Chapter 1 Introduction to Physics

1. The metre is defined as the distance travelled by light in $\dfrac{1}{299792458}$ second. Why didn't people choose some easier number such as $\dfrac{1}{300,000,000}$ second? Why not 1 second?

[Sol. Until 1960, meter was defined as the distance between two lines on a specific bar of platinum iridium alloy stored under controlled condition. Because of its limited accuracy, it was abandoned by scientist. From the above scale speed of light was 299792458 m/s and not 300000000 ms^{-1}. They needed something which could give them more accurate results in different places and at different times. Thus, in 1983, they adopted distance travelled by light in $\dfrac{1}{c}$ s.]

2. What are the dimensions of :
a. volume of a cube of edge *a*,
b. volume of a sphere of radius *a*,
c. the ratio of the volume of a cube of edge *a* to the volume of a sphere of radius *a?*

[Sol.
  (a) L^3
  (b) L^3
  (c) $M^0L^0T^0$.]

3. Suppose you are told that the linear size of everything in the universe has been doubled overnight. Can you test this statement by measuring sizes with a metre stick? Can you test it by using the fact that the speed of light is a universal constant and has not changed? What will happen if all the clocks in the universe also start running at half the speed?

[Sol. No, Yes, No
  After clock becomes slow, when 1 hr passes in clock, 2 hr passes in reality.
  $l = ct$: old clock time
  $2l = c(2t)$: new clock time
  $\therefore\ l = ct$.]

4. If all the terms in an equation have same units, is it necessary that they have same dimensions? If all the terms in an equation have same dimensions, is it necessary that they have same units?

[Sol. Yes, No [$\omega = 2\pi f$]
  ω has unit rad/sec but frequency has hertz.]

5. If two quantities have same dimensions, do they represent same physical content?
[Hint: No. Torque and Energy.]

6. It is desirable that the standards of units be easily available, invariable, indestructible and easily reproducible. If we use foot of a person as a standard unit of length, which of the above features are present and which are not?
[Hint: None are present.]

7. Suggest a way to measure the:
   a. thickness of a sheet of paper.
   b. distance between the sun and the moon.
[Hint: measure thickness of 100 pages together and divide the measured value by 100.]