

EXPERIMENT No. 1 USE OF VERNIER CALLIPERS

Aim: To determine volume of a solid sphere and a hollow cylinder by using Vernier callipers.

Apparatus: Vernier callipers, solid sphere, hollow cylinder

Diagram:

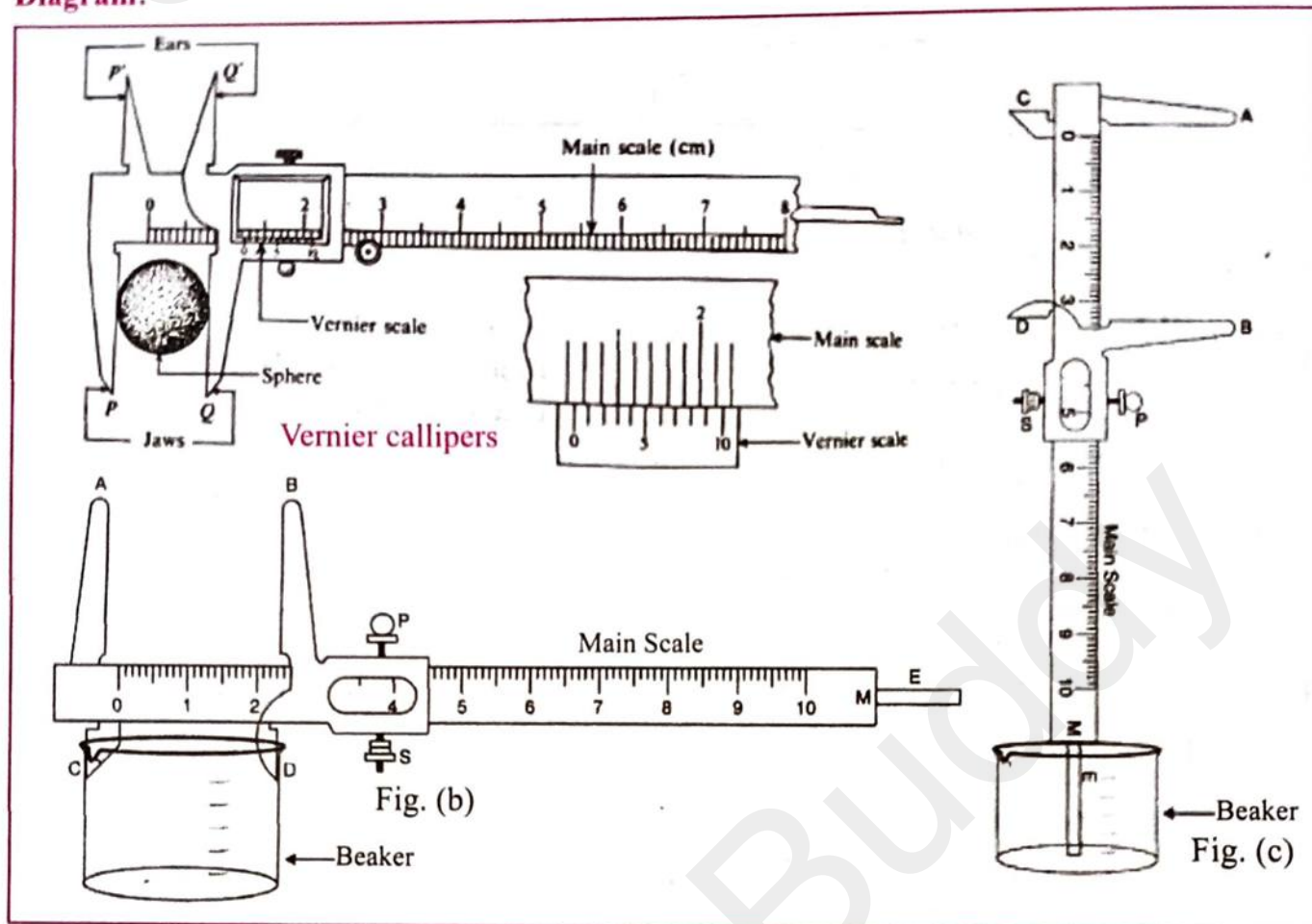


Fig.1.1 Vernier calliper

Formula:

1. Least count (L.C.) = $\frac{\text{(Smallest division on the main scale of vernier callipers)}}{\text{(Total number of divisions on vernier scale)}}$
2. Volume of solid sphere = $\frac{4}{3} \pi R^3$,
Where R – Radius of sphere
3. Volume of cylinder = $\pi r^2 h$, Where r- Radius of Cylinder, h- Height of Cylinder

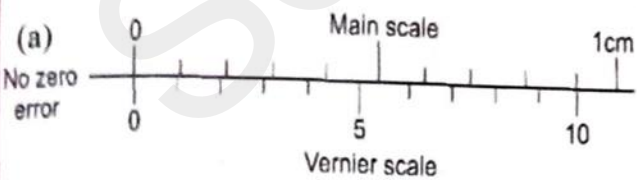
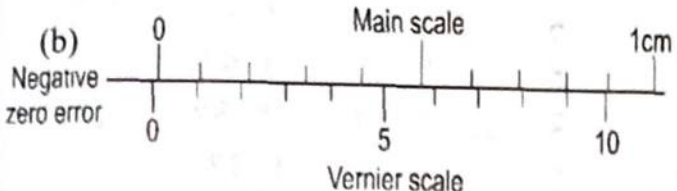
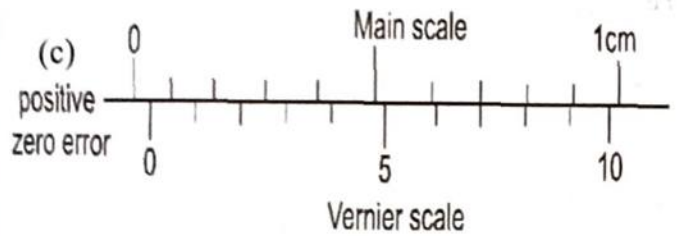
Observations:

Least count of Vernier calliper :

1. Smallest division on main scale = S =cm.
2. Total number of divisions on Vernier scale = N =
3. Least count = L.C. = $\frac{S}{N}$ =cm.

