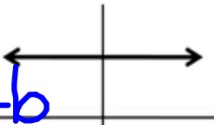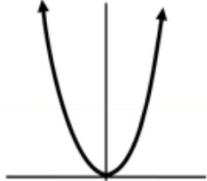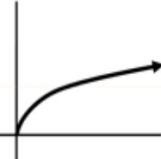# Sec 2.1.3
Transformations and Vertical Line Test (VLT)

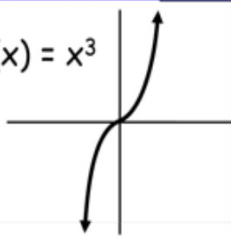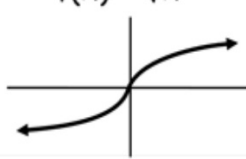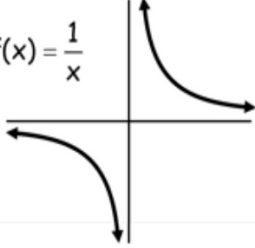**You should be able to:**
- graph a linear, basic quadratic, absolute value or cubic equation
-determine any vertical shifts

Library Function Graphs

$f(x) = a$ number

$y = mx + b$

Domain: $(-\infty, \infty)$
Range: the number

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

Domain: $(-\infty, \infty)$
Range: $[0, \infty)$

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

Domain: $[0, \infty)$
Range: $[0, \infty)$

$f(x) = |x|$

Domain: $(-\infty, \infty)$
Range: $[0, \infty)$

$f(x) = x^3$

Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$

$f(x) = \sqrt[3]{x}$

Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$

$f(x) = \dfrac{1}{x}$

Domain: $(-\infty, 0) \cup (0, \infty)$
Range: $(-\infty, 0) \cup (0, \infty)$

$d \longleftrightarrow x \qquad r \updownarrow y$

We will only be addressing vertical shifts.

**An overview...adding or subtracting a constant
after the function shifts the function up or down.**

$y = x^2$ $y = x^2 +3$ $y = x^2 - 4$

$y = x^3$ $y = x^3 +5$ $y = x^3 - 6$

$y = |x|$ $y = |x| +2$ $y = |x| -3$

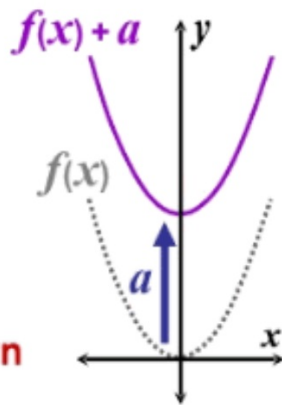moves the shape up

moves the shape
down

Translation

Any change to the position of a graph is called a **translation**.

$$y = f(x) + a$$

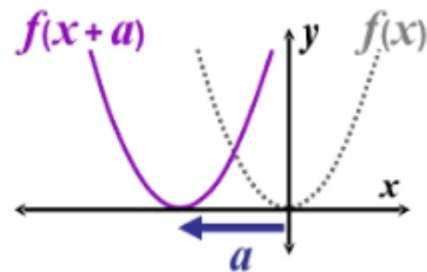Slides the graph of $f(x)$ **vertically**.

