21.4/21.5 More Exponential Transformations

Exponential Transformations Review

$f(x) = (b)^x$ has the points: $(-1, \frac{1}{b})$ $(0, 1)$ $(1, b)$

$f(x) = a(b)^x$ multiply the y-values of the points above by a

Transformations

$f(x) = a(b)^{x-c} + d$

- $+c$ "c units left"
- $-c$ "c units right"
- $+d$ "d units up"
- $-d$ "d units down"
- if negative "reflects over x-axis"
- $|a| > 1$ "vertical stretch by $|a|$"
- $|a| < 1$ "vertical shrink by $|a|$"

COMPLETE THE FOLLOWING ON THE GRAPH PAPER

Ex #1: State the transformations, identify the asymptote, graph the function, and state the domain and range.

a) $f(x) = 3^{x+4} + 1$	b) $f(x) = 2\left(\frac{1}{3}\right)^x - 4$	c) $f(x) = \frac{1}{2}(4)^{x-4} - 2$
d) $f(x) = -3(2)^{x-6} + 5$	e) $f(x) = \frac{1}{2}(2)^{x-4} + 1$	f) $f(x) = -2\left(\frac{1}{3}\right)^{x+4}$

Natural Base Exponential Functions

The natural number e (technically called Euler's number) comes up A LOT in Precalculus and Calculus when working with exponential functions, just like π comes up a lot in Geometry with circles.

$(-1, \frac{1}{b})$ $(0,1)$ $(1,b)$ → $(-1, \frac{1}{2.7})$ $(0,1)$ $(1,2.7)$

$e \approx 2.71828...$ $(-1, .4)$ $(0,1)$ $(1,2.7)$

You can use ^^^ that value instead of e in this class and always be correct.

COMPLETE THE FOLLOWING ON THE GRAPH PAPER

Ex #2: State the transformations, identify the asymptote, graph the function, and state the domain and range.

a) $f(x) = e^x$	b) $f(x) = -\frac{1}{2}e^x$	c) $f(x) = \frac{1}{4}e^x + 5$
d) $f(x) = e^{x-3} + 4$	e) $f(x) = -4e^{x-3} + 3$	f) $f(x) = 2e^{x+4}$

