

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

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

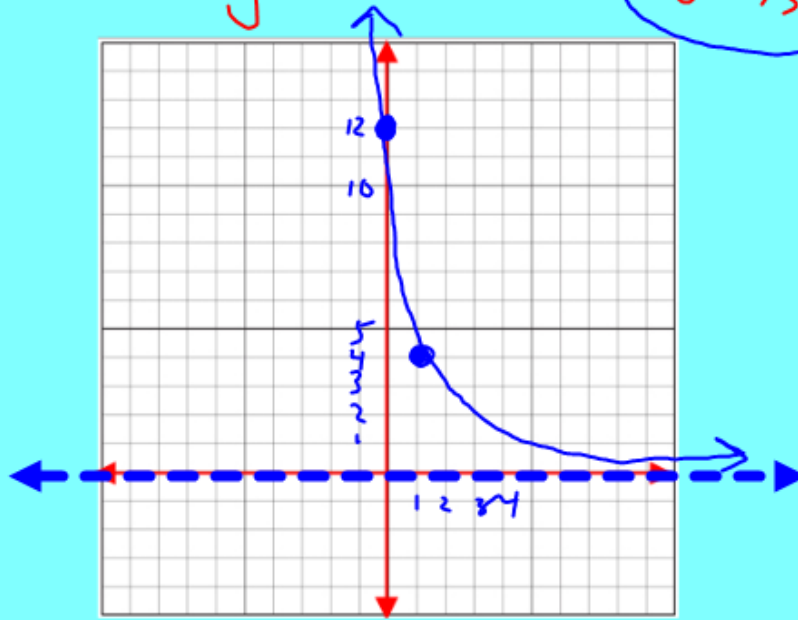
asymptote $\star (y=0)$

2 critical pts
 $(0, a)$ $\star (0, 12)$

$(1, a \cdot b)$ $(1, 12 \cdot \frac{1}{3})$
 $\star (1, 4)$

$$y = a \cdot b^x$$

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



