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3.10

5. Draw a right triangle with legs 5 cm and 12 cm. Draw a square with one side that is the hypotenuse of this triangle.

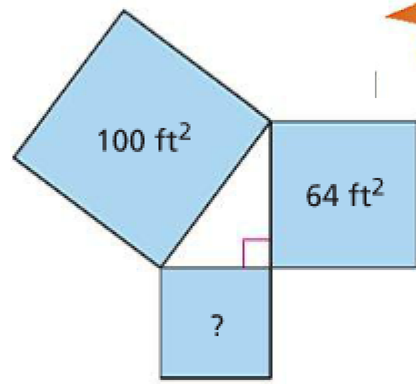
a. Use the Pythagorean Theorem to find the area of this square.

b. What is the perimeter of this square?

6. The diagram shows squares on the sides of a right triangle. It gives the areas of two of the squares.

a. Find the area of the third square.

b. Find the lengths of the three sides of the triangle.



How long is one side?

7. Construct a right triangle with a 17-cm hypotenuse and a leg of length 8 cm. Draw a square on the other leg of the triangle.

a. What is the area of the square you have drawn?

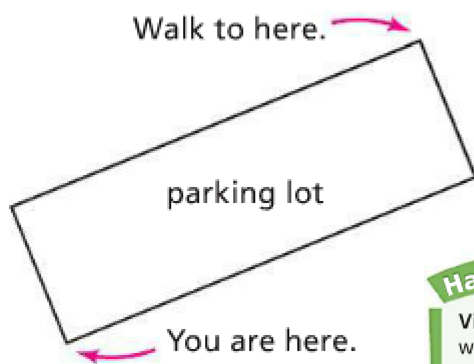
b. What is the length of the other leg of the triangle?

8. You are standing at one corner of a rectangular parking lot. The lot measures 100 feet by 300 feet.

a. You walk along the sides of the parking lot to the opposite corner. How far do you walk?

b. You walk diagonally across the parking lot back to your starting point. How far do you walk? How much shorter or longer is this path?

c. There might be cars in the parking lot. This could block you from walking directly on the diagonal. How might a path along the sides of the whole parking lot differ in length from a zig-zag path through the lot? Explain.



Habits of Mind

Visualize. Think of what the triangle must look like. In your "picture," think of what you are given. Then plan how to use what you know to do the construction.

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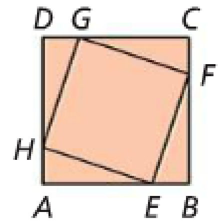
9. You have seen square ABCD before. Suppose $AE = BF = CG = DH = 3$, and $EB = FC = GD = HA = 1$. Find each of the following.



a. EF **b.** perimeter of $ABCD$ **c.** area of $ABCD$

10. Standardized Test Prep Three squares are arranged so that they meet at their vertices to determine a right triangle. Which are possible areas of the three squares?

A. (3, 4, 5) **B.** (5, 12, 13) **C.** (25, 16, 51) **D.** (9, 16, 25)

3.11

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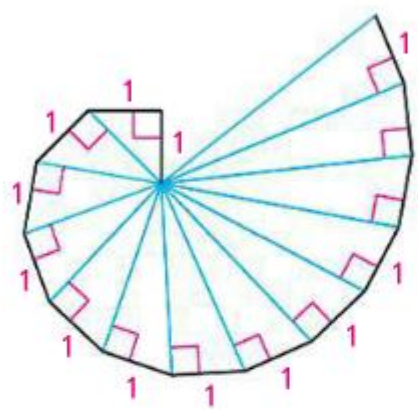
2. Find the height of an equilateral triangle with sides of the given length.

a. 1 cm **b.** 2 cm **c.** 3 cm **d.** 10 cm **e.** 100 in.

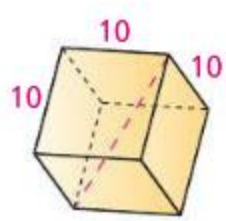
3. Find a pattern in the heights you found in Exercise 2. Write a rule that relates the height of an equilateral triangle to the length of its sides.

