Right-angled trigonometry

Leaving Certificate · Ordinary Level

Understand the idea

How to start

These sine, cosine and tangent ratios apply to right-angled triangles. The side names depend on the angle you choose.

1. Label opposite, adjacent and hypotenuse from the chosen angle.
2. Choose the ratio containing the known side and the side you need.
3. Write the equation, rearrange it and calculate in degree mode.

Key terms & definitions

Opposite
The side across from the chosen angle.

Adjacent
The side beside the chosen angle other than the hypotenuse.

Inverse trigonometric function
A calculator function used to recover an angle from a ratio.

Key ideas

• Relative to the chosen angle, label the opposite side, adjacent side and hypotenuse.

• $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$, $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$.

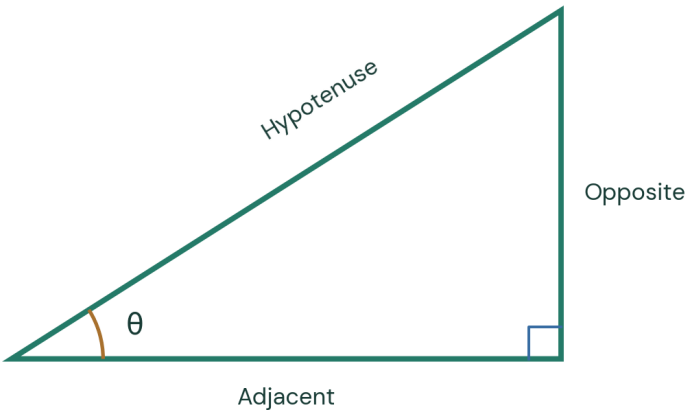
• Choose the ratio containing the known side and the side you need. Write the equation before rearranging.

• For an angle, use the inverse ratio on your calculator, such as $\theta = \sin^{-1}\left(\frac{\text{opposite}}{\text{hypotenuse}}\right)$.

• Use degree mode. Keep extra decimal places during working, including decimal angles.

• On the unit circle, a point at angle θ has coordinates $(\cos\theta, \sin\theta)$. The signs of the coordinates tell you the signs of cosine and sine.

• For angles from 90° to 180°, sine is positive and cosine is negative; from 180° to 270° both are negative; from 270° to 360° cosine is positive and sine is negative.



Label sides relative to θ: opposite across from θ, adjacent beside θ, hypotenuse opposite the right angle.

Quick reminder

• Label opposite, adjacent and hypotenuse relative to the angle.

• Choose the ratio containing the known and unknown sides.

• Use degree mode; use an inverse ratio to find an angle.

Worked examples

Example 01 · Start here: choose the ratio before calculating

A right triangle has hypotenuse 10 cm and angle 30°. Find the side opposite this angle.

Why this method?

Label the triangle relative to the marked angle. Choose sine because the question uses opposite and hypotenuse; do not choose a ratio just because it is familiar.

$\sin 30^\circ = \frac{o}{10}$	**Step 1** The known side is the hypotenuse and the unknown is opposite. Sine connects exactly these two sides.
$o = 10\sin 30^\circ$	**Step 2** Multiply both sides by 10 to undo the division by 10.
$o = 10(0.5) = 5$	**Step 3** In degree mode, $\sin 30^\circ$ is 0.5.

The opposite side is 5cm.	**Step 4** State the length and its unit.

Example 02 · Find an angle

A right triangle has opposite side 7 cm and hypotenuse 12 cm relative to angle θ. Find θ to one decimal place.

Why this method?

Label opposite, adjacent and hypotenuse relative to the chosen angle. Choose the ratio that contains the known and required sides.

$\sin\theta = \frac{7}{12}$	**Step 1** Choose sine
$\theta = \sin^{-1}(\frac{7}{12}) \approx 35.685^\circ$	**Step 2** Use inverse sine in degree mode
$\theta \approx 35.7^\circ$	**Step 3** Round at the end

Example 03 · Find a denominator side

A ladder makes an angle of 65° with level ground and reaches $4m$ up a vertical wall. Find its length.

Why this method?

Label opposite, adjacent and hypotenuse relative to the chosen angle. Choose the ratio that contains the known and required sides.

