1.3 Expansions and compressions

- Graphs can be expanded/compressed vertically and horizontally

Vertical Expansions/Compressions

$y = x^2$

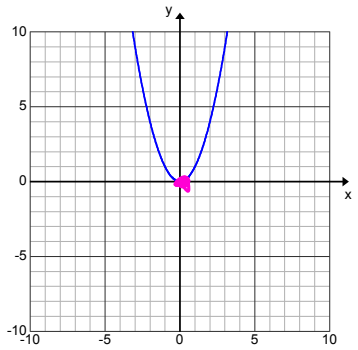
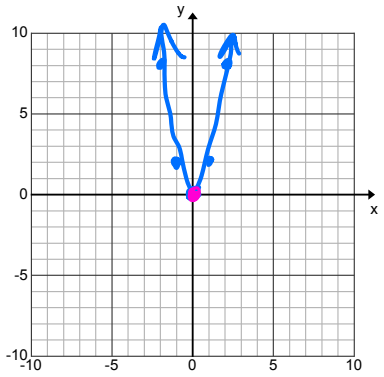


Table of Values

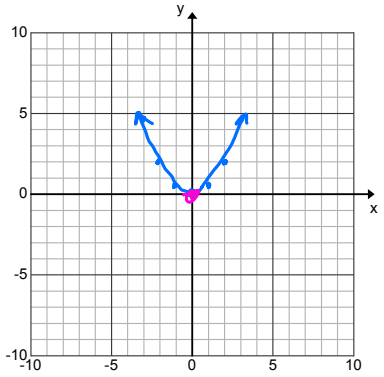
x	y
1	1
0	0
-1	1

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



Your f(x) values grow twice as fast.

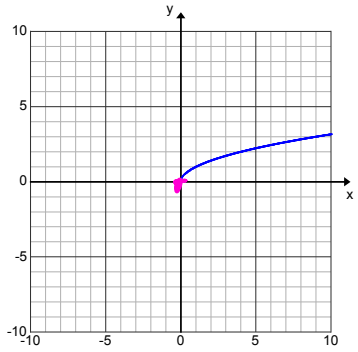
$y = \frac{1}{2}x^2$	$y = \frac{1}{2}(x^2)$
$2y = x^2$	$2(y) = x^2$



your f(x) values grow half as fast.

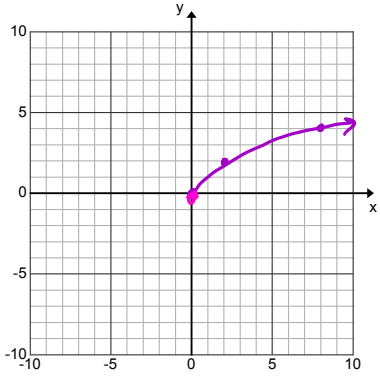
Horizontal Expansions/Compressions

$y = \sqrt{x}$

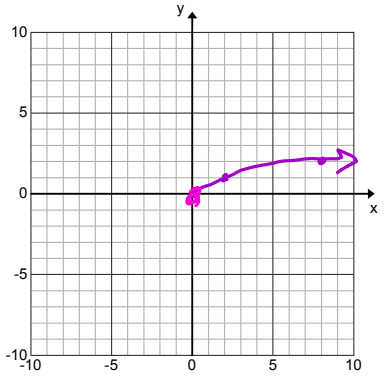


x	y
0	0
1	1
4	2

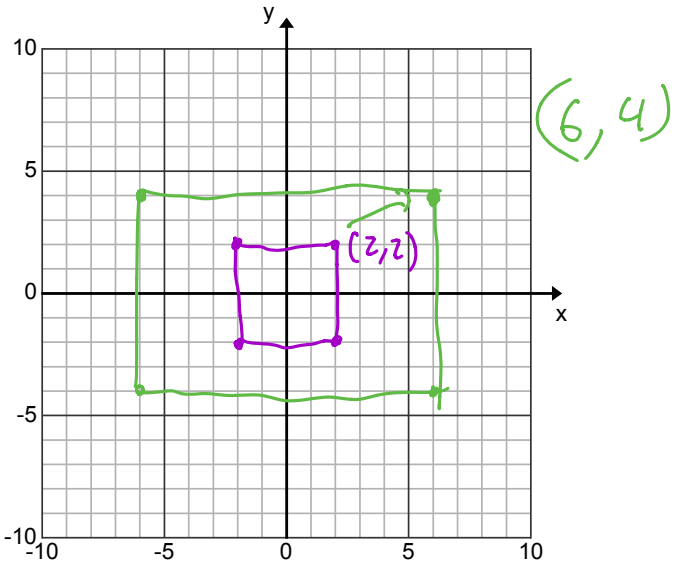
$y = \sqrt{2x}$



$y = \sqrt{\frac{1}{2}x} = \sqrt{\frac{x}{2}}$



This also works for general functions (f(x), g(x), k(x)…). For example, given the graph of $y = f(x)$ sketch a graph of $y = 2f(3x)$



Points on graphs can be expanded and compressed as well.
Ex. The point (2, 3) is on the graph of $y = g(x)$ then what point must be on the graph of $y = -3g\left(\frac{1}{2}x\right)$?

$\left(\frac{2}{\frac{1}{2}}, 3(-3)\right) \rightarrow (4, -9)$

In general:
The function $y = f(x)$ with the function $y = af(x)$ has been

- *Vertically Expanded if a>1 or a<-1*
- *Vertically Compressed if -1<a<1 (a≠0)*

The function $y = f(x)$ with the function $y = f(bx)$ has been

- *Horizontally Expanded if -1<b<1 (b≠0)*
- *Horizontally Compressed if b>1 or b<-1*

New Word: INVARIANT POINT is a point that doesn't move after it has been affected by a transformation.