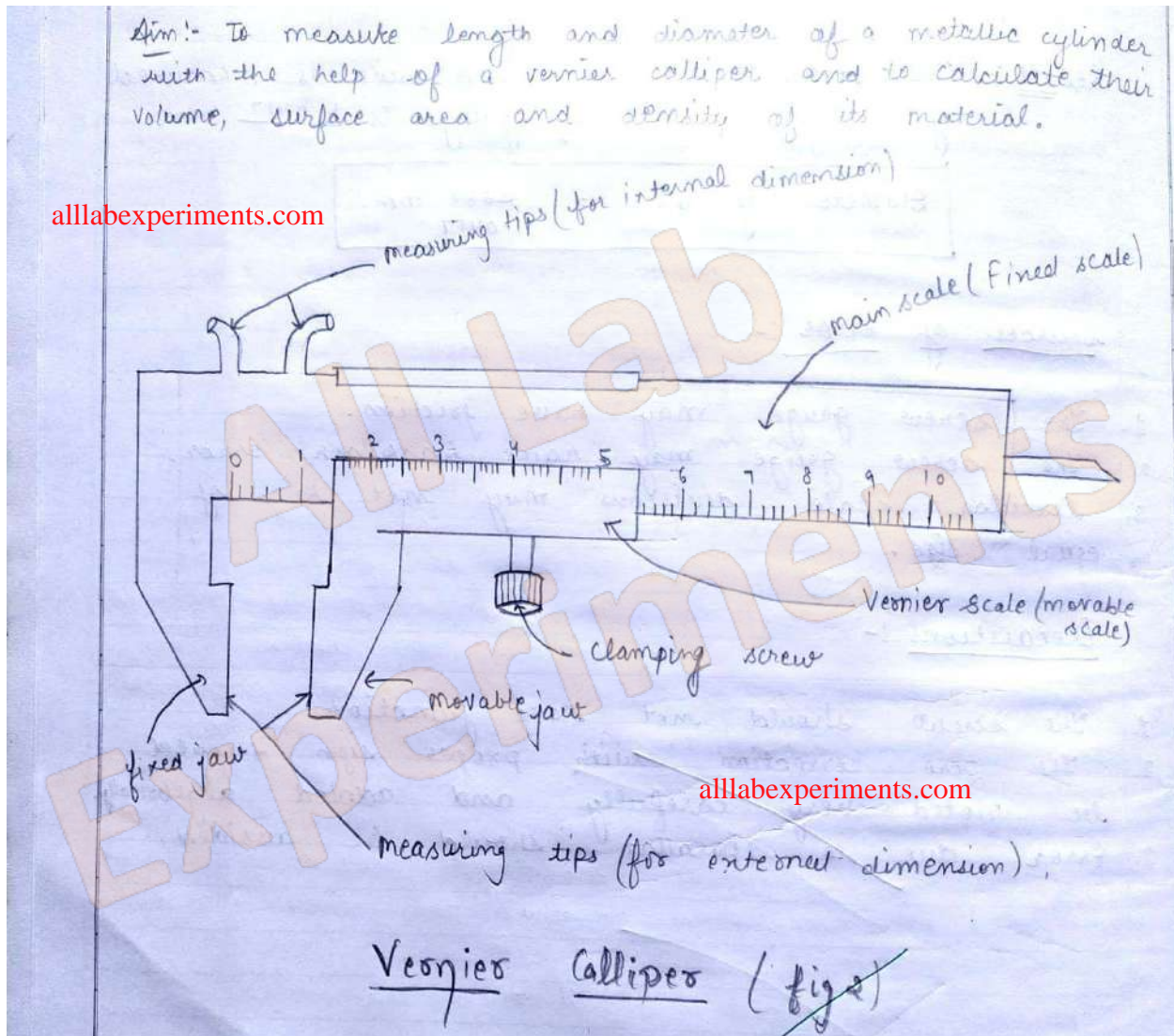


Vernier Caliper Practical File



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Aim:- To measure length and diameter of a metallic cylinder with the help of Vernier calliper and to calculate their volume, surface area and density of its material.

Apparatus and material required:-

Vernier calliper, a cylindrical object.

Principle:-

The difference in the magnitude of one main scale division (M.S.D) and one vernier scale division (V.S.D) is called the least count of the instrument, as it is the smallest distance that can be measured using the instrument.

$$n(\text{V.S.D}) = (n-1) \text{M.S.D}$$

Formulae used:-

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- (i) Volume of cylinder = $\pi R^2 L$
(ii) Surface area of cylinder = $2\pi R(R+L)$
(iii) Density of the material of cylinder = $\frac{\text{Mass}}{\text{Volume}}$
 $= \frac{\text{Mass}}{\pi R^2 L}$

Here, R = Radius
L = length



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Procedure :-

Measuring of diameter of a small cylindrical body:-

1. Keep the jaws of vernier calliper closed. Observe the zero error mark of the main scale. It must perfectly coincide with that of the vernier scale. If this is not so, account for the zero error for all observations to be made while using the experiment.
2. Look for the divisions on the vernier scale that coincides with a division on the main scale. Note the no. of divisions on the vernier scale, that coincides with the one on the main scale.
3. Then, loose the screw to release the moveable jaw. Slide it enough to hold the cylindrical body. Now, gently tighten the screw so as to clamp the instrument in this position to the body. alllabexperiments.com
4. Carefully, note the position of zero mark of the vernier calliper scale against the main scale. Usually, it will not perfectly coincide with any of the small division just to the left of the zero mark of vernier scale.
5. Start looking for exact coincidence of a vernier scale division with that of a main scale division in the vernier window from left and (zero) to the right. Note its number.



