

21.3/21.4 Expo. Graphs and Asymptotes & Transforming Expo. Functions

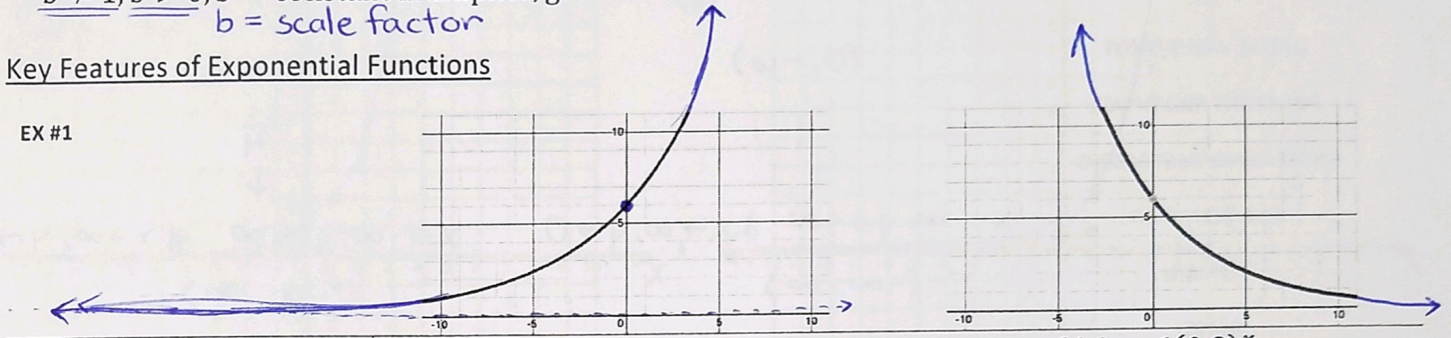
Exponential Function Review

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

$a \neq 0$, a = initial value = y - intercept on the graph = y - value when $x = 0$
 $b \neq 1$, $b > 0$, $b \neq 1$ = constant multiplier, growth factor if $b > 1$ & $a > 0$ and decay factor if $b < 1$ & $a > 0$
 b = scale factor

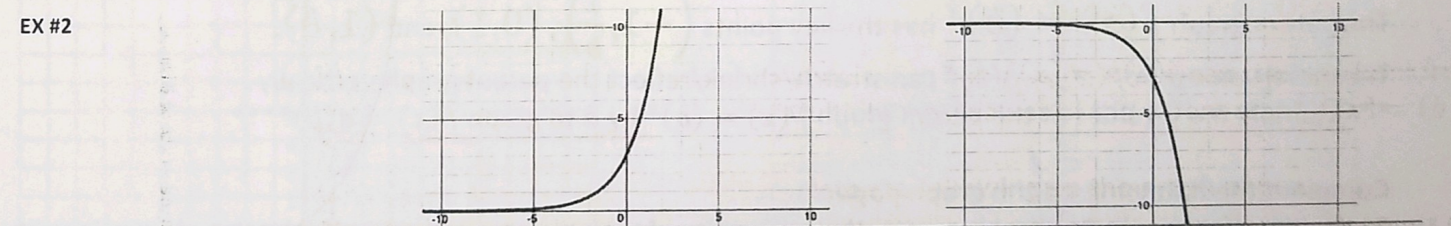
Key Features of Exponential Functions

EX #1



EQUATION	$f(x) = 6(1.2)^x$	$f(x) = 6(0.8)^x$
INITIAL VALUE/Y-INT	$(0, 6)$	$(0, 6)$
CONSTANT MULTIPLIER	1.2	0.8
INCREASING/DECREASING	↑	↓
END BEHAVIOR	$x \rightarrow -\infty, y \rightarrow 0$ & $x \rightarrow \infty, y \rightarrow \infty$	$x \rightarrow -\infty, y \rightarrow \infty$ & $x \rightarrow \infty, y \rightarrow 0$
DOMAIN ←→ left to right	$(-\infty, \infty)$	$(-\infty, \infty)$
RANGE ↑↓ bottom to top	$(0, \infty)$	$(0, \infty)$
ASYMPTOTE	$y = 0$	$y = 0$

