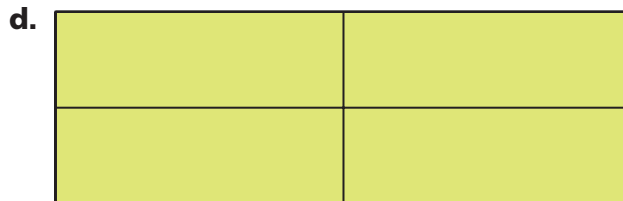
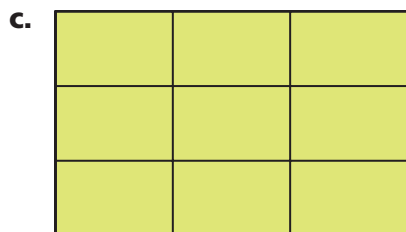
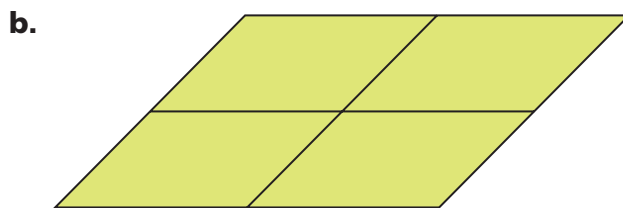
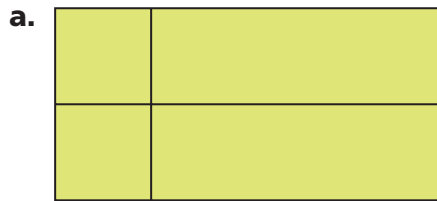


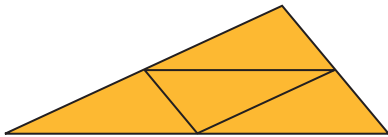
## Applications

1. Look for rep-tile patterns in the designs below. For each design, tell whether the small quadrilaterals are similar to the large quadrilateral. Explain. If the quadrilaterals are similar, give the scale factor from each small quadrilateral to the large quadrilateral.

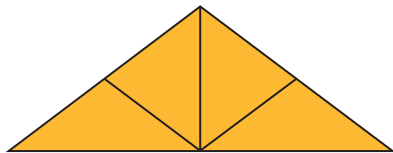


- 2.** Suppose you put together nine copies of a rectangle to make a larger, similar rectangle.
- What is the scale factor from the smaller rectangle to the larger rectangle?
  - How is the area of the larger rectangle related to the area of the smaller rectangle?
- 3.** Suppose you divide a rectangle into 25 smaller rectangles. Each rectangle is similar to the original rectangle.
- What is the scale factor from the original rectangle to each of the smaller rectangles?
  - How is the area of each of the smaller rectangles related to the area of the original rectangle?
- 4.** Look for rep-tile patterns in the designs below. For each design, tell whether the small triangles seem to be similar to the large triangle. Explain. When the triangles are similar, give the scale factor from each small triangle to the large triangle.

