1.3 Exercises Part 1 p22: 3-9 odd, 10, 11-15 odd

3. $f(x) = x - 5$ ; translate 4 units left  horizontal $g(x) = f(x-h)$ shift left $h < 0$  $h = -4$

$g(x) = f(x - -4)$

$= f(x+4)$

$g(x) = x + 4 - 5$

$\boxed{g(x) = x - 1}$

5. $f(x) = |4x+3| + 2$ , translate 2 units down  vertical shift $g(x) = f(x) + k$ $k < 0$ $k = -2$

$g(x) = f(x) - 2$

$g(x) = |4x+3| + 2 - 2$

$\boxed{g(x) = |4x+3|}$

7. $f(x) = 4 - |x+1|$  shift right 3  $g(x) = f(x-h)$  $h = 3$

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

$g(x) = 4 + |x-3+1|$

$\boxed{g(x) = 4 - |x-2|}$

9. $f(x) = -x - 5$

$g(x) = -x - 2$

Vertical shift 3 up

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

$= -x - 5 + 3$

$\boxed{g(x) = -x - 2}$

Horizontal shift 3 right

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

$= -(x-3) - 5$

$= -x + 3 - 5$

$\boxed{g(x) = -x - 2}$

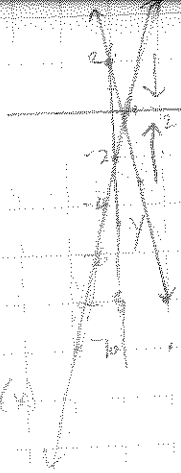
10. $f(x) = 4000x$ models net income

extra expense of \$12000 — take away from income.

$g(x) = 4000x - 12000$  This is $g(x) = f(x) - 12000$ shift down 12000.

It will take 3 weeks ($4000 \cdot 3$) to get back to zero income.

