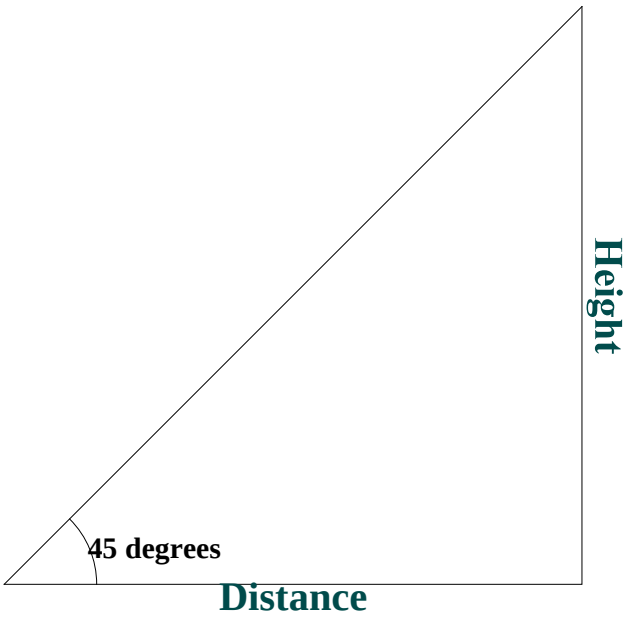
USING THE QUADRANT

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 Damen Hall. 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 equations of accelerated motion studied earlier this semester. 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 of the triangle 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 Damen Hall and your quadrant reads 45 degrees. When your quadrant shows this reading, then the distance

you are standing from the building will equal the height of the building. Tonight we will go outside and make measurements of Damen Hall. For next week you will work in teams of two; you will use your quadrant to measure the height of Damen Hall. You will take at least three measurements; your write up will include how you measured the distance from your observation point to the facade of Damen Hall. Your write up should include:

• your data set (and the name of your partner)
• a description of how you measured the horizontal distance to Damen
• a description of any difficulties or uncertainties in making your measurements and how you handled those difficulties/uncertainties
• a calculation showing how long it would take an object to fall from the top of Damen Hall. The acceleration due to gravity is 9.8 m / s^2 or 32.2 ft $/ s^2$. Show your work in detail.

Take your data with a partner, but all the answers should be the result of your independent effort.

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. You 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 measurments 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).

These observations require clear skies of course; it is highly preferable that each of you take all your own data, but it is permissible to work in groups to cover the hours of observation needed to complete this activity. If you work with partners to combine data, be very careful about the dangers inherent in combining data taken by different observers; you should make sure that you report data in a common way that is understandable to each member of the group, and you should spend some time working together taking measurements of the same object to ensure that you are taking data the same way. Finally, if you do work with others, make sure you indicate their names on your report, **and no group can have more than three students in it.**