$+a$ ⬆ up

$-a$ ⬇ down

$f(x) + a$

$f(x)$

a

$$y = f(x + a)$$

Slides the graph of $f(x)$ **horizontally**.
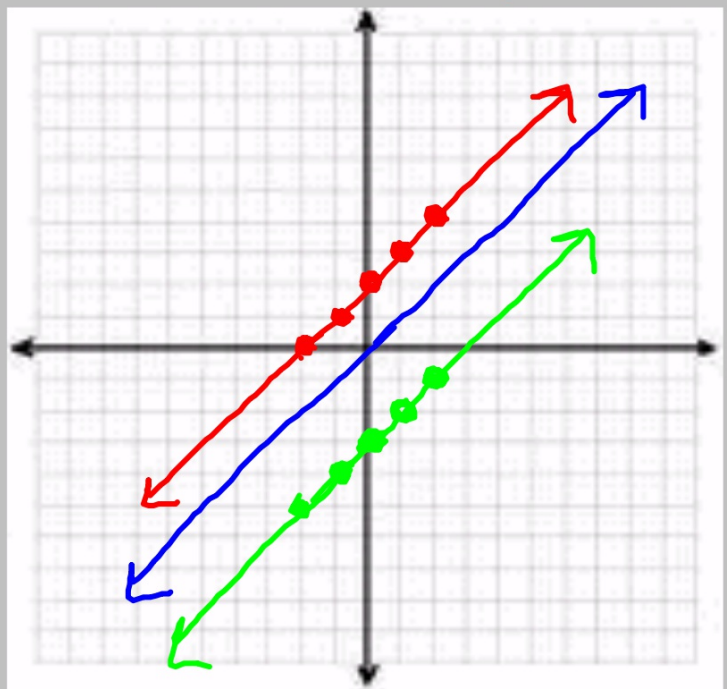
$f(x + a)$ $f(x)$

a

⚠ CAREFUL!

$+a$ ⬅ left

$-a$ ➡ right

Sketch f(x) and g(x) and compare. Your graph should contain ordered pairs on the interval of integers (-2,2)

f(x) = x
g(x) = x+2   ↑ 2
h(x) = x-3   ↓ 3

X	f(x)
-3	-3
-1	-1
1	1
3	3

Sketch and compare-

f(x) = -3x
g(x) = -3x + 4

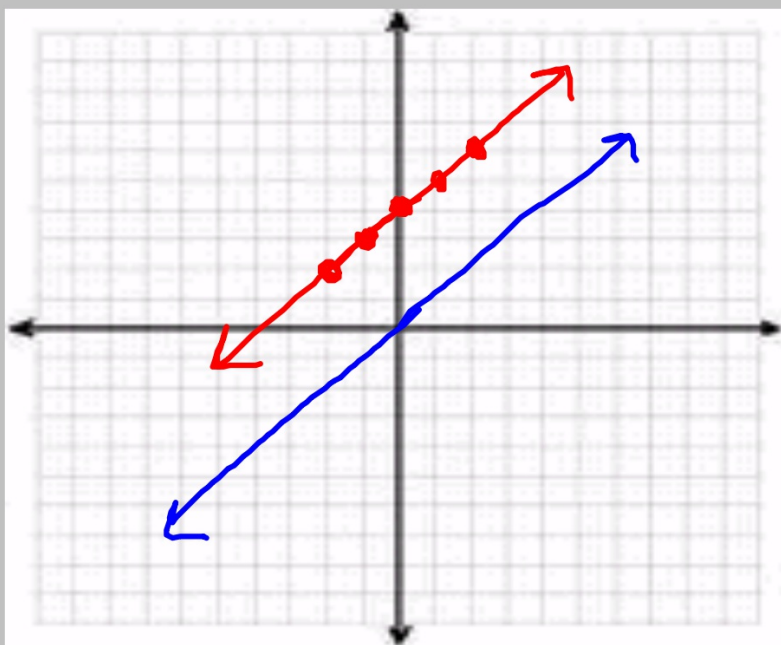| X	Y
-2	6
-1	3
0	0
1	-3
2	-6
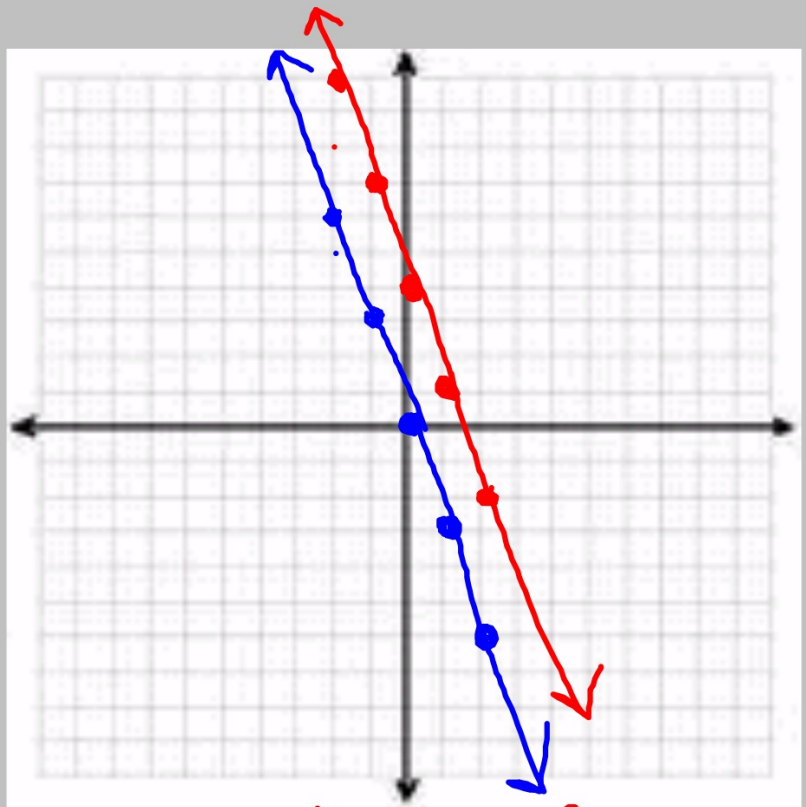
g(x) is moved up 4 from f(x)