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Observations and Calculations:-

(i) Least count of vernier calliper :-

Least count of main scale (S) = 1 mm

No. of division on vernier scale (N) = 10

$$\text{Vernier constant} = \frac{S}{N} = \frac{1}{10} \text{ mm}$$

$$\text{Least count} = 1 \text{ M.S.D} - 1 \text{ V.S.D}$$

$$\text{As } 10 \text{ V.S.D} = 9 \text{ M.S.D}$$

$$\Rightarrow 1 \text{ V.S.D} = \frac{9}{10} \text{ M.S.D}$$

$$\text{So, least count} = 1 \text{ M.S.D} - \frac{9}{10} \text{ M.S.D}$$

$$= \frac{1}{10} \text{ M.S.D} = \frac{1}{10} \times 1 \text{ mm} = 0.1 \text{ mm}$$
$$= \underline{0.01 \text{ cm}}$$

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(ii) Observation table for length of cylindrical body:-

Sr. No.	Main scale Reading (cm)	Vernier scale Division (V.S.D)	Vernier scale Reading (VSR = VSD × LC) cm	Total reading (cm)
1.	7.6	6	0.06	0.06 + 7.6 = 7.66
2.	7.7	9	0.09	0.09 + 7.7 = 7.79
3.	7.6	9	0.09	0.09 + 7.6 = 7.69
4.	7.6	8	0.08	0.08 + 7.6 = 7.68
5.	7.6	9	0.09	0.09 + 7.6 = 7.69

$$\text{Mean} = \frac{7.66 + 7.79 + 7.69 + 7.68 + 7.69}{5} = \frac{38.51}{5} = 7.702 \text{ cm}$$

$$\text{Mean} = 7.702 \text{ cm}$$

II) Diameter of cylinder:-

Sl. No.	Main Scale Reading (M.S.R) cm	Vernier Scale Division (V.S.D)	Vernier Scale Reading (V.S.R) = V.S.D \times L.C (cm)	Total reading (cm)
1.	0.9	8	$8 \times 0.01 = 0.08$	$0.9 + 0.08 = 0.98$
2.	0.9	8	$8 \times 0.01 = 0.08$	$0.9 + 0.08 = 0.98$
3.	1	3	$3 \times 0.01 = 0.03$	$1 + 0.03 = 1.03$
4.	1	2	$2 \times 0.01 = 0.02$	$1 + 0.02 = 1.02$

$$\text{Mean} = \frac{0.98 + 0.98 + 1.03 + 1.02}{4} = \frac{4.01}{4} = \underline{\underline{1.0025 \text{ cm}}}$$

$\text{Mean} = 1.0025 \text{ cm}$

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Calculations:-

length of cylinder (L) = 7.702 cm.

Radius of cylinder (R) = $\frac{1.0025}{2} = 0.5012 \text{ cm}$.

(i) Volume of Cylinder = $\pi R^2 L = \frac{22}{7} \times (0.5012)^2 \times (7.702)$
 $= 6.0806 \text{ cm}^3$

(ii) surface area of cylinder = $2\pi R(R+L)$
 $= 2 \times \frac{22}{7} \times 0.5012 (0.5012 + 7.702)$
 $\Rightarrow 25.822 \text{ cm}^2$

(iii) Density of cylinder = $\frac{\text{Mass}}{\text{Volume}} = \frac{43.29}{6.0806}$ | mass = 43.29g
 $\Rightarrow \underline{\underline{7.124 \text{ g/cm}^3}}$

6. Multiply this number by least count of the instrument and add the product to the main scale reading.
7. Repeat steps 3-6 to obtain the diameter of the body as different positions on its curved surface. Take sets of readings in each case.

• Result :-

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Volume of cylinder = 6.0806 cm^3

Length of cylinder = 7.702 cm

Diameter of cylinder = 1.0025 cm

Surface area of given cylinder = 25.822 cm^2

Density of cylinder = 7.124 g/cm^3

• Precautions :-

- 1) If the vernier scale is not sliding smoothly, over the main scale, apply machine oil.
- 2) Screw the vernier tightly without exerting under pressure to avoid any damage to the threads of the screw.
- 3) Keep the eye directly over the division mark to avoid any error due to parallax.



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• Sources of Error:-

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- (i) The jaws may not be easily at right angles to the main scale.
- (ii) Some error due to parallax is always there.
- (iii) The vernier scale may be loosely fitted with the movable jaws.
- (iv) The gradation on the scale may not be easily marked.



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