PHYSICS 133 Spring 2006 EXPERIMENT NO. 1
MEASURING AREA & ERROR ANALYSIS

Introduction

You and your partner will be given a piece of poster board with a closed curve drawn on it. You will measure the area enclosed inside this curve in two different ways.

Purpose

This lab illustrates a physical application of integral calculus. Method 1 for finding the area is a form of "numerical integration." More important, this lab introduces error analysis. You should study the document "Error and Uncertainty." The concepts and procedures or error analysis introduced there will be used in the present lab and will also form the basis for error treatment in subsequent labs. Midterm and final exams will require knowledge of this material too!

Procedure

Method 1: You may assume the poster board is cut to accurate right angles. Using a meter stick and a pencil, draw horizontal and vertical lines (parallel and perpendicular to the edges of the poster), and construct a rectangular grid with lines spaced at 1-inch intervals. Now use "numerical integration" to find the area inside the closed curve. Do this by counting squares inside the curve. Estimate fractions of squares as closely as you can by eye. Each partner should carry out this procedure and repeat it several times.

Express your determination of the area in square inches and in square centimeters. What is the uncertainty in your measurement; i.e., over what range of values do you estimate your determination of the area could reasonably vary?

Method 2: After you have finished method 1, weigh your entire rectangular sheet of poster board to find its weight W. Then determine its area A. From these quantities, determine the weight per unit area of the poster board material, $\sigma = W/A$. Estimate the uncertainty in this quantity.

Now use the scissors to cut out the closed figure. Weigh the cut-out figure, and then find its area, using the value of σ you found above. Include an estimate of the uncertainty.

Report

Compare the area determinations found by methods 1 and 2 above. Do they agree? Do they disagree? Discuss what you mean by agreement or disagreement in this context. (Note: regardless of what you may have been taught before, the term “error,” as used by professional scientists, is ***not*** the difference between what you measured and the “book” or theoretical value.)