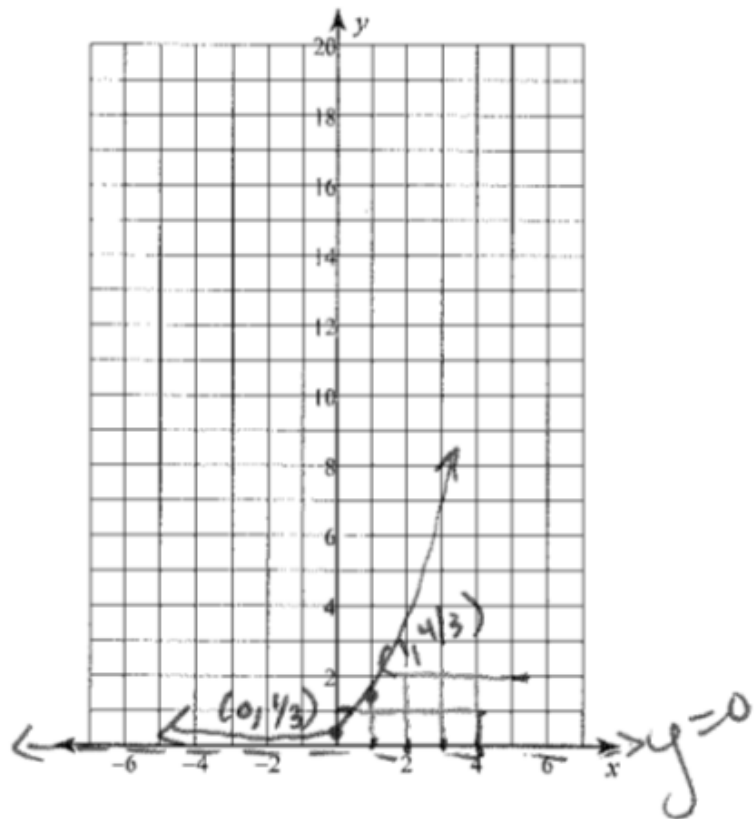
Decay

x	y
-2	108
-1	36
0	12
1	4
$\frac{2}{3}$	$\frac{4}{3}$
3	$\frac{4}{9}$

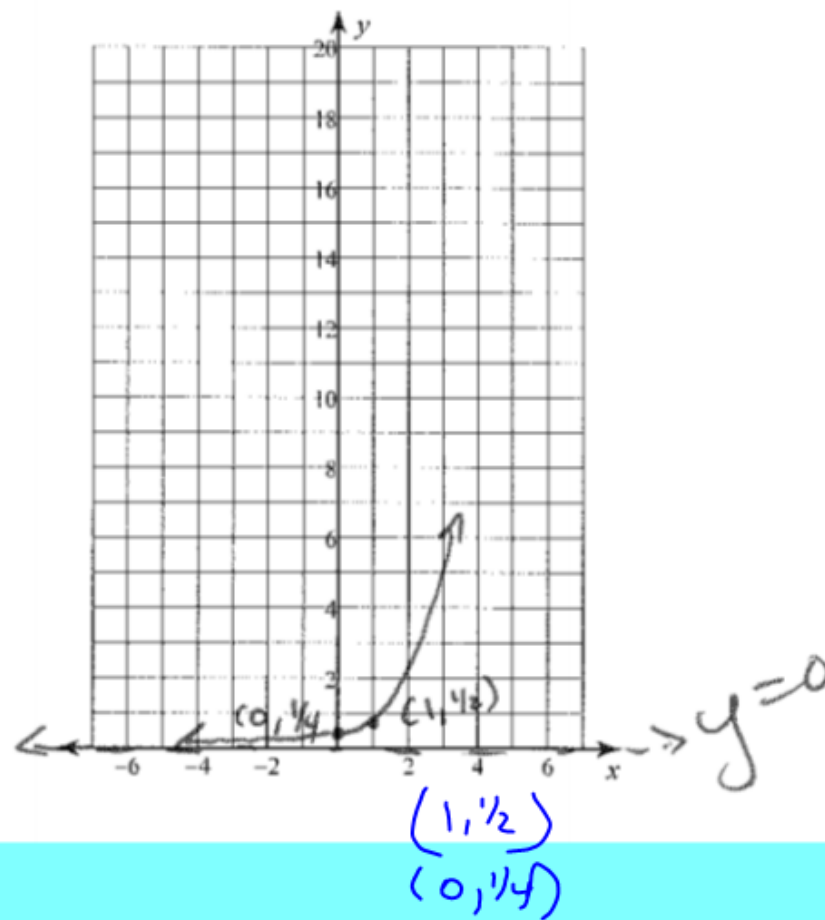
HW #2: Graphing exponential functions

Answer Key

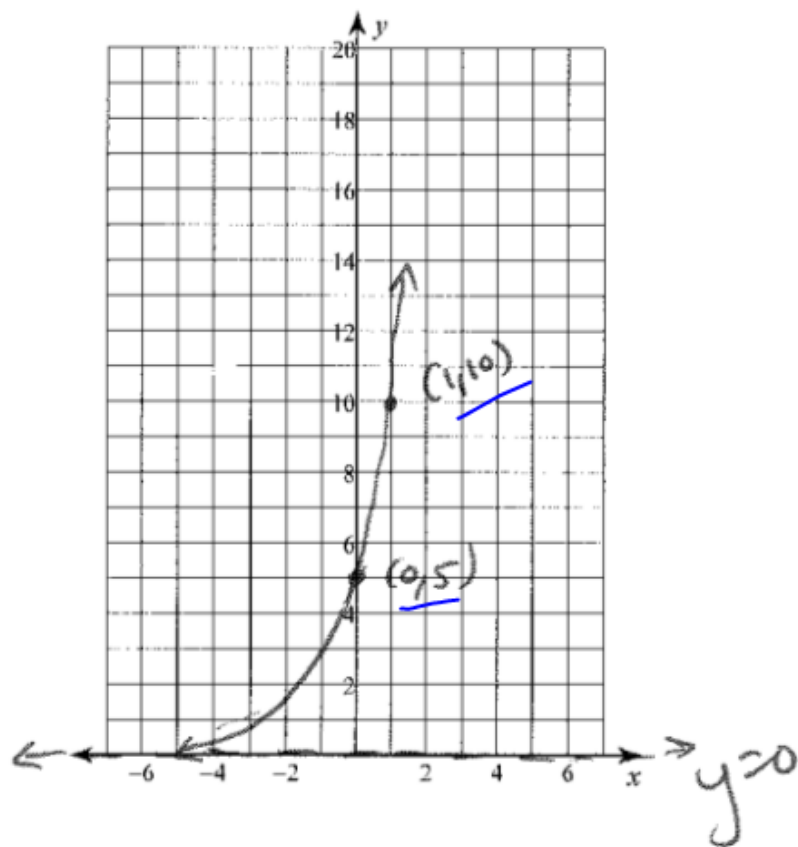
$$1) y = \frac{1}{3} \cdot 4^x$$



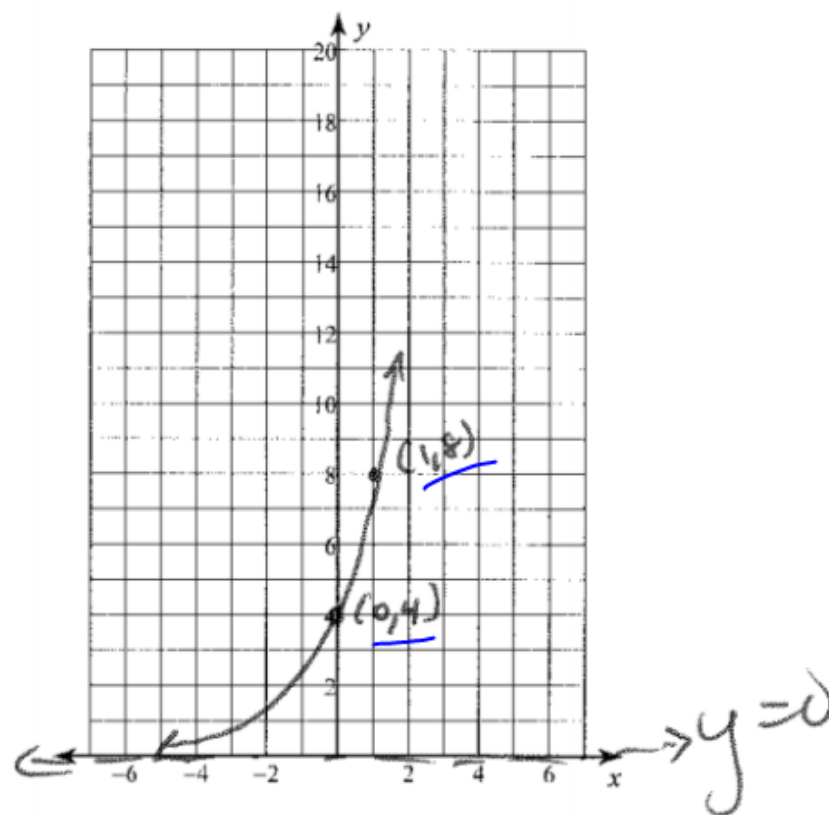
