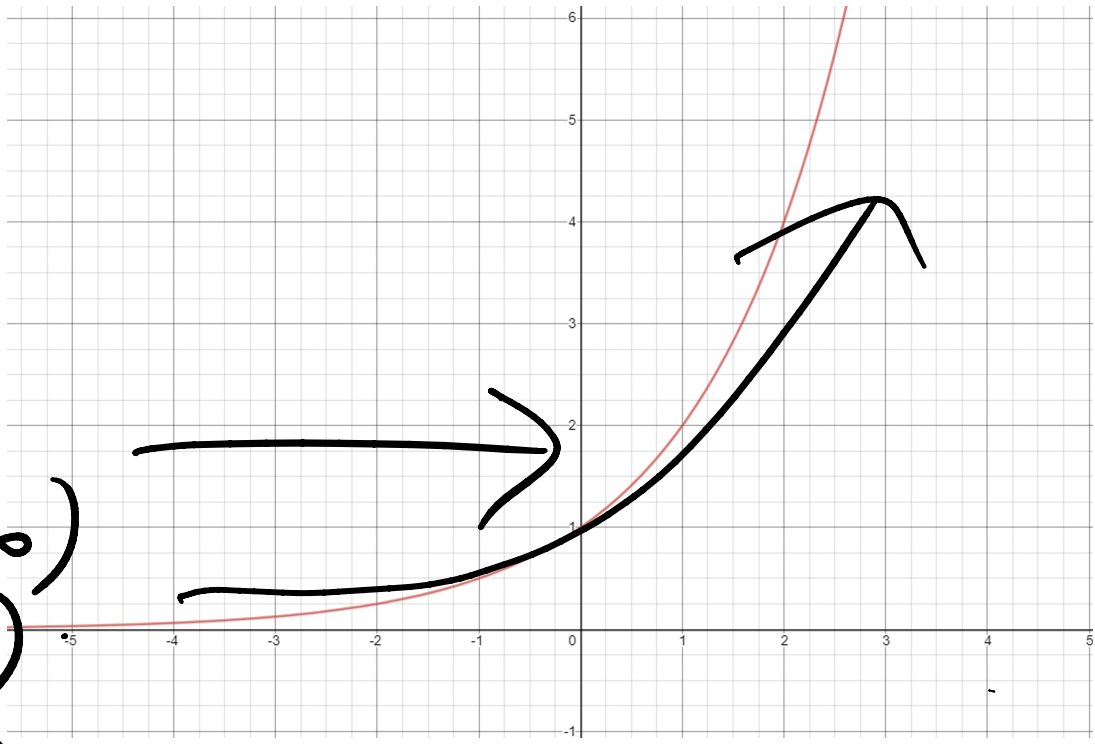
Find the transformations of

$$f(x) = 4 \cdot 3^{x+1}$$

a. Vertical compression by 4, shift left 1
b. Vertical stretch by 4, shift right 1
c. Shift up 4, Shift right 1
d. Shift up 4, Shift left 1
e. Vertical stretch by 4, horizontal stretch by 1
f. None of the above

Graph (Parent Function)

X	Y
-2	1/4
-1	1/2
0	1
1	2
2	4
3	



$y = 2^x$

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

Range: $(0, \infty)$

Asymptote: $y = 0$

End Behavior

As $x \to -\infty$, $y \to 0$

As $x \to \infty$, $y \to \infty$

Graph (Transformation)

$y = 3 \cdot 2^{2x-5} - 1$

$x' = 2x - 5$

$+5 \quad +5$

$x' + 5 = 2x$

$\frac{x'}{2} + \frac{5}{2} = \frac{2x}{2}$

x	y = 2^x	x' =	y' = $3y - 1$
-2	1/4		
-1	1/2		
0	1		
1	2		
2	4		

$x' =$

$$y = 3 \cdot 2^{2x-5} - 1$$

x	$y = 2^x$	x' = x/2 + 5/2	y' = 3y - 1
-2	1/4	(-2)/2 + 5/2 = 1.5	3(1/4)-1 = 3/4 - 1 = -0.25
-1	1/2	(-1)/2 + 5/2=2	3(1/2)-1 = 3/2-1=0.5
0	1	(0)/2 + 5/2 =2.5	3(1)-1= 3-1=2
1	2	(1)/2 + 5/2 =3	3(2)-1= 6-1=5
2	4	(2)/2+ 5/2 =3.5	3(4)-1= 12-1=11

