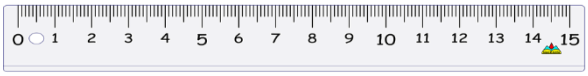
PHYS101 EXPERIMENT 1. MEASUREMENT AND ERRORS

Objective:

The aim of this experiment is to teach how to report experimental measurements together with associated errors and correct number of significant figures in table and graph form.

Equipment:

1. Ruler with millimeter divisions.



2. A Vernier calliper with 0.1 mm divisions.

3. A micrometer with 0.01 mm divisions.

4. Balance.

Procedure:

Part A: Measurements and Errors

1. **1.** Measure the length L, breadth B and thickness T of the rectangular object given using appropriate measuring devices. Estimate the error (uncertainty, which is the smallest division of the measuring device) in your measurements (ΔL in length L, ΔB in breadth B, and ΔT in thickness T) and record them properly with their absolute errors in Table 1.
2. **2.** Calculate the percentage error of your measurements and record them in Table 2. (Refer to the section on "Measurement and Errors" of the lab manual for definition of percentage error.)
3. **3.** Calculate the volume V of the given object. Calculate the error ΔV in volume. Calculate the percentage error of volume.
4. **4.** Weigh the metal plate and record its weight W. Estimate the error ΔW in your measurement and calculate the percentage error of weight.
5. **5.** Calculate the density ρ of the metal plate and the error $\Delta\rho$ in density. Calculate the percentage error of density.

Part B: Graphs

Measure the thickness of an ordinary A4 paper by the following method.

1. Take some number of papers, stack them on top of each other and measure the thickness of the stack using a Vernier calliper. Estimate the error (uncertainty) in your measurements.
2. Repeat the process described above for different number of papers in the stack five times and complete table.
3. Draw a graph from the values you have recorded. The independent variable *N* should be placed on the *x*-axis and the dependent variable *T* should be placed on the *y*-axis. We expect the relation between *N* and *T* to be a linear one. Indicate the best and the worst possible lines.
4. Find the slope m of the best possible line and the slope $\acute{m}$ of the worst possible line and calculate the maximum possible error $\Delta m = |m - \acute{m}|$.
5. Find the thickness of a single paper and estimate your error.

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Data & Results Part A: [20]

Length ( )		Breadth ( )		Thickness ( )	
L	ΔL	B	ΔB	T	ΔT

Table a1: Dimensional measurements

$100(\Delta L/L)$	$100(\Delta B/B)$	$100(\Delta T/T)$

Table a2: Percentage errors

V ( )	ΔV ( )	$100(\Delta V/V)$

Table a3: Volume with errors

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W ( )	ΔW ( )	$100(\Delta W/W)$

Table a4: Weight with errors

ρ ( )	$\Delta\rho$ ( )	$100(\Delta\rho/\rho)$

Table a5: Density with errors

Data & Results Part B: [10]

Number of Papers N					
Thickness of Stack $T \pm \Delta T$ ( )					

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PLOT: [25]

Slope: *y*-**intercept:**

Conclusion: [15]