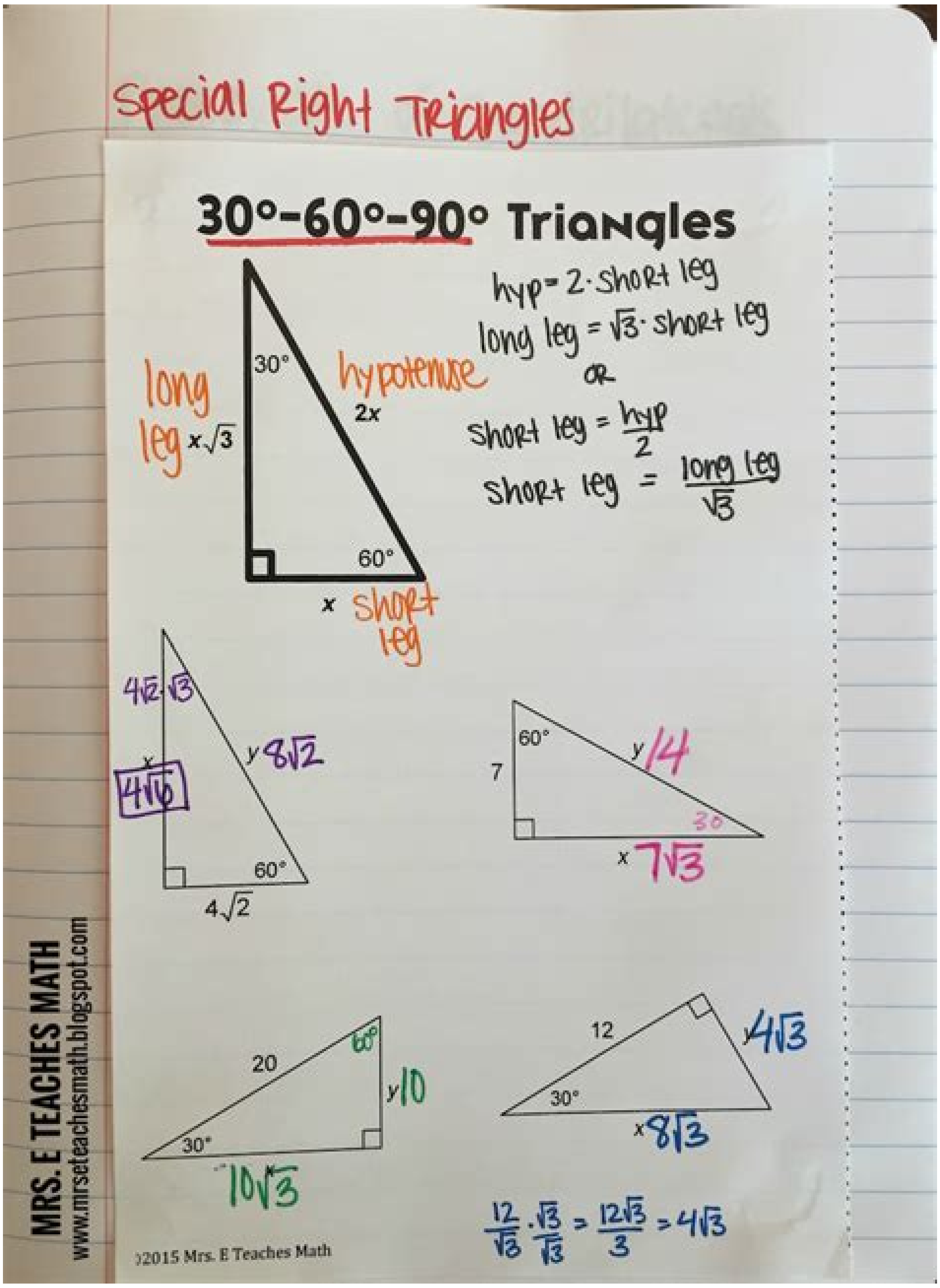
Special Right Triangles Answer Key


Special Right Triangles
30°-60°-90° Triangles
hyp = 2·short leg
long leg = √3·short leg
OR
short leg = hyp/2
short leg = long leg/√3
long leg
x√3
30°
hypotenuse
2x
60°
x
short leg
4√2·√3
x
4√6
y 8√2
60°
4√2
60°
7
y 14
30
x 7√3
20
60°
y 10
30°
10√3
12
4√3
30°
x 8√3
12/√3 · √3/√3 = 12√3/3 = 4√3
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Special right triangles answer key are essential tools in geometry that help students and professionals alike solve problems involving right triangles quickly and effectively. These triangles have specific angle measures and side ratios that make them unique. Understanding these special triangles can simplify calculations in various fields, including architecture, engineering, physics, and more. In this article, we will explore the properties of special right triangles, how to solve problems using them, and provide a comprehensive answer key to help clarify common questions and scenarios.

Understanding Special Right Triangles

Special right triangles are characterized by specific angle measures and their corresponding side lengths. The two primary types of special right triangles are the 45-45-90 triangle and the 30-60-90 triangle. Each of these triangles has unique properties that can be used to derive their side lengths based on the length of one side.

1. The 45-45-90 Triangle

A 45-45-90 triangle is an isosceles right triangle, meaning that it has two angles measuring 45 degrees and one angle measuring 90 degrees. The properties of this triangle are as follows:

- The legs of the triangle are of equal length.
- The length of the hypotenuse is equal to the length of a leg multiplied by the square root of 2.

