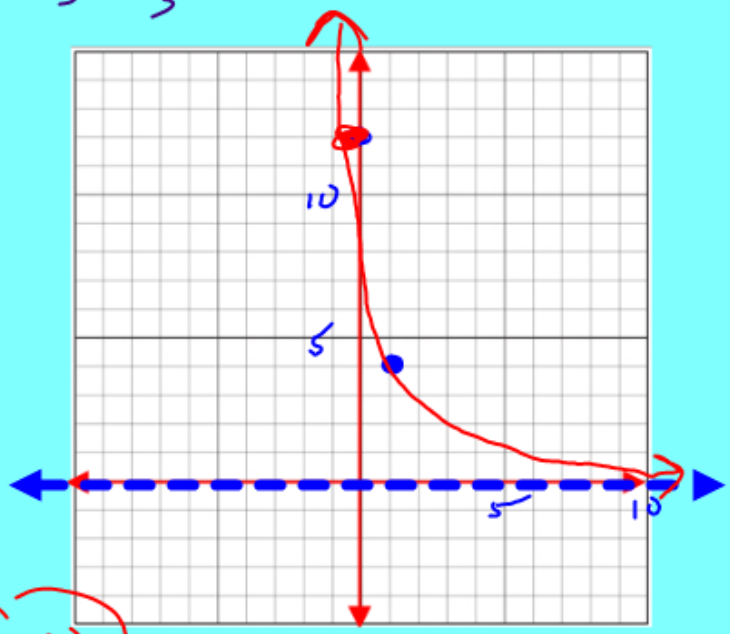
Warmup:
Graph the following exponential function.
Be sure to label your two points and the asymptote.

$y = a \cdot b^x$

$$y = 12\left(\frac{1}{3}\right)^x$$

$a = 12$
$b = \frac{1}{3}$



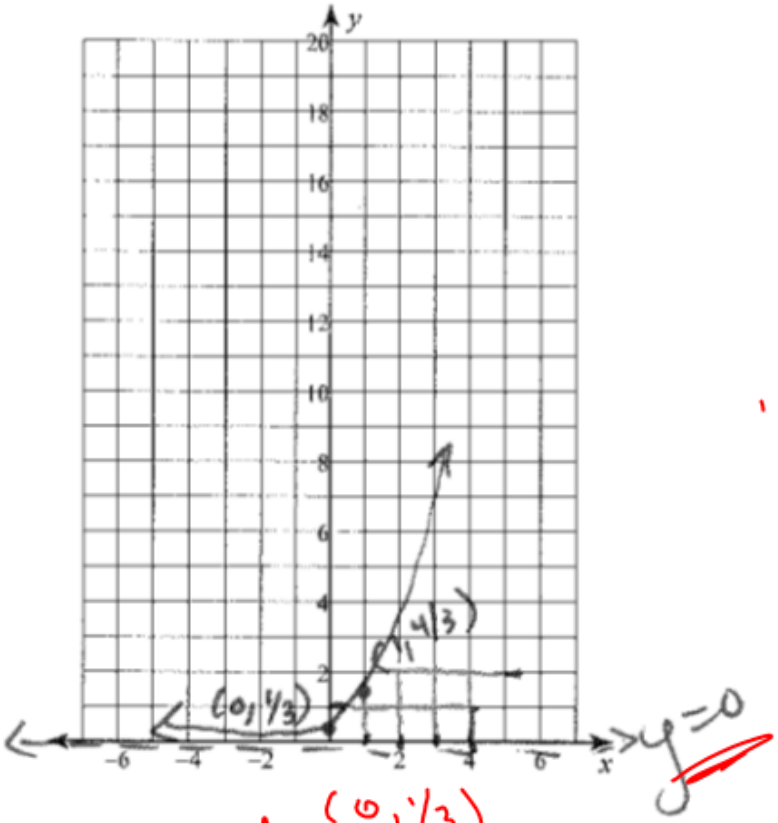
asymptote: $y = 0$

critical points
$(0, a)$ $(0, 12)$
$(1, a \cdot b)$ $(1, 12 \cdot \frac{1}{3})$ $(1, 4)$

