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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?
$f(x) + d$	$(x, y) \rightarrow (x, y + d)$	Vertical shift <u>UP</u> by d
$f(x) - d$	$(x, y) \rightarrow (x, y - d)$	Vertical shift <u>DOWN</u> by d
$c \cdot f(x)$	$(x, y) \rightarrow (x, cy)$	<u>Stretch vertically</u> by c
$\left(\frac{1}{c}\right) \cdot f(x)$	$(x, y) \rightarrow (x, (1/c)y)$	<u>Shrink vertically</u> by $1/c$ compression
$-f(x)$	$(x, y) \rightarrow (x, -y)$ switch sign	Flip over the x-axis reflection

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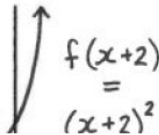
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Horizontal Transformations (x-values)

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?
$f(x + d)$	$(x, y) \rightarrow (x - d, y)$	Horizontal shift <u>LEFT</u> by d
$f(x - d)$	$(x, y) \rightarrow (x + d, y)$	Horizontal shift <u>RIGHT</u> by d
$f(c \cdot x)$ ex) $f(2x)$	$(x, y) \rightarrow (\frac{1}{c}x, y)$ ($\frac{1}{2}x, y$)	<u>Compression</u> <u>Shrink</u> horizontally by $\frac{1}{c}$
$f(\frac{1}{c} \cdot x)$ ex) $f(\frac{1}{3}x)$	$(x, y) \rightarrow (cx, y)$ ($3x, y$)	<u>Stretch</u> horizontally by c
$f(-x)$	$(x, y) \rightarrow (-x, y)$	Flip over the <u>y-axis</u> <u>reflection</u>



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$f(x)$

$f(x+3)$

left 3

mult. y-values by 2

$2f(x+3)$

vertical stretch by 2

reflect

$-2f(x+3)$

flip over x-axis

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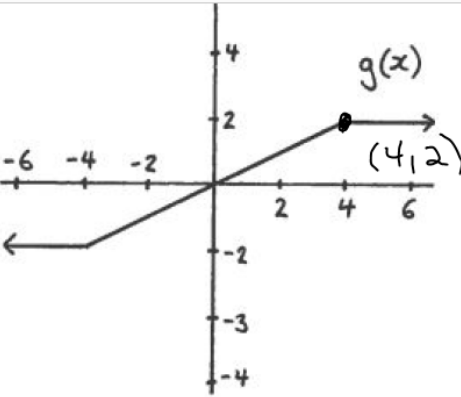
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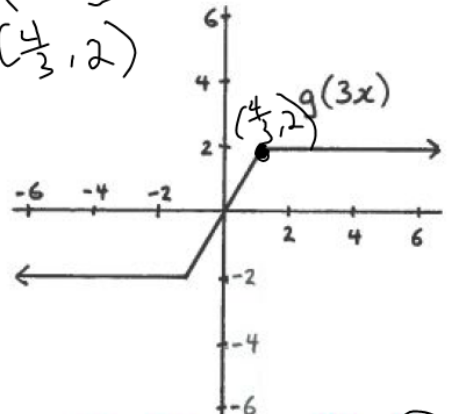
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$g(x)$



$(4, 2)$

$(4, 2) \rightarrow (4 \cdot \frac{1}{3}, 2)$
 $(\frac{4}{3}, 2)$

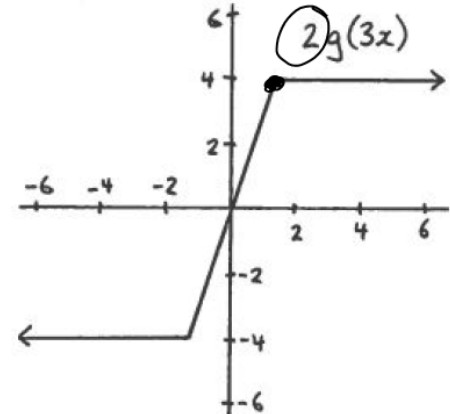


$g(3x)$

$(\frac{4}{3}, 2)$

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

$2g(3x)$



$2g(3x)$

$(\frac{4}{3}, 2) \rightarrow (\frac{4}{3}, 2 \cdot 2)$
 $\rightarrow (\frac{4}{3}, 4)$

stretch vertical by 2

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$\sqrt{x}, f(x) = |x|$

- Describe using words, the transformation that occurred from the parent function.
- Write the transformation function represented by the given dotted graph.

1.	2.	3.
$f(x) = x$ shifted left 4 up 1 $f(x) = x+4 + 1$		
4.	5.	6.