The ladder is the hypotenuse; the height is opposite the 65° angle.	**Step 1** Label the right triangle
$\sin 65^\circ = \frac{4}{L}$, so $L = \frac{4}{\sin 65^\circ}$.	**Step 2** Choose and rearrange sine
$L \approx 4.41\text{m}$	**Step 3** Divide 4 by $\sin 65^\circ$ in degree mode, then round the length to two decimal places.

Example 04 · An angle beyond 90 degrees

Find $\sin 150^\circ$ and $\cos 150^\circ$.

Why this method?

Read the requested quantity, choose the matching rule and follow the reason beside each line.

$180^\circ - 150^\circ = 30^\circ$	**Step 1** The reference angle is 30°. The point is in the upper-left quarter of the unit circle.
$\sin 150^\circ = \sin 30^\circ = \frac{1}{2}$	**Step 2** The vertical coordinate is positive.
$\cos 150^\circ = -\cos 30^\circ = -\frac{\sqrt{3}}{2}$	**Step 3** The horizontal coordinate is negative.

Example 05 · Use an exact ratio outside the first quadrant

Find $\sin 150^\circ$ and $\cos 150^\circ$ exactly.

$180^\circ - 150^\circ = 30^\circ$	**Step 1** Find the reference angle.
$\sin 150^\circ = \frac{1}{2}$	**Step 2** In quadrant II, y is positive.
$\cos 150^\circ = -\frac{\sqrt{3}}{2}$	**Final step** In quadrant II, x is negative.

Common mistake

Treating the same side as “opposite” whichever angle is used. Identify the chosen angle first. The opposite side faces that angle; the adjacent side touches it and is not the hypotenuse.

Exam technique

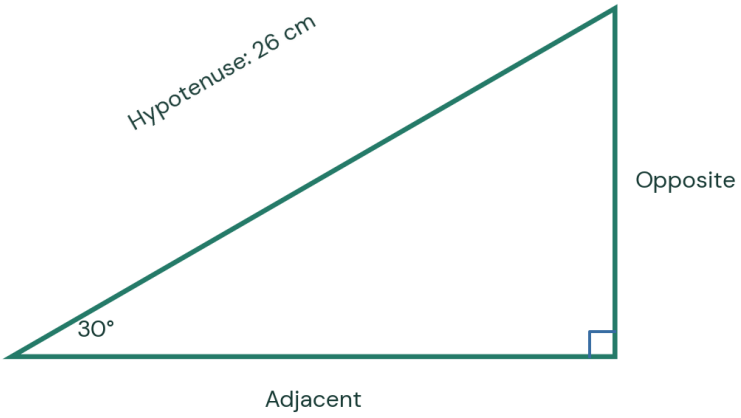
An angle of elevation is measured upwards from a horizontal line.

Try it yourself

Work on paper before checking the answers at the end. These questions are for self-checking, not submitted homework.

Question 1

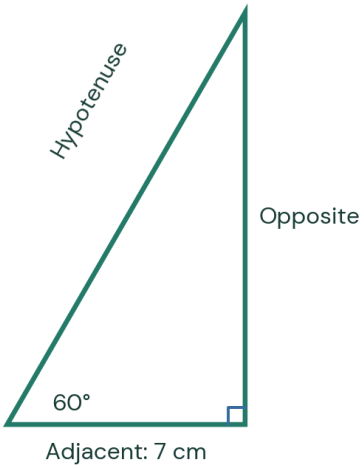
In a right-angled triangle, the angle θ is 30°. The hypotenuse is 26 cm. Find the side opposite θ.



Right triangle for this question. Angle 30 degrees; known hypotenuse is 26 cm. Other sides are not labelled with answers.

Question 2

In a right-angled triangle, the angle θ is 60°. The side adjacent to θ is 7 cm. Find the hypotenuse.



Right triangle for this question. Angle 60 degrees; known adjacent to θ is 7 cm. Other sides are not labelled with answers.

Watch an explanation

Corbettmaths — Trigonometry introduction:

Corbettmaths — Trigonometry missing sides:

Corbettmaths — Trigonometry missing angles:

Open the website chapter to load the embedded players. Use the rates and rules in your question for financial examples.

Self-check answers

Question 1

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Question 2

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Open the full chapter online