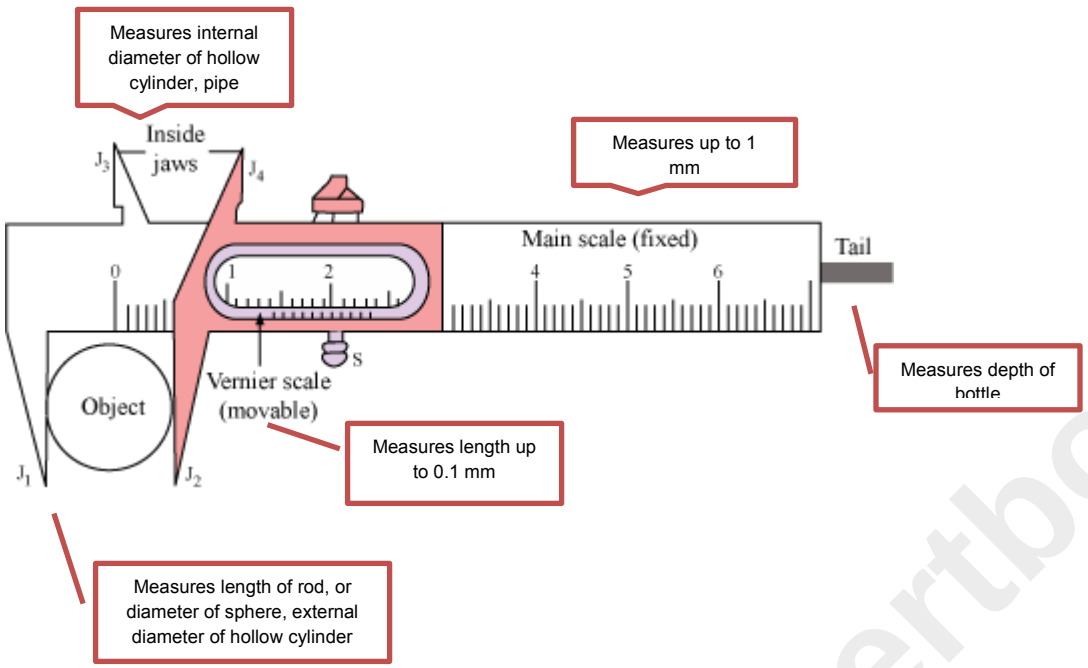
Physical Quantities and Measurements

Measurement of Lengths:

VERNIER CALLIPERS :



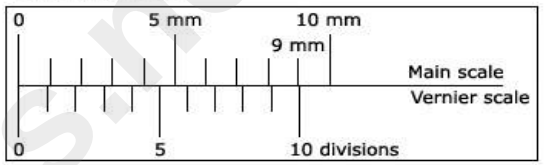
Measurement of length of an object using Vernier Callipers:

Least count L.C = $\frac{value\ of\ one\ mainscale\ division\ (x)}{total\ number\ of\ divisions\ on\ vernier(n)}$

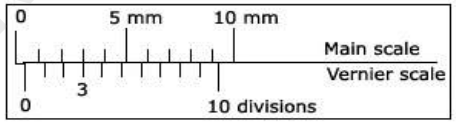
Observed Length = M.S.R + (V.S.R x L.C)

True Length = Observed Length – Zero error (with sign)

