# 5.3 Finding Unknown Measures in Similar Figures

Essential Question What information do you need to know to find the dimensions of a figure that is similar to another figure?

1 ACTIVITY: Drawing and Labeling Similar Figures

Work with a partner. You are given the red rectangle. Find a blue rectangle that is similar and has one side from $(-1, -6)$ to $(5, -6)$. Label the vertices.

a. Sample:
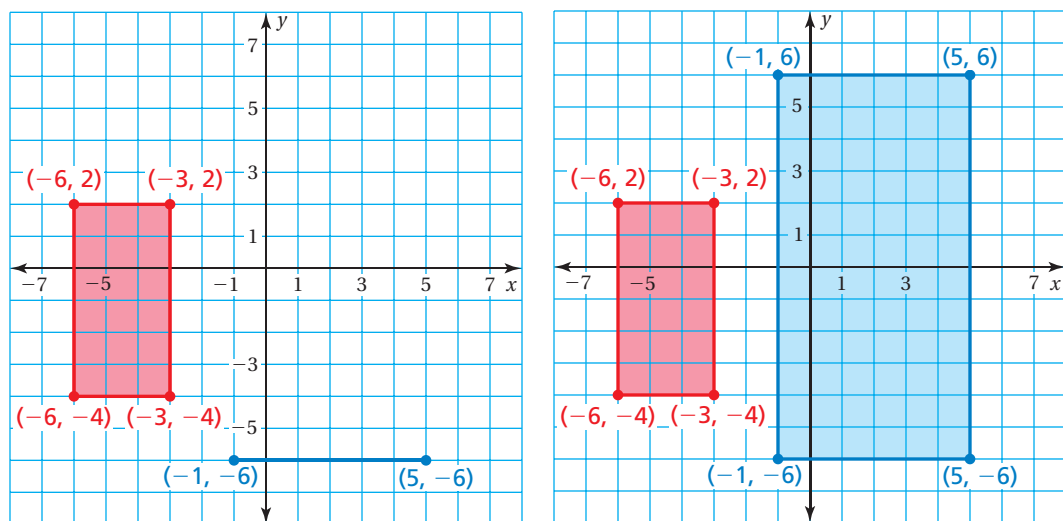
You can see that the two rectangles are similar by showing that ratios of corresponding sides are equal.

$$\frac{\text{Red Length}}{\text{Blue Length}} \stackrel{?}{=} \frac{\text{Red Width}}{\text{Blue Width}}$$

$$\frac{\text{change in } y}{\text{change in } y} \stackrel{?}{=} \frac{\text{change in } x}{\text{change in } x}$$

$$\frac{6}{12} \stackrel{?}{=} \frac{3}{6}$$

$$\frac{1}{2} = \frac{1}{2}$$

⋮ The ratios are equal. So, the rectangles are similar.

b. There are three other blue rectangles that are similar to the red rectangle and have the given side.

- Draw each one. Label the vertices of each.
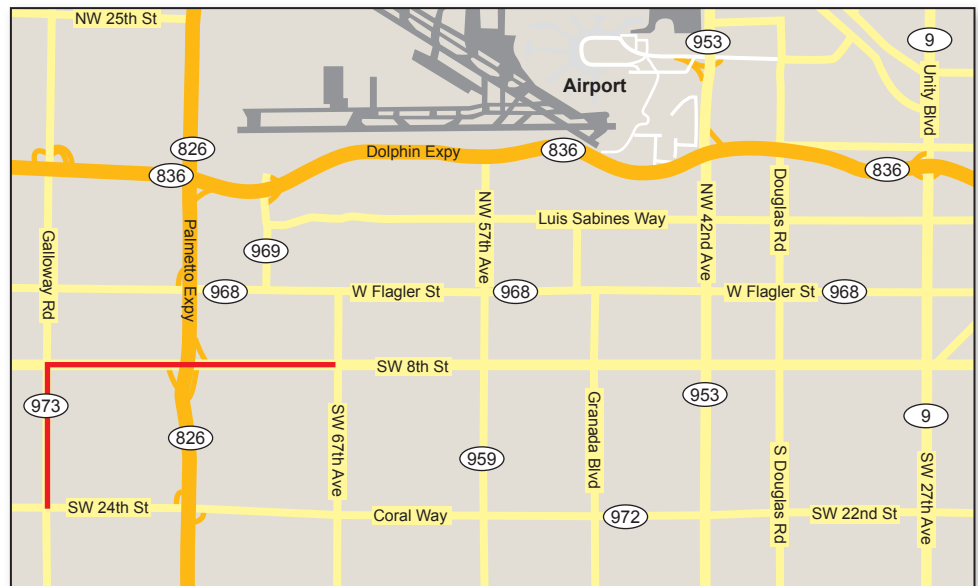- Show that each is similar to the original red rectangle.

