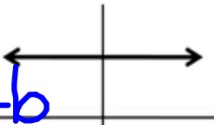
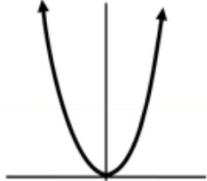
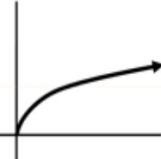



Sec 2.1.3
Transformations and Vertical Line
Test (VLT)

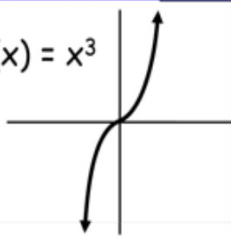
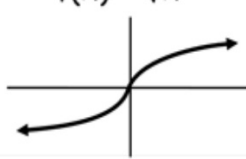
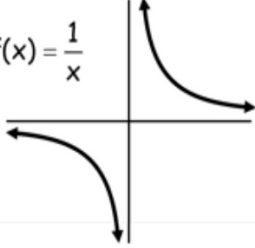
You should be able to:

- graph a linear, basic quadratic, absolute value or cubic equation**
- determine any vertical shifts**

$$y = mx + b$$

$f(x) = a \text{ number}$  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: $[0, \infty)$
--	--	--	--

Library Function Graphs

$f(x) = x^3$  Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$	$f(x) = \sqrt[3]{x}$  Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$	$f(x) = \frac{1}{x}$  Domain: $(-\infty, 0) \cup (0, \infty)$ Range: $(-\infty, 0) \cup (0, \infty)$
--	--	---

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

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

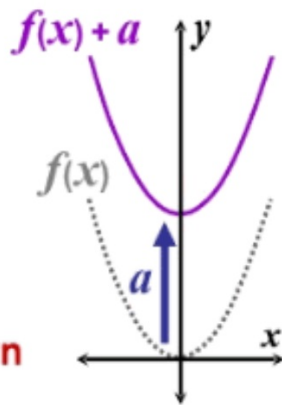
Any change to the position of a graph is called a **translation**.

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

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

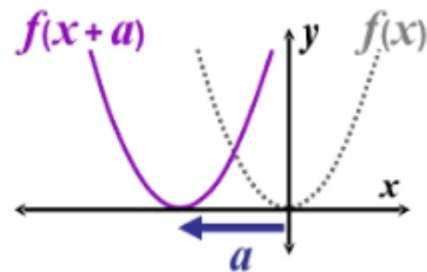
$+a$  **up**

$-a$  **down**



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

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



CAREFUL!

$+a$  **left**

$-a$  **right**

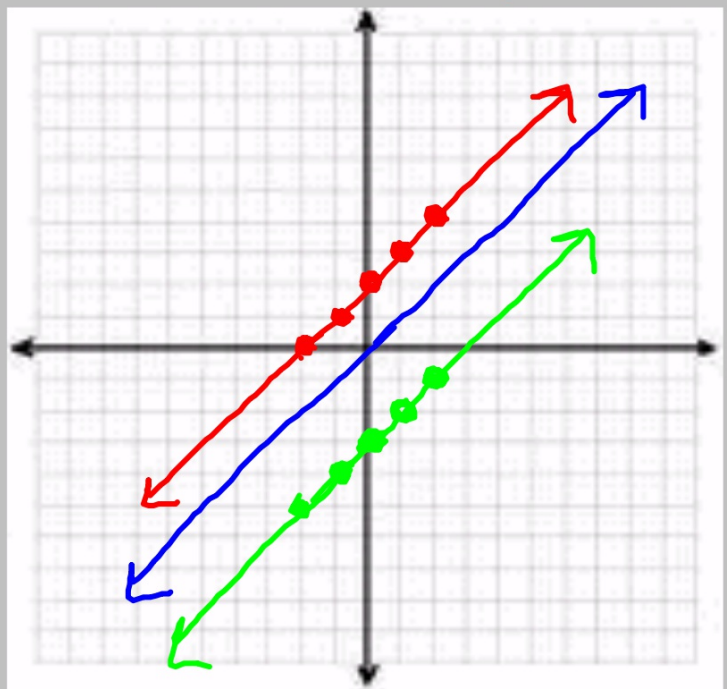
Sketch $f(x)$ and $g(x)$ and compare. Your graph should contain ordered pairs on the interval of integers $(-2,2)$

