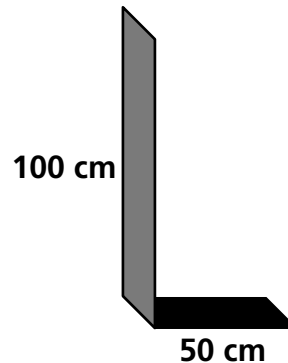


7E Indirect Measurement

M6G1.c, M6A2.c,
M6A2.g

The heights of very tall structures can be measured indirectly using similar figures and proportions. This method is called *indirect measurement*.

Augustine and Carmen want to measure the height of the school's flagpole. To do this, they go outside and hold a meterstick upright. The meterstick casts a shadow that measures 50 cm.



1. If the shadow of the flagpole measures 6 meters, how tall is the flagpole? To answer this question, follow these steps:
 - a. Draw a sketch of the flagpole and its shadow next to the sketch of the meterstick and its shadow.
 - b. Label the height of the flagpole x .
 - c. Write the proportion $\frac{\text{height of flagpole}}{\text{shadow of flagpole}} = \frac{\text{height of meterstick}}{\text{shadow of meterstick}}$, and substitute the values for the given measurements.
 - d. Solve the proportion for x .

Think and Discuss

2. **Explain** how you solved the proportion for x in number 1d.
3. **Explain** whether you could have solved the problem by writing the proportion as $\frac{\text{shadow of flagpole}}{\text{height of flagpole}} = \frac{\text{shadow of meterstick}}{\text{height of meterstick}}$.

LESSON

7E

Technology Lab**Indirect Measurement**

Use your computer tools to draw a diagram that helps you model indirect measurement.

Activity

It's spirit week at school and your team wants to decorate the light poles in the front of the building with strings of pennants in your school's colors. The pennants are strung together and sold by the foot. To know how many feet of pennants to buy, you need to know the height of the light poles.

1. The student who will be used for a comparison is 5 feet and 11 inches tall. The shadow cast by the student is 15 feet long. The shadow cast by the light pole is 88 feet long. You will use drawing tools to create and label a model of the student and a light pole.
2. To make the drawing tools easily accessible, click on the View menu and select the Toolbars option. From there, be certain Drawing is selected.
3. Draw the vertical line for the light pole. To draw a straight line, choose the Line command, click in your document and drag the line across the screen. Then, draw the horizontal line for the shadow. This line should start at the bottom of your first line. Then make lines for the student and the student's shadow.
4. Be sure to make your lines the right lengths. For example, the line for the student's shadow should be longer than the line for the pole. Also, the line for the student should be shorter than the line for the pole.
5. To make this drawing a useful problem-solving tool for math, the illustration should be labeled. Choose Text Box from the Insert menu. Type the label information into the box. Click and drag on the box handles to resize and reposition the words within the illustration.

LESSON

7E

Technology Lab**Indirect Measurement, continued**

6. Find the ratio of height to shadow to determine the height of the light.

The ratios you constructed should look like this. Remember to change all units to inches.

$$\frac{5 \text{ feet } 11 \text{ inches}}{15 \text{ feet}} = \frac{h \text{ feet}}{88 \text{ feet}} \qquad \frac{71 \text{ inches}}{180 \text{ inches}} = \frac{h \text{ inches}}{1056 \text{ inches}}$$

Think and Discuss

1. There are six light poles in the front of school. Will you be able to buy enough flags for each of the poles if they cost \$0.80 per foot and you have \$155.00 to spend on the project?
-
-

Try This

1. Complete the following ratios to compute the height of the missing side of these right triangles.

$$\frac{5}{20} = \frac{h}{120}$$

$$\frac{h}{9} = \frac{7}{21}$$

2. On a separate piece of paper, draw an illustration and show the ratio for a redwood tree that is 200 feet in height that casts a shadow 500 feet long.

LESSON

7E

Review for Mastery

Indirect Measurement

If you cannot measure a length directly, you can use indirect measurement. Indirect measurement uses similar figures and proportions to find lengths.

The small tree is 8 feet high and it casts a 12-foot shadow. The large tree casts a 36-foot shadow.

The triangles formed by the trees and the shadows are similar. So, their heights are proportional.

To find the height of the large tree, first set up a proportion. Use a variable to stand for the height of the large tree.

$$\frac{8}{12} = \frac{x}{36}$$

Write a proportion using corresponding sides.

$$8 \cdot 36 = 12 \cdot x$$

The cross products are equal.

$$12x = 288$$

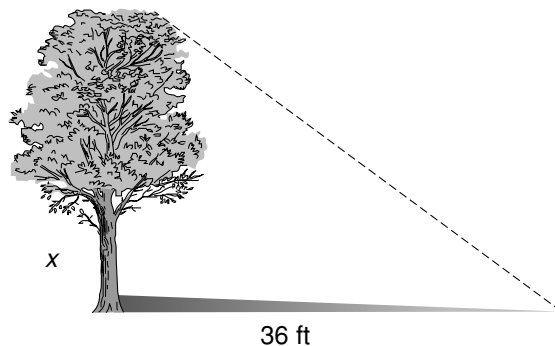
x is multiplied by 12.

$$\frac{12x}{12} = \frac{288}{12}$$

Divide both sides by 12.

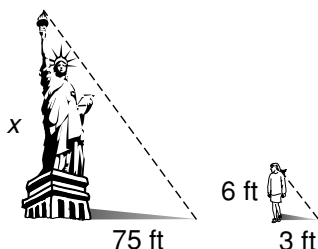
$$x = 24$$

So, the height of the tall tree is 24 feet.

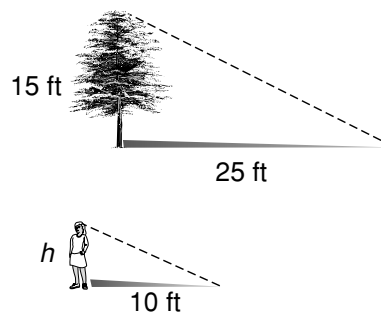


Use indirect measurement to find the missing heights.

1.



2.



LESSON

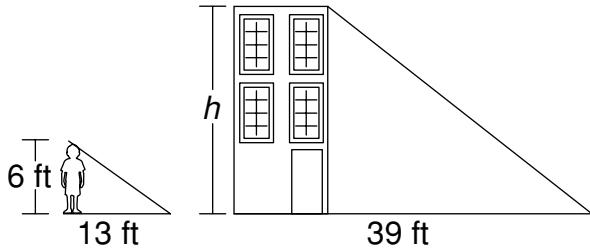
7E

Homework and Practice

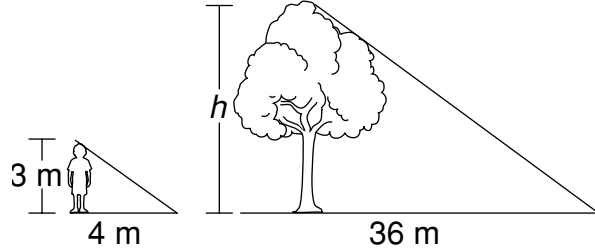
Indirect Measurement

Write the correct answer.

1. Use similar triangles to find the height of the building.



2. Use similar triangles to find the height of the tree.



3. A lamppost casts a shadow that is 15 yards long. A 3-foot-tall mailbox casts a shadow that is 5 yards long. How tall is the lamppost?

4. An 8-foot-tall statue stands in the park and casts a shadow that is 16 feet long. A dog stands next to it and is 3 feet tall. How long is the dog's shadow?

5. A building casts a shadow that is 420 meters long. At the same time, a person who is 2 meters tall casts a shadow that is 24 meters long. How tall is the building?

6. On a sunny day around noon, a tree casts a shadow that is 12 feet long. At the same time, a person who is 6 feet tall standing beside the tree casts a shadow that is 2 feet long. How tall is the tree?

7. A pole casts a shadow that is 21 feet long. A 3-foot-tall child standing next to the pole casts a shadow that is 9 feet long. How tall is the pole?

8. Jeremy has two trophies next to each other sitting in the window of his room. His football trophy is 7 inches tall and his basketball trophy is 13 inches tall. As the light shines in, the basketball trophy's shadow measures 26 inches. How long is the football trophy's shadow?