Work with a partner.

a. The red and blue rectangles are similar. Find the length of the blue rectangle. Explain your reasoning.
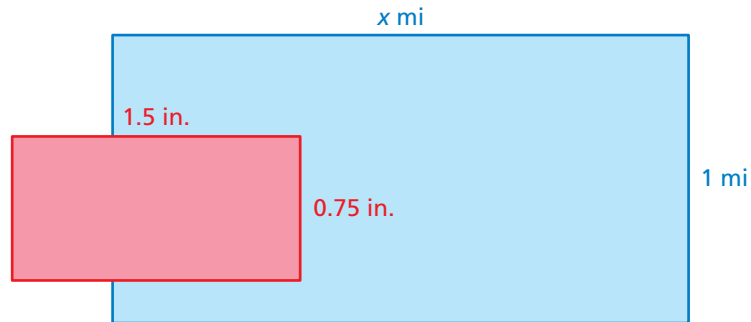
b. The distance marked by the vertical red line on the map is 1 mile. Find the distance marked by the horizontal red line. Explain your reasoning.

What Is Your Answer?

3. IN YOUR OWN WORDS What information do you need to know to find the dimensions of a figure that is similar to another figure? Give some examples using two rectangles.

4. When you know the length and width of one rectangle and the length of a similar rectangle, can you always find the missing width? Why or why not?

Practice Use what you learned about finding unknown measures in similar figures to complete Exercises 3 and 4 on page 210.
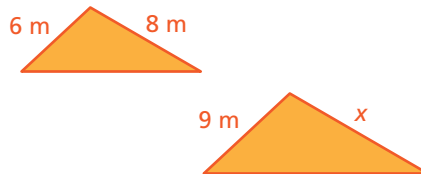
5.3 Lesson

EXAMPLE 1 — Finding an Unknown Measure

Key Vocabulary
indirect measurement, p. 209

The two triangles are similar. Find the value of x.

Corresponding side lengths are proportional. So, use a proportion to find x.

6 m   8 m

9 m x

$$\frac{6}{9} = \frac{8}{x}$$ Write a proportion.
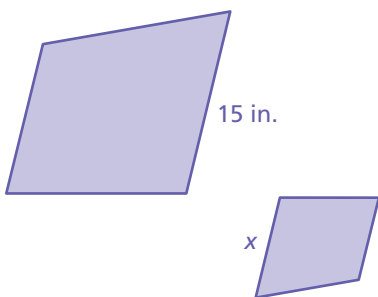
$$6x = 72$$ Use Cross Products Property.

$$x = 12$$ Divide each side by 6.

∴ So, x is 12 meters.

EXAMPLE 2 — Standardized Test Practice

15 in.

x

The two quadrilaterals are similar. The ratio of their perimeters is $12:5$. Find the value of x.

(A) 2.4 inches   (B) 4 inches

(C) 6.25 inches   (D) 36 inches

The ratio of the perimeters is equal to the ratio of corresponding side lengths. So, use a proportion to find x.

$$\frac{12}{5} = \frac{15}{x}$$ Write a proportion.

$$12x = 75$$ Use Cross Products Property.
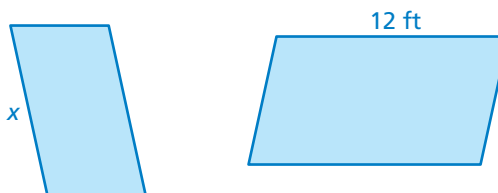
$$x = 6.25$$ Divide each side by 12.

∴ So, x is 6.25 inches. The correct answer is (C).