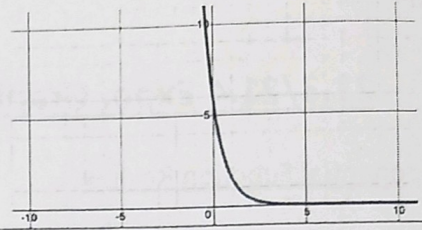
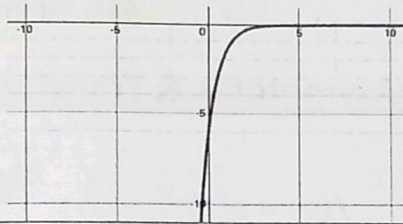
EX #2



EQUATION	$f(x) = 3(2)^x$	$f(x) = -3(2)^x$
INITIAL VALUE/Y-INT	$(0, 3)$	$(0, -3)$
CONSTANT MULTIPLIER	2	2
INCREASING/DECREASING	↑	↓
END BEHAVIOR	left: $x \rightarrow -\infty, y \rightarrow 0$ & right: $x \rightarrow \infty, y \rightarrow \infty$	down: $x \rightarrow -\infty, y \rightarrow 0$ & $x \rightarrow \infty, y \rightarrow -\infty$
DOMAIN	$(-\infty, \infty)$	$(-\infty, \infty)$
RANGE	$(0, \infty)$	$(-\infty, 0)$
ASYMPTOTE	$y = 0$	$y = 0$

$(0, -\infty)$
 ↑
WRONG

EX #3



EQUATION	$f(x) = -6\left(\frac{1}{4}\right)^x$	$f(x) = 6\left(\frac{1}{4}\right)^x$
INITIAL VALUE/Y-INT	$(0, -6)$	$(0, 6)$
CONSTANT MULTIPLIER	$\frac{1}{4}$	$\frac{1}{4}$
INCREASING/DECREASING	↑	↓
END BEHAVIOR	$x \rightarrow -\infty, y \rightarrow -\infty$ & $x \rightarrow \infty, y \rightarrow 0$	$x \rightarrow -\infty, y \rightarrow \infty$ & $x \rightarrow \infty, y \rightarrow 0$
DOMAIN	$(-\infty, \infty)$	$(-\infty, \infty)$
RANGE	$(-\infty, 0)$	$(0, \infty)$
ASYMPTOTE	$y = 0$	$y = 0$

Key Features Summary

When will the graphs increase?

$a > 0$ & $b > 1$
OR
 $a < 0$ & $b < 1$

Where is the asymptote for exponential functions?

$y = 0$
only for today

When will the graphs decrease?

$a < 0$ & $b > 1$
OR
 $a > 0$ & $b < 1$

What is the end behavior around the asymptotes?

$y \rightarrow 0$

Graphing Exponential Functions

← parent

The parent graph $f(x) = (b)^x$ has the key points $(-1, \frac{1}{b})$, $(0, 1)$, and $(1, b)$.

The initial value a in $f(x) = a(b)^x$ can stretch/shrink/reflect the parent graph vertically.

***Multiply the y-values of the parent graph $f(x) = (b)^x$ by a to graph $f(x) = a(b)^x$ ***

Complete the following on the graph paper.

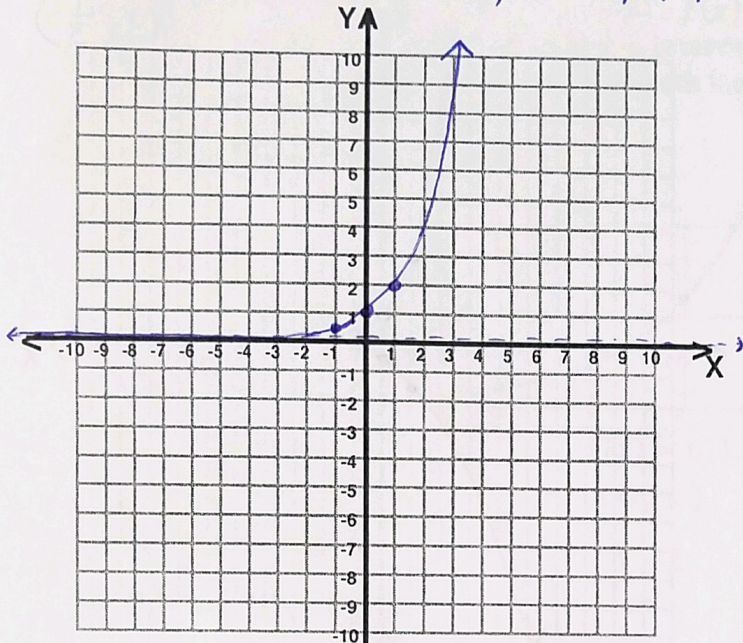
Ex #4: Identify the parent graph, identify the key points of the parent graph, identify the transformations of the parent graph (if any), then graph the functions on the graph paper.