$$f(x) = x$$

$$g(x) = x+2 \quad \uparrow 2$$

$$h(x) = x-3 \quad \downarrow 3$$

x	$f(x)$
-3	-3
-1	-1
1	1
3	3

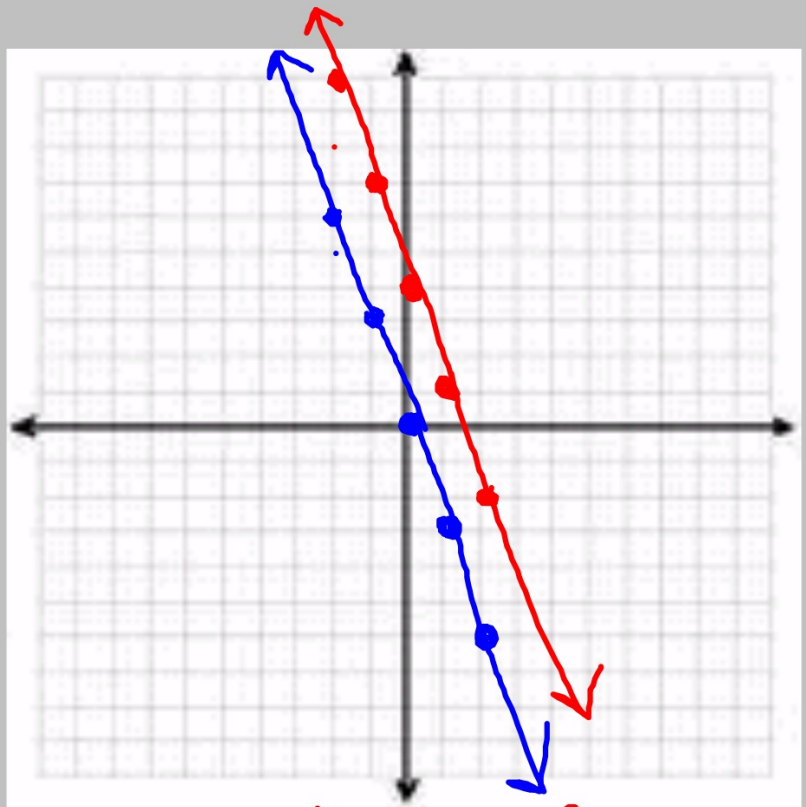


Sketch and compare-

$$f(x) = -3x$$

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

x	y
-2	6
-1	3
0	0
1	-3
2	-6



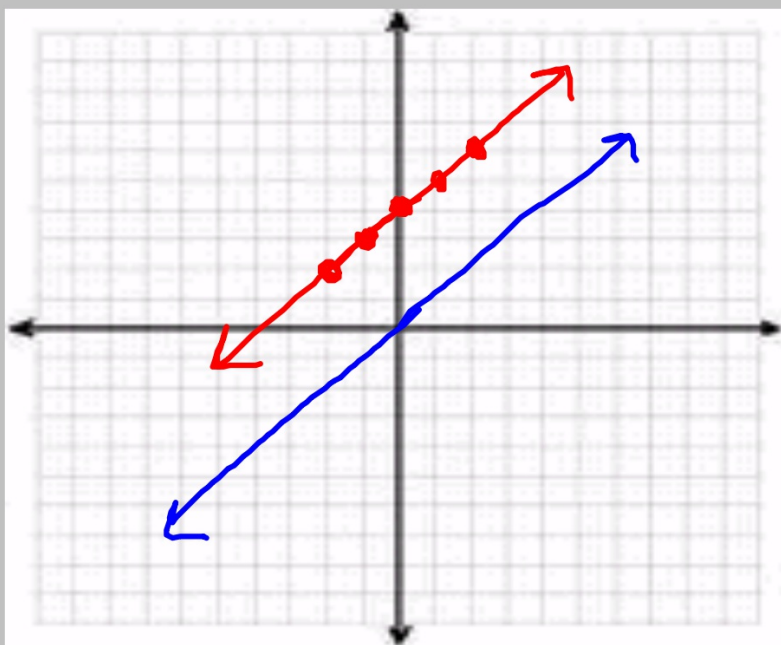
$g(x)$ is moved up 4 from $f(x)$

