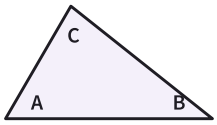
REFERENCE SHEET

Right Triangle Trigonometry

Opposite · Adjacent · Hypotenuse

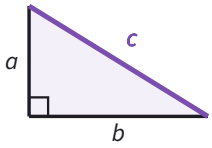
1 Start Here



Triangle Angle Sum

$A + B + C = 180°$

In a right triangle, the two acute angles add to 90°.

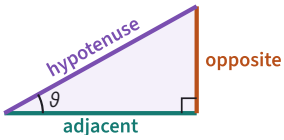


Pythagorean Theorem

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

Right triangles only. c is always the hypotenuse.

2 Vocabulary



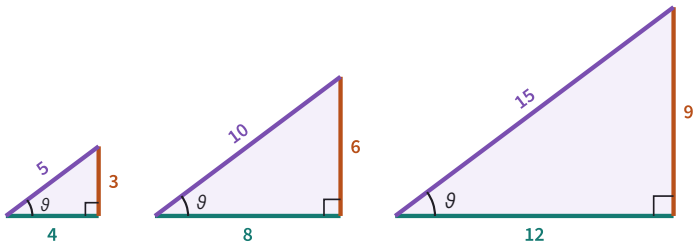
Hypotenuse: the longest side, across from the right angle.

Opposite: the leg across from angle θ.

Adjacent: the leg touching angle θ (not the hypotenuse).

Reference angle θ: the acute angle you are working from. Switch angles and opposite/adjacent switch too.

3 Why Trig Works: Similar Right Triangles



Right triangles that share an acute angle θ are **similar by AA**: each has a 90° angle and angle θ. Similar triangles have proportional sides, so every side ratio stays the same no matter how big the triangle is.

Ratio	Small	Medium	Large	Value
opp ÷ hyp	3/5	6/10	9/15	**0.6**
adj ÷ hyp	4/5	8/10	12/15	**0.8**
opp ÷ adj	3/4	6/8	9/12	**0.75**

The ratio depends **only on the angle**. That is why we can give each ratio a name, like sin θ, and use it for every right triangle with angle θ.

4 The Six Trig Functions

SOH · CAH · TOA

SOH — SINE: $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$

CAH — COSINE: $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$

TOA — TANGENT: $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

Reciprocal functions: flip the ratio of the partner above it.

COSECANT

$\csc\theta = \frac{\text{hyp}}{\text{opp}} = \frac{1}{\sin\theta}$

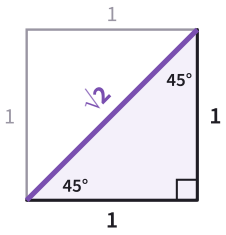
SECANT

$\sec\theta = \frac{\text{hyp}}{\text{adj}} = \frac{1}{\cos\theta}$

COTANGENT

$\cot\theta = \frac{\text{adj}}{\text{opp}} = \frac{1}{\tan\theta}$

5 Special Right Triangles

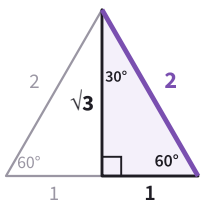


45°–45°–90°

Draw the diagonal of a square with side 1. It splits the square into two right triangles with angles 45°, 45°, 90°.

$1^2 + 1^2 = c^2$, so $c = \sqrt{2}$.

legs x, x · hypotenuse $x\sqrt{2}$



30°–60°–90°

Cut an equilateral triangle with side 2 in half. The cut splits the 60° top angle into 30° and the base into 1 and 1.

$1^2 + b^2 = 2^2$, so $b = \sqrt{3}$.

short leg x · long leg $x\sqrt{3}$ · hyp $2x$

The short leg is across from the 30° angle.

6 Inverse Trig Functions

Trig functions take an **angle** and give a **ratio**. Inverse trig functions go backward: they take a ratio and give the angle.

30° — sin → 0.5

0.5 — $\sin^{-1}$ → 30°

Read **$\sin^{-1}(x)$** as "the angle whose sine is x." Likewise for **$\cos^{-1}$** and **$\tan^{-1}$**. Use them when you know two sides and need an angle.

Calculator: 2nd (or SHIFT), then SIN, COS, or TAN.

7 Which Function Do I Use?

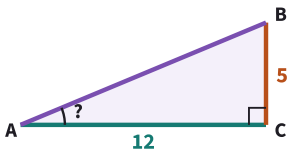
Label the sides from your angle, then match the two sides involved (known or wanted).

Two sides involved	Use	Inverse
Opposite & Hypotenuse	**sin**	$\sin^{-1}$
Adjacent & Hypotenuse	**cos**	$\cos^{-1}$
Opposite & Adjacent	**tan**	$\tan^{-1}$

Finding a **side**? Use sin, cos, or tan. Finding an **angle**? Use the inverse.

8 Skill 1: Find a Missing Angle

1. Label the sides from the angle you want: opposite, adjacent, hypotenuse.
2. Choose the function that uses the two sides you **know**.
3. Write the equation: trig(angle) = ratio.
4. Undo the trig with its **inverse**.
5. Calculate in degree mode and round.



EXAMPLE · FIND m∠A

From A: **opp = 5**, **adj = 12**

→ use tangent

$\tan A = \frac{5}{12}$

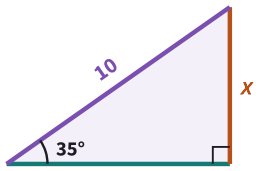
$A = \tan^{-1}\left(\frac{5}{12}\right) \approx 22.6°$

9 Skill 2: Find a Missing Side

1. Label the sides from the given angle.
2. Choose the function that links the **known side** and the **unknown side**.
3. Write the equation: trig(angle) = ratio with x.
4. Solve for x (multiply or divide).
5. Calculate in degree mode and round.

If x is on the bottom, divide:

$\cos 40° = \frac{8}{x} \rightarrow x = \frac{8}{\cos 40°} \approx 10.4$



EXAMPLE · FIND x

From 35°: **x = opp**, **hyp = 10**

→ use sine

$\sin 35° = \frac{x}{10}$

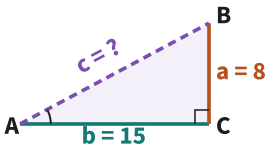
$x = 10 \sin 35° \approx 5.7$

10 Skill 3: Solve a Right Triangle

Solving means finding all three sides and all three angles. **C = 90°**; side a is across from A, b from B, c from C.

1. **Angles.** Know an acute angle? The other is 90° minus it. Know two sides? Use inverse trig.
2. **Sides.** Use sin, cos, or tan with a known angle, or the Pythagorean Theorem with two known sides.
3. **Check.** Angles add to 180°. The longest side is across from the largest angle.

CASE A · GIVEN TWO SIDES



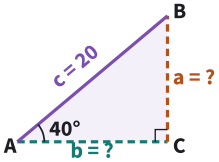
c: $c^2 = 8^2 + 15^2 = 289$, so **c = 17**

A: $\tan A = \frac{8}{15}$

$A = \tan^{-1}\left(\frac{8}{15}\right) \approx 28.1°$

B: $180° - 90° - 28.1° \approx 61.9°$

CASE B · GIVEN A SIDE AND AN ANGLE



B: $180° - 90° - 40° = 50°$

a: $\sin 40° = \frac{a}{20} \rightarrow a = 20 \sin 40°$

≈ 12.9

b: $\cos 40° = \frac{b}{20} \rightarrow b = 20 \cos 40°$

≈ 15.3

Check: $12.9^2 + 15.3^2 \approx 400 = 20^2$ ✓