

$$\begin{aligned}(x+7)^2 + x^2 &= 13^2 \\ x^2 + 14x + 49 + x^2 &= 169 \\ 2x^2 + 14x + 49 - 169 &= 0 \\ 2x^2 + 14x - 120 &= 0 \\ 2(x^2 + 7x - 60) &= 0 \\ 2(x-5)(x+12) &= 0 \\ x-5 = 0 \text{ or } x+12 = 0 \\ x = 5 \quad \quad \quad x = -12\end{aligned}$$

A negative number does not fit the conditions of the problem.

Thus, $x = 5$ and $x + 7 = 12$.

Check

$$\begin{aligned}5^2 + 12^2 &\stackrel{?}{=} 13^2 \\ 25 + 144 &\stackrel{?}{=} 169 \\ 169 &= 169 \quad \text{True statement}\end{aligned}$$

The width is 5 feet and the length is 12 feet.

Now work margin exercise 8.

Margin Exercise Answers

1. 15, 10 or -15 , -10 2. 21 rows 3. 16 feet by 18 feet 4. 12 feet by 14 feet or 7 feet by 24 feet
5. 33.9 ft 6. 127.3 ft 7. 8 feet 8. 6 ft and 8 ft

5.7 Exercises

Concept Check

Fill-in-the-Blank. Complete the sentences using information found in this section.

- Once an application problem has been read and understood, you should assign a _____ to the _____ quantities.
- After an application problem has been solved, it is important to _____ the solution with the problem to make sure the answer makes sense.
- The formula (or equation) related to the Pythagorean Theorem is _____.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

- The Pythagorean Theorem states that if the two legs of a right triangle are added, the sum will equal the hypotenuse.
- The Pythagorean Theorem can be used with any triangle.

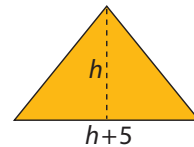
Applications

Write a quadratic equation for each of the following word problems. Then solve the word problem. Remember to check each solution with the wording of the original problem to make sure it is reasonable.

1. One number is eight more than another. Their product is -16 . What are the numbers?
2. One number is 10 more than another. If their product is -25 , find the numbers.
3. The square of an integer is equal to seven times the integer. Find the integer.
4. The square of an integer is equal to twice the integer. Find the integer.
5. If the square of a positive integer is added to three times the integer, the result is 28. Find the integer.
6. If the square of a positive integer is added to three times the integer, the result is 54. Find the integer.
7. One number is three more than another. Their product is 40. Find the numbers.
8. One positive number is three more than twice another. If the product is 27, find the numbers.
9. One positive number is five more than another. The sum of their squares is 53. What are the numbers?
10. One number is five less than another. The sum of their squares is 97. Find the numbers.
11. The difference between two positive integers is 4. If the smaller is added to the square of the larger, the sum is 38. Find the integers.
12. One positive number is 3 more than twice another. If the square of the smaller is added to the larger, the sum is 51. Find the numbers.
13. The product of a negative integer and 5 less than twice the integer equals the integer plus 56. Find the integer.
14. Find a positive integer such that the product of the integer with a number three less than the integer is equal to the integer increased by 32.
15. The length of a rectangle is twice the width. The area is 72 square inches. Find the length and width of the rectangle.
16. The length of a rectangle is three times the width. If the area is 147 square centimeters, find the length and width of the rectangle.
17. The length of a rectangle is four times the width. If the area is 64 square feet, find the length and width of the rectangle.

18. The length of a rectangle is five times the width. If the area is 180 square inches, find the length and width of the rectangle.
19. The width of a rectangle is 4 feet less than the length. The area is 45 square feet. Find the length and width of the rectangle.
20. The length of a rectangular yard is 3 meters greater than the width. If the area of the yard is 54 square meters, find the length and width of the yard.
21. The height of a triangle is 4 feet less than the base. The area of the triangle is 16 square feet. Find the length of the base and the height of the triangle.

22. The base of a triangle exceeds the height by 5 meters. If the area is 12 square meters, find the length of the base and the height of the triangle.

