

MAIN IDEA

Solve problems involving similar triangles.

New Vocabulary

indirect measurement

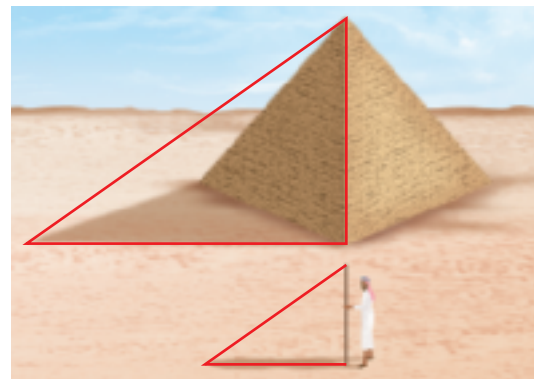
Math Online

glencoe.com

- Extra Examples
- Personal Tutor
- Self-Check Quiz

▶ **GET READY for the Lesson**

HISTORY Thales is known as the first Greek scientist, engineer, and mathematician. Legend says that he was the first to determine the height of the pyramids in Egypt by examining the shadows made by the Sun. He considered three points: the top of the objects, the lengths of the shadows, and the bases.



1. What appears to be true about the corresponding angles in the two triangles?
2. If the corresponding sides are proportional, what could you conclude about the triangles?

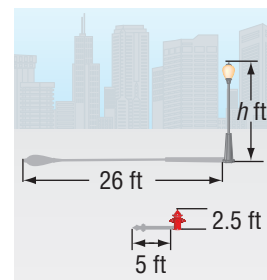
Indirect measurement allows you to use properties of similar polygons to find distances or lengths that are difficult to measure directly. The type of indirect measurement Thales used is called *shadow reckoning*. He measured his height and the length of his shadow then compared it with the length of the shadow cast by the pyramid.

$$\frac{\text{Thales' shadow}}{\text{pyramid's shadow}} = \frac{\text{Thales' height}}{\text{pyramid height}}$$

EXAMPLE Use Shadow Reckoning

- 1 CITY PROPERTY** A fire hydrant 2.5 feet high casts a 5-foot shadow. How tall is a street light that casts a 26-foot shadow at the same time? Let h represent the height of the street light.

Shadow	Height
hydrant →	← hydrant
street light →	← street light
$\frac{5}{26} = \frac{2.5}{h}$	$5h = 2.5 \cdot 26$ Find the cross products.
	$5h = 65$ Multiply.
$\frac{5h}{5} = \frac{65}{5}$	Divide each side by 5.
$h = 13$	



The street light is 13 feet tall.

CHECK Your Progress

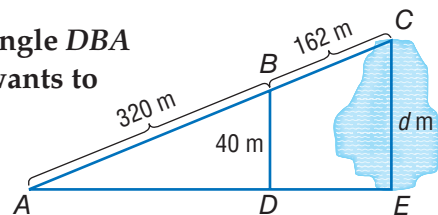
- a. **STREETS** At the same time a 2-meter street sign casts a 3-meter shadow, a telephone pole casts a 12.3-meter shadow. How tall is the telephone pole?

You can also use similar triangles that do not involve shadows to find missing measurements.

EXAMPLE Use Indirect Measurement

- 2 **LAKES** In the figure at the right, triangle DBA is similar to triangle ECA . Ramon wants to know the distance across the lake.

\overline{AB} corresponds to \overline{AC} and
 \overline{BD} corresponds to \overline{CE} .



$$\frac{AB}{AC} = \frac{BD}{CE}$$

Write a proportion.

$$\frac{320}{482} = \frac{40}{d}$$

Replace AB with 320, AC with 482, and BD with 40.

$$40 \cdot 482 = 320d$$

Find the cross products.

$$\frac{19,280}{320} = \frac{320d}{320}$$

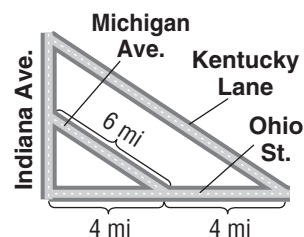
Multiply. Then divide each side by 320.

$$x = 60.25$$

The distance across the lake is 60.25 meters.

