BOARD NOTES

24 SEPTEMBER 2018

CC ALGEBRA
CHAPTER 2 FUNCTIONS & GRAPHS

- SECTION 2.5 - TRANSFORMATIONS OF FUNCTIONS

Objectives:

- Recognize the graph of common functions
- Use vertical shifts to graph functions
- Use horizontal shifts to graph functions
- Use reflections to graph functions
- Use vertical stretching and compression to graph functions
- Use horizontal stretching and compression to graph functions
- Graph functions involving a sequence of transformations

The Average Rate of Change of a Function

Let $(x_1, f(x_1))$ and $(x_2, f(x_2))$ be distinct points on the graph of a function f. (See **Figure 2.44**.) The **average rate of change of f** from x_1 to x_2 is

$$\frac{f(x_2) - f(x_1)}{x_2 - x_1}.$$

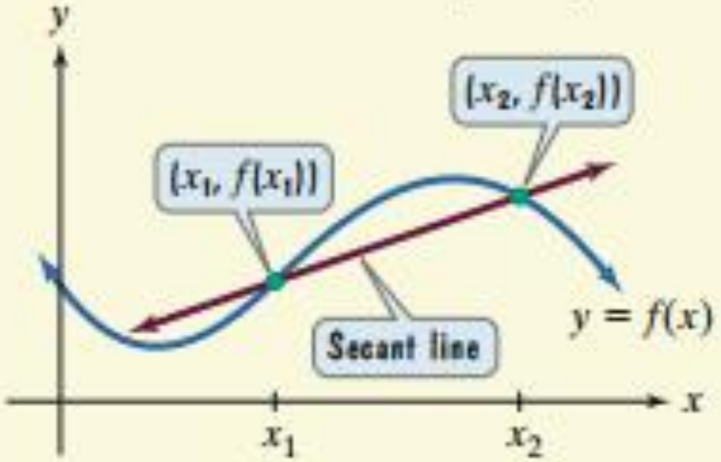
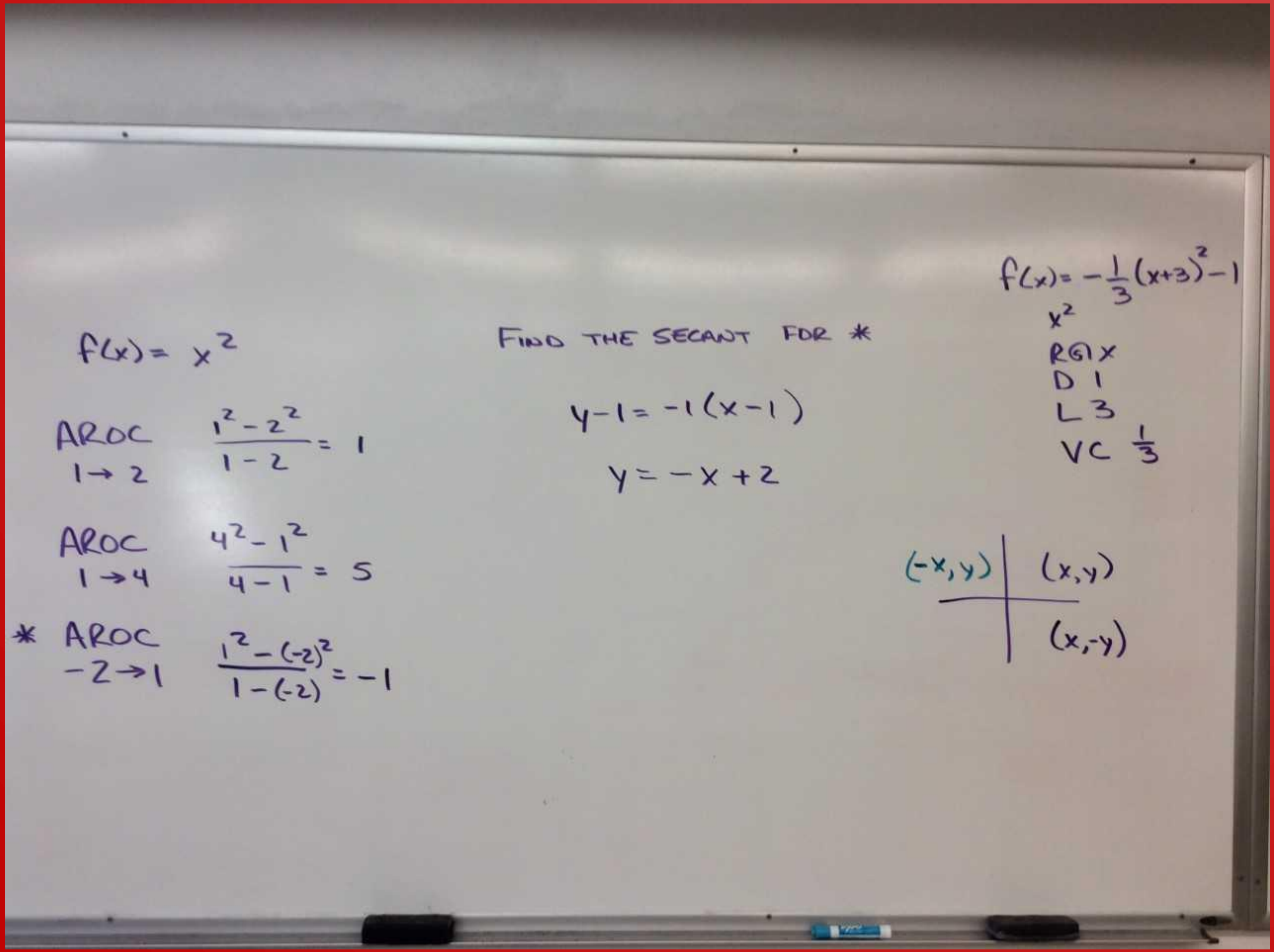
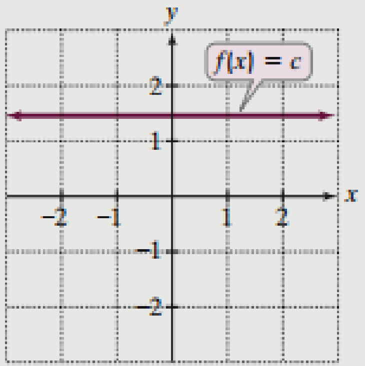