$$2) y = \frac{1}{4} \cdot 2^x$$



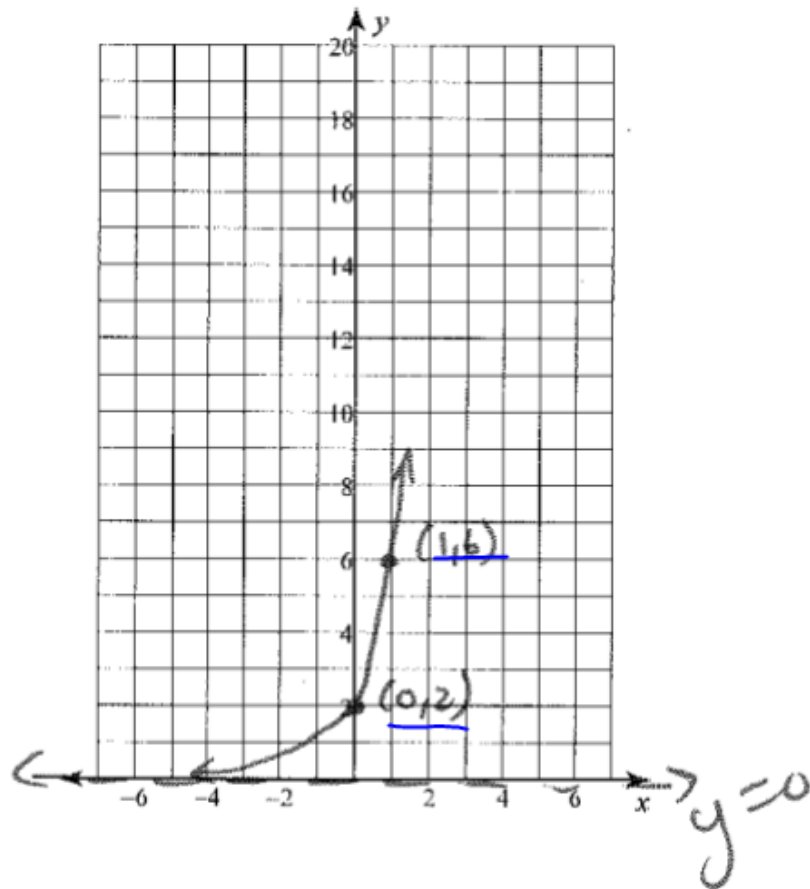
3) $y = 5 \cdot 2^x$



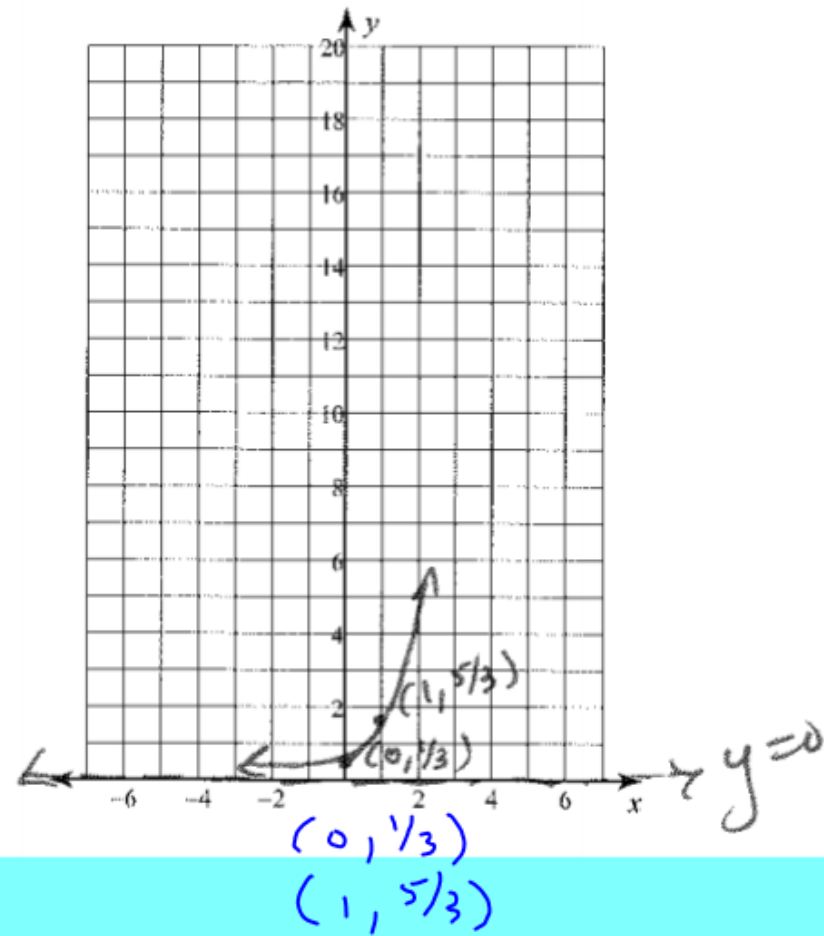
4) $y = 4 \cdot 2^x$



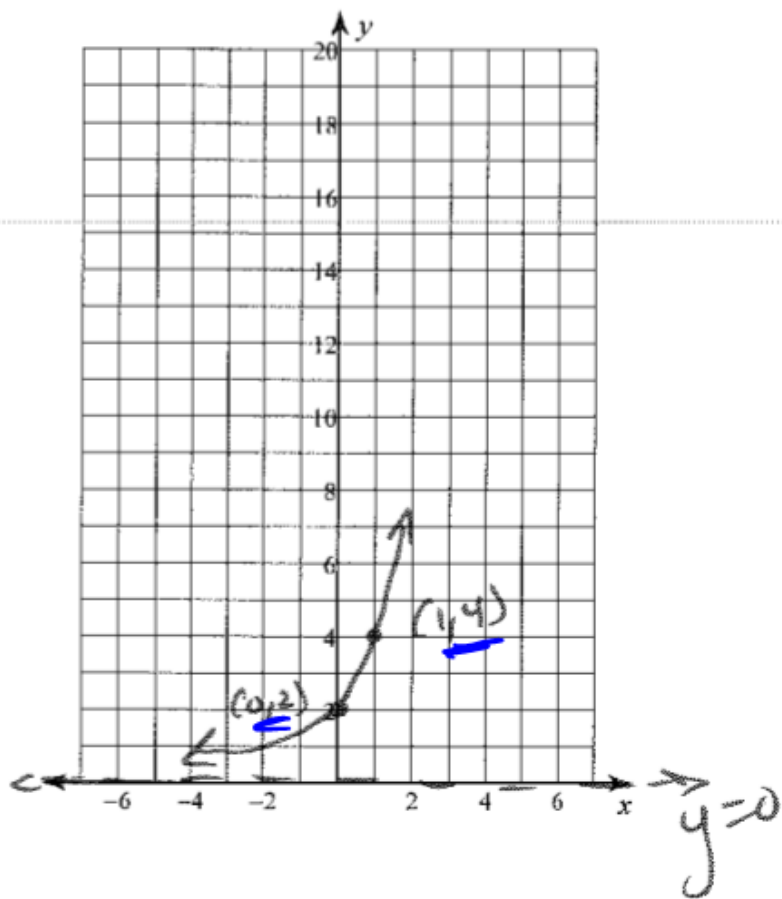
5) $y = 2 \cdot 3^x$



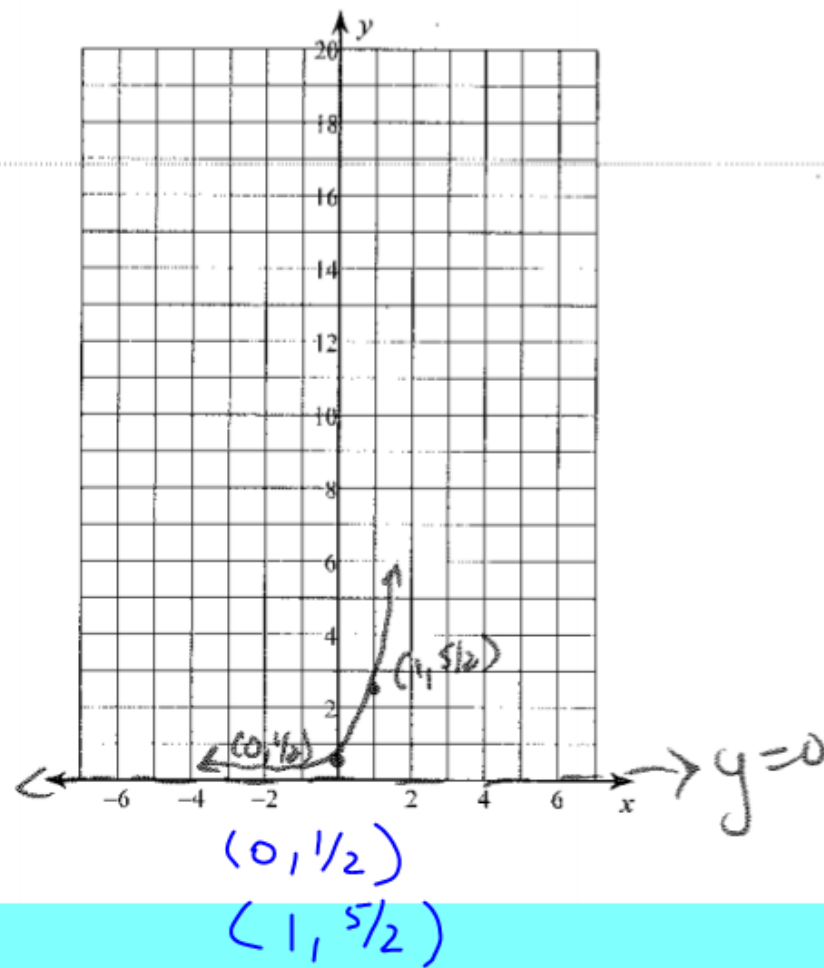
6) $y = \frac{1}{3} \cdot 5^x$



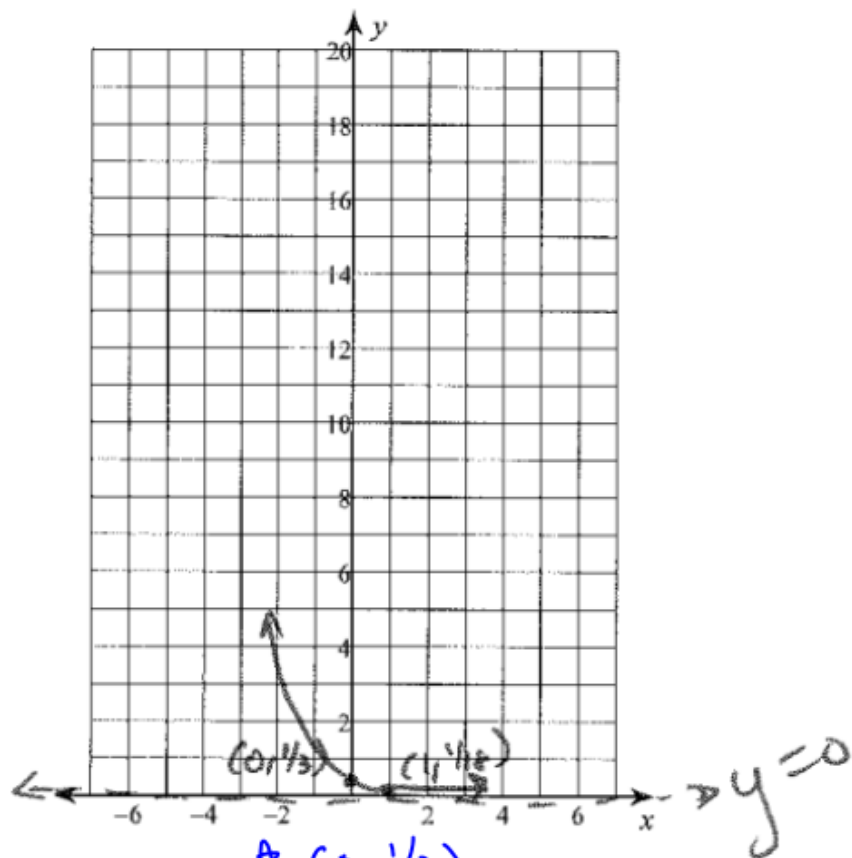