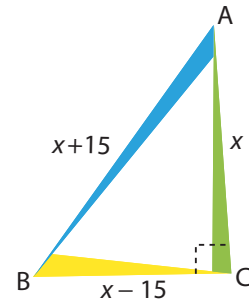


23. The base of a triangle is 6 inches greater than the height. If the area is 20 square inches, find the length of the base.
24. The base of a triangle is 3 feet less than the height. The area is 9 square feet. Find the height.
25. The perimeter of a rectangle is 32 inches. The area of the rectangle is 48 square inches. Find the dimensions of the rectangle.
26. The area of a rectangle is 24 square centimeters. If the perimeter is 20 centimeters, find the length and width of the rectangle.
27. A rectangle has a length 5 m less than twice its width. If the area is 63 m^2 , find the dimensions of the rectangle.
28. The length of a rectangle is 2 cm less than 3 times its width. If the area of the rectangle is 225 cm^2 , find the dimensions of the original rectangle.
29. Each side of a square is increased by 10 cm. The area of the resulting square is 9 times the area of the original square. Find the length of the sides of the original square.
30. If 5 m are added to each side of a square, the area of the resulting square is four times the area of the original square. Find the length of the sides of the original square.
31. The diagonal of a rectangle is 13 m. The length is 2 m more than twice the width. Find the dimensions of the rectangle.
32. The length of a rectangle is 4 m more than its width. If the diagonal is 20 m, what are the dimensions of the rectangle?
33. An orchard has 140 apple trees. The number of rows exceeds the number of trees per row by 13. How many trees are there in each row?

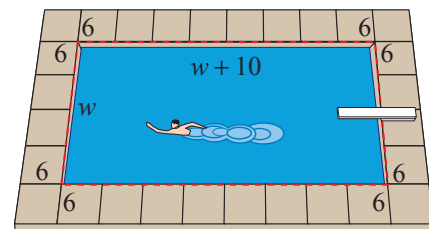
34. One formation for a drill team is rectangular. The number of members in each row exceeds the number of rows by 3. If there is a total of 108 members in the formation, how many rows are there?
35. A theater can seat 144 people. The number of seats in each row is 7 more than the number of rows. How many rows of seats are there?
36. The parking garage at Baltimore-Washington International Airport contains 8400 parking spaces. The number of cars that can be parked on each floor exceeds the number of floors by 1675. How many floors are there in the parking garage?
37. One bookshelf in the public library can hold 175 books. The number of books on each shelf exceeds the number of shelves by 18. How many books are on each shelf?
38. The length of a rectangle is 7 centimeters greater than the width. If 4 centimeters are added to both the length and width, the new area would be 98 square centimeters. Find the dimensions of the original rectangle.
39. Susan is going to fence a rectangular flower garden in her back yard. She has 50 feet of fencing and she plans to use the house as the fence on one side of the garden. If the area is 300 square feet, what are the dimensions of the flower garden?
40. A rancher is going to build a corral with 52 yards of fencing. He is planning to use the barn as one side of the corral. If the area is 320 square yards, what are the dimensions?
41. A telephone pole is to have a guy wire attached to its top and anchored to the ground at a point that is at a distance 34 feet less than the height of the pole from the base. If the wire is to be 2 feet longer than the height of the pole, what is the height of the pole?
42. Lucy is standing next to the General Sherman tree in Sequoia National Park, home of some of the largest trees in the world. The distance from Lucy to the base of the tree is 71 m less than the height of the tree. If the distance from Lucy to the top of the tree is 1 m more than the height of the tree, how tall is the General Sherman?
43. A Christmas tree is supported by a wire that is 1 foot longer than the height of the tree. The wire is anchored at a point whose distance from the base of the tree is 49 feet shorter than the height of the tree. What is the height of the tree?
44. An architect wants to draw a rectangle with a diagonal of 13 inches. The length of the rectangle is to be 2 inches more than twice the width. What dimensions should she make the rectangle?

45. Incline mats, or triangle mats, are offered with different levels of incline to help gymnasts learn basic moves. As the name may suggest, two sides of the mat are right triangles. If the height of the mat is 28 inches shorter than the length of the mat and the hypotenuse is 8 inches longer than the length of the mat, what is the length of the mat?

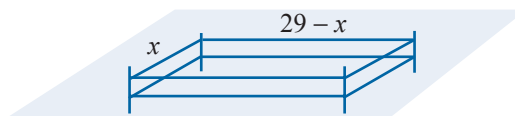
46. Bill uses mirrors to augment the “laser experience” at a laser show. At one show, he places three mirrors, A , B , C , in a right triangular form. If the distance between A and B is 15 m more than the distance between A and C , and the distance between B and C is 15 m less than the distance between A and C , what is the distance between mirror A and mirror C ?



