1. Vernier Calliper - Volume of a Cylinder

Aim : To find the volume of the given cylinder using a Vernier Calliper.

Apparatus Required : Vernier Calliper, Cylinder.

Formula : Volume of the cylinder = $V = \pi r^2 h$

where, $r \rightarrow$ radius of the cylinder
$h \rightarrow$ length / height of the cylinder

Observations and Tabular Column :-

Least Count (L.C) :- It is the smallest measurement that which any measuring instrument can measure accurately.

$$L.C = \frac{\text{Value of 1 main scale division}}{\text{Total no. of Vernier scale divisions}} = \frac{1 \text{ div}}{10}$$

$$L.C = \frac{1 \text{ mm}}{10} = 0.1 \text{ mm} = 0.01 \text{ cm}$$

L.C = 0.01 cm (for a Vernier Calliper).

To find height (h) and diameter (D) of the cylinder :-

Sl.No.	Dimension	M.S.R (cm)	V.S.C (div)	V.S.R = (V.S.C x L.C) (cm)	(M.S.R + V.S.R) (cm)	Mean (cm)
1.	Height (h)					
2.						
3.						
4.						
5.						h"
1.	Diameter (D)					
2.						
3.						
4.						
5.						D"

Calculations :-

1. Radius (r) = $\frac{\text{Diameter (D)}}{2}$ = = _____ cm

2. Volume of the Cylinder = V = $\pi r^2 h$ =

V = _____ cm^3

V = _____ m^3

Procedure :-

1. Observe and note the least count and zero error of the given Vernier Calliper (by closing the jaws of the Vernier Calliper).
2. Place the given cylindrical object between the jaws.
3. Note the main scale reading (M.S.R) and Vernier scale coincidence (V.S.C). Record them.
4. Repeat the experiment for different points of the object to get few set of readings.
5. Calculate the mean value of D and h of the cylinder.
6. Use these values in the formula to calculate the Volume of the cylinder.

Precautions :-

1. Before starting the experiment, the working of a Vernier Calliper should be carefully examined.
2. The least count of the instrument should be calculated before the experiment begins.
3. The vernier should be tightly screwed in position.
4. Too much pressure on the jaws should be avoided.
5. The Vernier Coincidence should be carefully noted.

Result :-

Volume of the given Cylinder using a Vernier Calliper is V = _____

Vernier Calliper - Volume of a rectangular block

Aim : To find the volume of the given rectangular block using a Vernier Calliper.

Apparatus Required : Vernier Calliper, Rectangular block

Formula : Volume of the rectangular block, $V = lbh$

where, $l \rightarrow$ length, $b \rightarrow$ breadth, $h \rightarrow$ height } of the rectangular block

Observations & Tabular Column :-

Least Count (L.C) :- It is the least measurement that can be taken accurately by any measuring device.

$$L.C = \frac{\text{Value of 1 main scale division}}{\text{Total no. of Vernier scale divisions}} = \frac{1\,div}{10}$$

$$L.C = \frac{1\,mm}{10} = 0.1\,mm = 0.01\,cm$$

L.C = 0.01 cm (for a Vernier Calliper)

To find length (l), breadth (b) and height (h) of the block :-

Sl.No	Dimension	M.S.R (cm)	V.S.C (div)	V.S.R = (V.S.C x L.C) (cm)	(M.S.R + V.S.R) (cm)	Mean (cm)
1	Length (l)					
2						
3						
4						l''
1	Breadth (b)					
2						
3						
4						b''
1	Height (h)					
2						
3						
4						h''

Calculations :-

Volume of the rectangular block : $V = lbh$

$= \_\_\_\_\_ cm^3$

$V =$

$V = \_\_\_\_\_ m^3$

Procedure :-

1. Observe and note the least count and zero error of the given Vernier Calliper (by closing the jaws of the Vernier Calliper).
2. Place the given rectangular block between the jaws (lengthwise).
3. Note the main scale reading (M.S.R) and Vernier scale coinciding (V.S.C). Record them.
4. Repeat the experiment for different points of the object for the same dimension to get a few of readings.
5. Calculate the mean value of the dimension of the rectangular block.
6. Repeat the steps 2 to 5 for other dimensions like breadth (b) and height (h) also.
7. Use these values in the formula to calculate the Volume of the rectangular block.

Precautions :- [Same as the experiment 1.].

Result :-

Volume of the given rectangular block is,

$V = \_\_\_\_\_$

3. Vernier Calliper - Internal radius of a Calorimeter

Aim :- To find the internal radius of a given calorimeter using a Vernier calliper.

Apparatus Required :- Vernier Calliper, Calorimeter.

