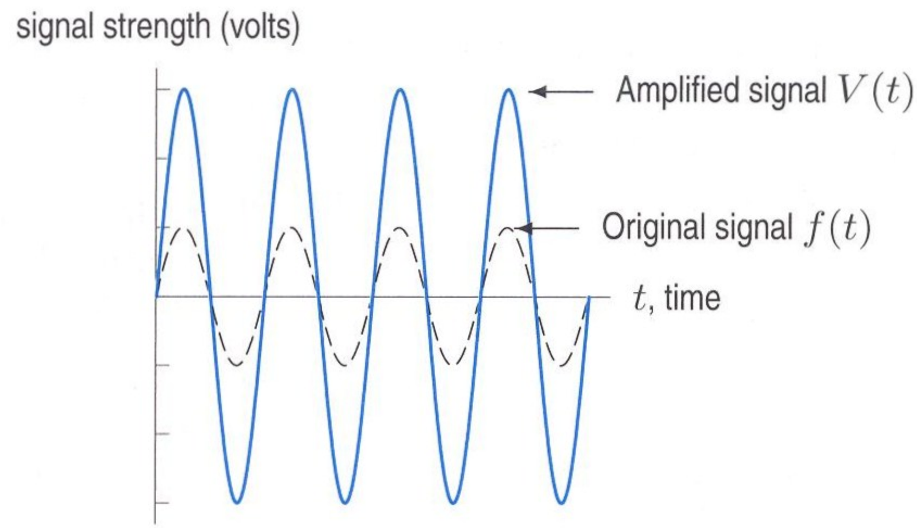
# Vertical Stretches and Compressions

Chapter 6

Section 3

# Vertical Stretch: A Stereo Amplifier

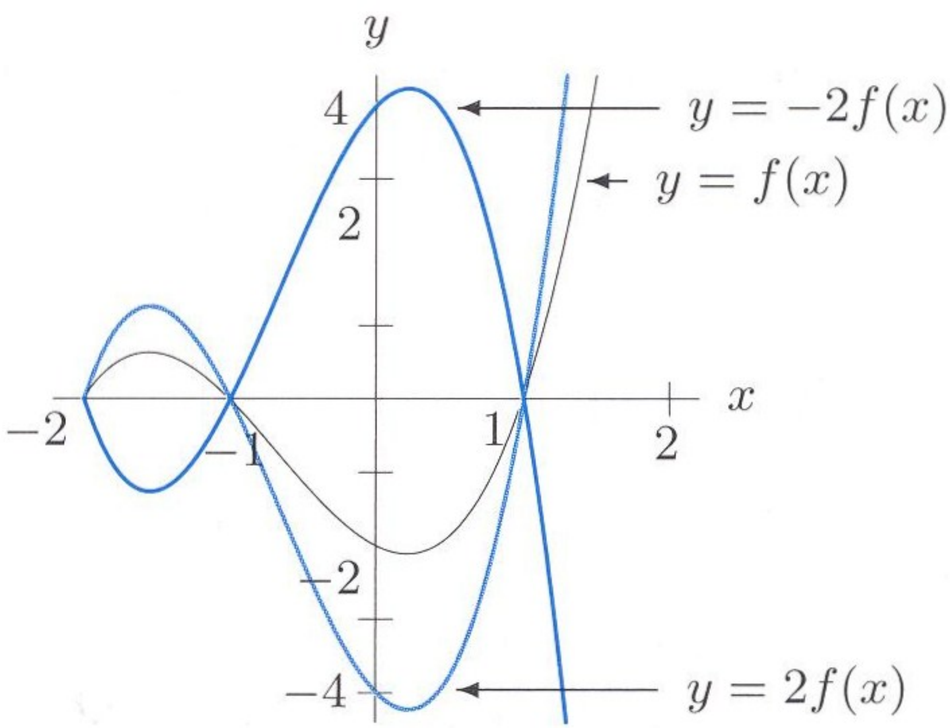
A stereo amplifier takes a weak signal from a cassette-tape deck, CD payer , or radio tuner and transforms it into a stronger signal to power a set of speakers.




$$V(t) = 3 \cdot f(t)$$

# Negative Stretch Factor

What happens if we multiply a function by a negative stretch factor?