No Zero Error

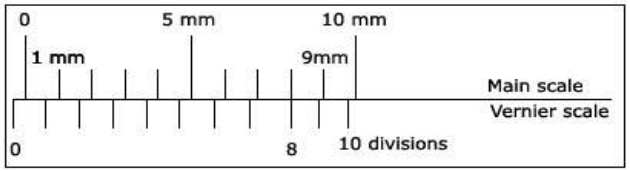


Positive Error



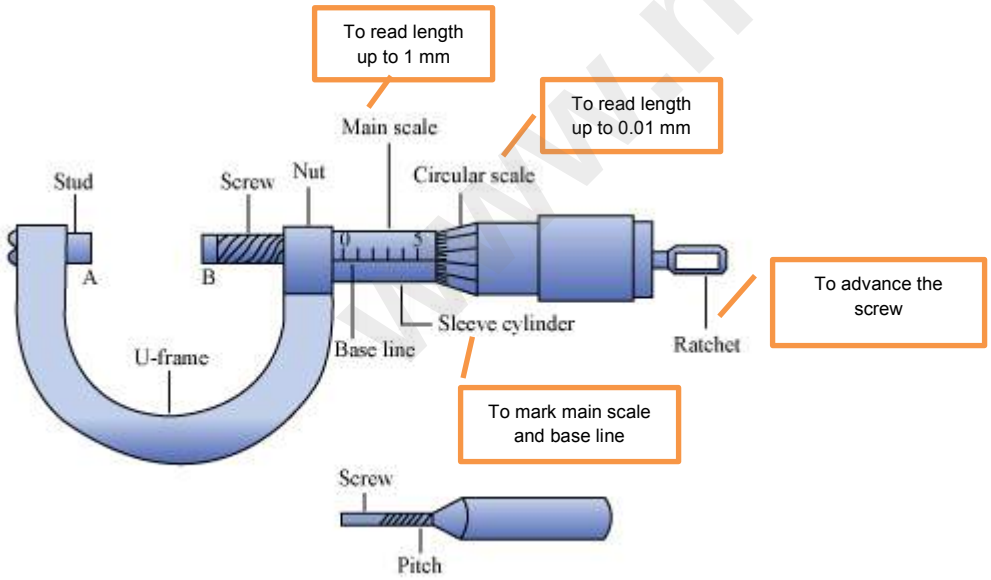
Zero error = +3xL.C
= +3x0.01 cm
= + 0.03 cm

Negative Error



Zero error = -(10-8)xLC
= - 0.02 cm

SCREW GUAGE :



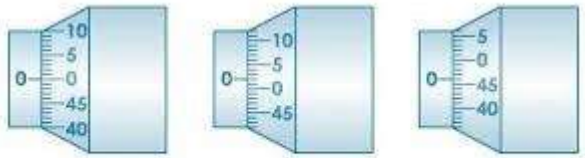
Measurement of diameter of a wire using Screw guage :

Observed Diameter = M.S.R + (C.S.R x L.C)

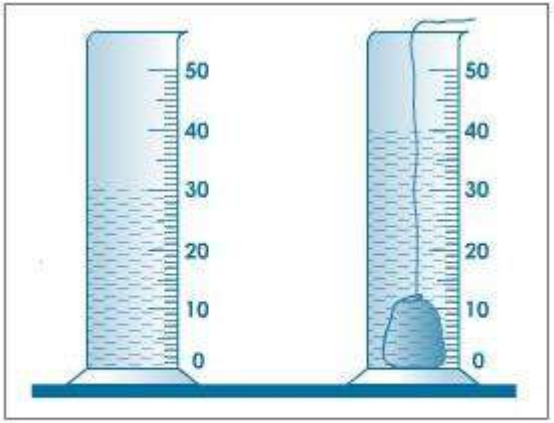
True Diameter = Observed Diameter – Zero error (with sign)

$$\text{Pitch of the screw} = \frac{\text{Distance moved by screw}}{\text{No. of full rotations given}}$$

$$\text{L.C.} = \frac{\text{Pitch}}{\text{Number of C.S. division}}$$

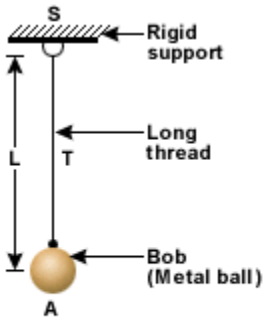


Measurement of Volume :

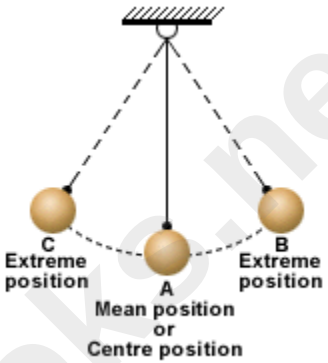


The difference in the above two readings gives the volume of the solid.

Measurement of Time:



(a) Simple pendulum



(b) Motion of a simple pendulum

Amplitude : Maximum displacement from mean position to either of extreme position.

Oscillation : from A->B->A->C->A is one oscillation.

