PHY 251 Week 1 worksheet

Uncertainties in Measurement

This exercise is to help you understand how uncertainties are estimated and utilized. See appendix A: Dealing With Uncertianty for more information.

1. Measure the width of a piece of paper with a ruler and estimate the uncertainty of your measurement. A standard piece of paper is $21.59 \pm 0.01cm$ wide. Is your measurement consistent with this?

2. Now crunch the piece of paper into the ball and measure the ball's diameterwith a ruler and estimate the new uncertainty. Is your measurement consistent with your partner's?

3. Discuss the factors that go into estimating the uncertainty of the first and second measurement. What important difference is present for the second measurement?

Error Propagation

This exercise is to help you understand how errors from measurements propagate as the numbers are used in equations. See appendix A: Dealing With Uncertianty for more information.

4. If one student measures the distance from Detroit to Lansing to be 90 $\pm$ 5 miles, and another student measures the distance from Lansing to Grand Rapids to be 70 $\pm$ 10 miles, then what is the total distance from Detroit to Grand Rapids. Be sure to include uncertainty and units.

5. What is the difference in the two distances? Be sure to include uncertainty and units.

6. Measure the width and length of a piece of paper with a ruler and estimate the uncertainty of each measurement. Find the area of the paper and it's associated uncertainty with units.

Graphs

This exercise is to help you understand how graphs are read and interpreted.

7. A student measures the position of a moving car as a function of time and plots the data below. The equation describing the car's motion is $x = x_0 + vt$, where x is the position of the car (in meters) at time t (in seconds), x_0 is the initial position of the car, and v is the velocity of the car. The student uses Kaliedagraph to compute a best-fit line for this data, shown on the graph. Does the car move with constant velocity?

8. What is the velocity of the car? Be sure to include units and uncertainty!

9. Another student measures the position of the same car but much further away (so the uncertainty of his measurements is much higher!) and makes a plot of his data similar to the first student, shown below. What velocity did the second student measure? Is his velocity consistent with the first student's measurement of velocity?