

Clinometer – Tree Height Measurer

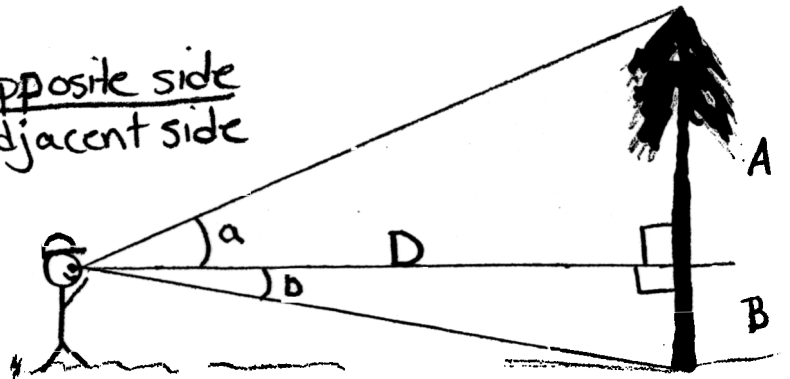
Tree height measurements provide the basis for calculating a variety of information useful to forest managers and ecologists including volume of timber, growth rate, and biomass (amount of living material). Besides it's just fun to know how tall trees are.

The measurement of tree height is based on the geometry of 90° triangles (unless you measure the height of trees directly with a tape measure or pole). The tree is one side of a triangle. The line between the measurer and the tree trunk is another side. The line between the observer and the top of the tree is the 3rd side. Because the measurer's viewing point generally is above the base of the tree, two triangles are formed.

Tangent of an angle = $\frac{\text{opposite side}}{\text{adjacent side}}$

$$A = \text{tangent } a \times D$$

$$B = \text{tangent } b \times D$$

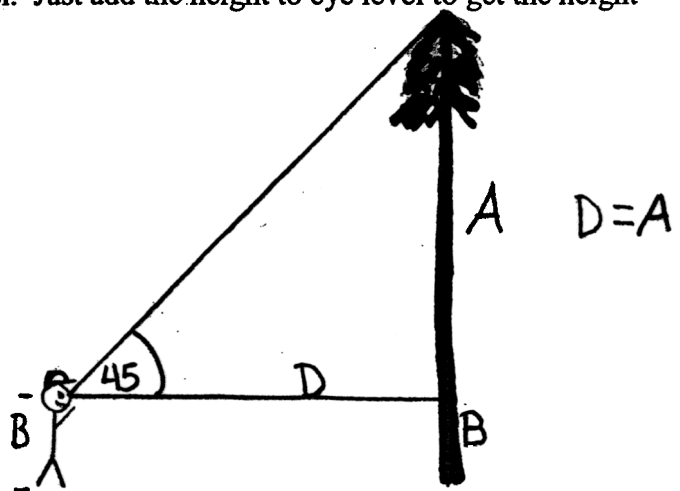


To determine the height of the tree, stand a measured distance from the tree (D) (usually 50, 66, or 100 feet) and measure the angle of sight to the top of the tree using the clinometer. This is angle a. Also measure the angle of sight to the base of the tree. This is angle b. To calculate height, multiply the tangents of each angle by the distance from the tree and add together.

Tangent of angle a X distance from tree + Tangent of angle b X distance from tree = tree height.

Major simplifying hint: The tangent of a 45° angle is 1

Instead of standing a pre-measured distance from the tree, move the appropriate distance from the tree to sight a 45° angle to the top of the tree. The distance from the measurer to the tree is equal to the height of the tree above eye level. Just add the height to eye level to get the height of the entire tree.



Using a clinometer (to measure height)

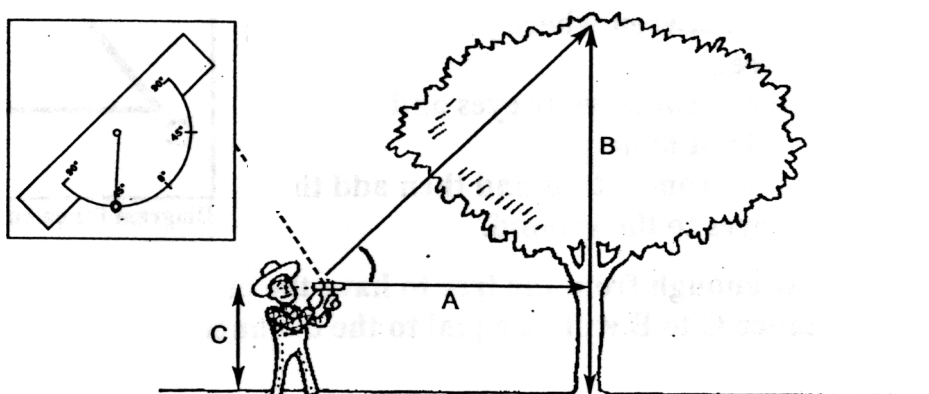
What you will need

- clinometer
- record sheet
- pencil
- tape measure

Instructions

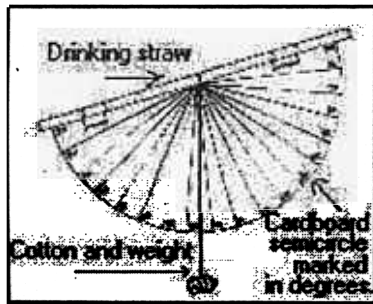
1. Hold the clinometer so that it registers a 45° angle.
2. Hold the clinometer up to your eyes and look along the upper edge.
3. Move toward or away from the object you are measuring until you can line up the top of the object along the edge of the clinometer (still held at a 45° angle.)
4. Measure the distance from where you are standing to the base of your object (A).
5. Add your height at eye level (C) to this measurement.
6. This is the approximate height of the object (B).
7. Fill in the table for each of the objects you measure.

Remember: Height of object = Distance from the object + Student height



Object chosen	Distance from object	+ Student height (to eye level)	= Height of object
<i>Example:</i> Top of the classroom wall	2 metres	1.45 metres	3.45 metres

Step 1. Make the clinometer



Clinometer marked in degrees

- You will need a drinking straw, a semicircle of cardboard, some tape, a piece of cotton and a weight.
- Use a protractor to mark the cardboard into degrees from 90 to 0 to 90 with zero at the bottom of the curve.
- Tape the straw along the straight edge of the semicircle.
- Tape the cotton to the centre of the straight edge of the semicircle. Attach a weight to the cotton.

Step 2. Use the clinometer

- Find a tall tree.
- Sight the top of the tree by looking through the straw.
- Ask your friend to read the angle on your clinometer (where the cotton is touching).
- Measure the distance between where you are standing and the base of the tree.
- Measure the distance between your eyes and the ground. (Get your friend to help)
- Calculate the distance from A to B and then add the distance from your eyes to the ground.

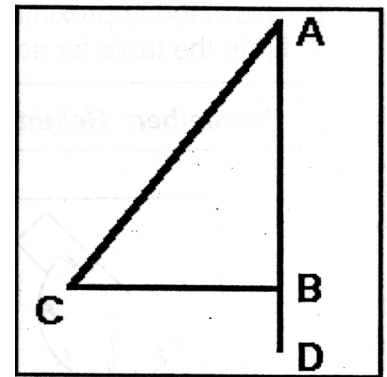


Diagram for calculating tree height.

NOTE: If you can get far enough from the tree to have the clinometer angle measuring 45degrees then the distance C to B will be equal to the distance B to A