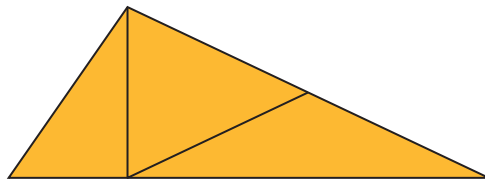
**a.**



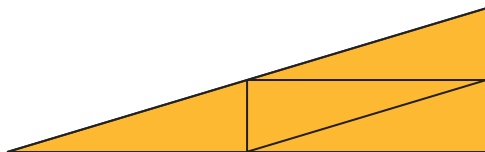
**b.**



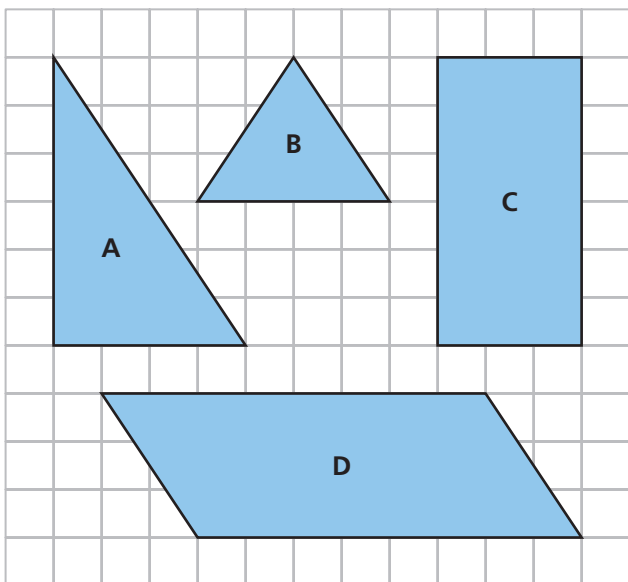
**c.**



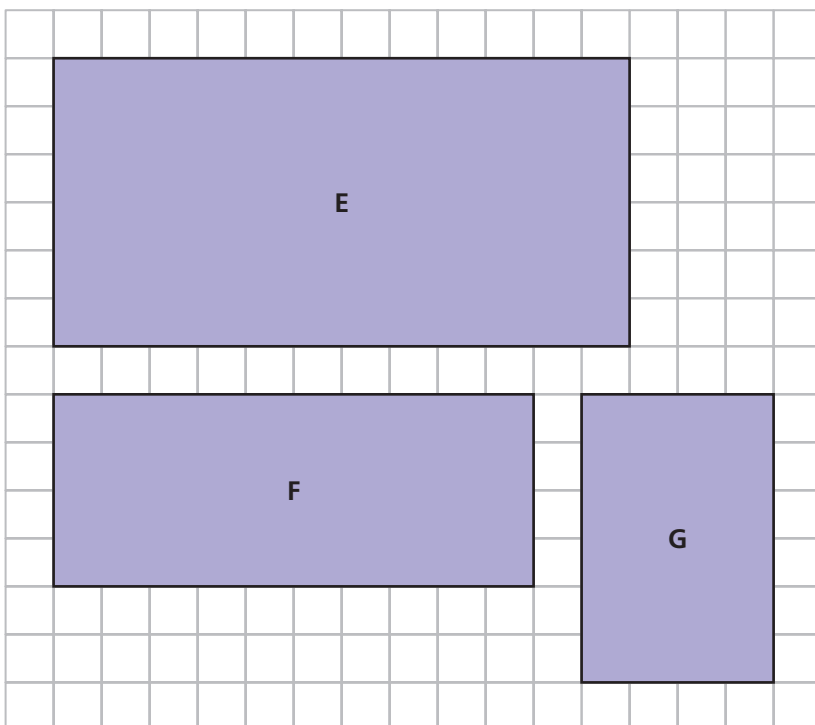
**d.**



5. Copy polygons A–D onto grid paper. Draw line segments that divide each of the polygons into four congruent polygons that are similar to the original polygon.

