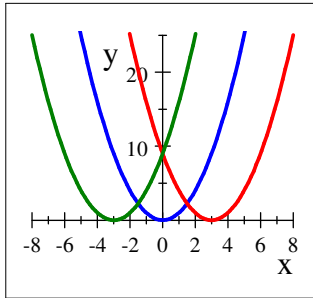


Transformation of function $y = f(x)$

(I) Shift ($c > 0$)

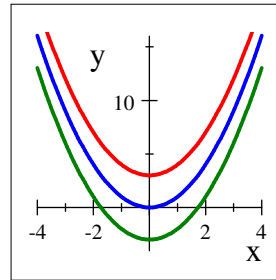
Horizontal (on x - axis)

$y = f(x - c)$	c units to the right $\rightarrow$
$f(x) = (x - 3)^2$	shift x^2 , 3 units $\rightarrow$
$y = f(x + c)$	c units to the left $\leftarrow$
$f(x) = (x + 3)^2$	shift x^2 , 3 units $\leftarrow$



Vertical (on y - axis)

$y = f(x) - c$	c units downward $\downarrow$
$f(x) = x^2 - 3$	shift x^2 , 3 units $\downarrow$
$y = f(x) + c$	c units upward $\uparrow$
$f(x) = x^2 + 3$	shift x^2 , 3 units $\uparrow$



$$f(x) = x^2$$

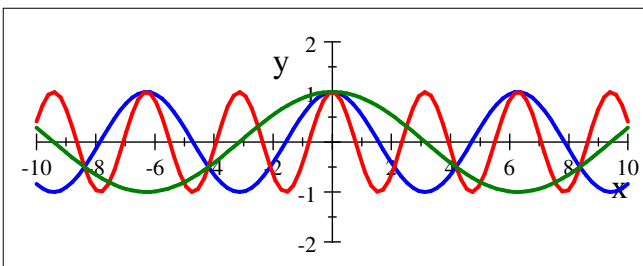
Horizontal

(II) Stretching ($c > 1$) $y = f\left(\frac{x}{c}\right)$

$$f(x) = \cos\left(\frac{x}{2}\right)$$

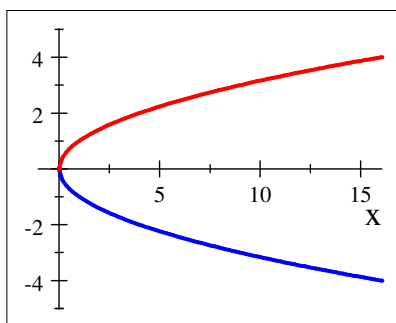
(III) Compress ($c > 1$) $y = f(cx)$

$$f(x) = \cos(2x)$$



(IV) Reflect : $y = -f(x)$

for exp $f(x) = \sqrt{x}$



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

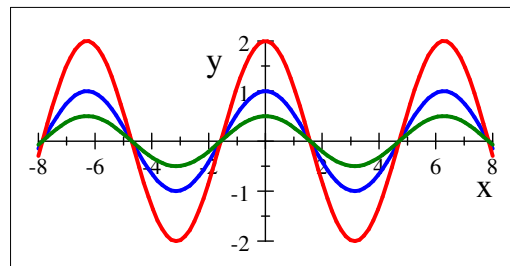
Vertical

(II) Stretching ($c > 1$) $y = cf(x)$

$$f(x) = 2\cos(x)$$

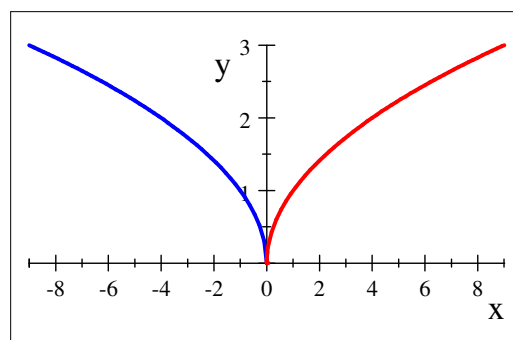
(III) Compress ($c > 1$) $y = \left(\frac{1}{c}\right)f(x)$

$$f(x) = \frac{1}{2}\cos(x)$$



(IV) Reflect : $y = f(-x)$

for exp $f(x) = \sqrt{-x}$



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