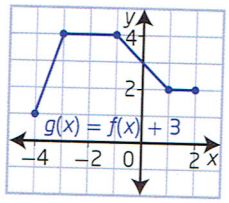
Answers

Chapter 1 Function Transformations

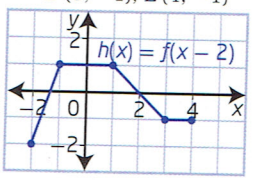
1.1 Horizontal and Vertical Translations, pages 12 to 15

1. a) $h = 0, k = 5$ **b)** $h = 0, k = -4$ **c)** $h = -1, k = 0$
d) $h = 7, k = -3$ **e)** $h = -2, k = 4$

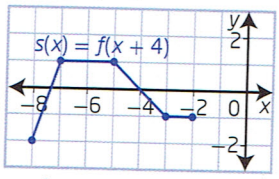
2. a) A′(−4, 1), B′(−3, 4), C′(−1, 4), D′(1, 2), E′(2, 2)



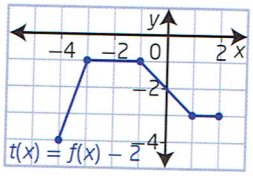
b) A′(−2, −2), B′(−1, 1), C′(1, 1), D′(3, −1), E′(4, −1)



c) A′(−8, −2), B′(−7, 1), C′(−5, 1), D′(−3, −1), E′(−2, −1)

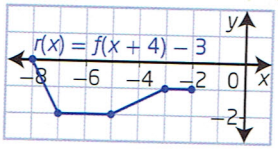


d) A′(−4, −4), B′(−3, −1), C′(−1, −1), D′(1, −3), E′(2, −3)



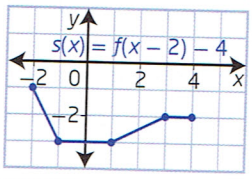
3. a) $(x, y) \rightarrow (x - 10, y)$ **b)** $(x, y) \rightarrow (x, y - 6)$
c) $(x, y) \rightarrow (x + 7, y + 4)$ **d)** $(x, y) \rightarrow (x + 1, y + 3)$

4. a)



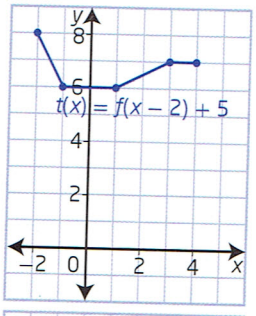
a vertical translation of 3 units down and a horizontal translation of 4 units left; $(x, y) \rightarrow (x - 4, y - 3)$

b)



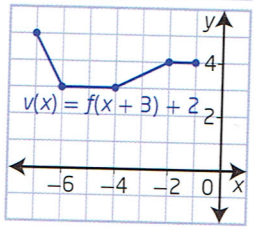
a vertical translation of 4 units down and a horizontal translation of 2 units right; $(x, y) \rightarrow (x + 2, y - 4)$

c)



a vertical translation of 5 units up and a horizontal translation of 2 units right; $(x, y) \rightarrow (x + 2, y + 5)$

d)



a vertical translation of 2 units up and a horizontal translation of 3 units left; $(x, y) \rightarrow (x - 3, y + 2)$

5. a) $h = -5, k = 4; y - 4 = f(x + 5)$
b) $h = 8, k = 6; y - 6 = f(x - 8)$
c) $h = 10, k = -8; y + 8 = f(x - 10)$
d) $h = -7, k = -12; y + 12 = f(x + 7)$

6. It has been translated 3 units up.

7. It has been translated 1 unit right.

8.

Translation	Transformed Function	Transformation of Points
vertical	$y = f(x) + 5$	$(x, y) \rightarrow (x, y + 5)$
horizontal	$y = f(x + 7)$	$(x, y) \rightarrow (x - 7, y)$
horizontal	$y = f(x - 3)$	$(x, y) \rightarrow (x + 3, y)$
vertical	$y = f(x) - 6$	$(x, y) \rightarrow (x, y - 6)$
horizontal and vertical	$y + 9 = f(x + 4)$	$(x, y) \rightarrow (x - 4, y - 9)$
horizontal and vertical	$y = f(x - 4) - 6$	$(x, y) \rightarrow (x + 4, y - 6)$
horizontal and vertical	$y = f(x + 2) + 3$	$(x, y) \rightarrow (x - 2, y + 3)$
horizontal and vertical	$y = f(x - h) + k$	$(x, y) \rightarrow (x + h, y + k)$

9. a) $y = (x + 4)^2 + 5$ **b)** $\{x \mid x \in R\}, \{y \mid y \geq 5, y \in R\}$
c) To determine the image function's domain and range, add the horizontal and vertical translations to the domain and range of the base function. Since the domain is the set of real numbers, nothing changes, but the range does change.

10. a) $g(x) = |x - 9| + 5$
b) The new graph is a vertical and horizontal translation of the original by 5 units up and 9 units right.
c) Example: (0, 0), (1, 1), (2, 2) → (9, 5), (10, 6), (11, 7)
d) Example: (0, 0), (1, 1), (2, 2) → (9, 5), (10, 6), (11, 7)
e) The coordinates of the image points from parts c) and d) are the same. The order that the translations are made does not matter.

11. a) $y = f(x - 3)$ **b)** $y + 5 = f(x - 6)$

12. a) Example: It takes her 2 h to cycle to the lake, 25 km away. She rests at the lake for 2 h and then returns home in 3 h.
b) This translation shows what would happen if she left the house at a later time.
c) $y = f(x - 3)$

13. a) Example: Translated 8 units right.
b) Example: $y = f(x - 8)$, $y = f(x - 4) + 3.5$, $y = f(x + 4) + 3.5$

14. a) Example: A repeating X by using two linear equations $y = \pm x$.
b) Example: $y = f(x - 3)$. The translation is horizontal by 3 units right.

15. a) The transformed function starts with a higher number of trout in 1970. $y = f(t) + 2$
b) The transformed function starts in 1974 instead of 1971. $y = f(t - 3)$

16. The first case, $n = f(A) + 10$, represents the number of gallons he needs for a given area plus 10 more gallons. The second case, $n = f(A + 10)$, represents how many gallons he needs to cover an area A less 10 units of area.

17. a) $y = (x - 7)(x - 1)$ or $y = (x - 4)^2 - 9$
b) Horizontal translation of 4 units right and vertical translation of 9 units down.
c) y-intercept 7