3.4

Using the Pythagorean Relationship

Focus on...

After this lesson, you will be able to...

- ❑ use the Pythagorean relationship to determine the missing side length of a right triangle

A baseball diamond is a square. How could you determine the distance from second base to home plate? How many different strategies can you develop?

Explore the Math

Materials

- centimetre grid paper
- ruler

How do you determine the missing side length of a right triangle?

1. On centimetre grid paper, draw a right triangle.

2. Describe two methods for finding the length of the hypotenuse of a right triangle.

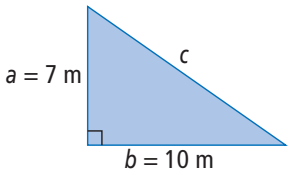
Reflect on Your Findings

3. **a)** Describe a situation in which one method would be better to use than another.

   b) Work with a partner to determine the distance from second base to home plate on a baseball diamond. Share your solution with another pair of classmates.

Example 1: Determine the Length of the Hypotenuse of a Right Triangle

Determine the length of hypotenuse c. Express your answer to the nearest tenth of a metre.



Solution

Strategies
Solve an Equation

Use the Pythagorean relationship, $c^2 = a^2 + b^2$, where the length of the hypotenuse is c, and the lengths of the legs are a and b.

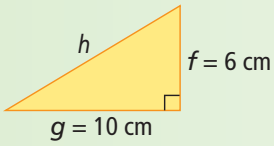
$c^2 = 7^2 + 10^2$
$c^2 = 49 + 100$
$c^2 = 149$
$c = \sqrt{149}$
$c \approx 12.2$

Strategies
What other method(s) could you use to solve this problem?

The length of the hypotenuse is approximately 12.2 m.

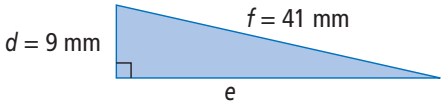
Show You Know

Determine the length of the hypotenuse for the right triangle, to the nearest centimetre.



Example 2: Determine the Length of a Leg of a Right Triangle

What is the length of leg e of the right triangle?



Solution

Strategies
Solve an Equation

Use the Pythagorean relationship, $d^2 + e^2 = f^2$, where the length of the hypotenuse is f, and the lengths of the legs are d and e.

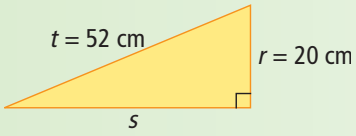
$9^2 + e^2 = 41^2$
$81 + e^2 = 1681$
$81 + e^2 - 81 = 1681 - 81$
$e^2 = 1600$
$e = \sqrt{1600}$
$e = 40$

Why do you subtract 81?

The length of the leg is 40 mm.

Show You Know

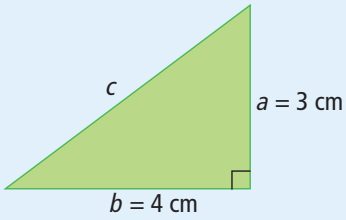
Determine the length of leg s of the right triangle.



Key Ideas

- The Pythagorean relationship can be used to determine the length of the hypotenuse of a right triangle when the lengths of the two legs are known.

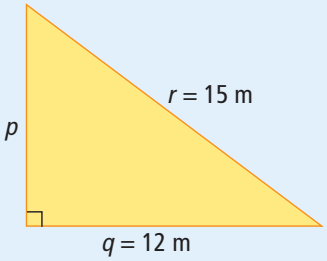
$c^2 = a^2 + b^2$
$c^2 = 3^2 + 4^2$
$c^2 = 9 + 16$
$c^2 = 25$
$c = \sqrt{25}$
$c = 5$



The length of hypotenuse c is 5 cm.

- The Pythagorean relationship can be used to determine the leg length of a right triangle when the lengths of the hypotenuse and the other leg are known.

$p^2 + q^2 = r^2$
$p^2 + 12^2 = 15^2$
$p^2 + 144 = 225$
$p^2 + 144 - 144 = 225 - 144$
$p^2 = 81$
$p = \sqrt{81}$
$p = 9$



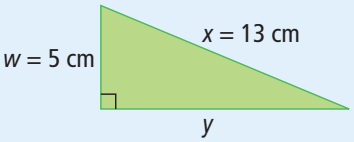
The length of leg p is 9 m.

Communicate the Ideas

1. Jack must determine the missing side length of a triangle. He decides to draw it and then measure it, as shown. Do you agree with the method that Jack is using? Explain.

2. Kira calculated the missing side length of the right triangle.

$y^2 = 5^2 + 13^2$
$y^2 = 25 + 169$
$y^2 = 194$
$y \approx 13.9$
The length of side y is approximately 13.9 cm.



Is Kira correct? If she is correct, explain how you know. If she is incorrect, explain the correct method.

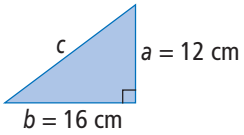
Check Your Understanding

Practise

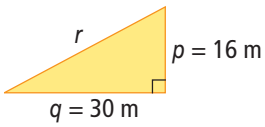
For help with #3 and #4, refer to Example 1 on page 102.

3. Determine the length of each hypotenuse.

a)

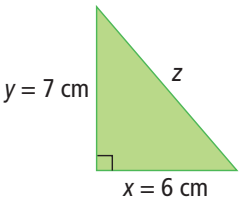


b)



4. What is the length of each hypotenuse? Give your answer to the nearest tenth of a centimetre.

a)



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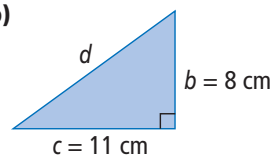
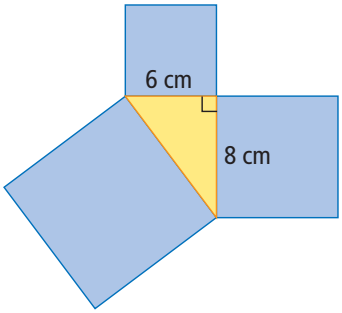


5. a) What is the area of each square attached to the legs of the right triangle?