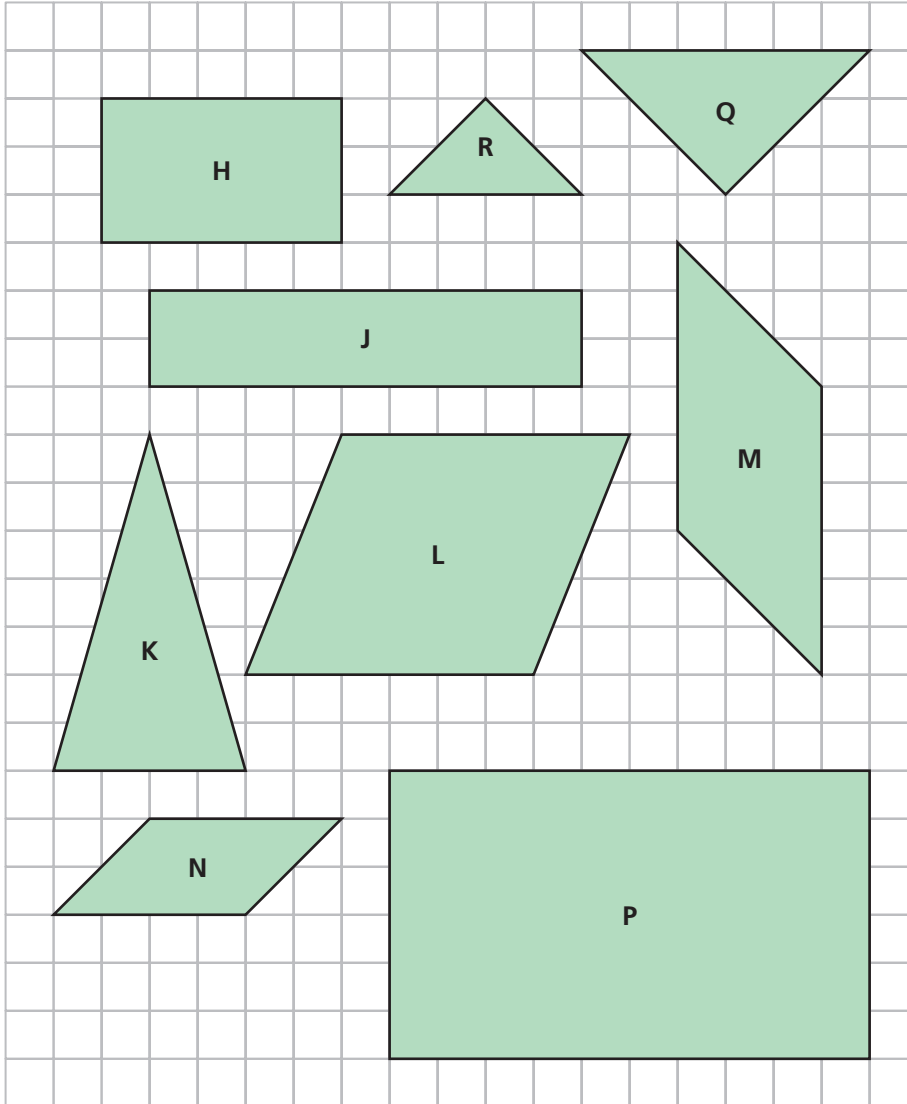


6. a. For rectangles E–G, give the length and width of a different similar rectangle. Explain how you know the new rectangles are similar.



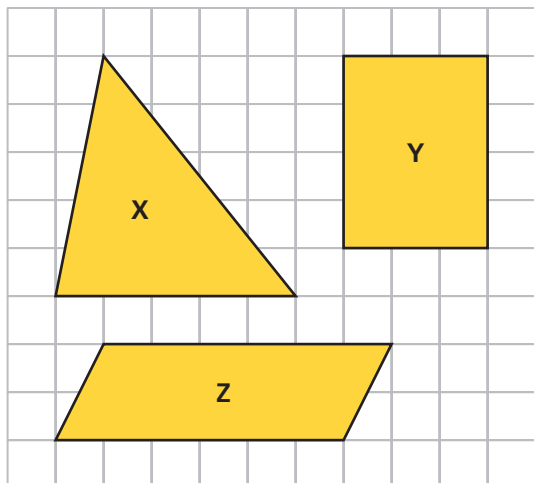
- b.** Give the scale factor from each original rectangle in part (a) to the similar rectangles you described. Explain what the scale factor tells you about the corresponding lengths, perimeters, and areas.

- 7.** Use the polygons below.



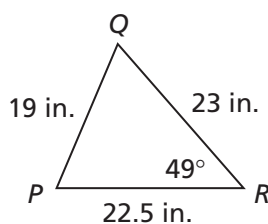
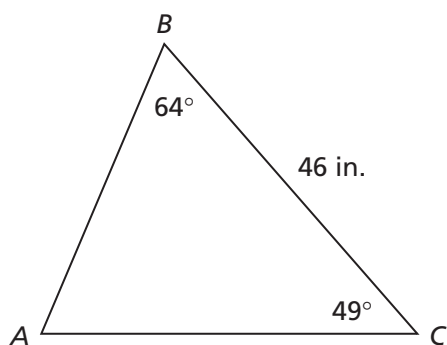
- a.** List the pairs of similar shapes.  
**b.** For each pair of similar shapes, find the scale factor from the smaller shape to the larger shape.

