To Measure Internal Diameter and Depth of a Given Beaker/Calorimeter Using Vernier Callipers and Hence Find its Volume.

Aim

To measure internal diameter and depth of a given beaker/calorimeter using Vernier Callipers and hence find its volume.

Apparatus

Vernier callipers, a beaker or a calorimeter, magnifying glass.

Theory

(i) For measuring internal diameter and depth. Same as in Experiment 1A.
(ii) For volume:
Volume of beaker or calorimeter = internal area of cross section x depth

or $$V = \pi\left(\frac{D}{2}\right)^2 . d$$

where, D = internal diameter of beaker/calorimeter
d = depth of beaker/calorimeter.

Diagram

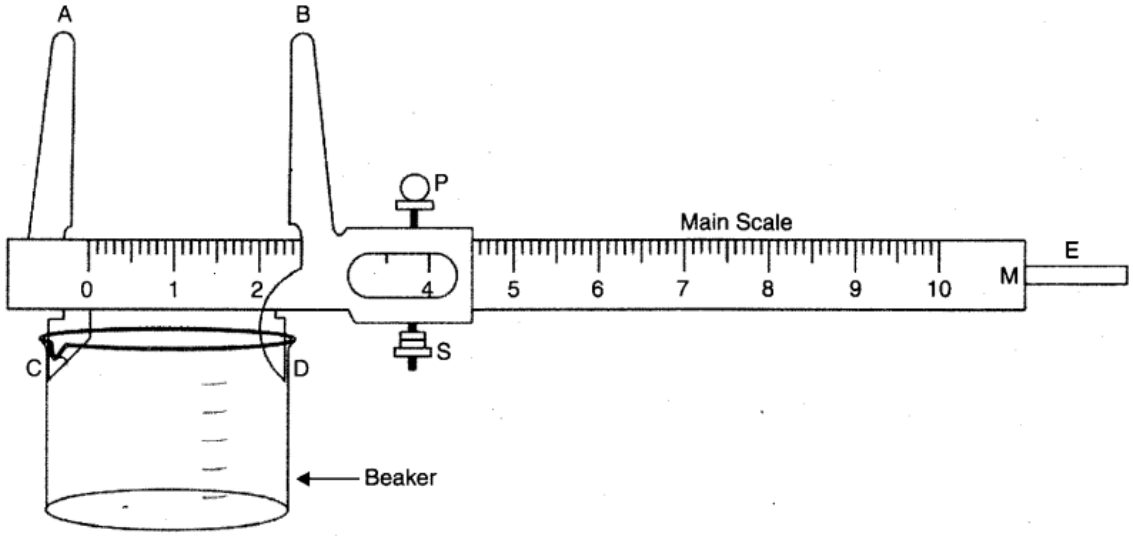

Fig. (*a*) Internal diameter of beaker.

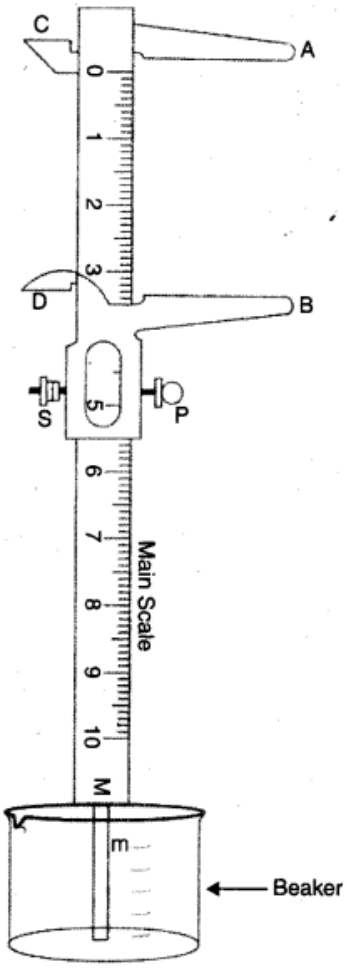

Fig. (*b*) Depth of beaker.

Procedure

1. Determine the vernier constant (V.C.) i.e., least count of the vernier callipers and record it stepwise.
2. Bring the movable jaw BD in close contact with the fixed jaw AC and find the zero error. Do it three times and record it. If there is no zero error, then record, zero error nil.
   Measurement of internal diameter
3. Put the jaws C and D inside the beaker or calorimeter and open them till each of them touches the inner wall of the beaker or calorimeter, , without any undue pressure on the walls. Tight the screw attached to the vernier scale gently.
4. Note the-position of the zero mark of the vernier scale on the main scale. Record the main scale reading just before the zero mark of the vernier scale. This reading (IV) is called main scale reading (M.S.R.).