Sketch and compare-

• $f(x) = x$

• $g(x) = x + 4$

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



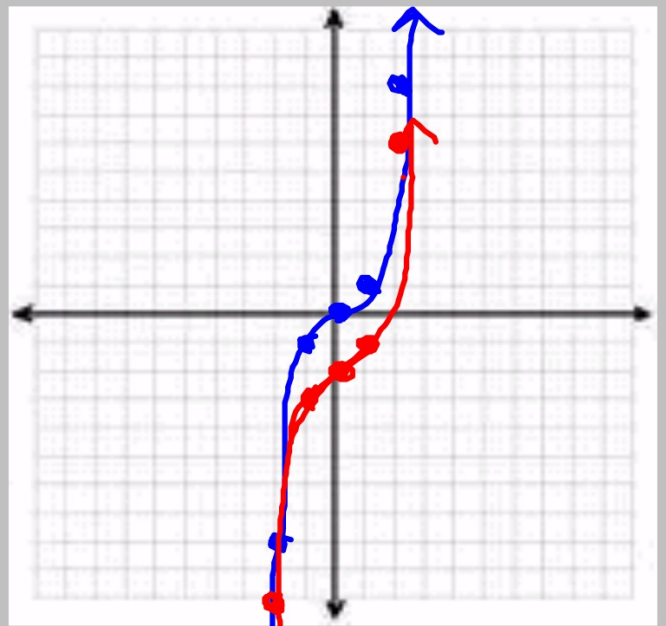
Sketch and compare-

$$f(x) = x^3$$

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

x	y
-2	-8
-1	-1
0	0
1	1
2	8

-10
-3
-2
-1
6

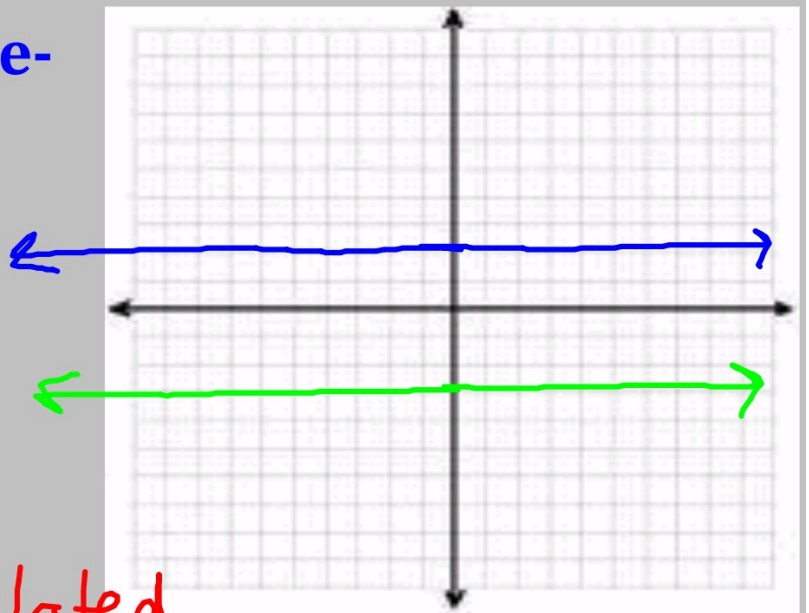


$g(x)$ is translated vertically down 2 units from $f(x)$

Sketch and compare-

$f(x) = 2$ •

$g(x) = -3$ •

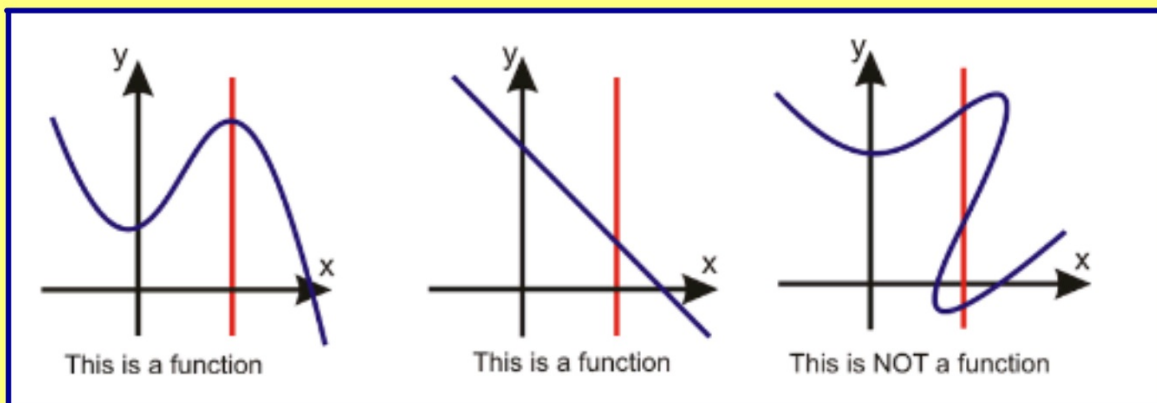


$g(x)$ is translated vertically down 5 units from $f(x)$

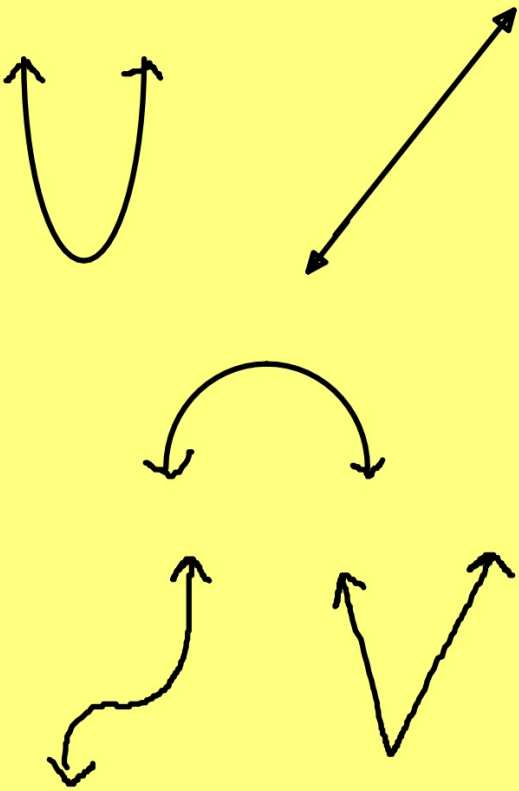
Vertical Line Test (VLT)

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.