7) $y = 2 \cdot 2^x$



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



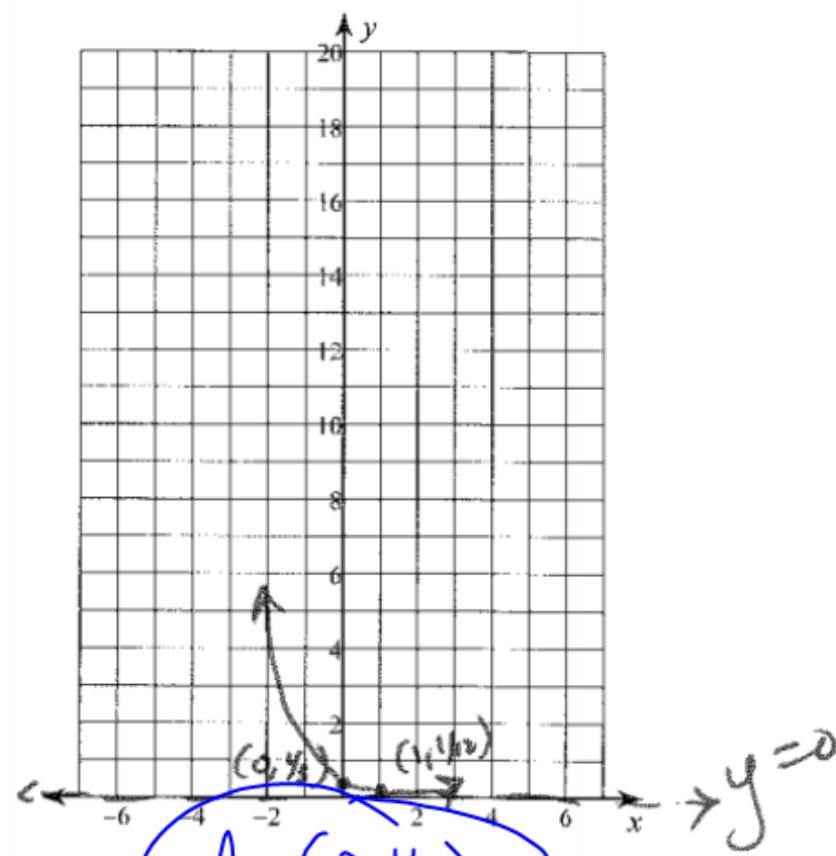
$$9) y = \frac{1}{3} \cdot \left(\frac{1}{6}\right)^x$$



★ $(0, \frac{1}{3})$

★ $(1, \frac{1}{18})$

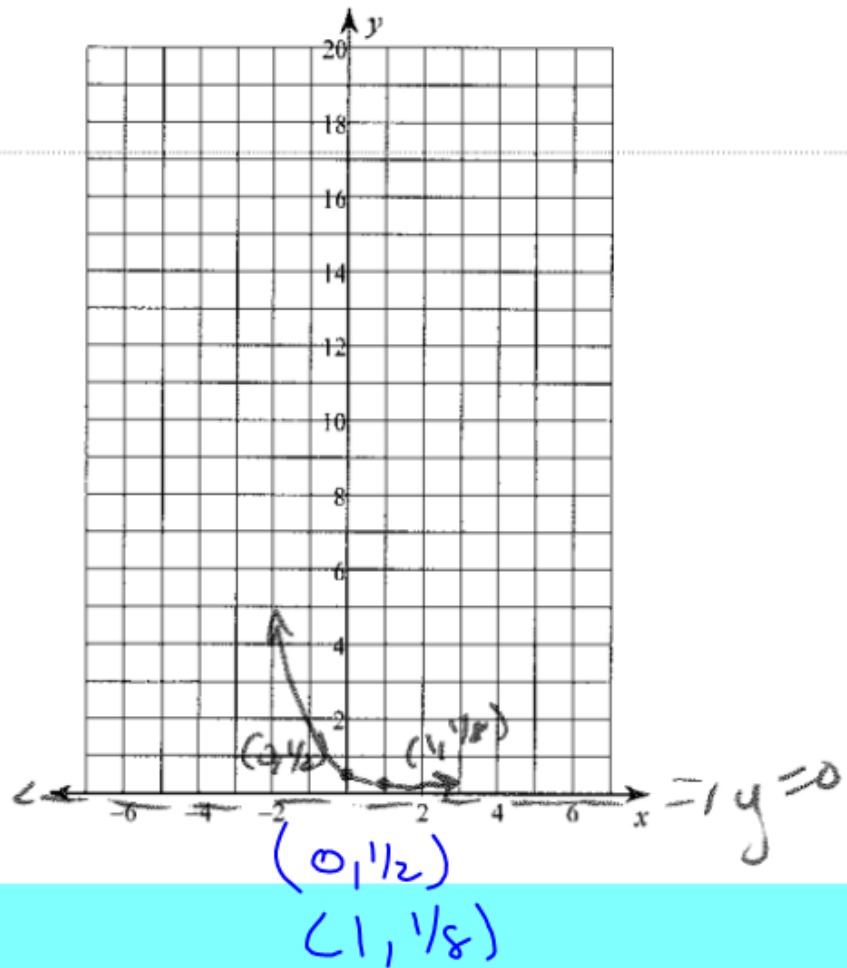
$$10) y = \frac{1}{3} \cdot \left(\frac{1}{4}\right)^x$$