CHECK Your Progress

- b. **STREETS** Find the length of Kentucky Lane.

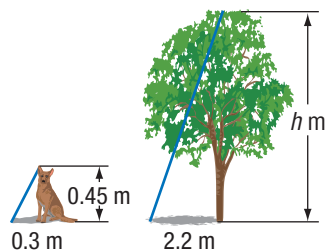


CHECK Your Understanding

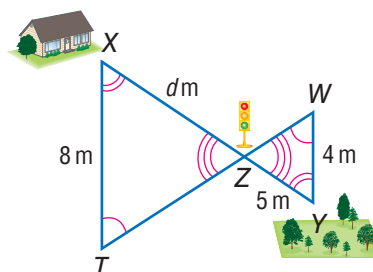
Examples 1 and 2
 (pp. 232–233)

In Exercises 1 and 2, the triangles are similar.

1. **TREES** How tall is the tree?



2. **WALKING** Find the distance from the park to the house.



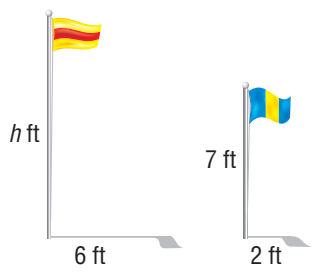
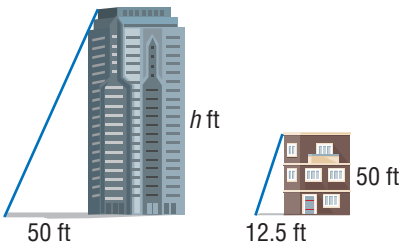
Practice and Problem Solving

HOMework HELP

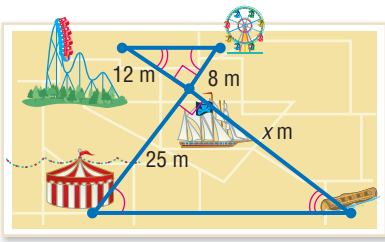
For Exercises	See Examples
3–4	1
5–6	2

In Exercises 3–8, the triangles are similar. Write a proportion and solve the problem.

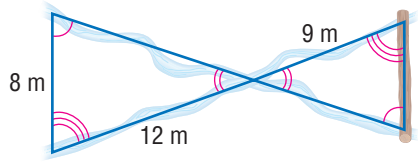
3. **BUILDING** How tall is the building? 4. **FLAGS** How tall is the taller flagpole?



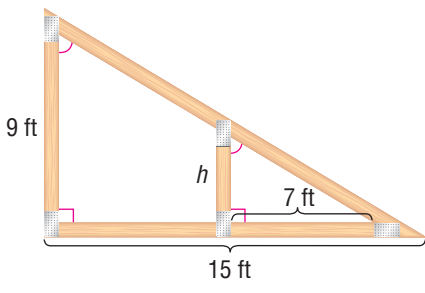
5. **PARKS** How far is it from the log ride to the pirate ship?



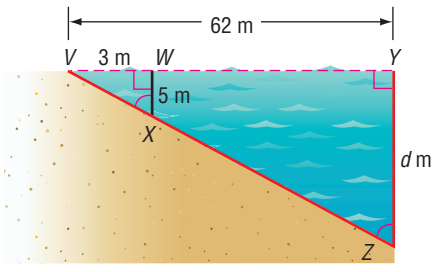
6. **CREEKS** About how long is the log that goes across the creeks?



7. **CONSTRUCTION** Find the height of the brace.



8. **LAKES** How deep is the water 62 meters from the shore?



For Exercises 9 and 10, draw a diagram.