1. To find the zero error :

Bring the two jaws of Vernier callipers in contact. Observe and conclude according to the following given conditions.

Position of main Scale	Observation	Conclusion
<p>(a)</p>  <p>No zero error</p>	If zero division of the main scale coincides with zero division of Vernier scale	There is no zero error
<p>(b)</p>  <p>Negative zero error</p>	If zero division of the Vernier scale is on right side of zero division of main scale and if m^{th} division of Vernier scale coincides with same division of main scale.	Negative zero error $= -(N - m) \times \text{L.C}$
<p>(c)</p>  <p>positive zero error</p>	If zero division of Vernier scale is on left side of zero division of main scale and if m^{th} division of Vernier scale coincides with same division on main scale.	Positive zero error $= +m \times \text{L.C}$

\therefore Zero error $Z = \dots\dots\dots\text{cm.}$
(with sign)

II. To determine volume of sphere:

1. Hold the given solid sphere between the lower jaws of Vernier callipers. as shown in fig 1.1.
2. Note the position of zero mark of Vernier scale on the main scale. Let the reading be 'A'.
3. Note the Vernier division (B) that coincides with some division on the main scale.
4. Then calculate the total reading (T) with formula $T = A + (B \times \text{L.C.})$
5. Take at least three independent reading for different positions of sphere.
6. Apply correction according to zero error ($T + Z$) and find the mean value of diameter (D) and

calculate radius of sphere $= r = \frac{D}{2}$.

III. To find the inner diameter and length of the hollow cylinder. (Use upper jaws for measuring inner diameter)

Observation Table:

Object	Obs. No.	Dimensions	Main Scale Reading A (cm)	Coincident Vernier Scale division B	Vernier scale reading C = (B X L.C.) (cm)	Total Reading T = A + C (cm)	Corrected Reading = T - Z.E(cm)	Mean Reading (cm)
Sphere	1	Diameter (D)	1.5	5	5	1.55	1.55	1.56
	2		1.5	5	5	1.55	1.55	
	3		1.5	5	5	1.55	1.55	
Cylinder	1	Inner Diameter (d)	1.6	5	5	1.65	1.65	1.65
	2		1.6	5	5	1.65	1.65	
	3		1.6	5	5	1.65	1.65	
Cylinder	1	Depth/ Length (h)	5.3	2	2	5.32	5.32	5.32
	2		5.3	2	2	5.32	5.32	
	3		5.3	2	2	5.32	5.32	

Calculations:

1. Radius of sphere (R) = $\frac{D}{2} = \dots \frac{1.5}{2} \dots \text{cm.}$

$= 0.75 \text{ cm.}$

2. Volume of sphere (V) = $\frac{4}{3} \pi R^3 = \dots \frac{4}{3} \times 3.14 \dots \text{cm}^3.$

$= \frac{4}{3} \times 3.14 \times 0.42187$

$= \frac{4}{3} \times 1.3246875$

$= 1.77 \text{ cm}^3$

3. Inner radius of Cylinder (r) = $\frac{d}{2} = \dots 0.8 \dots \text{cm.}$

$= \frac{1.6}{2}$

$= 0.8 \text{ cm}$

4. Inner volume of cylinder V = $\pi R^2 h = \dots 11.36 \dots \text{cm}^3.$

$= 3.14 \times (0.825)^2 \times 5.32$

$= 3.14 \times 0.680625 \times 5.32$

$= 11.36$

Result :

1. Volume of sphere =1.77.....cm³.
2. Volume of cylinder =11.36..... cm³.

Precautions:

1. Hold the object tightly between the jaws; do not press the jaws too hard.
2. Take observations for diameter at different positions of the object.
3. Eye should be exactly perpendicular to the Vernier scale while observing reading.

Additional Experiment you can do:

Procedure : Take a small mug or cylindrical glass having thick bottom. Measure its inner diameter by using upper ends of the jaws. Measure depth by using depth measurement strip. Hence, calculate capacity (inner volume) of the mug or glass.

Multiple-choice Questions

1. If smallest division on the main scale of Vernier Callipers is 0.05cm and number of division on the Vernier scale is 25, the L.C. of Vernier Callipers is
a) 0.0002 cm b) 0.002 cm c) 0.001cm ~~d) 0.01cm~~
2. Upper jaws are used to find
a) outer diameter ~~b) inner diameter~~ c) length d) thickness

Questions

1. What is zero error?

Zero error is a technical term, which means, how far away zero from zero is reading of the instrument when the real value is known is be zero. It can be either positive or negative.

2. How do you apply the correction due to zero error?

Positive zero error occurs when the '0' marking of the thumb scale is below the horizontal reference line of the main scale. The error is +x mm. To correct the reading, we subtract the error from the measurement.

Remark and sign of teacher: