

## **PHY 122 LAB 2: Error Propagation - Volumes**

### **Introduction:**

In this lab, we practice error analysis by measuring volumes of a few regular shapes. You need to carefully read the “DataAna” handout.

### **Procedure:**

We will determine the volume of various shaped objects using Vernier calipers to measure relevant dimensions. The Vernier is accurate to 1/10mm, but that doesn't mean your data are that good. Take several independent readings for each dimension. Make sure everyone learns to use the calipers. Take the mean and standard deviation of these readings for all partners for each dimension.

Measure the relevant dimensions for each of the following objects:

1. A rectangular prism.
2. A triangular prism.
3. A hollow cylinder (find the volume of solid material). Be sure to also measure the “wall thickness” directly with the calipers.
4. A bullet shape object, approximated as a cylinder plus hemisphere of matching diameter.
5. (optional) A small plastic cup. Estimate the volume of the cup by finding the volume of water that fills a regular shape (rectangular box).

### **Analysis**

Find the volume of each of the above objects. Express your answer in  $\text{cm}^3$ .

1. Analyze the hollow cylinder two ways: directly from diameters, and using the wall thickness with average diameter. Which is more accurate?
2. Do error analysis using the spreadsheet method.

### **Report:**

1. State clearly each formula for volume.
2. Organize your report with tables that clearly state the value and error for each dimension and calculated volume.
3. You need not replicate original data in the report if it is reasonably neat.
4. Your abstract need only state the results for the cylinder.

**Lab Quiz (You must show your work, to get proper credit!)**

1. Find the area of a flat piece of metal according to the data in the table below for the length of each side. State the answer as mean  $\pm$   $\sigma$  units. eg Area =  $3.2 \pm 0.2 \text{ cm}^2$ . Since you now understand the “mechanics” of finding  $\sigma$  you may use any computing accessory you wish.

Side X (cm)	Side Y (cm)
8.4	6.3
8.6	5.9
8.3	6.2
8.7	6.5
8.5	6.3
8.8	6.1

2. Find the volume of a right cylinder with measured dimensions of:  
diameter  $d=3.2 \pm 0.2 \text{ cm}$   
height  $h=12.6 \pm 0.2 \text{ cm}$ .