

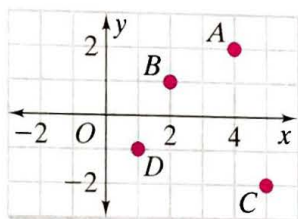
# 8-1

# Translations

## Check Skills You'll Need

1. **Vocabulary Review**  
In what *quadrant* is  $(-3, 5)$  located?

Name the coordinates of each point.



2. A            3. B  
4. C            5. D



## What You'll Learn

To graph and describe translations in the coordinate plane  
**New Vocabulary** transformation, translation, image

## Why Learn This?

Translations are used in games and in the arts. You can use translations to plan a winning chess strategy or choreograph a figure-skating routine.

A **transformation** is a change in the position, shape, or size of a figure. A **translation** is a transformation that moves each point of a figure the same distance and in the same direction.

The figure you get after a transformation is an **image** of the original figure. To identify the image of point A, use prime notation ( $A'$ ). You read  $A'$  as "A prime."

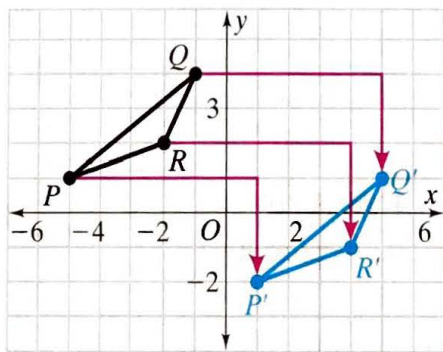


## EXAMPLE Graphing a Translation

### CONTENT STANDARDS

8.G.1.a, 8.G.1.b,  
8.G.1.c, 8.G.3

- 1 **Multiple Choice** If  $\triangle PQR$  below is translated 6 units to the right and 3 units down, what are the coordinates of point  $P'$ ?  
(A)  $P'(-1, -2)$     (B)  $P'(-2, 1)$     (C)  $P'(-2, -1)$     (D)  $P'(1, -2)$



Slide each vertex right 6 units and down 3 units. Label and connect the images of the vertices.

The answer is D.

## Quick Check

1.  $\triangle JKL$  has vertices  $J(0, 2)$ ,  $K(3, 4)$ , and  $L(5, 1)$ . Translate  $\triangle JKL$  4 units to the left and 5 units up. What are the coordinates of  $J'$ ?

Notice in Example 1 that  $\triangle P'Q'R'$  is congruent to  $\triangle PQR$ . A translation of a figure preserves the side lengths and angle measures of the figure. You can use arrow notation to describe the translation. The translation of each point is shown below.

$$P(-5, 1) \rightarrow P'(1, -2) \quad \leftarrow \text{Read } P \rightarrow P' \text{ as "point } P \text{ goes to point } P \text{ prime."}$$

$$Q(-1, 4) \rightarrow Q'(5, 1)$$

$$R(-2, 2) \rightarrow R'(4, -1)$$

The arrow notation for the translation of the triangle is  $\triangle PQR \rightarrow \triangle P'Q'R'$ .

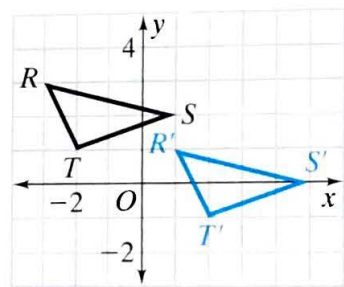
You can use arrow notation to write a general rule that describes a translation. For Example 1,  $(x, y) \rightarrow (x + 6, y - 3)$  shows an ordered pair  $(x, y)$  and describes a translation to the right 6 units and down 3 units.

### EXAMPLE Describing a Translation

- 2 Write a rule to describe the translation of the black triangle to the blue triangle.

