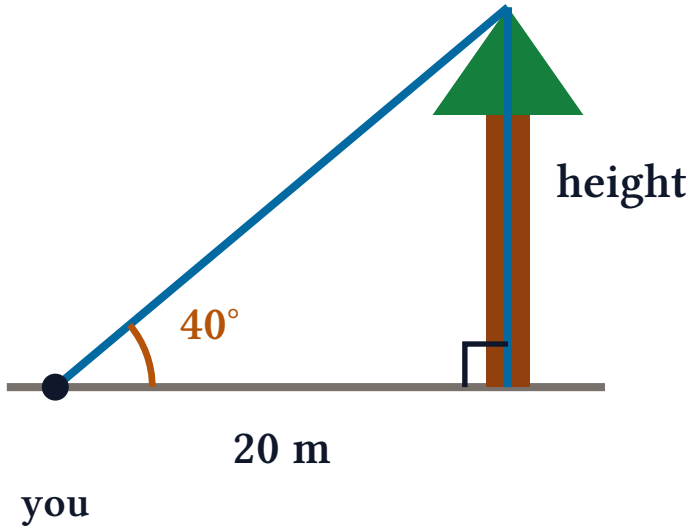
Mathematics 10C

Unit M: Measurement and trigonometry

Primary trigonometric ratios in right triangles

A tree from the ground

- You stand 20 m from the trunk.
- The angle up to the top is 40 degrees.
- The height is the opposite side.



Three ratios

- The hypotenuse sits across from the right angle.
- Sine uses opposite over hypotenuse.

Key terms

hypotenuse

The longest side of a right triangle, the side across from the right angle. (the side opposite the right angle)

opposite side

The leg across the triangle from a chosen acute angle. (across from a named acute angle)

adjacent side

The leg that touches a chosen acute angle and is the remaining side once the hypotenuse is identified. (beside a named acute angle)

sine

The ratio of the opposite side to the hypotenuse for an acute angle in a right triangle. ($\sin\theta$ = opposite/hypotenuse)

Key terms

cosine

The ratio of the adjacent side to the hypotenuse for an acute angle in a right triangle. ($\cos\theta = \text{adjacent}/\text{hypotenuse}$)

tangent

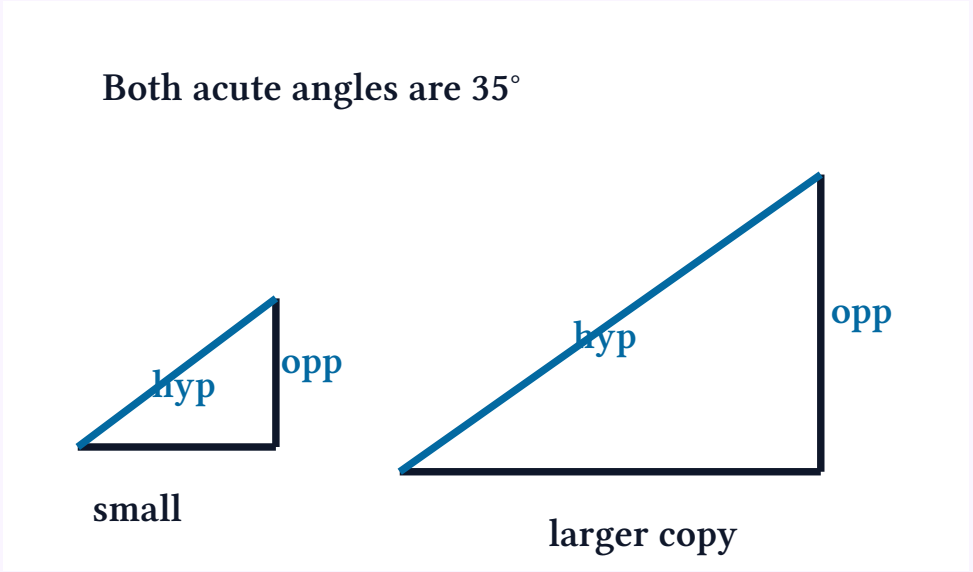
The ratio of the opposite side to the adjacent side for an acute angle in a right triangle. ($\tan\theta = \text{opposite}/\text{adjacent}$)

angle of elevation

The angle between a horizontal line of sight and the line looking up to an object. (angle above the horizontal)

A 3-4-5 ratio that scales

- In a small triangle, opposite 3 and hypotenuse 5 give sine 0.6.
- Doubling both sides gives 6 and 10, and $^{6}/_{10}$ is still 0.6.