$f(x) = 3^x$

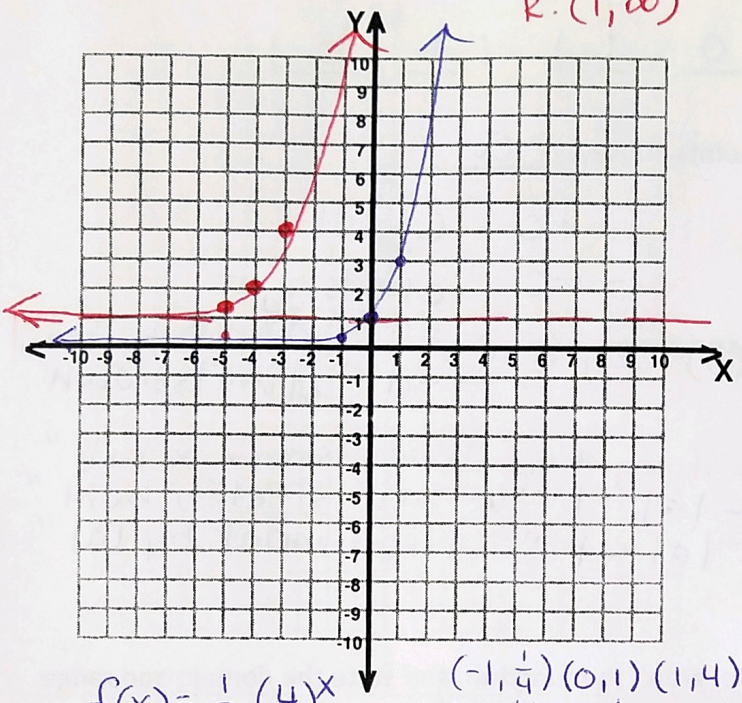
$f(x) = 3^{x+4} + 1$

4 left & 1 up

$y = 1$

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

R: $(1, \infty)$



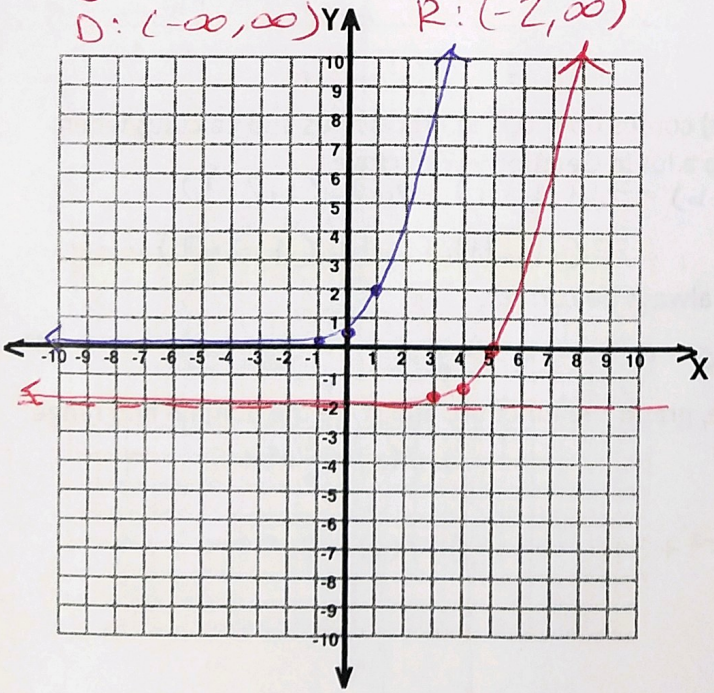
$f(x) = \frac{1}{2}(4)^x$ $(-1, \frac{1}{4})(0,1)(1,4)$