11. $f(x) = -5x + 2$, reflection in x-axis



multiply y-value (output) by -1

$g(x) = -f(x)$

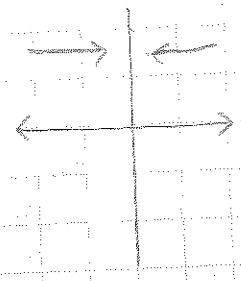
$= -(-5x + 2)$

$g(x) = 5x - 2$



13. $f(x) = |6x| - 2$; reflection in y-axis

multiply x-value (input) by -1



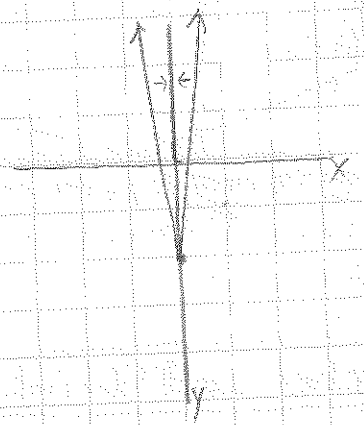
$g(x) = f(-x)$

$= |6(-x)| - 2$

$= |-1 \cdot (6x)| - 2$

$= |-1| \cdot |6x| - 2$

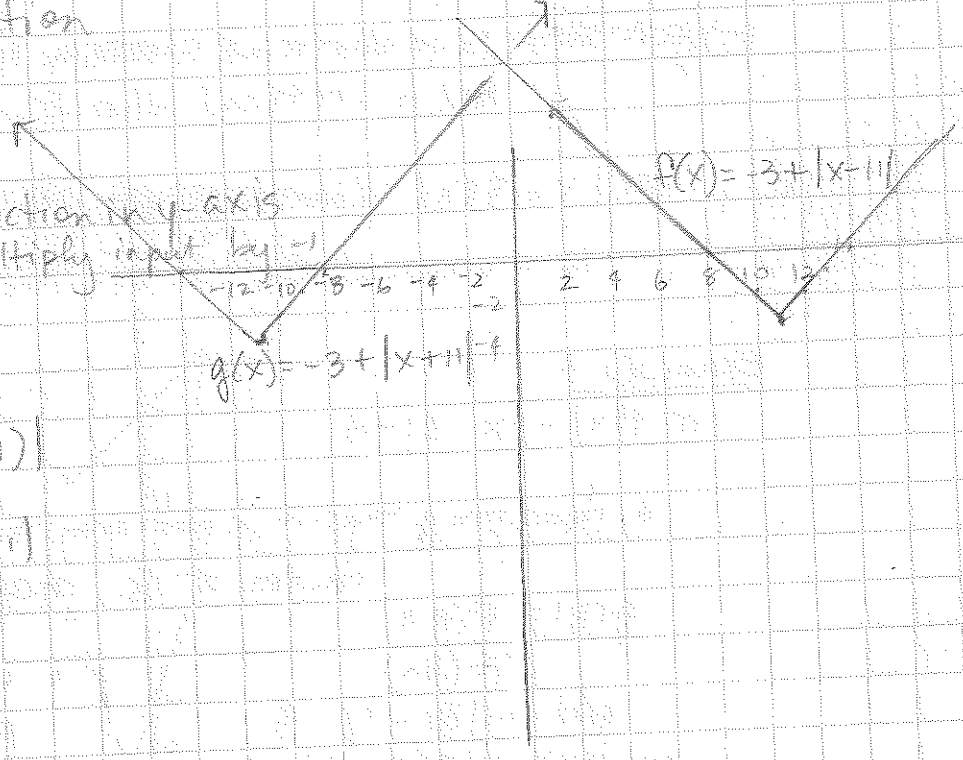
$g(x) = |6x| - 2$



$f(x)$ is its own reflection in the y-axis

15. $f(x) = -3 + |x+11|$ reflection in y-axis

multiply input by -1



$g(x) = f(-x)$

$= -3 + |-x+11|$

OR

$= -3 + |-1(x+11)|$

$= -3 + |-1| \cdot |x+11|$

$g(x) = -3 + |x+11|$

## 1.3 Exercises Part 2 p22: 2, 17-21 odd, 22, 27-31 odd

2. a) $f(x) = 2x + 3$ up 2

$g(x) = f(x) + 2$
$= 2x + 3 + 2$
$g(x) = 2x + 5$ ✓

b) $f(x) = x + 5$ horizontal shrink by factor of $\frac{1}{2}$
factor of $\frac{1}{a}$
$a = 2$

$g(x) = f(ax)$
$= f(2x)$
$g(x) = 2x + 5$ ✓

c) $f(x) = x + 3$ stretch vertically by factor of 2

$g(x) = 2 \cdot f(x)$
$= 2(x + 3)$
$g(x) = 2x + 6$ ✗
doesn't belong

d) $f(x) = 2x + 3$ translate left 1 unit

$g(x) = f(x + 1)$
$= 2(x + 1) + 3$
$= 2x + 2 + 3$
$g(x) = 2x + 5$ ✓

17. $f(x) = x + 2$; vertical stretch by factor of 5

$g(x) = 5 \cdot f(x)$
$= 5(x + 2)$
$\boxed{g(x) = 5x + 10}$

19. $f(x) = |2x| + 4$; horizontal shrink by factor of $\frac{1}{2}$
by factor of $\frac{1}{a}$
$a = 2$

$g(x) = f(ax)$
$= f(2x)$
$= |2(2x)| + 4$
$\boxed{g(x) = |4x| + 4}$

21. $f(x) = -2|x - 4| + 2$ vertical shrink by factor of $\frac{1}{2}$
(y-values in g are half the y-values in f)

$g(x) = \frac{1}{2} \cdot f(x)$
$= \frac{1}{2}(-2|x - 4| + 2)$

$= \frac{1}{2}(-2)|x - 4| + 1$

$\boxed{g(x) = -|x - 4| + 1}$

22. $f(x) = 6 - x$ horizontal shrink by factor of $\frac{1}{3}$
(because x values of g are $\frac{1}{3}x$ values of f)

