PHYS 11A Lab - General Physics: Mechanics

Fall 2020

Lab #1 – Measurement and Uncertainty

Names: _____

Objective Statement: Describe your objective for this lab in a few sentences, and state any hypothesis formed ahead of doing the experiment. We are getting creative here, as you are working with what you have at home. Did you decide to compare the densities of 3 different types of beans? Or are you comparing the density of you and your roommate? Just make sure you choose 2 or more relatively cylindrical objects to compare. Remember this is a physics class… it's okay to call your roommate a "cylinder".

First some theory and an introduction to error propagation: The density of a sphere

To determine the density of a sphere we will need to know its mass and its volume, since density is mass divided by volume. We will want to use an equation for density that depends on the mass of the sphere and its diameter. List your equation below:

What measurements must you take in order to get the data necessary to complete your calculation?

We write the uncertainty associated with those measurements as δx and δy, where x and y are your measurements (aka variables). In our example, what are the uncertainties? List them below:

Complete the following error propagation formula for your case:

$$\delta \quad = \left[\left(\frac{\partial}{\partial} \delta \quad \right)^2 + \left(\frac{\partial}{\partial} \delta \quad \right)^2 \right]^{1/2}$$

Complete the 2 partial derivatives:

Report out your final equation representing the propagated error for density.

Error propagation in practice: The density of a "cylinder"

What objects are you comparing in this experiment? How cylindrical are they? Justify your choices.

Measure the "cylinders" mass M, diameter D, and height H. Since you have very limited equipment at home you might be using very creative methods for measurements. Give very detailed estimates for your uncertainties, δM, δD, and δH with explanations.

Use propagation of error to **obtain a formula** for $\delta\rho$, and calculate values for ρ and $\delta\rho$ for all your objects.

Conclusion: Summarize your findings (**including relevant numbers, uncertainties, etc.**), and compare them to your objective statement/hypothesis.