8. For parts (a)–(c), use grid paper.



- Sketch a triangle similar to triangle X with an area that is  $\frac{1}{4}$  the area of triangle X.
- Sketch a rectangle similar to rectangle Y with a perimeter that is 0.5 times the perimeter of rectangle Y.
- Sketch a parallelogram similar to parallelogram Z with side lengths that are 1.5 times the side lengths of parallelogram Z.

Triangle  $ABC$  is similar to triangle  $PQR$ . For Exercises 9–14, use the given side and angle measurements to find the indicated angle measure or side length.



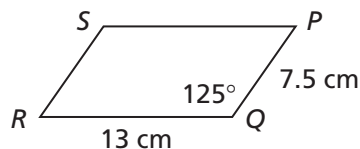
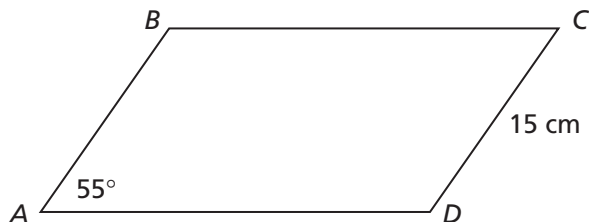
- angle  $A$
- angle  $P$
- length of side  $AC$
- angle  $Q$
- length of side  $AB$
- perimeter of triangle  $ABC$

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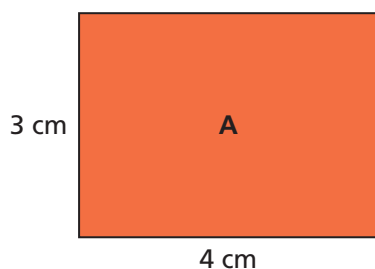
For: Multiple-Choice  
Skills Practice

Web Code: ana-2354

**Multiple Choice** For Exercises 15–18, use the similar parallelograms below.



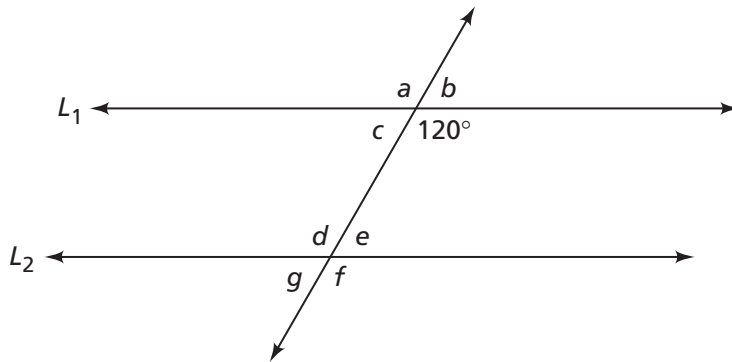
15. What is the measure of angle  $D$ ?  
**A.**  $55^\circ$       **B.**  $97.5^\circ$       **C.**  $125^\circ$       **D.**  $135^\circ$
16. What is the measure of angle  $R$ ?  
**F.**  $55^\circ$       **G.**  $97.5^\circ$       **H.**  $125^\circ$       **J.**  $135^\circ$
17. What is the measure of angle  $S$ ?  
**A.**  $55^\circ$       **B.**  $97.5^\circ$       **C.**  $125^\circ$       **D.**  $135^\circ$
18. What is the length of side  $AB$  in centimeters?  
**F.** 3.75      **G.** 13      **H.** 15      **J.** 26
19. Suppose a rectangle B is similar to rectangle A below. If the scale factor from rectangle A to rectangle B is 4, what is the area of rectangle B?



