

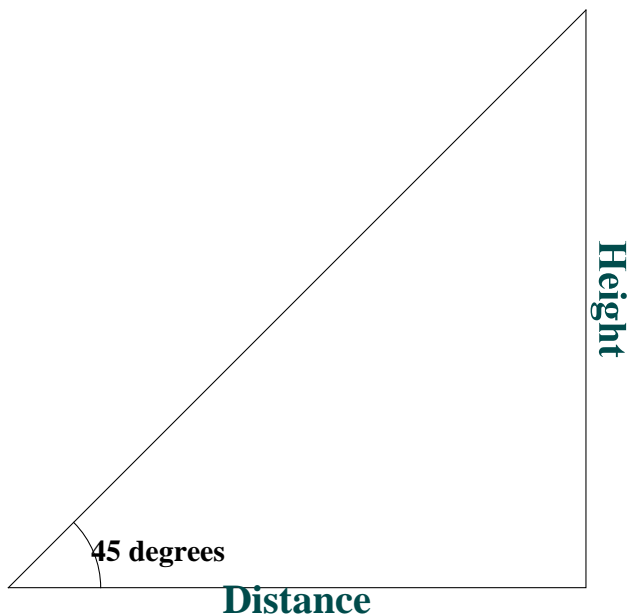
USING THE QUADRANT

You should have with you tonight a completed quadrant (using the template posted on line last week). Tonight we will begin using the quadrant to make a series of observations showing how scientists make use of angle measurements.

First Activity

The first activity we will do once we have checked your quadrants is to measure the height of a tall building or object. Tonight, we will measure the height of a tall object near campus. An obvious way to do this would be to climb to the top of the building, lower a ruler or something that can be measured off, and determine the height of the building by direct measurement. Or we could drop something from the top and measure the time for it to reach the ground, and use the appropriate equations of physics to solve the problem. Both of these techniques have the disadvantage of requiring physical presence on the top of the building. In some cases, it is extremely difficult if not impossible to make direct measurements, and scientists have learned that measuring angles, coupled with some basic math, provides us with a powerful analytic tool.

Let's consider the figure below to see how we can use the quadrant to measure the height of a building. As you might remember from geometry, 45 - 90 - 45 degree right triangle has the property that the height equals the length; in this case the diagram shows us that the height of the building equals the distance of the observer from the building.



This means that you can use your quadrant to find that location (or set of locations) where you stand facing the tall object and your quadrant reads 45 degrees. When your quadrant shows this reading, then the distance you are standing from the base of the object will equal its height. Tonight we will go outside and make measurements of a tall building or object. You can measure the height of an object or building by taking at least three measurements; your write up will include how you measured the distance from your observation point to the base of the object. Your write up should include:

- your data set
- a description of how you measured the horizontal distance to the base of the measured object
- a description of any difficulties or uncertainties in making your measurements and how you handled those difficulties/uncertainties

Second Activity

If the sun is visible tonight, we will begin this activity; if not we will start next week (dependent, of course, on weather). I will show you how to use the quadrant to measure the angle of the sun in the sky. NEVER look directly at the sun; I will show you how to use the quadrant to cast an image of the sun on your hand; when you see the solar disk on your hand, then you know the quadrant is pointed at the sun; the angle recorded by the quadrant is the angle of the sun above the horizon.

In astronomy, the angle of the sun above the horizon is called the altitude. Your assignment will be to make observations of the sun throughout one day and plot these measurements on graph paper (you must use real graph paper and not use a piece of 8 1/2 x 11 paper adapted for use as graph paper. You will need to measure the altitude of the sun roughly once per hour starting in the morning and extending into the afternoon; you will need a span of at least 6 hours of observation; more will be better. Your assignment will consist of:

- submitting your data; a table showing the altitude of the sun and each time at which you measured it; make sure you also indicate the day on which measurements were made
- a graph of altitude vs. time
- your estimate of the time of sunrise and sunset for the day of observation (made by extrapolating the curve representing solar altitude during the day).