Formula :- Internal radius of the calorimeter is,

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

where $D \rightarrow$ Internal diameter of the calorimeter.

Observations & Tabular Column :-

Least Count (L.C) :- It is the smallest measurement that which any measuring instrument can measure accurately.

$$L.C = \frac{\text{Value of 1 main scale division}}{\text{Total no. of Vernier scale divisions}} = \frac{1 \text{ div}}{10}$$

$$L.C = \frac{1 \text{ mm}}{10} = 0.1 \text{ mm} = 0.01 \text{ cm}$$

L.C = 0.01 cm [for a Vernier Calliper]

To find the internal diameter (D) of the Calorimeter :-

Sl.No.	Dimension	M.S.R cm	V.S.C div	V.S.R = (V.S.C × L.C) (cm)	(M.S.R + V.S.R) cm	Mean (cm)
1.	Internal Diameter (D)					
2.						
3.						
4.						D''

Calculations :-

Internal radius (r) of the calorimeter is,

$$r = \frac{D}{2} = \text{\_\_\_\_\_} = \text{\_\_\_\_\_ cm}$$

$$r = \text{\_\_\_\_\_ m}$$

Procedure :-

1. Observe and note the least count and zero error of the given Vernier Calliper (by closing the jaws of the Vernier calliper).
2. Place the given calorimeter between the upper jaws of the Vernier calliper.
3. Note the main scale reading (M.S.R) and Vernier scale coincidence (V.S.C). Record them.
4. Repeat the experiment for different points of the object to get a few set of readings.
5. Calculate the mean value of D of the calorimeter
6. Use this mean value in the formula to calculate the internal radius of the calorimeter.

Precautions :- (Same as Experiment 1.)

Result :- Internal radius of the given Calorimeter is,

r = _____

4. Screw gauge - Thickness of the glass sheet/plate

Aim :- To find the thickness of the given glass sheet/plate using a screw gauge.

Apparatus Required :- Screw gauge, a thin glass sheet/plate

Formula :- Nil

Observations & Tabular Column :-

Least Count (L.C) :- It is the least measurement that any measuring instrument can measure accurately.

$$\text{Pitch of the screw} = \frac{\text{Distance moved}}{\text{No. of rotations made}} = \frac{4\text{ mm}}{4} = 1\text{ mm}$$

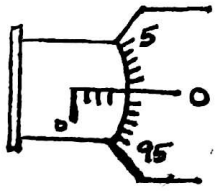
$$\therefore \text{Least Count (L.C)} = \frac{\text{Pitch of the screw}}{\text{Total no. of circular scale divisions}} = \frac{1\text{ mm}}{100}$$

$$\text{L.C} = 0.01\text{ mm}$$

Zero Error (Z.E) = e = _____

Zero Correction (Z.C) = x = −(e) = _____

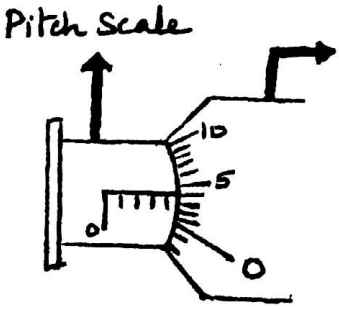
Rough fig :-



Z.E = Nil

eg:- e = 0

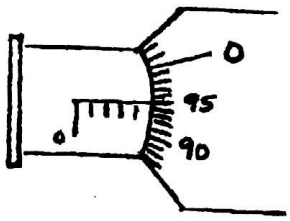
∴ x = 0



Positive error

eg:- e = +4

x = −4



Negative error

eg:- e = −5

x = +5

To find the thickness (t) of the given glass sheet / plate.

Sl.No	Dimension	(A) P.S.R (mm)	(B) Observed H.S.C (div)	(C) Corrected H.S.C (B+x) div	(D) Corrected reading [A + C(L.C)] mm	Mean (mm)
1.	Thickness (t)					
2.						
3.						
4.						t =

Calculations :- Nil

Procedure :-

1. Observe and note the least count, zero error and make zero correction of the given screw gauge by closing the gap between the two metal studs.
2. Place the given glass sheet/plate between the gap of two studs of the screw gauge.
3. Note linear (or) Pitch scale reading (P.S.R) and Circular (or) Head scale coincidence (H.S.C). Record them.
4. Repeat the experiment for different points of the object to get a few set of readings.
5. Calculate the mean value of the thickness (t) of the given glass sheet/plate.

Precautions :-

1. Examine the working of the given screw gauge before starting the experiment.
2. To avoid the error, due to back-lash, the screw should always be turned in the same direction.
3. Note the zero error carefully and it should be always taken into account.