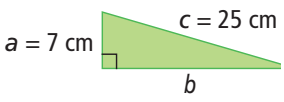
b) What is the area of the square attached to the hypotenuse?

c) What is the length of the hypotenuse?

For help with #6 and #7, refer to Example 2 on page 102.

6. Determine the length of the leg for each right triangle.

a)



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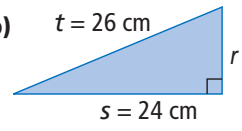
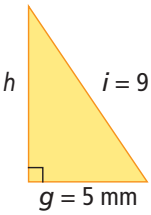


7. What is the missing length of the leg for each triangle? Give your answer to the nearest tenth of a millimetre.

a)



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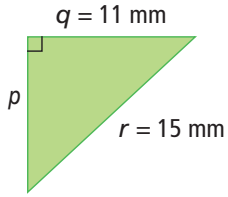
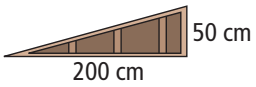
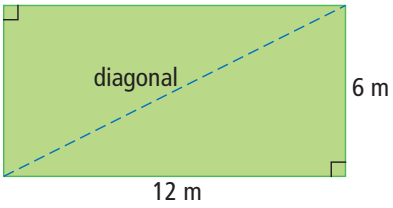


Apply

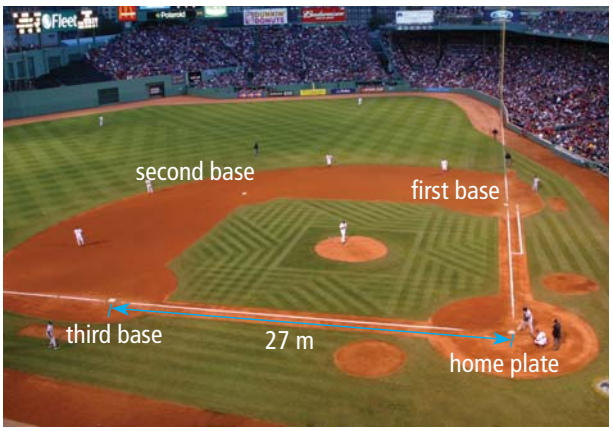
8. The side view of a ramp at a grocery store is in the shape of a right triangle. Determine the length of the ramp, to the nearest centimetre.



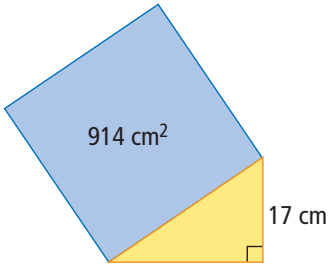
9. Tina wants to construct a path along the diagonal of her yard. What length will the path be? Express your answer to the nearest tenth of a metre.



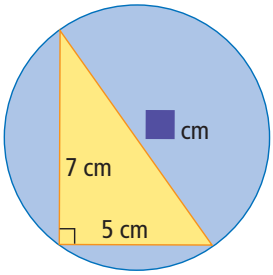
10. What is the minimum distance the player at third base has to throw the ball to get the runner out at first base? Express your answer to the nearest tenth of a metre.



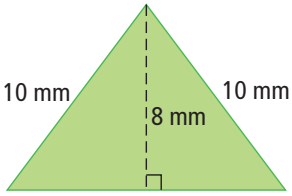
11. The right triangle below has a square attached to its hypotenuse. What is the perimeter of the triangle? Give your answer to the nearest tenth of a centimetre.



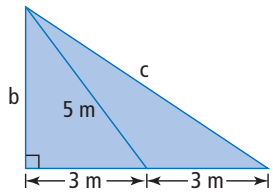
12. The hypotenuse of the triangle cuts the circle in half. What is the diameter of the circle? Express your answer to the nearest tenth of a centimetre.



13. Determine the length of the base of the large triangle. Express your answer to the nearest tenth of a millimetre.

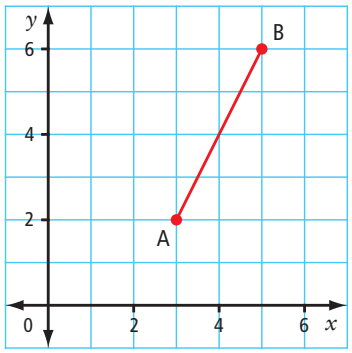


14. What are the lengths of b and c? Write your answer to the nearest tenth of a metre where appropriate.

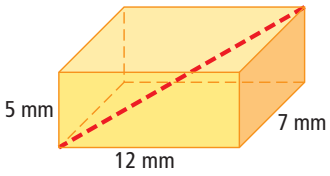


Extend

15. The coordinate grid shown was drawn on centimetre grid paper. What is the length of line segment AB? Express your answer to the nearest tenth of a centimetre.



16. What is the length of the red diagonal in the box? Express your answer to the nearest tenth of a millimetre.



MATH LINK

For each of the following questions, express your answer to the nearest tenth of a centimetre.

a) What is the distance between A and B? Explain.

b) If you have to follow the lines on the game board, what is the shortest distance between C and D?

c) If you do not have to follow the lines on the game board, what is the shortest distance between C and D? Justify your answer.