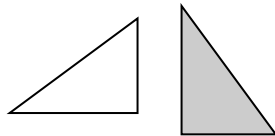


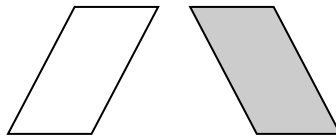
**Chapter
7****Maintaining Mathematical Proficiency**

Tell whether the shaded figure is a translation, reflection, or rotation of the nonshaded figure.

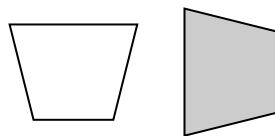
1.



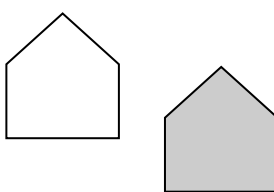
2.



3.



4.



Find the perimeter and area of the polygon with the given vertices.

5. $A(-4, 5), B(2, 5), C(2, -1), D(-4, -1)$

6. $E(0, 3), F(-3, 7), G(0, 7)$

7.1**Translations**

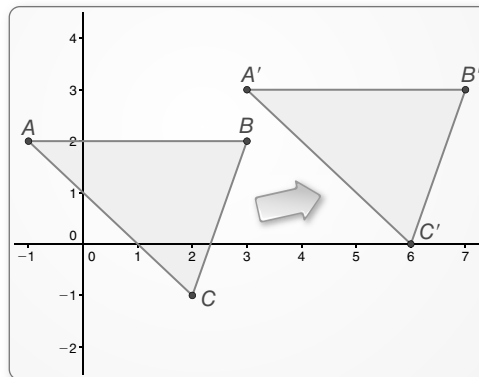
For use with Exploration 7.1

Essential Question How can you translate a figure in a coordinate plane?**1 EXPLORATION:** Translating a Triangle in a Coordinate PlaneGo to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner.

- Use dynamic geometry software to draw any triangle and label it $\triangle ABC$.
- Copy the triangle and *translate* (or slide) it to form a new figure, called an *image*, $\triangle A'B'C'$. (read as “triangle *A* prime, *B* prime, *C* prime”).
- What is the relationship between the coordinates of the vertices of $\triangle ABC$ and those of $\triangle A'B'C'$?
- What do you observe about the side lengths and angle measures of the two triangles?

Sample

**2 EXPLORATION:** Translating a Triangle in a Coordinate PlaneGo to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

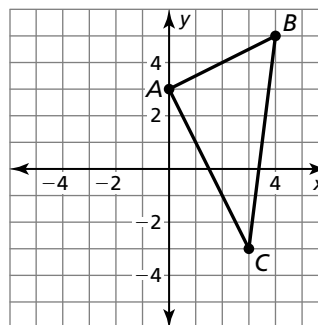
Work with a partner.

- The point (x, y) is translated a units horizontally and b units vertically. Write a rule to determine the coordinates of the image of (x, y) .

$$(x, y) \rightarrow (\underline{\quad}, \underline{\quad})$$

7.1 Translations (continued)

- b. Use the rule you wrote in part (a) to translate $\triangle ABC$ 4 units left and 3 units down. What are the coordinates of the vertices of the image, $\triangle A'B'C'$?



- c. Draw $\triangle A'B'C'$. Are its side lengths the same as those of $\triangle ABC$? Justify your answer.

3 EXPLORATION: Comparing Angles of Translations

Work with a partner.

- a. In Exploration 2, is $\triangle ABC$ a right triangle? Justify your answer.

- b. In Exploration 2, is $\triangle A'B'C'$ a right triangle? Justify your answer.

- c. Do you think translations always preserve angle measures? Explain your reasoning.

Communicate Your Answer

- 4. How can you translate a figure in a coordinate plane?

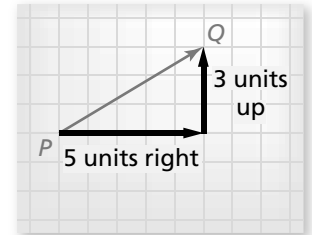
- 5. In Exploration 2, translate $\triangle A'B'C'$ 3 units right and 4 units up. What are the coordinates of the vertices of the image, $\triangle A''B''C''$? How are these coordinates related to the coordinates of the vertices of the original triangle, $\triangle ABC$?