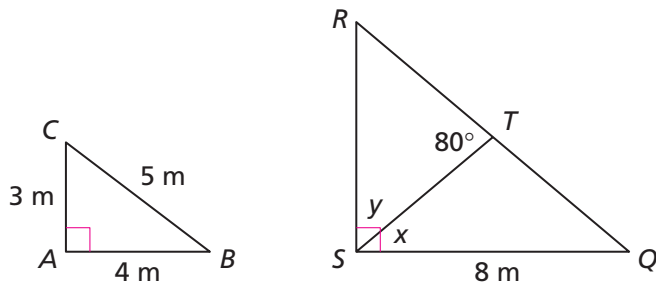
20. Suppose rectangle E has an area of 9 square centimeters and rectangle F has an area of 900 square centimeters. The two rectangles are similar. What is the scale factor from rectangle E to rectangle F?
21. Suppose rectangles X and Y are similar. The dimensions of rectangle X are 5 centimeters by 7 centimeters. The area of rectangle Y is 140 square centimeters. What are the dimensions of rectangle Y?

# Connections

22. In the figure below, lines  $L_1$  and  $L_2$  are parallel.
- a. Use what you know about parallel lines to find the measures of angles  $a$  through  $g$ .



- b. When the sum of the measures of two angles is  $180^\circ$ , the angles are **supplementary angles**. For example, angles  $a$  and  $b$  above are supplementary angles because they fit together to form a straight line ( $180^\circ$ ). List all pairs of supplementary angles in the diagram.
23. Suppose you have two supplementary angles (explained above). The measure of one angle is given. Find the measure of the other angle.
- a.  $160^\circ$                       b.  $90^\circ$                       c.  $x^\circ$
24. The two right triangles are similar.



- a. Find the length of side  $RS$ .
- b. Find the length of side  $RQ$ .
- c. Suppose the measure of angle  $x$  is  $40^\circ$ . Find the measure of angle  $y$ .

- d. Find the measure of angle  $R$ . Explain how you can find the measure of angle  $C$ .

Angle  $x$  and angle  $y$  are called **complementary angles**.

Complementary angles are a pair of angles whose measures add to  $90^\circ$ .

- e. Find two more pairs of complementary angles in triangles  $ABC$  and  $QRS$  besides angles  $x$  and  $y$ .

25. For parts (a)–(f), find the number that makes the fractions equivalent.

a.  $\frac{1}{2} = \frac{3}{\square}$

b.  $\frac{5}{6} = \frac{\square}{24}$

c.  $\frac{3}{4} = \frac{6}{\square}$

d.  $\frac{8}{12} = \frac{2}{\square}$

e.  $\frac{3}{5} = \frac{\square}{100}$

f.  $\frac{6}{4} = \frac{\square}{10}$

26. For parts (a)–(f), suppose you copy a figure on a copier using the given size factor. Find the scale factor from the original figure to the copy in decimal form.

a. 200%

b. 50%

c. 150%

d. 125%

e. 75%

f. 25%

27. Write each fraction as a decimal and as a percent.

a.  $\frac{2}{5}$

b.  $\frac{3}{4}$

c.  $\frac{3}{10}$

d.  $\frac{1}{4}$

e.  $\frac{7}{10}$

f.  $\frac{7}{20}$

g.  $\frac{4}{5}$

h.  $\frac{7}{8}$

i.  $\frac{3}{5}$

j.  $\frac{15}{20}$





28. For parts (a)–(d), tell whether the figures are mathematically similar. Explain. If the figures are similar, give the scale factor from the left figure to the right figure.

a.



b.



c.

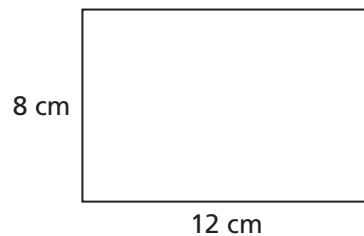


d.