a) $f(x) = (2)^x$	b) $f(x) = \frac{1}{4}(2)^x$	c) $f(x) = -3(2)^x$
d) $f(x) = \left(\frac{1}{3}\right)^x$	e) $f(x) = 2\left(\frac{1}{3}\right)^x$	f) $f(x) = -\frac{1}{2}\left(\frac{1}{3}\right)^x$
g) $f(x) = (4)^x$	h) $f(x) = -\frac{1}{4}(4)^x$	i) $f(x) = \frac{1}{2}(4)^x$

parent doesn't change

$f(x) = 1(2)^x$
parent: $(2)^x$

key points: $(-1, \frac{1}{2}), (0, 1), (1, 2)$

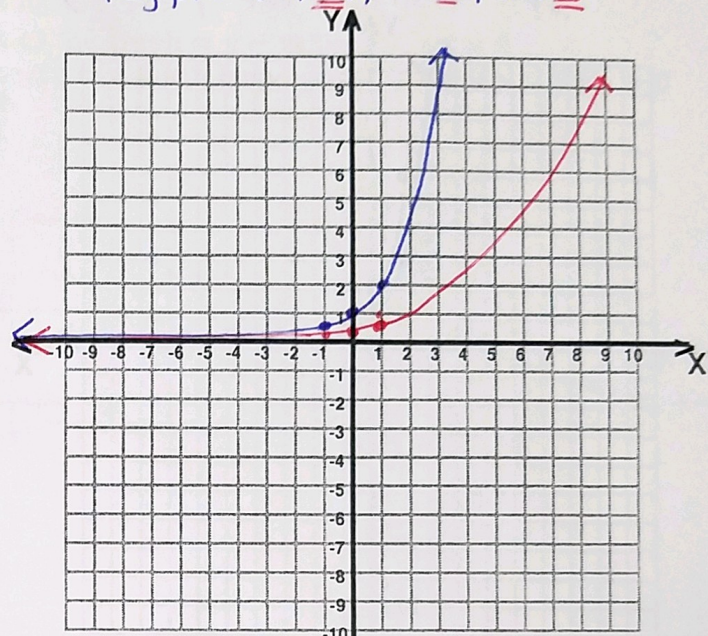


transformations: No transformations

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

parent: 2^x

key pts: $(-1, \frac{1}{2}), (0, 1), (1, 2)$

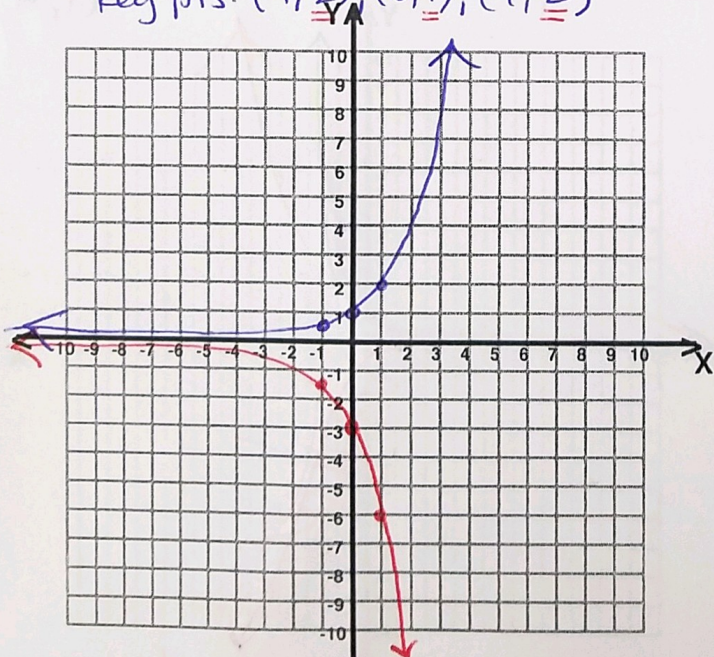


transformation: vertical shrink by $\frac{1}{4}$

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

parent: 2^x

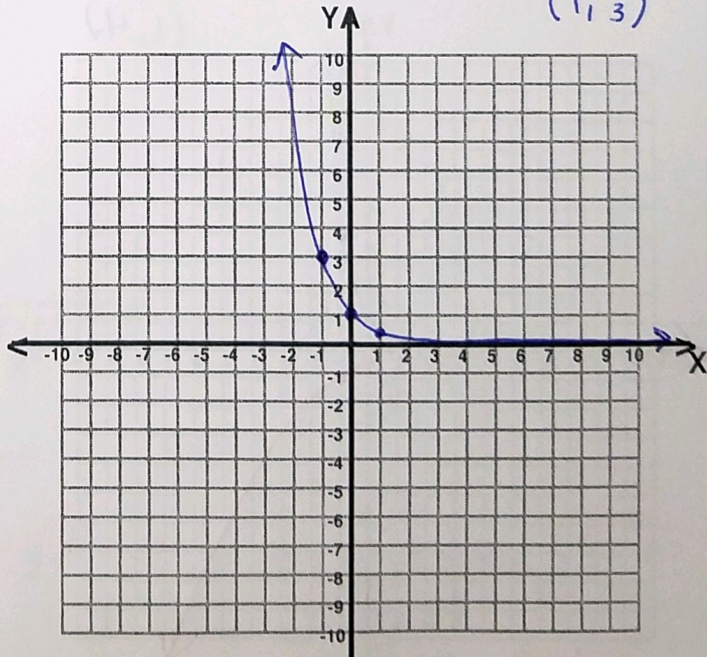
key pts: $(-1, \frac{1}{2}), (0, 1), (1, 2)$



transformations: reflect over x-axis
vertical stretch by 3

$f(x) = (\frac{1}{3})^x$
parent: $(\frac{1}{3})^x$

key pts: $(-1, 3), (0, 1), (1, \frac{1}{3})$



NO transformations

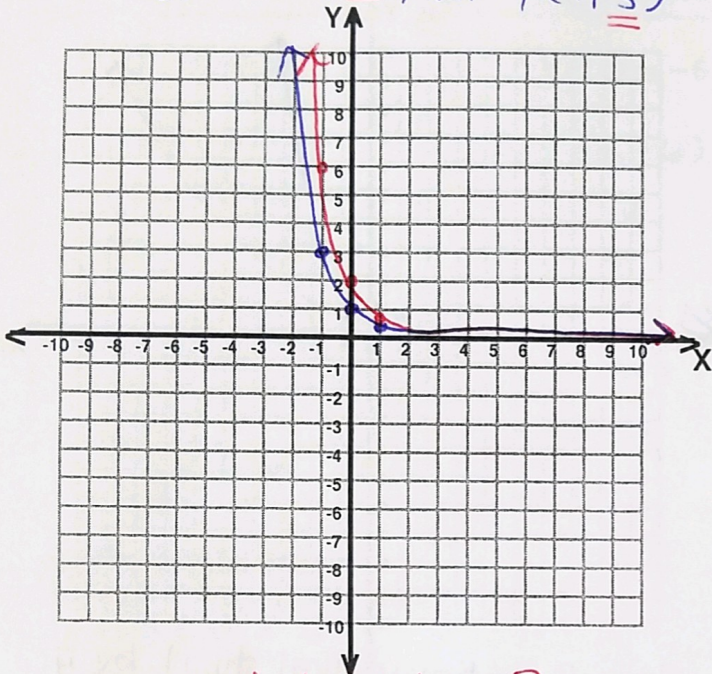
$$1\left(\frac{3}{1}\right) = 3$$

$$\left(-1, \frac{1}{\frac{1}{3}}\right) = (-1, 3)$$

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

parent: $\left(\frac{1}{3}\right)^x$

key pts: $(-1, \underline{3})$, $(0, 1)$, $(1, \underline{\frac{1}{3}})$

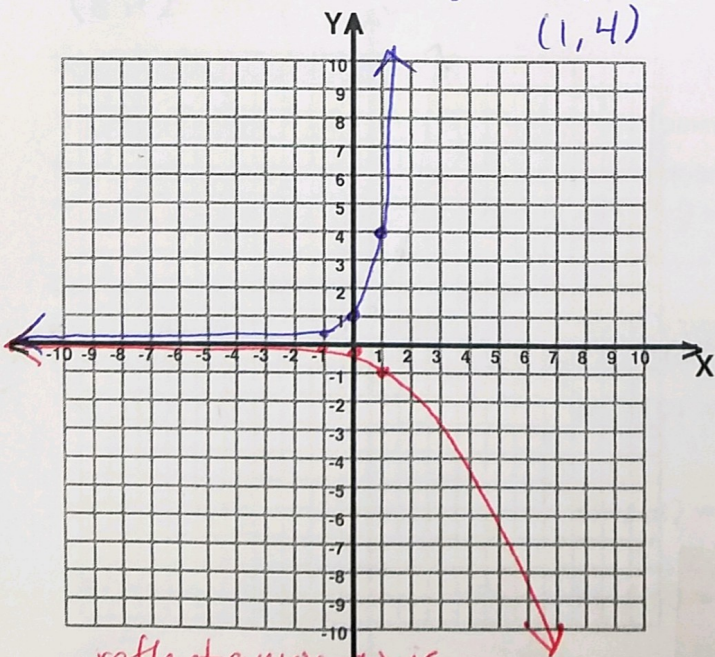


vertical stretch by 2

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

parent: 4^x

key pts: $(-1, \frac{1}{4})$, $(0, 1)$, $(1, 4)$

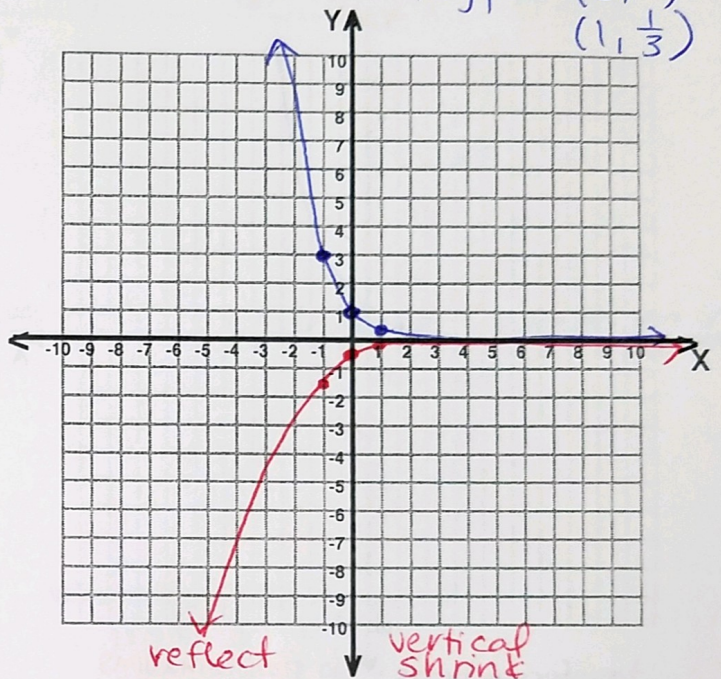


reflect over x-axis
vertical shrink by $\frac{1}{4}$

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

parent: $\left(\frac{1}{3}\right)^x$

key pts: $(-1, 3)$, $(0, 1)$, $(1, \frac{1}{3})$



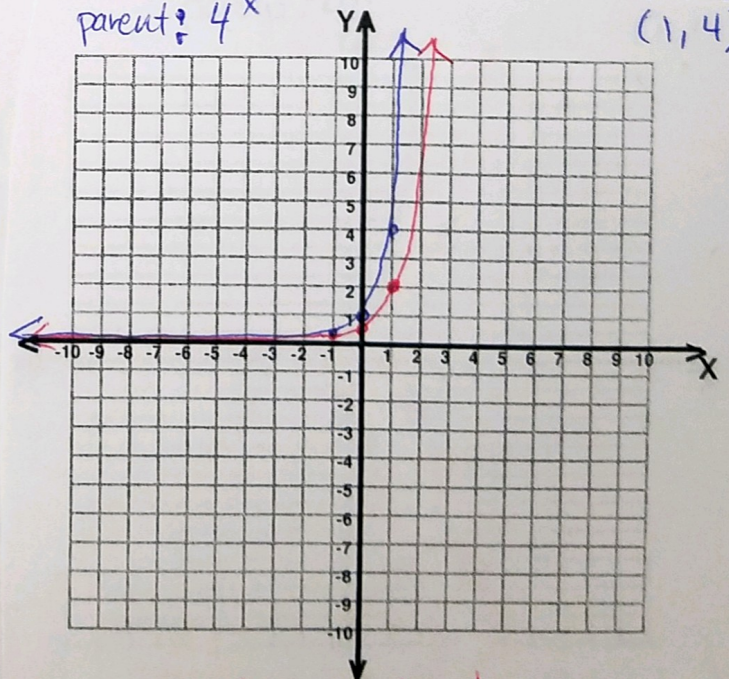
reflect over x-axis

vertical shrink by $\frac{1}{2}$

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

parent: 4^x

key pts: $(-1, \frac{1}{4})$, $(0, 1)$, $(1, 4)$



vertical shrink by $\frac{1}{2}$