# Summary for Vertical Stretch or Compression

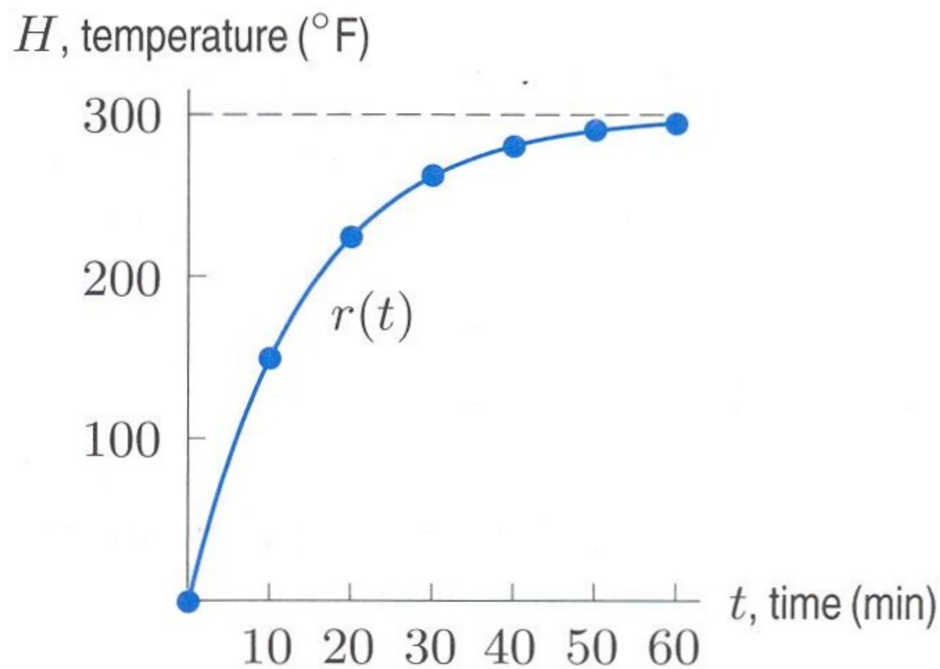
If $f$ is a function and $k$ is a constant, then the graph of $y = k \cdot f(x)$ is the graph of $y = f(x)$

- Vertically stretched by a factor of $k$, if $k > 1$.
- Vertically compressed by a factor of $k$, if $0 < k < 1$.
- Vertically stretched or compressed by a factor of $|k|$ and reflected across $x$-axis, if $k < 0$.

