

Lesson 12-2: Exponential Functions
 -follow a multiplication pattern
 -follow a +/- pattern in their second differences

An exponential function has the form $f(x) = ab^x$ where $a \neq 0$, $b \neq 1$, and $b > 0$.

[Ex. 1: Evaluating an Exponential Function]

(a) The function $f(x) = 2(3)^x$ models an insect population after x days. What will the population be on the 5th day?

$$f(x) = 2(3)^5$$

$$f(x) = 486$$

(b) The function $f(x) = 1500(0.995)^x$, where x is the time in years, models a prairie dog population. How many prairie dogs will there be in 8 years?

$$f(x) = 1500(0.995)^8$$

$$f(x) \approx 1441$$

[Ex 2: Transforming Exponential Functions]

Original: $f(x) = ab^x$
base

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

① Vertical Translation (shift)

$$ab^x + c \leftarrow \text{up}$$

$$ab^x - c \leftarrow \text{down}$$

$$f(x) = 2^x + 3 \leftarrow \text{shift up 3}$$

$$f(x) = 2^x - 3 \leftarrow \text{shift down 3}$$

② Horizontal Translation (shift)

$$ab^{x+c} \leftarrow \text{shift left}$$

$$ab^{x-c} \leftarrow \text{shift right}$$

$$f(x) = 2^{x+3} \leftarrow \text{shift left 3}$$

$$f(x) = 2^{x-3} \leftarrow \text{shift right 3}$$

③ Reflections

$$-ab^x \rightarrow \text{reflects across } x$$

$$ab^{-x} \rightarrow \text{reflects across } y$$

$$f(x) = -3 \cdot 2^x \rightarrow \text{ref. across } x$$

$$f(x) = 3 \cdot 2^{-x} \rightarrow \text{ref. across } y$$

④ Vertical Stretch & Shrink

$$\begin{matrix} \text{greater than} & \rightarrow & a & b^x & \leftarrow & \text{less than 1 but} \\ 1 = \text{stretch} & & & & & \text{greater than 0} \\ & & & & & \text{shrink} \end{matrix}$$

$$f(x) = 3 \cdot 2^x \rightarrow \text{stretch of } 3$$

$$f(x) = \frac{1}{3} \cdot 2^x \rightarrow \text{shrink of } \frac{1}{3}$$

[Practice]

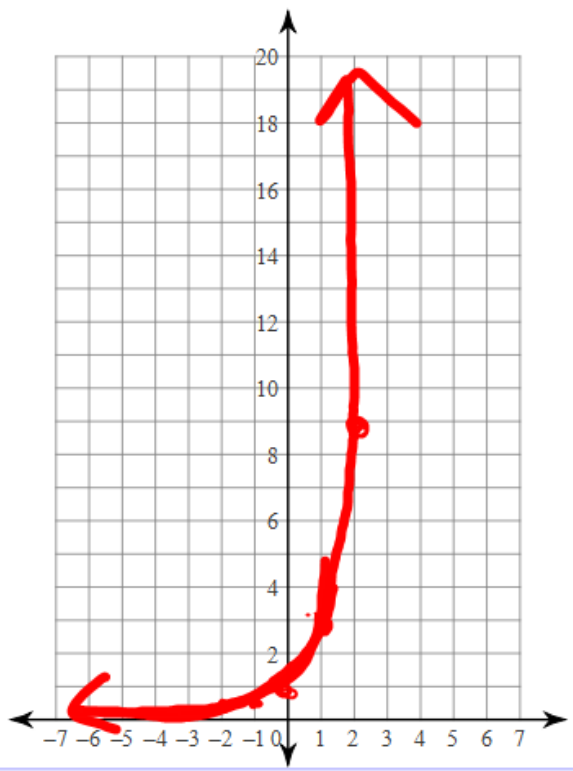
① $-2(8^{x+4}) - 3$
shift left 4
reflect across x \rightarrow stretches by 2 \leftarrow shift down 3

② $\frac{1}{4}(4^{-x}) + 2$
shrink by 1/4 \rightarrow reflects across y \leftarrow shifts up 2

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 Lines Zoom:

EXAMPLES: Sketch the graph of each function. Describe the transformation from the parent function $y = ab^x$

1) $y = 3^x$

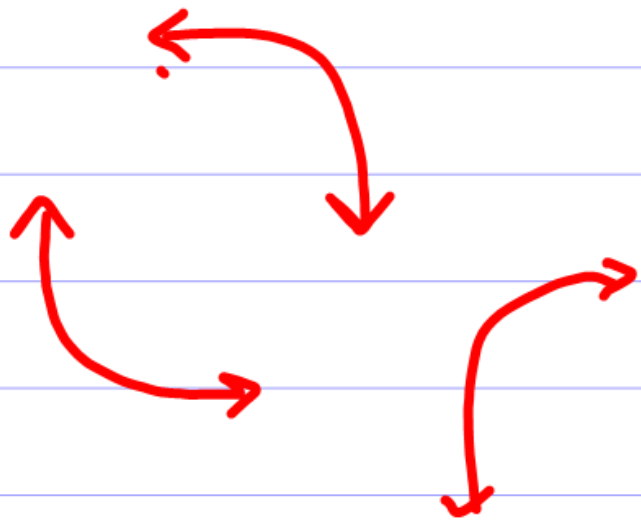


No transformation

X	y
-2	.111
-1	.333
0	1
1	3
2	9

~~X~~ \square

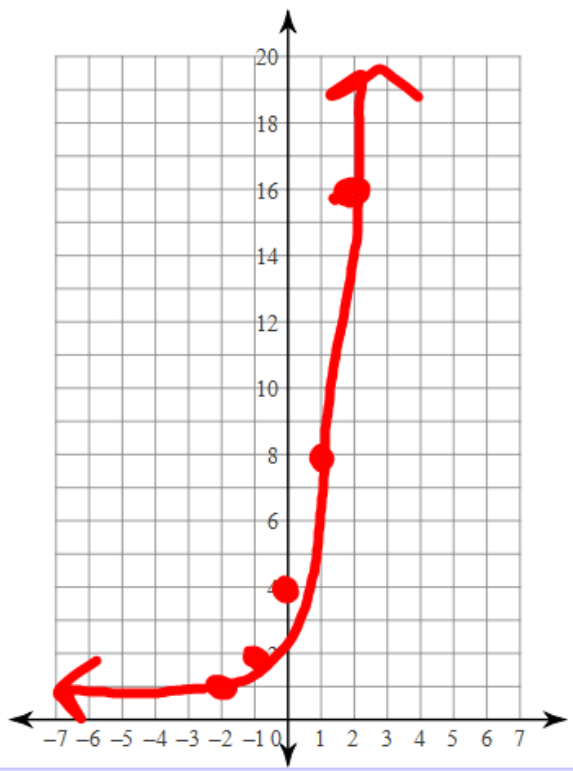
$\triangle \triangle \approx$



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EXAMPLES: Sketch the graph of each function. Describe the transformation from the parent function $y = ab^x$

2) $y = 4 \cdot 2^x$



Stretch of 4

x	y
-2	1
-1	2
0	4
1	8
2	16