FIGURE 2.44



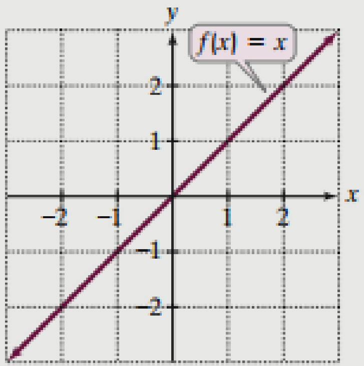
f(x) = x^2
AROC 1→2 (1^2 − 2^2)/(1 − 2) = 1
AROC 1→4 (4^2 − 1^2)/(4 − 1) = 5
* AROC −2→1 (1^2 − (−2)^2)/(1 − (−2)) = −1
FIND THE SECANT FOR *
y − 1 = −1(x − 1)
y = −x + 2
f(x) = −1/3 (x+3)^2 − 1
x^2
R@x
D 1
L 3
VC 1/3
(−x, y)
(x, y)
(x, −y)

Constant Function



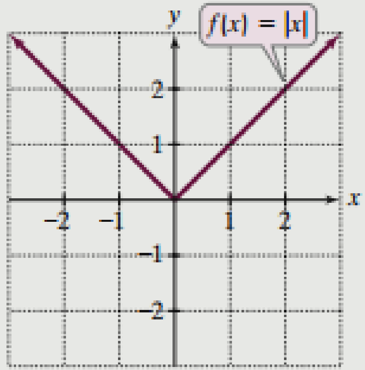
- Domain: $(-\infty, \infty)$
- Range: the single number c
- Constant on $(-\infty, \infty)$
- Even function

