

Lab Skills Worksheet - Week 1

The purpose of this introductory lab session is to familiarize you with simple measurement techniques and simple data analysis and plotting using Microsoft Excel. These are basic skills you will need throughout the quarter in different occasions.

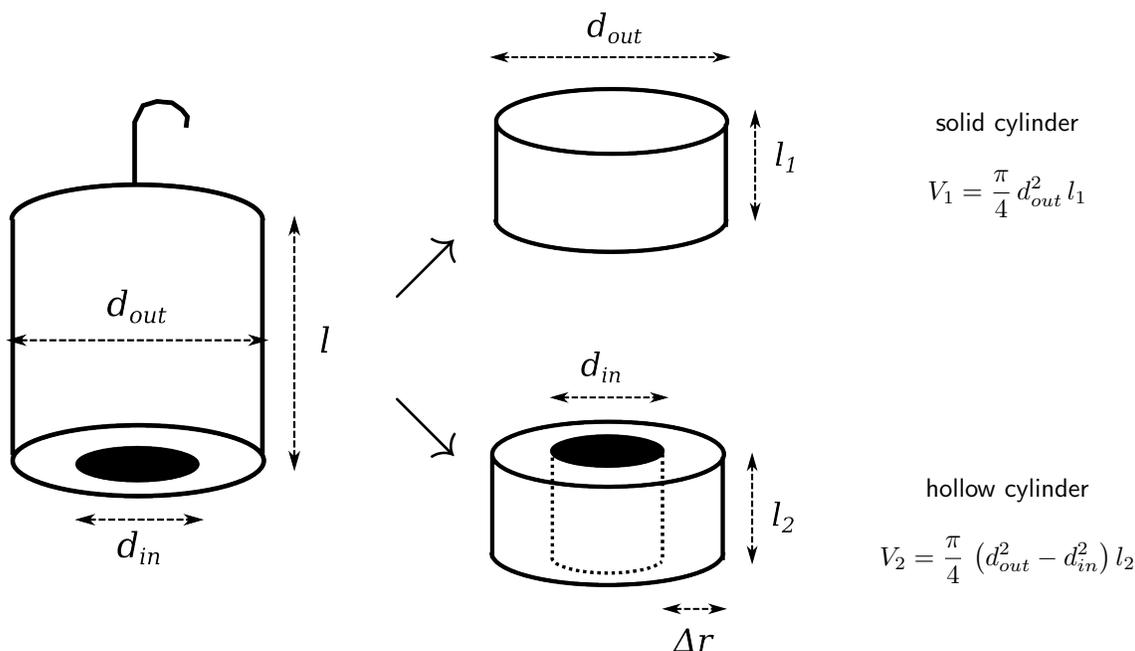
This worksheet will guide you through the steps. You will be asked to measure the volume of a number of weights and then make some plots, think about and describe the results.

MEASURE THE VOLUME OF A COPPER WEIGHT AND DETERMINE THE PRECISION OF YOUR MEASUREMENT.

All measurements must be reported with a concise description of measurement uncertainty, an estimate for uncertainty, and units. All calculated values should be reported with a properly propagated uncertainty. Show your work!

1. Choose a stamped weight

- The weights take the shape of a cored cylinder. The volume of the weight will be approximated as the sum of two parts: a solid cylinder and a hollow cylinder.



2. Measure the inner and outer diameters of the weight using calipers.

- (a.) What is the instrumentation error?

$$(\delta d)_{instrum} = \underline{\hspace{2cm}}$$

(b.) What are the best estimates for d_{in} and d_{out} (with uncertainties and proper significant figures)?

$$d_{in} = \underline{\hspace{10cm}}$$

$$d_{out} = \underline{\hspace{10cm}}$$

3. Measure the total height of the cylinder using calipers.

$$l = \underline{\hspace{10cm}}$$

4. Measure the height of the lower section of the cylinder using calipers.

(a.) Investigate the cylinder geometry and discuss if there are any other significant sources of uncertainty (other than instrumental uncertainty). Discuss.

(b.) What is the best estimate for l_2 ?

$$l_2 = \underline{\hspace{10cm}}$$

5. Calculate the height of the upper section of the cylinder

$$l_1 = l - l_2$$

DETERMINE THE VOLUME OF MANY MASSES

Include your results from the first part of the worksheet, and fill in the rest of this table by measuring l , l_2 , d_{in} , and d_{out} for four more weights. Now that you have demonstrated sample calculations and determined the dominant source of uncertainty in these measurements, use *Excel formulas* to calculate l_1 , V_1 , V_2 , and V .

Print out your Excel spreadsheet and attach it to this worksheet. Include units in your table column headings.

$m,$	$d_{in},$	$d_{out},$	$l,$	$l_2,$	$l_1,$	$V_1,$	$V_2,$	$V,$

PLOT THE VOLUME VS. PRINTED MASS

Create a summary table of the x and y values that you are planning to plot, and use Excel to generate a plot of the volume vs. mass for your calculated values. Print out your table and plot and attach it to this worksheet.

All plots you make in this course should be properly titled, axes should be properly labeled (with units), and accompanied by a descriptive caption.

Here are some points you can address in your caption:

- How precise do you think your data is? (including discussion of relative size of error bars are, if applicable)
- What kind of curve do you expect to see, assuming all of the masses are made of the same material?
- What kind of curve do you observe? Is it different from what you expected?
- Were there any approximations or assumptions that you made that might affect the accuracy of your results? Do you observe that these approximations and assumptions systematically affect your results, or do they seem unimportant?