HW #2: Graphing exponential functions

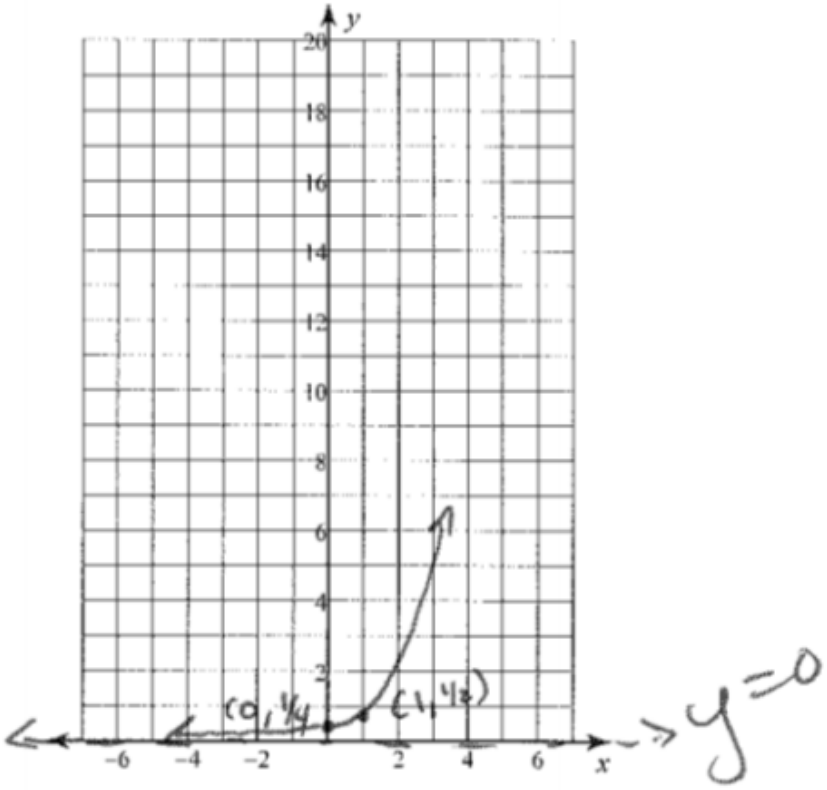
Answer Key

1) $y = \frac{1}{3} \cdot 4^x$



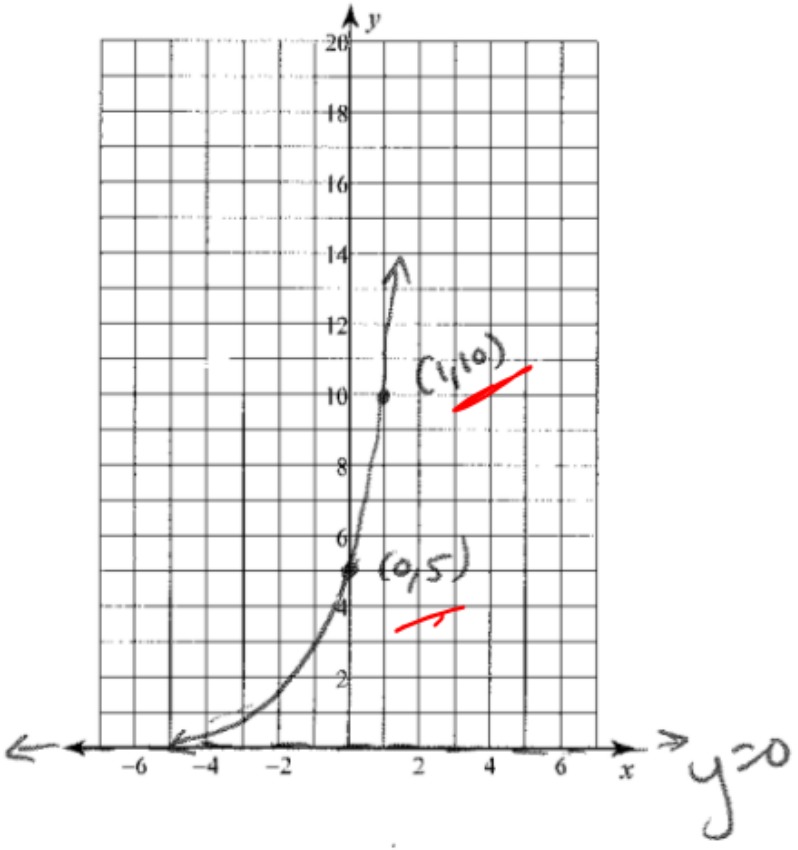
★ (0, 1/3)
(1, 4/3)

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

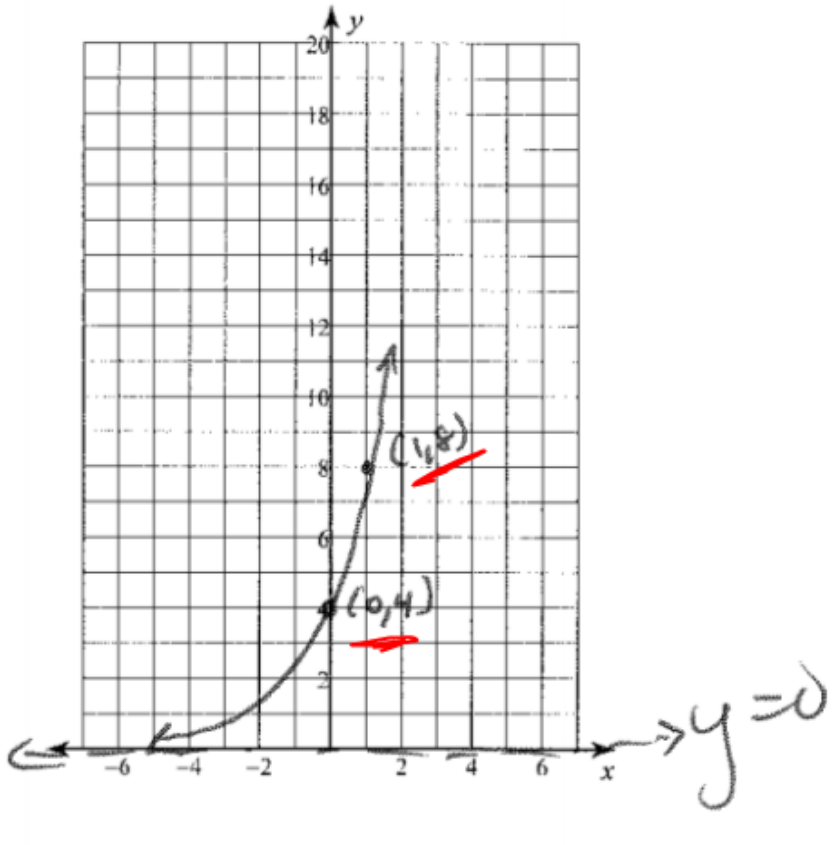


★ (0, 1/4)
(1, 1/2)

