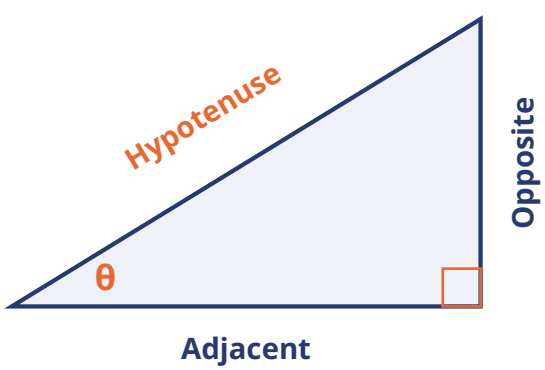
Sin, Cos, Tan: the Three Ratios

In a right-angled triangle, each ratio compares two sides. Always label the sides **from the angle θ** you are working with.



SOH sin θ = Opposite / Hypotenuse

CAH cos θ = Adjacent / Hypotenuse

TOA tan θ = Opposite / Adjacent

Opposite: across from θ. **Adjacent:** next to θ. **Hypotenuse:** the longest side, opposite the right angle.

Remember it: SOH CAH TOA

Ratio	Formula	Say it as
sin θ	Opposite ÷ Hypotenuse	SOH
cos θ	Adjacent ÷ Hypotenuse	CAH
tan θ	Opposite ÷ Adjacent	TOA

The three reciprocal ratios

Ratio	Equals	In sides
cosec θ	1 ÷ sin θ	Hypotenuse ÷ Opposite
sec θ	1 ÷ cos θ	Hypotenuse ÷ Adjacent
cot θ	1 ÷ tan θ = cos θ ÷ sin θ	Adjacent ÷ Opposite

Also: **tan θ = sin θ ÷ cos θ**

Common mistakes

- Mixing up opposite and adjacent: they change when you switch to the other acute angle.
- Using the formulas on a triangle that has no 90° angle.
- Forgetting to set the calculator to **degree** mode.
- Answer to sin or cos greater than 1: impossible, so recheck your sides.

Values Table for Standard Angles

Learn this table. It appears in almost every Class 10 trigonometry exam.

θ	0°	30°	45°	60°	90°
sin θ	0	1/2	1/√2	√3/2	1
cos θ	1	√3/2	1/√2	1/2	0
tan θ	0	1/√3	1	√3	not defined
cosec θ	not defined	2	√2	2/√3	1
sec θ	1	2/√3	√2	2	not defined
cot θ	not defined	√3	1	1/√3	0

Memory trick for sin: write 0, 1, 2, 3, 4 and take √(n/4) of each: √0/2, √1/2, √2/2, √3/2, √4/2 = 0, 1/2, 1/√2, √3/2, 1. For cos, read the same list backwards.

Key identities

Identity	Also written as
$\sin^2\theta + \cos^2\theta = 1$	$\sin^2\theta = 1 - \cos^2\theta$ or $\cos^2\theta = 1 - \sin^2\theta$
$1 + \tan^2\theta = \sec^2\theta$	$\sec^2\theta - \tan^2\theta = 1$
$1 + \cot^2\theta = \operatorname{cosec}^2\theta$	$\operatorname{cosec}^2\theta - \cot^2\theta = 1$

Complementary angles

Rule (θ and 90° − θ)	Example
$\sin(90° - \theta) = \cos\theta$	$\sin 60° = \cos 30°$
$\cos(90° - \theta) = \sin\theta$	$\cos 75° = \sin 15°$
$\tan(90° - \theta) = \cot\theta$	$\tan 50° = \cot 40°$

Exam tip

- Many answers can be left in surd form (like √3/2) unless the question asks for a decimal. √2 ≈ 1.414 and √3 ≈ 1.732.

Worked Examples and Practice

Try each question yourself before reading the answer.

Example 1: find a side

Q. A ladder 10 m long leans against a wall and makes an angle of 60° with the ground. How high up the wall does it reach?

Solution. The ladder is the hypotenuse, and the height is opposite the 60° angle, so use sin. sin 60° = height ÷ 10, so height = 10 × √3/2 = 5√3 ≈ **8.66 m**.

Example 2: find an angle

Q. In a right-angled triangle the side opposite θ is 5 cm and the side adjacent to θ is 5 cm. Find θ.

Solution. Opposite and adjacent are given, so use tan. tan θ = 5 ÷ 5 = 1, and tan 45° = 1, so θ = **45°**.

Example 3: use an identity

Q. If sin θ = 3/5, find cos θ (θ is acute).

Solution. Use $\sin^2\theta + \cos^2\theta = 1$. $\cos^2\theta = 1 - 9/25 = 16/25$, so cos θ = **4/5**.

Your turn

1. Find the value of sin 30° + cos 60°.

2. A tree casts a shadow 12 m long when the sun's angle of elevation is 45°. How tall is the tree?

3. Simplify: $(1 - \sin^2\theta) \div \cos\theta$.

4. If tan θ = 4/3, find sin θ and cos θ.

5. Evaluate: sin 60° cos 30° + cos 60° sin 30°.

Answers

- 1) 1 | 2) 12 m | 3) cos θ | 4) sin θ = 4/5, cos θ = 3/5 | 5) 1

Want more practice? Take the free quizzes at thepractiseground.in and read the full guide at thepractiseground.in/blog/trigonometry-beginners-sin-cos-tan-made-easy.