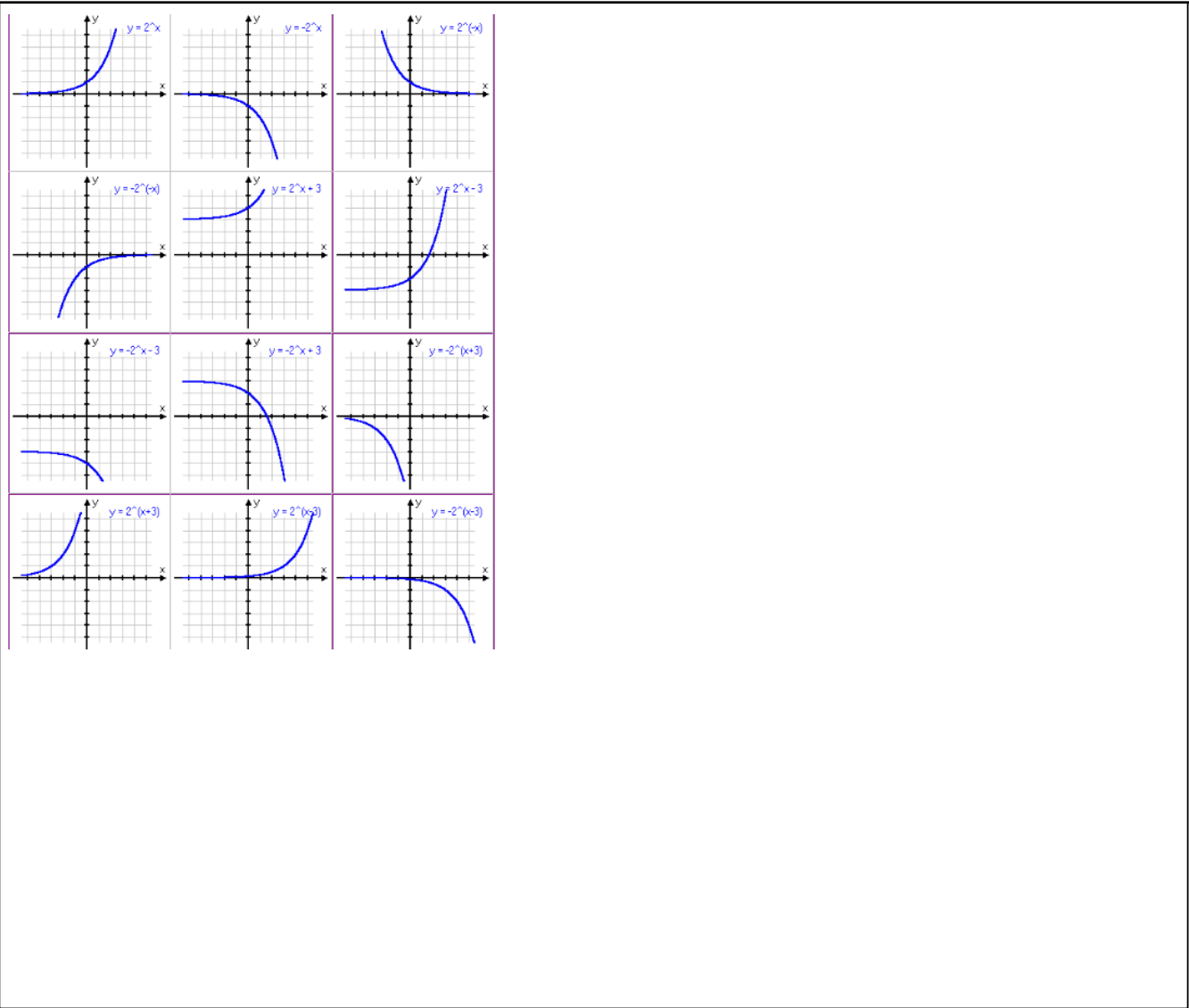


Exponential Functions - notes.notebook



# What do you know?

$$y = a^x$$

$$\log_a b = x$$

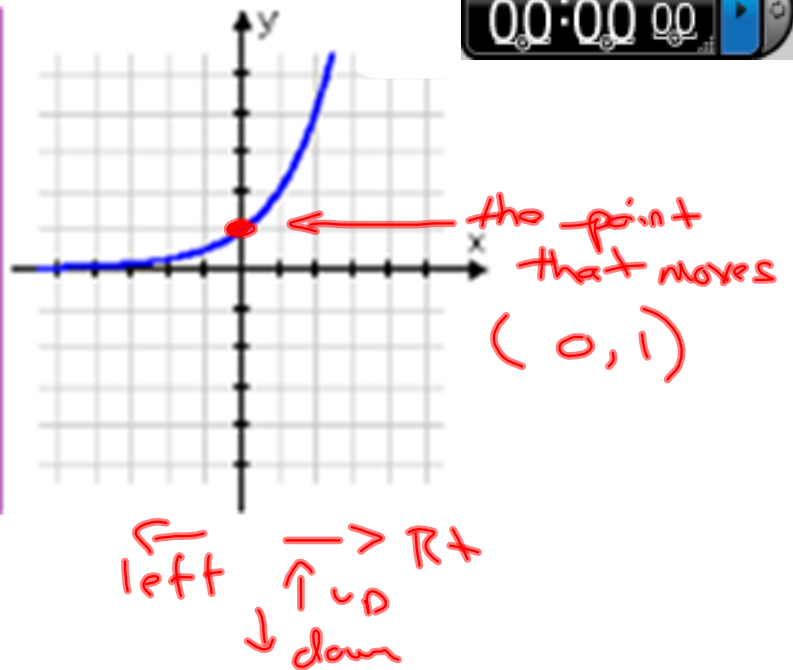
On each card, write the equation of the graph.

The Parent Function is

$$y = 2^x$$
$$y = a^x$$

Use your previous knowledge from transformations to write your equations.

Hint



Handwritten notes illustrating transformations of functions. The functions are grouped into two categories: "opp." (opposite) and "same".

**opp. (Opposite):**

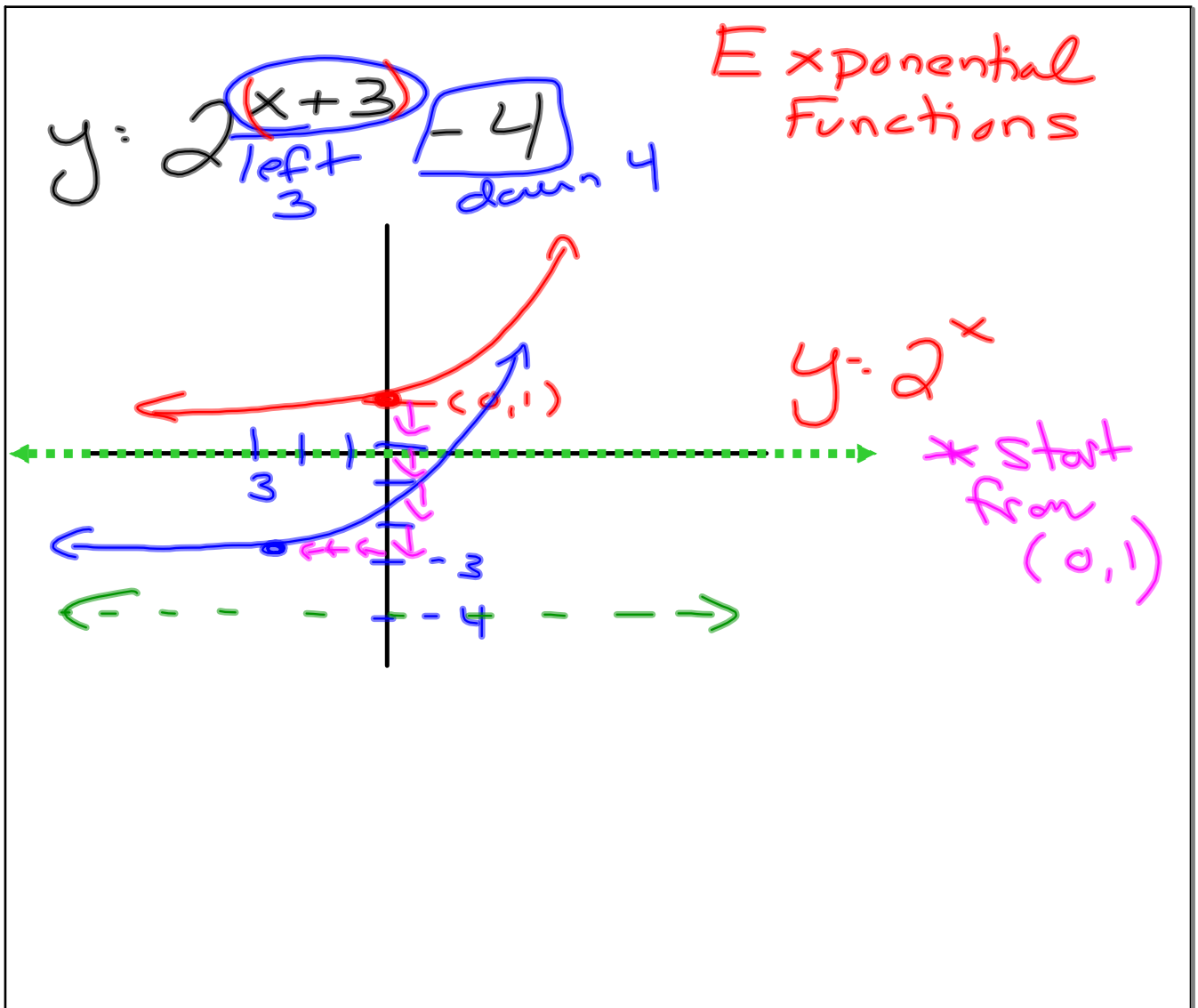
- $y = -(x+4)^2 - 3$
- $y = -|x+4| - 3$
- $y = -\sqrt{x+4} - 3$
- $y = 2^{x+4} - 3$

