

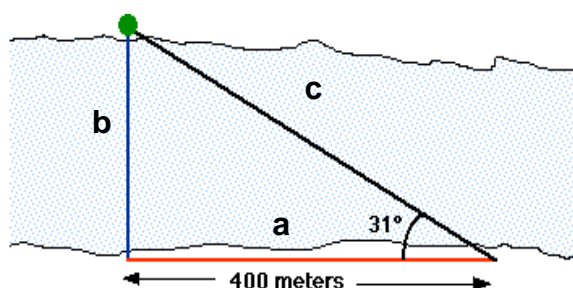
MATHEMATICS

Level One

'Surveying' the River Width

Many wonder if the sine, cosine and tangent functions that you learn about in the classroom have a real- world use. They do!

Surveyors use the trigonometric functions a lot. For example, they can use trigonometry to work out the distance across rivers.

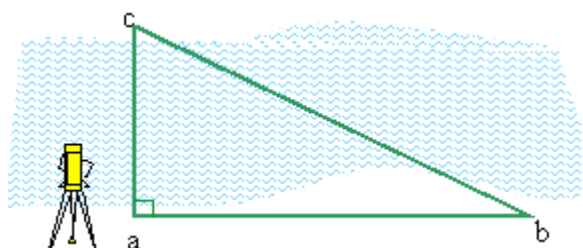


We first set up a survey peg directly across the river from some landmark (like another peg or a tree). Then we head downstream a distance that we can measure; in this case, 400 metres. Now we take a sighting on the tree from downstream (side c). The surveying

instrument (or theodolite) will tell us what our horizontal angle is. In this case, it's 31 degrees. You can see the right-angled triangle, so you can work out sides b or c using SOHCAHTOA rules.

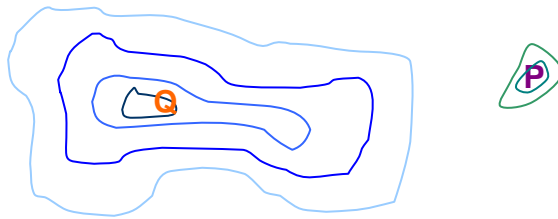
Below are a few examples using trigonometry, see how you go.

1) Becky the Surveyor needs to know the width of the river so that a new bridge can be built. She has already placed two pegs at points **a**, and **c** (the two end points of the bridge) but because of technical problems cannot measure between them. She goes to **b** and measures the horizontal angle between a and c as 36.8°. She measures a distance from b to c 513.86m.



- Label the diagram with the information given.
- If the pegs on each side are set back 1m from the river bank, what is the width of the river?
- How far down the river did you set up?

- 2) You have been asked to calculate the height of the local Radio Tower so that you can calculate the coverage you will receive from it. You position your theodolite 100m away from the tower and measure the angle of elevation to the top of the tower as 42° . Find its height to three decimal places. How would you change your answer if you had to consider the height of the instrument?
- 3) A surveyor stands at point P. He measures the angle of elevation to the top of the Mountain top Q to be 20.8° and the slope distance to be 5.76km. His measurement is made from a height of 1.584m above ground.
 - a. Draw a diagram showing the information you have been given.
 - b. How high is the mountain, in relation to the height of ground level at P?
 - c. How far are you away from the top of the mountain?



- 4) A 60m pole casts a 25m shadow to the left, what is the elevation of the sun
- 5) A 100m pole casts a 120m shadow to the right, what is the elevation of the sun? If no shadow was cast what would the angle of elevation of the sun be? Where on the Earth's surface could this occur?

EXTENSION: - A challenge for level one!

Two surveyors stand on opposite sides of a valley. They are on a straight line through a trig station, A. Andy is north of Anna and the trig station is north of Andy. They sight to another trig station, B further along the ridge, due west of trig station, A. Andy measures a horizontal angle of 62.48° from the trig station A to trig station B, while Anna measures a horizontal angle of 46.54° from the trig station A to trig station B. The distance between the two trigs is 2680m.

- a. Draw and label a diagram.
- b. Calculate the width of the valley.
- c. How far is Andy from both trigs?
- d. How far is Anna from both trigs?