**For Exercises 29–31, decide if the statement is true or false. Justify your answer.**

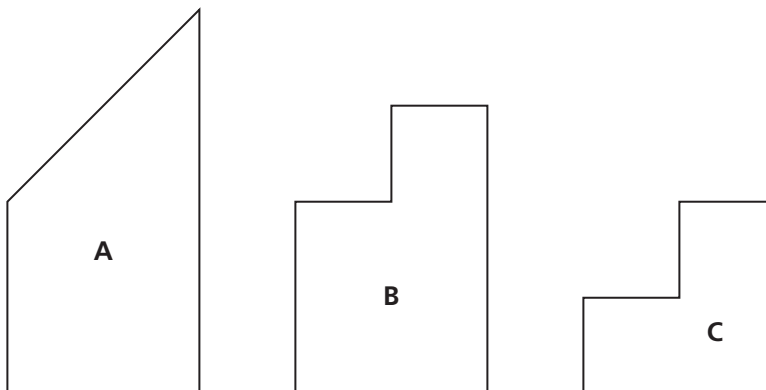
- 29.** All squares are similar.
- 30.** All rectangles are similar.
- 31.** If the scale factor between two similar shapes is 1, then the two shapes are the same size. (Note: If two similar figures have a scale factor of 1, they are *congruent*.)
- 32. a.** Suppose the following rectangle is reduced by a scale factor of 50%. What are the dimensions of the reduced rectangle?



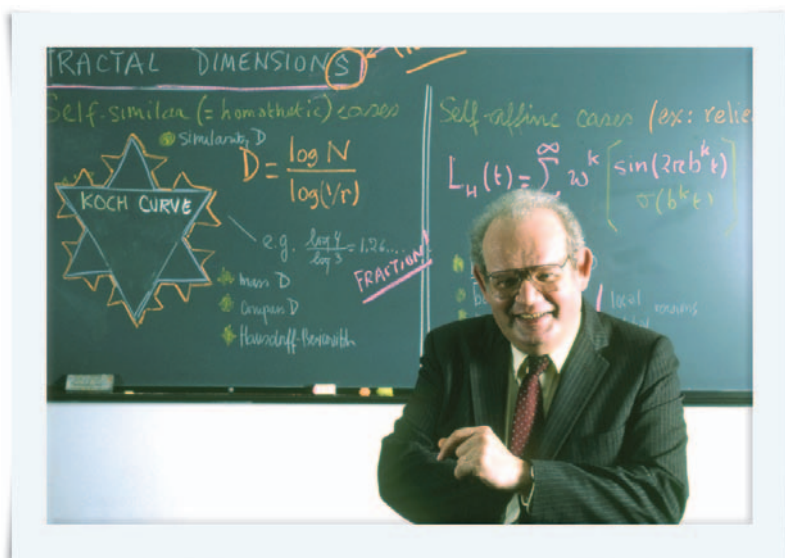
- b.** Suppose the reduced rectangle in part (a) is reduced again by a scale factor of 50%. Now, what are the dimensions of the rectangle?
- c.** How does the reduced rectangle from part (b) compare to the original rectangle from part (a)?

## Extensions

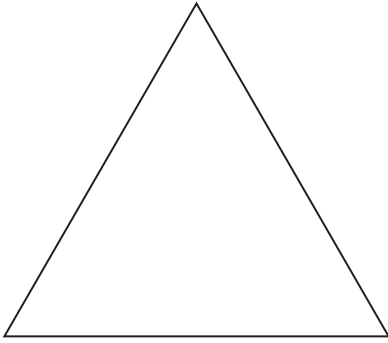
- 33.** Trace each shape. Divide each shape into four smaller pieces that are similar to the original shape.