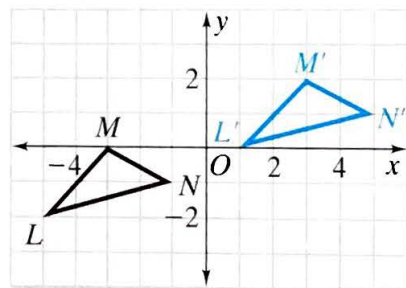
Each point has moved 4 units to the right and 2 units down. So the translation adds 4 to the  $x$ -coordinate and subtracts 2 from the  $y$ -coordinate.

The rule is  $(x, y) \rightarrow (x + 4, y - 2)$ .



### Quick Check

2. Write a rule that describes the translation shown on the graph at the right.

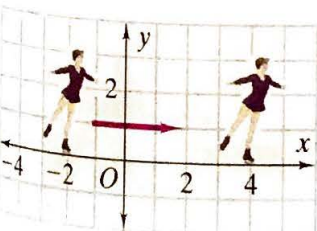


### Test Prep Tip

Draw arrows from each original point to its image to help you see the translation.

## Check Your Understanding

- Vocabulary** A (transformation, image) is a change in the position, shape, or size of a figure.
- Sports** The graph at the left shows an ice skater moving across the ice. How far and in what direction does the skater move?



Graph each point and its image after the given translation.

- $T(1, 3)$ , left 2 units
- $V(-4, 4)$ , down 6 units
- $S(4, 0)$ , right 1 unit, down 3 units
- $X(0, -2)$ , right 7 units



# Homework Exercises

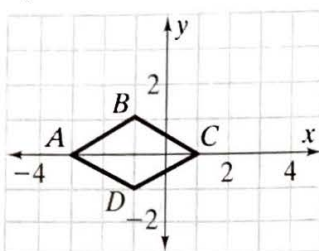
For more exercises, see **Extra Skills and Word Problems**.

## GO for Help

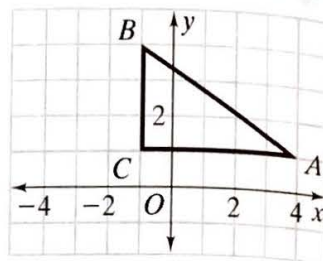
For Exercises	See Examples
7–10	1
11–14	2

Copy each figure. Then graph the image after the given translation.

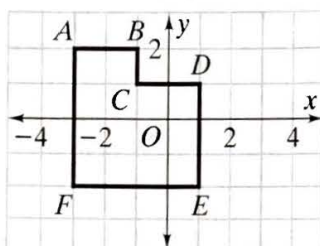
7. up 2 units



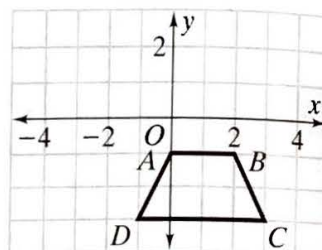
8. left 3 units, down 4 units



9. right 4 units, up 3 units

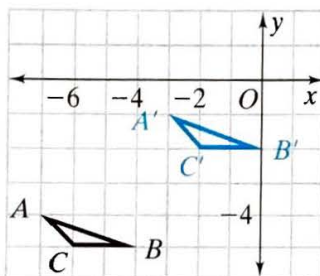


10. left 2 units, up 1 unit

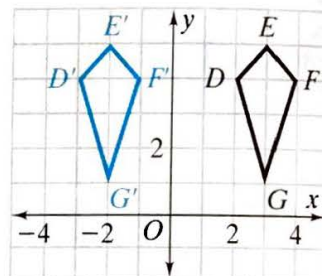


Write a rule that describes the translation shown on each graph.

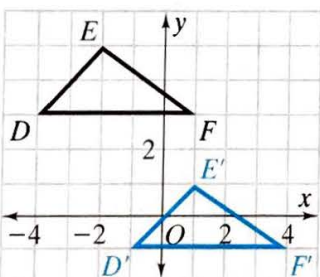
11.



