Subject: Calculus
Created by: Matthias Fisseha
Revised: 07/10/2018

Transformations of Functions

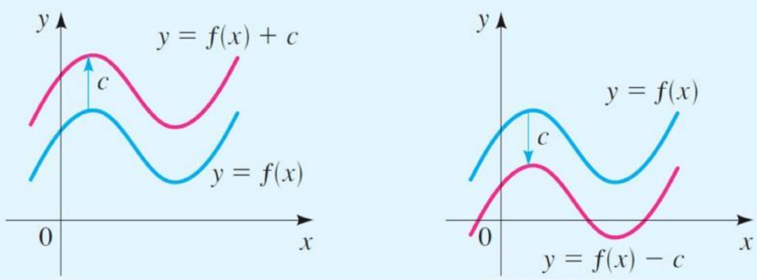
Vertical Shifting

Vertical Shifts of Graphs

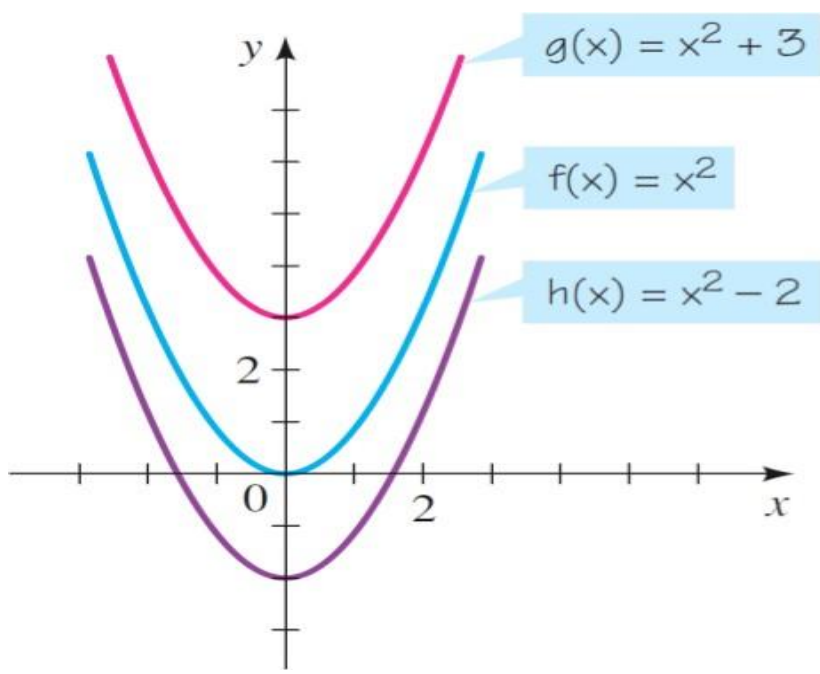
Suppose $c > 0$.

To graph $y = f(x) + c$, shift the graph of $y = f(x)$ upward c units.

To graph $y = f(x) - c$, shift the graph of $y = f(x)$ downward c units.



Example



(510) 885-3674
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scaa@csueastbay.edu

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Transformations of Functions

