

Transformations of Functions

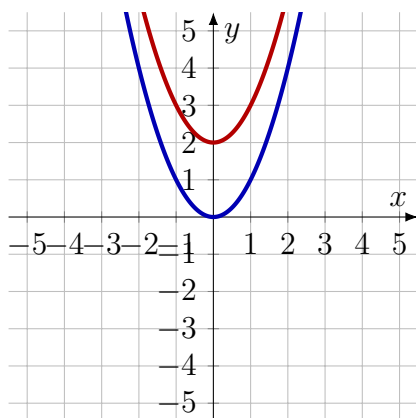
For the graph $f(x)$, the following table depicts the effect of various transformations.

Transformation	Effect	Details
$y = f(x) + C$	vertical shift by C units	$+ C$ shifts graph up $- C$ shifts graph down
$y = f(x + C)$	horizontal shift by C units	$+ C$ shifts graph left $- C$ shifts graph right
$y = Cf(x)$	vertical stretch or compression	graph stretches when $ C > 1$ graph compresses when $ C < 1$
$y = f(Cx)$	horizontal stretch or compression	graph stretches when $ C < 1$ graph compresses when $ C > 1$
$y = -f(x)$	reflection about x-axis	if $f(-x) = -f(x)$, the function is odd and has origin symmetry
$y = f(-x)$	reflection about y-axis	if $f(x) = f(-x)$, the function is even and has y-axis symmetry

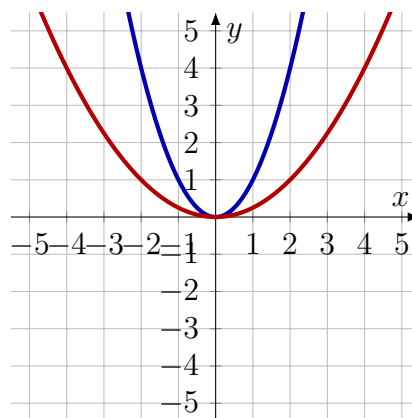
Examples:

Key $f(x)$: blue graph, y : red graph

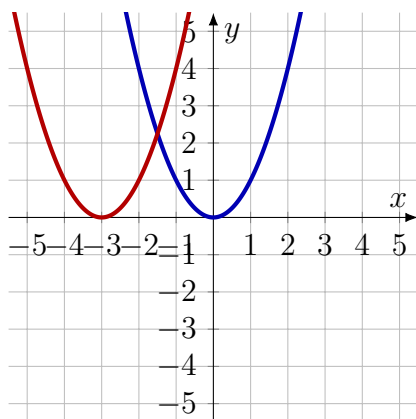
1. Vertical: $f(x) = x^2$ $y = x^2 + 2$



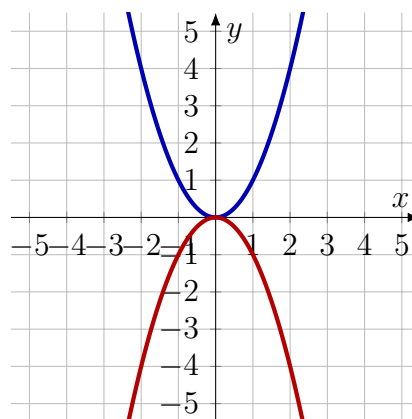
4. Compression: $f(x) = x^2$, $y = (0.5x)^2$



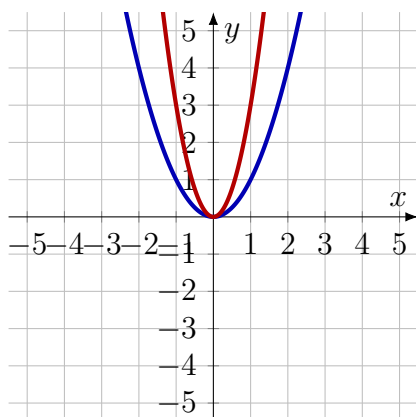
2. Horizontal: $f(x) = x^2$, $y = (x + 3)^2$



5. Reflection: $f(x) = x^2$, $y = -x^2$



3. Stretch: $f(x) = x^2$ $y = 3x^2$



6. Combo: $f(x) = x^2$, $y = (x - 3)^2 - 4$