**same (Same):**

- $-3$

**Transformations:**

- Reflections:  $(0,0)$  (up/down),  $(0,1)$  (up/down)
- Translations:  $(0,p)$  (right),  $(0,1)$  (left)
- Vertical shifts:  $\uparrow +$ ,  $\downarrow -$
- Horizontal shifts:  $\leftarrow \oplus$ ,  $\rightarrow \ominus$



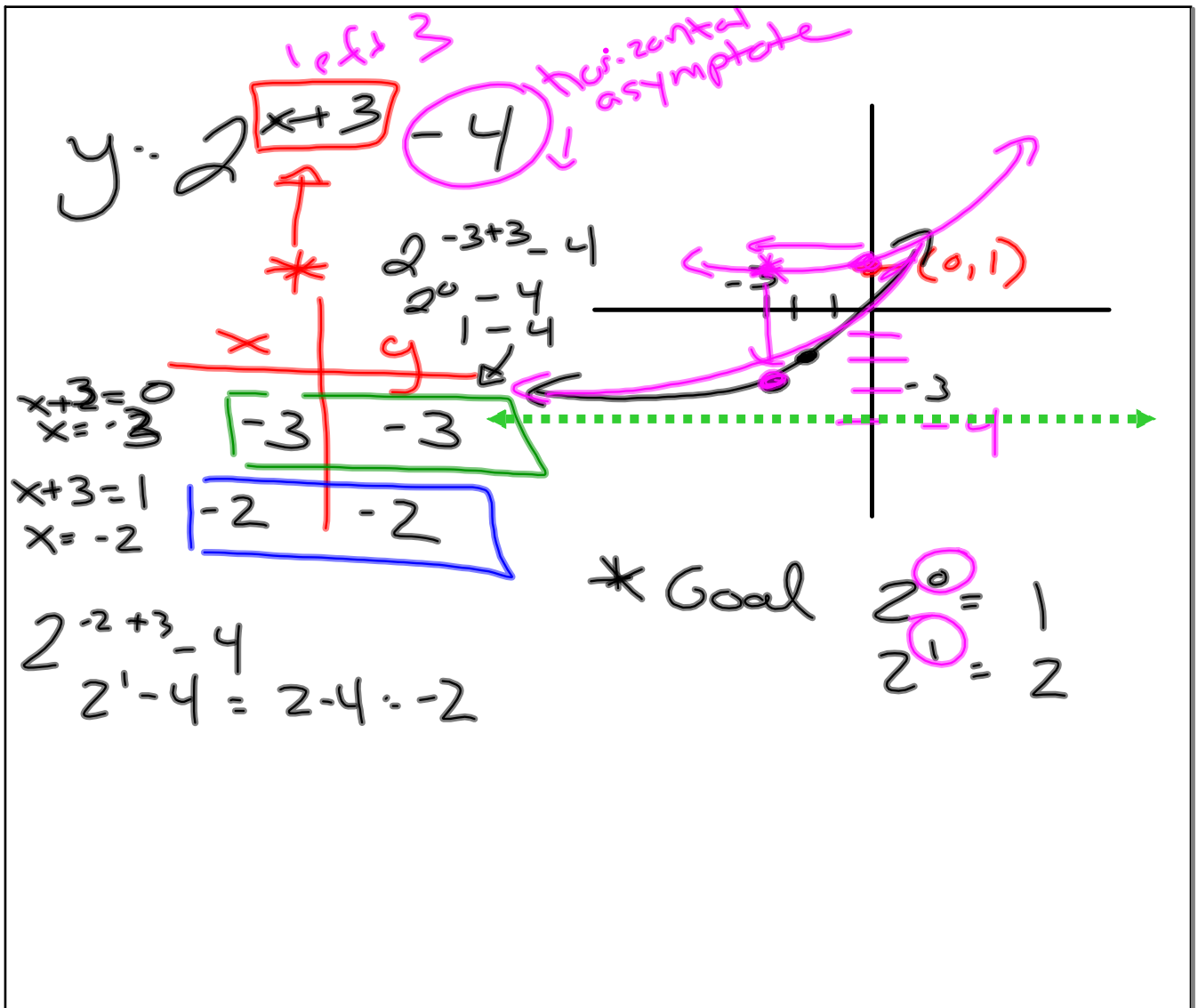
$y = (x + 4)^2 - 3$       opp.      same  
 $y = |x + 4| - 3$   
 $y = \sqrt{x + 4} - 3$   
 $y = 2^{x+4} - 3$

$(0,0)$   
 $(0,0)$   
 $(0,0)$   
 $(0,1)$

$\left. \begin{matrix} \oplus \\ \ominus \end{matrix} \right\} \rightarrow$        $\uparrow +$        $\downarrow -$

$y = -(x+2)^2 - 3$   
 ↑  
 Flip over x-axis

$y = (-x+2)^2 - 3$   
 ↑  
 Flip over y-axis

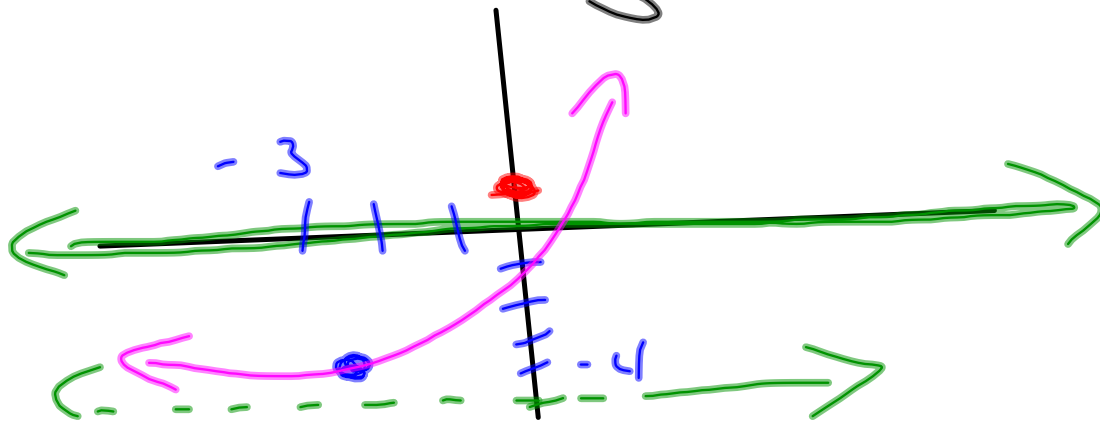


$$y = 2^{x+3} - 4$$

parent function

$$y = 2^x \quad * (0, 1)$$

move left 3  
down 4





$$y = 2^{x+3} - 4 \quad \text{HA}$$

Goal:

2200

$$\text{Exp} = 0$$

$$\text{Exp} = 1$$

Exp

"0"  $x+3=0$   
 $x=-3$

"1"  $x+3=1$   
 $x=-2$

x	y
-3	-3
-2	-2

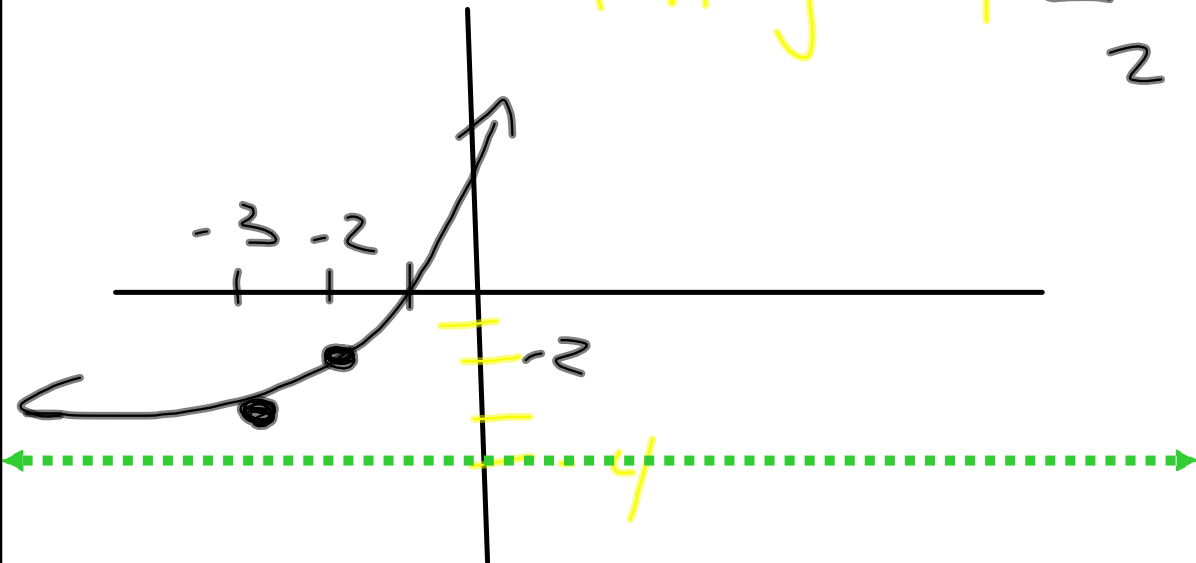
HA  $y = -4$

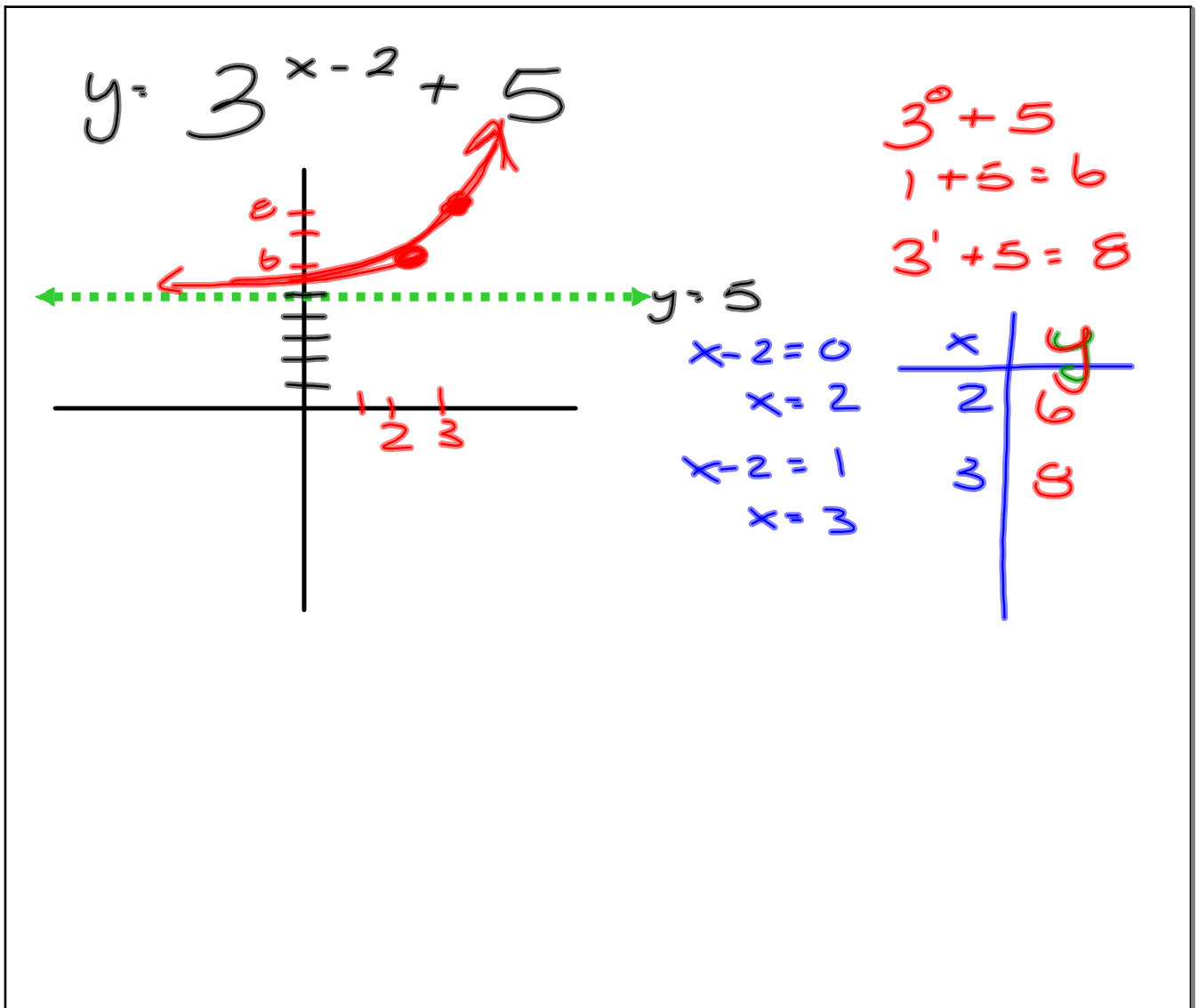
$$2^{-3+3} = 2^0 = 1 - 4 = -3$$

$$2^{-2+3} = 2^1 = 2 - 4 = -2$$

$$2^{-1+3} = 2^2 = 4 - 4 = 0$$

$$2^{0+3} = 2^3 = 8 - 4 = 4$$





$$y = \frac{1}{2}^{x-2} - 5$$

$x-2$       $-5$      down 5

$$y = \frac{1}{2}^{x-2} - 5$$

Exp:  
"0"

$$x-2=0$$

$$x=2$$

"1"