(1.5, -0.25)
(2, 0.5)
(2.5, 2)
(3, 5)
(3.5, 11)

$y = 3 \cdot 2^{2x-5} - 1$

(1.5, -0.25)
(2, 0.5)
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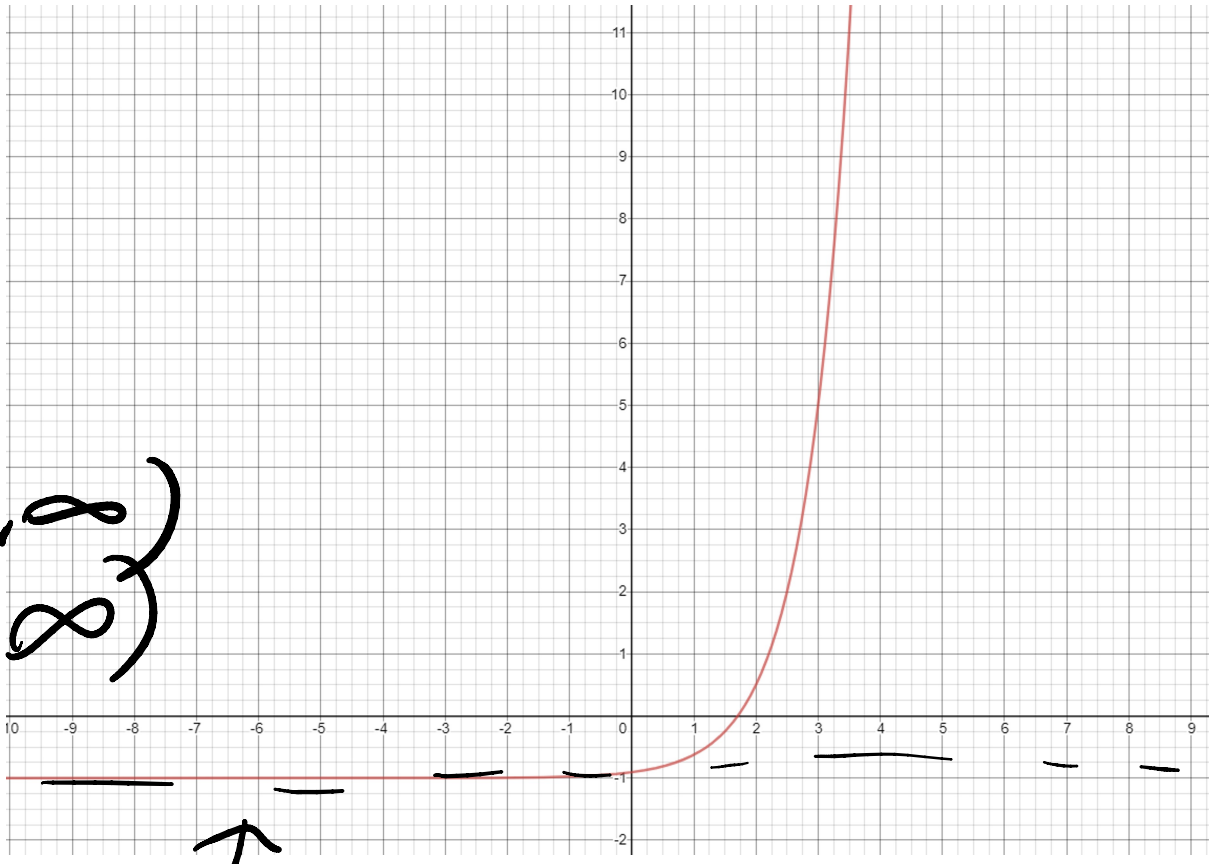
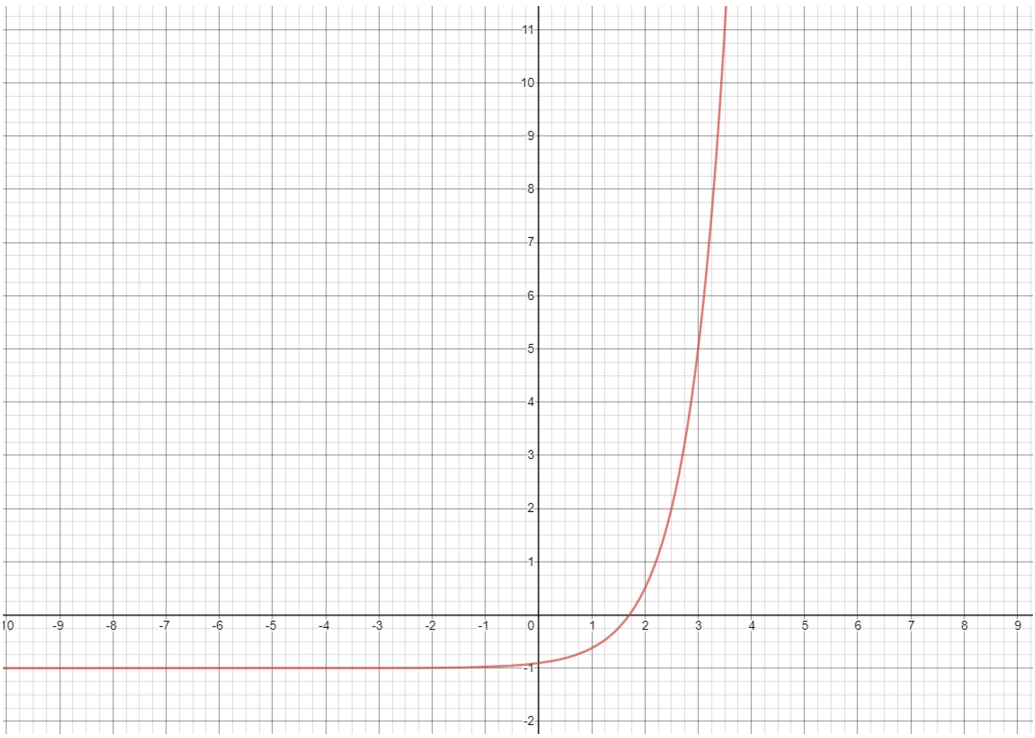
(3.5, 11)