4. An equilateral triangle has side length s. Find a formula for its area in terms of s.

5. Find the length of each segment shown in blue. Describe a pattern in the lengths.



6. The diagram below shows a cube and one of its diagonals. The edges of the cube are 10 inches long. How long is the diagonal?



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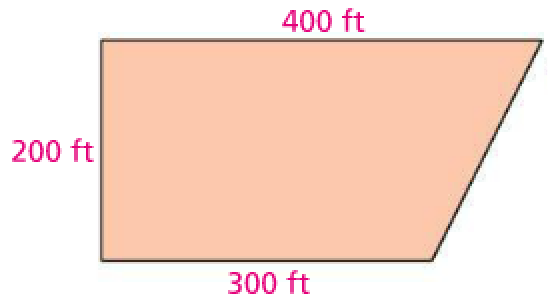
7. An airplane leaves Los Angeles. It flies 100 miles north. It turns due east and flies 600 miles. Then it turns north again and flies 350 miles. About how far is the airplane from its starting point?

Why does the Pythagorean Theorem not give the precise distance here?

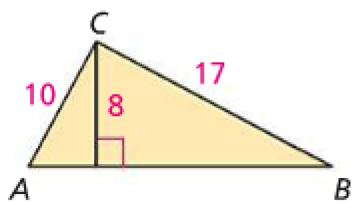
8. What is the area of the plot of land shown in the diagram? (State any assumptions you make.)



Habits of Mind

Be critical. Do you think the measure of $\angle ACB$ is less than 90°, equal to 90°, or greater than 90°?

9. Find the area of $\triangle ABC$.



A Pythagorean triple is a set of three positive integers (a, b, c), such as (3, 4, 5), that satisfy the equation $a^2 + b^2 = c^2$. If you have a Pythagorean triple (a, b, c), you can build a right triangle with side lengths a, b, and c.

However, not all right triangles have integer side lengths.

10. Look back through your work in this section. Find two other Pythagorean triples.

11. The following triples are members of a family of Pythagorean triples. (There are other Pythagorean triples that do not belong to this family.) Check that each triple listed below is a Pythagorean triple. How are these triples enough alike to justify calling them a family?

- (3, 4, 5)
- (6, 8, 10)
- (30, 40, 50)
- (45, 60, 75)
- (300, 400, 500)

12. Draw triangles with the following side lengths. What do the triangles have in common?

a. 6 cm, 8 cm, 10 cm **b.** 3 in., 4 in., 5 in. **c.** 15 cm, 20 cm, 25 cm

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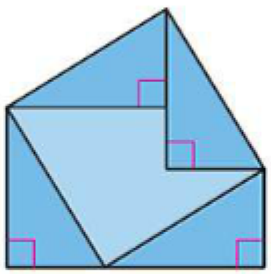
13. Standardized Test Prep Which of the following triples is NOT a Pythagorean triple?

A. (21, 28, 35) **B.** (42, 56, 98) **C.** (9, 40, 41) **D.** (39, 52, 65)

14. Take It Further Explain the following pictorial proof of the Pythagorean Theorem. It was probably devised by George Biddel Airy (1801–1892), an astronomer. It is more difficult than the ones already shown in this investigation, but the poem to the right of the diagram may help you explain the proof.



Here I am as you may see,
$a^2 + b^2 - ab$.
When two triangles on me stand,
Square of hypotenuse is planned.
But if I stand on them instead,
The squares of both the sides are read.

15. Take It Further The Pythagorean Theorem makes a statement about the areas of squares built on the sides of a right triangle. What can you say if the shapes built are not squares? What would you find if the shapes you constructed on the sides of a right triangle were semicircles? Equilateral triangles? Rectangles? Construct various shapes on the sides of a right triangle. Explore the cases for which it is possible to relate the three areas in some way.