$$x-2=1$$

$$x=3$$

x	y
2	-4
3	-4.5

$$\frac{1}{2}^{2-2} - 5$$

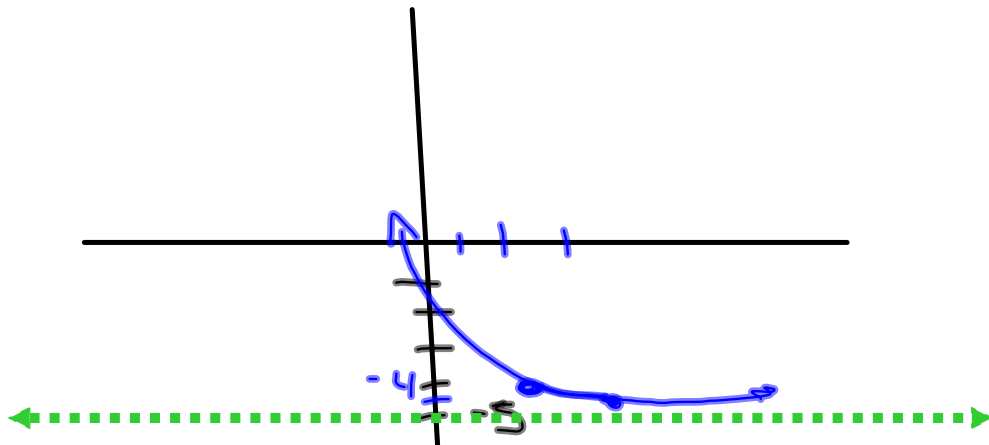
$$\frac{1}{2}^0 - 5$$

$$1 - 5 = -4$$

$$\frac{1}{2}^{3-2} - 5$$

$$\frac{1}{2}^1 - 5$$

$$-4.5$$

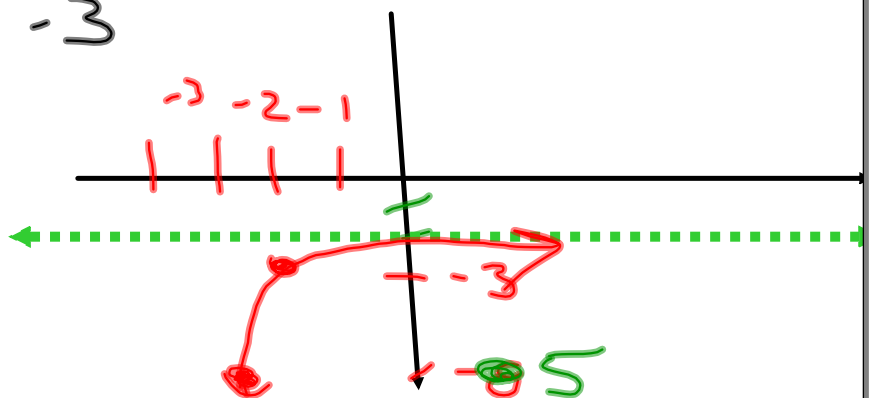


$$y = -3^{-2x-5} - 2 \quad \text{HA}$$

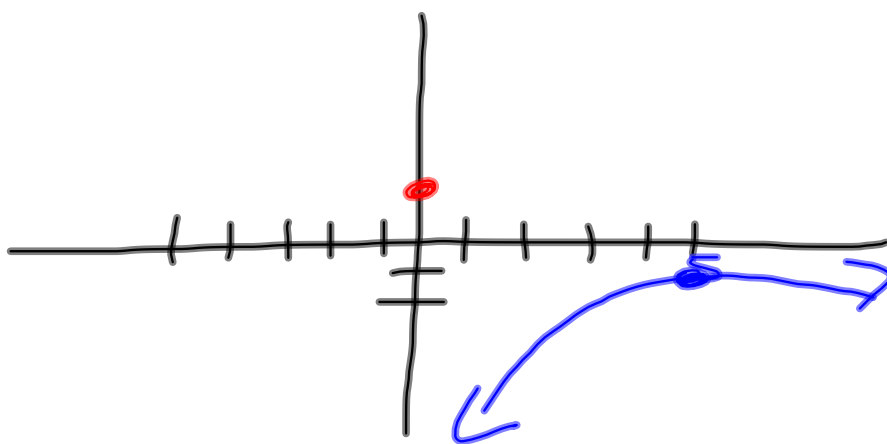
$$\begin{aligned} -2x - 5 &= 0 \\ -2x &= 5 \\ x &= -5/2 \end{aligned}$$

$$\begin{aligned} -2x - 5 &= -1 \\ +5 & \quad +5 \\ \hline -2x &= 6 \\ x &= -3 \end{aligned}$$

x	y
$-5/2$ $-2.5$	$-(3^0) - 2$ $-1 - 2$
$-3$	$-(3^1) - 2$ $-3 - 2$



$$y = -3^{-2x-5} - 2$$



12 HOUR

Class Ends at

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

$x+3=0$   
 $x=-3$

$2^0 = 2^0 - 4 = 1 - 4 = -3$

$x+3=1$   
 $x=-2$

$2^1 = 2^1 - 4 = 2 - 4 = -2$

$2^{-2+3}$   
 $2^1$

$5^0 = 1$   
 $5^1 = 5$

$$y = 4^{-x+1} + 3$$

$$\begin{aligned} -x+1 &= 0 \\ \frac{-1}{-x} &= \frac{-1}{-1} \\ -x+1 &= 1 \end{aligned}$$

x	y
1	4
0	7

$4^0$

$4^1$

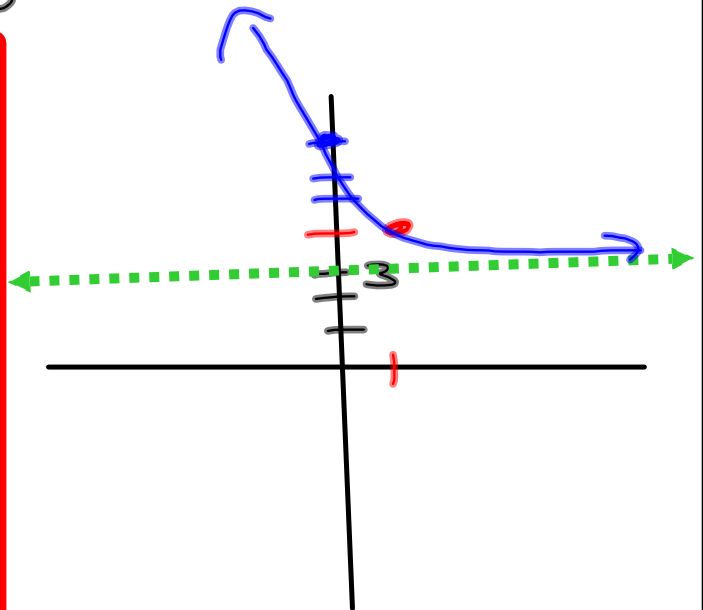
$4^0 + 3$

$1 + 3 = 4$

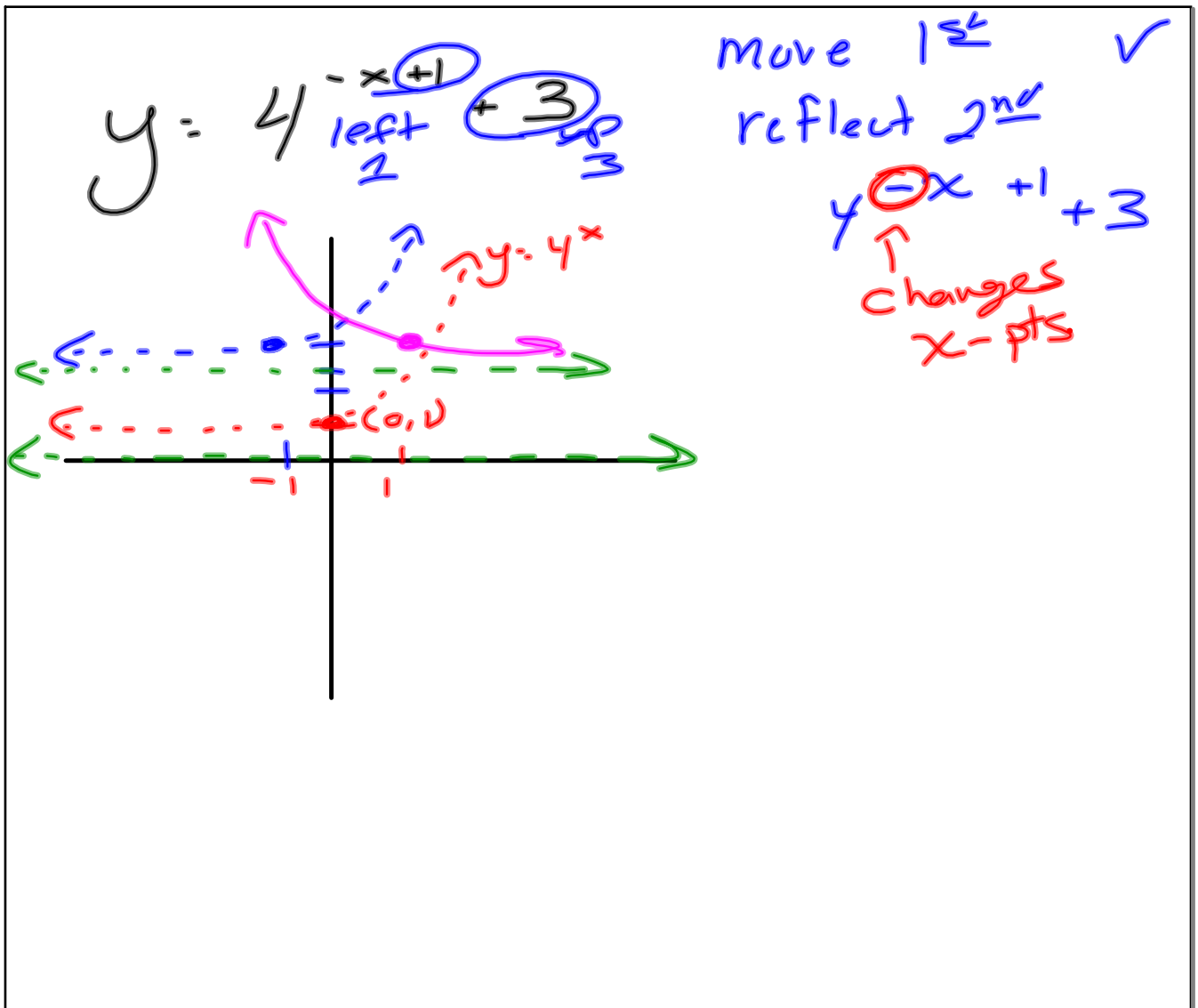
$4^1 + 3$

$4 + 3 = 7$

HA:  $y = 3$







$$y = \frac{1}{2}^{x+3} - 5$$

H/A

Exp: "0"

$$x+3=0$$

$$x=-3$$

"1"