# A yam is placed in a 300°F oven

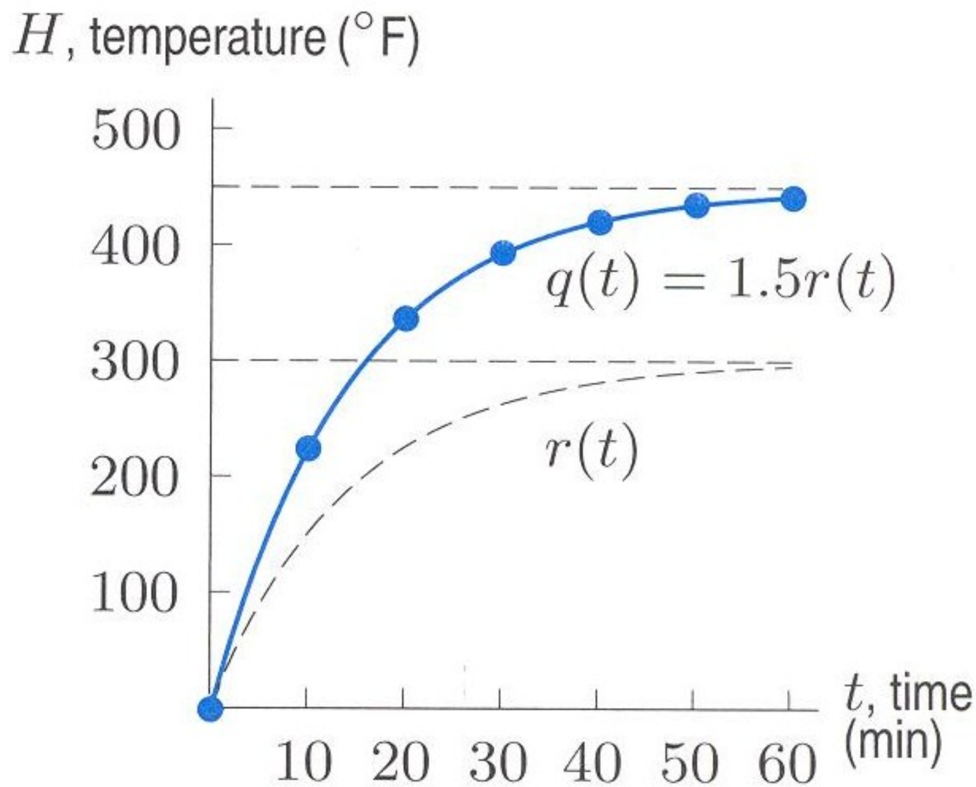
| $t$ (min) | $r(t)$ (°F) |
|---|---|
| 0 | 0 |
| 10 | 150 |
| 20 | 225 |
| 30 | 263 |
| 40 | 281 |
| 50 | 291 |
| 60 | 295 |

Describe the function $r$ in words.



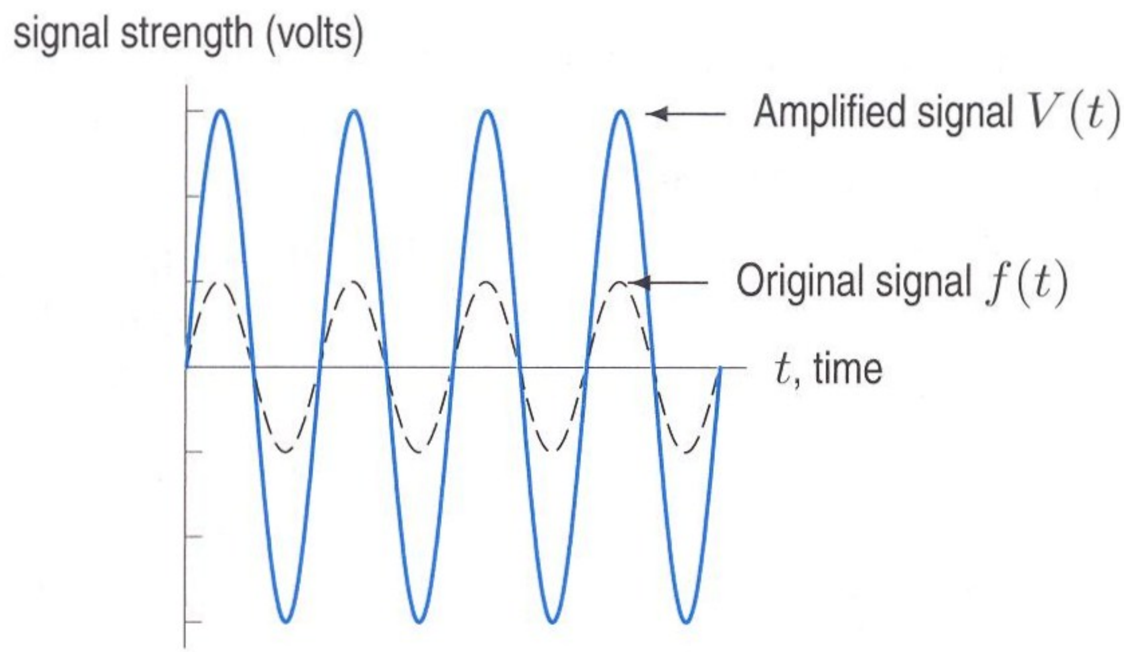
# Make a table of values for $q(t) = 1.5 \cdot r(t)$

| $t$ (min) | $r(t)$ (°F) | $q(t)$ (°F) |
|---|---|---|
| 0 | 0 | |
| 10 | 150 | |
| 20 | 225 | |
| 30 | 263 | |
| 40 | 281 | |
| 50 | 291 | |
| 60 | 295 | |