Result :- The thickness of the given glass sheet using a screw gauge is, $t =$ _____

5. Screw Gauge – Volume of a Sphere

Aim :- To find the volume of a sphere using a screw gauge.

Apparatus Required :- Screw gauge, Sphere.

Formula :- Volume of the Sphere, $V = \frac{4}{3}\pi r^3$

where, $r \rightarrow$ radius of the Sphere

Observations & Tabular Column :-

(Same as Experiment No. 4 till -ve error)

To find the diameter (D) of the sphere :-

Sl. No.	Dimension	(A) P.S.R (mm)	(B) Observed H.S.C. (div)	(C) Corrected H.S.C. (B + x) (div)	Corrected reading [A + C (L.C)] (mm)	Mean (mm)
1.						
2.						
3.						
4.						D"

Calculations :-

1. Radius of the sphere, $r = \frac{D}{2}$ = _____ mm
2. Volume of the sphere, $V = \frac{4}{3}\pi r^3$ =

V = _____ mm^3

V = _____ m^3

Procedure :-

1. Observe and note the least count, zero error and make zero correction of the given screw gauge by closing the gap between the two metal studs.
2. Place the given sphere between the gap of two studs of the screw gauge.
3. Note Pitch scale reading (P.S.R) and head scale coincidence (H.S.C). Record them.
4. Repeat the experiment for different points of the object to get a few set of readings.

5. Calculate the mean value of the diameter (D) of the sphere. Hence find the radius (r) of the sphere.
6. Use the value of r in the formula to find the Volume of the given sphere.

Precautions :-

[Same as experiment 4]

Result :- Volume of the given sphere using a screw gauge is,

V = _____

6. Screw Gauge - Volume of the Wire

Aim :- To find the thickness of a given wire using a screw gauge and hence to find its volume.

Apparatus Required :- Screw gauge, wire, metre scale

Formula :- Volume of the wire = $V = \pi r^2 h$

where, $r \rightarrow$ radius, $h \rightarrow$ length } of the wire.

Observations and Tabular Column :-

(same as experiment no. 4 till -ve error)

Length of the wire = h = _____ cm = _____ mm

To find the thickness / Diameter (D) of the wire :-

Sl. No.	Dimension	(A) P.S.R (mm)	(B) Observed H.S.C (div)	(C) Corrected H.S.C (B + x) (div)	Corrected reading [A + C(L.C)] (mm)	Mean (mm)
1.						
2.						
3.						
4.						D =

Calculations :-

1. Radius of the wire, $r = \frac{\text{Diameter}}{2} = \frac{D}{2}$ = _____ mm
2. Volume of the wire, $V = \pi r^2 h$ =

V = _____ mm^3

V = _____ m^3

Procedure :-

1. Observe and note the least count, zero error and make zero correction of the given screw gauge by closing the gap between the two metal studs.

2. Place the given wire between the gap of the two metal s of the screw gauge.
3. Note Pitch scale reading (P.S.R) and Head Scale Coincidence (H.S.C). Record them.
4. Repeat the experiment for different points of the wire to get a few set of readings.
5. Find the mean value of the diameter (D) of the wire and also its radius (r).
6. Measure the total length (h) of the given wire using a metre scale.
7. Use the values of r and h in the formula to find the volume of the given wire.

Precautions : [same as Experiment No. 4].

Result :-

1. The thickness (diameter) of the given wire = D = _____
2. Volume of the given wire, V = _____

7. Parallelogram law of Vectors (forces):

Aim: To find the unknown weight of a given object using parallelogram law of vectors (forces).

Apparatus Required: Gravesand's apparatus (A vertical wooden board with two fixed pulleys), slotted weights, with two weight hangers, long cotton strings, sheet of white paper, board pins, compass, divider, protractor and sharp pointed pencil.

Theory: When two forces acting simultaneously at a point are represented in magnitude and direction by two adjacent sides of a parallelogram, then, their resultant is represented in both magnitude and direction along the diagonal of the parallelogram passing through the point of intersection of the two forces.

