GEOMETRY AND TRIGONOMETRY / 01 UNDERSTAND

Right triangles

An illustrated lesson ▪ Theory, reasoning and worked examples

Identify the right angle first

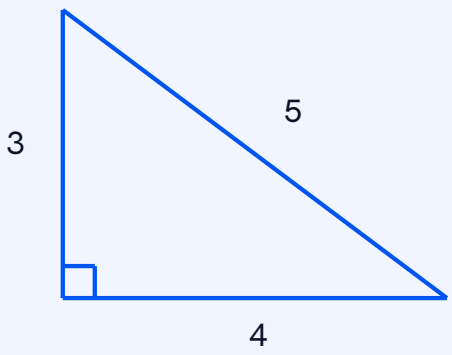
A right triangle contains a 90-degree angle. The side opposite that angle is the hypotenuse, always its longest side. The other two sides are legs. In $a^2 + b^2 = c^2$, c must be the hypotenuse. The diagram may be rotated; position on the page does not determine a side's role.

The theorem compares squared lengths

The Pythagorean theorem states that the sum of the squares on the legs equals the square on the hypotenuse. It does not say the leg lengths themselves add to the hypotenuse. For legs 3 and 4, 9 + 16 = 25, so the hypotenuse is 5. The labelled diagram shows this exact example.

Lengths are positive

Solving $c^2 = 25$ algebraically gives $c = \pm 5$, but a side length is positive, so c = 5. Keep the exact square root if the problem asks for an exact value. Rounding a side too early can distort a later area or trigonometric calculation.



$3^2 + 4^2 = 5^2$

9 + 16 = 25

Hypotenuse: opposite 90°

The small square marks the right angle.

Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

The two legs and hypotenuse satisfy $a^2 + b^2 = c^2$.

GEOMETRY AND TRIGONOMETRY / 02 BUILD THE METHOD

From idea to method

Solve for the missing side

For a missing hypotenuse, add the squares of the legs. For a missing leg, subtract the known leg's square from the hypotenuse's square. If c = 13 and a = 5, then b^2 = 169 - 25 = 144 and b = 12. The largest side must remain the hypotenuse.

Recognize special triangles

A 45-45-90 triangle has side ratio 1:1:√(2). A 30-60-90 triangle has ratio 1:√(3):2, with the shortest side opposite 30 degrees. These ratios scale together. Identifying the angle opposite each side is essential before assigning lengths.

Connect sides to trigonometry

For an acute angle theta, sin(theta) = opposite/hypotenuse, cos(theta) = adjacent/hypotenuse and tan(theta) = opposite/adjacent. Opposite and adjacent depend on the chosen angle; the hypotenuse does not. Complementary acute angles interchange the opposite and adjacent legs.

WORKED EXAMPLE / USE A TRIGONOMETRIC RATIO

In a 3-4-5 right triangle, theta is the angle opposite the side of length 3. Find sin(theta) and cos(theta).

01 Set up the reasoning

The hypotenuse is 5 because it lies opposite the right angle.

02 Apply the relationship

The opposite leg is 3, so sin(theta) = 3/5.

03 Interpret and check

The adjacent leg is 4, so cos(theta) = 4/5. Their squares add to 1: 9/25 + 16/25 = 1.

Keep these distinctions handy

Missing hypotenuse	c = √(a^2 + b^2).
Missing leg	a = √(c^2 - b^2).
Acute-angle ratios	sin = opposite/hypotenuse; cos = adjacent/hypotenuse.

GEOMETRY AND TRIGONOMETRY / 03 CONNECT & REMEMBER

See the deeper pattern

Apply the theorem beyond a drawn triangle

A rectangle's diagonal forms a right triangle with its length and width. On a coordinate plane, horizontal and vertical differences between two points are perpendicular legs, producing distance = $\sqrt{((\text{change in } x)^2 + (\text{change in } y)^2)}$. The same geometric relationship underlies all these contexts.

ONE MORE WORKED APPLICATION

A right triangle has legs of length 27 and 36. What is the hypotenuse length?

1. $c^2 = 27^2 + 36^2 = 2025$.

2. Take the positive square root: $c = 45$.

Answer: 45

Mistakes to recognize

- Check that the triangle really has a right angle.
- Do not use the hypotenuse as a leg in the formula.
- Choose the reference angle before identifying opposite and adjacent sides.

A quick understanding check

Which side must be longest?

Explanation: The hypotenuse, opposite the 90-degree angle.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Geometry and Trigonometry, then look for right triangles questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

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