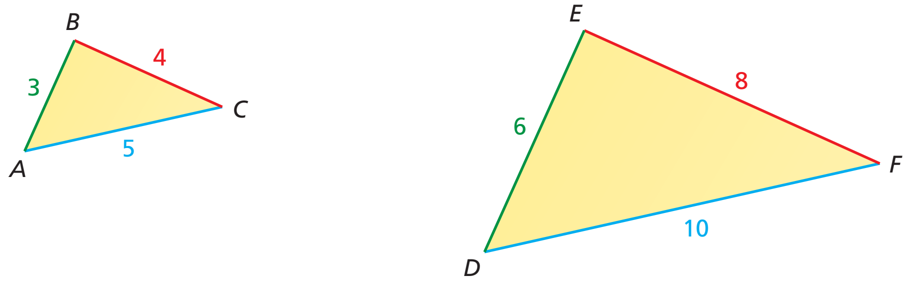
5.4 Using Similar Triangles

Essential Question Which properties of triangles make them special among all other types of polygons?

You already know that two triangles are **similar** if and only if the ratios of their corresponding side lengths are equal.



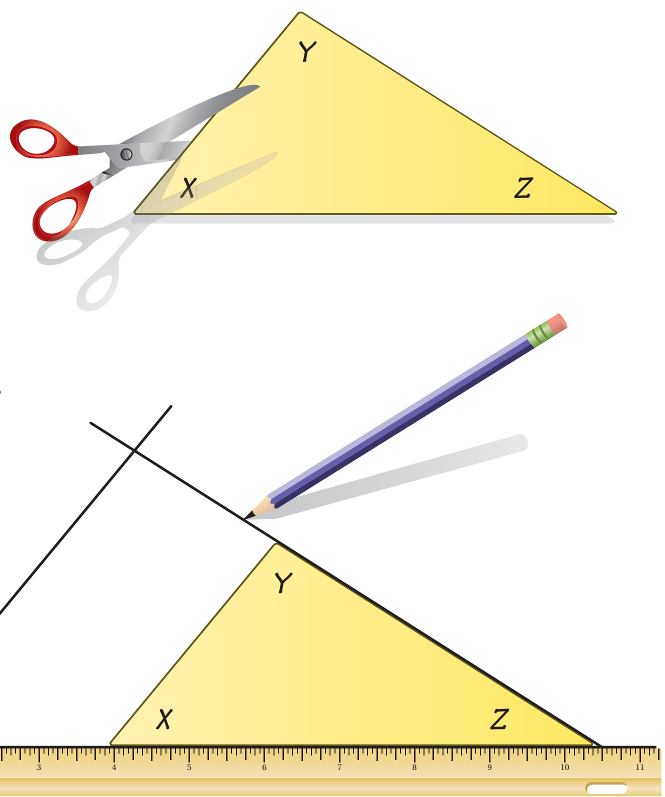
For example, $\triangle ABC$ is similar to $\triangle DEF$ because the ratios of their corresponding side lengths are equal.

$$\frac{6}{3} = \frac{10}{5} = \frac{8}{4}$$

1 ACTIVITY: Angles of Similar Triangles

Work with a partner.

- **Discuss how to make a triangle that is larger than $\triangle XYZ$ and has the *same* angle measures as $\triangle XYZ$.**
- **Measure the lengths of the sides of the two triangles.**
- **Find the ratios of the corresponding side lengths. Are they all the same? What can you conclude?**



2 ACTIVITY: Amazing Triangles

Work with a partner. Use what you know about polygons to decide whether each statement is true. In each case, explain your reasoning.

a. If two triangles are similar, then the ratios of their corresponding side lengths are equal.

If two quadrilaterals are similar, then the ratios of their corresponding side lengths are equal.

b. If the ratios of the corresponding sides of two triangles are equal, then the triangles are similar.

If the ratios of the corresponding sides of two quadrilaterals are equal, then the quadrilaterals are similar.

c. If two triangles are similar, then their corresponding angles are congruent.

If two quadrilaterals are similar, then their corresponding angles are congruent.

d. If the corresponding angles in two triangles are congruent, then the triangles are similar.