Identity Function



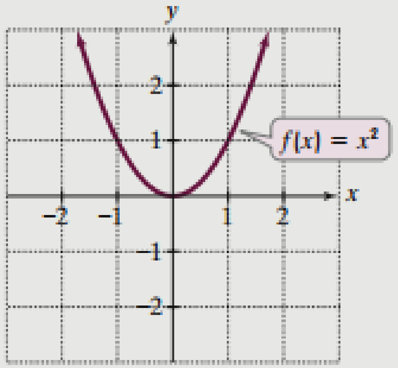
- Domain: $(-\infty, \infty)$
- Range: $(-\infty, \infty)$
- Increasing on $(-\infty, \infty)$
- Odd function

Absolute Value Function



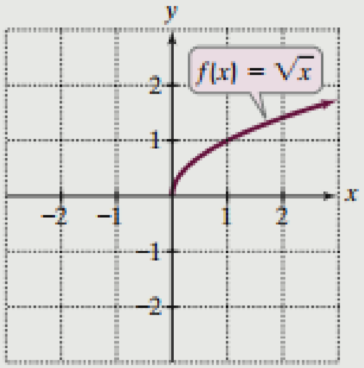
- Domain: $(-\infty, \infty)$
- Range: $[0, \infty)$
- Decreasing on $(-\infty, 0)$ and increasing on $(0, \infty)$
- Even function

Standard Quadratic Function



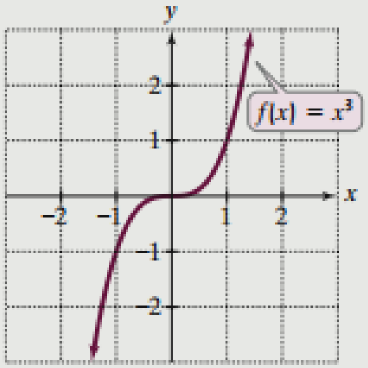
- Domain: $(-\infty, \infty)$
- Range: $[0, \infty)$
- Decreasing on $(-\infty, 0)$ and increasing on $(0, \infty)$
- Even function

Square Root Function



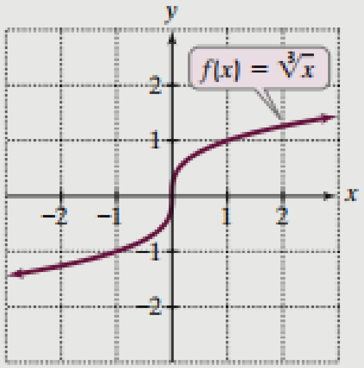
- Domain: $[0, \infty)$
- Range: $[0, \infty)$
- Increasing on $(0, \infty)$
- Neither even nor odd

Standard Cubic Function



- Domain: $(-\infty, \infty)$
- Range: $(-\infty, \infty)$
- Increasing on $(-\infty, \infty)$
- Odd function

Cube Root Function

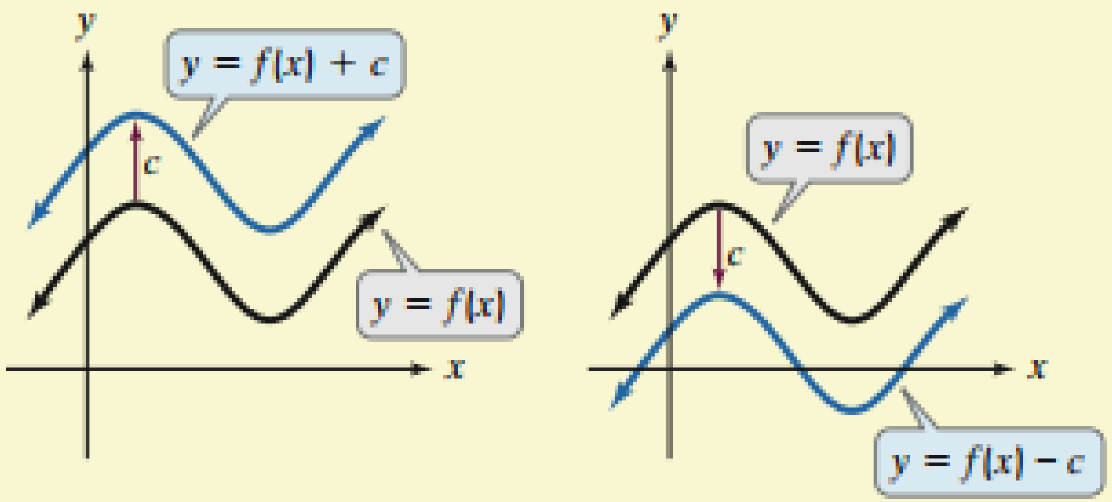


- Domain: $(-\infty, \infty)$
- Range: $(-\infty, \infty)$
- Increasing on $(-\infty, \infty)$
- Odd function

Vertical Shifts

Let f be a function and c a positive real number.