# Stretch Factors and Average Rates of Change

A positive stretch factor does not change where a function is increasing or decreasing. However the average rate of change does change. See below



# The Yam Example Revisited

| $t$ (min) | $r(t)$ (°F) | $q(t)$ (°F) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 150 | 225 |
| 20 | 225 | 337.5 |
| 30 | 263 | 394.5 |

Calculate the average rate of change of $r$ and $q$ over the time periods given in the table to the right.

| time (min) | 0-10 | 10-20 | 20-30 |
|---|---|---|---|
| rate for $r$ (°F/min) | | | |
| rate for $q$ (°F/min) | | | |

# Verifying the Average Rate of Change

Let $g(x) = k \cdot f(x)$. Consider the average rate of change for $g$ from $a$ to $b$.

$$\begin{array}{c}\text{Average rate of} \\ \text{change of } y = g(x)\end{array} = \frac{\Delta y}{\Delta x} = \frac{g(b) - g(a)}{b - a}$$

$$g(b) = k \cdot f(b); \quad g(a) = k \cdot f(a)$$

$$\begin{array}{c}\text{Average rate of} \\ \text{change of } y = g(x)\end{array} = \frac{k \cdot f(b) - k \cdot f(a)}{b - a}$$

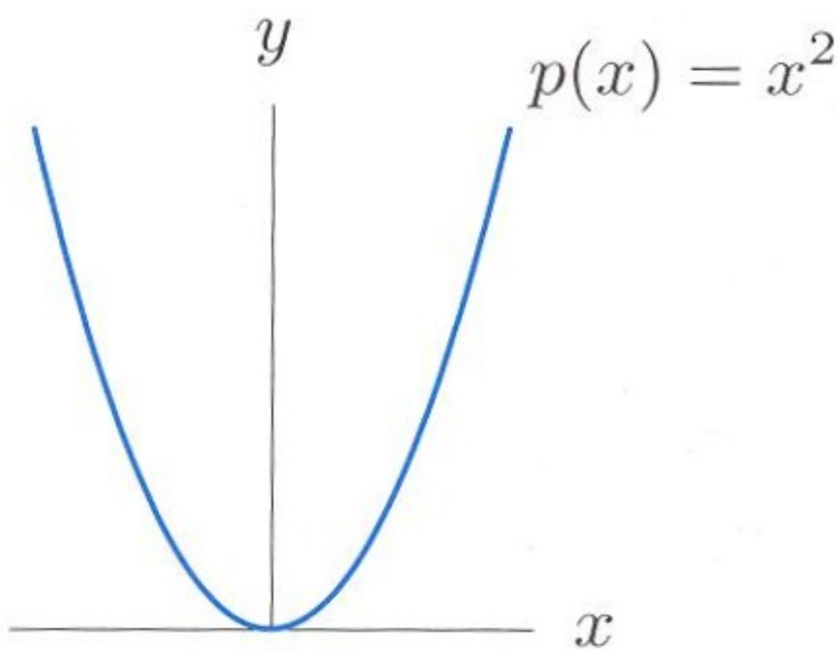
$$k \cdot \frac{f(b) - f(a)}{b - a} = k \cdot \begin{array}{c}\text{Average rate of} \\ \text{change of } y = f(x)\end{array}$$