If the corresponding angles in two quadrilaterals are congruent, then the quadrilaterals are similar.

e. If the corresponding sides of two triangles are congruent, then the two triangles have identical shapes.

If the corresponding sides of two quadrilaterals are congruent, then the two quadrilaterals have identical shapes.

What Is Your Answer?

3. **IN YOUR OWN WORDS** Which properties of triangles make them special among all other types of polygons? Describe two careers in which the special properties of triangles are used.

Practice Use what you learned about similar triangles to complete Exercises 3 and 4 on page 210.

English Spanish

5.4 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
similar triangles, *p. 208*
indirect measurement, *p. 209*

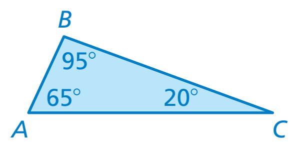
Triangles that have the same shape but not necessarily the same size are **similar triangles**.

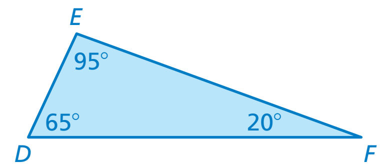
Key Idea

Angles of Similar Triangles

Words Two triangles have the same angle measures if and only if they are similar.

Example





Triangle ABC is similar to triangle DEF: $\triangle ABC \sim \triangle DEF$.

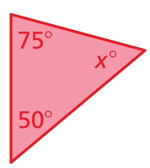
Study Tip

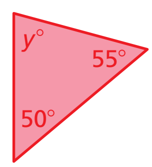
If two angles in one triangle are congruent to two angles in another triangle, then the third angles are also congruent.

EXAMPLE 1 Identifying Similar Triangles

Tell whether the triangles are similar. Explain.

a.



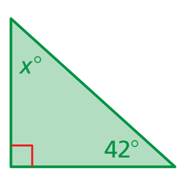


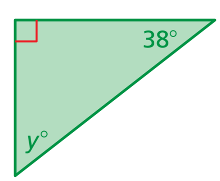
$$75 + 50 + x = 180$$
$$125 + x = 180$$
$$x = 55$$

$$y + 50 + 55 = 180$$
$$y + 105 = 180$$
$$y = 75$$

The triangles have the same angle measures, 75°, 50°, and 55°. So, they are similar.

b.





$$x + 90 + 42 = 180$$
$$x + 132 = 180$$
$$x = 48$$

$$90 + 38 + y = 180$$
$$128 + y = 180$$
$$y = 52$$

The triangles do not have the same angle measures. So, they are not similar.

Multi-Language Glossary at BigIdeasMath.com.

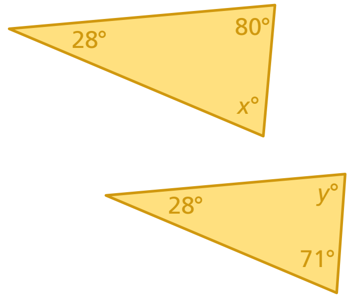
English Spanish

On Your Own

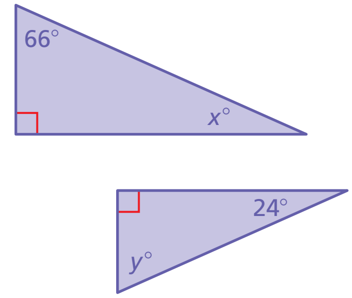
Now You're Ready
Exercises 5–8

Tell whether the triangles are similar. Explain.

1.

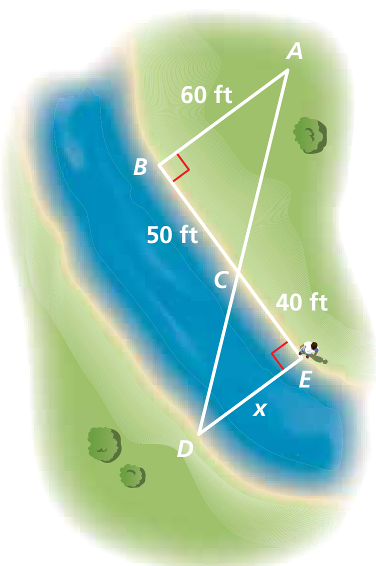


2.



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

EXAMPLE 2 Using Indirect Measurement



You plan to cross a river and want to know how far it is to the other side. You take measurements on your side of the river and make the drawing shown. (a) Explain why $\triangle ABC$ and $\triangle DEC$ are similar. (b) What is the distance x across the river?

a. $\angle B$ and $\angle E$ are right angles, so they are congruent. $\angle ACB$ and $\angle DCE$ are vertical angles, so they are congruent.

Because two angles in $\triangle ABC$ are congruent to two angles in $\triangle DEC$, the third angles are also congruent. The triangles have the same angle measures, so they are similar.

b. The ratios of the corresponding side lengths in similar triangles are equal. Write and solve a proportion to find x.

$$\frac{x}{60} = \frac{40}{50} \qquad \text{Write a proportion.}$$

$$60 \cdot \frac{x}{60} = 60 \cdot \frac{40}{50} \qquad \text{Multiply each side by 60.}$$

$$x = 48 \qquad \text{Simplify.}$$

The distance across the river is 48 feet.

On Your Own

Now You're Ready
Exercises 10 and 11

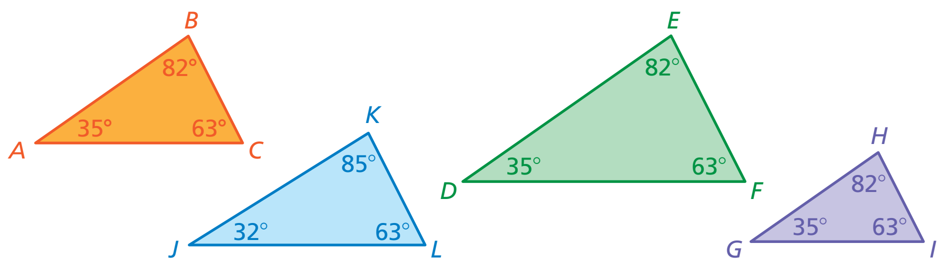
3. **WHAT IF?** In Example 2, the distance from vertex A to vertex B is 55 feet. What is the distance across the river?

5.4 Exercises

Vocabulary and Concept Check

1. **REASONING** How can you use similar triangles to find a missing measurement?

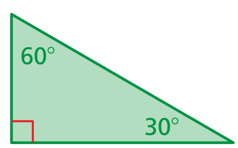
2. **WHICH ONE DOESN'T BELONG?** Which triangle does *not* belong with the other three? Explain your reasoning.



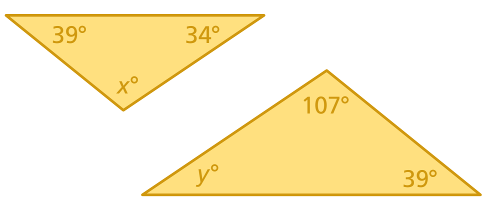
Practice and Problem Solving

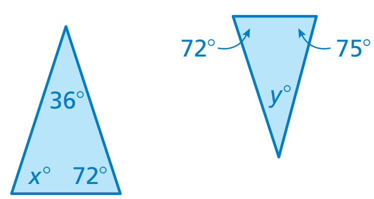
Make a triangle that is larger than the one given and has the same angle measures. Find the ratios of the corresponding side lengths.

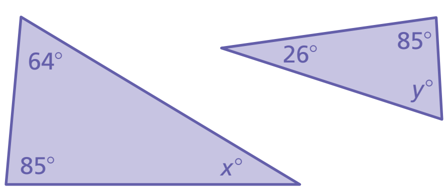
3. 

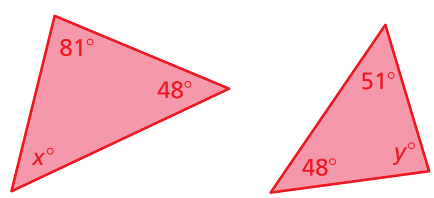
4. 

Tell whether the triangles are similar. Explain.

1 5. 

6. 

7. 

