

General Physics I (PHYS 101)

Lab. Exercise No. 3

Name:	Marks Obtained:	
Student's ID:	Section:	Date:

Accuracy of Physical Measurements

PERFORMANCE OBJECTIVES

After completion of this laboratory exercise the students will be able to:

1. Acquaint themselves with measuring procedures, accuracy of measurement and reading accuracy
2. Compare experimentally measured values of volumes with theoretically calculated values of volumes obtained by using mass-density formula.

MATERIALS AND EQUIPMENT

Micrometer screw gauge, wooden cylinder, metallic cylinder, metallic cube, a piece of wire, and balance.

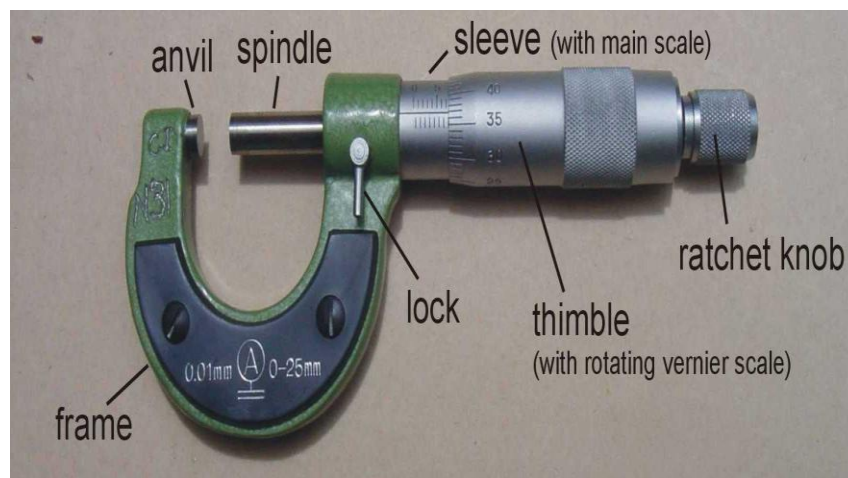
THE MICROMETER SCREW GAUGE

Micrometer (device)

A micrometer sometimes known as a micrometer screw gauge, is a device used widely in mechanical engineering and machining for precisely measuring, along with other metrological instruments such as dial calipers and vernier calipers. Micrometers are often, but not always, in the form of calipers.

1. Construction

The micrometer screw gauge enables you to measure small thicknesses (such as the diameter of a piece of wire) to a high degree of precision. The main features of this instrument are shown in Figure 1.



2. How to measure the Pitch of the Screw Gauge:

The screw is also a modified version of the inclined plane. While this may be somewhat difficult to visualize, it may help to think of the threads of the screw as a type of circular ramp (or inclined plane).



“The vertical distance between two adjacent screw threads is called the pitch of a screw”.

One complete revolution of the screw will move it into an object a distance to the pitch of the screw.

As an example, assume that you place a ruler parallel to a screw and count 10 threads in a distance of one mm. The pitch of the screw would be 1/10. Since there are 10 threads per inch of screw, the distance between two adjacent screw threads is 1/10 of an inch. Also, remember that one complete revolution of a screw will move the screw into an object a distance equal to the pitch of the screw. Therefore, one complete revolution will move a screw with 1/10 pitch a distance of 1/10 of an inch into an object. The pitch of any screw can be calculated as follows:

3. Calculate the pitch of the given screw gauge:

[0.5 Marks]

Distance traveled by the thimble(reading on sleeve) mm	Number of rotation	Pitch of the screw = $\frac{\text{distance travelled}}{\text{number of rotation}}$ mm
	1	
	2	
	3	

Pitch of the screw = -----mm

4. Calculate the least count of the given screw gauge:

[0.5 Marks]

Pitch of the screw = ----- mm = ----- cm

Total no. of divisions on the circular scale = ----- div

Least count = $\frac{\text{pitch of the screw}}{\text{total no. of divisions on circular scale}}$

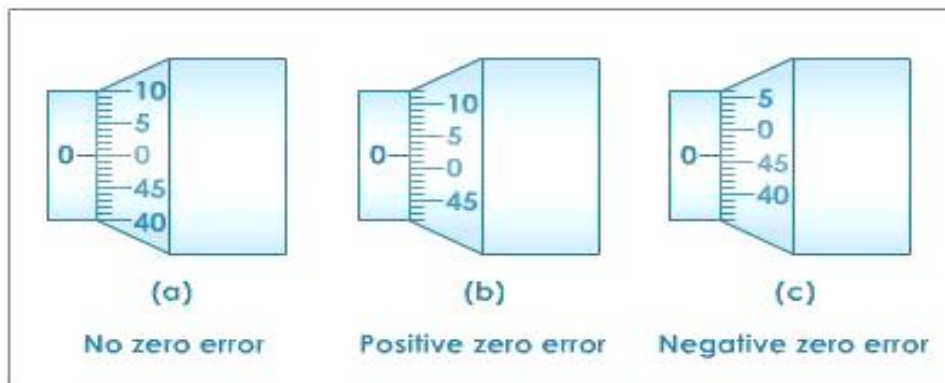
= -----

Least count = ----- mm = ----- cm

5. Zero Error Determination

Before starting your measurements you must determine the zero error of the micrometer. It is determined by turning the ratchet head until the anvil and the spindle faces are in contact. When the spindle is made to touch the extended part of the fixed jaw (Anvil), the thimble should point to zero on the sleeve. The thimble may show some reading if there is a zero error. The zero error is determined by the number of the thimble divisions (t) multiplied by the minimum reading of the micrometer, i.e.

