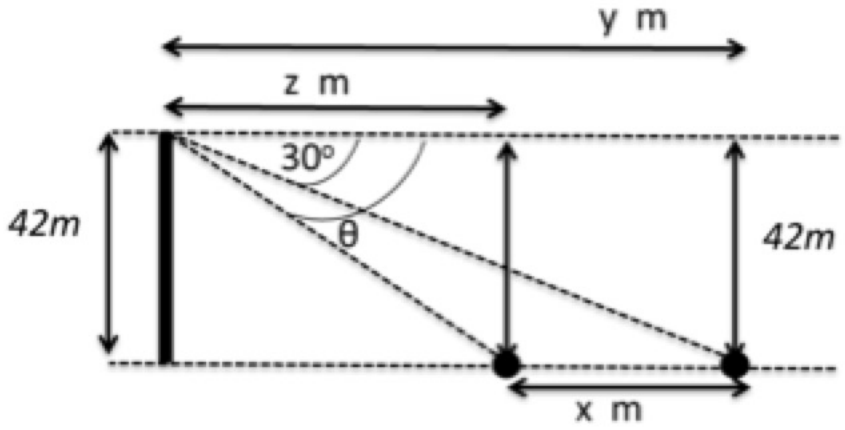
AIMSSEC

AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE
TEACHER NETWORK

CLIFF RESCUE



Two ships are heading towards a lighthouse on the same path, one behind the other. From a height of 42 metre the closer ship can be observed at an angle of depression θ where tan θ = ⅘ and the other ship at an angle of depression of 30 degrees. Draw a diagram.

How far are the two ships from each other?

SOLUTION

$$\tan\theta = \frac{42}{z} = \frac{4}{5}$$

$$z = \frac{5 \times 42}{4} = 52.5$$

$$\tan 30 = \frac{42}{y}$$

$$y = 42\sqrt{3}$$

The distance between the ships is

$$x = y - z = 42\sqrt{3} - 52.5 \ = 20.25m$$

NOTES FOR TEACHERS

Why do this activity?

This application shows learners an application of school mathematics to a real life problem.

Intended learning outcomes

Practice in reading a question and drawing a diagram from the information given.
Use and consolidation of knowledge of special angles.
Development of problem solving skills.

Possible approach

Give learners the problem to read and ask them to draw the diagram for themselves.

Review the diagrams. Then ask the learners to work individually to solve the problem then to compare their answers with a partner.

Finally ask a pair of learners to write up the solution on the board and to explain their working.

Emphasise that it is much quicker to use the tangent ratios that that they should know for 30^o than to use a calculator.

Discuss the practical situation and why a slightly longer rope is needed.

Key Questions

Can you find right angled triangles?
Which distances can you calculate from the right angled triangles?

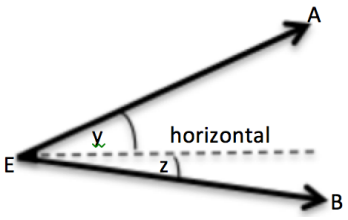
Possible extension

Try the similar problem Cliff Rescue https://aiminghigh.aimssec.ac.za/grades-10-and-11-cliff-rescue/

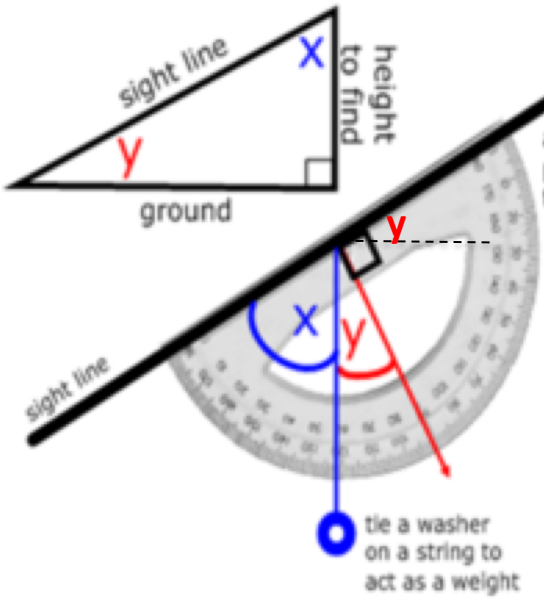
Possible support

The class could make their own clinometers and do some projects.