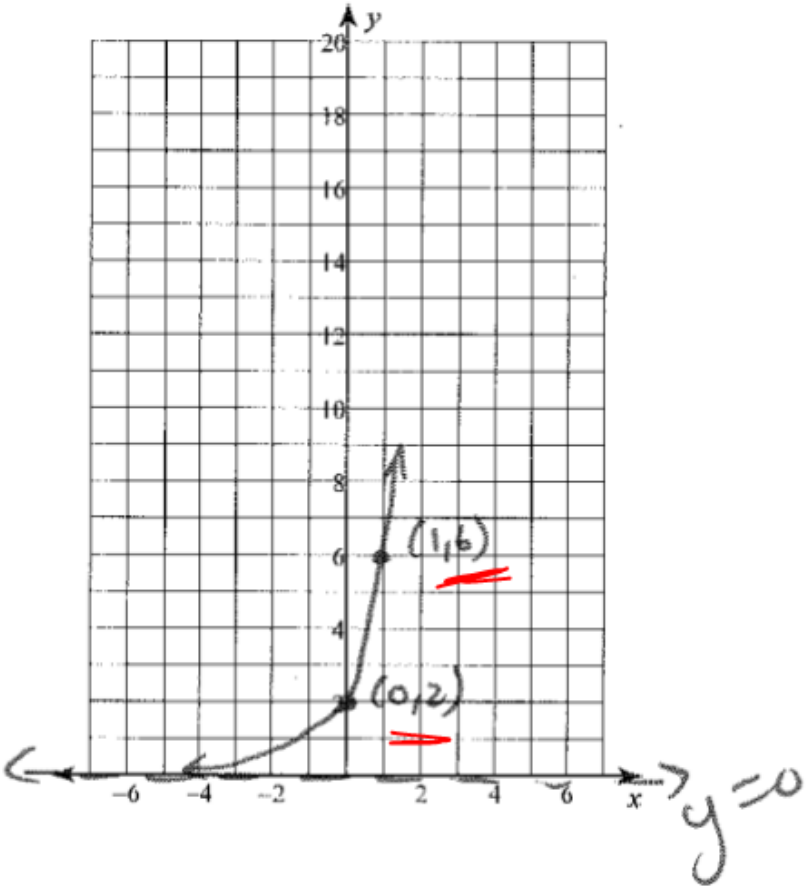
3) $y = 5 \cdot 2^x$



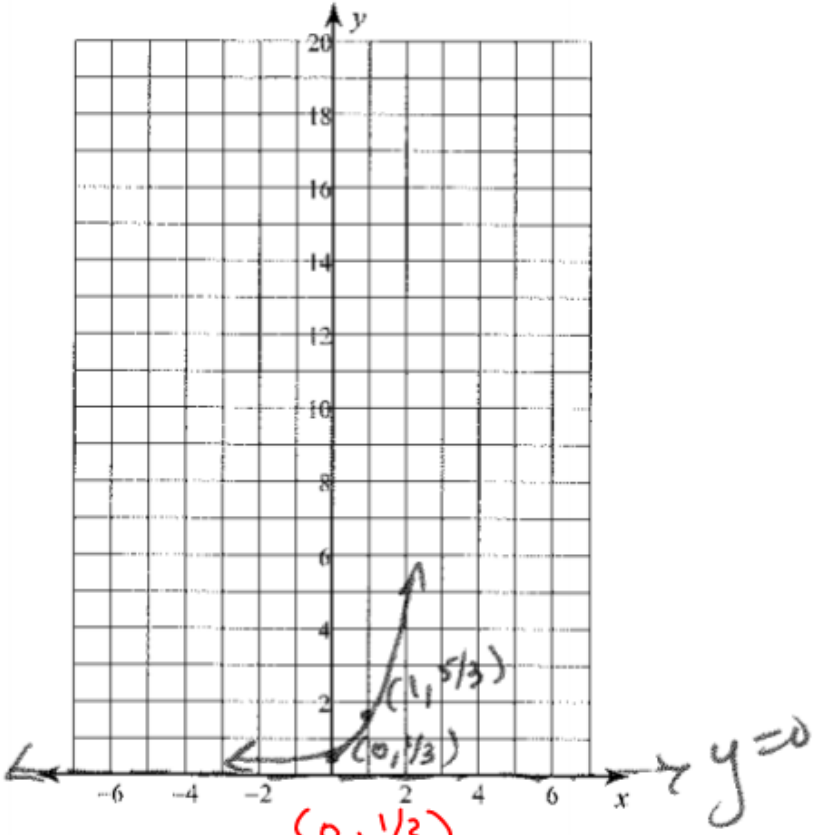
4) $y = 4 \cdot 2^x$



5) $y = 2 \cdot 3^x$



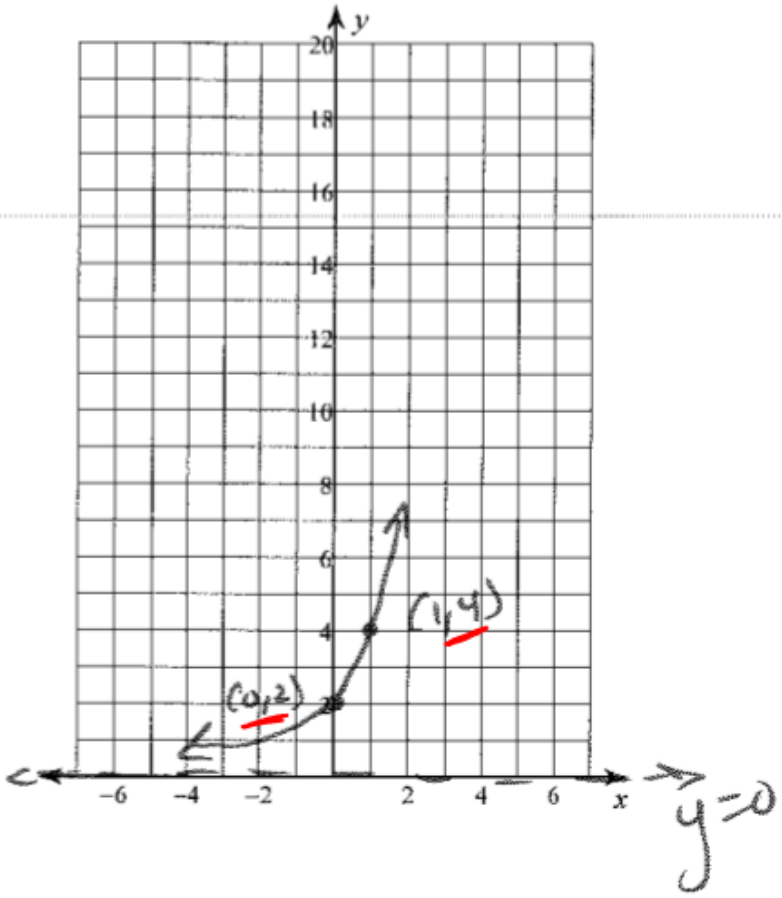
6) $y = \frac{1}{3} \cdot 5^x$



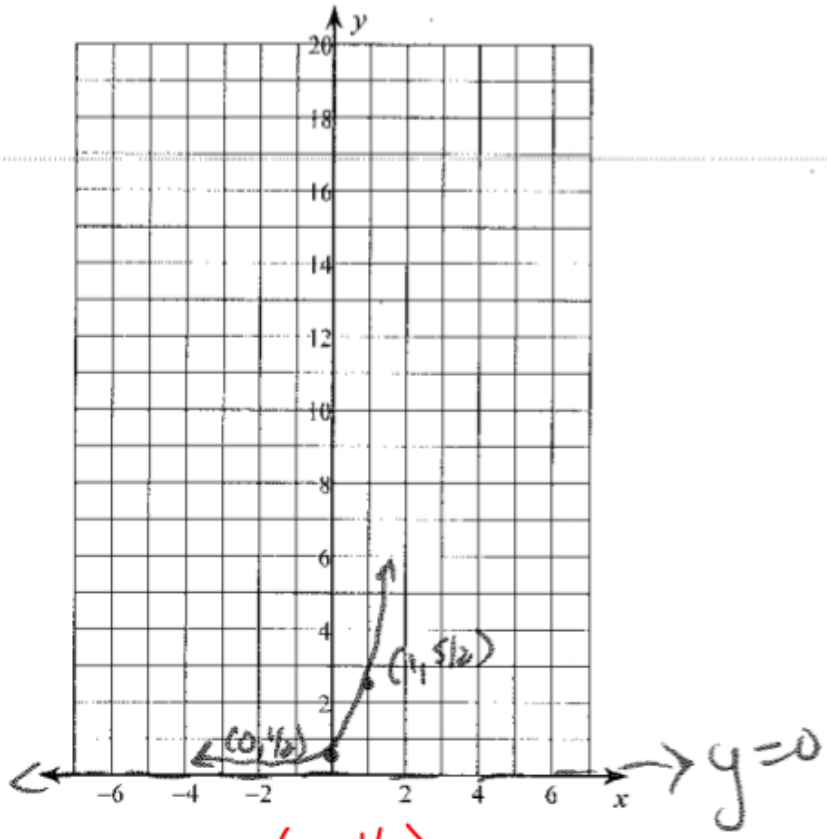
(0, 1/3)

(1, 5/3)