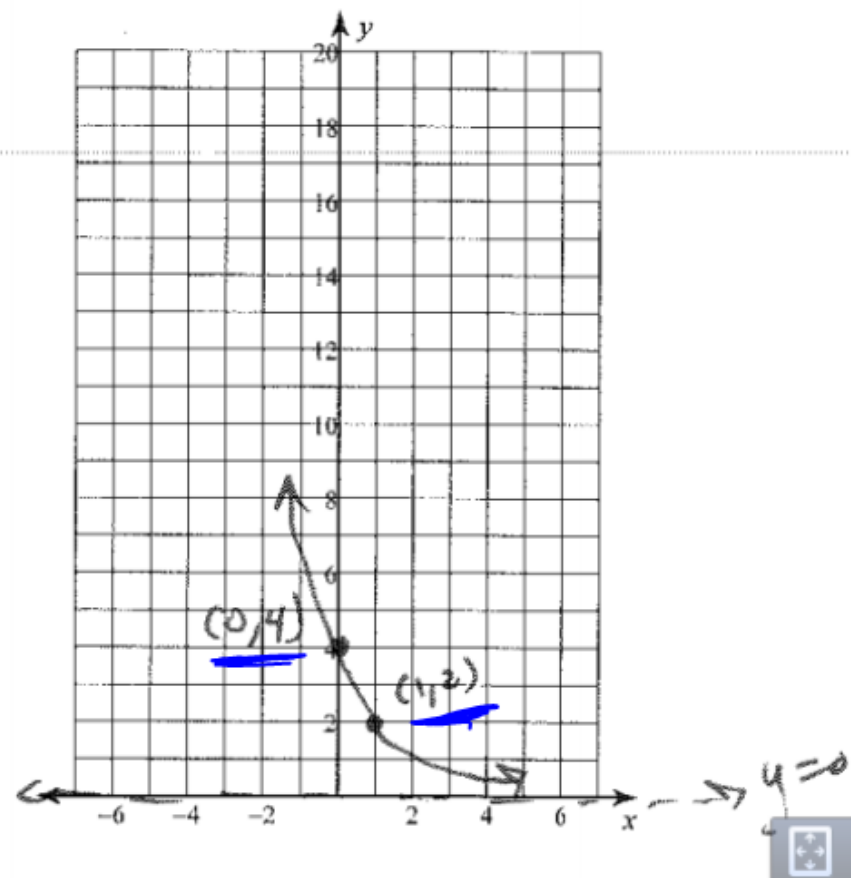
★ $(0, \frac{1}{3})$

$(1, \frac{1}{12})$

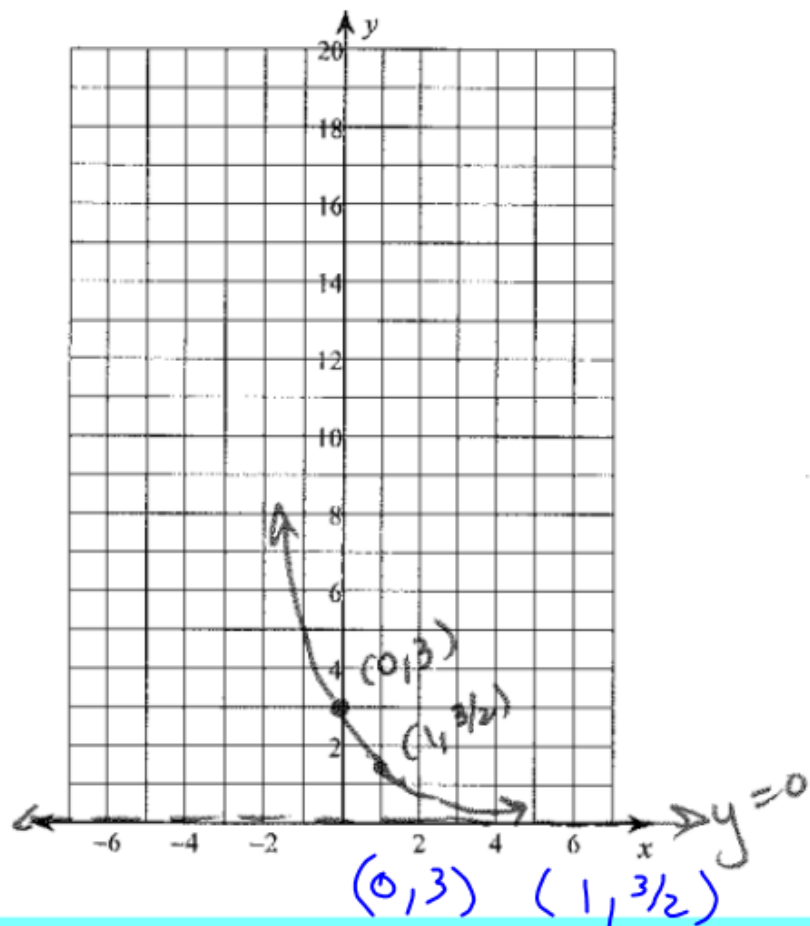
$$11) y = \frac{1}{2} \cdot \left(\frac{1}{4}\right)^x$$



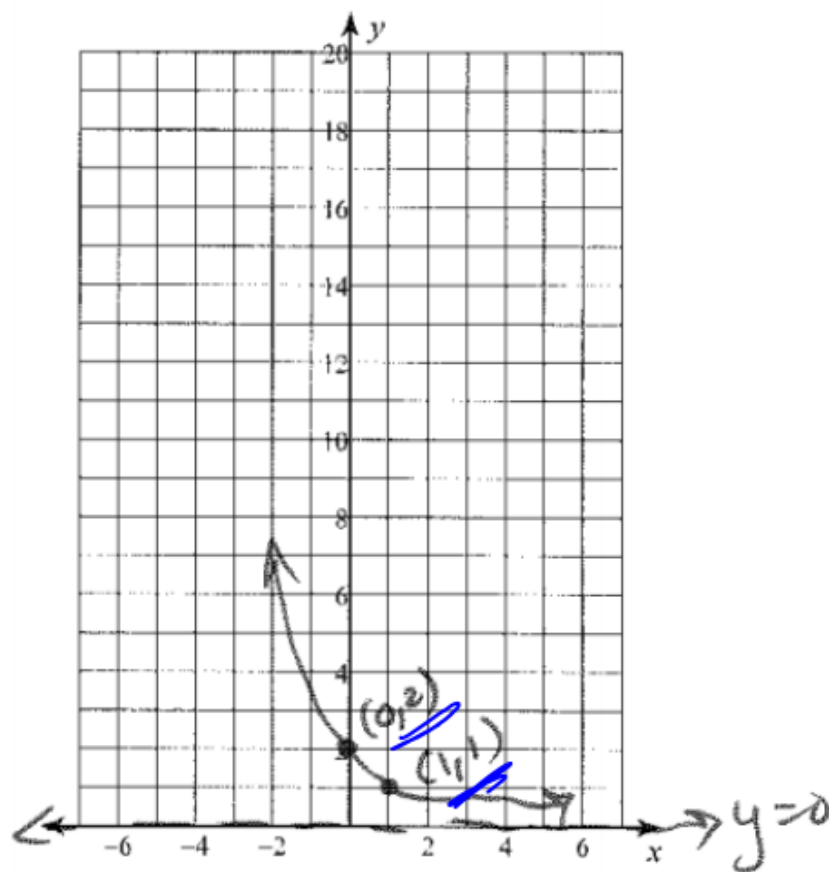
$$12) y = 4 \cdot \left(\frac{1}{2}\right)^x$$



