Experiment 1: Determination of linear dimensions and density of solids and liquids

Aim: a) To measure the dimensions of rectangular, cylindrical and spherical objects.

b) To determine mass by using a digital balance and

c) To determine density in g/cc and kg/m^3.

Apparatus: Regular solid rods of different metals, digital vernier caliper, digital balance, beakers, thread, pure water, salt and pipette.

Density is the fundamental property of a solid. We say copper (Cu) is heavier than aluminium (Al).This means density of Cu is higher than Al. How to measure density of solid? In this experiment we will determine the density of solid objects made of different metals.

A. Density of regular solids

Definition: **Density** = $\frac{\text{mass}}{\text{volume}}$ $\frac{(g)}{(cc)}$; **SI** unit of mass is **kg** and volume is **m**^{3}.

Mass is weighed in gram (g) in a digital balance. Volume in **cm**^{3} (cubic centi meter (**cc**)).

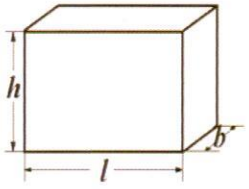
1cm ×1cm× 1cm= 1cm^3; 100 cm= 1m; therefore100cm×100cm ×100cm = 10^6cm^3 = 1m^3

1000 g = 1 kg; Density of water = 1.000g/cc at 4°C equals 1000 kg/m^3.

Figure 1.1: Vernier Caliper is used to measure diameter in mm.

Least count = 0.01 mm

How to use the caliper?



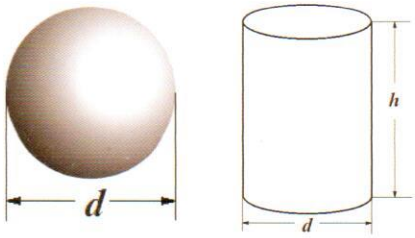
1. Join the jaws of caliper.
2. Press zero button until display shows 0.00 mm to make error free.
3. Take the rectangular block
4. Measure the length (l), breadth (b), and height (h).
5. Record the l, $b$and h values in mm in the observation table in your laboratory notebook. 10mm = 1cm
6. Convert l, b and h in mm to cm.

Formulae:

Volume of the rectangular block = $l \times b \times h$ cm^3

Volume of solid cylinder = $\pi \times \left(\frac{d}{2}\right)^2 \times h$ cm^3; d=diameter

Volume of sphere = $\frac{4}{3} \times \pi \times \left(\frac{d}{2}\right)^3$ cm^3; d=diameter



Observation and results

Metal	Shape		Dimension and Reading mm	mm	Mean mm	cm	Volume in cc	Mass in g	Density g/cc	Density Kg/m^3
Iron or Al	Rectangular Block	l								
		b								
		h								
Brass	Cylinder	d								
		h								
Cu	Cylinder	d								
		h								
Al	Cylinder	d								
		h								
Steel	Sphere	d								

Here: l = length, b= breadth, h= height, d= diameter

B. Determine density of solids of irregular shape?

A stone is a solid of irregular shape. Its mass can be measured. Volume of such objects cannot be determined using Vernier caliper. But its volume can be determined using Archimedes principle and its density. This method is called Buoyancy method.

Buoyancy method:

Archimedes principle is the supreme principle to determine the density of materials in any shape. It states that the *buoyant force experienced by a submerged object is equal to the weight of the liquid displaced by the object.* Because of buoyant force weight of an object inside the liquid feels