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



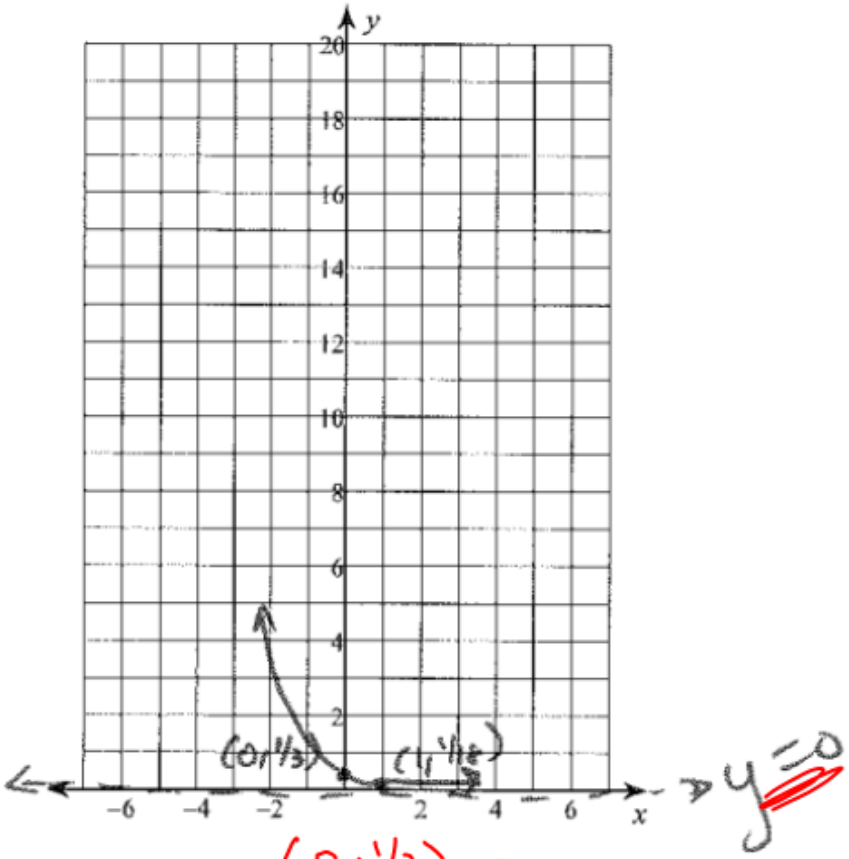
8) $y = \frac{1}{2} \cdot 5^x$



(0, 1/2)

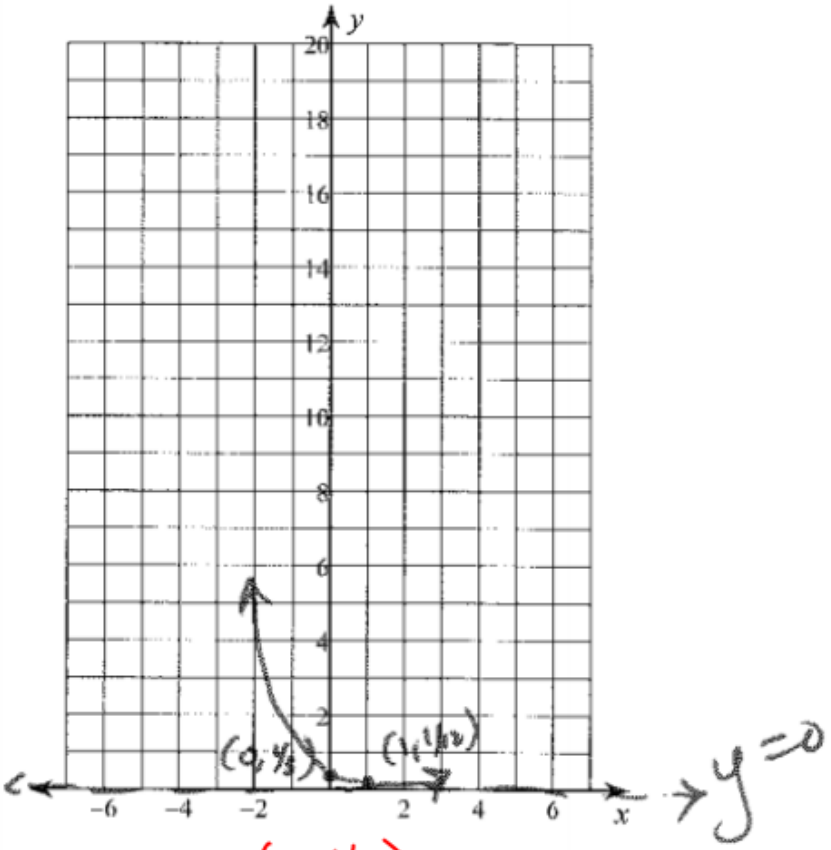
(1, 5/2)

9) $y = \frac{1}{3} \cdot \left(\frac{1}{6}\right)^x$



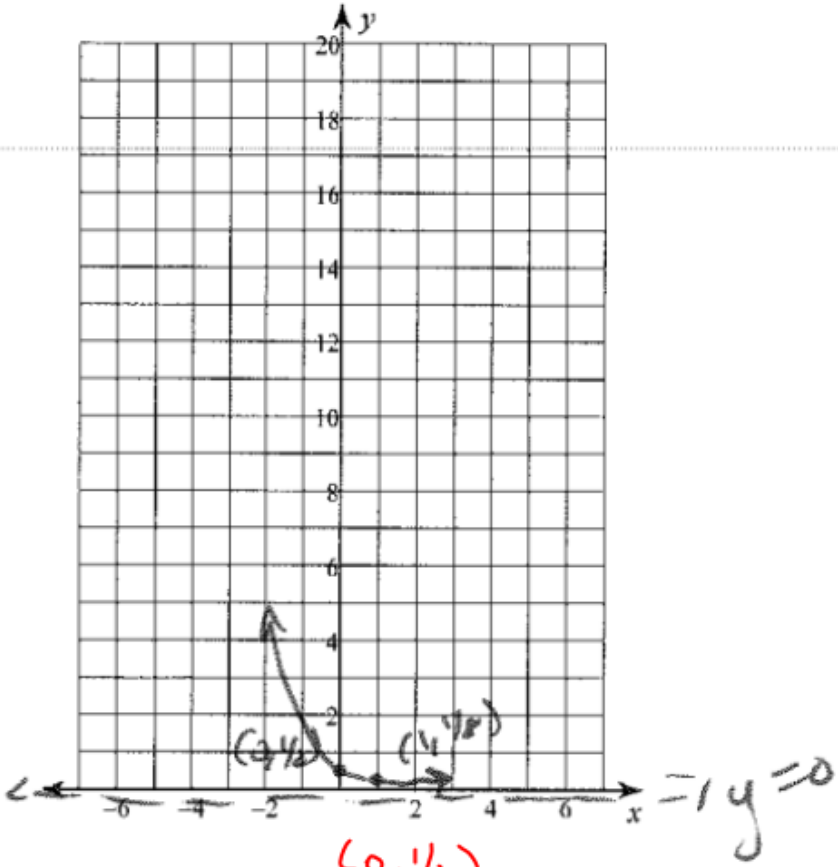
(0, 1/3)
(1, 1/18)

10) $y = \frac{1}{3} \cdot \left(\frac{1}{4}\right)^x$



(0, 1/3)
(1, 1/12)