$f(x) = \frac{1}{2}(4)^{x-4} - 2$ $(-1, \frac{1}{8})(0, \frac{1}{2})(1,2)$

vertical shrink by $\frac{1}{2}$, right 4, down 2

$y = -2$

D: $(-\infty, \infty)$ R: $(-2, \infty)$



$f(x) = 2(\frac{1}{3})^x$ $(-1, \frac{1}{6})(0,1)(0,2)(1, \frac{1}{3})$ WIN WIN

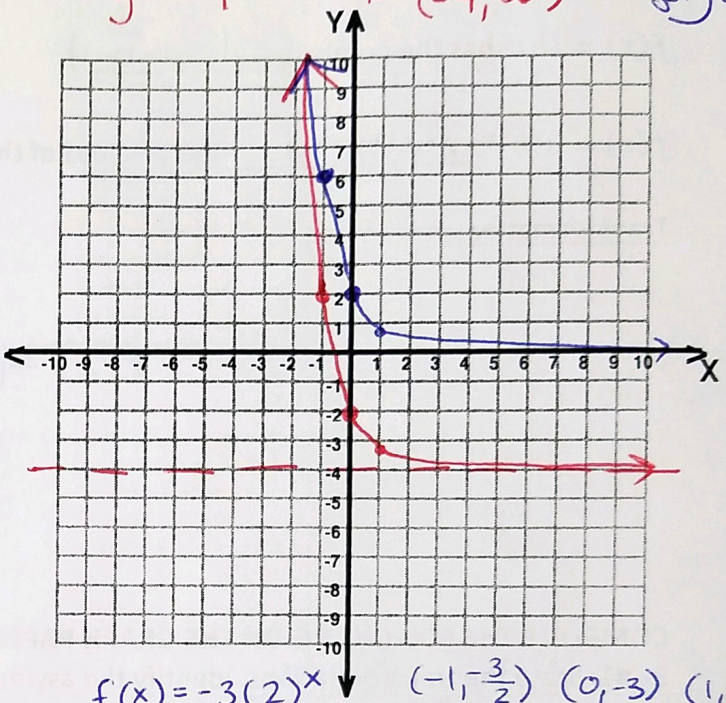
$f(x) = 2(\frac{1}{3})^x - 4$

vertical stretch by 2 & down 4

$y = -4$

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

R: $(-4, \infty)$



$f(x) = -3(2)^x$ $(-1, -\frac{3}{2})(0,-3)(1,-6)$

$f(x) = -3(2)^{x-6} + 5$

reflect over x-axis, vertical stretch by 3, right 6, up 5

$y = 5$

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

R: $(-\infty, 5)$

$f(x) = \frac{1}{2}(2)^x$ $(-1, \frac{1}{4})$ $(0, \frac{1}{2})$ $(1, 1)$

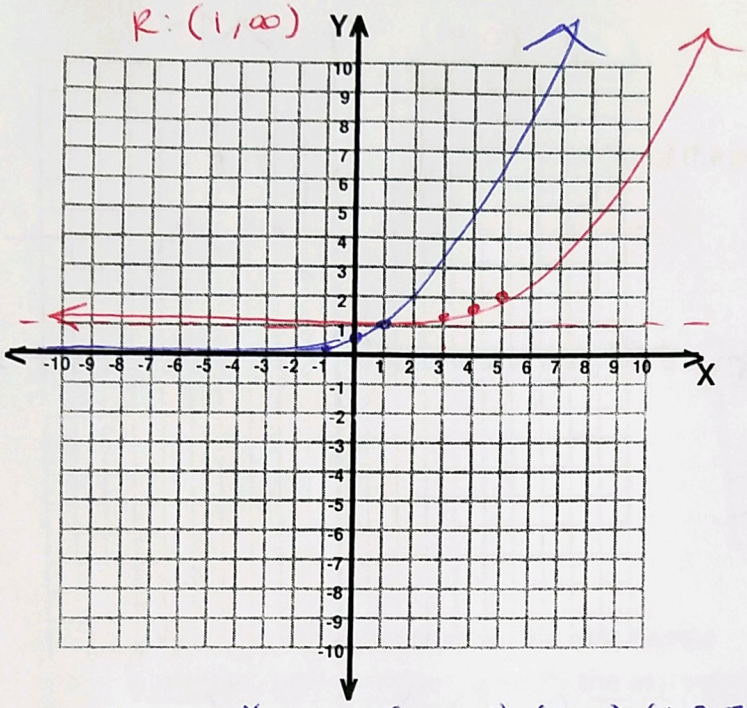
$f(x) = \frac{1}{2}(2)^{x-4} + 1$

