MATHEMATICS · GRADES 10-12

SOH CAH TOA

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is the memory trick that helps you work out heights and distances with triangles, like how tall a building is or how long a ladder must be, without mixing up which sides go where. Three little words hold the three ratios, so you can remember which sides belong together even under pressure. With the right ratio picked, one angle and one side are enough to find the side you need. It is the shortcut that keeps every triangle problem straight, whether you are on a building site or in an exam.



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Rule

SOH CAH TOA: SOH means sine is opposite over hypotenuse, CAH means cosine is adjacent over hypotenuse, and TOA means tangent is opposite over adjacent.

The three little words hold all three ratios.

Worked examples

EXAMPLE 1

Q In a right triangle, an angle is 30 degrees and the hypotenuse is 12. Find the side opposite the angle.

SOLUTION

This is a find-a-side question, so start with the one rule to remember: label the sides first, in this order, opposite, then hypotenuse, then adjacent. The side across from the angle is the opposite.

You know the hypotenuse and you want the opposite, so you need the ratio that uses opposite and hypotenuse. That is sine: $\sin = \frac{\text{opposite}}{\text{hypotenuse}}$.

So $\sin 30 \text{ degrees} = \frac{\text{opposite}}{12}$. $\sin 30 \text{ degrees}$ is $\frac{1}{2}$, so the opposite is $12 \times \frac{1}{2}$, which is 6.

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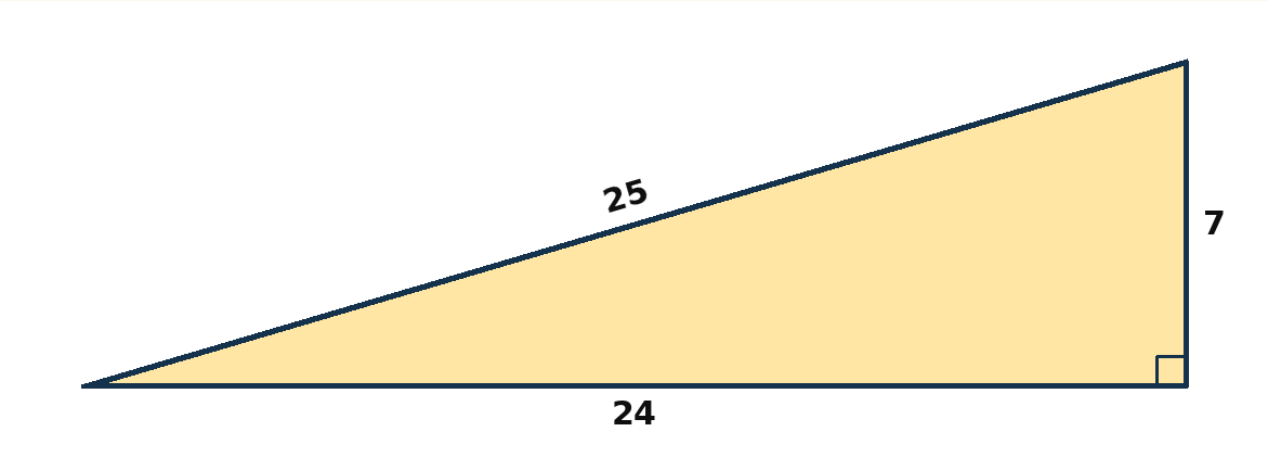
EXAMPLE 2

Q **The picture shows a right triangle with sides 7, 24 and 25. Write the sine, cosine and tangent of the angle at the left, where the 24 side meets the 25 side.**



SOLUTION

This is a write-the-ratios question, so label the sides first: take the angle at the left, where the 24 side meets the 25 side. The side across from that angle is the opposite, 7; the longest side is the hypotenuse, 25; the side left over is the adjacent, 24.

Now use SOH CAH TOA. Sine is opposite over hypotenuse, so $\sin = \frac{7}{25}$. Cosine is adjacent over hypotenuse, so $\cos = \frac{24}{25}$. Tangent is opposite over adjacent, so $\tan = \frac{7}{24}$.

So $\sin = \frac{7}{25}$, $\cos = \frac{24}{25}$ and $\tan = \frac{7}{24}$

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Practice questions

1 Which side of a right triangle is always the longest?

- A Opposite
- B Adjacent
- C Hypotenuse
- D Shortest side

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2 An angle in a right triangle is 30 degrees and the hypotenuse is 20. Find the side opposite the angle.

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3 An angle is 60 degrees and the adjacent side is 5. Find the hypotenuse of the right triangle.

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4 The opposite side is 3 and the hypotenuse is 5. What is the sine of the angle?

A $\frac{5}{3}$

B $\frac{3}{5}$

C $\frac{4}{5}$

D $\frac{3}{4}$

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5 The opposite side is 5 and the adjacent side is 12. What is the tangent of the angle?

A $\frac{12}{5}$

B $\frac{5}{13}$

C $\frac{5}{12}$

D $\frac{12}{13}$

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6 A ladder 10 m long leans against a wall at an angle of 30 degrees to the ground. How high up the wall does the top of the ladder reach?

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7 **The opposite side is 3 and the hypotenuse is 6. What is the angle?**

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8 **The opposite side is 1 and the adjacent side is 1. What is the angle?**

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9 **Which ratio uses the opposite side and the hypotenuse?**

A Cosine

B Tangent

C Sine

D Hypotenuse over adjacent

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10 A ramp rises 5 m over a run of 12 m, and the slope is 13 m long. Find the sine, cosine and tangent of the angle the ramp makes with the ground.

A $\frac{5}{13}, \frac{12}{13}, \frac{5}{12}$

B $\frac{12}{13}, \frac{5}{13}, \frac{12}{5}$

C $\frac{5}{12}, \frac{12}{5}, \frac{13}{5}$

D $\frac{13}{12}, \frac{5}{12}, \frac{12}{13}$

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ANSWER KEY

1. Hypotenuse

2. 10

3. 10

4. $\frac{3}{5}$

5. $\frac{5}{12}$

6. 5 m

7. 30 degrees

8. 45 degrees

9. Sine

10. $\frac{5}{13}$, $\frac{12}{13}$, $\frac{5}{12}$

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