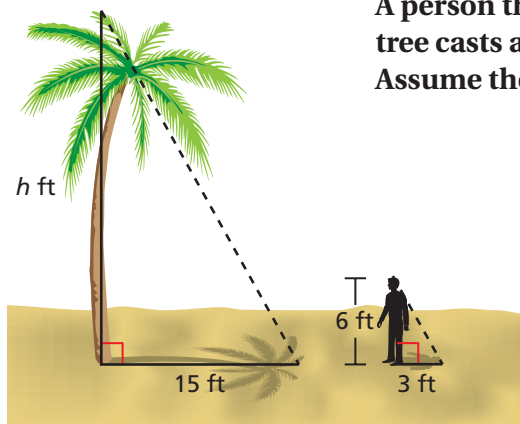### On Your Own

Now You're Ready
Exercises 3–8

1. The two quadrilaterals are similar. The ratio of the perimeters is $3:4$. Find the value of x.

12 ft

x

Multi-Language Glossary at BigIdeasMath.com.

Indirect measurement uses similar figures to find a missing measure that is difficult to find directly.

EXAMPLE 3 Using Indirect Measurement

A person that is 6 feet tall casts a 3-foot-long shadow. A nearby palm tree casts a 15-foot-long shadow. What is the height h of the palm tree? Assume the triangles are similar.

Corresponding side lengths are proportional.

$$\frac{h}{6} = \frac{15}{3} \qquad \text{Write a proportion.}$$

$$6 \cdot \frac{h}{6} = \frac{15}{3} \cdot 6 \qquad \text{Multiply each side by 6.}$$

$$h = 30 \qquad \text{Simplify.}$$
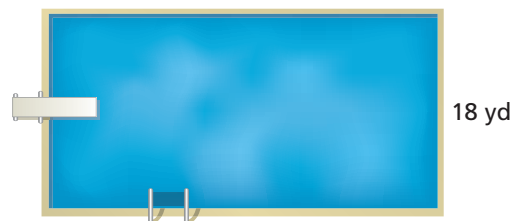
⋮ The palm tree is 30 feet tall.

On Your Own

Now You're Ready
Exercise 9

2. WHAT IF? Later in the day, the palm tree in Example 3 casts a 25-foot-long shadow. How long is the shadow of the person?

EXAMPLE 4 Using Proportions to Find Area

A swimming pool is similar in shape to a volleyball court. What is the area A of the pool?

18 yd

$$\frac{\text{Area of court}}{\text{Area of pool}} = \left(\frac{\text{width of court}}{\text{width of pool}}\right)^2$$
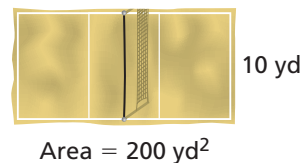
$$\frac{200}{A} = \left(\frac{10}{18}\right)^2 \qquad \text{Substitute.}$$

$$\frac{200}{A} = \frac{100}{324} \qquad \text{Simplify.}$$

10 yd

$$A = 648 \qquad \text{Solve the proportion.}$$

Area = 200 yd²

⋮ The area of the pool is 648 square yards.

On Your Own

3. The length of the volleyball court in Example 4 is 20 yards. What is the perimeter of the pool?

Check It Out
Help with Homework
BigIdeasMath com

✓ Vocabulary and Concept Check

1. **REASONING** How can you use corresponding side lengths to find unknown measures in similar figures?

2. **CRITICAL THINKING** In which of the situations would you likely use indirect measurement? Explain your reasoning.

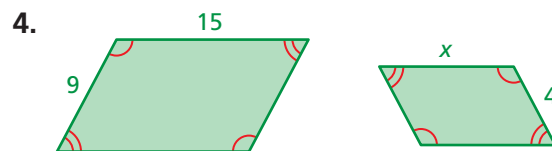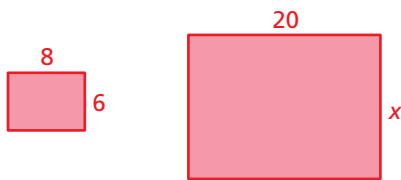Finding the height of a statue   Finding the width of a doorway

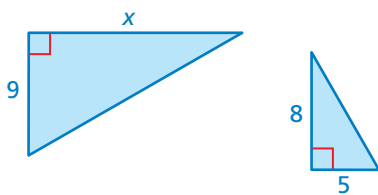Finding the width of a river   Finding the length of a lake

Practice and Problem Solving
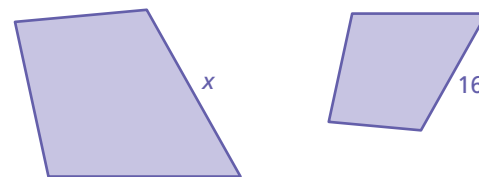
The polygons are similar. Find the value of x.