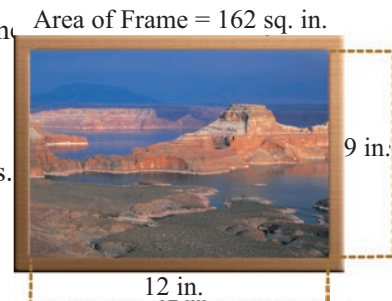
47. The Wilsons have a rectangular swimming pool that is 10 ft longer than it is wide. The pool is completely surrounded by a concrete deck that is 6 ft wide. The total area of the pool and the deck is 1344 ft^2 . Find the dimensions of the pool.




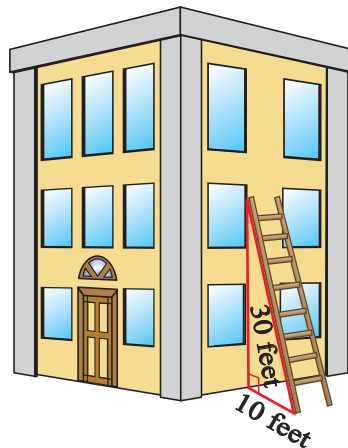
48. An apartment building has the same number of units on each floor. The building has five times as many units per floor as number of floors, and there are 405 units total. How many floors does the building have?
49. A large U-Haul truck is 8 ft tall. The length of the truck is 4 ft longer than three times the width. What are the dimensions of the truck if the volume is 1590 ft^3 ?
50. A farmer fenced in a 198-square-meter portion of his field with 58 meters of fencing. What are the length and width of the field? (**Hint:** The length plus the width is equal to half of the perimeter.)




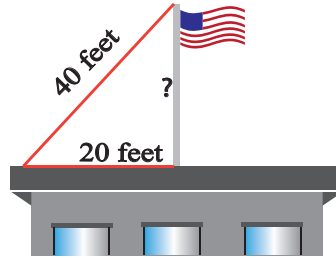
- a. Write an equation to express the area of the field.
- b. Solve the equation from Part a. for the variable.
- c. Use the answer from Part b. to determine the length and width of the field.
51. A photograph 9 in. wide and 12 in. long is surrounded by a frame of uniform thickness. The area of the frame itself, not including the center, is 162 in.^2 . Find the thickness of the frame.



52. The Mona Lisa is a famous painting by Leonardo da Vinci. The painting is 30 in. by 21 in. It is surrounded by a frame of uniform thickness whose area (not including the center) is 756 in.^2 Find the thickness of the frame.
53. A 40-volt generator with a resistance of 4 ohms delivers power externally of $40I - 4I^2$ watts, where I is the current measured in amperes. Find the current needed for the generator to deliver 100 watts of power.
54. Find the current needed for the 40-volt generator in Exercise 17 to deliver 64 watts of power.
55. Raymond operates a small sign-making business. He finds that if he charges x dollars for each sign, he sells $40 - x$ signs per week. What is the least number of signs he can sell to have an income of \$336 in one week?
56. It costs Mrs. Snow \$3 to build a picture frame. She estimates that if she charges x dollars each, she can sell $60 - x$ frames per week. What is the lowest price necessary to make a profit of \$432 each week?
57. The Ski Club is planning to charter a bus to a ski resort. The cost will be \$900 and each member will share the cost equally. If the club had 15 more members, the cost per person would be \$10 less. How many are in the club now? (**Hint:** If x = number in club now, $\frac{900}{x}$ = cost per person.)
58.  A ladder is 30 ft long and you want to place the base of the ladder 10 ft from the base of a building. About how far up the building (to the nearest tenth of a foot) will the ladder reach?



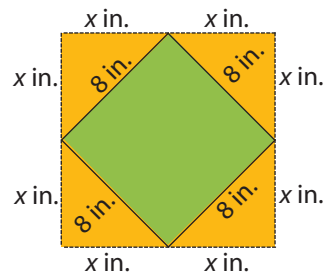
59.  A flag pole is on top of a building and is held in place by steel cables attached to the top of the pole. If one such cable is 40 ft long and is attached at a point on the roof of the building 20 ft from the base of the flag pole, what is the length of the flag pole (to the nearest tenth of a foot)?



60. The approximate horizontal distance d , in yards, that a football travels after it leaves a player's hands at a speed of v miles per hour is given by $d = 0.022v^2$. Determine the exit velocity of a football that travelled 50 yards.

Writing & Thinking

61. The pattern in Kara's linoleum flooring is in the shape of a square 8 inches on a side with right triangles (with legs whose lengths are x inches) placed on each side of the original square so that a new larger square is formed. What is the area of the new square? Explain why you do not need to find the value of x .



62. Suppose that you are to solve an applied problem and the solution leads to a quadratic equation. You decide to use the quadratic formula to solve the equation. Explain what restrictions you must be aware of when you use the formula.