Domain: $(-\infty, \infty)$
Range: $(-1, \infty)$

asymptote: $y = -1$

What is the equation of the horizontal asymptote?



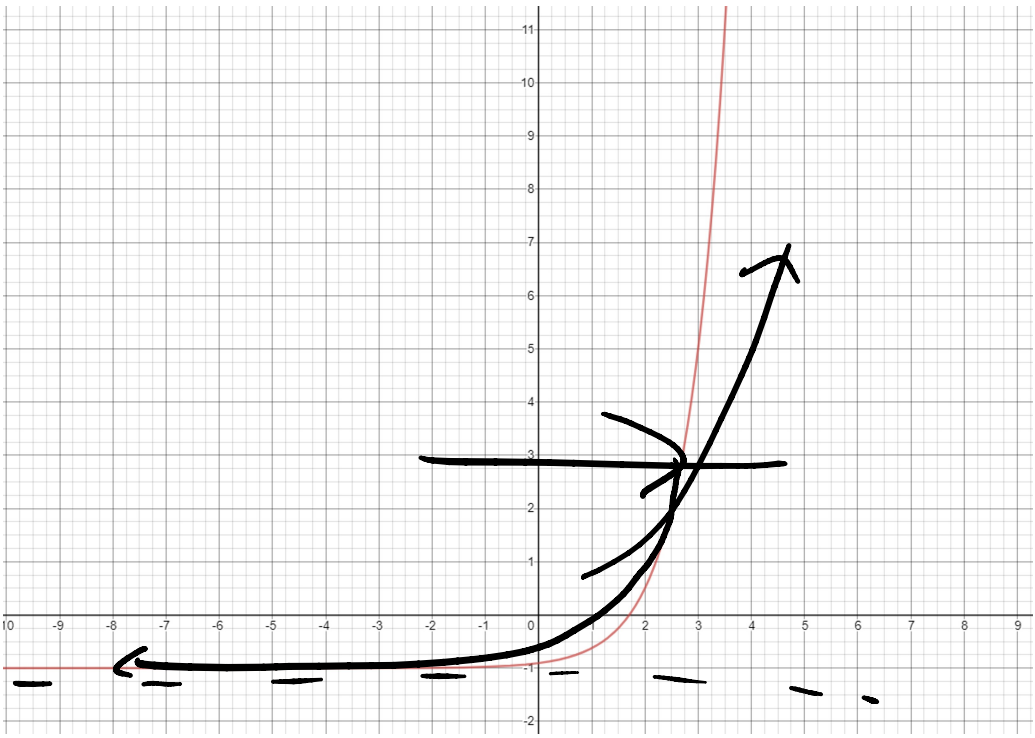
What is the equation of the horizontal asymptote?

y = -1

What is the end behavior?