① ② **3.**

20
8
6
x

4.

15
9
x
4

5.

x
9
8
5

6.

21
9
6
x

7. The ratio of the perimeters is $7 : 10$.

x
12

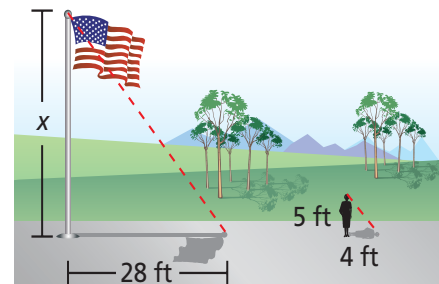**8.** The ratio of the perimeters is $8 : 5$.

x
16

③ **9. FLAGPOLE** What is the height x of the flagpole? Assume the triangles are similar.

x
5 ft
28 ft
4 ft

10. CHEERLEADING A rectangular school banner has a length of 44 inches and a perimeter of 156 inches. The cheerleaders make signs similar to the banner. The length of a sign is 11 inches. What is its perimeter?

11. **SQUARE** The ratio of the side length of Square A to the side length of Square B is 4 : 9. The side length of Square A is 12 yards. What is the perimeter of Square B?

12. **RIVER** Is the distance QP across the river greater than 100 meters? Explain.

$\triangle PQR \sim \triangle STR$
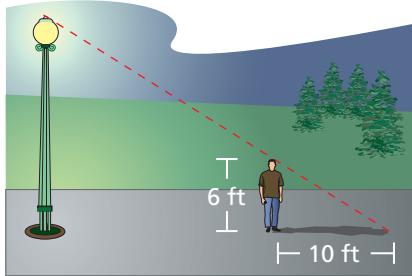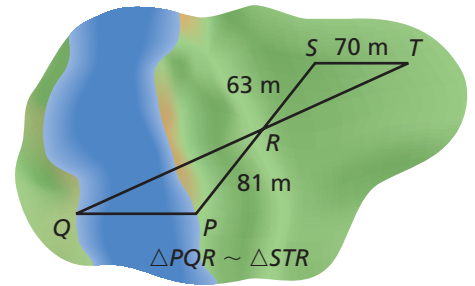
13. **STREET LIGHT** A person standing 20 feet from a street light casts a shadow as shown. How many times taller is the street light than the person? Assume the triangles are similar.

14. **AREA** A school playground is similar in shape to the community park. You can mow 250 square yards of grass in 15 minutes. How long would it take you to mow the grass on the playground?
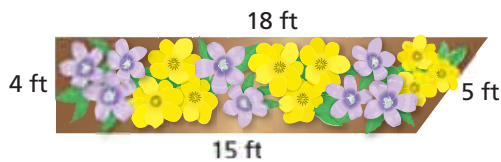
15. **Critical Thinking** Two bottles of fertilizer are needed to treat the flower garden shown. How many bottles are needed to treat a similar garden with a perimeter of 105 feet?

Fair Game Review *What you learned in previous grades & lessons*

Copy and complete the statement using a ratio. Round to the nearest hundredth, if necessary. *(Section 3.6)*

16. 4 mi ≈ ____ km

17. 12.5 in. ≈ ____ cm

18. 110 kg ≈ ____ lb

19. 6.2 km ≈ ____ mi

20. 10 cm ≈ ____ in.

21. 92.5 lb ≈ ____ kg

22. **MULTIPLE CHOICE** A recipe that makes 8 pints of salsa uses 22 tomatoes. Which proportion can you use to find the number n of tomatoes needed to make 12 pints of salsa? *(Section 3.4)*

   (A) $\dfrac{n}{8} = \dfrac{22}{12}$
   (B) $\dfrac{8}{22} = \dfrac{12}{n}$
   (C) $\dfrac{22}{n} = \dfrac{12}{8}$
   (D) $\dfrac{8}{22} = \dfrac{n}{12}$