Sketch and compare-

f(x) = x

g(x) = x +4

g(x) is moved
4 units up
from f(x)

Sketch and compare-

$f(x) = x^3$

$g(x) = x^3 - 2$

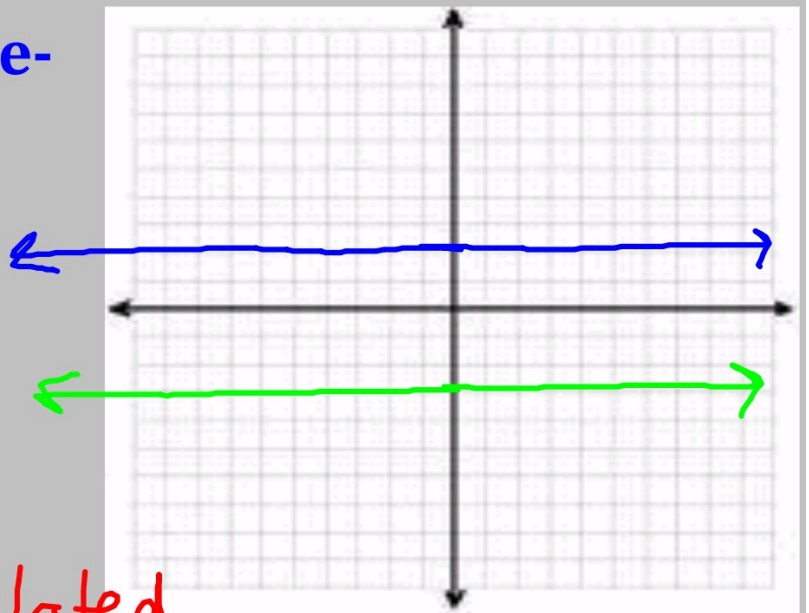| X	Y
-2	-8
-1	-1
0	0
1	1
2	8

-10
-3
-2
-1
6
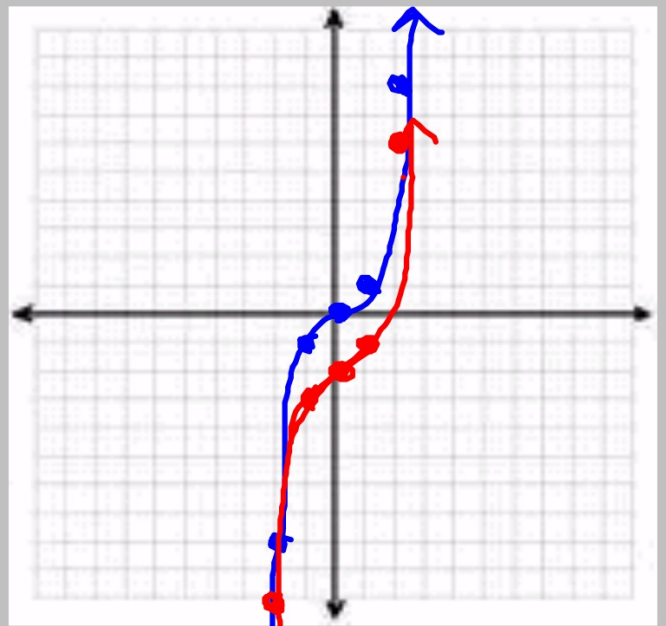
g(x) is translated
vertically down 2
units from f(x)
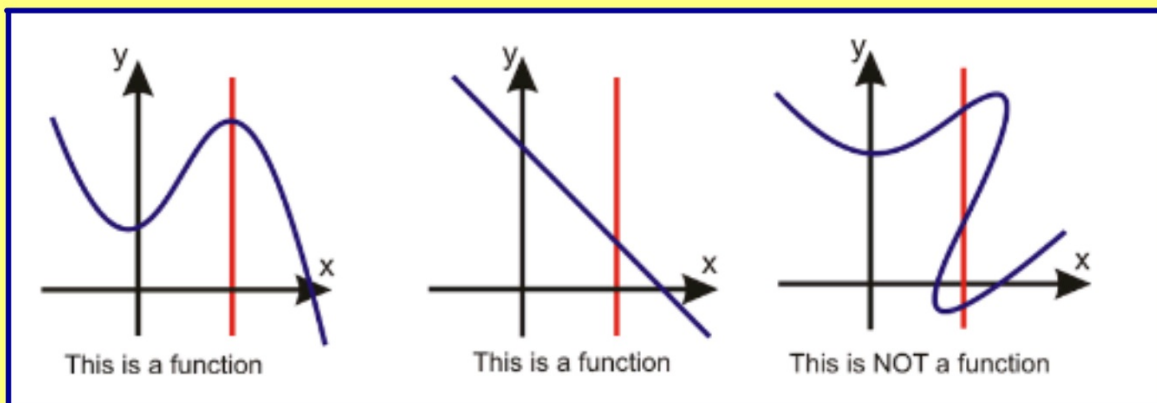
Sketch and compare-

f(x) = 2

g(x) = -3

g(x) is translated
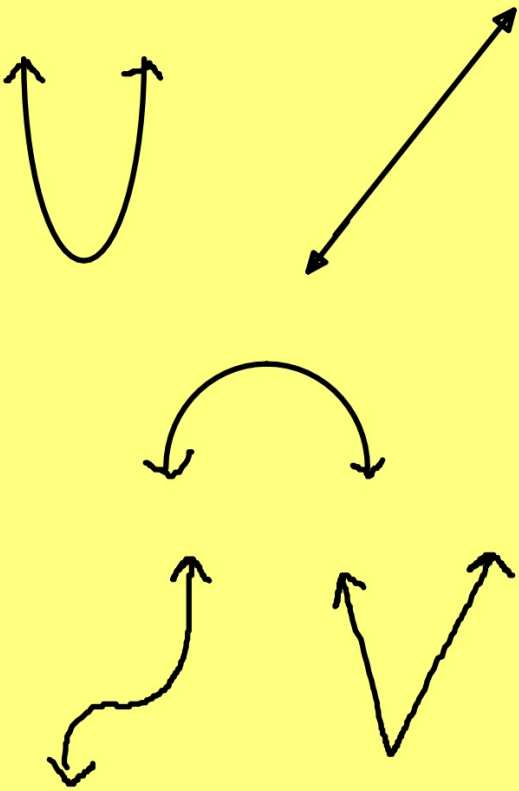vertically down 5 units
from f(x)

Vertical Line Test (VLT)

