

The Hypotenuse Of A Right Triangle Measures 18 Cm And One Of Its Legs Measures 10 Cm. Find The Measure

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Understanding the properties of right triangles is fundamental in geometry, especially when solving for unknown sides using the Pythagorean theorem. In this article, we will explore how to determine the length of the missing leg in a right triangle when given the hypotenuse and one leg. The specific problem states: The hypotenuse of a right triangle measures 18 cm, and one of its legs measures 10 cm. Find the measure of the other leg.

This problem provides an excellent opportunity to review the Pythagorean theorem, apply algebraic techniques, and understand the geometric principles behind right triangles.

Understanding the Right Triangle and Its Components

Before solving the problem, it is essential to understand the components involved:

- Right Triangle: A triangle with one 90-degree angle.
- Hypotenuse (c): The side opposite the right angle, and the longest side of the triangle.
- Legs (a and b): The two sides forming the right angle.

Given:

- Hypotenuse $(c = 18, \text{cm})$
- One leg $(a = 10, \text{cm})$
- The other leg (b) is unknown and needs to be found.

Applying the Pythagorean Theorem

The Pythagorean theorem states that in a right triangle:

$$a^2 + b^2 = c^2$$

Where:

- (a) and (b) are the legs,

- c is the hypotenuse.

Given the values:

$$10^2 + b^2 = 18^2$$

Calculating the squares:

$$100 + b^2 = 324$$

Now, isolate b^2 :

$$b^2 = 324 - 100$$

$$b^2 = 224$$

To find b , take the square root of both sides:

$$b = \sqrt{224}$$

Calculating the Missing Leg

The square root of 224 can be simplified:

1. Prime factorization of 224:

$$224 = 2 \times 112 = 2 \times 2 \times 56 = 2 \times 2 \times 2 \times 28 = 2 \times 2 \times 2 \times 2 \times 14 = 2 \times 2 \times 2 \times 2 \times 2 \times 7$$

2. Expressed as prime factors:

$$224 = 2^5 \times 7$$

3. Simplify the square root:

$$\sqrt{224} = \sqrt{2^5 \times 7} = \sqrt{2^4 \times 2 \times 7} = \sqrt{(2^4) \times (2 \times 7)} = \sqrt{16 \times 14}$$

4. Simplify further:

$$\sqrt{16 \times 14} = \sqrt{16} \times \sqrt{14} = 4 \times \sqrt{14}$$

Therefore:

$$b = 4 \times \sqrt{14} \text{ cm}$$

For an approximate decimal value:

$$\sqrt{14} \approx 3.7417$$

$$b \approx 4 \times 3.7417 \approx 14.9668 \text{ cm}$$

Final answer:

$$\boxed{b \approx 14.97 \text{ cm}}$$

The measure of the missing leg is approximately 14.97 cm.

Step-by-Step Solution Summary

To summarize the steps involved in solving for the missing leg:

1. Identify the known values: hypotenuse $(c = 18\text{ cm})$, one leg $(a = 10\text{ cm})$.
2. Apply the Pythagorean theorem: $(a^2 + b^2 = c^2)$.
3. Substitute known values: $(100 + b^2 = 324)$.
4. Solve for (b^2) : $(b^2 = 224)$.
5. Find (b) by calculating $(\sqrt{224})$, simplified as $(4\sqrt{14})$.
6. Approximate the decimal value for practical use: approximately 14.97 cm.

Additional Tips for Solving Right Triangle Problems

When approaching similar problems, consider the following:

- Always verify the given data: Ensure the hypotenuse is the longest side.
- Identify known and unknown components: Clearly distinguish between what is given and what is to be found.
- Use the Pythagorean theorem carefully: Substitute known values and perform algebraic operations step-by-step.
- Simplify square roots when possible: Look for perfect squares to simplify radical expressions.
- Use a calculator for decimal approximations: Especially when dealing with non-perfect squares.

Real-Life Applications of Finding Missing Sides in

Right Triangles

Understanding how to find missing sides in right triangles has numerous practical applications:

- Architecture and Engineering: Calculating lengths of structural components.
- Navigation and GPS: Determining distances when traveling diagonally.
- Computer Graphics: Calculating pixel distances and diagonals.
- Physics: Resolving vectors into components.
- Everyday Problem Solving: For example, determining the length of a ladder needed to reach a certain height when placed at a specific distance from the wall.

Practice Problems to Reinforce Understanding

To solidify your grasp of right triangle problems, try solving these:

- In a right triangle, the hypotenuse measures 25 cm, and one leg measures 15 cm. Find the other leg.
- A right triangle has legs of 8 cm and 15 cm. What is the length of the hypotenuse?
- If the hypotenuse of a right triangle is 20 meters, and one leg is 12 meters, what is the length of the other leg?

Conclusion

Determining the missing side in a right triangle when given the hypotenuse and one leg is a fundamental skill in geometry, rooted in the Pythagorean theorem. In the specific problem where the hypotenuse measures 18 cm and one leg measures 10 cm, the other leg measures approximately 14.97 cm. Understanding these concepts not only enhances your mathematical problem-solving skills but also prepares you for real-world applications where spatial reasoning is essential.

By following systematic steps—applying the Pythagorean theorem, simplifying radicals, and performing accurate calculations—you can confidently solve similar problems with ease. Keep practicing with different values and scenarios to strengthen your understanding of right triangle properties and the Pythagorean theorem.

Frequently Asked Questions

What is the length of the remaining leg in a right triangle where the hypotenuse measures 18 cm and one leg measures 10 cm?

The remaining leg measures approximately 14.42 cm, found using the Pythagorean theorem: $\sqrt{(18^2 - 10^2)} = \sqrt{(324 - 100)} = \sqrt{224} \approx 14.97$ cm.

How do you find the length of a missing leg in a right triangle when the hypotenuse and one leg are known?

Use the Pythagorean theorem: $\text{Leg} = \sqrt{(\text{Hypotenuse}^2 - \text{Known leg}^2)}$.

If the hypotenuse of a right triangle is 18 cm and one leg is 10 cm, what is the length of the other leg?

The other leg is approximately 14.97 cm, calculated as $\sqrt{(18^2 - 10^2)} = \sqrt{(324 - 100)} = \sqrt{224} \approx 14.97$ cm.

What is the significance of the Pythagorean theorem in solving for missing sides in right triangles?

It allows you to calculate the length of an unknown side when the other two sides are known, specifically for right triangles: $a^2 + b^2 = c^2$.

Can the length of the unknown leg in a right triangle be greater than the hypotenuse?

No, in a right triangle, the hypotenuse is always the longest side, so the unknown leg cannot be longer than the hypotenuse.

What is the approximate value of the missing leg if the hypotenuse is 18 cm and one leg measures 10 cm?

Approximately 14.97 cm, calculated using the Pythagorean theorem.

How do you verify the length of a side in a right triangle after calculating it?

You can verify by plugging the side length back into the Pythagorean theorem to see if the sum of the squares equals the hypotenuse squared.

What are common mistakes to avoid when applying the Pythagorean theorem in such problems?

Common mistakes include confusing the hypotenuse and legs, not squaring the numbers properly, and forgetting to take the square root after subtracting.

Is it necessary to use a calculator for finding the missing leg in this problem?

While it's not strictly necessary, using a calculator makes computing square roots more accurate and easier.

What is the final answer for the measure of the unknown leg in the given problem?

The measure of the unknown leg is approximately 14.97 cm.

Additional Resources

The Hypotenuse of a Right Triangle Measures 18 cm and One of Its Legs Measures 10 cm. Find the Measure is a classic problem in geometry that offers a practical application of the Pythagorean theorem. This problem provides an excellent opportunity for students and math enthusiasts to sharpen their problem-solving skills, understand the significance of right triangles, and explore the relationships between their sides. By carefully analyzing and solving this problem, learners gain insight into fundamental geometric principles that are applicable in various fields, from engineering to architecture.

Understanding the Problem

The problem states that in a right triangle, the hypotenuse measures 18 cm, and one of the legs measures 10 cm. The goal is to find the length of the other leg. To approach this, it's essential to understand the key components involved:

- Hypotenuse: The longest side of a right triangle, opposite the right angle.
- Legs: The two sides that form the right angle.

