Measuring inaccessible dimensions (Project for up to 4 students)

In this project you'll be measuring and calculating inaccessible dimension of a real object. If you choose measuring the height, select a tall building (Tower of Warriner Hall) or a "significant" tree. You may also select measuring inaccessible horizontal dimension, such as the width of Chippewa River.

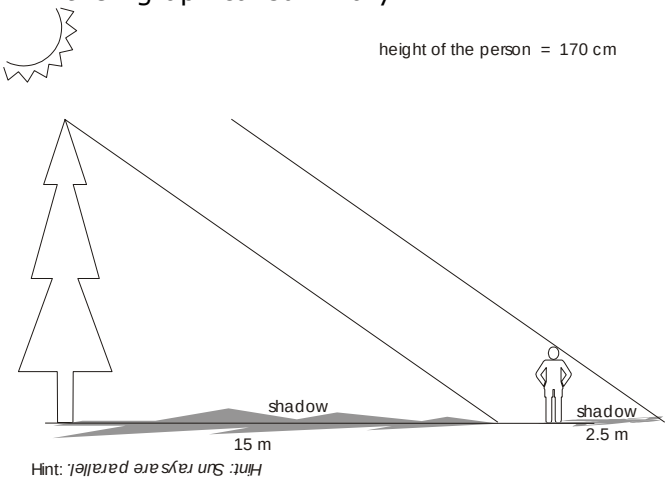
Write a scientific report on how you measured the dimension and what your results are. Expected report length is more than 1 and less than 4 pages and it should include the following.

- Identify clearly the object you are measuring. If it is not well-know object, specify its exact position on the map.
- Select two methods of calculating the desired height or width. Briefly explain both methods and use geometrical arguments to show that the methods you used are valid.
- Briefly describe the procedure of measuring dimensions you need to calculate the desired height or width (using the first method).
- Include all measures you took.
- Include all calculation you carried out to find the desired height or width.
- State the result.

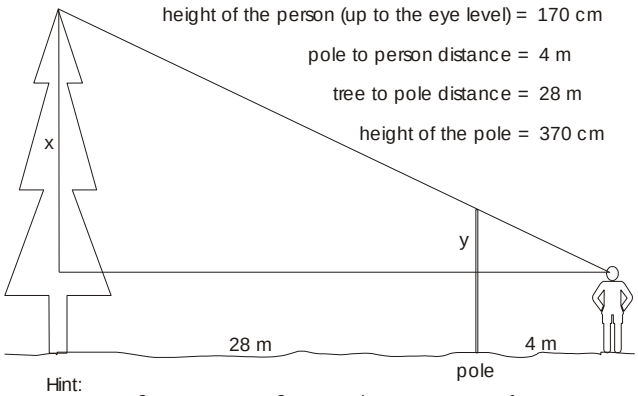
To validate your first measurement, carry out measurements using the second method. You don't have to provide all the details but make sure you state the result and compare it to the one you got with the method #1.

Based on the comparison and your own conjectures, discuss how accurate your result is. You may give a range in which you think the actual dimension is but make sure to explain why you choose that particular range. Briefly state the role of all members of your group.

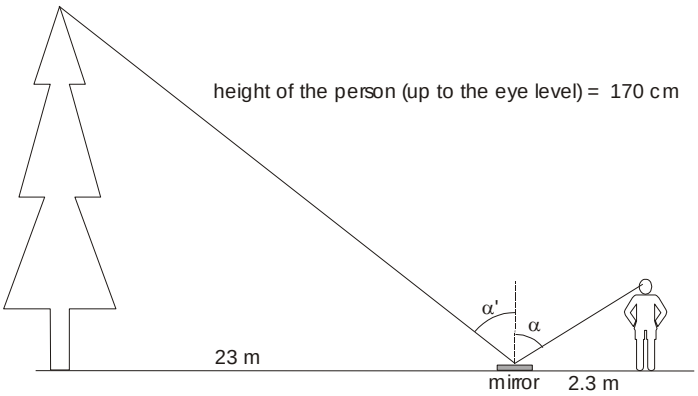
You may use any of the methods we talked about in the class. For your reference, here is their graphical summary:



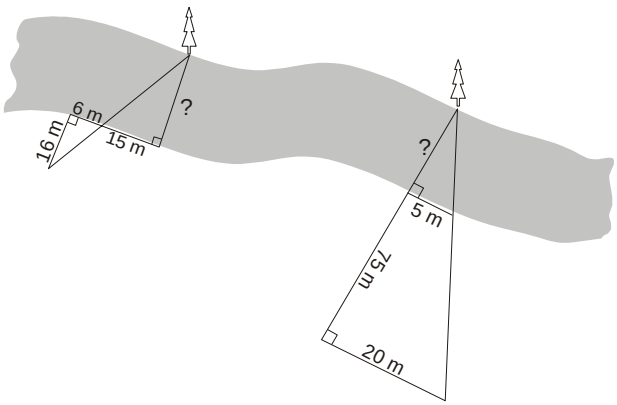
Hint: *Sun rays are parallel.*



Hint:
Hint: Find y and then x. Add the person's height to x to find the hight of the tree.



Hint: *Hint: $\alpha = \alpha'$*



Physical Surveying (Project for up to 4 students)

Physical survey a simple survey that generally determines land boundaries and building locations. In this project, you will be marking out (constructing) given geometric figures using only simple tools.

> *Supplies: string or yarn, measure tape (at least 5m), longer nails or pegs, hammer. You may use chalk as an alternative to string and nails. And of course, you will not be able to use protractor, ruler or compass in your constructions.* ***The scale of the project does not allow using a regular protractor, ruler or compass. Make sure that you use alternative tools!***

Instructions:

Find a flat, reasonably large area where you'll be constructing your figures. Make sure it's away from busy traffic and private property. Public parks are usually good place to carry out your project.

If you use nails or pegs to mark out your figures, make sure you will not be walking on a protected lawn or otherwise interfere with natural environment. Use nails large enough to fix strings but small enough not to destroy plants!

As an alternative, you may use chalk on an empty parking lot. Here you'll be facing the problem how to make lines perfectly straight, which you will have to explain in your report (it is easier if you use nails and string).

Figures to mark out:

- Mark out a rectangle 3m x 4m. Explain how you made sure your shape is a rectangle (sides are perfectly perpendicular, opposite are congruent, etc.).
- Select an existing straight line (for example a curb, fence etc.) and mark out a line perpendicular to it. Explain how you made sure it is perpendicular. There is a few ways to do it, you may consider Pythagorean or Euclidean theorems. (Tying evenly spaced knots on a string may help).
- Select an existing straight line (for example a curb, fence etc.) and mark out a line parallel to it. Explain how you ensured it is parallel.
- Mark out the following angles: 60°, 30° and 45°. (Tying evenly spaced knots on a yarn may help).

Report:

Your report should include:

1. List of all supplies used to construct each figure.
2. Brief, yet clear explanation of key ideas of your method. Step-by-step write up is not necessary but the key ideas should be explained clearly enough for anyone to be able to reproduce your procedure.
3. At least one photograph of each of the constructed figures. (You do not have to print the pictures if you submit your project electronically.)

Write-up for each figure you constructed should not take up more than a half page (excluding pictures).

You may stop by to discuss your methods before you apply them if you wish.

Transformations and symmetry (project for up to 2 students)

Transformation and symmetry provide a rich resource for school geometry. Do your own research on how transformations or symmetry are used in math classes and create your own activity for a grade of your choice. It does not have to be a lesson plan. A plan for a shorter activity or project for students will be fine as well. An example of such activity: https://www.weareteachers.com/geometry-transformation-activity-aquarium/

Your activity does not have to be created from scratch but of course it cannot be a complete copy of what someone else did. Find an inspiration online or in a library and work from there.

Your project should contain:

- Intended grade level
- Outline of the activity/project – what instructions and materials will be given to students? What the students will be doing?
- Brief reflection – what the students will be getting out of your activity/project?
- Cite the sources you used for inspiration and describe your contributions.