Assume the original function is ***f(x)***.

Vertical Transformations (y-values)

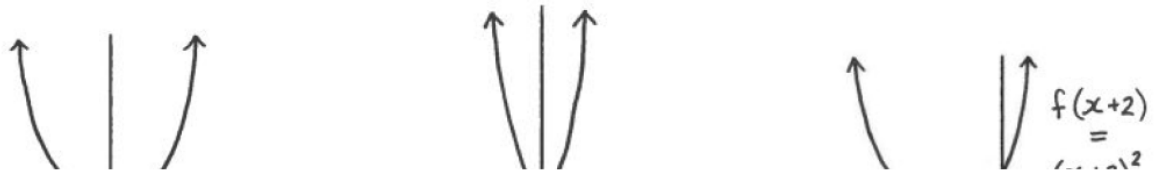
How is the original function changing? (What is the new function?)	How are the points of f(x) affected?	What does this look like on the graph?
$f(x) + d$	(x, y) → (x, y + d)	Vertical shift UP by d
$f(x) - d$	(x, y) → (x, y - d)	Vertical shift DOWN by d
$c \cdot f(x)$ ex) $2f(x)$	(x, y) → (x, cy) (x, 2y)	Stretch vertically by c
$\frac{1}{c} f(x)$ ex) $\frac{1}{3}f(x)$	(x, y) → (x, (1/c)y) $(x, \frac{1}{3}y)$	Shrink vertically by 1/c (compression)
$-f(x)$	(x, y) → (x, -y) switch the sign	Flip over the x-axis (reflection)

0 < c < 1

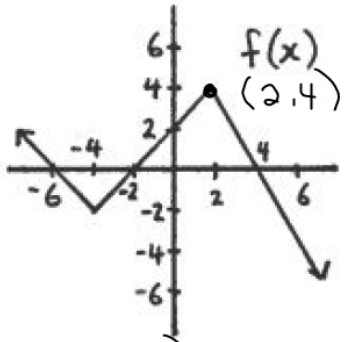
Horizontal Transformations (x-values)

How is the original function changing? (What is the new function?)	How are the points of f(x) affected?	What does this look like on the graph?
$f(x + d)$ ★	(x, y) → (x - d, y)	Horizontal shift LEFT by d
$f(x - d)$ ★	(x, y) → (x + d, y)	Horizontal shift RIGHT by d
$f(c \cdot x)$ ex) $f(2x)$	(x, y) → ((1/c)x, y) $(\frac{1}{2}x, y)$	Shrink horizontally by $\frac{1}{c}$ (compression)
$f(\frac{1}{c} \cdot x)$ ex) $f(\frac{1}{3}x)$	(x, y) → (cx, y) $(3x, y)$	Stretch horizontally by c
$f(-x)$	(x, y) → (-x, y) switch sign of x	Flip over the y-axis (reflect)

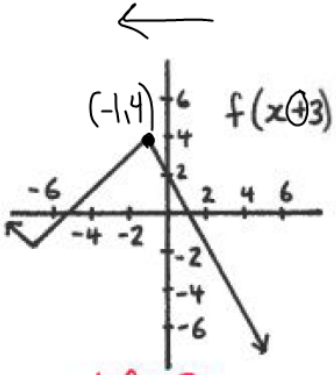
mult. by reciprocal ★ ★

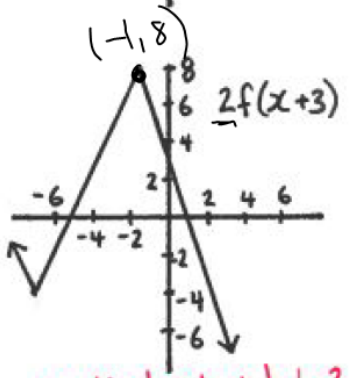


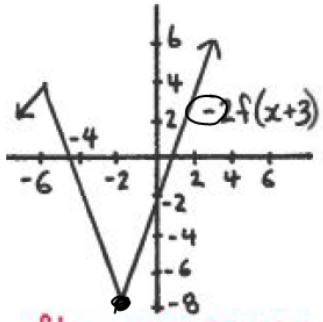
More Examples

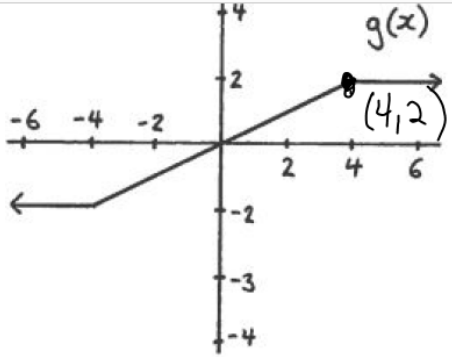


left 3 $(2,4) \to (2-3,4) \to (-1,4)$
V.S. by 2 $(-1,4) \to (-1,4 \cdot 2) \to (-1,8)$
reflect $(-1,8) \to (-1,-8)$
×



