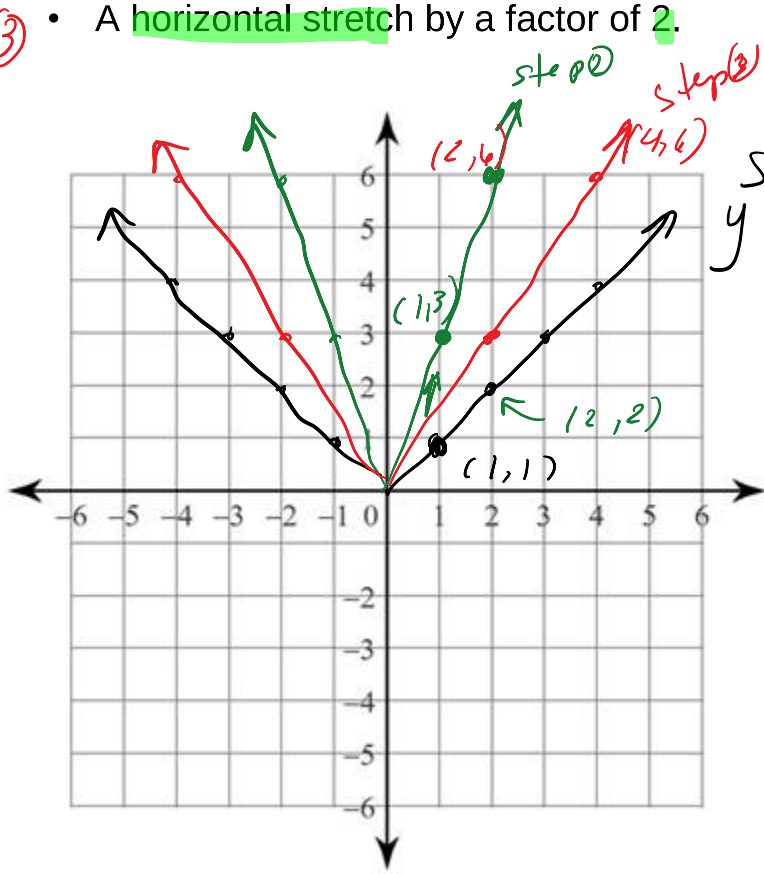
Combining Transformations

(1) Graph the function $y = |x|$. Apply the following transformations in the order they are given. After each step, use mapping notation to describe the transformation from the original function.

- (2) A vertical stretch by a factor of 3.
- (3) A horizontal stretch by a factor of 2.



step ① : base function

$y = |x|$

step ② vertical stretch by 3, so $a = 3$

$(x, y) \rightarrow (x, 3y)$

step ③ horizontal stretch by 2, so $b = \frac{1}{2}$

$(x, 3y) \rightarrow (2x, 3y)$

Mapping Notation:

$$(x, y) \rightarrow (2x, 3y)$$

$= |x|$. Apply the following transformations in the order they

final function $y = 3\left|\frac{1}{2}x\right|$

a b

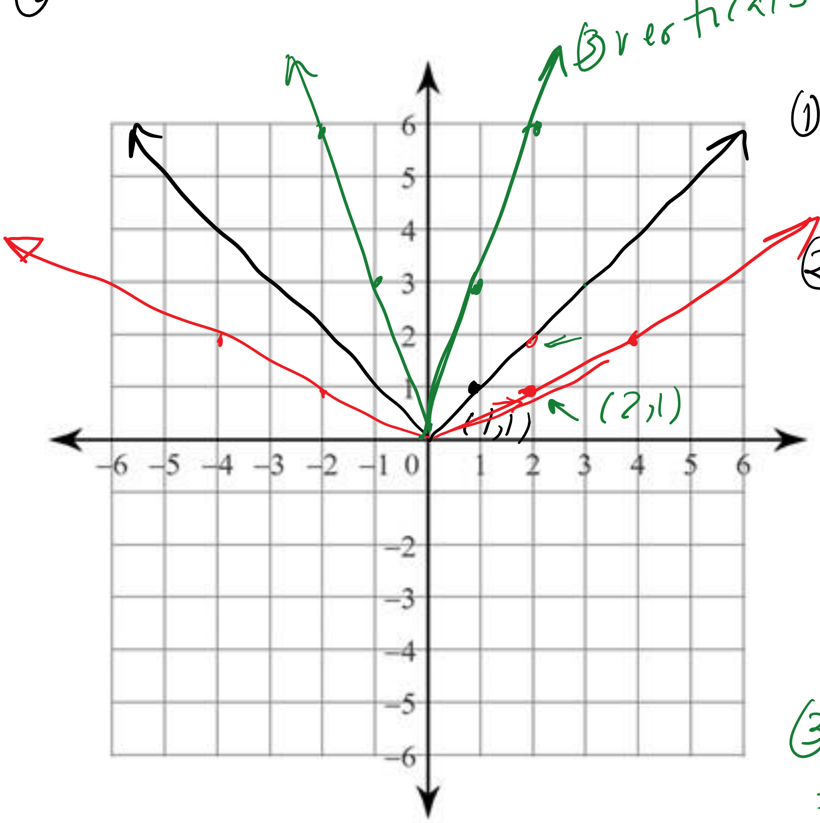
Graph the function

are given. After each step, use mapping notation to describe the transformation from the original function.

① $y = |x|$

② • A horizontal stretch by a factor of 2.

③ • A vertical stretch by a factor of 3.



① $y = |x|$ base function

② horizontal stretch by factor of 2:

$\Rightarrow$ multiply x-coord. by 2

$(x, y) \to (2x, y)$

$(1,1) \to (2,1)$

$(2,2) \to (4,2)$

③ vertical stretch by 3

$\Rightarrow$ multiply y-coord by 3

$(2x, y) \to (2x, 3y)$

$(2,2) \to (2,6)$

Mapping Notation:

$(x, y) \to (2x, 3y)$

Did the order in which you performed the stretches change the resulting image? No!

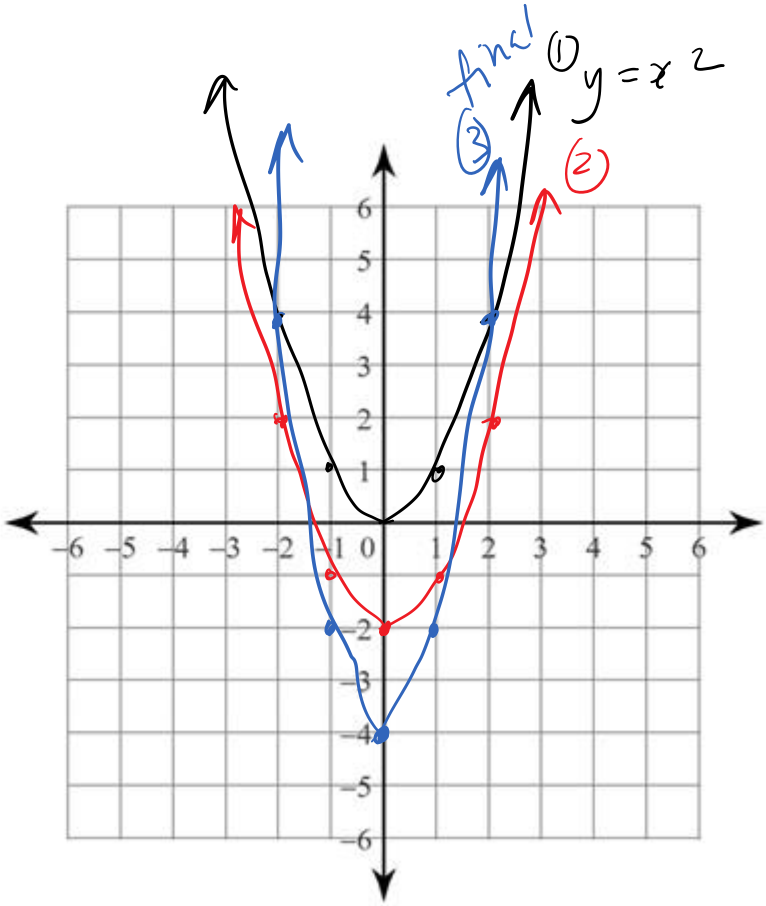
$= x^2$. Apply the following transformations in the order they

are given. After each step, use mapping notation to describe the transformation from the original function.

Graph the function (1) $y = x^2$

(2) • A vertical translation of 2 down.

(3) • A vertical stretch by a factor of 2.



