

Transformation	Function	Description
Horizontal shift	$f(x+h)$	shift left h units.
	$f(x-h)$	shift right h units.
Vertical shift	$f(x)+k$	shift up k units.
	$f(x)-k$	shift down k units.
Reflection	$-f(x)$	reflect across x-axis
	$f(-x)$	reflect across y-axis
Vertical stretch/compress	$af(x), a > 1$	stretch vertically by a factor of a
	$af(x), 0 < a < 1$	compress vertically by a factor of a
Horizontal stretch/compress	$f(ax), a > 1$	compress horizontally by a factor of $\frac{1}{a}$
	$f(ax), 0 < a < 1$	stretch horizontally by a factor of $\frac{1}{a}$.

3-7 Practice

Form G

Transformations of Linear Functions

- Writing** Identify three types of transformations of linear functions.
- Explain how a function may be reflected about the x -axis.
- Explain how a function may be reflected about the y -axis.
- What is the difference between a slope change and a translation?

For each pair of functions, describe a transformation that maps $f(x)$ to $g(x)$.

5. $f(x) = 5x$; $g(x) = 5(-x)$

reflection
on the y -axis.

7. $f(x) = 2x$; $g(x) = 2(x+4)$

horizontal
by 4 units to
the left.

9. $f(x) = -x - 5$; $g(x) = -(x-3) - 5$

horizontal
by 3 units to the
right.

6. $f(x) = x + 7$; $g(x) = (x+1) + 7$

horizontal transformation
by 1 unit to the right.

8. $f(x) = 10x + 1$; $g(x) = 10x + 4$

vertical shift
3 units up.

10. $f(x) = x$; $g(x) = -x$

reflection either
 x -axis or y -axis.

$$\begin{array}{r}
 y - 1 = 2x + 1 \\
 y - 1 = 2x - 6 \\
 \quad \quad \quad + 1 \\
 \hline
 y = 2x - 5
 \end{array}$$

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3-7 Practice (continued)

Form G

Transformations of Linear Functions

Given: $f(x) = 2x + 1$

Graph the indicated transformation.

11. $f(x - 2)$

12. $f(-x)$

13. $f(x) - 2$

14. $-f(x)$

15. **Reasoning** Write a function, $f(x)$, that represents a gym membership cost of \$20 per month for x months.

16. Explain how a fee increase of 25% can be represented. Use $g(x)$ for the new function.

17. Graph $f(x)$ and $g(x)$ on the same graph and describe the transformation.

$$\begin{array}{r} y-1 = 2x+1 \\ +1 \\ \hline y = 2x-5 \end{array}$$

11) ~~f~~ $f(x) = 2x+1$

$$f(x-2)$$

$$f(2x+1+2)$$

$$f = 2x-1$$

~~$f = 2x-3$~~

13) $y = (2x+1)$

$$f(x) - 2$$

$$f = (2x+1) - 2$$

$$f = 2x-1$$

~~$2x-3$~~

12) $f(x) = 2x+1$

$$f(-x)$$

$$f = -2x+1$$

14) $f(x) = 2x+1$

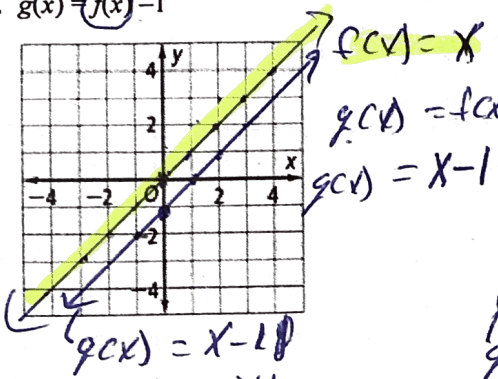
$$f = (x)$$

$$f = (2x+1)$$

$$f = -2x-1$$

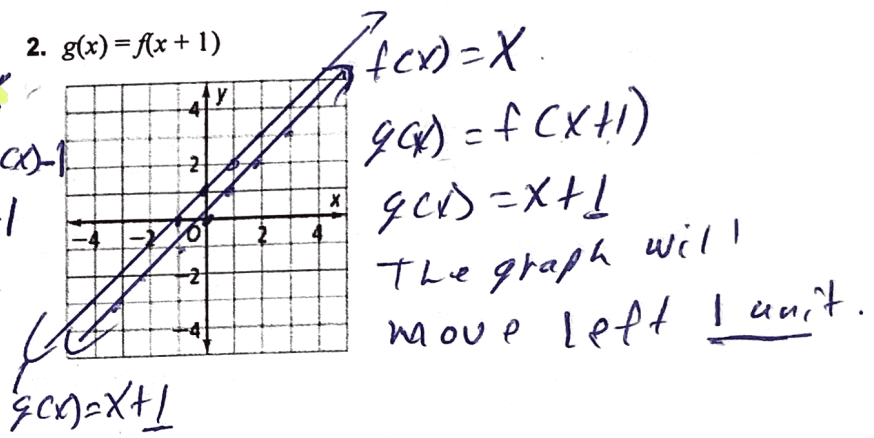
Determine the effects on the graph of the parent function, $f(x) = x$, for each $g(x)$, function. Graph both functions on the same coordinate grid.

