# applying the pythagorean theorem answer key

Applying the Pythagorean Theorem Answer Key provides a comprehensive understanding of one of the most fundamental concepts in mathematics. The Pythagorean theorem, a statement about the relationship between the sides of a right triangle, is crucial for various applications in geometry, physics, engineering, and even computer science. This article will delve into the theorem itself, provide examples of its applications, and present a detailed answer key to help students grasp how to solve problems involving this theorem.

## The Basics of the Pythagorean Theorem

The Pythagorean theorem is stated as follows:

In a right triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the lengths of the other two sides.

Mathematically, this is expressed as:

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

Where:
- $c$ = length of the hypotenuse,
- $a$ and $b$ = lengths of the other two sides.

## Understanding Right Triangles

To effectively apply the Pythagorean theorem, it is essential to understand the properties of right triangles:

1. Definition: A right triangle is a triangle in which one angle measures 90 degrees.
2. Hypotenuse: The longest side, opposite the right angle.
3. Legs: The other two sides, which can vary in length.

Visualizing these components is key to applying the theorem correctly.

## Applications of the Pythagorean Theorem

The Pythagorean theorem is not just a theoretical concept; it has practical applications in various fields. Here are some common uses:

## 1. Construction and Architecture

In construction, ensuring that corners are square is critical. Using the

Pythagorean theorem allows builders to confirm that angles are right angles. For instance, if you measure 3 feet along one side and 4 feet along the other, the diagonal should measure 5 feet if the corner is indeed a right angle.

## 2. Navigation and Surveying

Surveyors use the theorem to calculate distances across land. For example, if a surveyor needs to determine the distance across a field, they can create a right triangle using known distances along the field's edges.

## 3. Computer Graphics

In computer graphics, the Pythagorean theorem is used to calculate the distance between two points on a screen, aiding in rendering and animation.

## 4. Physics and Engineering

In physics, the theorem is essential for calculating resultant vectors, especially when analyzing forces acting at right angles.

# Examples of Problem-Solving Using the Pythagorean Theorem

To solidify the understanding of the theorem, let's look at several examples with step-by-step solutions.

## Example 1: Finding the Hypotenuse

Problem: A right triangle has legs measuring 6 cm and 8 cm. What is the length of the hypotenuse?

Solution:
1. Identify the lengths of the legs: $a = 6$ cm, $b = 8$ cm.
2. Apply the Pythagorean theorem:
$$
c^2 = a^2 + b^2
$$
$$
c^2 = 6^2 + 8^2
$$
$$
c^2 = 36 + 64
$$
$$
c^2 = 100
$$
3. Solve for $c$:

$$
c = \sqrt{100} = 10 \text{ cm}
$$

Answer: The hypotenuse measures 10 cm.


## Example 2: Finding a Leg of the Triangle

Problem: A right triangle has a hypotenuse of 13 m and one leg measuring 5 m. What is the length of the other leg?

Solution:
1. Identify the known values: $c = 13$ m, $a = 5$ m.
2. Rearrange the Pythagorean theorem to solve for $b$:
$$
c^2 = a^2 + b^2 \implies b^2 = c^2 - a^2
$$
3. Substitute the known values:
$$
b^2 = 13^2 - 5^2
$$
$$
b^2 = 169 - 25
$$
$$
b^2 = 144
$$
4. Solve for $b$:
$$
b = \sqrt{144} = 12 \text{ m}
$$

Answer: The length of the other leg is 12 m.


## Example 3: Real-Life Application in Navigation

Problem: A pilot flies 300 km east and then 400 km north. What is the straight-line distance from the starting point to the destination?

Solution:
1. Identify the east distance as one leg: $a = 300$ km, and the north distance as the other leg: $b = 400$ km.
2. Apply the Pythagorean theorem:
$$
c^2 = a^2 + b^2
$$
$$
c^2 = 300^2 + 400^2
$$
$$
c^2 = 90000 + 160000
$$
$$
c^2 = 250000
$$

3. Solve for \( c \):
\[
c = \sqrt{250000} = 500 \text{ km}
\]

Answer: The straight-line distance is 500 km.

# Answer Key Summary

Here's a summary of the answers to the examples we discussed:

1. Example 1: Hypotenuse = 10 cm
2. Example 2: Other leg = 12 m
3. Example 3: Straight-line distance = 500 km

# Conclusion

Understanding and applying the Pythagorean theorem is essential for anyone studying mathematics, engineering, or physics. By mastering this theorem, students gain valuable problem-solving skills that are applicable in real-world situations. The answer key provided serves as a guide to ensure comprehension and accuracy in solving problems related to right triangles. Practicing various problems will further enhance the ability to apply the Pythagorean theorem effectively in diverse scenarios.

# Frequently Asked Questions

## What is the Pythagorean theorem?

The Pythagorean theorem states that in a right triangle, the square of the length of the hypotenuse (c) is equal to the sum of the squares of the lengths of the other two sides (a and b), expressed as $a^2 + b^2 = c^2$.

## How do you apply the Pythagorean theorem to find the length of a side?

To find the length of a side in a right triangle, rearrange the formula: if you know a and b, use $c = \sqrt{a^2 + b^2}$; if you know c and a, use $b = \sqrt{c^2 - a^2}$; and if you know c and b, use $a = \sqrt{c^2 - b^2}$.

## Can the Pythagorean theorem be used for non-right triangles?

No, the Pythagorean theorem specifically applies to right triangles. For non-right triangles, other methods such as the Law of Cosines must be used.

## What are some real-world applications of the

## Pythagorean theorem?

The Pythagorean theorem is used in various fields such as architecture for determining distances, navigation for calculating shortest paths, and in physics for vector resolution.

## What is the relationship between the Pythagorean theorem and distance in a coordinate system?

In a coordinate system, the distance between two points (x1, y1) and (x2, y2) can be calculated using the Pythagorean theorem as $d = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}$.

## How can I check if a triangle is a right triangle using the Pythagorean theorem?

To check if a triangle is a right triangle, verify if the lengths of its sides satisfy the Pythagorean theorem: $a^2 + b^2$ should equal $c^2$, where c is the longest side.

## What is the importance of the Pythagorean theorem in mathematics?

The Pythagorean theorem is fundamental in mathematics as it establishes a key relationship between the sides of right triangles, paving the way for further studies in geometry, trigonometry, and calculus.

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