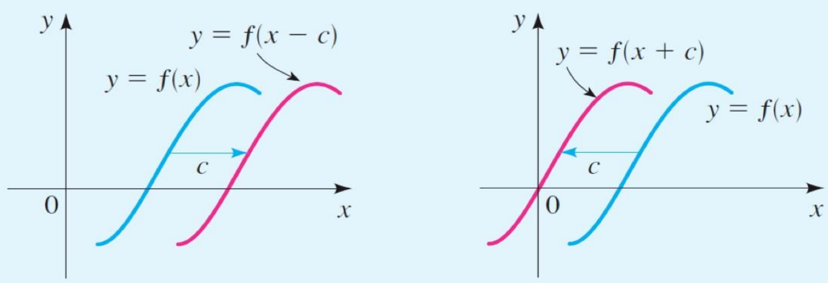
Horizontal Shifting

Horizontal Shifts of Graphs

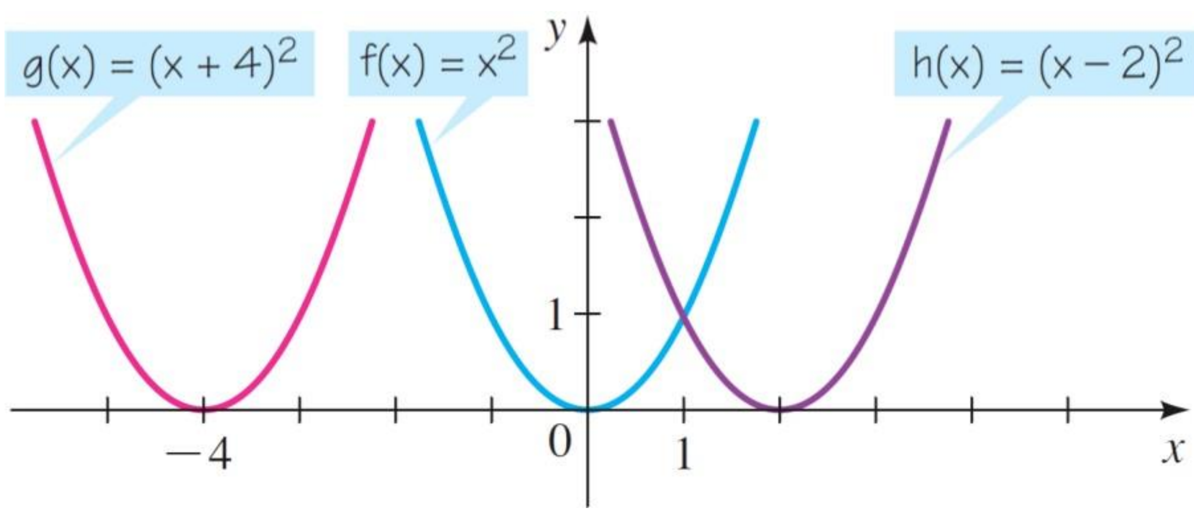
Suppose $c > 0$.

To graph $y = f(x - c)$, shift the graph of $y = f(x)$ to the right c units.

To graph $y = f(x + c)$, shift the graph of $y = f(x)$ to the left c units.



Example



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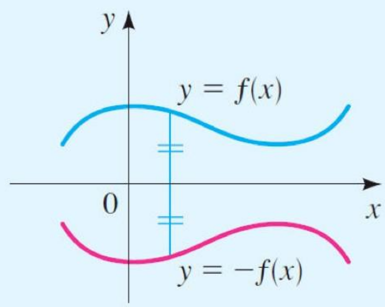
Transformations of Functions

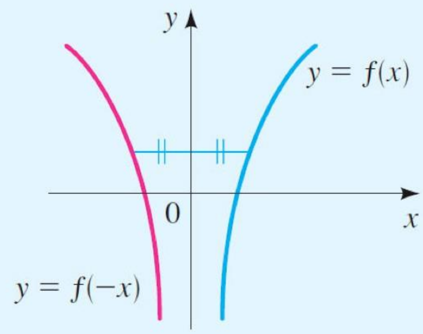
Reflecting Graphs

Reflecting Graphs

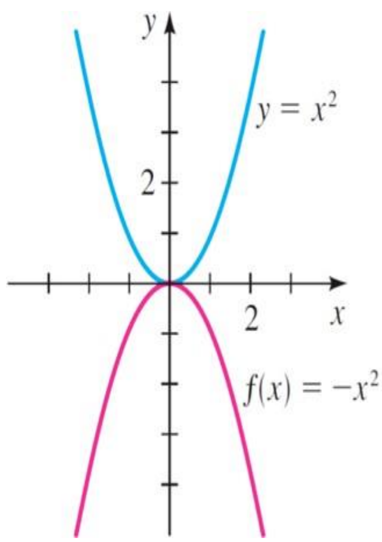
To graph $y = -f(x)$, reflect the graph of $y = f(x)$ in the x-axis.

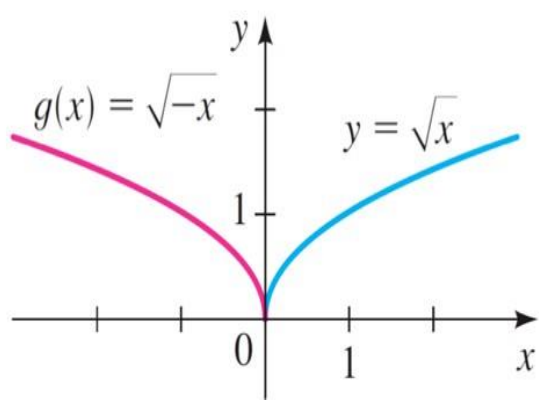
To graph $y = f(-x)$, reflect the graph of $y = f(x)$ in the y-axis.





Examples





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Transformations of Functions

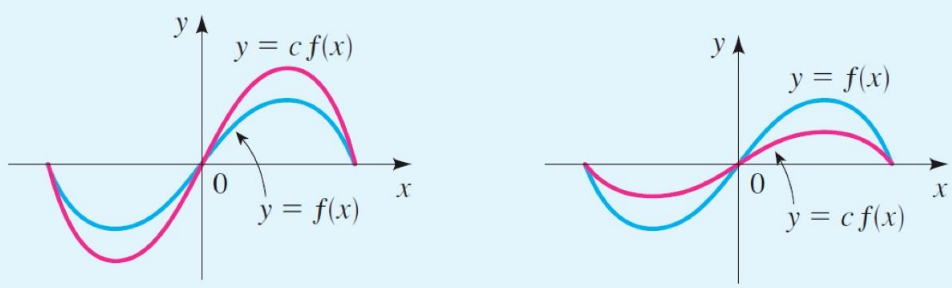
Vertical Stretching and Shrinking

Vertical Stretching and Shrinking of Graphs

To graph $y = cf(x)$:

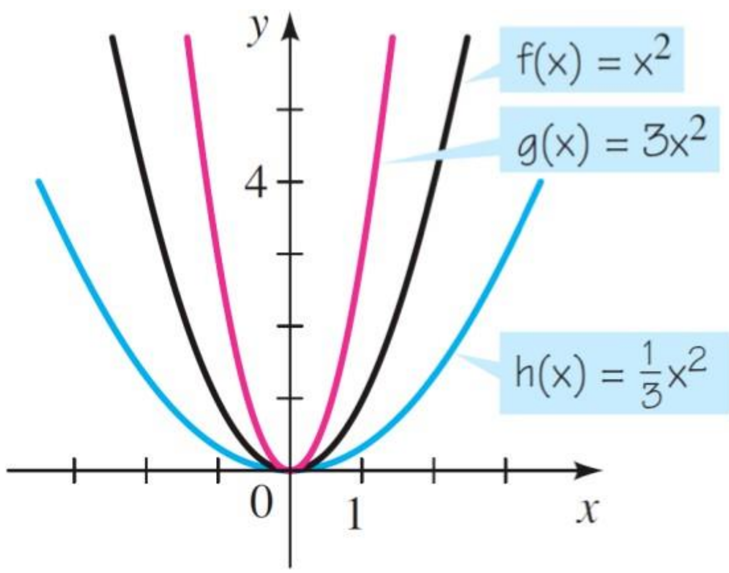
If $c > 1$, stretch the graph of $y = f(x)$ vertically by a factor of c.

If $0 < c < 1$, shrink the graph of $y = f(x)$ vertically by a factor of c.



$c > 1$ $\qquad$ $0 < c < 1$

Example



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Transformations of Functions

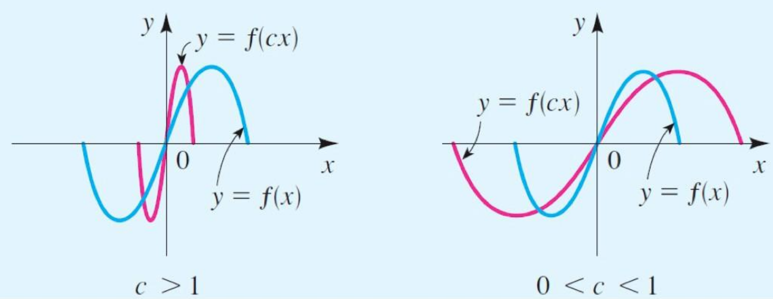
Horizontal Stretching and Shrinking

Horizontal Shrinking and Stretching of Graphs

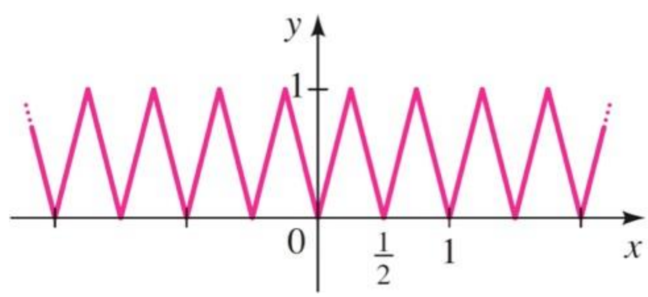
To graph $y = f(cx)$:

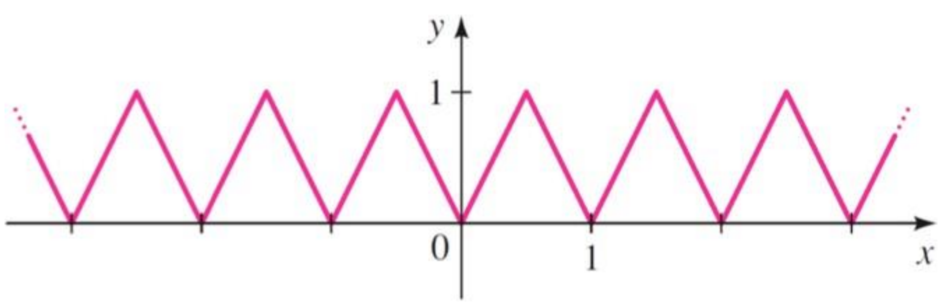
If $c > 1$, shrink the graph of $y = f(x)$ horizontally by a factor of $1/c$.

If $0 < c < 1$, stretch the graph of $y = f(x)$ horizontally by a factor of $1/c$.



Example





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References --- The following work was referenced to during the creation of this handout: *Algebra and Trigonometry: Fourth Edition (Stewart, Redlin, Watson).*

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scaa@csueastbay.edu

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