

Introduction

Objective: This component of Physics100 is designed for two main purposes:

1. Reinforce concepts in lectures with hand-on experiments.
2. Prepare quality future physicist

Experimental Physicists experience followings;

- You try to find answers/ questions nobody solved before.
- You usually do not have perfect settings for experiment.
- You encounter situations you (or anybody) never encountered before.

What is expected as a Physicist

- Is not simply following prepared procedures
- A critical thinker/ adjuster/ fixer
- Questioner/ Evaluator

From above reasons, followings are expected in this lab

1. Your goal is not to blindly follow lab procedures, generate preliminary results, and leave.
2. You are the main operator in this lab. You need to know what you are doing in each step of your action.
3. Always try to obtain the best results. Do not settle with proper/expected result and think about how you can make it better.
4. The group with the best results will be rewarded bonus points.
5. When you obtained results from your measurement (sometimes with large errors), think about what these results means and what caused errors in your measurements. If you can obtain logical scientific reasoning for your errors/and results, you will be also rewarded bonus points.
6. Your handout and instructor would act only as your guides. Given handout procedure is only an outline and you are encouraged to upgrade/ modify with proper reasons.

Hands-On-Practice I. SI measurements and Density

[PURPOSE]

In this lab, we introduce the concept of density and measure the densities of various samples.

[CONCEPTS]

The density (ρ) of an object with uniform composition is defined as its mass (M) per its volume (V). The SI unit of density is $[\text{kg}/\text{m}^3]$ or $[\text{g}/\text{cm}^3]$. In example the density of water at 4°C is $1 \text{ g}/\text{cm}^3$.

$$\rho = \frac{M}{V}$$

The densities of most liquids and solids vary slightly with changes in temperature and pressure since the average spacing between molecules changes. The densities of gas show even drastic dependence with temperature and pressure. Density may be determined experimentally by measuring the mass and the volume of objects. The mass can be easily measured with a balance and the volume of regularly shaped objects can be calculated from length measurements. The volume of irregular objects may be obtained by submerging them in water and measuring the amount of water displaced.

In this lab, we will determine densities of objects with different geometries and sizes.

Rectangular Block: $V_{\text{block}} = l \times w \times h$

Cylinder: $V_{\text{cylinder}} = \pi r^2 h$

Sphere: $V_{\text{sphere}} = \frac{4}{3} \pi r^3$

[ESTIMATION]: Estimate the density of each sample.

	Sample 1 Block	Sample 2 Cylinder	Sample 3	Sample 4 Mystery X
Density (g/cm ³)				

[PLAN AND MEASUREMENT]

Discuss about the best method to measure each sample. Describe your methods. In your descriptions include equipments used and why you chose those equipments. Show all your calculations and discussions during procedures.

A. sample 1 (wooden block)

Mass	Plan
m= g	Procedure and calculation
Volume	Plan
V= cm ³	Procedure and calculation
Density (g/cm ³)	

[Discussion]

Is your measured value of the density reasonable? Depend your answer.

Is your measured value of the density similar to the estimated value? If not explain why.

B. sample 2 (wooden cylinder)

Mass	Plan
m= g	Procedure and calculation
Volume	Plan
V= cm ³	Procedure and calculation
Density (g/cm ³)	

[Discussion]

Is your measured value of the density reasonable? Depend your answer.

Is your measured value of the density similar to the estimated value? If not explain why.

C. sample 3 ()

Mass	Plan
m= g	Procedure and calculation
Volume	Plan
V= cm ³	Procedure and calculation
Density (g/cm ³)	

[Discussion]

Is your measured value of the density reasonable? Depend your answer.

Is your measured value of the density similar to the estimated value? If not explain why.

D. sample 4 (mystery X)

Mass	Plan
m= g	Procedure and calculation
Volume	Plan
V= cm ³	Procedure and calculation
Density (g/cm ³)	

[Discussion]

Is your measured value of the density reasonable? Depend your answer.

Is your measured value of the density similar to the estimated value? If not explain why.