$g(x) = f(a \cdot x)$ factor of $\frac{1}{a}$

$a = 3$

$g(x) = f(3x)$

$\boxed{g(x) = 6 - 3x}$

23. shift left C. $y = f(x+2)$

24. vertical stretch A. $y = 2f(x)$

25. vertical shift D. $y = f(x) + 2$

26. horizontal shrink B. $y = f(2x)$

27. $f(x) = x$ vertical stretch by factor of 2 followed by translation 1 up

$g(x) = 2 \cdot f(x) + 1$

$\boxed{g(x) = 2x + 1}$

29. $f(x) = |x|$ ; translation 2 units left followed by a horizontal stretch by a factor of 2
factor of $\frac{1}{a}$
$a = \frac{1}{2}$

translation first $h(x) = f(x+2)$

$h(x) = |x+2|$

horizontal stretch $g(x) = h(ax)$

$g(x) = h(\frac{1}{2}x)$

$g(x) = |\frac{1}{2}x + 2|$

31. $f(x) = |x|$ reflect across x-axis
vertical stretch by factor of 2

$g(x) = -2|x|$

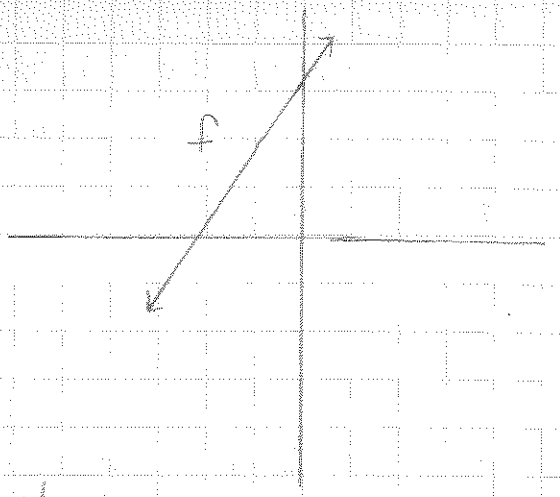
OR (OR) reflect across x-axis
horizontal shrink by factor of $\frac{1}{2}$
by factor of $\frac{1}{a}$
$a = 2$

$g(x) = -f(ax)$

$= -f(2x)$

$g(x) = -|2x|$

## 1.3 cont'd Exercises




42. $y = mx + b$

a. reflect the graph in the y-axis
- sign of slope changes
- y-intercept stays same
- sign of x-intercept changes

b. Shrink f vertically by factor of $\frac{1}{3}$
- slope and y-intercept are reduced ($\frac{1}{3}$ of former value)
- x-intercept stays same

c. Stretch graph horizontally by factor of 2
- slope becomes $\frac{1}{2}$ of previous slope
- y-intercept stays same
- x-intercept is doubled

Advanced:

36. $f(t) = -\frac{7}{5}t + 17.2$ $t$ = years since 2006

$g(t) =$ Suppose Sales decrease at twice the rate. This means they go down the same amount in half as much time. horizontal shrink by factor of $\frac{1}{2}$. factor of a, $a = 2$

$g(t) = f(2t)$

$g(t) = f(2t)$

$= -\frac{7}{5}(2t) + 17.2$

$g(t) = -\frac{14}{5}t + 17.2$

OR you can just think of doubling the rate of change. $2(-\frac{7}{5}) = -\frac{14}{5}$.

43. $g(x) = -4|x| + 2$

First stretch vertically by factor of 4, then translate down 2 units. (This way the stretch doesn't move the vertex.) Then reflect in x-axis so vertex is now at 2 rather than -2.

$g(x) = -(4|x| - 2)$

44. $d = 72|x - 30|$ $x$ = # of days, $d$ = miles from halfway point

The race could start on a date later than June 1