$$x+3=1$$

$$x=-2$$

x	y
-3	-4
-2	<u>-4.5</u>

$$\frac{1}{2}^{-3+3} - 5$$

$$\frac{1}{2}^0 - 5$$

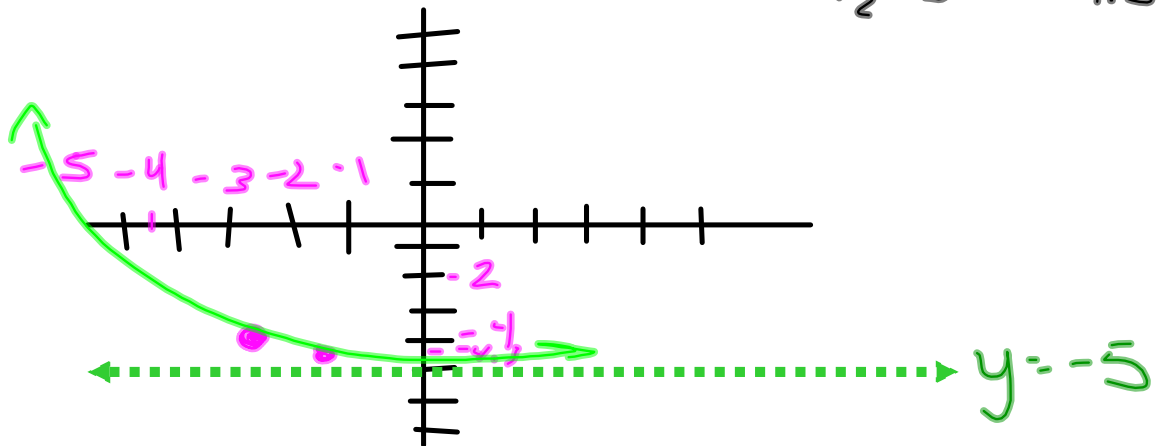
$$1 - 5 = -4$$

$$\frac{1}{2}^{-2+3} - 5$$

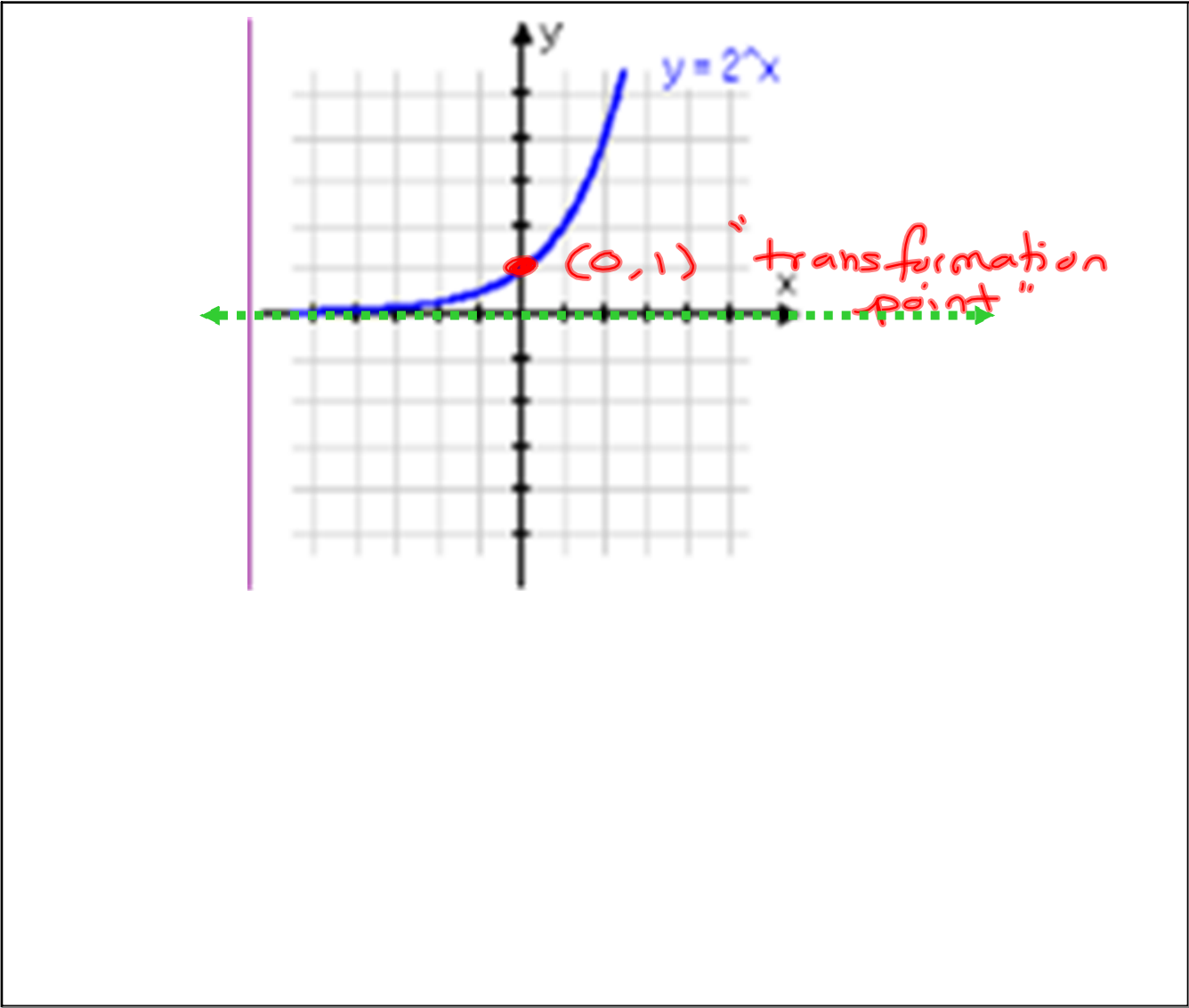
$$\frac{1}{2}^1 - 5$$

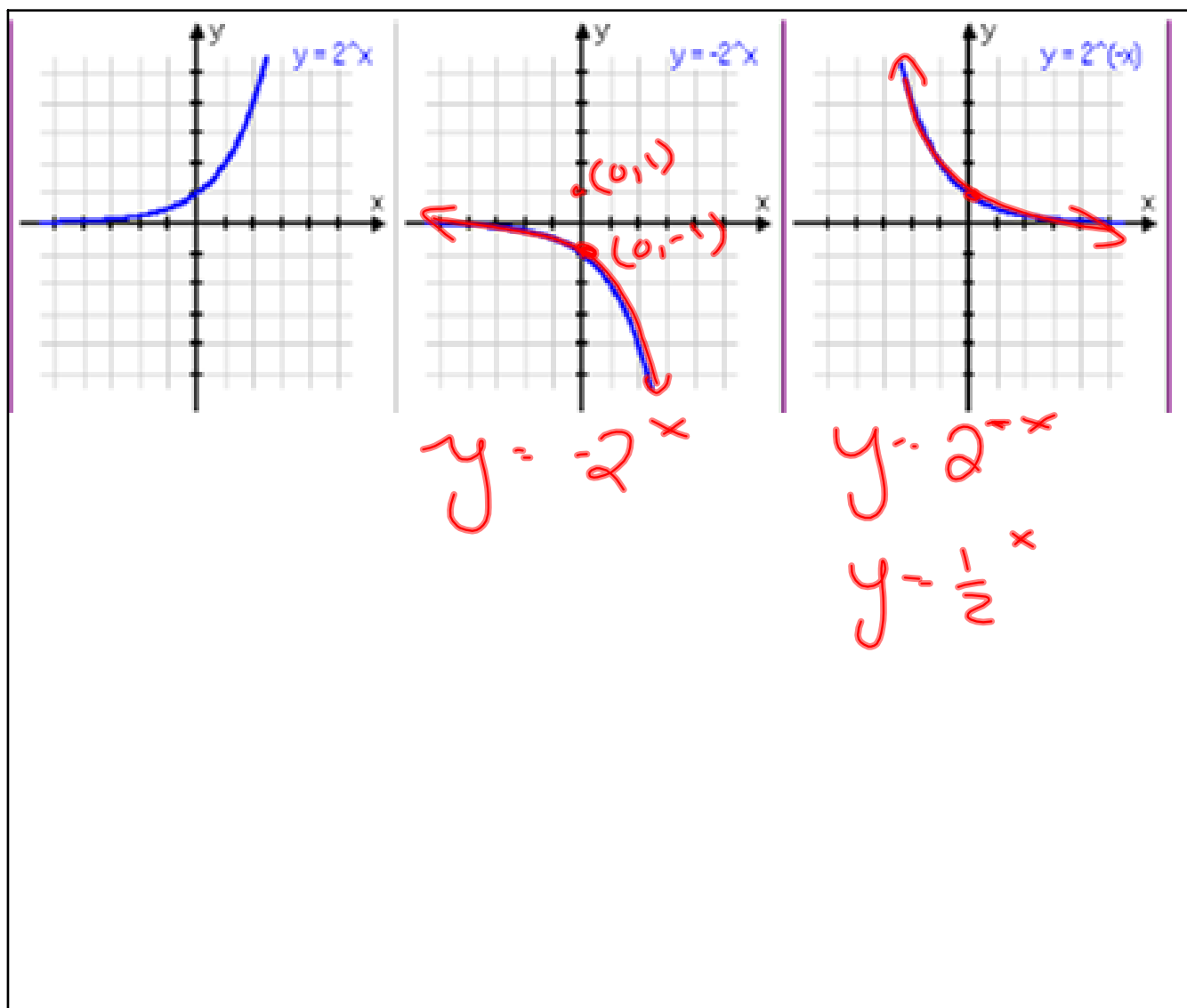
$$\frac{1}{2} - 5 = -4.5$$

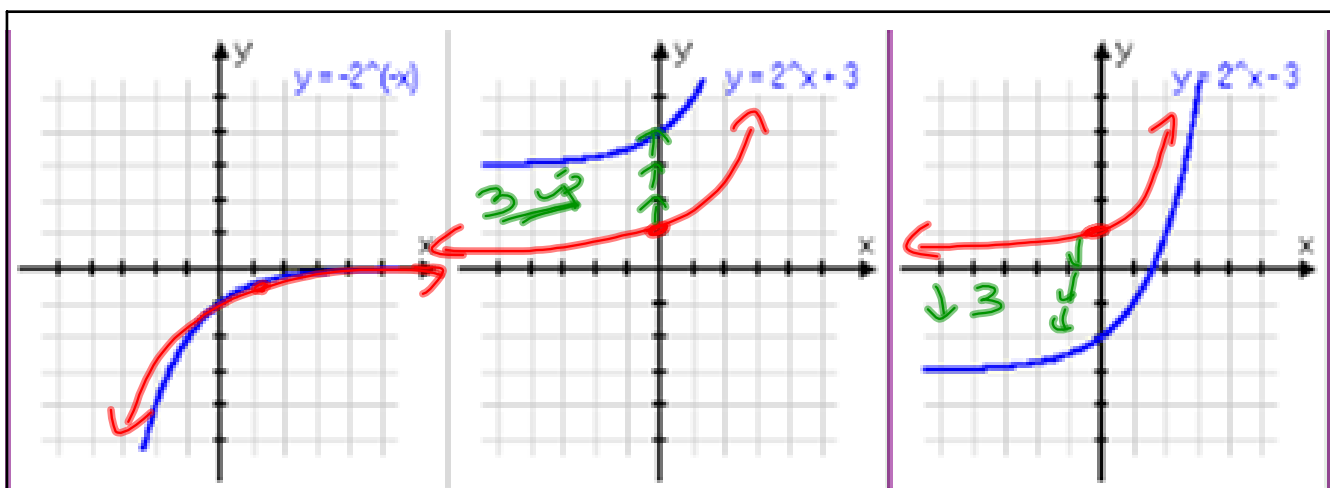
H/A:  $y = -5$



$$y = -3^{2x-5} - 2$$





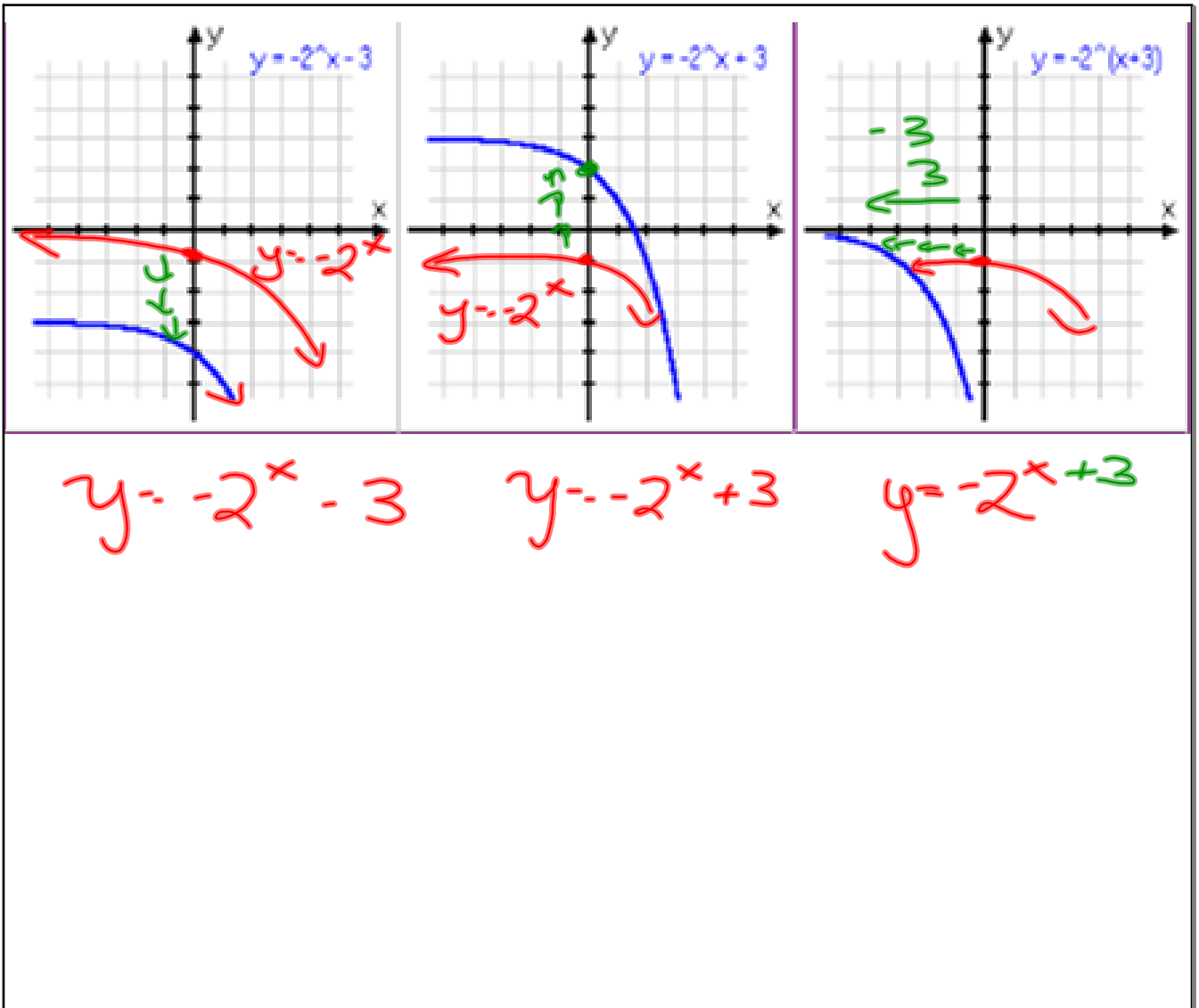


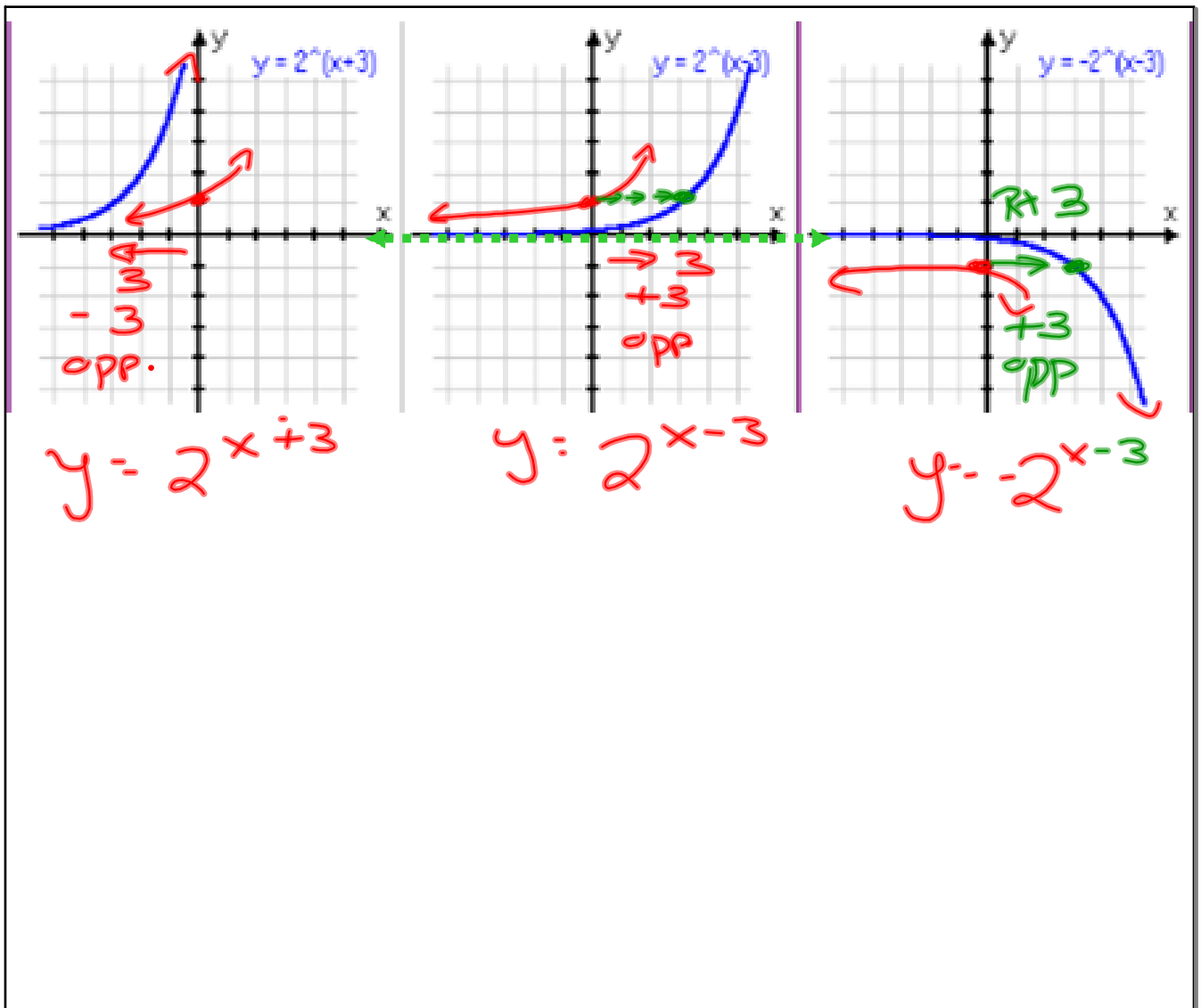
$$y = -2^{-x}$$

\* inverse  
 $y = x$

$$y = 2^x + 3$$

$$y = 2^x - 3$$







$(0,0)$   $y = (x - )^2 +$

$(0,0)$   $y = \sqrt{x -} +$

$(0,0)$   $y = |x - | +$

$(0,1)$   $y = 2^{(x - )} +$