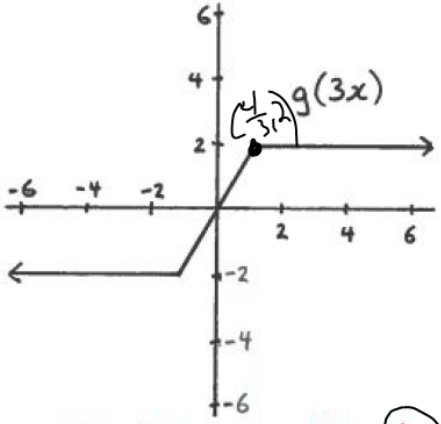




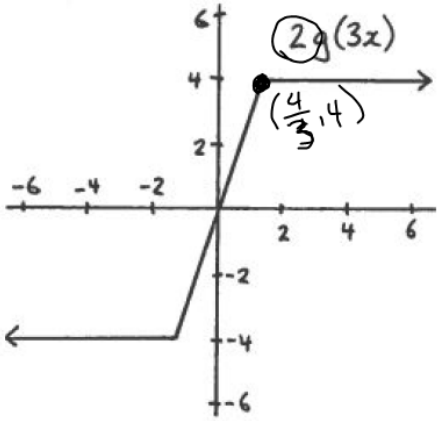


H.S. $(4,2) \rightarrow \left(4 \cdot \frac{1}{3}, 2\right)$
$\rightarrow \left(\frac{4}{3}, 2\right)$

V.S. $\left(\frac{4}{3}, 2\right) \rightarrow \left(\frac{4}{3}, 2 \cdot 2\right)$
$\rightarrow \left(\frac{4}{3}, 4\right)$



shrink horizontal by $\frac{1}{3}$

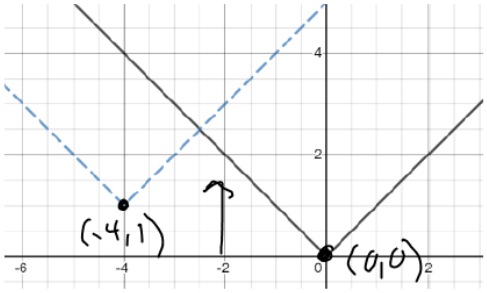


stretch vertical by 2

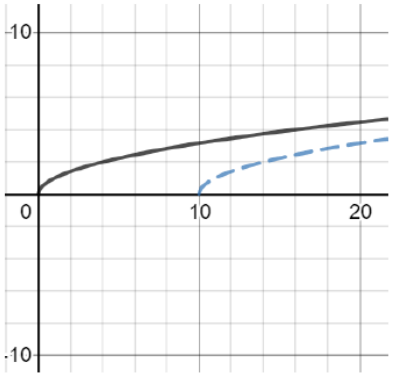
Part 1: For the given graphs below, provide the following information:

- Identify the given parent function: $f(x) = x$, $f(x) = x^2$, $f(x) = x^3$, $f(x) = b^x$, $f(x) = \sqrt{x}$, $f(x) = |x|$
- Describe using words, the transformation that occurred from the parent function.
- Write the transformation function represented by the given dotted graph.

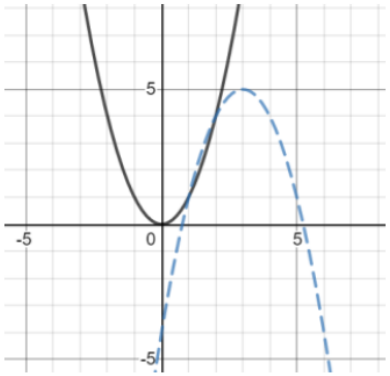
1.



2.



3.



Parent fxn $f(x) = |x|$

left 4, up 1

$f(x) = |x+4| + 1$

Part 2: Describe the transformations occurred from the given functions below.

7. What transformation converts the graph of $f(x) = -9(x-7)^2 + 9$ to $g(x) = -9(x-7)^2 + 6$?

8. What transformation converts the graph of $f(x) = -5|x+2| + 6$ to $g(x) = -5|x+10| + 7$?

10 - 2 = 8 spaces to the left 7 - 6 = 1 space up

9. What transformation converts the graph of $f(x) = 3(x)^3 + 1$ into the graph of $g(x) = 6(x)^3 + 1$?