$$\frac{1}{50} \times 0.5 \text{ mm } (t) = 0.01 \text{ mm} \times t$$



6. Calculate the Zero error in your instrument

CS = ----- div (on circular scale)

[1 Mark]

$$ZE = CS \times 0.001$$

ZE = ----- cm

7. Reading a metric micrometer

The spindle of an ordinary metric micrometer has 2 threads per millimeter, and thus one complete revolution moves the spindle through a distance of 0.5 millimeter (0.05cm). The longitudinal line on the frame is graduated with 1 millimeter divisions and 0.5 millimeter (0.05cm) subdivisions. The thimble has 50 graduations, each being 0.01 millimeter (0.001cm) one-hundredth of a millimeter (or one-thousandth of a centimeter). To read a metric micrometer, note the number of millimeter divisions visible on the scale of the sleeve, and add the total to the particular division on the thimble which coincides with the axial line on the sleeve.

Suppose that the thimble were screwed out so that graduation 5, and one additional 0.5 subdivision were visible (as shown in the image), and that graduation 28 on the thimble coincided with the axial line on the sleeve. The reading then would be $5.00 + 0.5 + 0.28 = 5.78 \text{ mm}$.



8. Finding the Surface Area and Volume of a Cylinder Using a Micrometer

Procedure:

1. Determine the zero error of the given micrometer.
2. Follow steps 1-6 to measure the diameter of the given wire. Record your result in Table 2 and calculate its cross-sectional area.
3. Follow steps 1-6 to measure the diameter and height of a metallic cylinder. Record your result in Table 2 and calculate its radius, base area, surface area and volume
4. You must use the appropriate units for both measured and calculated readings.

9. Observations

Observations for a metallic sphere

[02 Marks]

Metallic sphere	Main Scale (MS) cm	Circular Scale (CS) div	Fractional Part (FP=0.001 × CS) cm	Total Reading (TR=FP+MS) cm	Correct Reading CR=TR - (± ZE) cm
Diameter of the sphere (D)					

Radius of the given **metallic sphere**

[0.5 Marks]

$$R = \frac{D}{2}$$

$$= \text{----- cm}$$

Volume the given **metallic sphere**

[0.5 Marks]

$$V = \frac{4}{3} \pi R^3$$

$$=$$

$$= \text{----- cm}^3$$

Mass of the given **metallic sphere (m)** = -----g

Density of the given **metallic sphere**

[0.5 Marks]

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

$$=$$

$$= \text{-----g/cm}^3$$

Observations for a piece of wire

[02 Marks]

Piece of wire	Main Scale (MS) cm	Circular Scale (CS) div	Fractional Part (FP=0.001 × CS) cm	Total Reading (TR=FP+MS) cm	Correct Reading (CR=TR - (± ZE) cm
Diameter of the wire(D)					

Radius of the given **Piece of wire**

[0.5 Marks]

$$R = \frac{D}{2}$$

= -----cm

Area of cross-section of the given **piece of wire**

$$A = \pi R^2$$

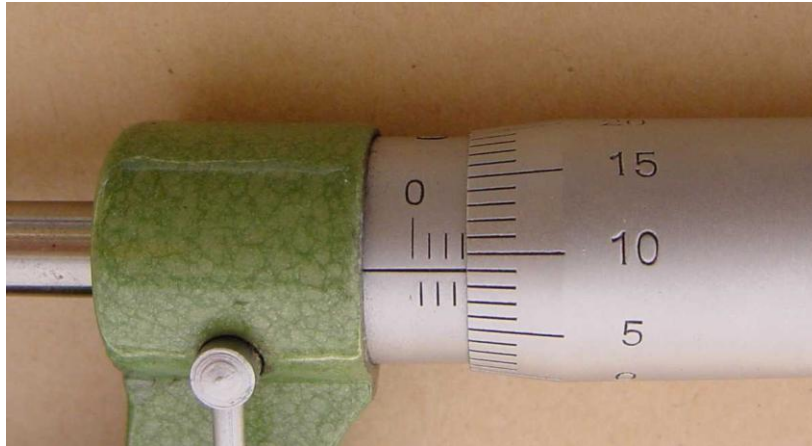
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= ----- cm²

Exercises

[2 marks]

1.



Main Scale (MS) cm	Circular Scale (CS) div	Fractional Part (FP= 0.001 × CS) cm	Total Reading (TR=FP+MS) cm	Correct Reading (CR=TR ± ZE) cm



Main Scale (MS) cm	Circular Scale (CS) div	Fractional Part (FP= 0.001 × CS) cm	Total Reading (TR=FP+MS) cm	Correct Reading (CR=TR ± ZE) cm

End of the Lab Exercise