Lab Report Guidelines for Physics 6

There will be approximately eight laboratory experiments performed during the semester for Physics 6. *For each experiment a lab report is due approximately one week after the lab is completed*, (the instructor will indicate the exact due date). The basic information to include in the reports is a description of the experiment, a complete set of data obtained during the experiment, analysis and interpretation of the data, and a conclusion section. By including the following sections, in the order given, you will be writing a complete report*.

1. Cover Page. The cover page should include your name, the name of the experiment, as well as the date you performed the experiment. Also include the names of your lab partners.

2. Lab Manual. Including the actual lab manual in your report provides an accurate description of the experiment.

3. Original Data Sheets. Include any original sheets of paper where data was recorded, plus all graphs and tables printed from the computer.

4. Principle's Section. The principle's section should provide a description of the underlying Physics principles, laws and facts that are being tested by the experiment. This section should also include the derivation of any specific formulas that are to be used in the analysis section. Usually the lab manual will suggest which formulas need to be derived in the principle's section.

5. Calculations and Analysis. The calculations and analysis section should contain all the calculations and error analysis suggested in the lab manual. Carefully answering all the questions and performing all the calculations suggested in the C and A section of the lab manual will complete this section.

6. Tabular Summary. The tabular summary should summarize your calculations by listing the experimental and theoretical values together with the percentage errors of all the important quantities calculated in the analysis section.

7. Conclusion. The conclusion section of the report should include two parts. A brief summary of the purpose of the experiment, including your observations of the physical results, and a statement concerning the factors which may have caused a discrepancy between the experimental and theoretical results, in other words, a statement about the sources of error in the experiment. Try to include at least three well thought out possible occurrences where errors may have crept into the results of your experiment.

Although it is not required, you are encouraged to write your reports on a computer using word processing software and perhaps a mathematical program (like Excel or Mathematica) to help do calculations and graphical analysis. *If you choose to write your report by hand, please write in ink and not pencil! A neat and organized report is definitely a factor in the lab report grade.*

You may discuss your lab reports, and check your calculations with your lab partners and other members of the class, but *it is essential to write the report yourself*. When writing the principle's section and the conclusion section, *be sure to put your ideas in your own words*, and **do not simply copy the principles or purpose sections from the lab manual**. Try to express yourself clearly and correctly, even though grammatical and spelling errors will not be counted against you.

***Note**: Alternate lab report formats (such as a 'technical journal format') are acceptable as long as a discussion of principle's, calculations, results, and a conclusion are included. If you are interested to write your lab report in a different format than the one presented here, please see instructor to discuss the alternate formats.

Measurement of Length

(Physics 6, Experiment # 1)

Virtual instructions on p7

Purpose:

To study the principle of vernier scales and micrometer screws and to use the vernier and the micrometer in the measurement of length.

Apparatus and Materials needed:

Vernier Caliper and micrometer calipers in both Metric and English systems
Meter stick
Hollow cylinder
Mass balance
Metal cylinders (Brass, Copper, and Steel)

Theory:

A caliper is an instrument used to determine lengths. A caliper with a vernier scale is called vernier caliper and one with a micrometer screw is a micrometer caliper.

The vernier is an auxiliary scale attached to measuring instruments which enables one to make accurate estimates. It has a graduation different from those of the main scale but bearing a simple relation to them. The general principle of all verniers is that the number or vernier divisions is always equal to a smaller number of main scale divisions, usually one less:

$$nV = (n-1)$$

where n is the number of vernier divisions, V is the length of vernier division and S is the length of the main scale division.

The term "least count" or LC is applied to the smallest distance which can be measured accurately by a vernier. It is equal to the difference in length between the main scale division and a vernier division.

$$LC = S - V$$
$$LC = (1 / n) \times S = S / n$$

The zero reading, Z.R. is the vernier division which coincides with any main scale division when the jaws of the calipers are closed.

The actual reading or A.R. can be obtained from the equation below

$$A.R. = p + (q \times L.C.) - (Z.R. \times L.C.)$$

Where p is the exact main scale division just before the zero of the vernier scale
q is the vernier scale division which coincides with any main scale division.

The micrometer caliper consists of a screw mounted on a cylindrical frame. The main scale which is the linear scale (L. S.) is fixed on the cylinder while the screw has a circular scale (C.S.). When the screw is turned, the linear distance that the edge of the circular scale has moved after one revolution is called the pitch of the screw. The pitch (P) usually coincides with the smallest L.S. division. The least count of the instrument is given as:

$$LC = P / n$$

Where P is the pitch

n is the number of divisions in C.S. and the actual reading is given by the equation

$$A.R. = L.S._{\text{reading}} + (C.S._{\text{reading}} \times L.C.) - (Z.R \times L.C.)$$

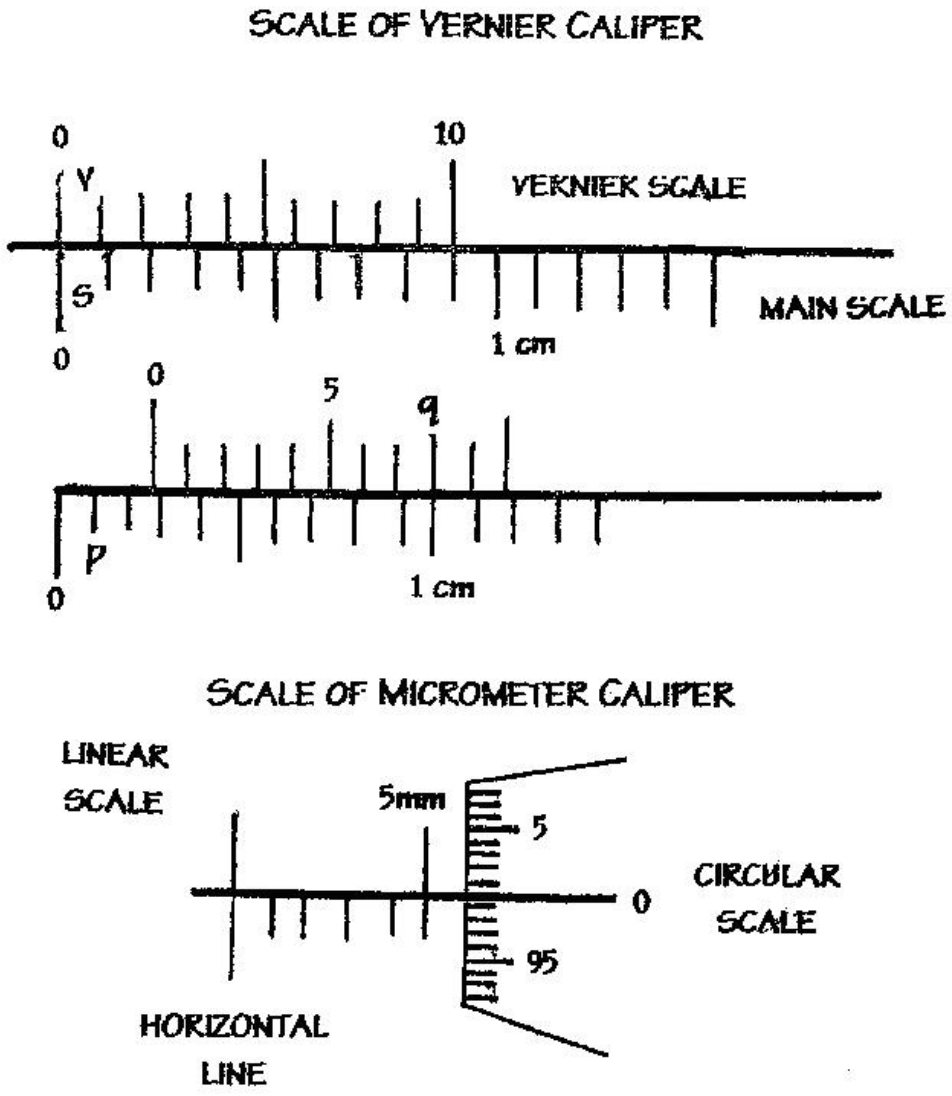
Where $L.S._{\text{reading}}$ is the linear scale reading just before the edge of the C.S.

$C.S._{\text{reading}}$ is the division of the C.S. which coincides with the horizontal line of the L.S.

L.S. is the least count.

Z.R. is the zero reading which is the number of division past the zero mark in the C.S. when the caliper is closed

Diagram:



Example:

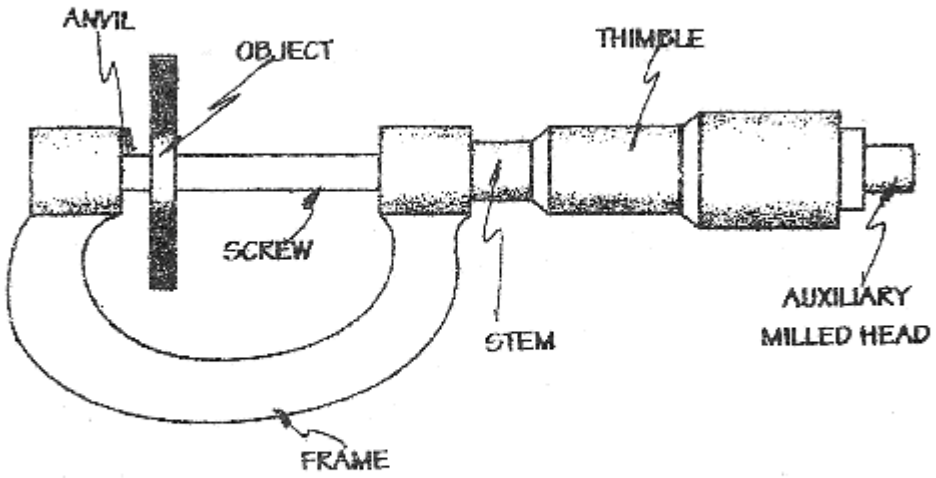
(Assume ZR = 0)

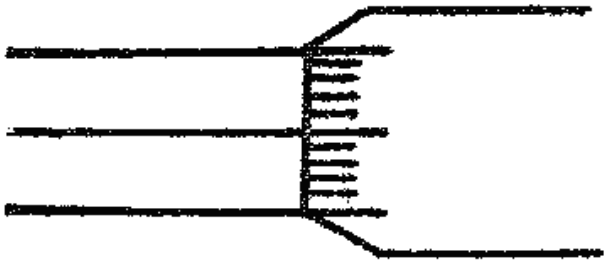
P = 0.2, q = 8
A.R. = 0.2 + 8 (0.01)
A.R. = 0.28

(Assume ZR = 0)

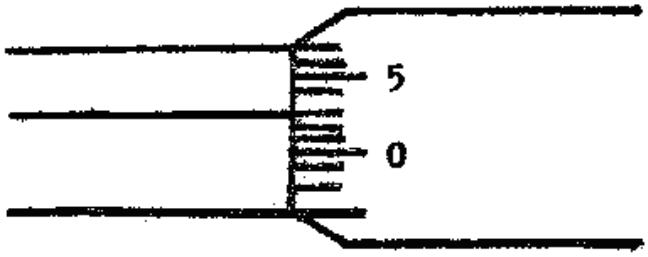
L.S. = 6 mm, C.S. = 0
A.R. = 6 mm + 0 (0.01 mm)
A.R. = 6.0 mm