\*opp: Inside outside \*SAME

↑ ⊕ ↓ ⊖

Looking at

$$y = a^x$$

$y = e^x$   
 $y = 2.7^x$



Graph  $y = 2^x$

$y = e^x$

$y = 3^x$

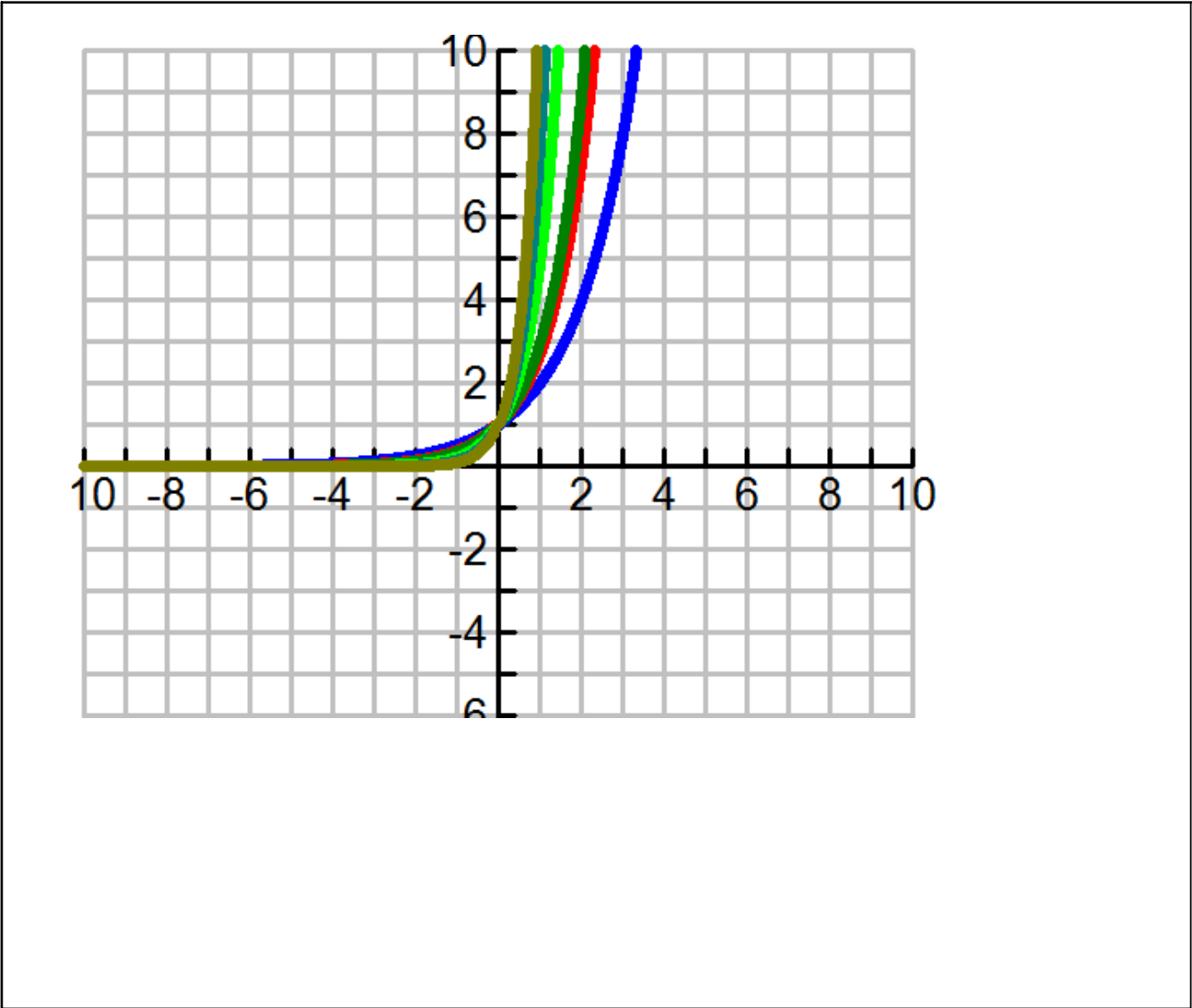
$y = 5^x$

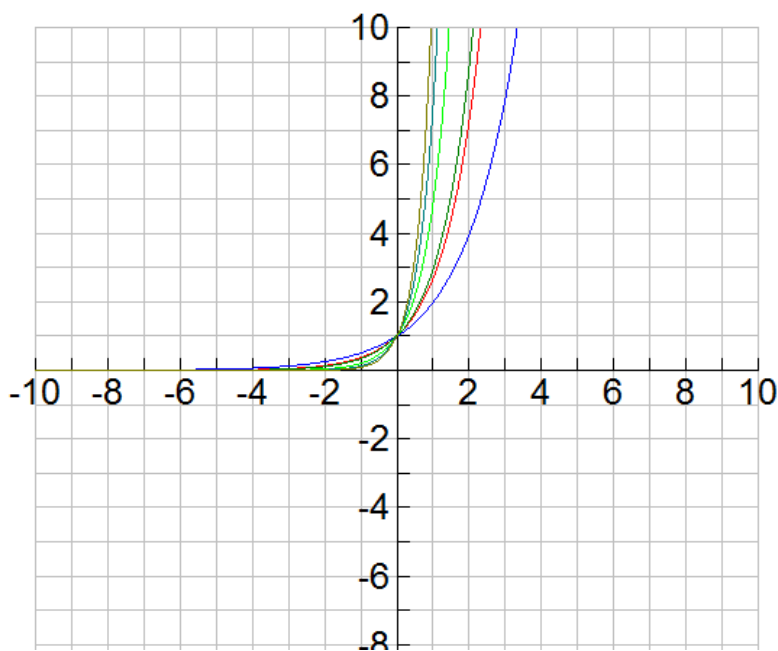
$y = 8^x$

$y = 12^x$

What is the difference?

What is the same?





What move a function?

"Inside"

"Outside"

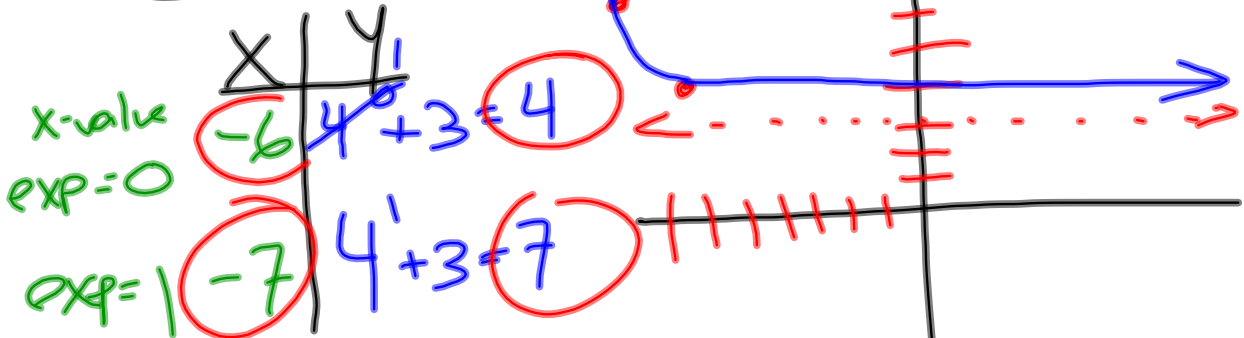
$$y = 2^{(x - \quad)} + \underline{\hspace{2cm}}$$

**This changes the point ( 0 , 1 )**

Another way to graph these functions

$y = 4^{-x-6} + 3$  V.A.

*(Note: In the original image,  $-x-6$  is circled in red, and a box around  $+3$  has an arrow pointing to  $\uparrow 3$ )*