The problem provides two known measurements:

- Hypotenuse (c) = 18 cm
- One leg (a) = 10 cm

The unknown is the other leg (b). This setup directly suggests the use of the Pythagorean theorem, which relates the sides of a right triangle.

The Pythagorean Theorem: The Core Concept

Statement of the Theorem

The Pythagorean theorem states that in a right triangle:

$$a^2 + b^2 = c^2$$

where:

- a and b are the lengths of the legs,
- c is the length of the hypotenuse.

This fundamental relationship is invaluable for solving problems involving right triangles.

Application of the Theorem in the Given Problem

Given:

- $c = 18\text{ cm}$
- $a = 10\text{ cm}$

Substituting these into the theorem:

$$10^2 + b^2 = 18^2$$

which simplifies to:

$$100 + b^2 = 324$$

From this, solving for b^2 :

$$b^2 = 324 - 100$$
$$b^2 = 224$$

Finally, taking the square root:

$$b = \sqrt{224}$$

which simplifies to:

$$b \approx 14.97\text{ cm}$$

Thus, the length of the other leg is approximately 14.97 cm.

Step-by-Step Solution Process

Step 1: Write down known values

- Hypotenuse $(c = 18\text{ cm})$
- Known leg $(a = 10\text{ cm})$

Step 2: Set up the Pythagorean theorem

$$a^2 + b^2 = c^2$$

Plugging in known values:

$$10^2 + b^2 = 18^2$$

Step 3: Simplify the equation

$$100 + b^2 = 324$$

Step 4: Isolate (b^2)

$$b^2 = 324 - 100 = 224$$

Step 5: Calculate (b)

$$b = \sqrt{224} \approx 14.97\text{ cm}$$

Step 6: Final answer

The other leg measures approximately 14.97 cm.

Features and Significance of the Solution

Advantages of Using the Pythagorean Theorem in This Context:

- Simplicity: Provides a straightforward method to find unknown sides in right triangles.
- Universality: Applicable to various geometric problems beyond basic triangles.
- Educational Value: Reinforces understanding of right triangle properties and algebraic manipulation.

Limitations:

- Presumes the triangle is right-angled; applying it elsewhere leads to errors.
- Requires accurate measurements; inaccuracies can lead to incorrect results.
- Does not directly address the angles, only the sides.

Real-World Applications of Finding the Missing Side

Understanding how to compute the missing side of a right triangle is essential in numerous practical fields:

- Architecture and Construction: Ensuring structures are properly aligned and measuring distances indirectly.
- Navigation and Surveying: Calculating distances that are not directly measurable.
- Engineering: Designing components that involve right-angle relationships.

The problem exemplifies how fundamental geometric principles underpin real-world problem solving.

Alternative Approaches and Extensions

While the Pythagorean theorem is the most direct method here, other methods or related concepts can deepen understanding:

- Using Trigonometry: If angles are known, sine or cosine ratios can be used.
- Coordinate Geometry: Placing the triangle on a coordinate plane to verify calculations.
- Calculating Angles: Using inverse trigonometric functions to find angles if needed.

Extensions of this problem could involve finding angles or verifying the properties of the triangle once all side lengths are known.

Common Mistakes to Avoid

- Incorrectly identifying the hypotenuse: Remember, the hypotenuse is always the longest side.
- Mixing up sides and angles: Ensure sides are correctly labeled.
- Neglecting to take the square root at the end: Remember that $b = \sqrt{224}$, not just 224.
- Using wrong formulas: The Pythagorean theorem only applies to right triangles, not oblique triangles.

Being cautious with these details ensures accurate results and a solid understanding of the concepts involved.

Conclusion

The problem of finding the missing side of a right triangle when the hypotenuse and one leg are known exemplifies the power and elegance of the Pythagorean theorem. By carefully applying the theorem, we established that the unknown leg measures approximately 14.97 cm. This process not only reinforces essential geometric principles but also highlights their relevance in practical contexts. Whether in academic settings or real-world applications, mastering such problems enhances analytical skills and deepens appreciation for the interconnectedness of mathematical concepts. The ability to analyze right triangles accurately is foundational for anyone pursuing studies or careers involving geometry, architecture, engineering, or navigation.

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