7.1**Practice**

For use after Lesson 7.1

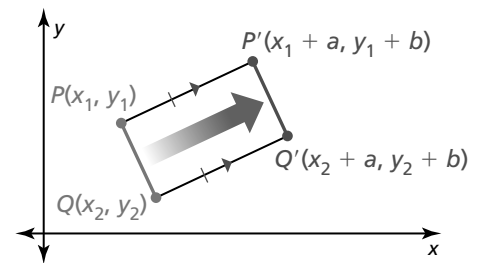
Core Concepts**Vectors**

The diagram shows a vector. The **initial point**, or starting point, of the vector is P , and the **terminal point**, or ending point, is Q . The vector is named \overline{PQ} , which is read as “vector PQ .” The **horizontal component** of \overline{PQ} is 5, and the **vertical component** is 3. The **component form** of a vector combines the horizontal and vertical components. So, the component form of \overline{PQ} is $\langle 5, 3 \rangle$.

**Notes:****Translations**

A **translation** moves every point of a figure the same distance in the same direction. More specifically, a translation *maps*, or moves, the points P and Q of a plane figure along a vector $\langle a, b \rangle$ to the points P' and Q' , so that one of the following statements is true.

- $PP' = QQ'$ and $\overline{PP'} \parallel \overline{QQ'}$, or
- $PP' = QQ'$ and $\overline{PP'}$ and $\overline{QQ'}$ are collinear.

**Notes:**

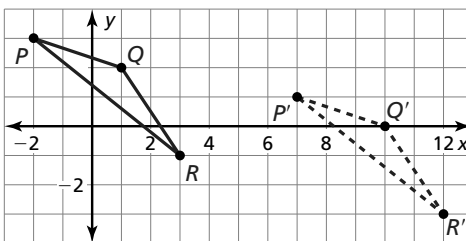
7.1 Practice (continued)

Worked-Out Examples

Example #1

Graph $\triangle PQR$ with vertices $P(-2, 3)$, $Q(1, 2)$, and $R(3, -1)$ and its image after the translation.

$(x, y) \rightarrow (x + 9, y - 2)$



$P(-2, 3) \rightarrow P'(7, 1)$

$Q(1, 2) \rightarrow Q'(10, 0)$

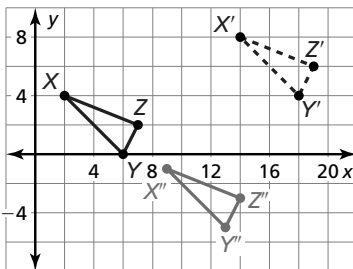
$R(3, -1) \rightarrow R'(12, -3)$

Example #2

Graph $\triangle XYZ$ with vertices $X(2, 4)$, $Y(6, 0)$, and $Z(7, 2)$ and its image after the composition.

Translation: $(x, y) \rightarrow (x + 12, y + 4)$

Translation: $(x, y) \rightarrow (x - 5, y - 9)$



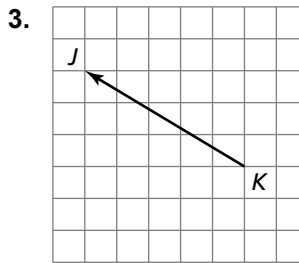
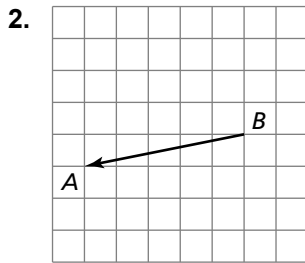
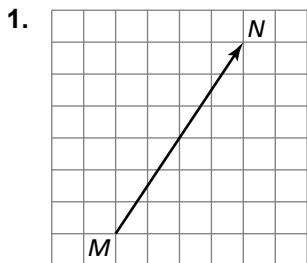
$X(2, 4) \rightarrow X'(14, 8) \rightarrow X''(9, -1)$

$Y(6, 0) \rightarrow Y'(18, 4) \rightarrow Y''(13, -5)$

$Z(7, 2) \rightarrow Z'(19, 6) \rightarrow Z''(14, -3)$

Practice A

In Exercises 1–3, name the vector and write its component form.