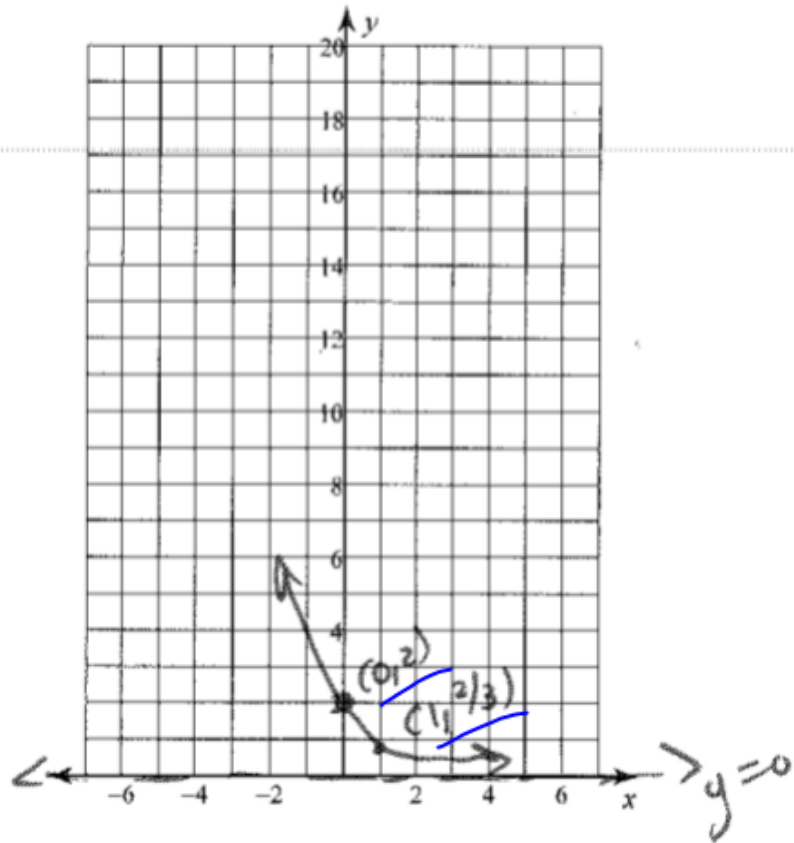
$$13) y = 3 \cdot \left(\frac{1}{2}\right)^x$$



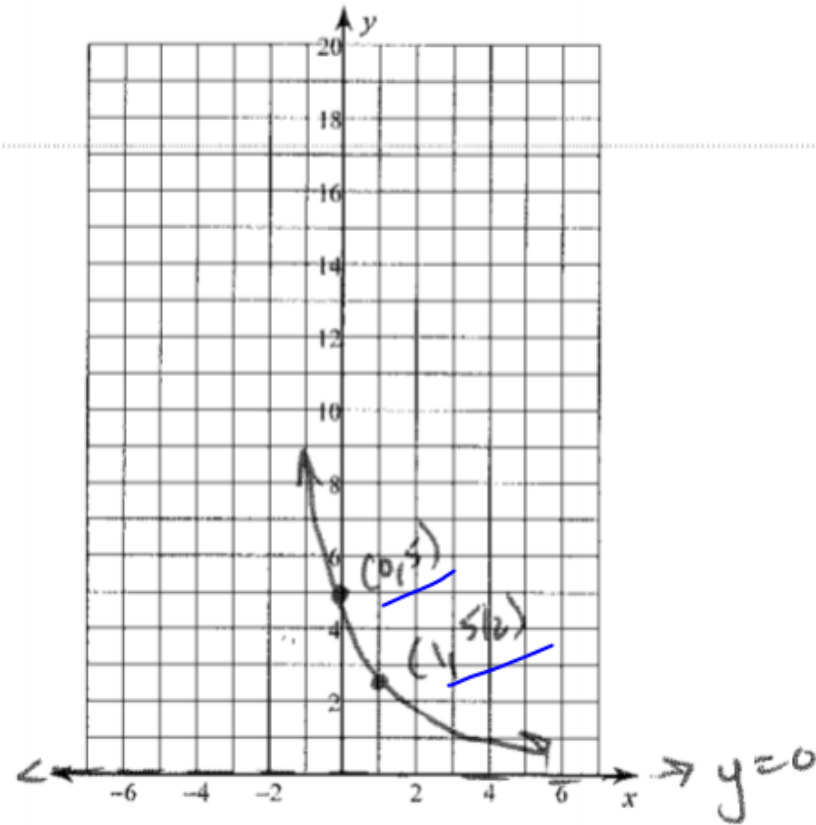
$$14) y = 2 \cdot \left(\frac{1}{2}\right)^x$$



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



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



Warmup:

Graph the following exponential function.

Be sure to label your two points and the asymptote.

