Kuwait University	Course 125 Phys. Lab.I
Physics Department	Experiment 2: Measurement of density

Objectives

- Determination of length, diameter and mass of cylindrical objects
- Determination of the Least count and the Accuracy of the measuring devices
- Calculation of the density of the objects and comparison with the accepted values of the density of the metals

References

R. A. Serway, Physics for Scientists and Engineers,
Chapter 1. Introduction: Physics and Measurement
D. Halliday, R. Resnick and J.Walker, Fundamentals of Physics,
Chapter 1. Measurement.

Equipment list

- Four cylindrical objects of different size made from the same material (aluminium or steel or brass)
- Measuring devices:

  Vernier caliper (Figure 1),

  micrometer screw gauge (Figure 2),

  laboratory triple balance,

Theory:

The density of any substance is defined as the **mass of a unite volume** of that substance. The obvoius way of finding it is by determining the mass of a known volume of the substance and divide this mass by the volume. The volume of any solide which has a simple geometric form may be determined from its dimensions; which, if the body is small, are most conveniently measured by a Vernier caliper and a micrometer screw gauge. The mass; however , is found by the use of the laboratory triple balance.

micrometer screw gauge

The micrometer screw gauge (Figre 2) is most convenient for the accurate measurement of short lengths. The object whose length is to be measured is placed between the end of the screw and the anvil. The distance through which the screw travels is measured by two scales:

- **Main Scale** which is divided to millemeters on the upper part and half millemeters on the lower part.
- **Rotating Scale** which is divided to (50) divisions each of which represents (0.01 mm).

The two scales are related to each other such that one complete revolution of the rotating scale equals half a millimeters on the main scale. The Least Count of the micrometer is equal to the ratio of the smallest division on the main scale to number of divisions on the rotating scale.

Vernier caliper

The Vernier caliper (Figre 1) is considered also as a convenient device for accurate measurement of short lengths of small objects. The object whose length is to be measured is placed between the jaws. The distance through which the jaws travel is measured by two scales:

- **Main Scale** which is divided to inches on the upper part and centimeters on the lower part.
- **Vernier Scale** which is divided to (10) divisions each of which represents (0.01 cm).

Procedure

1. Use the micrometer screw gauge to **measure the diameter** d of the cylindrical objects.

2. Use the Vernier caliper to **measure the length** l of the cylindrical objects.

3. Use the laboratory triple balance to **measure the mass** m of the cylindrical objects.

4. Calculate the volume V for each cylindrical object using the measured values of diameter d and length l.

Calculations, Graphs

5. Calculate the density ρ for each piece from

$$\rho = \frac{m}{V}. \tag{1}$$

6. Calculate the average density $\bar{\rho}$.

7. From table one **Plot** a graph of the mass m (y axis) of each cylindrical object versus its volume V (x axis). According to equation 1 the graph should be a straight line through the origin.

8.Get the average density $\bar{\rho}$ from the slope of this line.

9. Compare the density with the accepted values for the density of metals.

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Laboratory Assignment

Read carefully the description of the laboratory session and complete the following lab assignment:

1. Insert the units of all physical quantities in the following table:

quantity	length	diameter	mass	volume	density
symbol	l	d	m	V	ρ
unit					

2. A cylinder has a length of 3.23 cm, a diameter of 1.75 cm, and a mass of 88.25 grams. What is the density of the cylinder? Based on its density, of what kind of material might it be made?

3. The Figure (2.3) shows a vernier caliper scale set to a particular reading. Find the reading of the scale.

4. From any suitable table in your textbook get the density of water, iron,aluminum, copper.

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Worksheet for Experiment 2

Table 1

Object	diameter	Length	mass	V	ρ = density
cylinder 1					
cylinder 2					
cylinder 3					
cylinder 4					

$\bar{\rho}$ from the table =

$\bar{\rho}$ from the graph =

Discussion:

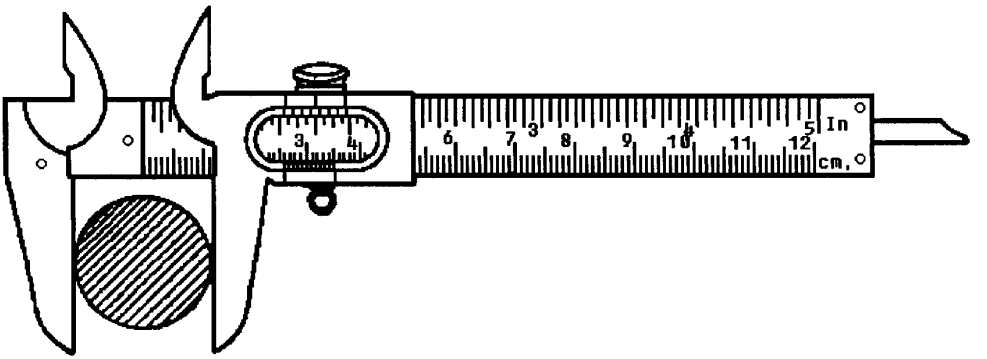

Figure 2.1 Vernier Caliper

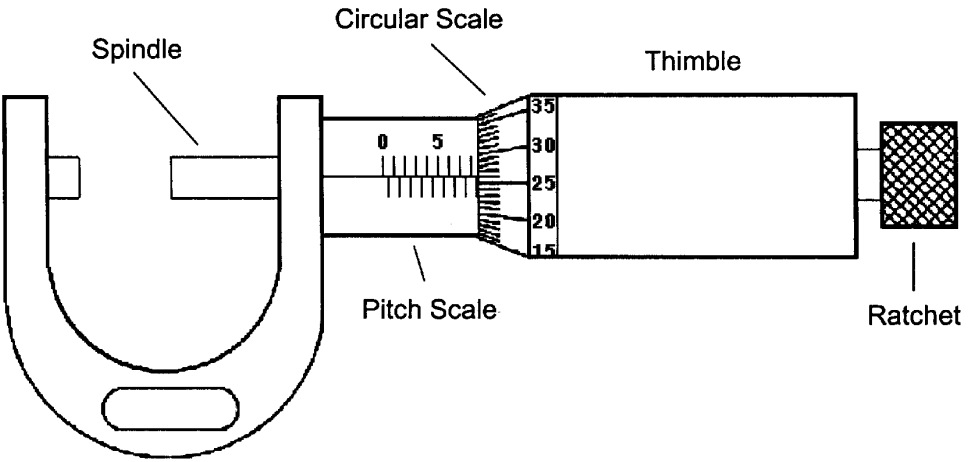

Figure 2.2 Micrometer Screw Gauge

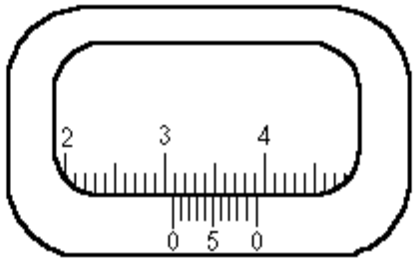

Figure (2.3) : Problem 3 of the assignment