

apply the pythagorean theorem answer key

Apply the Pythagorean theorem answer key is a crucial concept in geometry that allows individuals to solve problems involving right triangles. This theorem, attributed to the ancient Greek mathematician Pythagoras, states that 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. This article will delve into the details of applying the Pythagorean theorem, providing examples, explanations, and an answer key for practice problems.

Understanding the Pythagorean Theorem

The Pythagorean theorem can be expressed with the equation:

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

Where:

- c is the length of the hypotenuse,
- a and b are the lengths of the other two sides.

This theorem is fundamental in various fields, including architecture, engineering, and physics, as it helps in determining distances and relationships between points in a two-dimensional plane.

Key Components of the Theorem

To effectively apply the Pythagorean theorem, understanding its components is essential:

1. **Right Triangle:** A triangle that has one angle measuring 90 degrees.
2. **Hypotenuse:** The longest side of a right triangle, opposite the right angle.
3. **Legs:** The two sides that form the right angle, usually denoted as a and b .

Applications of the Pythagorean Theorem

The applications of the Pythagorean theorem are extensive. Below are some common scenarios where this theorem is useful:

- **Construction and Architecture:** Ensuring structures are built correctly and are stable.
- **Navigation:** Calculating the shortest distance between two points.
- **Design:** Creating right angles in various designs and layouts.
- **Computer Graphics:** Calculating distances between points on a digital plane.

Examples of Applying the Pythagorean Theorem

Let's explore some practical examples to illustrate how to apply the Pythagorean theorem.

Example 1: Finding the Length of the Hypotenuse

Suppose a right triangle has legs measuring 3 cm and 4 cm. To find the length of the hypotenuse:

1. Identify the lengths of the legs: $a = 3$ cm, $b = 4$ cm.
2. Apply the Pythagorean theorem:

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

Substituting the values:

$$c^2 = 3^2 + 4^2$$

$$c^2 = 9 + 16$$

$$c^2 = 25$$

3. Solve for c :

$$c = \sqrt{25}$$

$$c = 5 \text{ cm}$$

Thus, the length of the hypotenuse is 5 cm.

Example 2: Finding the Length of a Leg

Now consider a right triangle where the hypotenuse measures 10 cm, and one leg measures 6 cm. To find the length of the other leg:

1. Identify the known values: $c = 10$ cm, $a = 6$ cm. We need to find b .
2. Apply the Pythagorean theorem:

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

Substituting the values:

$$10^2 = 6^2 + b^2$$

$$100 = 36 + b^2$$

3. Rearranging the equation gives:

$$b^2 = 100 - 36$$

$$b^2 = 64$$

4. Solve for b :

$$b = \sqrt{64}$$

$$b = 8 \text{ cm}$$

Thus, the length of the other leg is 8 cm.

Practice Problems with Answer Key

To reinforce your understanding of the Pythagorean theorem, try solving the following practice problems. The answer key is provided at the end.

Practice Problems

1. A right triangle has legs measuring 5 m and 12 m. Find the length of the hypotenuse.
2. The hypotenuse of a right triangle measures 13 ft, and one leg measures 5 ft. Find the length of the other leg.
3. A ladder is leaning against a wall, reaching a height of 9 ft, and its base is 12 ft away from the wall. Calculate the length of the ladder.
4. A right triangle has a hypotenuse of 17 cm and one leg measuring 8 cm. Determine the length of the other leg.

Answer Key

1. Hypotenuse Calculation:

- Given $a = 5$ m, $b = 12$ m.

$$c = \sqrt{5^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} = 13 \text{ m.}$$

2. Leg Calculation:

- Given $c = 13$ ft, $a = 5$ ft.

$$b = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = \sqrt{144} = 12 \text{ ft.}$$

3. Ladder Calculation:

- Given $a = 9$ ft, $b = 12$ ft.

$$c = \sqrt{9^2 + 12^2} = \sqrt{81 + 144} = \sqrt{225} = 15 \text{ ft.}$$

4. Leg Calculation:

- Given $c = 17$ cm, $a = 8$ cm.

$$b = \sqrt{17^2 - 8^2} = \sqrt{289 - 64} = \sqrt{225} = 15 \text{ cm.}$$

Conclusion

The Pythagorean theorem is an essential mathematical principle that provides a clear method for

solving problems involving right triangles. By applying the theorem correctly, individuals can determine the lengths of sides and gain insights into various practical applications. Mastery of the Pythagorean theorem not only enhances one's mathematical skills but also serves as a foundational tool in many real-world scenarios. Practicing the problems provided will further solidify your understanding and ability to apply this theorem effectively.

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 the hypotenuse?

To find the length of the hypotenuse, square the lengths of the two other sides, add those squares together, and then take the square root of the sum. For example, if $a = 3$ and $b = 4$, then $c = \sqrt{(3^2 + 4^2)} = \sqrt{(9 + 16)} = \sqrt{25} = 5$.

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

No, the Pythagorean theorem is specifically applicable to right triangles. For non-right triangles, other methods, such as the Law of Cosines, are used.

What is the Pythagorean theorem used for in real life?

The Pythagorean theorem is used in various real-life applications, including construction, navigation, computer graphics, and physics, to calculate distances and relationships between objects.

What are some common mistakes when applying the Pythagorean theorem?

Common mistakes include misidentifying the hypotenuse, using the formula incorrectly, or failing to take the square root when solving for the hypotenuse.

How can the Pythagorean theorem be applied in coordinate geometry?

In coordinate geometry, the Pythagorean theorem can be used to find the distance between two points (x_1, y_1) and (x_2, y_2) using the formula: $\text{distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

What is the converse of the Pythagorean theorem?

The converse of the Pythagorean theorem states that if in a triangle, the square of the length of one side is equal to the sum of the squares of the lengths of the other two sides, then the triangle is a right triangle.

Can the Pythagorean theorem be extended to three dimensions?

Yes, the Pythagorean theorem can be extended to three dimensions using the formula: $d = \sqrt{a^2 + b^2 + c^2}$, where d is the diagonal distance and a , b , and c are the lengths of the sides of a rectangular prism.

What resources are available for practicing Pythagorean theorem problems?

Resources for practicing Pythagorean theorem problems include online math practice websites, math textbooks, educational apps, and tutoring services that provide exercises and answer keys for self-assessment.

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