# Summary Average Rate of Change

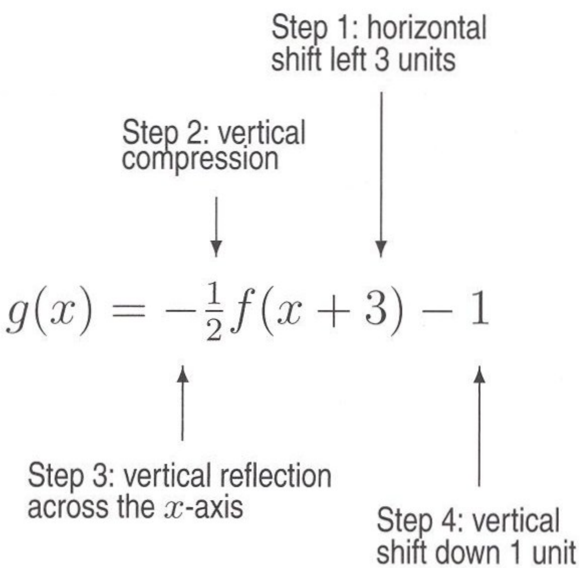
If $g(x) = k \cdot f(x)$, then on any interval, the average rate of change of $g = k \cdot$ (average rate of change of $f$).

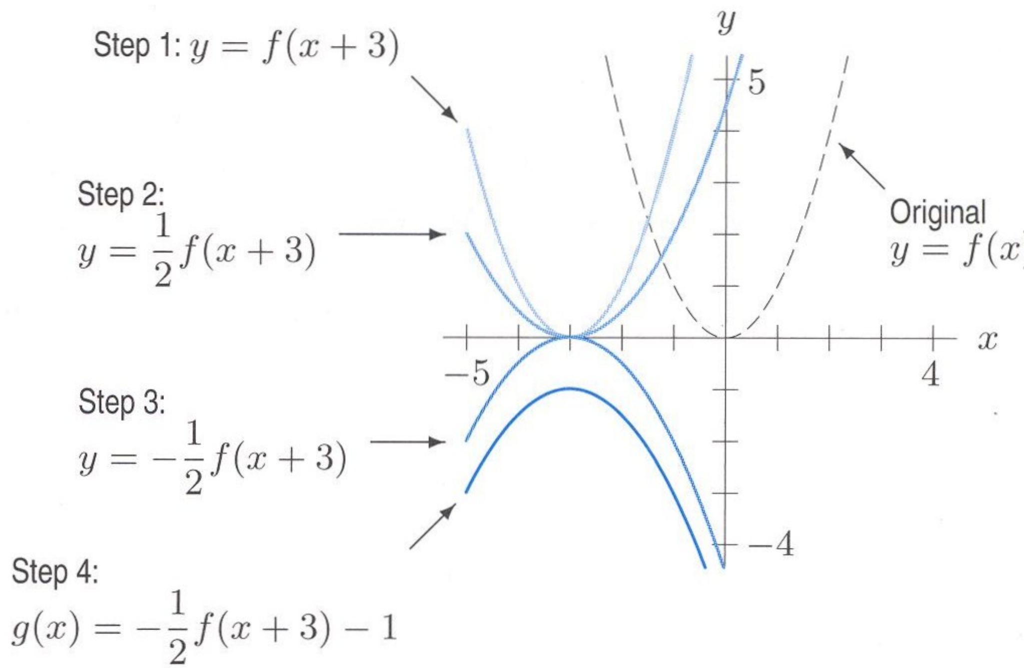
# Combining Transformations

The function $y = f(x) = x^2$ is graphed below.
Graph $g(x) = -\frac{1}{2} f(x + 3) - 1$



# Solution to Previous Example



# Exercise #5 and #7

Let $P(n)$ be a function whose domain is $-3 < n \leq 8$ and whose range is $-6 \leq P(n) < 12$. Find a possible formula for the function in terms of $P(n)$.

- #5 The domain of $R(n)$ is $-3 < n \leq 8$ and the range is $-60 < R(n) \leq 30$
- #7 The domain of $T(n)$ is $-10 < n \leq 1$ and the range is $-1.5 \leq T(n) < 3$

# Exercise #13

Using the table listed below create a table of values for

a) $f(-x)$ b) $-f(x)$ c) $3f(x)$

| $x$ | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|
| $f(x)$ | 13 | 6 | 1 | -2 | -3 | -2 | 1 | 6 | 13 |