Measurements

Before coming to lab think about and write out steps for the uncertainty for the volume and density of the cylinder found in the calculation section. This way during the lab you can just apply the equations.

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

Data

Tabletop

Calculate the length of each dimension of the tabletop.

Aluminum Block

Select the letter designation of your aluminum block.

Record the linear dimensions of the aluminum block.

Aluminum Cylinder

Select the letter designation of your aluminum cylinder.

Record the length and inner diameter of the aluminum cylinder.

Measure the outer diameter of the cylinder at the following places.

Table 1

Position	**Outer Diameter (in)**
at the top at 0 degrees	
at the top at 90 degrees from the first measurement	
1/3 down the cylinder at 0	
1/3 down the cylinder at 90 degrees	
2/3 down the cylinder at 0 degrees	
2/3 down the cylinder at 90 degrees	
at the bottom at 0 degrees	
at the bottom at 90 degrees	

Steel Ball

Select the letter designation for the steel ball.

Measure and record the diameter of the steel ball 8 times.

Table 2

Orientation	**Diameter (mm)**
1	
2	
3	
4	
5	
6	
7	
8	

Masses

Record the masses of the aluminum block, the aluminum cylinder, and the steel ball.

Table 3

Object	**Mass (g)**
aluminum block	
aluminum cylinder	
steel ball	

Liquids

Record the masses for each of the unknown liquid samples.

Table 4

Liquid	**Letter Designation**	**Mass of the Filled Cylinder (g)**	**Mass of the Empty Cylinder (g)**	**Mass of the Liquid Samples (g)**
1				
2				
3				

Record the volume of the liquid samples.

Table 5

Liquid	Volume (mL)
1	
2	
3	

Calculations

Tabletop Surface Area

Compute the surface area of the tabletop.

Find the uncertainty in the surface area using the propagation of errors described in the Propagation of Errors Appendix of the lab manual.

What is the percent uncertainty ($\Delta SA/SA \times 100\%$) for the surface area?

Aluminum Block Volume

Compute the volume and the uncertainty in the volume for the aluminum block.

What is the percent uncertainty for the volume?

Aluminum Cylinder Volume and Density

Enter the average outer diameter and its uncertainty. (Use propagation of error methods to determine the uncertainty.)

Calculate $r^2_{\text{outer,avg}} - r^2_{\text{inner}}$ and its uncertainty.

Use $V = \pi L \left(r^2_{\text{outer,avg}} - r^2_{\text{inner}} \right)$ to calculate the volume of the hollow cylinder.

Now calculate the density of the aluminum cylinder and the error in your measurement.

Does your measurement agree with the known value for the density of aluminum?

Steel Ball Volume

Find the average radius and its error. (Use propagation of error methods to determine the error.)

Using this data compute the volume (and its uncertainty) for the steel ball.

Aluminum Block Density

Compute the density (and its uncertainty) of aluminum using the measurements of the aluminum block.

Density of Liquids

Compute the density (and uncertainty) for the three unknown liquids.

Table 6

Liquid	Density (g/cm^3)
1	
2	
3	

Questions

Use the values of the densities of the three unknown liquids and information given in the Densities of Various Liquids table in the lab manual to determine the identity of the liquids. If your calculations do not agree with any substance given in the table, select "inconclusive results."

Table 7

Liquid	Identity of Liquid
1	
2	
3	

What is the sensitivity, in grams, of the triple beam balance? (Do not enter units for this answer.)

The volume of a cylinder is calculated using the formula $V = \pi(d^2/4)\ell$. Which dimension should be more carefully measured, the diameter or the length?

Why? Include equations and numerical examples in your explanation.