Make your own clinometer to measure angles of elevation and depression



If an observer with her eye at E looks up to a point A, then the angle between the horizontal and EA, shown in the diagram as ∠y, is called the angle of elevation. Similarly if the observer looks down to a point B then the angle between the horizontal and EB, shown as ∠Z, is called the angle of depression.



The diagram shows an instrument to measure these angles. It can be made simply and cheaply. To read the angles you need a protractor. To get an accurate vertical you need a weight (such as a heavy paperclip, a washer or a ball of plasticene) tied to a piece of string as the plumb line. To make the sight line use a drinking straw or stick.

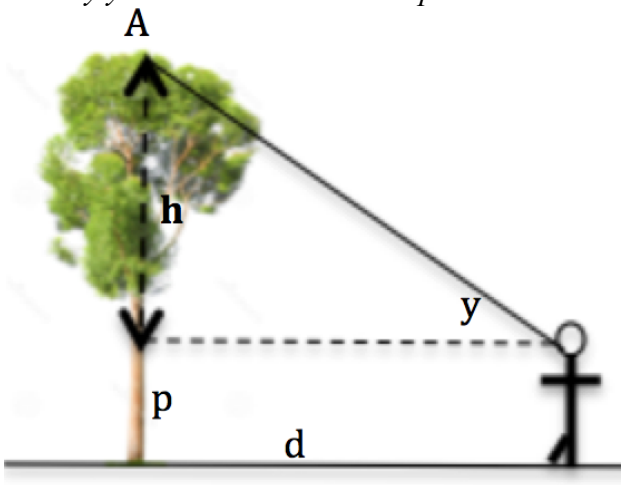
If you hold the protractor with the 90^o mark on the vertical the sight line is horizontal. Two people find the angle of elevation ∠y, one holds the instrument to their eye looking at the object of interest through the straw along the line of sight. The other person reads the angle between the vertical plumb line and the 90^o mark on the protractor. This is ∠y equal to the angle of elevation.

Some suggestions for practical activities

As a preparation for using trigonometry for finding angles and distances you can ask learners to draw accurate scale drawings and make measurements from their drawings to find angles and distances. All these activities are suitable for senior phase. At FET phase learners can do the same activities and, using sketches rather than accurate scale drawing, find the angles and distances by trigonometry.

Measuring the height of trees and buildings

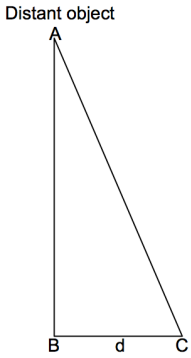
Clearly you can't climb to the top to do the measurement so scale drawing or trigonometry is useful.



1. Measure a distance along the ground (say 30 metres) from the bottom of the tree or building and stand on this spot. Call this distance d
2. Measure the angle between the horizontal and the line from your eye to the top of the tree (angle of elevation). Call this angle y.
3. Draw the right angled triangle with a horizontal line from your eye to the tree, a vertical line up the tree (or building) and the line from your eye to the top.
4. Mark the distance d, the height of the building above this level h and angle y.
5. Then h divided by d is the tangent of angle y. Use trigonometry to calculate h. Add the height p from the ground to your eye level to get the height of the tree.

How far is it across the river or how far is that boat away across the sea

Can you find this without swimming across? You might do this across some imaginary river say in your school hall or playground or a nearby field.



1. You want to find the distance straight across the river. Take a sighting on a tree or some object directly opposite to you on the far bank, call this object A. Now mark the spot you are standing with some object B that you will be able to see from along the river bank. (It might be a far away village, or a ship at sea and you might be on a beach instead of on a river bank.)
2. Measure the distance d between where you are standing and another spot C along the river bank on your side of the river. ABC is a right angled triangle.
3. From the second observation point C measure the angle between the direction CB and the direction CA. Then the distance AB divided by the distance BC = d (which you know) gives you the tangent of this angle ∠CAB and you can calculate the width of the river.

East West and North South distances

1. Village A is 50 kilometres North West of village B. How far North is it from village B and how far west is it?
2. The diagram you need is a right angled triangle with angles of 45 degrees and hypotenuse of length 50 km. You can use sine and cosine to calculate the EW and NS distances or Pythagoras Theorem.