

3.2 Transformations of Exponential Functions

Standard:

A.CED.2



Old Write function using tables

Let's recall the parent function for exponential functions:

$$f(x) = (a)(r)^x$$

a = y-value when $x=0$

r = common ratio

①

x	-1	0	1	2	3
f(x)	.2	1	5	25	125

$$f(x) = (1)(5)^x$$

②

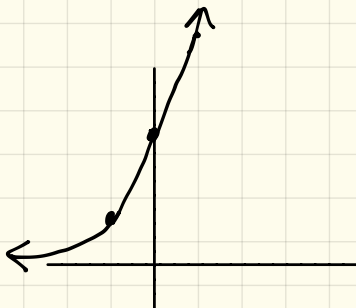
x	-2	-1	0	1	2
f(x)	.33	1	3	9	81

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

New Transformations for Exponential Functions (use graphing calculator.)

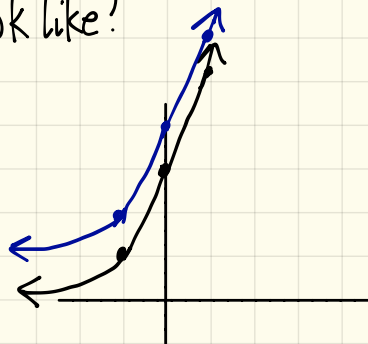
Let's consider the following exponential function:
Graph the function.

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



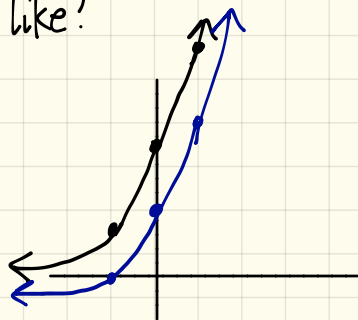
What does $f(x) = (3)(2)^x + 1$ look like?

The graph shifted up 1 unit.



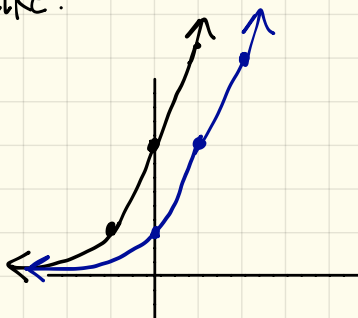
What does $f(x) = (3)(2)^x - 1$ look like?

The graph shifted down 1 unit.



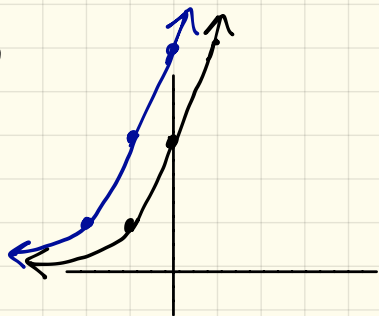
What does $f(x) = (3)(2)^{x-1}$ look like?

The graph shifted right 1 unit.



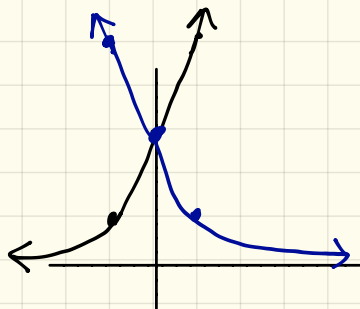
What does $f(x) = (3)(2)^{x+1}$ look like?

The graph shifted left 1 unit.



What does $f(x) = (3)\left(\frac{1}{2}\right)^x$ look like?

The graph reflected across the y-axis.
(DECAY)



General Rules — Memorize

The parent function for exponential functions $\rightarrow f(x) = (a)(b)^x$

- 1 $f(x) = (a)(b)^x + c \rightarrow$ shift up c units $f(x) + c$
- 2 $f(x) = (a)(b)^x - c \rightarrow$ shift down c units $f(x) - c$
- 3 $f(x) = (a)(b^{x+c}) \rightarrow$ shift left c units $f(x+c)$
- 4 $f(x) = (a)(b^{x-c}) \rightarrow$ shift right c units $f(x-c)$
- 5 $f(x) = (a)(b)^x$ if $0 < b < 1 \rightarrow$ reflection across y-axis

[Examples] From the functions, determine the transformation.