vertical shrink by $\frac{1}{2}$, right 4, up 1

$y = 1$

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

R: $(1, \infty)$



$f(x) = -2(\frac{1}{3})^x$ $(-1, -6)$ $(0, -2)$ $(1, -\frac{1}{6})$

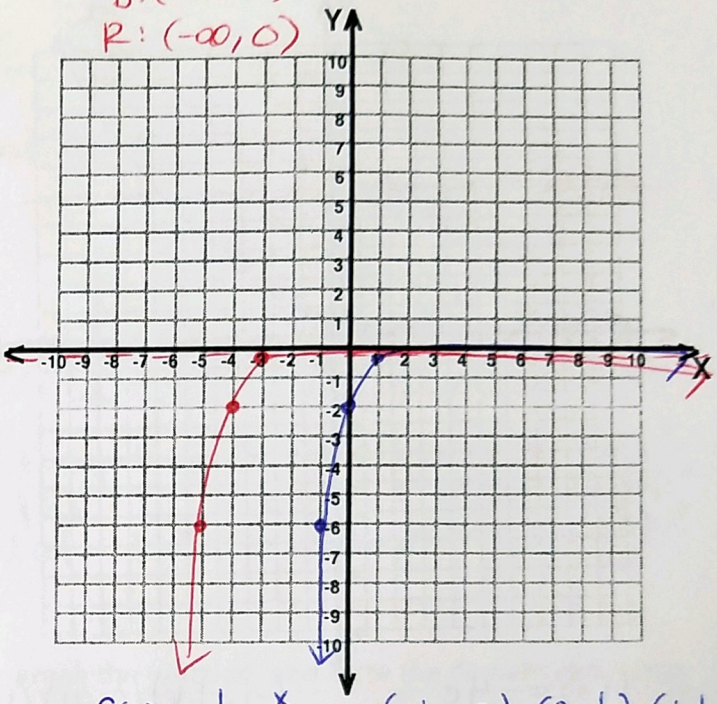
$f(x) = -2(\frac{1}{3})^{x+4}$

left 4, reflect over x-axis, vertical stretch by 2

$y = 0$

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

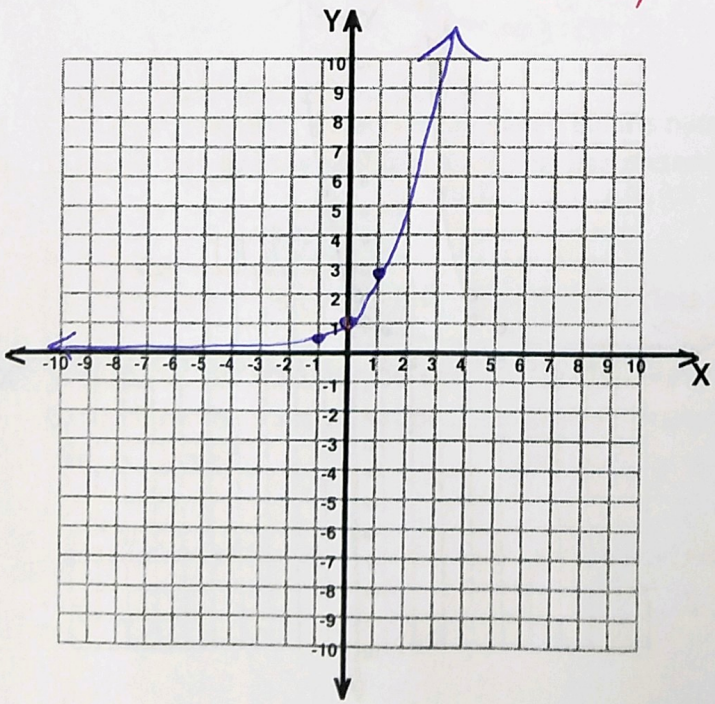
R: $(-\infty, 0)$



$f(x) = e^x$ $(-1, .4)$ $(0, 1)$ $(1, 2.7)$

No transformations

$y = 0$ D: $(-\infty, \infty)$ R: $(0, \infty)$

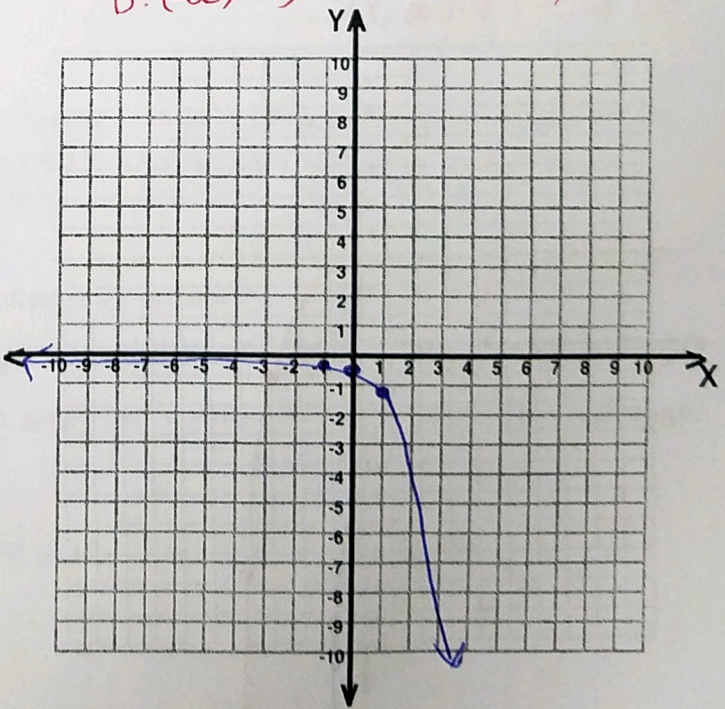


$f(x) = -\frac{1}{2}e^x$ $(-1, -.2)$ $(0, -\frac{1}{2})$ $(1, -1.35)$

reflection over x-axis, vert. shrink by $\frac{1}{2}$

$y = 0$

D: $(-\infty, \infty)$ R: $(-\infty, 0)$

