

### Check Skills You'll Need

1. **Vocabulary Review**  
A *translation* moves each point in a figure the same   ? in the same direction.

Graph the point  $A(2, 4)$  and its image after the given translation.

- left 2 units
- up 4 units
- down 1 unit, left 4 units
- up 2 units, right 3 units

**GO for Help**  
Lesson 8-1

### What You'll Learn

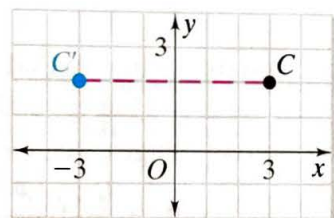
To graph reflections in the coordinate plane and to identify lines of symmetry

**New Vocabulary** reflection, line of reflection, reflectional symmetry, line of symmetry

### Why Learn This?

Reflections appear everywhere in the world around us. You can see reflections in a mirror or a pool of water, or in shapes in art and nature.

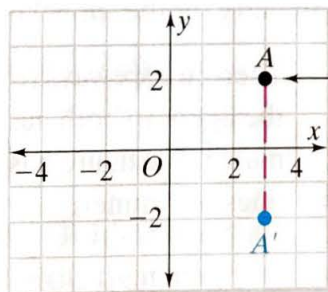
A **reflection** is a transformation that flips a figure over a line. This line is the **line of reflection**. Like translations, reflections change the position of a figure but not its size or shape.



In the diagram at the left,  $C$  and  $C'$  are the same distance from the line of reflection. The segment connecting  $C$  and  $C'$  is perpendicular to the line of reflection, the  $y$ -axis.

### EXAMPLE Graphing Reflections of a Point

- 1 Graph the point  $A(3, 2)$ . Then graph its image after it is reflected over the  $x$ -axis. Name the coordinates of  $A'$ .



Since  $A$  is 2 units above the  $x$ -axis,  $A'$  is 2 units below the  $x$ -axis.

The coordinates of  $A'$  are  $(3, -2)$ .

### Quick Check

1. Graph the point  $D(-2, 1)$ . Then graph its image after it is reflected over the  $y$ -axis. Name the coordinates of  $D'$ .

## Vocabulary Tip

Congruent figures have the same shape and size.

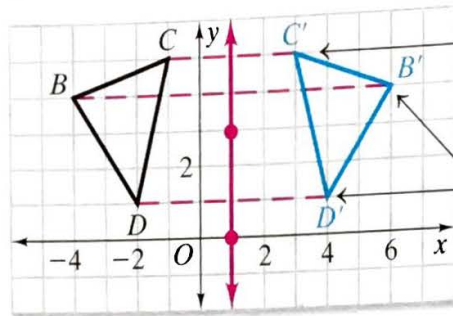
## GO for Help

For help with graphing points, go to Lesson 1-7.

When you reflect a figure over a line, the image is congruent to the original figure.

## EXAMPLE Graphing Reflections of a Shape

- 2 Graph  $\triangle BCD$  and its image after it is reflected over the line through  $(1, 3)$  and  $(1, 0)$ . Name the coordinates of the vertices of  $\triangle B'C'D'$ .



Since  $C$  is 2 units to the left of the red line,  $C'$  is 2 units to the right of the line.

Reflect the other vertices. Draw  $\triangle B'C'D'$ .

The coordinates of the vertices are  $B'(6, 4)$ ,  $C'(3, 5)$ , and  $D'(4, 1)$ .

## Quick Check

2.  $\triangle EFG$  has vertices  $E(4, 3)$ ,  $F(3, 1)$ , and  $G(1, 2)$ . Graph  $\triangle EFG$  and its image after it is reflected over the  $x$ -axis. Name the coordinates of the vertices of  $\triangle E'F'G'$ .

If a figure can be reflected over a line so that the reflected image matches the original figure, then the figure has **reflectional symmetry**. The line that divides the figure into mirror images is called a **line of symmetry**.

Many shapes in nature have reflectional symmetry. In the leaf at the left, the black line approximates a line of symmetry.

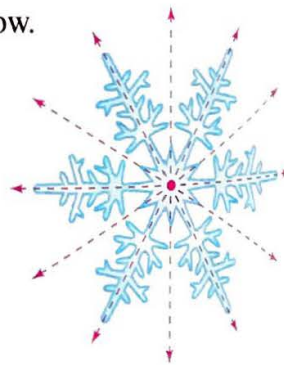


## EXAMPLE Identifying Lines of Symmetry

- 3 Draw the lines of symmetry for the snowflake below.



There are six ways to fold the figure so both halves match. The figure has six lines of symmetry.



## Quick Check

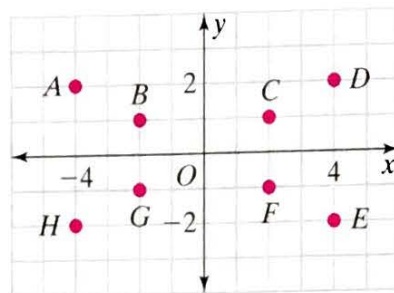
3. Copy the flag at the right. Draw the lines of symmetry.



# Check Your Understanding

1. **Vocabulary** Line  $a$  divides a figure into two halves. How can you tell whether  $a$  is a line of symmetry?

Use the graph at the right. Match each point with its image after a reflection over the given axis.