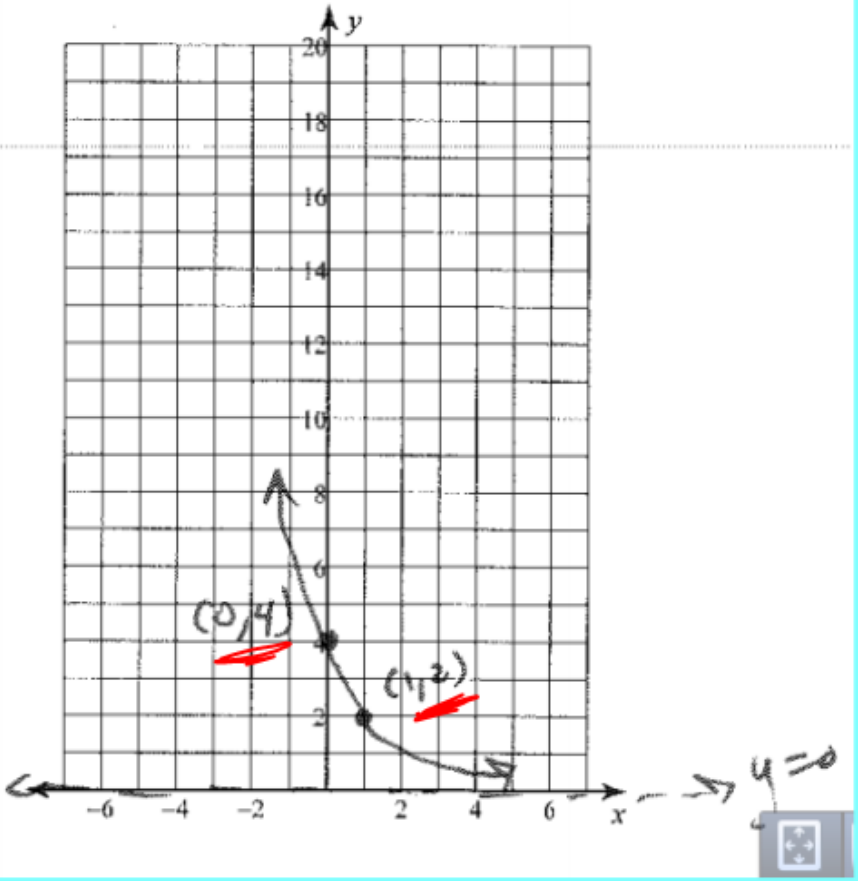
11) $y = \frac{1}{2} \cdot \left(\frac{1}{4}\right)^x$



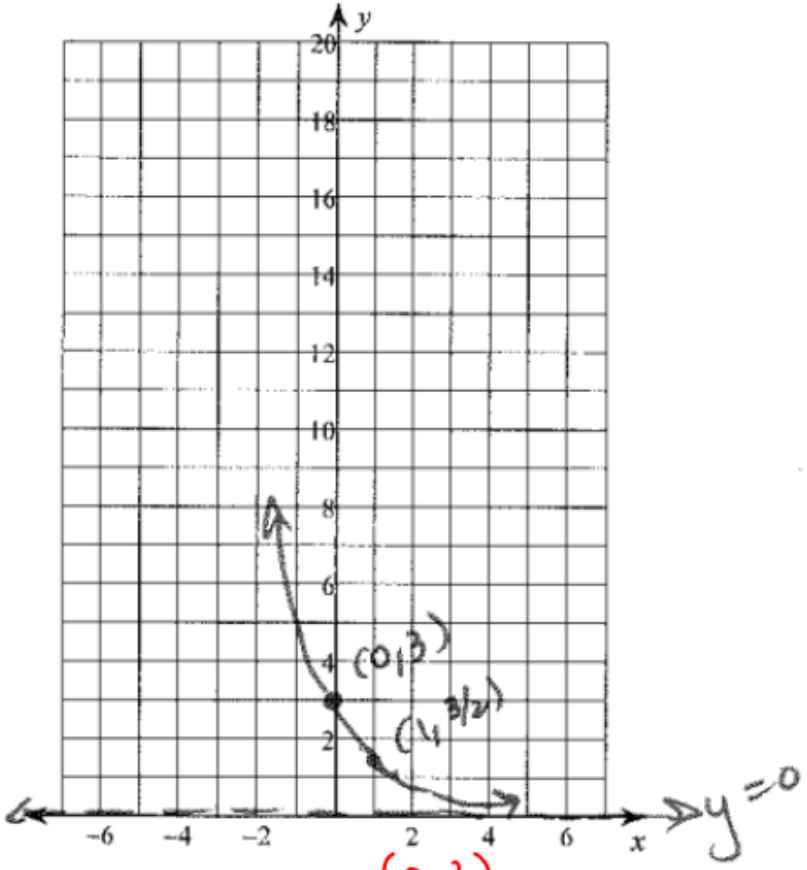
(0, 1/2)

(1, 1/8)

12) $y = 4 \cdot \left(\frac{1}{2}\right)^x$



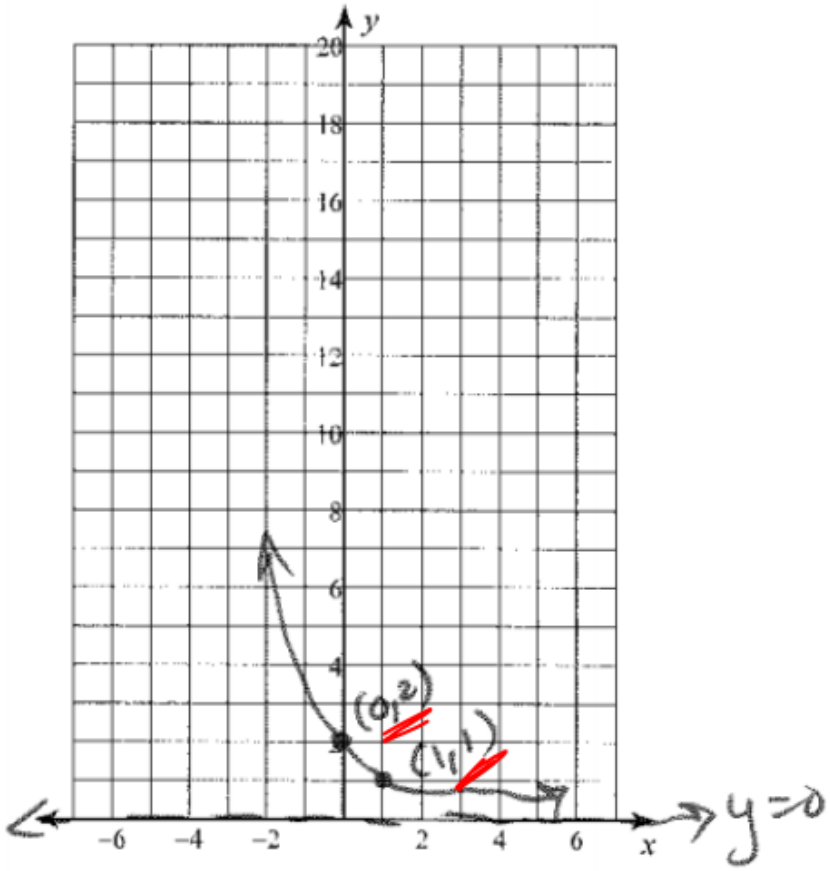
13) $y = 3 \cdot \left(\frac{1}{2}\right)^x$