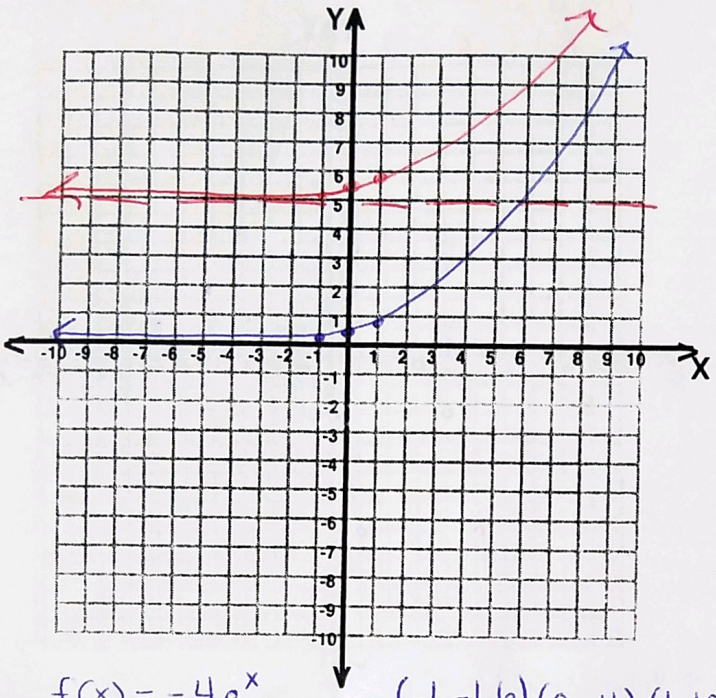


$f(x) = \frac{1}{4}e^x$ $(-1, .1)$ $(0, \frac{1}{4})$ $(1, .7)$

$f(x) = \frac{1}{4}e^x + 5$

vertical shrink by $\frac{1}{4}$, up 5

$y = 5$ D: $(-\infty, \infty)$ R: $(5, \infty)$



$f(x) = e^x$

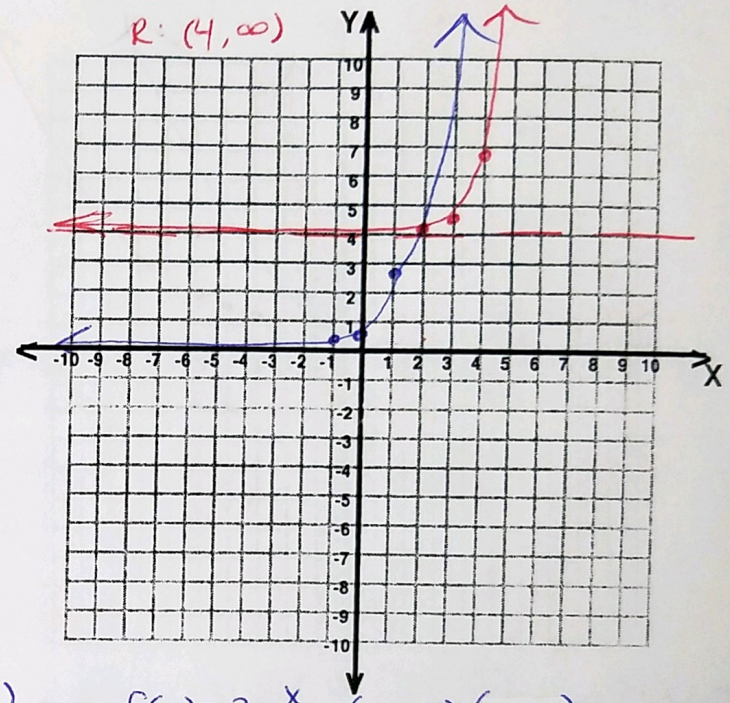
$f(x) = e^{x-3} + 4$

right 3, up 4

$y = 4$

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

R: $(4, \infty)$



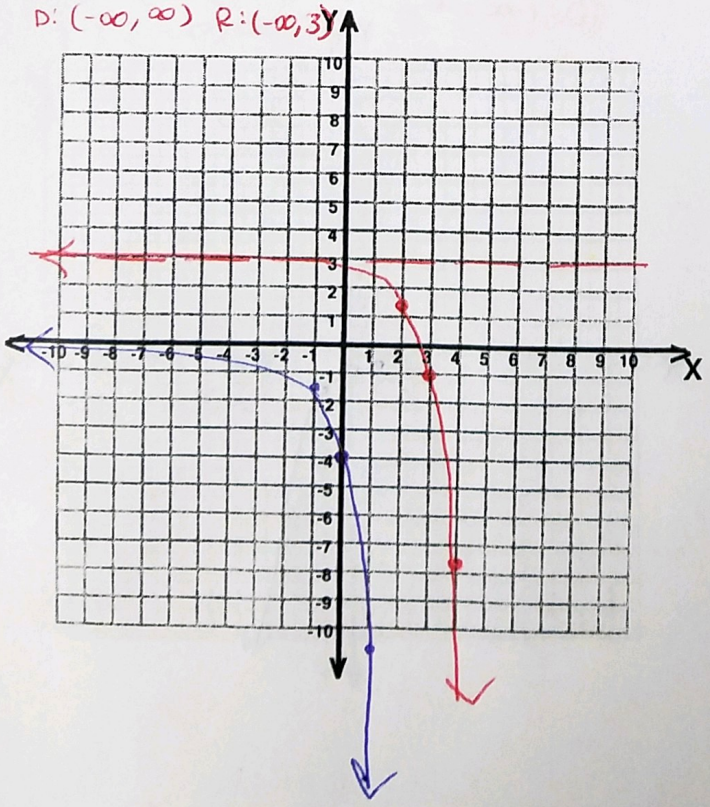
$f(x) = -4e^x$ $(-1, -1.6)$ $(0, -4)$ $(1, -10.8)$

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

reflect over x-axis, right 3, up 3, vertical stretch by 4

$y = 3$

D: $(-\infty, \infty)$ R: $(-\infty, 3)$



$f(x) = 2e^x$ $(-1, .8)$ $(0, 2)$ $(1, 5.4)$

$f(x) = 2e^{x+4}$

vertical stretch by 2, left 4

$y = 0$

D: $(-\infty, \infty)$ R: $(0, \infty)$