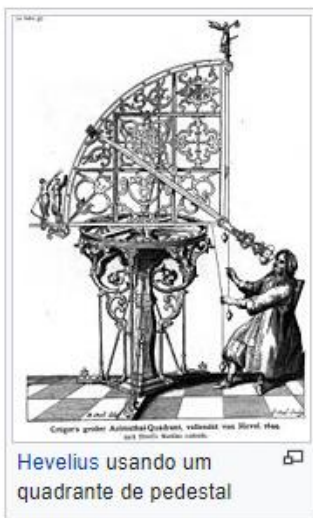


Inaccessible height

Quadrant

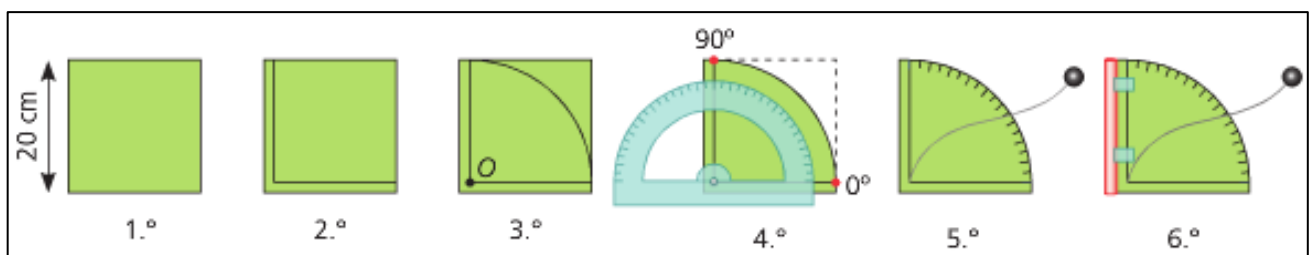
The quadrant is an ancient instrument used to measure angles.

More than five hundred years ago, it was used by astronomers and Portuguese navigators to determine the height of stars (expressed in the form of an angle) and the Sun.



Building a quadrant (see picture 1)

- 1° - Cut a 20-cm square in thick cardboard.
 - 2° - With the ruler, leave a 1 cm margin on two adjacent sides.
 - 3° - Draw a quarter of a circle with center O and with a radius of 19 cm.
 - 4° - With the protractor, graduate the quadrant (from 0° to 90°).
- Then cut out the card.
- 5° - Pierce the card at point O and attach a 30 cm long wire, with a weight at the end.
 - 6° - Cut a straw and fix it with tape on the 90° side.



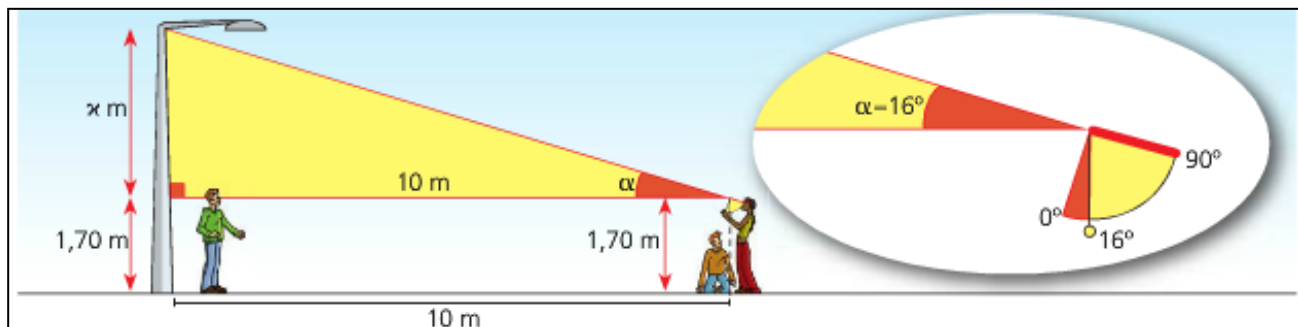
Picture 1

How to measure an inaccessible height

Using the quadrant, a measuring tape and Trigonometry, it is possible to measure the height of a tree, a house or any other high point.

To do this, observe the high point, through the crosshairs (straw) of the quadrant on the side where the 90° is marked, and read the angle marked by the wire that hangs vertically, as shown in the figure below.

This angle is equal to the amplitude angle α indicated in picture 2



Picture 2

Task

- Build a quadrant as suggested above (Picture 1).
- Choose and identify three inaccessible points that you may find in the space, inside or outside, of the school (like the pictures show) and determine the height of each one respectively (if necessary, consult the trigonometry notes below).

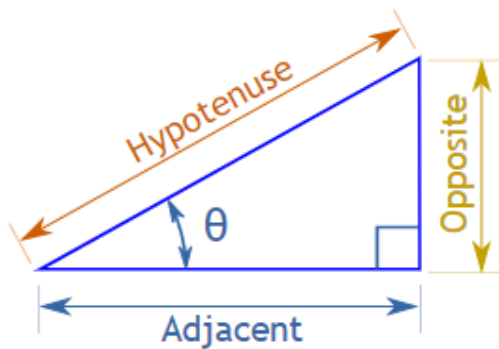


Basic Trigonometry

$$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$$

$$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

$$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$$



How to remember? Think "**Sohcahtoa**"!

It works like this:

Soh... Sine = Opposite / Hypotenuse
...cah... Cosine = Adjacent / Hypotenuse
...toa Tangent = Opposite / Adjacent

Example: Find the length of the side **y**:

- **Step 1** The two sides we are using are **Opposite** (y) and **Adjacent** (7).
- **Step 2** SOHCAHTOA tells us to use **Tangent**.
- **Step 3** Put our values into the tangent function:

$$\begin{aligned}\tan 53^\circ &= \text{Opposite/Adjacent} \\ &= y/7\end{aligned}$$

- **Step 4** Solve:

$$\text{Start with: } \tan 53^\circ = y/7$$

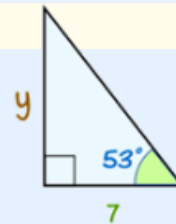
$$\text{Swap: } y/7 = \tan 53^\circ$$

$$\text{Multiply both sides by 7: } y = 7 \tan 53^\circ$$

$$\text{Calculate: } y = 7 \times 1,32704\dots$$

$$y = \mathbf{9,29} \text{ (to 2 decimal places)}$$

$$\text{Side } y = \mathbf{9,29}$$



In: <https://www.mathsisfun.com/sine-cosine-tangent.html>