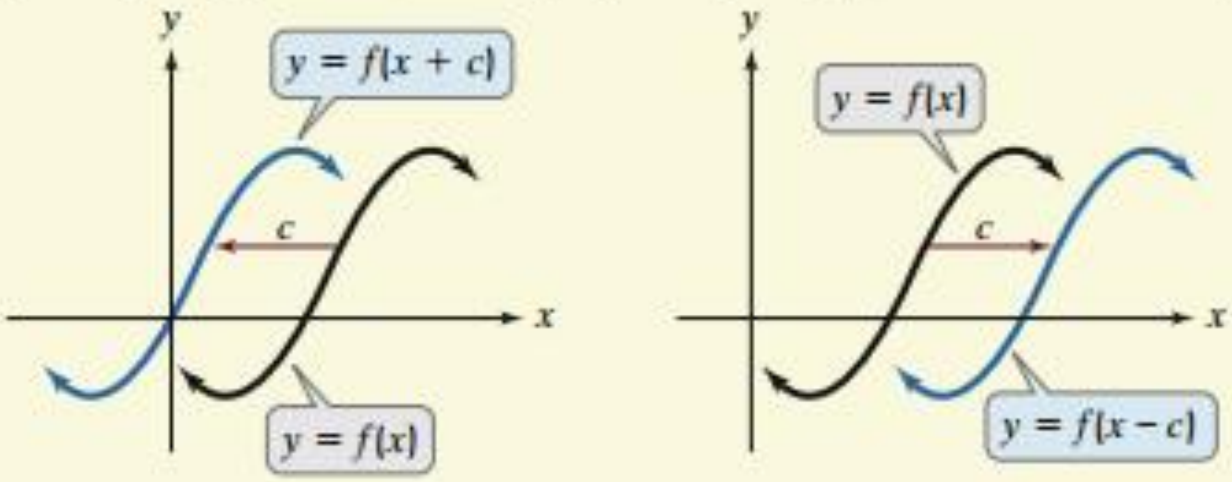
- The graph of $y = f(x) + c$ is the graph of $y = f(x)$ shifted c units vertically upward.
- The graph of $y = f(x) - c$ is the graph of $y = f(x)$ shifted c units vertically downward.



Horizontal Shifts

Let f be a function and c a positive real number.

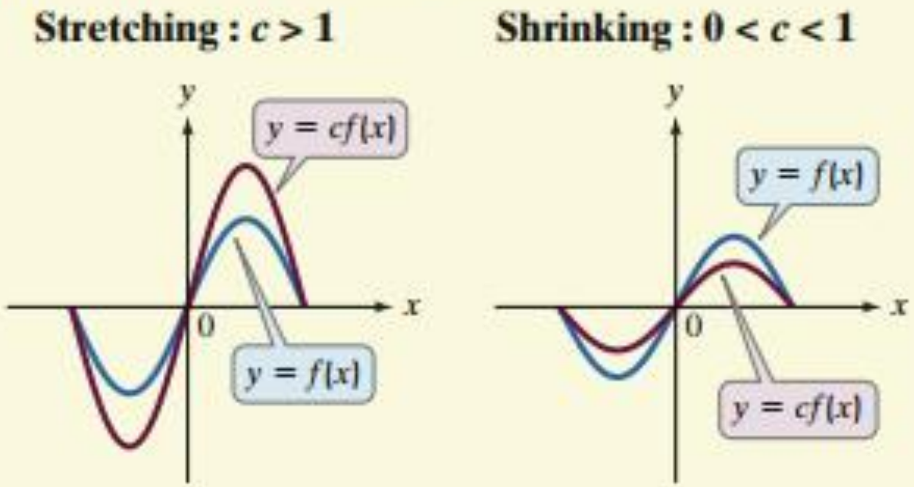
- The graph of $y = f(x + c)$ is the graph of $y = f(x)$ shifted to the left c units.
- The graph of $y = f(x - c)$ is the graph of $y = f(x)$ shifted to the right c units.