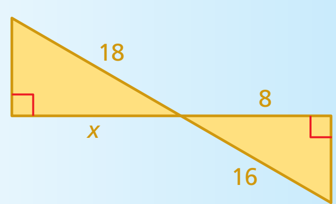
8. 

9. **ERROR ANALYSIS** Describe and correct the error in using indirect measurement.

$$\frac{16}{18} = \frac{x}{8}$$

$$18x = 128$$

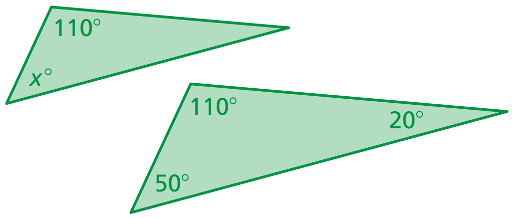
$$x \approx 7$$



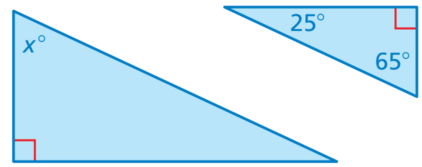
English Spanish

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

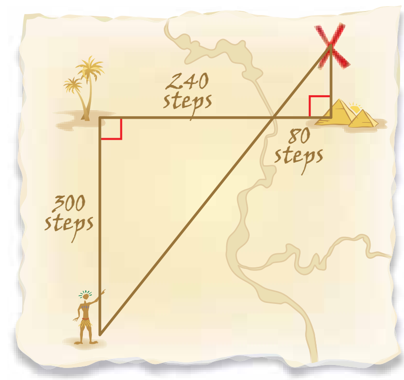
10.



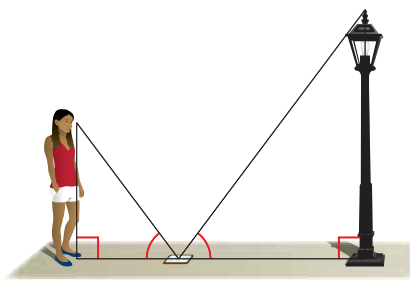
11.



12. **TREASURE** The map shows the number of steps you must take to get to the treasure. However, the map is old and the last dimension is unreadable. How many steps do you take from the pyramids to the treasure?



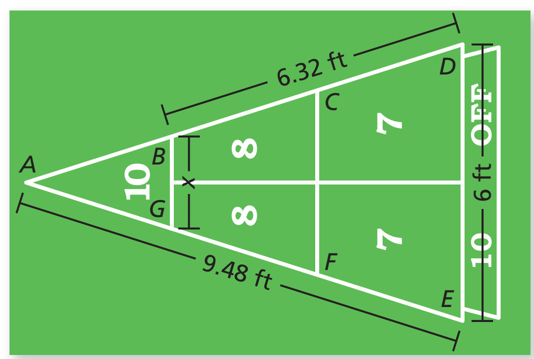
13. **CRITICAL THINKING** The side lengths of a triangle are increased by 50% to make a similar triangle. Does the area increase by 50% as well? Explain.



14. **PROJECT** Using a mirror, a tape measure, and indirect measurement, you can find the height of a lamppost. Place the mirror flat on the ground 6 feet from the lamppost. Move away from the mirror and the lamppost until you can see the top of the lamppost in the mirror. Measure the distance between yourself and the mirror. Then use similar triangles to find the height of the lamppost.

15. **Geometry** The drawing shows the scoring zone of a standard shuffleboard court. $\triangle DAE \sim \triangle BAG \sim \triangle CAF$. The lengths of segments *AG*, *GF*, and *FE* are equal.

a. Find *x*. **b.** Find *CF*.



Fair Game Review What you learned in previous grades & lessons

Does the equation represent a *linear* or *nonlinear* function? Explain. SECTION 4.4

16. $y = \dfrac{5}{x}$ **17.** $y = -5.4x + \pi$ **18.** $y = 2x - 8$ **19.** $y = 6x^2 + x - 1$

20. **MULTIPLE CHOICE** Which two lines are parallel? SECTION 2.2

Ⓐ blue and red Ⓑ red and green

Ⓒ green and blue Ⓓ all three are parallel