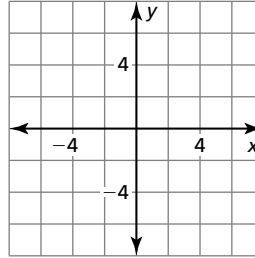


7.1 Practice (continued)

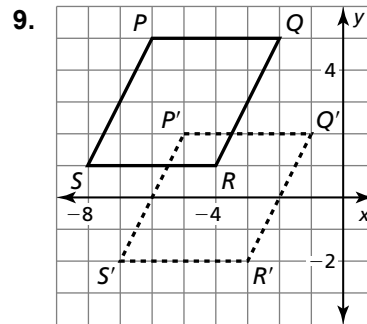
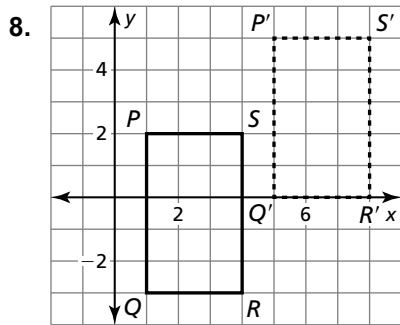
In Exercises 4–7, the vertices of $\triangle ABC$ are $A(1, 2)$, $B(5, 1)$, $C(5, 4)$.

Translate $\triangle ABC$ using the given vector. Graph $\triangle ABC$ and its image.

4. $\langle -4, 0 \rangle$
5. $\langle -2, -4 \rangle$
6. $\langle 0, -5 \rangle$
7. $\langle 1, -3 \rangle$



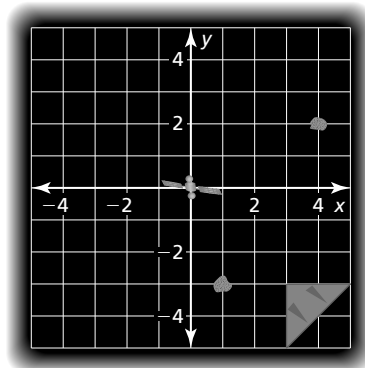
In Exercises 8 and 9, write a rule for the translation of quadrilateral $PQRS$ to quadrilateral $P'Q'R'S'$.



In Exercises 10 and 11, use the translation.

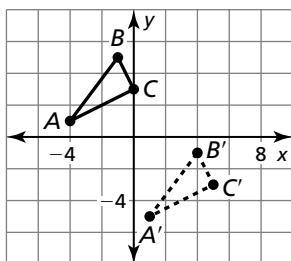
$$(x, y) \rightarrow (x + 6, y - 3)$$

10. What is the image of $J(4, 5)$?
11. What is the image of $R'(0, -5)$?
12. In a video game, you move a spaceship 1 unit left and 4 units up. Then, you move the spaceship 2 units left. Rewrite the composition as a single transformation.



Practice B

- The vertices of $\triangle FGH$ are $F(-2, -6)$, $G(3, 0)$, and $H(1, -4)$. Translate $\triangle FGH$ using the vector $\langle -2, 7 \rangle$. Graph $\triangle FGH$ and its image.
- Find the component form of the vector that translates $A(-4, 8)$ to $A'(7, -9)$.
- Write a rule for the translation of $\triangle ABC$ to $\triangle A'B'C'$.



In Exercises 4 and 5, use the translation $(x, y) \rightarrow (x - 4, y + 3)$.

- What is the image of $G(-2, 4)$?
- What is the image of $H(-10, 5)$?
- Graph $\triangle JKL$ with vertices $J(-2, 8)$, $K(1, -3)$, and $L(5, 4)$ and its image after the composition.

Translation: $(x, y) \rightarrow (x + 6, y - 1)$

Translation: $(x, y) \rightarrow (x - 1, y - 7)$

- Is the transformation given by $(x, y) \rightarrow (2x + 2, y + 1)$ a translation? Explain your reasoning.
- A popular kid's game has 15 tiles and 1 open space. The goal of the game is to rearrange the tiles to put them in order (from least to greatest, starting at the upper left-hand corner and going across each row). Use the figure to write the transformation(s) that describe the path of where the 8 tile is currently, and where it must be by the end of the game. Can this same translation be used to describe the path of all the tiles?
- Graph any triangle and translate it in any direction. Draw translation vectors for each vertex of the triangle. Is there a geometric relationship between all the translation vectors? Explain why this makes sense in terms of the slope of the line.
- Point $P(4, -2)$ undergoes a translation given by $(x, y) \rightarrow (x + 3, x - a)$, followed by another translation $(x, y) \rightarrow (x - b, x + 7)$ to produce the image of $P''(-5, 8)$. Find the values of a and b and point P' .

8	2	3	7
5	6	4	14
1	9		13
11	15	10	12