(2) vertical translation

$(x,y) \to (x, y-2)$

$(0,-2)$

$(1,-1)$

$(2,2)$

(3) vertical stretch

$\to (0,-4)$

$\to (1,-2)$

$\to (2,4)$

mult. y-coord by 2

vertical stretch by 2

down by 2

Mapping Notation:

$$(x,y) \to (x, 2(y-2))$$

$$(x,y) \to (x, 2y-4)$$

$= x^2$. Apply the following transformations in the order they are given. After each step, use mapping notation to describe the transformation from the original function.

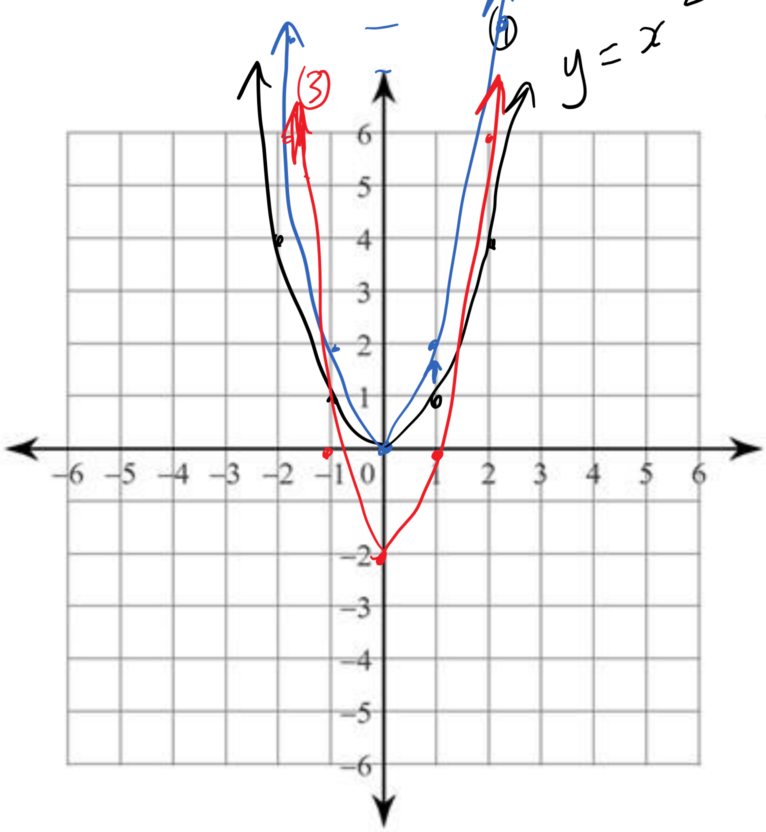
Graph the function ① $y = x^2$

② • A vertical stretch by a factor of 2.

③ • A vertical translation of 2 down.

② vert. stretch

① $y = x^2$ base function



② vertical stretch by 2

③ Vert. translation 2 Down

$(0,0) \to (0,0) \to (0,-2)$

$(1,1) \to (1,2) \to (1,0)$

$(2,4) \to (2,8) \to (2,6)$

mult y-coord by 2

Mapping Notation:

vert. stretch

vert. translation

$(x, y) \to (x, 2y - 2)$

Did the order in which you performed the stretches change the resulting image?

Yes!

When applying several transformations to a function, STRETCHES & Reflections must be done before TRANSLATIONS

A transformed function can be written in the form $\boxed{y = af\left(b(x - h)\right) + k}$.

horizontal trans.
$h+$: RIGHT
$h-$: LEFT

vert. translation
$k+ \to$ up
$k- \to$ Down

A function written in this form has undergone the following transformation:

a: vertical stretch about the x-axis by a factor of 2 mult. y-coord by a

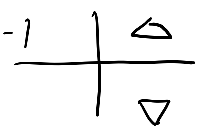
If $a < 0$, REFLECT in x-axis

b: horizontal stretch by a factor of $\frac{1}{|b|}$ x mult. x-coord by $\frac{1}{|b|}$

If $b < 0$, REFLECT in y-axis

<u>Example 1</u>

$a = -1$



The function $y = f(x)$ is transformed to the function $g(x) = -2f(2x + 6) - 1$.
Describe the transformations that were applied to $y = f(x)$.