A 30 degree triangle

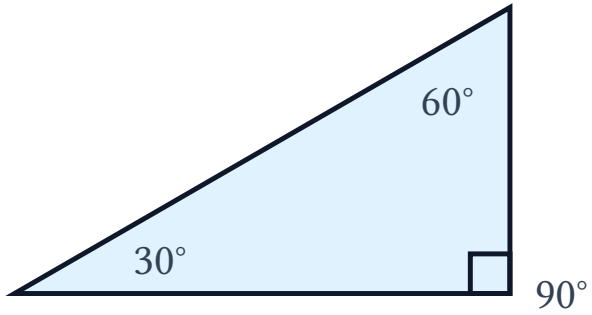
- The hypotenuse is 10 cm.
- Using $\sin 30° = 0.5$, the opposite side is 5 cm.
- Using the rounded value $\cos 30° = 0.866$, the adjacent side is 8.66 cm.

The third angle

- The right angle is 90 degrees.
- The acute pair sums to 90 degrees.
- Here the other acute angle is 60 degrees.

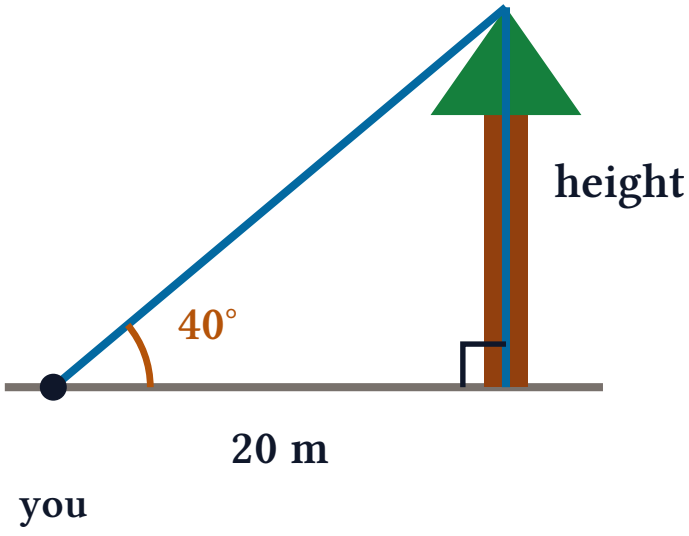
Acute angles sum to 90°

30° + 60° = 90°



Choosing tangent for the tree

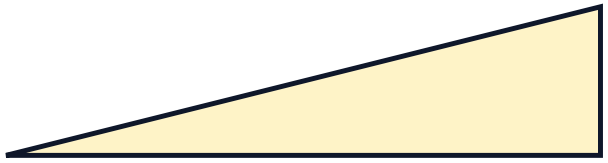
- You know the adjacent side (20 m) and want the opposite side (the height), so use tangent.
- Tangent is opposite over adjacent.
- Using the rounded value $\tan 40° = 0.839$, the height is $20 \times 0.839 = 16.78$ m.



The Pythagorean theorem for sides

- A ramp rises 0.6 m over a run of 3.6 m.
- The squares are 0.36 and 12.96.
- Their sum is 13.32, and the ramp is about 3.65 m.

Ramp 0.6 m rise, 3.6 m run



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

A ladder against a wall

- The ladder is 6.5 m and the base is 2.5 m out.
- The height is $\sqrt{6.5^2 - 2.5^2} = \sqrt{36} = 6m$.

Quick check

- The hypotenuse is 13 cm and one acute angle is 25 degrees.
- The opposite side uses sine: opposite = 13 × sin 25°.

A ratio or a theorem

- An angle measure points to sine, cosine, or tangent.
- Three sides and a right angle point to the Pythagorean theorem.