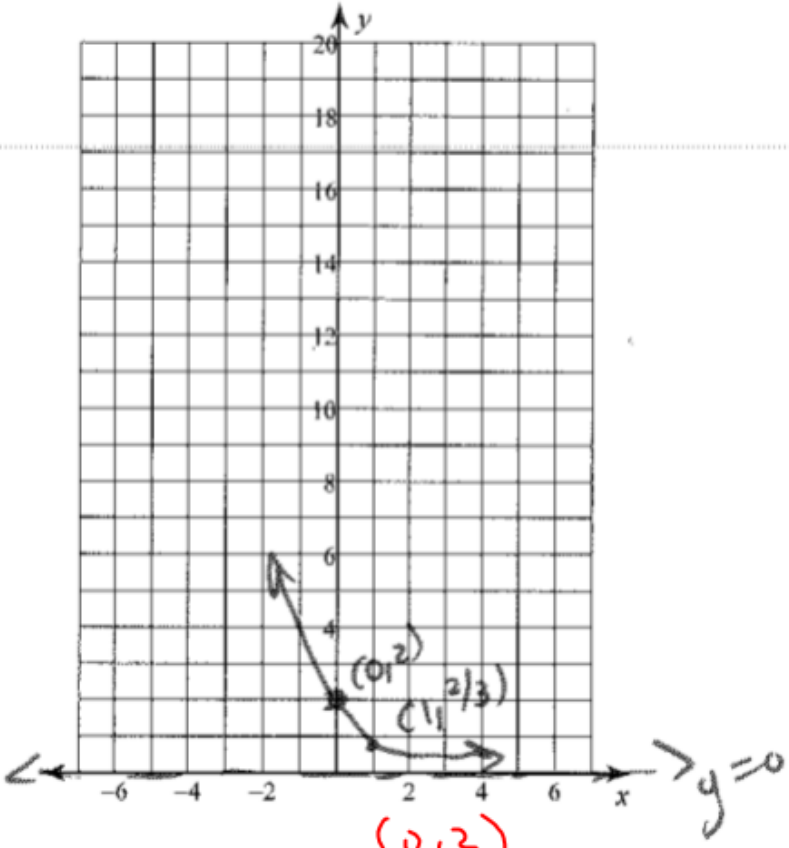
(0, 3)

(1, 3/2)

14) $y = 2 \cdot \left(\frac{1}{2}\right)^x$

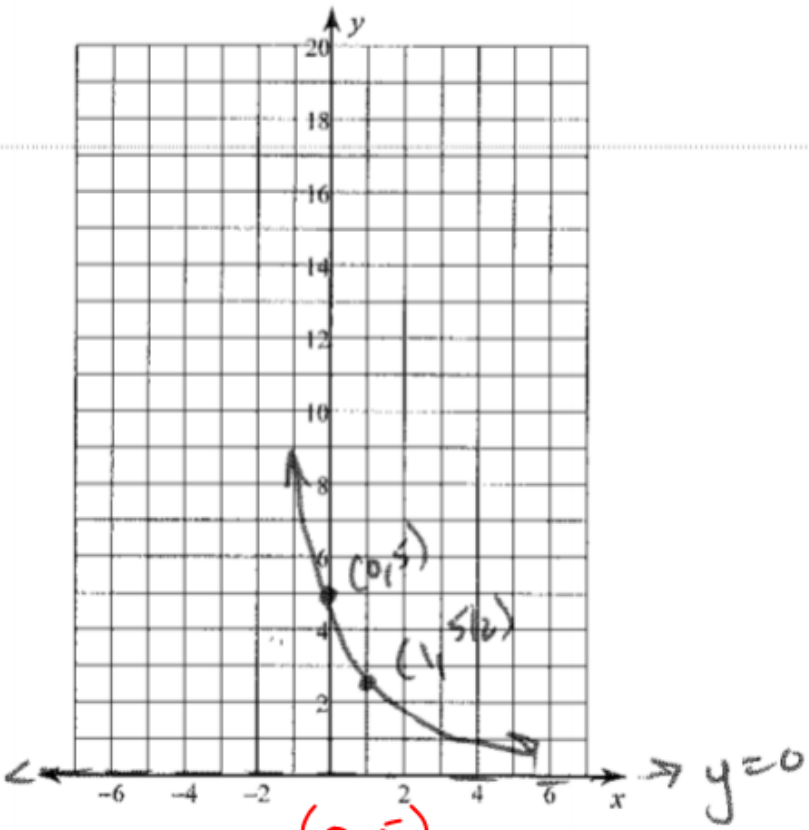


15) $y = 2 \cdot \left(\frac{1}{3}\right)^x$



(0,2)
(1,2/3)

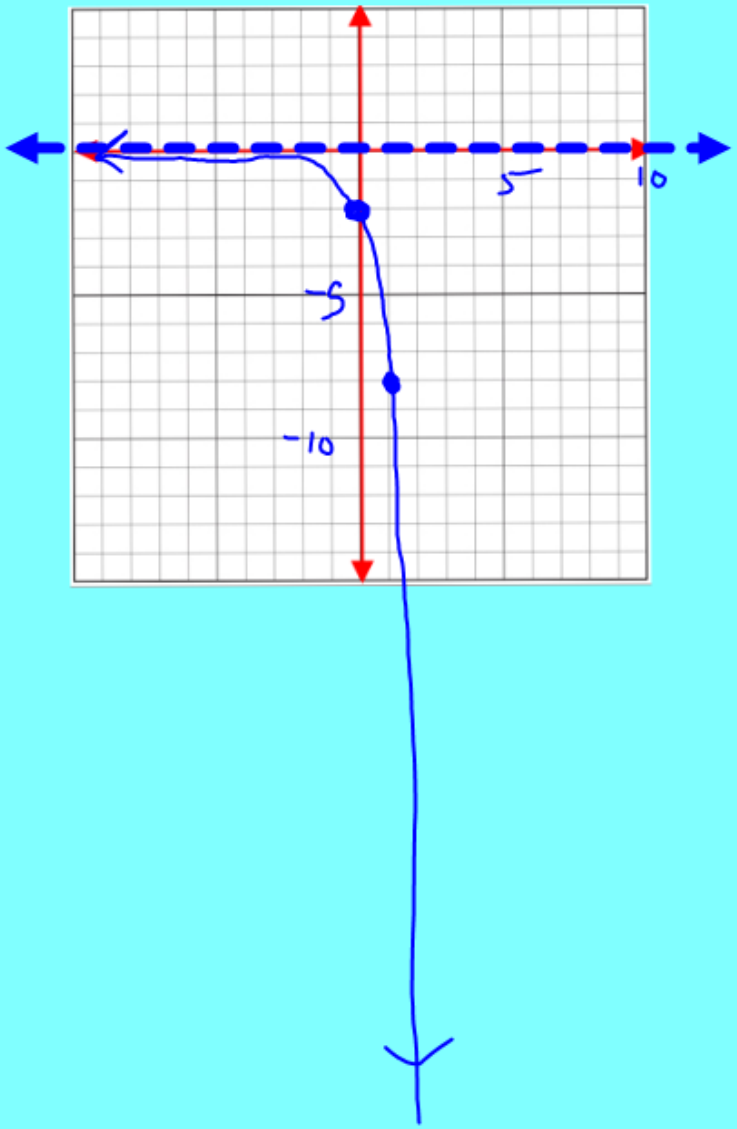
16) $y = 5 \cdot \left(\frac{1}{2}\right)^x$



(0,5)
(1,5/2)

Warmup:
Graph the following exponential function.
Be sure to label your two points and the asymptote.