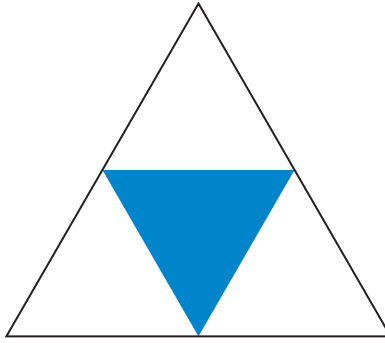
- 34.** The **midpoint** is a point that divides a line segment into two segments of equal length. Draw a figure on grid paper by following these steps:
- Step 1** Draw a square.
- Step 2** Mark the midpoint of each side.
- Step 3** Connect the midpoints in order with four line segments to form a new figure. (The line segments should not intersect inside the square.)
- Step 4** Repeat Steps 2 and 3 three more times. Work with the newest figure each time.
- What kind of figure is formed when the midpoints of the sides of a square are connected?
  - Find the area of the original square.
  - Find the area of the new figure that is formed at each step.
  - How do the areas change between successive figures?
  - Are there any similar figures in your final drawing? Explain.
- 35.** Repeat Exercise 34 using an equilateral triangle.
- 36.** Suppose rectangle A is similar to rectangle B and to rectangle C. Can you conclude that rectangle B is similar to rectangle C? Explain. Use drawings and examples to illustrate your answer.
- 37.** The mathematician Benoit Mandelbrot called attention to the fact that you can subdivide figures to get smaller figures that are mathematically similar to the original. He called these figures *fractals*. A famous example is the Sierpinski triangle.



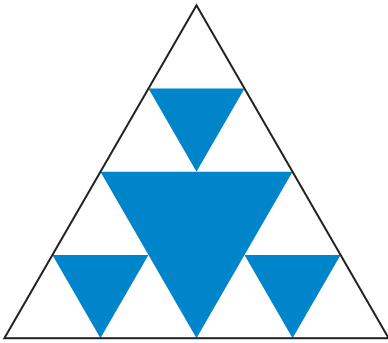
You can follow these steps to make the Sierpinski triangle.



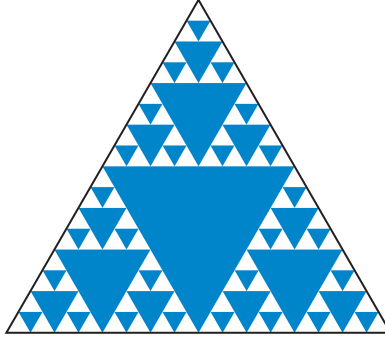
**Step 1** Draw a large triangle.



**Step 2** Mark the midpoint of each side. Connect the midpoints to form four identical triangles that are similar to the original. Shade the center triangle.



**Step 3** For each unshaded triangle, mark the midpoints. Connect them in order to form four identical triangles. Shade the center triangle in each case.



**Step 4** Repeat Steps 2 and 3 over and over. To make a real Sierpinski triangle, you need to repeat the process an infinite number of times! This triangle shows five subdivisions.

- a. Follow the steps for making the Sierpinski triangle until you subdivide the original triangle three times.
- b. Describe any patterns you observe in your figure.
- c. Mandelbrot used the term *self-similar* to describe fractals like the Sierpinski triangle. What do you think this term means?

**For Exercises 38–42, read the paragraph below and answer the questions that follow.**

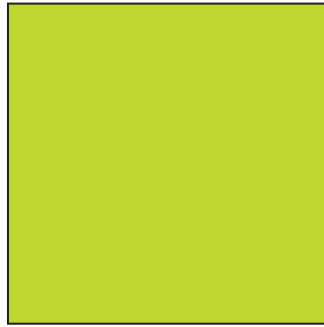
When you find the area of a square, you multiply the length of the side by itself. For a square with a side length of 3 units, you multiply  $3 \times 3$  (or  $3^2$ ) to get 9 square units. For this reason, you call 9 the *square* of 3.

Three is called the *square root* of 9. The symbol, “ $\sqrt{\quad}$ ” is used for the square root. This gives the fact family below.

$$3^2 = 9$$

$$\sqrt{9} = 3$$

- 38.** The square has an area of 10 square units. Write the side length of this square using the square root symbol.



- 39. Multiple Choice** What is the square root of 144?  
**A.** 7                    **B.** 12                    **C.** 72                    **D.** 20,736
- 40.** What is the length of the side of a square with an area of 144 square units?
- 41.** You have learned that if a figure grows by a scale factor of  $s$ , the area of the figure grows by a factor of  $s^2$ . If the area of a figure grows by a factor of  $f$ , what is the scale factor?
- 42.** Find three examples of squares and square roots in the work you have done so far in this unit.