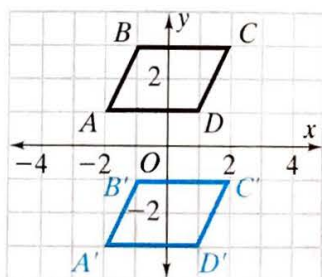
12.



13.



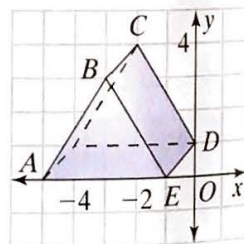
14.



## GPS

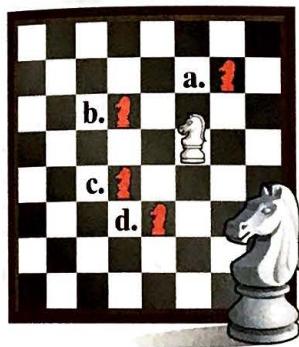
15. **Guided Problem Solving** Suppose the figure at the right is translated 6 units to the right and 5 units down. Without graphing, what are the coordinates of the image points?

- What are the coordinates of the vertices?
- To translate to the right, do you add to or subtract from the  $x$ -coordinate?
- To translate down, do you add to or subtract from the  $y$ -coordinate?



Match each rule with the correct translation.

16.  $(x, y) \rightarrow (x - 6, y + 2)$       A.  $P(4, -1) \rightarrow P'(3, -6)$   
 17.  $(x, y) \rightarrow (x + 3, y)$       B.  $Q(3, 0) \rightarrow Q'(-3, 2)$   
 18.  $(x, y) \rightarrow (x - 1, y - 5)$       C.  $R(-2, 4) \rightarrow R'(1, 4)$   
 19. Use graph paper to complete parts (a)–(e).  
 a. Draw a rectangle with vertices  $A(1, 6)$ ,  $B(4, 6)$ ,  $C(4, 2)$ , and  $D(1, 2)$ .  
 b. What are the lengths of the sides of rectangle  $ABCD$ ? What are the angle measures?  
 c. Perform any translation of rectangle  $ABCD$ . Use arrow notation to describe your translation.  
 d. How do the lengths of the sides of rectangle  $A'B'C'D'$  compare with the lengths of the sides of rectangle  $ABCD$ ? How do the angle measures compare?  
 e. Do you think that your answer to part (d) is true for any translation of a figure? Explain your reasoning.



20. **Games** The chessboard at the left shows four possible moves for the white knight. Write a rule to describe each move as a translation, using the knight's original position as the origin.  
 21. **Writing in Math** Suppose you translate a point to the left 1 unit and up 3 units. Describe what you would do to the coordinates of the original point to find the coordinates of the image.  
 22. **Challenge** Graph the equation  $y = \frac{1}{2}x$ . Translate the line up 3 units. Describe the image.

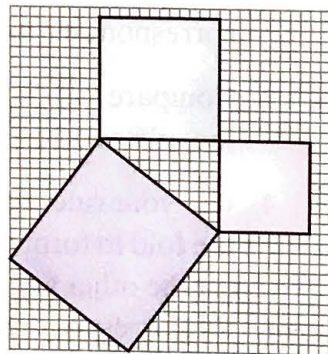


## Test Prep and Mixed Review

Practice

### Multiple Choice

23. Point  $A(2, 3)$  is translated 2 units to the right and 4 units down. What are the coordinates of point  $A'$ ?  
 (A)  $(0, 0)$       (B)  $(0, -1)$       (C)  $(4, 0)$       (D)  $(4, -1)$   
 24. Javier drew a right triangle on graph paper with legs of length 9 and 12. He then drew squares as shown. What was the area of the square opposite the right angle?  
 (F) 15 units<sup>2</sup>      (H) 81 units<sup>2</sup>  
 (G) 144 units<sup>2</sup>      (J) 225 units<sup>2</sup>



Graph each linear equation.

25.  $y = \frac{1}{3}x$       26.  $y = -5x + 2$

### GO for Help

For Exercises	See Lesson
25–26	4-2