Formula: Magnitude of resultant force is,

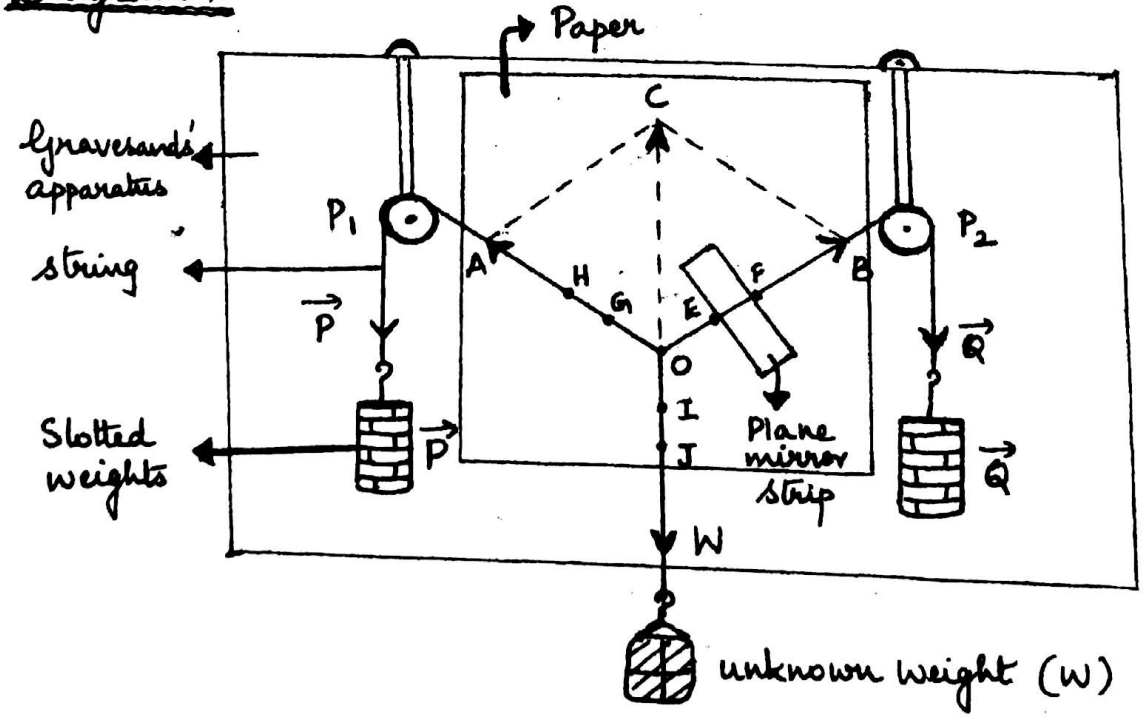
$$R = (P^2 + Q^2 + 2PQ\cos\theta)^{1/2}$$

where

$P, Q \rightarrow$ magnitudes of forces $\vec{P}$ & $\vec{Q}$

$\theta \rightarrow$ angle between $\vec{P}$ and $\vec{Q}$.

Diagram:



Observation and Tabular Column :-

The weight of the given object (using spring balance) } = _____ gwt

Scale (S) ⇒ 1 cm = 50 gwt

To find magnitude of unknown weight of the object :-

Sl No	Force (P) = Wt. of the hanger + slotted weights		Force (Q) = Wt. of the hanger + slotted weights		Length of (OC)	Unknown weight	Mean weight
	Wt. in gwt	OA (cm)	Wt. in gwt	OB (cm)	R cm	W = RxS (gwt)	W (gwt)
1.							
2.							W"

Procedure :-

1. Set up the Gravesand's apparatus for its vertical position.
2. Check for frictionless pulleys P_1 and P_2 (if not oil them). and strings alongwith the weight hangers and the slotted weights not touching anywhere on the board.
3. Adjust the string between the pulleys, so that the central knot (O) is almost at the centre of the board.
4. Fix a white sheet of paper with board pins leaving enough gap (space) above and below this central knot (O) on the paper.
5. Mark this point O on the paper, by closing one eye without any parallax.
6. To mark the directions of forces $\vec{P}$, $\vec{Q}$ and $\vec{W}$, place the given plane mirror strip on the paper (as shown) to mark points E F at the edges of the mirror strip without any parallax between the string and

its image in the mirror strip.

7. Same way mark points G, H, I and J along the string on the paper for other two forces (as in fig).
8. Note the weights P and Q on either sides.
9. Now, remove the paper from the board.
10. Choose a proper scale [say 1cm : 50gwt] and cut an arc of length OA and OB on adjacent sides. From these points again cut 2 arcs to form a point C (as in fig).
11. Join AC, BC and the diagonal OC. Measure OC = R, with the help of a divider and scale for accuracy.
12. The magnitude of the unknown weight will be the magnitude of R×S. (S → Scale chosen)
13. Repeat the steps from 4 to 12 for different values of P and Q to get other set.
14. Find the weight of the body by a spring balance to verify your result.

Precautions :-

1. The hangers carrying the weights should not touch the board.
2. The pulleys should be frictionless.
3. The unknown weight should be kept vertical.
4. Suitable scale should be selected to draw a parallelogram.
5. Mark the points on the paper without any parallax between the string and its image on the mirror. When the strings and weights are at rest.

Result :-

The unknown weight of the given body by using parallelogram law of vectors (forces) } = _____