Vertically Stretching and Shrinking Graphs

Let f be a function and c a positive real number.

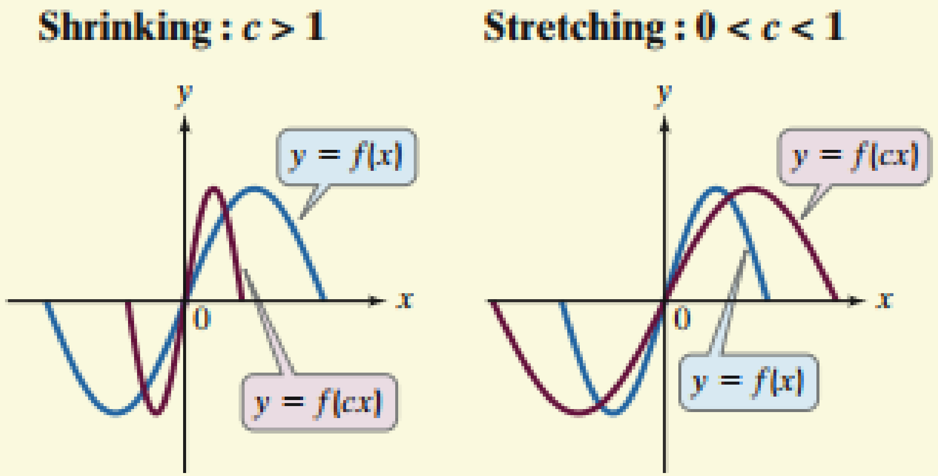
- If $c > 1$, the graph of $y = cf(x)$ is the graph of $y = f(x)$ vertically stretched by multiplying each of its y-coordinates by c.
- If $0 < c < 1$, the graph of $y = cf(x)$ is the graph of $y = f(x)$ vertically shrunk by multiplying each of its y-coordinates by c.



Horizontally Stretching and Shrinking Graphs

Let f be a function and c a positive real number.

- If $c > 1$, the graph of $y = f(cx)$ is the graph of $y = f(x)$ horizontally shrunk by dividing each of its x-coordinates by c.
- If $0 < c < 1$, the graph of $y = f(cx)$ is the graph of $y = f(x)$ horizontally stretched by dividing each of its x-coordinates by c.