Formulas:
- If the length of each leg is x, then the length of the hypotenuse h is given by:

$$
h = x\sqrt{2}
$$

Example:
If one leg of a 45-45-90 triangle is 5 units, the hypotenuse can be calculated as:

$$
h = 5\sqrt{2} \approx 7.07 \text{ units}
$$

2. The 30-60-90 Triangle

The 30-60-90 triangle has angles measuring 30 degrees, 60 degrees, and 90 degrees. The properties of this triangle are defined by the ratios of its sides:

- The side opposite the 30-degree angle (the shorter leg) is half the length of the hypotenuse.
- The side opposite the 60-degree angle (the longer leg) is equal to the length of the shorter leg multiplied by the square root of 3.

Formulas:
- If the length of the hypotenuse is h, then the lengths of the legs are:
- Shorter leg $s = \frac{h}{2}$
- Longer leg $l = s\sqrt{3} = \frac{h\sqrt{3}}{2}$

Example:
If the hypotenuse of a 30-60-90 triangle is 10 units, the lengths of the legs can be calculated as:
- Shorter leg $s = \frac{10}{2} = 5 \text{ units}$
- Longer leg $l = 5\sqrt{3} \approx 8.66 \text{ units}$

Applications of Special Right Triangles

Special right triangles are used in various applications across different disciplines. Here are some key areas where they play a significant role:

1. Architecture and Construction

In architecture and construction, special right triangles are often used to ensure that structures are built at precise angles. For example, when designing roofs, trusses, or any structure requiring diagonal supports, knowing the ratios of a 30-60-90 triangle helps in calculating the lengths of beams and supports accurately.

2. Trigonometry and Calculus

Special right triangles lay the foundation for understanding trigonometric functions. Angles of 30, 45, and 60 degrees are common in trigonometric problems, allowing students to apply their knowledge of triangle ratios to solve for unknown lengths and angles.

3. Navigation and Surveying

In navigation and surveying, special right triangles facilitate the calculation of distances and angles. Surveyors use these principles to create accurate maps and determine land boundaries.

Practice Problems and Answer Key

To reinforce the understanding of special right triangles, here is a set of practice problems along with an answer key.

Practice Problems

1. In a 45-45-90 triangle, one leg measures 8 units. What is the length of the hypotenuse?

2. In a 30-60-90 triangle, the hypotenuse is 12 units. Find the lengths of both legs.

3. A ladder is leaning against a wall, forming a 30-60-90 triangle with the ground. The distance from the wall to the base of the ladder is 6 units. How long is the ladder?

4. If the hypotenuse of a 45-45-90 triangle is 10 units, what are the lengths of the legs?

5. In a 30-60-90 triangle, if the longer leg measures 8 units, what is the length of the hypotenuse?

Answer Key

1. Answer:
\[
h = 8\sqrt{2} \approx 11.31 \text{ units}
\]

2. Answer:
- Shorter leg \(s = \frac{12}{2} = 6 \text{ units} \)
- Longer leg \(l = 6\sqrt{3} \approx 10.39 \text{ units} \)

3. Answer:
- The base (shorter leg) is 6 units.
- The hypotenuse (ladder length) \(h = 6 \times 2 = 12 \text{ units} \).

4. Answer:
\[
x = \frac{10}{\sqrt{2}} \approx 7.07 \text{ units (for each leg)}
\]

5. Answer:
- Shorter leg \(s = \frac{l}{\sqrt{3}} = \frac{8}{\sqrt{3}} \approx 4.62 \text{ units} \)
- Hypotenuse \(h = \frac{8}{\sqrt{3}} \times 2 \approx 9.24 \text{ units} \)

Conclusion

Understanding special right triangles is crucial for anyone studying geometry or related fields. The properties of the 45-45-90 and 30-60-90 triangles provide a solid foundation for solving various mathematical problems with ease. This article has provided a detailed overview of these triangles, their applications, and practice problems with an answer key to facilitate learning and comprehension. Mastering these concepts will not only enhance mathematical skills but also contribute to practical applications in everyday life and professional scenarios.

Frequently Asked Questions

What are special right triangles?

Special right triangles are triangles with specific angle measures that allow for easy calculations of side lengths. The two most common types are the 45-45-90 triangle and the 30-60-90 triangle.

What are the side ratios for a 45-45-90 triangle?

In a 45-45-90 triangle, the side lengths are in the ratio 1:1:√2. This means if each leg is 'x', the hypotenuse will be 'x√2'.

What are the side ratios for a 30-60-90 triangle?

In a 30-60-90 triangle, the side lengths are in the ratio 1:√3:2. The shortest side (opposite the 30-degree angle) is 'x', the longer leg (opposite the 60-degree angle) is 'x√3', and the hypotenuse is '2x'.

How do you derive the side lengths of a 45-45-90 triangle?

You can derive the side lengths of a 45-45-90 triangle using the Pythagorean theorem. If both legs are 'x', then the hypotenuse 'c' is calculated as c = √(x^2 + x^2) = x√2.

How do you derive the side lengths of a 30-60-90 triangle?

In a 30-60-90 triangle, you can start with the shortest side 'x'. The longer leg is derived as x√3, and the hypotenuse is simply 2x, based on the properties of the triangle.

What is the importance of special right triangles in geometry?

Special right triangles simplify calculations in geometry and trigonometry, allowing for quick and accurate determination of side lengths and angles without the need for a calculator.

Can special right triangles be used in real-world applications?

Yes, special right triangles are widely used in various fields such as architecture, engineering, and physics for solving problems related to angles and distances.

How can I remember the side ratios of special right triangles?

A good way to remember the ratios is to memorize the patterns: for 45-45-90, think '1, 1, √2'; for 30-60-90, remember '1, √3, 2'; visualizing the triangles can also help reinforce memory.

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