9. **FERRIS WHEELS** The Giant Wheel at Cedar Point in Ohio is one of the tallest Ferris wheels in the country at 136 feet tall. If the Giant Wheel casts a 34-foot shadow, write and solve a proportion to find the height of a nearby man who casts a $1\frac{1}{2}$ -foot shadow.

10. **BASKETBALL** At 7 feet 2 inches, Margo Dydek is one of the tallest women to play professional basketball. Her coach, Carolyn Peck, is 6 feet 4 inches tall. If Ms. Peck casts a shadow that is 4 feet long, about how long would Ms. Dydek's shadow be? Round to the nearest tenth.

EXTRA PRACTICE

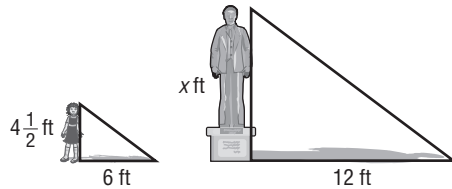
See pages 679, 703.

H.O.T. Problems

- OPEN ENDED** Describe a situation that requires indirect measurement. Explain how to solve the problem.
- CHALLENGE** You cut a square hole $\frac{1}{4}$ -inch wide in a piece of cardboard. With the cardboard 30 inches from your face, the moon fits exactly into the square hole. The moon is about 240,000 miles from Earth. Estimate the moon's diameter. Draw a diagram of the situation. Then write a proportion and solve the problem.
- WRITING IN MATH** What measures must be known in order to calculate the height of tall objects using shadow reckoning?

TEST PRACTICE

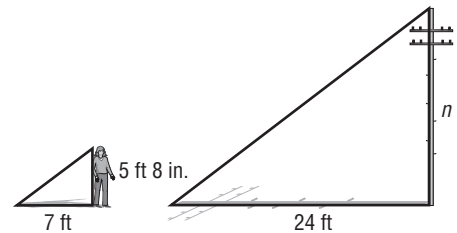
14. A child $4\frac{1}{2}$ feet tall casts a 6-foot shadow. A nearby statue casts a 12-foot shadow.



What is the height of the statue?

- A $8\frac{1}{4}$ ft C $13\frac{1}{2}$ ft
 B 9 ft D 24 ft

15. A telephone pole casts a 24-foot shadow. Belinda, who is 5 feet 8 inches tall, casts a 7-foot shadow.

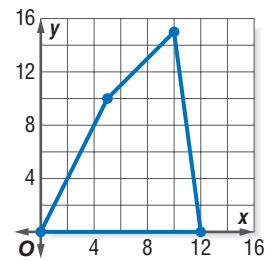


Which is closest to the height of the telephone pole?

- F 50 ft H 20 ft
 G 40 ft J 10 ft

Spiral Review

- WATER SAFETY** A Coast Guard boat was patrolling a region of ocean shown on the grid. If their search region was reduced to 60% of its original size, what are the coordinates of region's boundary? (Lesson 4-8)
- PARTIES** For your birthday party, you make a map to your house on a 3-inch wide by 5-inch long index card. How long will your map be if you use a copier to enlarge it so it is 8 inches wide? (Lesson 4-7)



Estimate each square root to the nearest whole number. (Lessons 3-2)

18. $\sqrt{11}$ 19. $\sqrt{48}$ 20. $-\sqrt{118}$

GET READY for the Next Lesson

PREREQUISITE SKILL Solve each proportion. (Lesson 4-5)

21. $\frac{1 \text{ in.}}{12 \text{ ft}} = \frac{x \text{ in.}}{50 \text{ ft}}$ 22. $\frac{8 \text{ cm}}{x \text{ km}} = \frac{1 \text{ cm}}{100 \text{ km}}$ 23. $\frac{1 \text{ cm}}{3 \text{ m}} = \frac{x \text{ cm}}{62 \text{ m}}$ 24. $\frac{1 \text{ in.}}{50 \text{ mi}} = \frac{2 \text{ in.}}{x \text{ mi}}$