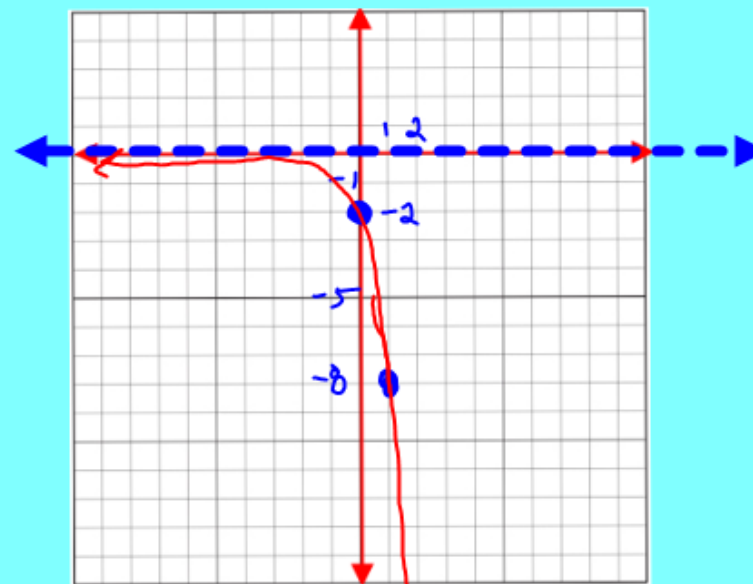
$$y = -2(4)^x$$

a \cdot b^x
 ↓ ↓
 -2 4

asymptote: $y = 0$

critical points
 $(0, -2)$
 $(1, -8)$

$(0, a)$
 $(1, a \cdot b)$



$y = 2(4)^x$ $(0, 2)$
 $(1, 8)$

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

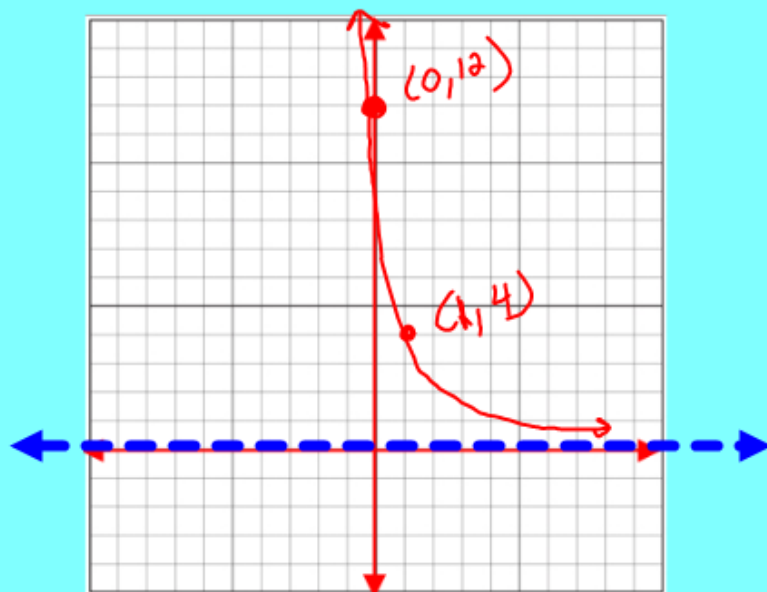
Domain: $(-\infty, \infty)$ *

Range: $(0, \infty)$

y-intercept: $(0, 12)$

Asymptote: $y = 0$

$$\text{slope} = \frac{12 - 4/3}{0 - 2} = \left(-\frac{16}{3}\right)$$



End Behavior: as $x \rightarrow \infty$ $y \rightarrow \frac{0}{\infty}$
as $x \rightarrow -\infty$ $y \rightarrow \frac{\infty}{\infty}$

* ~~Increasing~~ or Decreasing? $(-\infty, \infty)$

(Slope)

Rate of Change from 0 to 2 $(0, 12)$
 $(2, 4/3)$

Characteristics of Exponential Function

Function

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

Range $(\text{asymptote}, \infty)$ or $(-\infty, \text{asymptote})$

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

Asymptote: $Y=0$ or $y = k$

Increasing or Decreasing?

$(-\infty, \infty)$

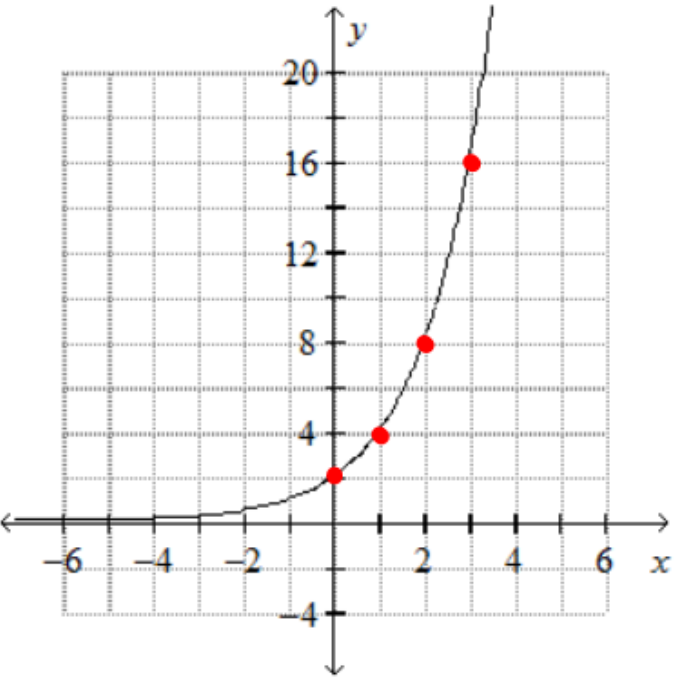
End Behavior:

as $x \rightarrow -\infty$ $y \rightarrow$ asymptote or $-\infty$ or ∞

as $x \rightarrow \infty$ $y \rightarrow$ asymptote or $-\infty$ or ∞

Rate of Change:

Find slope between two points



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

Range: $(0, \infty)$

y-intercept: $(0, 2)$

Asymptote: $y = 0$

End Behavior:

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

as $x \rightarrow \infty$ $y \rightarrow \infty$

slope: $\frac{1}{2} \left(\begin{matrix} (1, 4) \\ (3, 16) \end{matrix} \right) = \frac{12}{2} = 6$ Rate of Change from 1 to 3:

Increasing or Decreasing?

$(-\infty, \infty)$

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 h horizontal shift k vertical shift

↳ reflection
(a is negative)

horizontal shift 5
vertical shift 4

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

$$y = 2(3)^{x-5} + 4$$

Let's recall transformations of Quadratic Functions:

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

opp *same*

Where is the vertex?

$$(2, -4)$$

What are the transformations from the parent function?

right 2

down 4

$$y = 3(x - 2)^2 - 4$$

right 2
↑
down 4

Given the following exponential function:

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

What are the transformations of this function?

Down 2

Left 3

$$4(5)^{x-2} + 5$$

Right 2
up 5

$$2(3)^x + 1$$

up 1

$$3(5)^{x-6}$$

Right 6

Graphing transformations of exponential functions:

To graph:

1. Identify the two critical points.
2. Identify the asymptote (it's always $y = 0$).
3. Translate the critical points and asymptote.
4. Draw a smooth curve.

$$\begin{pmatrix} 0 & a \\ 1 & a-b \end{pmatrix}$$

(starts @ $y=0$)

vertical
shift
only

Identify your two critical points:

$(0, 3)$ $(1, 6)$

Identify your asymptote:

$y = 0$

Identify the transformations:

Left 3

Down 2

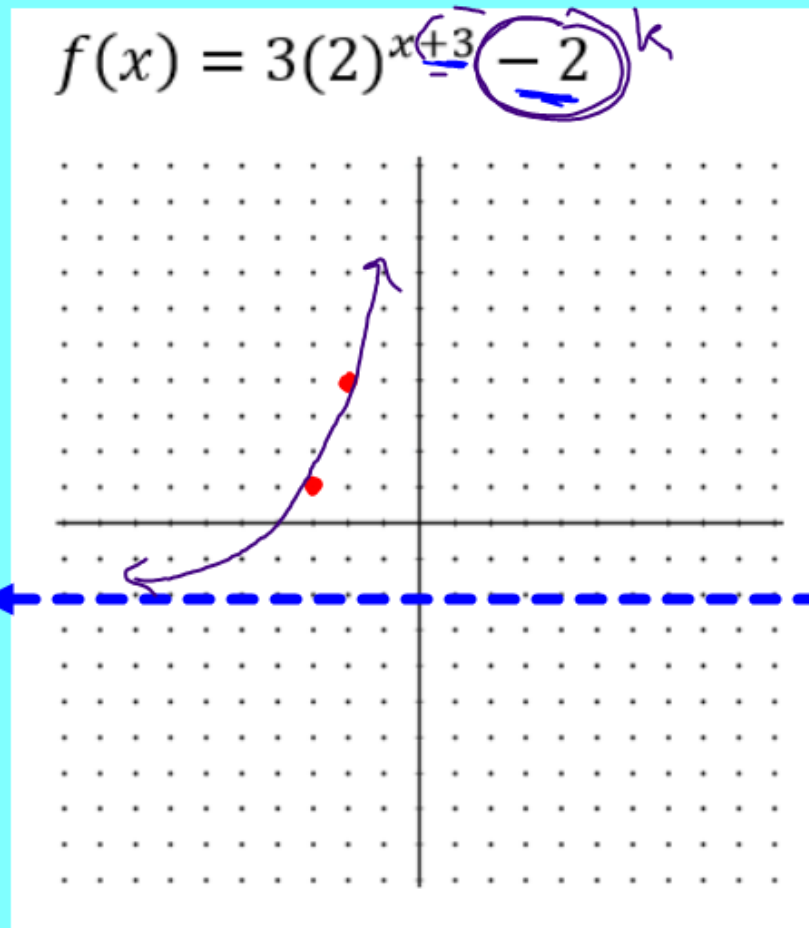
Where should the new critical points be located?

