LESSON 7.4

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Practice with Examples

For use with pages 421–428

GOAL **Identify and use translations in the plane.**

VOCABULARY

A **translation** is a transformation that maps every two points P and Q in the plane to points P' and Q', so that the following properties are true: 1) $PP' = QQ'$ and 2) $\overline{PP'} \parallel \overline{QQ'}$, or $\overline{PP'}$ and $\overline{QQ'}$ are collinear.

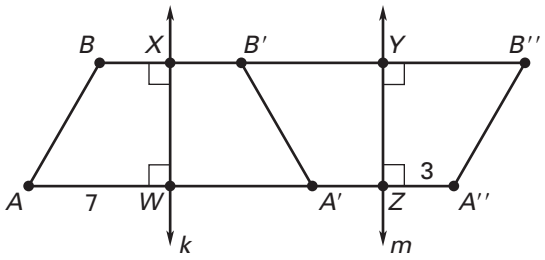
A **vector** is a quantity that has both direction and *magnitude*, or size.

When a vector is drawn as ray $\overrightarrow{PQ}$, the **initial point,** or starting point, of the vector is point P and the **terminal point,** or ending point, of the vector is point Q.

The **component form** of a vector combines the horizontal and vertical components.

EXAMPLE 1 Using Theorem 7.5

In the diagram, a reflection in line k maps $\overline{AB}$ to $\overline{A'B'}$, a reflection in line m maps $\overline{A'B'}$ to $\overline{A''B''}$, $k \parallel m$, $AW = 7$, and $ZA'' = 3$.



a. Name some congruent segments.

b. Does $WZ = XY$? Explain.

c. What is the length of $\overline{AA''}$?

SOLUTION

a. Here are some sets of congruent segments: $\overline{AB}$, $\overline{A'B'}$, and $\overline{A''B''}$; $\overline{BX}$ and $\overline{XB'}$; $\overline{B'Y}$ and $\overline{YB''}$.

b. Yes, $WZ = XY$ because $\overline{WZ}$ and $\overline{XY}$ are opposite sides of a rectangle.

c. Because $AA'' = BB''$, the length of $\overline{AA''}$ is $7 + 7 + 3 + 3$, or 20 units.

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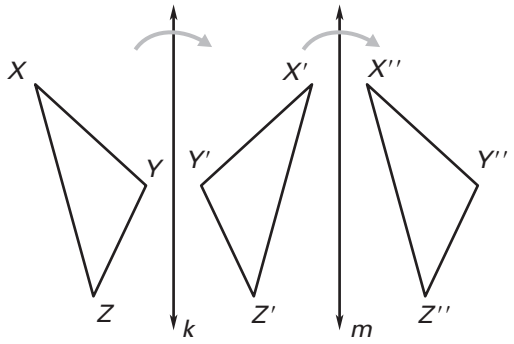
Exercises for Example 1

In the diagram $k \parallel m$, $\triangle XYZ$ is reflected in line k, and $\triangle X'Y'Z'$ is reflected in line m.



1. Name two segments parallel to $\overline{YY''}$.

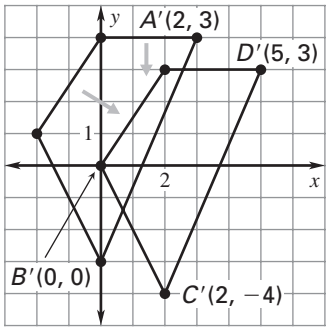
2. If the length of $\overline{ZZ''}$ is 6 cm, what is the distance between k and m?

3. A translation maps $\triangle XYZ$ onto which triangle?

4. Which lines are perpendicular to $\overline{XX''}$?

EXAMPLE 2 ## Translations in a Coordinate Plane

Sketch a quadrilateral with vertices $A(0, 4)$, $B(-2, 1)$, $C(0, -3)$, and $D(3, 4)$. Then sketch the image of the quadrilateral after the translation $(x, y) \rightarrow (x + 2,\ y - 1)$.

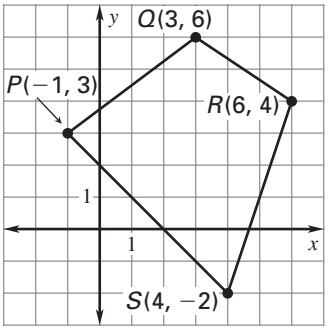


SOLUTION

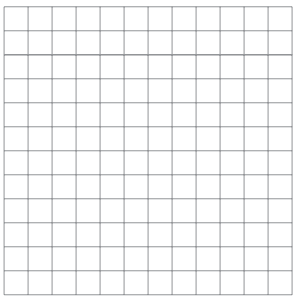
Plot the points as shown. Shift each point 2 units to the right and 1 unit down to find the translated vertices.

Exercises for Example 2

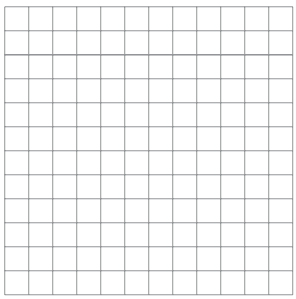
In Exercises 5–8, copy figure *PQRS* and draw its image after the translation.



5. $(x, y) \rightarrow (x - 4,\ y + 1)$



6. $(x, y) \rightarrow (x,\ y - 5)$



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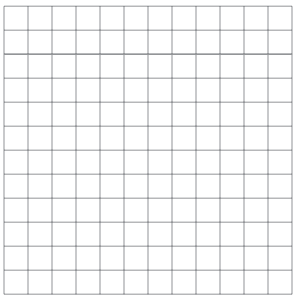
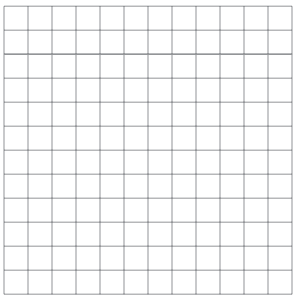
7. $(x, y) \rightarrow (x - 2,\ y - 2)$

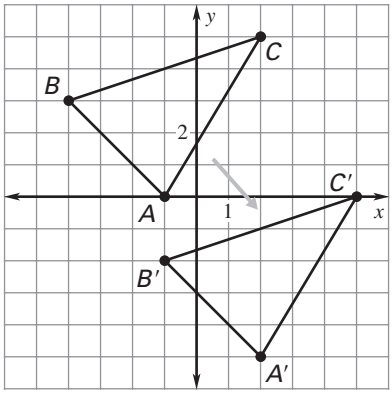


8. $(x, y) \rightarrow (x + 7,\ y + 3)$



EXAMPLE 3 Finding Vectors

In the diagram, $\triangle ABC$ maps onto $\triangle A'B'C'$ by a translation. Write the component form of the vector that can be used to describe the translation.



SOLUTION

Choose any vertex and its image, say A and A'. To move from A to A', you move 3 units to the right and 5 units down. The component form of the vector is $\langle 3, -5 \rangle$.

Exercises for Example 3

In Exercises 9 and 10, write the component form of the vector that describes the translation which maps $\triangle ABC$ onto $\triangle A'B'C'$.

9. $A(3, 6), B(1, 0), C(4, 8); A'(1, 2), B'(-1, -4), C'(2, 4)$

10. $A(-6, -2), B(-5, 3), C(1, -1); A'(-3, -5), B'(-2, 0), C'(4, -4)$