5. Note the number (n) of the vernier scale division which coincides with some division of the main scale.
6. Repeat steps 4 and 5 after rotating the vernier callipers by 90° for measuring internal diameter in a perpendicular direction.
7. Find total reading and apply zero correction.
   Measurement of depth
8. Keep the edge of the main scale of vernier callipers on its peripheral edge. This should be done in such a way that the tip of the strip is able to go freely inside the beaker along its depth.
9. Keep sliding the moving jaw of the vernier callipers until the strip just touches the bottom of the beaker. Take care that it is just perpendicular to the bottom surface. Now tighten the screw of the vernier callipers.
10. Repeat steps 4 and 5 for four different positions along the circumference of the upper edge of the beaker or calorimeter.
11. Find total reading and apply zero correction.
12. Take mean of two different values of internal diameter and four different values of the depth.
13. Calculate the volume by using proper formula and show that in the result with proper unit.

Observations

1. Determination of Vernier Constant (Least Count) of the vernier callipers
   1 M.S.D. = 1 mm 10 V.S.D. = 9 M.S.D.
   ∴ 1 V.S.D. = 9/10 M.S.D. = 0.9 mm
   Vernier constant, V.C. = 1 M.S.D. – 1 V.S.D. = (1 – 0.9) mm
   = 0.1 mm = 0.01 cm.
2. Zero error = (i)……..cm, (ii)……..cm, (iii)……..cm.
   Mean zero error (e) =……..cm
   Mean zero correction (c) = – (e) =……..cm.
3. Table for the Internal Diameter (D)

Serial No. of Observations	*Main Scale Reading (N) (cm)*	*Vernier Scale Reading*		*Total Reading*	
		No. of Vernier division coinciding (n)	*Value [n × (V.C.)]*	*Observed $D_0 = N + n \times V.C.$*	*Corrected $D = D_0 + c$*
1.					$D_1 =$
2.					$D_2 =$
3.					$D_3 =$
4.					$D_4 =$

4. Table for the depth (d)

Serial No. of Obs.	Position	Main Scale Reading (N) (cm)	Vernier Scale Reading		Total Reading	
			No. of Vernier division coinciding (n)	Value [n × (V.C.)]	Observed $d_0 = N + n \times (V.C.)$	Corrected $d = d_0 + c$
1.	at A					$d_1 =$
2.	at B					$d_2 =$
3.	at C					$d_3 =$
4.	at D					$d_4 =$

Calculations

Mean corrected internal diameter,

$$D = \frac{D_1(a) + D_1(b)}{2} = \text{..... cm}$$

Mean corrected depth,

$$d = \frac{d_1 + d_2 + d_3 + d_4}{4} = \text{..... cm}$$

Volume of beaker/calorimeter $= \pi \left(\frac{D}{2}\right)^2 d = \text{..... cm}^3$

Result

The volume of the beaker/calorimeter is ……cm^3.

Precautions

Same as given in Experiment 1A.

Sourcess of error

Same as given in Experiment 1A.

Viva Voce

Question. 1. Why is a slide callipers called a Vernier Callipers ?
Answer. Because it was first designed by a French mathematician, Pierre Vernier.

Question.2. What is the principle of a vernier scale ?
Answer. The number of vernier scale divisions coinciding with main scale divisions should either be one less or one more.

$$1 \text{ V.S.D.} = \frac{1 \text{ M.S.D.}}{\text{No. of divisions on V.S.}}$$

Question.3. Define vernier constant.
Answer. It is the difference between value of one main scale division and one vernier scale division of a vernier callipers.

Question.4. Define least count of a measuring instrument.
Answer. It is the least quantity that the instrument can measure accurately. (For a vernier callipers, its. least count is equal to vernier constant.)

Question.5. Give least counts of a metre scale, vernier callipers, screw gauge and a spherometer.
Answer. Metre scale (1 mm), vernier callipers (0.1 mm),

Question.6. screw gauge and spherometer (0.01 mm). What is a zero error ?
Answer. It is the error in the vernier callipers, if the zeros of the main scale and vernier scale do not coincide when the lower jaws are in contact.

Question.7. How does zero error arise in the instrument ?
Answer. It arises due to wear and tear of the instrument caused by its long use.

Question.8. When is zero error positive and when is it negative ?
Answer. Zero error is positive when vernier zero is to the right of main scale zero and negative if it is to the left.

Question.9. How is zero error applied ?
Answer. Zero error is a algebraically subtracted from the observed reading.

Question.10. What is zero correction ? How is it applied ?
Answer. Negative of zero error is zero correction. It is algebraically added to the observed reading.

Question.11. What is the utility of vernier scale over meter scale ?
Answer. It increases the accuracy of measurement.

Question.12. What are other measurements that can be made by a vernier callipers ?

Answer. The callipers jaws are used for measuring internal diameter of hollow cylinder or calorimeter. The thin metallic strip attached to the back side of the main scale is used for measuring depth of a vessel.

Question.13. Can we measure the thickness of a piece of paper by vernier callipers ?
Answer. No.

Question.14. What is the least count of your laboratory vernier callipers ?
Answer. The least count is 0.01 cm.

Question. 15. What is an angular vernier ?
Answer. An angular vernier is used for measuring fraction of a degree of an angle. It is provided in sextants and spectrometers, which measure angular displacements.