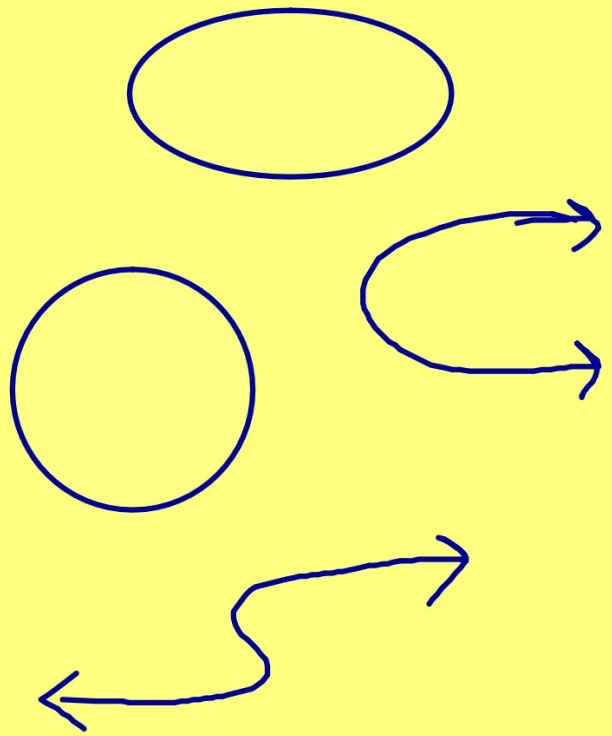
(i.e. a vertical line drawn anywhere on the graph can only intersect the graph once for the graph to be a function)



Functions....



Not functions



SUGGESTED PRACTICE-

SEC 2.1

PAGE 22**4**-225

39-50 ODDS

55-6**4**

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.

Answers to Selected Exercises AA11

Exercise Set 2.1

1. not a 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; $\{-3, -2, -1, 0\}; \{-3, -2, -1, 0\}$
 2. y is a function of x . 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. a. 2 b. $x^2 + 12x + 38$ 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. $-4x + 5$
 29. a. $\frac{15}{4}$ b. $\frac{15}{4}$ c. $\frac{4x^2 - 1}{x^2}$ 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. 4

37. a. 1 b. -1 c. 1

39. $f(x) = x + 3$
 $g(x) = x$

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

41. $f(x) = -2x$
 $g(x) = -2x - 1$

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

43. $g(x) = x^2 + 1$
 $f(x) = x^2$

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

45. $f(x) = |x|$
 $g(x) = |x| - 2$

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

47. $f(x) = x^2$
 $g(x) = x^2 + 2$

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

49. $f(x) = 5$
 $g(x) = 3$

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

51. $f(x) = x$
 $g(x) = x - 1$

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

53. $f(x) = x$
 $g(x) = x - 1$

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

55. -2 57. function 59. not a function 61. function 63. function 65. -4 67. 4 69. 0 71. 2 73. 2
 75. a. $f(-1) = 2$ and $f(3) = 4$ 81. a. $[0, 5)$ b. $[-1, 5)$ c. 2 d. -1 e. $f(3) = 1$ 83. a. $[0, \infty)$ b. $[1, \infty)$ c. none
 85. a. $[-2, 6]$ b. $[-2, 6]$ c. 4 d. 4 e. $f(-1) = 5$ 87. a. $(-\infty, \infty)$ b. $(-\infty, -2]$ c. none
 89. a. $(-\infty, \infty)$ b. $(0, \infty)$ c. none d. 1.5 e. $f(4) = 6$ 91. a. $[-5, -2, 0, 1, 3]$
 93. -2; 10 95. -38 97. $-2x^3 - 2x$
 99. a. $\{(Philippines, 12), (Spain, 13), (Italy, 14), (Germany, 14), (Russia, 16)\}$ b. yes; Each country corresponds to exactly one age.
 101. a. $\{(Philippines, 12), (Spain, 13), (Italy, 14), (Germany, 14), (Russia, 16)\}$ d. no; 14 in the domain corresponds to two members of the range, Italy and
 c. $\{(12, Philippines), (13, Spain), (14, Italy), (14, Germany), (16, Russia)\}$ e. 76; The chance that a 60-year-old will survive to age 70 is 76%.
 103. The chance that a 60-year-old will survive to age 70 is 83%. b. underestimates by 2% 105. $C = 100,000 + 100x$, where x is the number of
 107. $T = \frac{40}{x} + \frac{40}{x + 50}$, where x is the rate on the outgoing trip; does not make sense