Name_____ Date_____

Significant Digits and Mass Density

PROPOSE:

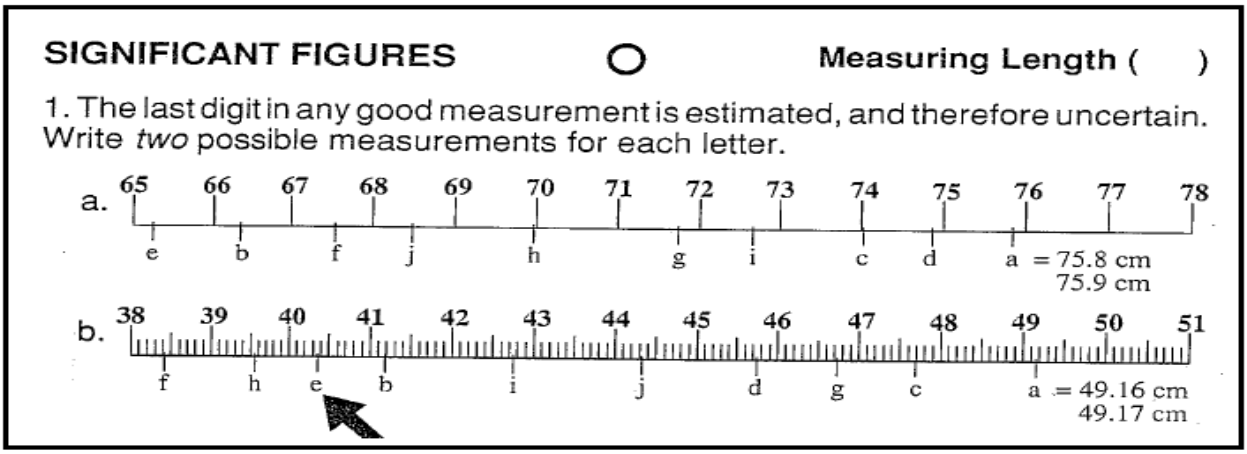
A measuring device is designed to measure a certain physical property of an object with limited accuracy. In this lab, you will learn how to estimate the last digit in a measurement, determine the number of significant digits, measure the mass densities of two objects, and then calculate the percentage errors.

APPARATUS:

Large glass marble, acrylic cylinder, Vernier calipers, and digital scale from the lab kit.

PROCEDURE

A. Significant Figures: Following the instructions and write down the correct **measurements** and their units in the table below. Remember that the last digit is always an estimated number.



	A		b	
	Reading 1	Reading 2	Reading 1	Reading 2
a				
b				
c				
d				
e				
f				
g				
h				
i				
j				

A. Answer the Following Questions:

1. Four students gave these measurements for letter "e" in the b ruler marked by an arrow above: 40.36 cm, 40.34 cm, 40.37 cm, and 40.35 cm. Are all these measurements valid? Why?

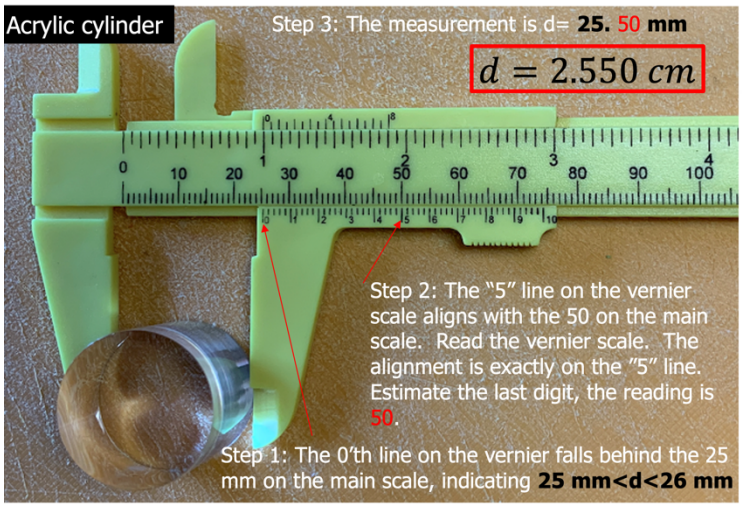
2. Any valid measurement contains only significant digits. What are the number of significant digits in the "e" measurement?

3. Is it possible to calibrate a ruler so accurately that measuring uncertainty is eliminated? Explain.

B. Measure the Dimensions of Objects

A caliper is a widely utilized tool for measuring the dimensions of an object. It offers greater precision compared to the conventional rulers used in schools.
When using a regular ruler, the accuracy of the last estimated digit is 1/10 of mm. A caliper offers enhanced confidence in the accuracy of this last digit's reading, it is to 1/100 of mm. To become familiar with the use of a caliper, you can watch the instructional video available at https://amrita.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=469.

Measure and record the dimensions and the masses of the objects using a caliper and a digital balance. Conduct three trials for each measurement and calculate the average. Record your measurements in Table 1.



Note (1): The caliper displays measurements in millimeters (mm). To convert to centimeters (cm), shift the decimal point one place to the left before recording the values in Table 1.

Note (2): To prepare the digital balance for use, install the batteries and press the right P/T key to zero the reading. Ensure the balance is set to measure in grams (g) by pressing the left "M" key repeatedly until "g" appears on the screen. A video tutorial on using the digital balance is available on the "Science Interactive" website.

Table 1 Size, Mass, and Mass Density of the Glass Sphere and the Acrylic Cylinder

Object	Measurement	Trial 1	Trial 2	Trial 3	Average	$V(cm^3)$ Volume	$\rho(\frac{g}{cm^3})$ Density
Glass Sphere	Diameter (cm)						
	Mass (g)						
Acrylic Cylinder	Diameter (cm)						
	Height (cm)						
	Mass (g)						

C. Calculate the Volumn and the Mass Density of the Objects

a. The volume of the sphere:

$V = \frac{4}{3} \times \pi \times (\frac{d}{2})^3 =$

b. The volume of the cylinder:

$V = \pi \times (\frac{d}{2})^2 \times h =$

c. The mass density of the glass sphere:

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

d. The mass density of the acrylic cylinder:

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

Copy these calculated numbers back to Table 1.

D. Mass density is a measure of the composition of a materail. The table on the right is provided by Science Interactive. Do your measurments match the values listed in bulk?

Material	Density (g/cm³)
Acrylic	1.18
Brass	8.55
Copper	8.94
Glass	2.70
Lead	11.34
Steel	8.05
Wood, Oak	0.77
Wood, Pine	0.48