① $f(x) = (5)(3)^x + 6$

Starts at $(0, 5)$
Common ratio is 3
transformation: shift up 6

② $f(x) = (5)(3^{x+1})$

starts at $(0, 5)$
Common ratio is 3
transformation: shifts left 1

③ $f(x) = (2)(2^{x+3}) - 6$

starts at $(0, 2)$
Common ratio is 2
transformation: shift down 6
shift left 3

④ $f(x) = (2)(\frac{1}{2})^x - 6$

starts at $(0, 2)$
Common ratio is $\frac{1}{2}$
transformation: shift down 6
reflection across y-axis

[More Examples] Write functions using descriptions.

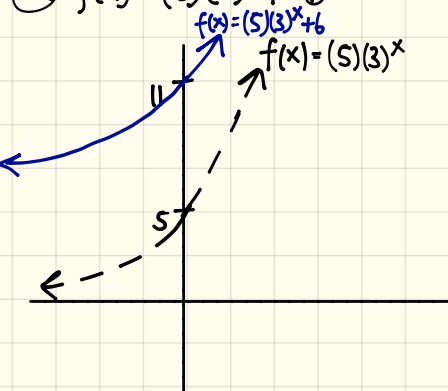
⑤ Function starts at $(0, 5)$ with common ratio 3 where shifting left 3 units — $f(x) = (5)(3^{x+3})$

⑥ Function starts at $(0, 2)$ with common ratio 7 where it shifts up 5 units — $f(x) = (2)(7)^x + 5$

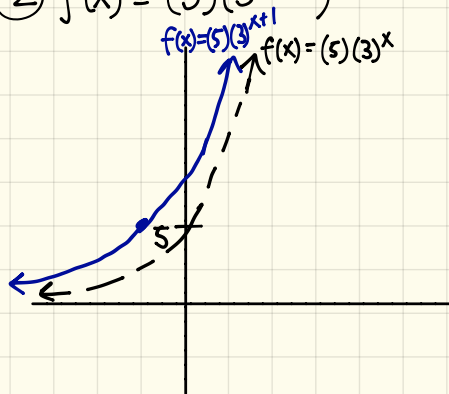
⑦ Function starts at $(0, -1)$ with common ratio $\frac{1}{2}$, where it shifts right 2 units & up 3 units. — $f(x) = (-1)(\frac{1}{2}^{x-2}) + 3$

[Examples] Sketch the graphs of each.

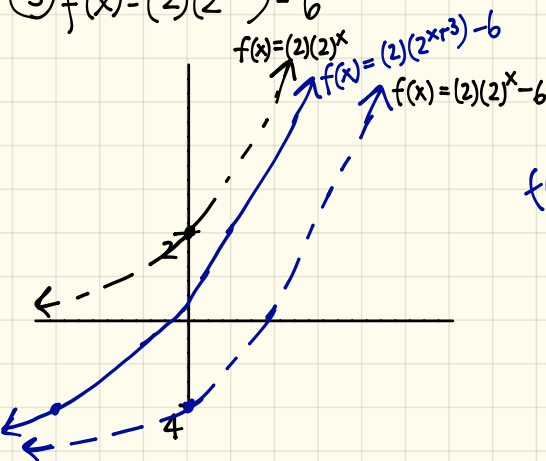
① $f(x) = (5)(3)^x + 6$



② $f(x) = (5)(3^{x+1})$



③ $f(x) = (2)(2^{x+3}) - 6$



④ $f(x) = (2)(\frac{1}{2})^x - 6$