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

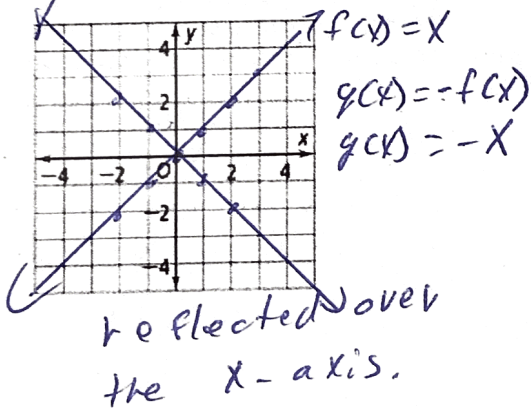


The graph will move one unit down.

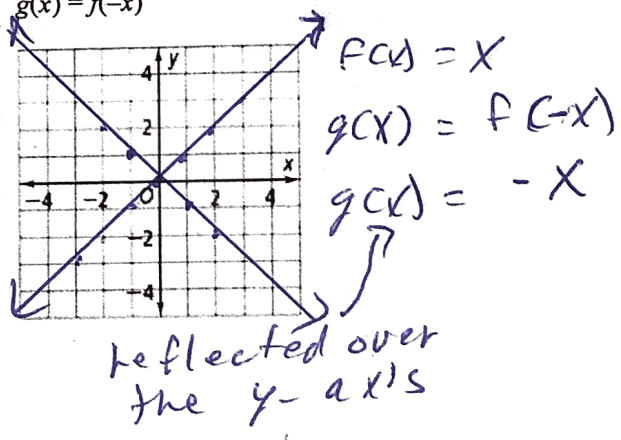
2. $g(x) = f(x + 1)$



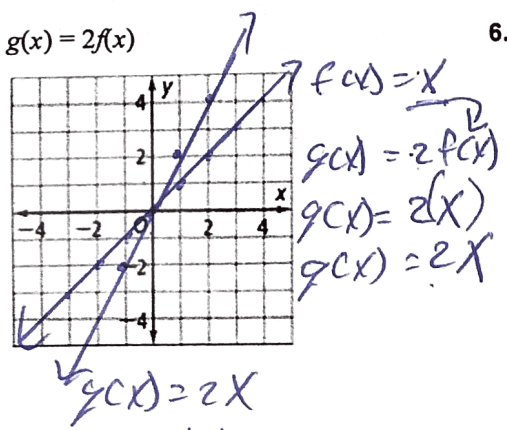
3. $g(x) = -f(x)$



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

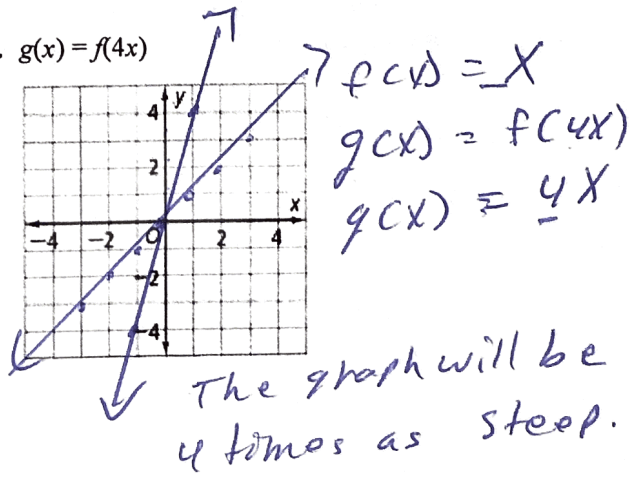


5. $g(x) = 2f(x)$



The graph will be 2 times as steep.

6. $g(x) = f(4x)$



3-7 Practice (continued)

Form K

Transformations of Linear Functions

7. A car rental store rents cars for \$20 a day. The function $f(x) = 20x$ represents the daily rental fee for x days. The company decides to add a one-time \$10 fee for cleaning. Write the function $g(x)$, which gives the new cost per day, as a transformation of $f(x)$. How would the graph of $g(x)$ compare to that of $f(x)$?

$g(x) = 20x + 10$ Same slope but translated up 10 units.

$p(x) = 20x$

Tell whether each transformation is a reflection, a translation, or both a reflection and a translation of $f(x)$

8. $g(x) = f(x) + 5$

~~both reflection~~
and translation units up.

9. $h(x) = -f(x) + 1$

both reflection and translation

reflected over the x-axis and translated 1 unit up.

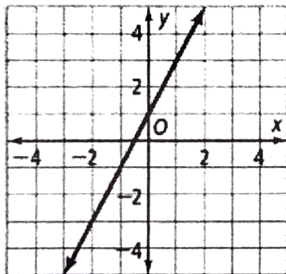
10. $k(x) = f(x - 4)$

~~translated~~
translation units to the right

11. $m(x) = f(x + 1) - 2$

translation 1 unit to the left / 2 down.

12. **Multiple Representations** The graph shows the function $f(x)$. Write an equation for $g(x)$ that would translate the graph vertically. Then write an equation for $h(x)$ that would change the steepness of the graph. Explain your reasoning.



13. **Writing** In the graph shown, $g(x)$ is a transformation of the function $f(x)$. Is the transformation a reflection or a translation? Explain your answer. Write the equation for $g(x)$.

