

Argyle's Outdoor Educational Classroom

Measuring Trees Activity

What is a **Clinometer**?

It is an instrument for measuring slope angle of a line of sight. It is included in some compasses.

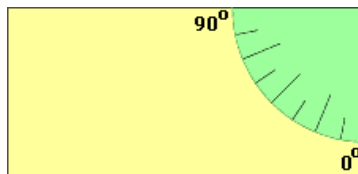
How to make a Clinometer?

Materials Needed:

- piece of cardboard or stiff paper, approximately 25 cm x 30 cm.
- photocopy of enlarged protractor 0 - 90°
- straw
- tape
- scissors
- thread
- button

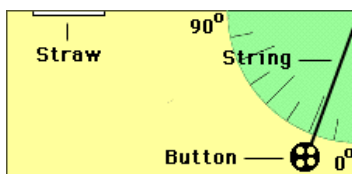
How to make a Clinometer:

1. Cut out the photocopy of the protractor carefully along to 0° and the 90° lines.
2. Glue the protractor into the upper right corner of the cardboard so that the edges match.

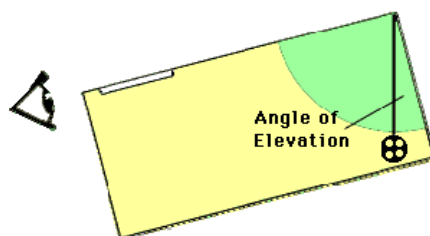


3. Attach the string as close as possible to the upper right corner of the cardboard and attach the button so that it swings freely below the numbers.
4. Tape a 5 - 10 cm piece of straw in the upper left corner so that it sights along the 90° line.

Argyle's Outdoor Educational Classroom



5. To use clinometer: Look through the straw at the object. Have partner read the angle of elevation shown by the string.



(From <http://mathcentral.uregina.ca/RR/database/RR.09.97/bracken1.html#clin>)

ANGLE OF ELEVATION PROBLEMS

1. To measure the height of an inaccessible TV tower, a surveyor paces out a base line of 200m and measures the angle of elevation to the top of the tower to be 62° . How high is the tower?
2. A tourist stands 15m back from the base of a statue and looks up to the top of the statue. If the angle of evaluation is 48° , find the height of the statue.
3. A student paces a base line 12m from the bottom of flagpole. She then uses a clinometer to measure a 35° Angle of Elevation. How high is the flagpole? (The distance from the ground to the student's eyes is 150 cm).

(From <http://mathcentral.uregina.ca/RR/database/RR.09.97/bracken1.html#clin>)

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CLINOMETER: JOBS TO BE DONE

1. **PACER:** for each object to be measured, this person must pace off the distance from the object to the **SIGHTER**. This must be done in a straight line. The **PACER** must then tell the **RECORDER** how many paces it took.
2. **SIGHTER:** this person is in charge of the Clinometer. For each measurement, the **SIGHTER** sights the top of the object and remains still while the **ANGLE READER** has read the angle. He/she should also remain still until the **PACER** has measured the base line.
3. **ANGLE READER:** when the **SIGHTER** has sighted the top of the object, this person reads the size of the **ANGLE OF ELEVATION** shown on the Clinometer and approximates it to the nearest degree. The **ANGLE READER** then tells the **RECORDER** the value of the angle.
4. **RECORDER:** this person will record on the chart the **ANGLE OF ELEVATION**, the number of paces in the base line and the distance from the sighter's eyes to the ground.

(From <http://mathcentral.uregina.ca/RR/database/RR.09.97/bracken1.html#clin>)

PROCEDURES

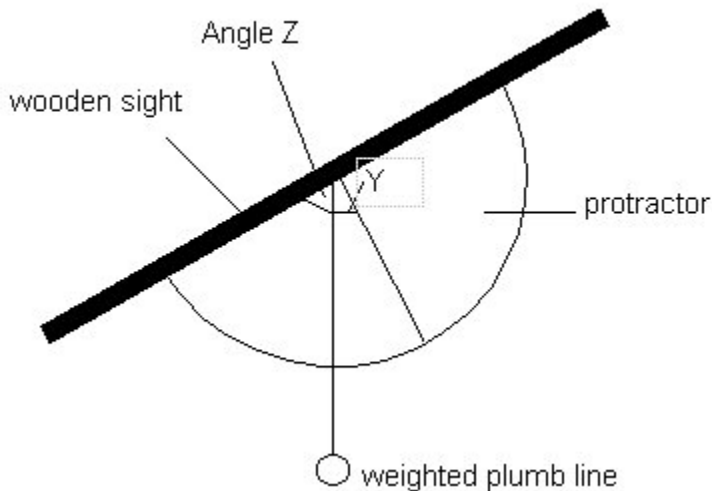
1. The **RECORDER** should be the one to take the instructions and chart outside.
2. The **SIGHTER** should have the Clinometer.
3. When the measurements are finished, return to the classroom and copy the information collected by the **RECORDER**.
4. Draw the diagrams and calculate the rest of the information needed in the table.

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The use of a clinometer to measure tree height.

A clinometer is a fairly simple instrument which is used to measure the angle of a slope. By using the principles of trigonometry, the height of tall objects can be calculated from the angles measured.

A clinometer can easily be made from a large protractor. A narrow piece of wood should be glued to the base of the protractor to act as a sighting line. A weighted plumb line is then fastened to the mid point of the base line of the protractor.