$$y = -2(4)^x$$

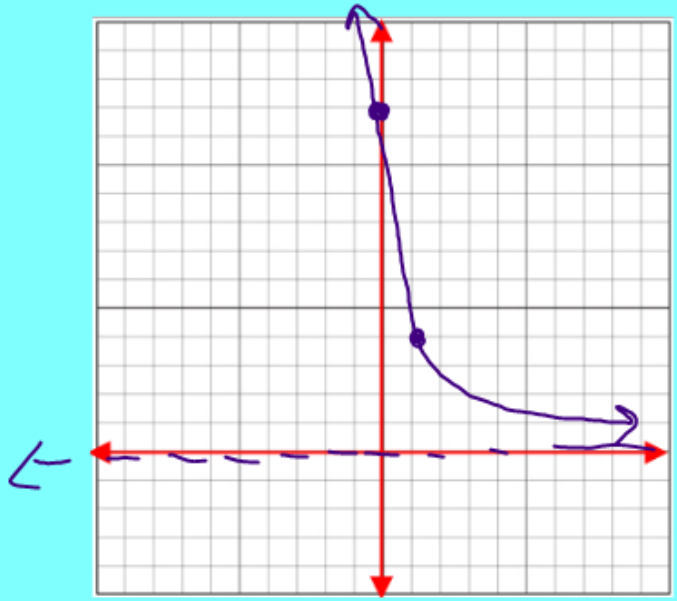


asymptote $y = 0$

$(0, a)$ $(0, -2)$

$(1, ab)$ $(1, -8)$

$$y = 12\left(\frac{1}{3}\right)^x$$



- Domain: $(-\infty, \infty)$ ★
- Range: $(0, \infty)$
- y-intercept: $(0, 12)$
- Asymptote: $y = 0$
- End Behavior: as $x \to -\infty$, $y \to \infty$
  as $x \to \infty$, $y \to 0$
- ★ Increasing or Decreasing?
  $(-\infty, \infty)$
- ★ Rate of Change from 0 to 2

Slope

$(0, 12)$ $(2, 4/3)$ $\quad \frac{12 - 4/3}{0 - 2} = \frac{-16}{3}$

Characteristics of Exponential Functions

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

End Behavior:

$as\ x \to -\infty\ y \to asymptote\ or -\infty\ or\ \infty$

$as\ x \to \infty\ y \to asymptote\ or -\infty\ or\ \infty$

Range $(asymptote, \infty)\ or\ (-\infty, asymptote)$ (above / below)

y-intercept: (0,a) or plug in 0

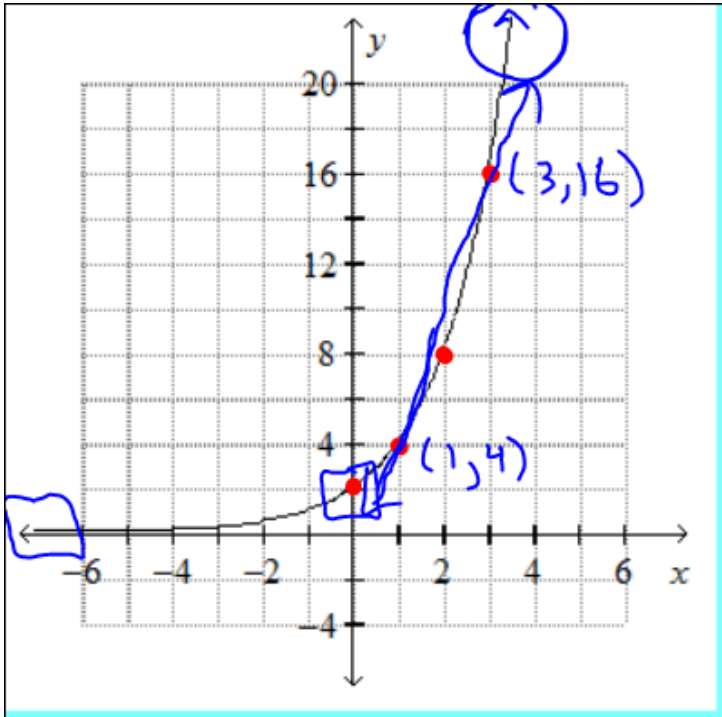
Asymptote: Y=0 or y = k

Increasing or Decreasing?

$(-\infty, \infty)$

Rate of Change:

Find slope between two points



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

Range: $(0, \infty)$

y-intercept: $(0, 2)$

Asymptote: $y = 0$

End Behavior:

as $x \to -\infty$ $y \to 0$

as $x \to \infty$ $y \to \infty$

Increasing or Decreasing?

$(-\infty, \infty)$

Rate of Change from 1 to 3:

$\frac{16-4}{3-1} = \frac{12}{2} \Rightarrow 6$

$y = a \cdot b^x$

Transformations of Exponential Functions:

Just like with the other parent functions, we can transform exponential functions. The basic form of transformations looks like:

$$f(x) = ab^{(x-h)} + k$$

Where: a stretch/shrink reflection (a is neg.) h horizontal shift k vertical shift

Let's recall transformations of Quadratic Functions:

$$y = (x - 2)^2 - 4$$

opposite

Where is the vertex? (2 , -4)

What are the transformations from the parent function?

shift right 2

down 4

Given the following exponential function:

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

opposite

What are the transformations of this function?

shifts left 3

shift down 2

$y = 2(3)^{x-1} + 4$ right 1 up 4

$y = 5(6)^{x} - 7$ down 7

$y = -6(5)^{x-5}$ Right 5 Reflect

Graphing transformations of exponential functions:

To graph:

1. Identify the two critical points. (0, a) (1, ab)
2. Identify the asymptote (it's always y = 0). starts @
3. **Translate** the critical points and asymptote. (only shift vertical)
4. Draw a smooth curve.

Identify your two critical points: (0,a) (1,ab)

★ (0,3) (1,6) ★

Identify your asymptote:

★ y=0 ★

Identify the transformations:

Left 3 Down 2

Where should the new critical points be located? (-3,1) (-2,4)

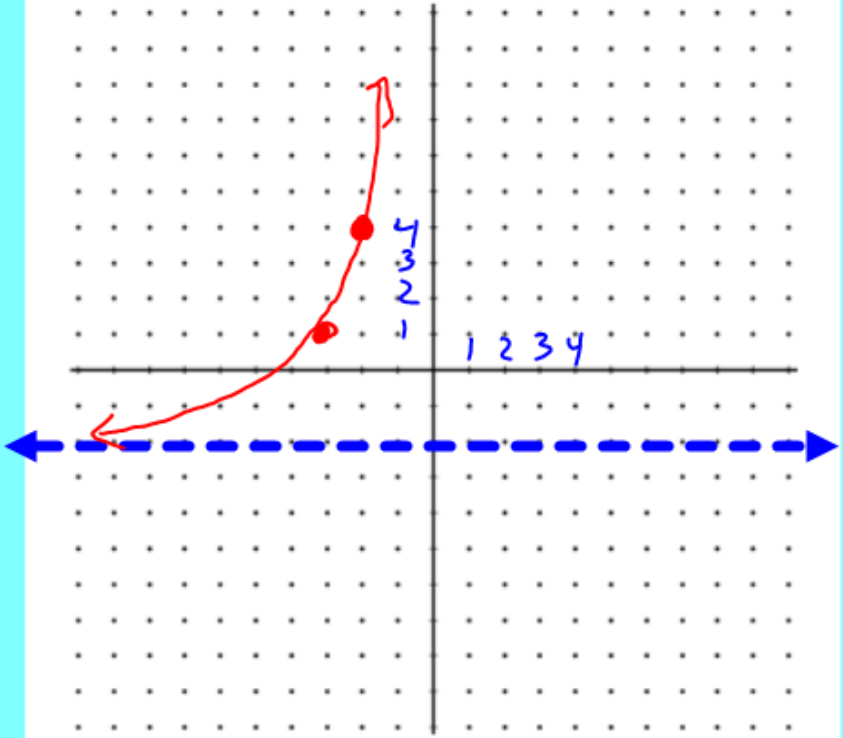
Where is the asymptote located now?