As $x \to -\infty$, $y \to$ -1

As $x \to \infty$, $y \to$ ∞



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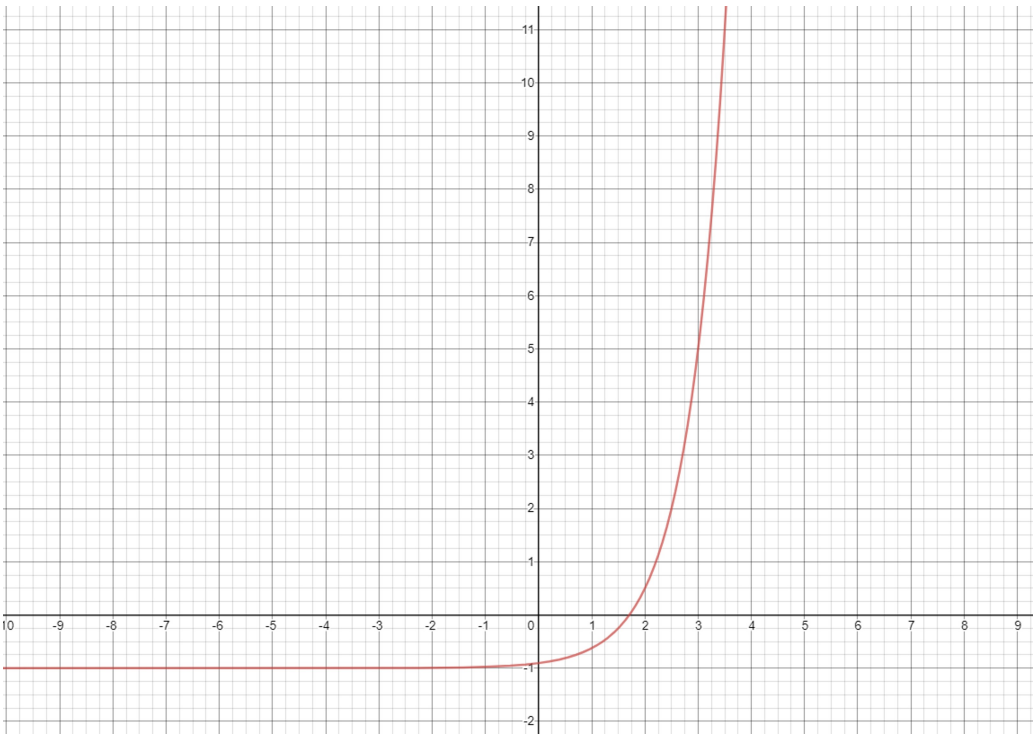

What are the transformations?

$y = 3 \cdot 2^{2x-5} - 1$.

x	y = 2^x	x' = x/2 + 5/2	y' = 3y - 1

.

Fill in the blank.

_____ _____ by 3
(Vertical/Horizontal) (Stretch/Compression)

_____ _____ by 1/2
(Vertical/Horizontal) (Stretch/Compression)

Shift _____ by 5/2
(Up/Down/Left/Right)

Shift _____ by 1
(Up/Down/Left/Right)

What are the transformations?

$y = 3 \cdot 2^{2x-5} - 1$

x	$y = 2^x$	x' = x/2 + 5/2	y' = 3y - 1

Vertical (Vertical/Horizontal) Stretch (Stretch/Compression) by 3

Horizontal (Vertical/Horizontal) Compression (Stretch/Compression) by 1/2

Shift Right (Up/Down/Left/Right) by 5/2

Shift Down (Up/Down/Left/Right) by 1

Graphing Activity

- Every one gets a Graphing Exponential Functions FlipBook
- Each group will go to a station to work the problems in the station on the FlipBook for about 4-5 minutes
- We will rotate through the different stations

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