Up grade when "on it"  $\uparrow$   
 Up grade otherwise  $\downarrow$

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

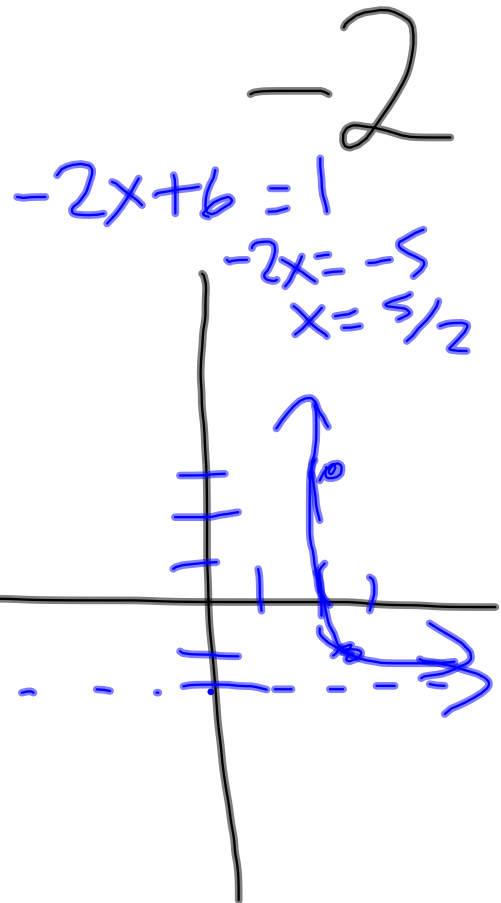
x	y
2	$1 - 5 = -4$
3	$\frac{1}{2} - 5 = -4.5$

$y = \left(\frac{1}{3}\right)^{-3x} + 0$

x	y
0	1
$-\frac{1}{3}$	4

$$y = 5^{-2x+6}$$

x	y
3	$5^{-2} = \frac{1}{4}$
$\frac{5}{2}$	$5^{-2} = \frac{1}{4}$





Construction Activity of folding paper of an exponential function.

Cut out the coordinate plane

Now draw an exponential function

Draw the line  $y = x$

Fold your paper along the line  $y = x$

Trace your graph

Unfold your paper and trace again so that you have both graphs on your paper