MICROMETER CALIPER

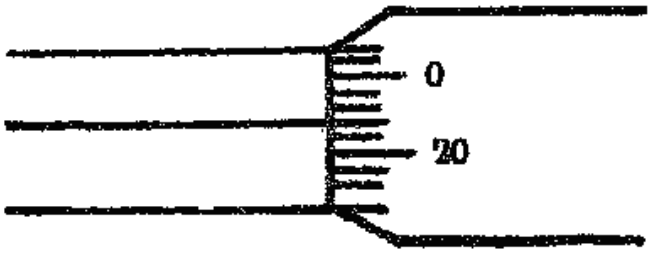




FOR NON ZERO READING

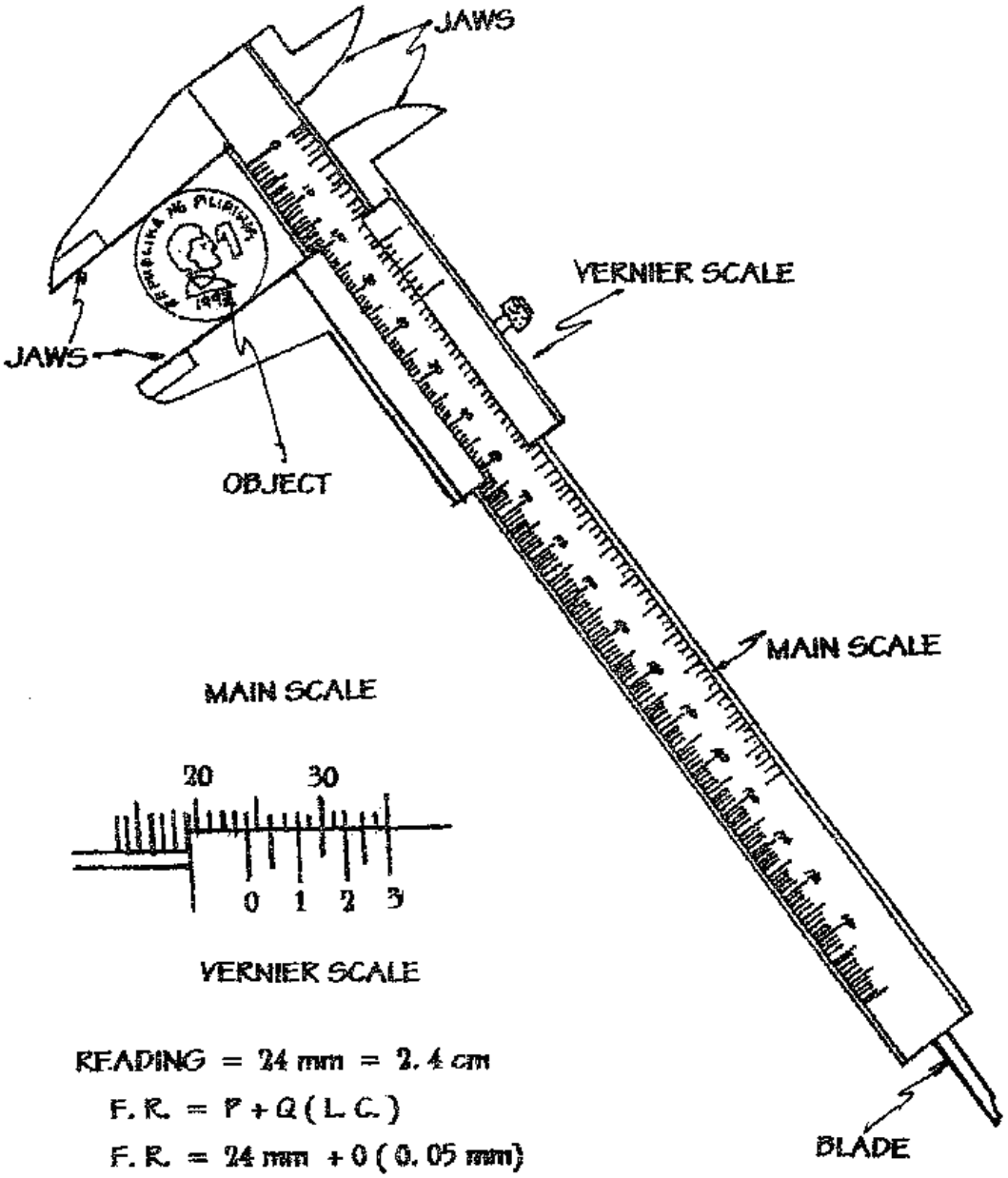


ZERO CORRECTION = 3 X 0. 001 = 0. 003 in



ZERO CORRECTION = 3 X 0. 001 = −0. 003 in

VERNIER CALIPER



MAIN SCALE

VERNIER SCALE

READING = 24 mm = 2.4 cm

F. R. = P + Q (L. C.)

F. R. = 24 mm + 0 (0. 05 mm)

F. R. = 24 mm

Procedure:

Part A: Determination of the least count

1) Examine the vernier caliper.
2) Record the number of the vernier divisions and the length of the smallest main scale division.
3) Calculate the least count.
4) Repeat using a vernier caliper in the English system and micrometer caliper in the Metric system.
5) Measure the width of a meter stick using these instruments.

Part B: Measurements on a hollow cylinder

1) With the use of a vernier caliper, measure the external and internal depths, external and internal diameters of the hollow cylinder. Take several measurements of each dimension for consistency.
2) Weigh the cylinder with the electronic balance.

Data:

A: Determination of Least Count

	Vernier Caliper		Micrometer
	Metric	English	Metric
Number of vernier divisions (n)			
Length of smallest main scale of division (s)			
Least count (LC)			
Width of meter stick			

1. Watch the Intro Video here (ignore the login page):
http://www.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=558
2. Click through each of the Tabs at the site listed below
starting with the the Video tab:
http://www.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4
3. Then measure and report the objects in the simulator here:
http://www.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4
4. Write a small essay and report findings of your virtual measurements
5. Submit on CANVAS
6. Learn about the Micrometers here (no write-up):
7. https://disher.com/2016/06/20/micro-use-micrometer/
8. https://www.stefanelli.eng.br/en/virtual-micrometer-thousandth-inch-simulator/

B: Measurement on a Hollow Cylinder using Vernier Caliper

Inner depth (h_1)	cm
Outer depth (h_2)	cm
Interior diameter (d_1)	cm
Exterior diameter (d_2)	cm
Inner volume (V_1)	cm^3
Outer volume (V_2)	cm^3
Volume of cylinder (V)	cm^3
Density of cylinder (ρ)	g/cm^3
Mass of cylinder (m)	g
Actual mass (m_0)	g
% Error	%

C: Measurement on a Metal Cylinder using Micrometer Caliper
(Pick any two different metals out of three)

Name of Metal	Diameter (cm)	Length (cm)	Volume (cm^3)	Mass (g)

Name of Student: _____

Date Performed: _____

Instructor's Initial: _____

Computations:

1) Calculate the volume of the cylinder.
2) Compute the mass of the cylinder from the obtained volume and density.
3) Find the percentage error between the calculated mass and the actual mass.