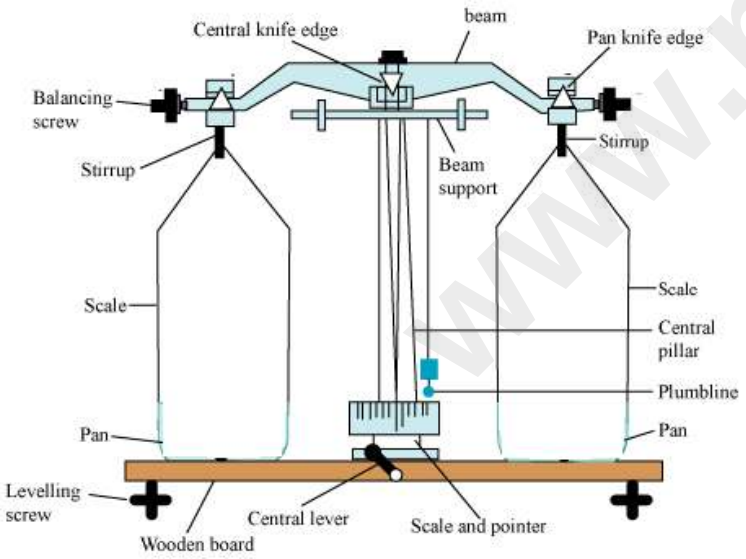
Period of oscillation : time taken to complete one oscillation.

Frequency : number of oscillations made in one second.

Time period, $T = 2\pi\sqrt{\frac{l}{g}}$

Seconds Pendulum : A pendulum with a time period of 2 seconds. Its effective length is nearly 1 m.

Measurement of Mass:



Conditions for a True balance :

The balance must satisfy two conditions:

1. Both arms must be of equal lengths , and
2. Both the pans must be of equal weights.

Experimentation

Presentation of Data :

1. In Tabular form
2. In Graphical Form

Tabular form types :

1. Headed columns and Numbered rows :

Observations:

For time period (with a stop watch)

Least count of stop watch = ... s

No. of observations	Length l (in cm)	Time for 20 oscillations t (in second)	Time period $T = t/20$ (in second)	l/T^2 (in cm s^{-2})
1				
2				
3				
4				
5				
6				

Mean value of $\frac{l}{T^2}$ =.....cm s^{-2}

2. Headed rows and Numbered columns:

Observations:
For volume of solid by displacement of water

Least count of measuring cylinder = ... ml

No. of observations	1	2	3	4
Initial level of water V_1 (in ml)				
Final level of water on dipping of solid V_2 (in ml)				
Volume of the solid $V = V_2 - V_1$ (in ml or cm^3)				

Mean volume of solid V = ...cm^3

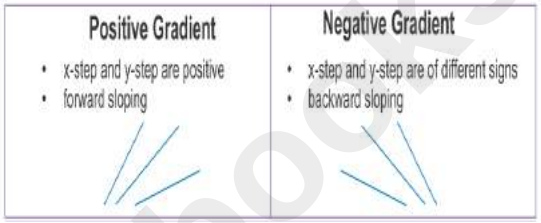
Advantage of tabular form of data presentation

- Helps in quick grasping and analysis of observations

In the experiment to study the variation in time period with the length of a simple pendulum, a look at the table will show that the time period of a simple pendulum increases with the increase in its length

Graphical Form : - Presentation steps :

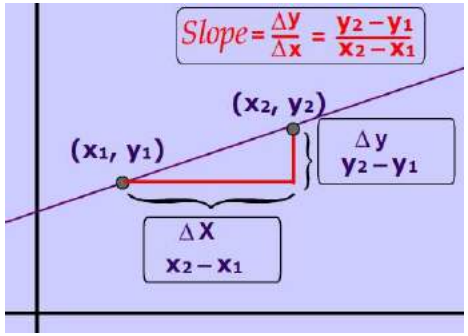
1. Title of graph
2. Selection of origin and axes
3. Labeling of axes
4. Selection of scale
5. Plotting the points and accuracy of plots
6. Plotting the best fit straight line (or curve)



Use of Straight line Graph :

- Identifying proportional relationship

- Slope of a straight line graph



Physical Quantities :

The quantities which can be measured.
Two types : Scalar and Vector.

Scalar Quantities :

Has only Magnitude , No Direction
Example: Mass, distance, time, speed etc.,

Vector Quantities :

Has both Magnitude and Direction
Example : Displacement, Velocity, Acceleration, Force etc.,