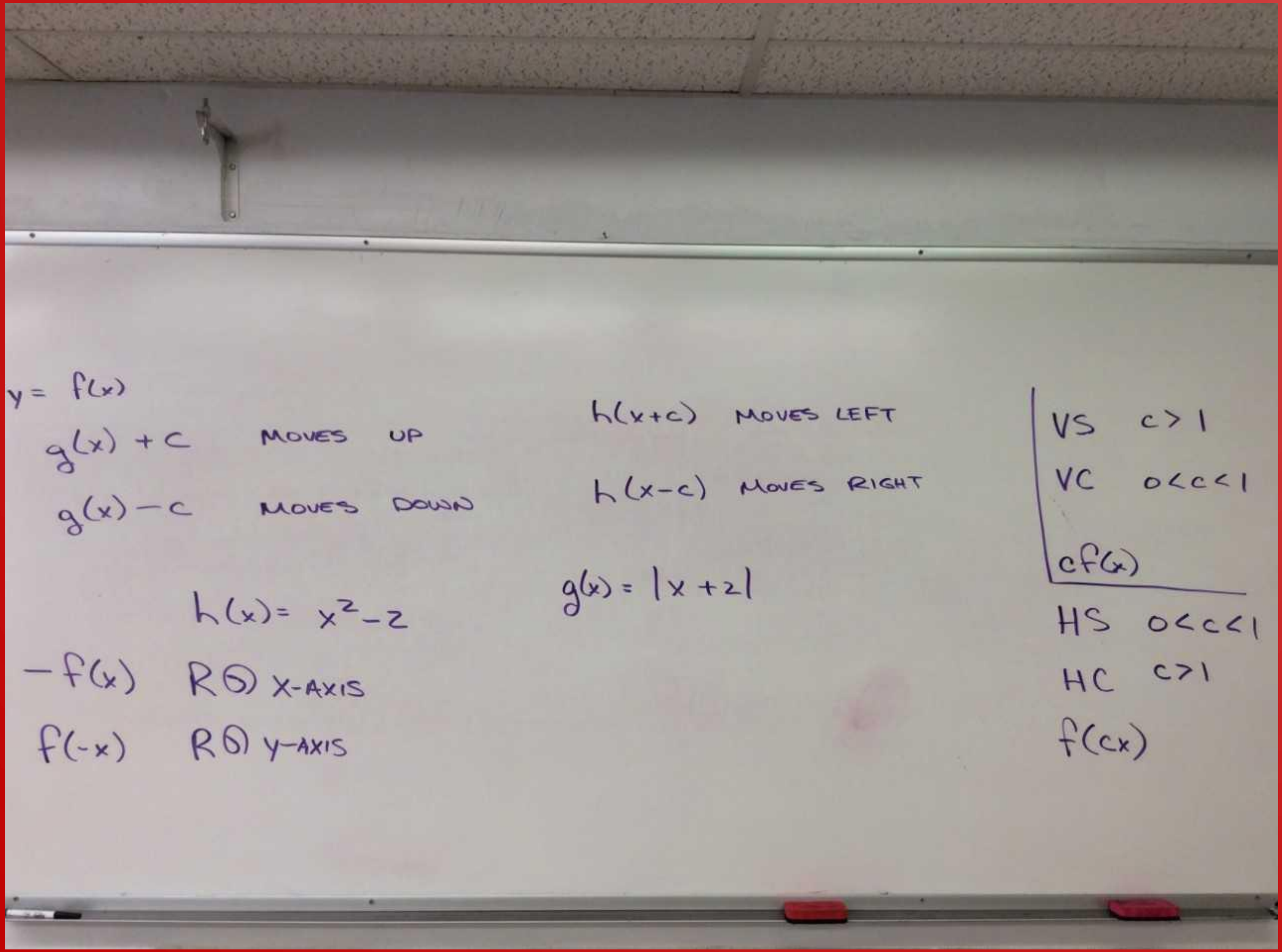


To Graph:	Draw the Graph of f and:	Changes in the Equation of $y = f(x)$
Vertical shifts		
$y = f(x) + c$	Raise the graph of f by c units.	c is added to $f(x)$.
$y = f(x) - c$	Lower the graph of f by c units.	c is subtracted from $f(x)$.
Horizontal shifts		
$y = f(x + c)$	Shift the graph of f to the left c units.	x is replaced with $x + c$.
$y = f(x - c)$	Shift the graph of f to the right c units.	x is replaced with $x - c$.
Reflection about the x-axis $y = -f(x)$	Reflect the graph of f about the x-axis.	$f(x)$ is multiplied by -1.
Reflection about the y-axis $y = f(-x)$	Reflect the graph of f about the y-axis.	x is replaced with $-x$.
Vertical stretching or shrinking		
$y = cf(x), c > 1$	Multiply each y-coordinate of $y = f(x)$ by c, vertically stretching the graph of f.	$f(x)$ is multiplied by c, $c > 1$.
$y = cf(x), 0 < c < 1$	Multiply each y-coordinate of $y = f(x)$ by c, vertically shrinking the graph of f.	$f(x)$ is multiplied by c, $0 < c < 1$.
Horizontal stretching or shrinking		
$y = f(cx), c > 1$	Divide each x-coordinate of $y = f(x)$ by c, horizontally shrinking the graph of f.	x is replaced with cx, $c > 1$.
$y = f(cx), 0 < c < 1$	Divide each x-coordinate of $y = f(x)$ by c, horizontally stretching the graph of f.	x is replaced with cx, $0 < c < 1$.

Order of Transformations

A function involving more than one transformation can be graphed by performing transformations in the following order:

1. Horizontal shifting
2. Stretching or shrinking
3. Reflecting
4. Vertical shifting



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