2.  $A$ ,  $y$ -axis                      3.  $B$ ,  $x$ -axis  
 4.  $H$ ,  $y$ -axis                      5.  $F$ ,  $y$ -axis  
 6.  $E$ ,  $x$ -axis                      7.  $C$ ,  $x$ -axis

# Homework Exercises

For more exercises, see Extra Skills and Word Problems.

GO for Help	
For Exercises	See Examples
8–13	1
14–16	2
17–19	3

Graph the given point and its image after each reflection over the given axis. Name the coordinates of the reflected point.

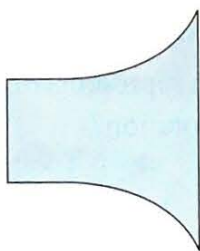
8.  $H(-3, 2)$ ,  $x$ -axis              9.  $G(2, 4)$ ,  $y$ -axis              10.  $B(-3, -4)$ ,  $y$ -axis  
 11.  $D(0, -2)$ ,  $x$ -axis            12.  $C(4, -3)$ ,  $x$ -axis            13.  $M(5, 0)$ ,  $y$ -axis

$\triangle MPS$  has vertices  $M(4, 5)$ ,  $P(1, 2)$ , and  $S(5, 1)$ . Graph  $\triangle MPS$  and its image after a reflection over each line. Name the new coordinates.

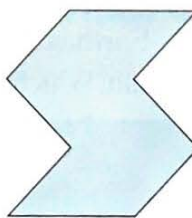
14.  $x$ -axis                      15.  $y$ -axis                      16. line through  $(1, -2)$  and  $(4, -2)$

Copy each figure that has reflectional symmetry. Draw the lines of symmetry. Write *no reflectional symmetry* where applicable.

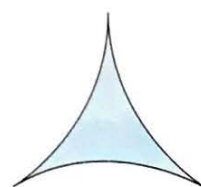
17.



18.



19.



**GPS**

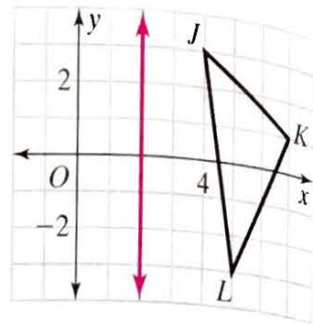
20. **Guided Problem Solving** Does the flag at the right have reflectional symmetry? If so, state how many lines of symmetry it has.



- **Understand the Problem** Find whether you can fold the figure so both halves match.
- **Make a Plan** Copy the figure and try folding it in different ways.

21. The word **COB** has reflectional symmetry. Which capital letters in the alphabet have reflectional symmetry?

22. a. Graph the image of  $\triangle JKL$  after it is reflected over the red line. Name the coordinates of  $\triangle J'K'L'$ . What do you notice about the y-coordinates?  
 b. Translate  $\triangle J'K'L'$  to the left 3 units. Name the coordinates of  $\triangle J''K''L''$ .



**Figure EFGH** has vertices  $E(2, 5)$ ,  $F(4, 5)$ ,  $G(6, 1)$ , and  $H(3, 1)$ . Graph figure  $EFGH$  and its image after a reflection over each line. Name the coordinates of the vertices of the reflected figure.

23. y-axis    24. x-axis    25. line through  $(0, 2)$  and  $(-3, 2)$

26. **Art** The figure at the right is folded along a red line of symmetry. Copy the figure and sketch the unfolded figure.



27. **Writing in Math** How many lines of symmetry does a circle have? Explain your answer.  
 28. **Challenge** When connected in order, the points  $(-3, -3)$ ,  $(-4, -1)$ ,  $(-1, 2)$ ,  $(2, 5)$ , and  $(4, 4)$  form half of a figure. The line of symmetry of the complete figure is  $y = x$ . Draw the complete figure.

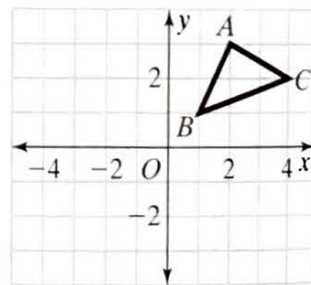


## Test Prep and Mixed Review

**Practice**

### Multiple Choice

29. If  $\triangle ABC$  is reflected over the x-axis, what are the coordinates of  $C'$ ?  
 (A)  $(2, -4)$                       (C)  $(-2, 4)$   
 (B)  $(4, -2)$                       (D)  $(-4, 2)$



30. Earth is about 93,000,000 miles from the sun. Which expression represents this number in scientific notation?  
 (F)  $9.3 \times 10^{-7}$                       (H)  $9.3 \times 10^6$   
 (G)  $9.3 \times 10^{-6}$                       (J)  $9.3 \times 10^7$

31. Which list shows the numbers in order from least to greatest?  
 (A)  $\sqrt{5}$ , 2.4,  $\frac{7}{3}$ ,  $\sqrt{2}$                       (C)  $\sqrt{5}$ ,  $\frac{7}{3}$ , 2.4,  $\sqrt{2}$   
 (B)  $\sqrt{2}$ ,  $\sqrt{5}$ ,  $\frac{7}{3}$ , 2.4                      (D)  $\sqrt{2}$ , 2.4,  $\sqrt{5}$ ,  $\frac{7}{3}$

**GO for Help**

For Exercises	See Lesson
32-34	1-4

**Given the lengths of two legs of a right triangle, find the length of the hypotenuse.**

32.  $a = 6$ ,  $b = 8$

33.  $a = 5$ ,  $b = 12$

34.  $a = 7$ ,  $b = 24$