y = -2

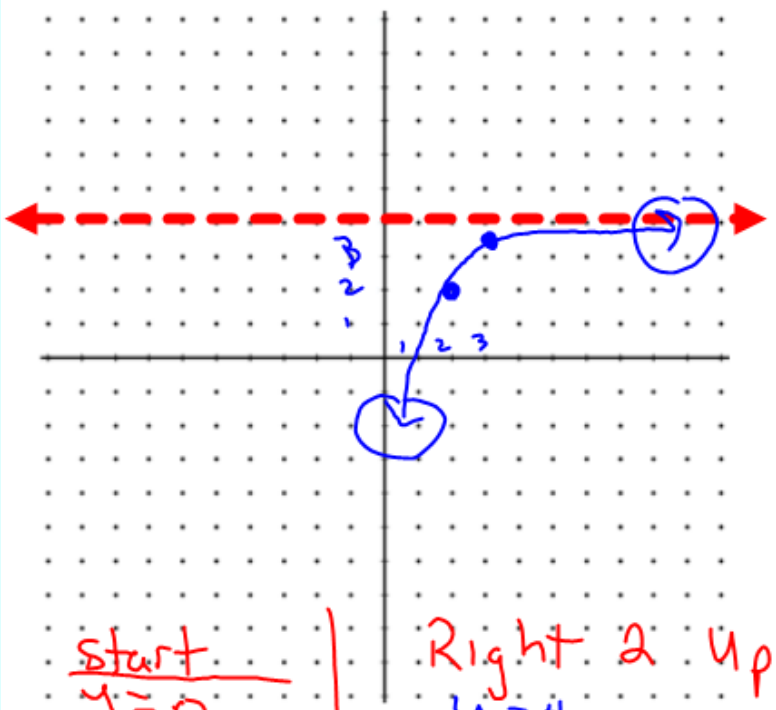
GRAPH IT!!!

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

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



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



a) y – intercept (0, -28)

b) Increasing or Decreasing? ($-\infty$, ∞)

c) a = -2 b = 1/4

d) Critical Points: (2, 2) and (3, 3.5)

e) Asymptote? y = 4

f) Domain $(-\infty, \infty)$ Range $(-\infty, 4)$

g) End Behavior

as $x \to -\infty$ $y \to -\infty$

as $x \to \infty$ $y \to 4$

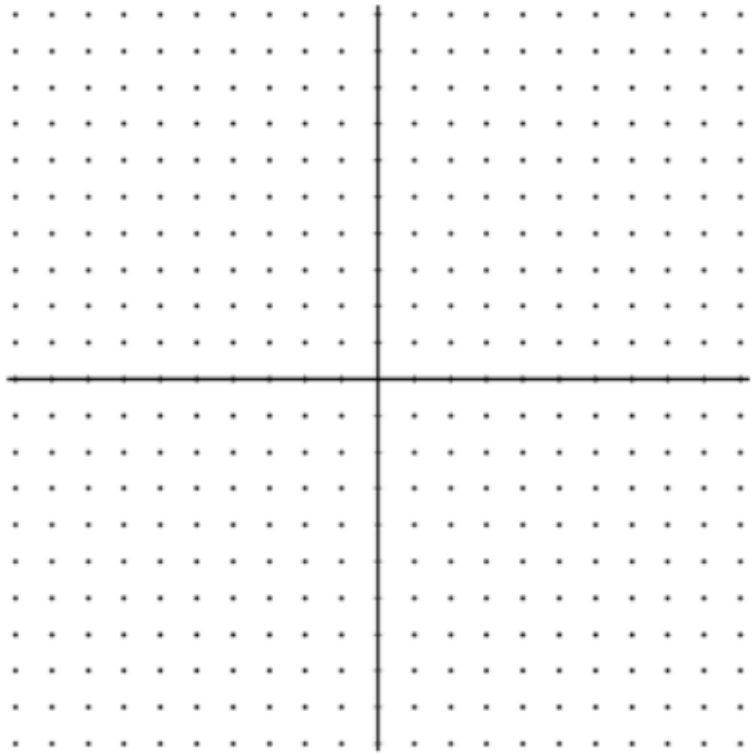
start
y = 0

Right 2 Up 4
y = 4

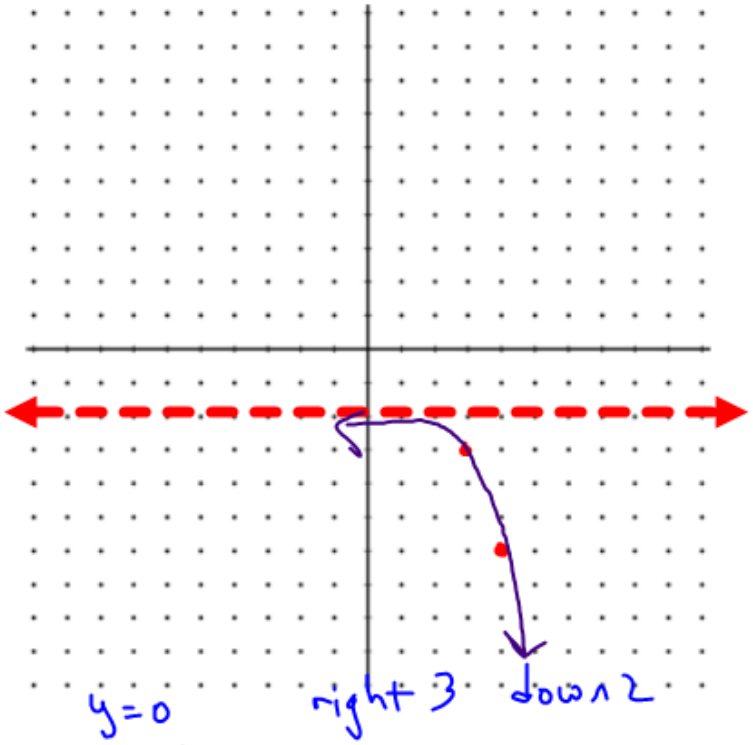
(0, -2) → (2 , 2)

(1, -1/2) → (3 , 3.5)

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



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



a) y – intercept $(0, \frac{-129}{64}) \approx (0, -2.02)$

b) Increasing or Decreasing? $(-\infty, \infty)$

c) a = -1 b = 4

d) Critical Points: $(3, -3)$ and $(4, -6)$

e) Asymptote? $y = -2$

f) Domain $(-\infty, \infty)$ Range $(-\infty, -2)$

g) End Behavior

as $x \to -\infty$ $y \to -2$

as $x \to \infty$ $y \to -\infty$

$y = 0$

$(0, -1)$

$(1, -4)$

$(3, -3)$

$(4, -6)$

$y = -2$

HW #3

Graphing Transformations of Exponential Functions