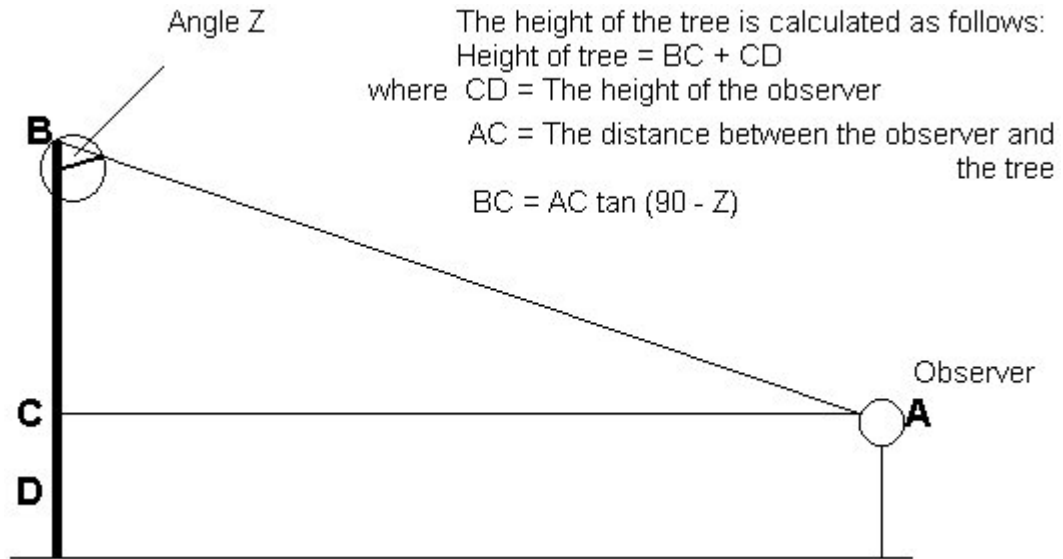


A clinometer which is purchased, rather than home-made, will read the angle Y, shown in the diagram at left.

The line BC, in the diagram below is then calculated by the formula:
 $BC = AC \tan Y$

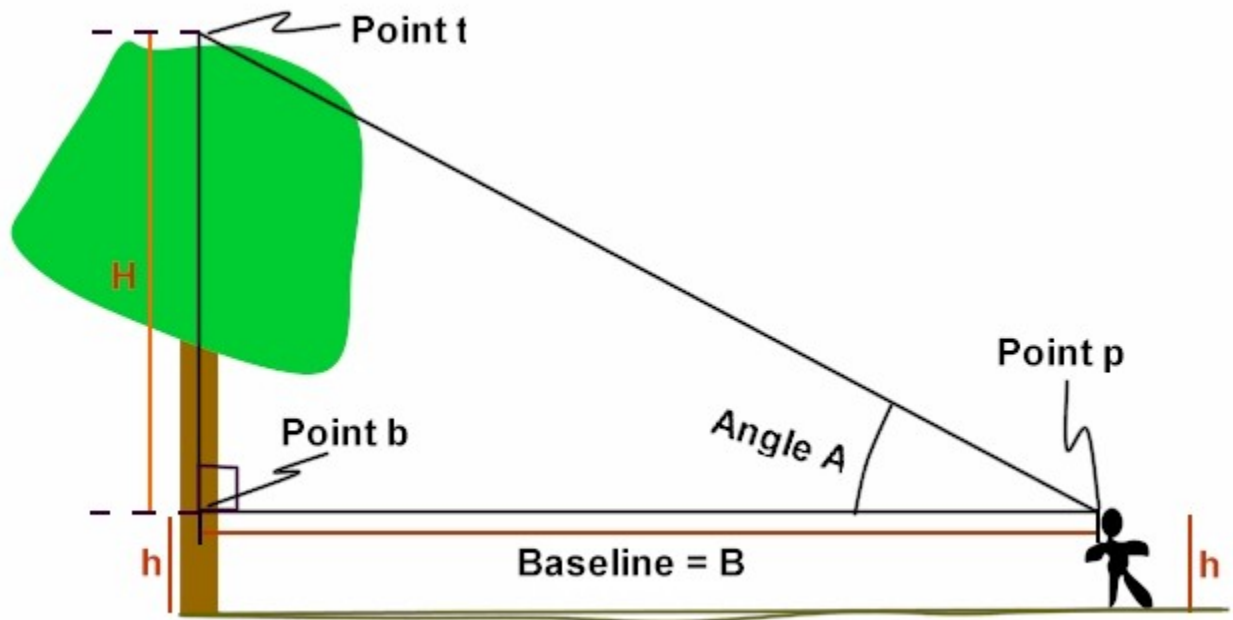
To use the clinometer, hold the base (formed by the wooden sight) uppermost, so that the plumb line hangs down vertically (as shown above). Hold the clinometer out at arms length and sight along it, until your eye and your arm make a straight line to the top of the tree. Someone else should then read off the angle made by the plumb line on the protractor (Z).

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(from: <http://www.countrysideinfo.co.uk/newpage2.htm>)

How to Calculate The Height of a Tree:



h = height of survey observer (to eye level)

*Above: Measuring the height of a mature tree. Where a tree is too tall for its height to be measured directly, it can easily be calculated using simple trigonometry. The survey recorder stands at a measured distance from the base of the tree (baseline B). Using a hand-held device called a clinometer, he or she measures the angle in degrees between the horizontal, their eye and the top of the tree (the **angle bpt = angle A**). Then, using tangent tables (obtained from trigonometrical tables or from a calculator) and the equation **Height of Tree** = $h + B \times \tan(A)$, the survey recorder can calculate the height of the tree and record it in a table.*

(From: http://www.countrysideinfo.co.uk/wet_wood_survey_2001/height.htm)

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What to do: Calculate the height of three trees in the outdoor classroom by using a clinometer. Fill in the data in the following table.

Baseline B	Angle A	h	<i>Height of Tree = $h + B \times \tan(A)$</i>