If the criteria for a function is that no x value can pair with two or more y values, then the graph will not have two points "on top of" each other.
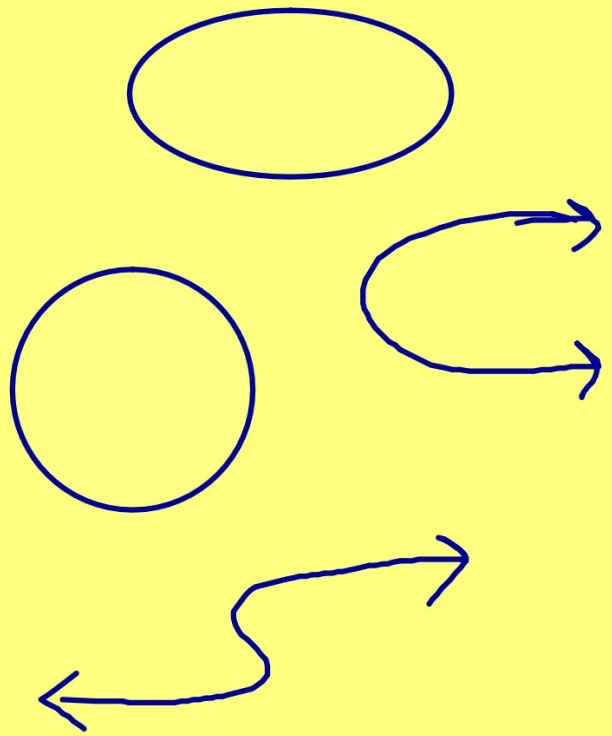
(i.e. a vertical line drawn anywhere on thegraph can only intersect the graph once for the graph to be a function)

Functions....   Not functions

SUGGESTED PRACTICE—

SEC 2.1
PAGE 224-225
39-50 ODDS
55-64

39-50 odds....photo on next page and website

graphs

55-58 is a function

59-60 is not a function

61 is a function

62 is not a function

63-64 is a function

.

The pictures don't come through well on my email, so I'll definitely post on my website via my ipad. They're much clearer.

Exercise Set 2.1

1. function; {1, 3, 5}; {2, 4, 5}   3. not a function; [3, 4]; [4, 5]   5. function; [3, 4, 5, 7]; [-2, 1, 9]   7. function; [-3, -2, -1, 0]; [-3, -2, -1, 0]
9. not a function; {1}; {4, 5, 6}   11. y is a function of x.   13. y is a function of x.   15. y is not a function of x.   17. y is not a function of x.
19. y is a function of x.   21. y is a function of x.   23. y is a function of x.   25. y is a function of x.   27. a. 29   b. 4x + 9   c. -4x + 5
31. a. 13   b. 1   c. $x^4 - x^2 + 1$ d. $81x^4 - 9x^2 + 1$ 33. a. 3   b. 7   c. $\sqrt{x} + 3$
35. a. $\frac{15}{4}$ b. $\frac{15}{4}$ c. $\frac{4x^2 - 1}{x^2}$ 37. a. 1   b. -1   c. 1

The graph of g is the graph of f shifted up by 3 units.

The graph of g is the graph of f shifted down by 1 unit.

The graph of g is the graph of f shifted up by 1 unit.

The graph of g is the graph of f shifted down by 2 units.

The graph of g is the graph of f shifted up by 2 units.

The graph of g is the graph of f shifted up by 2 units.

The graph of g is the graph of f shifted down by 1 unit.

The graph of g is the graph of f shifted to the right by 1 unit.

55. function   57. function   59. not a function   61. function   63. function
71. -2   73. 2   77. a. (-∞, ∞)   b. [-4, ∞)   c. -3 and 1   d. -3   e. f(-1) = 5
79. a. (-∞, ∞)   b. [1, ∞)   c. none   81. a. [0, 5)   b. [-1, 5)   c. 2   d. -1   e. f(3) = 1
83. a. [0, ∞)   b. [0, ∞)   c. none   85. a. [-2, 6]   b. [-2, 6]   c. 4   d. 4   e. f(-1) = 2 and f(3) = 4
87. a. (-∞, ∞)   b. (-∞, -2]   c. none   89. a. (-∞, ∞)   b. (0, ∞)   c. none   91. a. [-5, -2, 0, 1, 3]
95. -38   97. $-2x^3 - 2x$