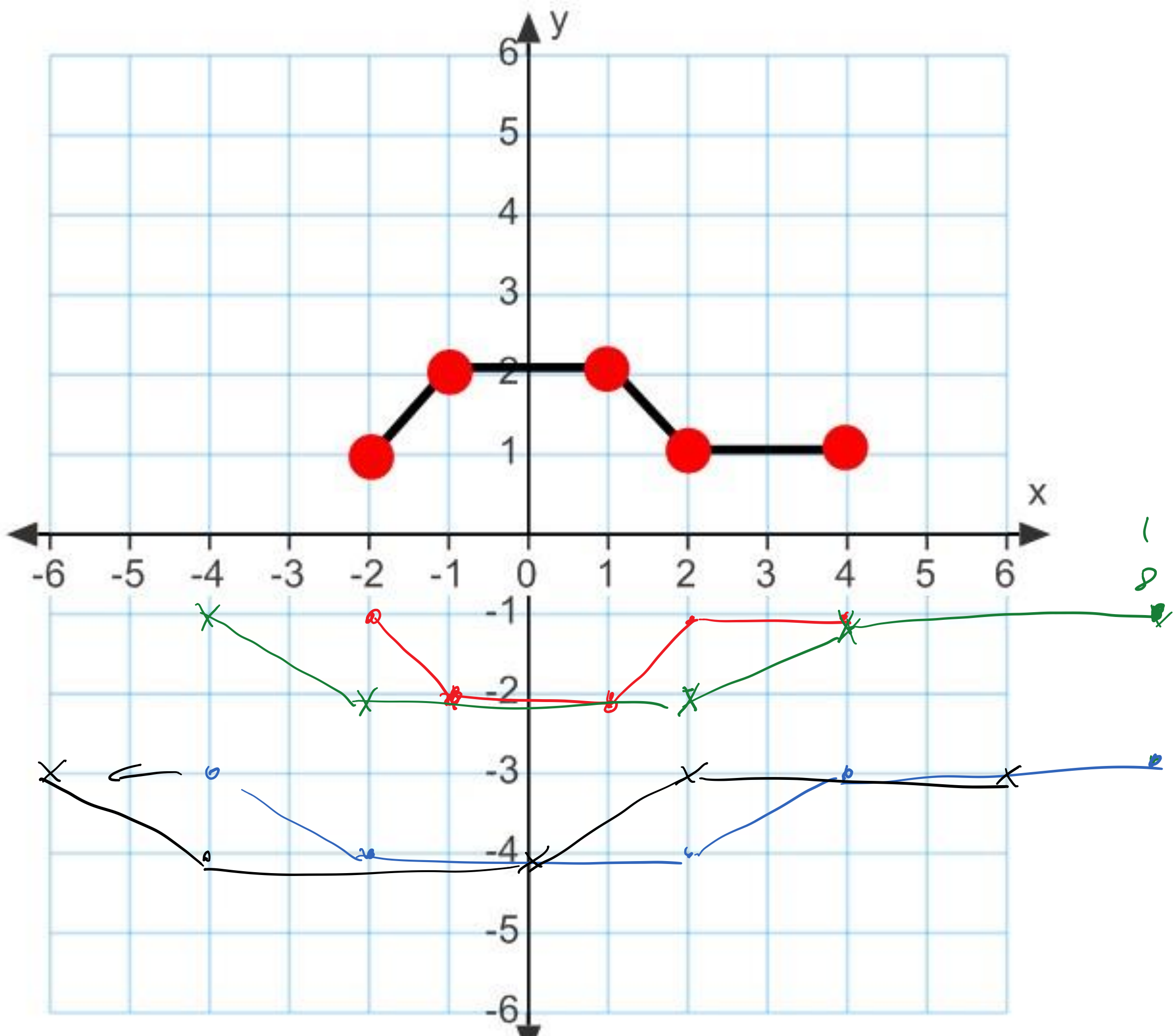
<u>Example 2</u>

A key point (-1, 2) lies on the graph $y = f(x)$. What is its image point under the following transformation of the graph of $y = f(x)$?

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

Example 3

The graph of $y = f(x)$ is given. Sketch the graph of $y + 2 = -f(\frac{1}{2}(x + 2))$.



$y = a f(b(x - h)) + k$

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

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

× mult. y by −1

$a = -1$

Reflect about x-axis

$b = \frac{1}{2}$

horizont stretch by a factor of 2

× mult. by 2

horiz. trans.

LEFT 2

vert. trans.

DOWN 2