$(-3, 1)$ $(-2, 4)$

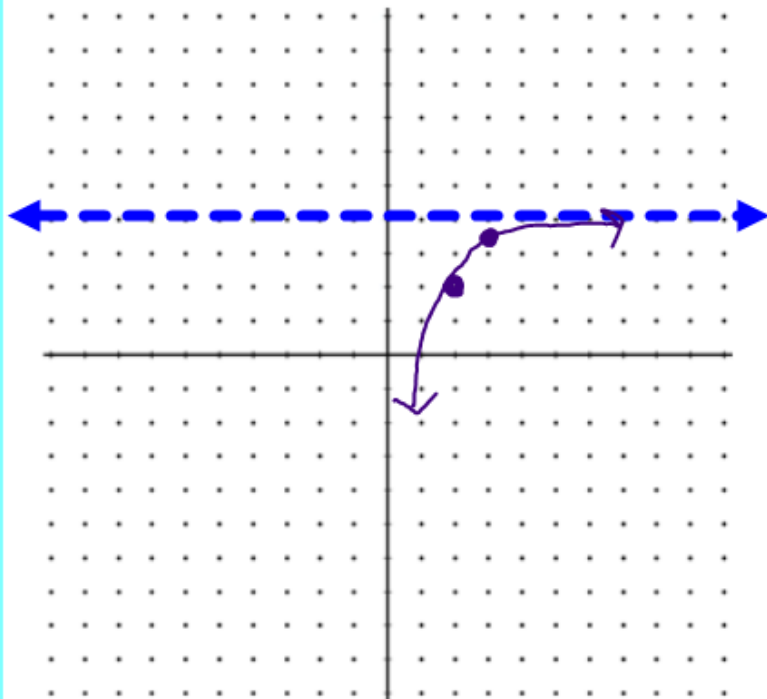
Where is the asymptote located now?

$y = -2$

GRAPH IT!!!



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



$(0, -2)$
 $(1, -\frac{1}{2})$
 right 2 up 4
 $(2, 2)$
 $(3, 3.5)$

a) ^{plug in 0} y-intercept $(0, -28)$

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

c) $a = -2$ $b = \frac{1}{4}$

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

e) Asymptote? $y = 4$

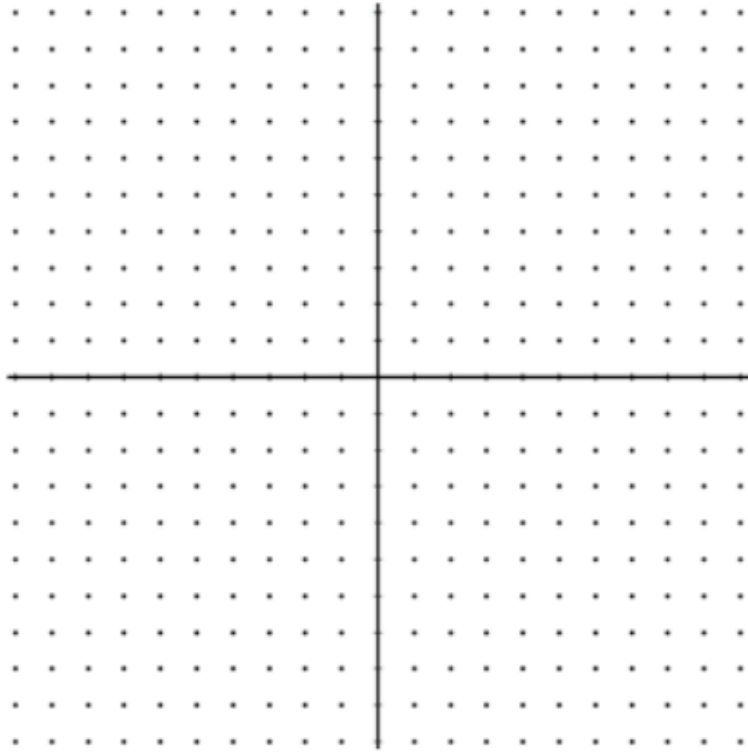
f) Domain $(-\infty, \infty)$ Range $(-\infty, 4)$

g) End Behavior _____

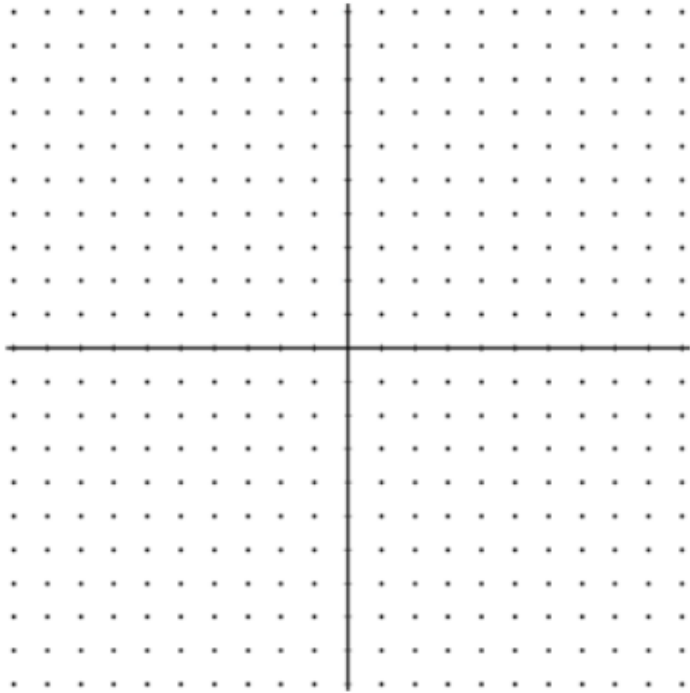
as $x \rightarrow -\infty$ $y \rightarrow -\infty$

as $x \rightarrow \infty$ $y \rightarrow 4$

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



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



a) y-intercept _____

b) Increasing or Decreasing?

c) a = _____ b = _____

d) Critical Points: _____ and _____

e) Asymptote? _____

f) Domain _____ Range _____

g) End Behavior _____

HW #3

Graphing Transformations of Exponential Functions