CHAPTER NO. 1 (MEASUREMENTS)

Question 1.1:- Name several repetitive phenomenon occurring in nature which could serve as reasonable time standard.

Answer:- Every type of natural phenomenon which repeats itself after some interval of time can serve as a reasonable standard of time. Some of the natural phenomena are as under:-

i. Rotation of earth around the sun.
ii. Rotation of moon around the earth.
iii. Vibrations of the atoms of the lattice.
iv. Change in position and size of shadows of objects during day time.
v. Change in position of sun during day time and change in position of stars during night time.
vi. Rising and setting of sun.
vii. Rising and setting of moon.

Question 1.2:- Give the drawbacks to use the period of a pendulum as a time standard.

Answer:- The time period of a simple pendulum is given as $\mathbf{T = 2\pi\sqrt{\frac{l}{g}}}$. It depends on length of the pendulum and value of acceleration due to gravity. Frictional effects i.e. air resistance and support friction also affect the time period of the simple pendulum. It is common to note that:-

i. Length of the pendulum may change due to variation in temperature.
ii. Value of acceleration due to gravity changes due to altitude and change in geographical position.
iii. Frictional effects due to air resistance and support friction cannot be nullified.

It is clear that time period of a simple pendulum is not a controlled quantity due to aforementioned drawback and hence cannot be used as a reasonable time standard.

Question 1.3:- Why do we find it useful to have two units for the amount of substance, the kilogram and the mole?

Answer:- It is very useful to use two units for amount of substance.

The **kilogram** is more frequently used at macro level (in our daily life calculations) to measure the amount of substance while the **mole** is used at microscopic level (for making atomic calculations) to measure the amount of substance because one mole of any substance contains equal number of atoms, molecules, radicals, ions etc.

Question 1.4:- Three students measured the length of a needle with a scale on which minimum division is 1 mm and recorded as (i) 0.2145 m (ii) 0.21 m (iii) 0.214 m. Which record is correct and why?

Answer:- The minimum division on a scale is called its least count. The least count of the given scale is **1 mm = 0.001 m** which indicates that the scale can measure correct length up to three decimal points in standard unit **"meter".** Therefore, the correct reading is **0.214 m.**

Question 1.5:- An old saying is that "A chain is only as strong as its weakest link". What analogous statement can you make regarding experimental data used in a computation?

Answer:- Analogous statements regarding experimental data used in computations are given as:-

i. A reading will be more precise if it has less absolute error.
ii. A reading will be more accurate if it has less percentage error.

Question 1.6:- The period of a simple pendulum is measured by a stop watch. What type of errors are possible in the time period?

Answer:- The possible errors in the time period of a simple pendulum are due to:-

i. Zero error of the stop watch.
ii. Parallax error in the reading of the stop watch.
iii. Air resistance.
iv. Very large amplitude of simple pendulum.
v. Unknown reasons **(Random error).**
iv. Poor calibration or incorrect marking of the stop watch scale **(Systematic error).**

Question 1.7:- Does a dimensional analysis give any information on constant of proportionality that may appear in an algebraic expression? Explain.

Answer:- There are two possible cases given as under:-

i. If any algebraic relation or equation of any physical quantity (phenomenon) is derived by using dimensional analysis, no information on value of the constant can be extracted from this analysis. However, constant of proportionality appearing in such relations is always dimensionless (without any unit).

ii. If any algebraic relation or equation of a physical quantity (phenomenon) is derived mechanically or experimentally, the dimensional analysis can give us the dimension and hence unit of constant of proportionality appearing in such relations.

Question 1.8:- Write the dimensions of (i) Pressure (ii) Density.

Answer:- We know that:-

Pressure = $\frac{Force}{Area}$ P = $\frac{F}{A}$ [P] = $\frac{[F]}{[A]}$, As [F] = [MLT^{-2}] and [A] = [L^2] So [P] = $\frac{[MLT^{-2}]}{[L^2]}$ = [$ML^{-1}T^{-2}$]	Density = $\frac{Mass}{Volume}$ ρ = $\frac{m}{V}$ [ρ] = $\frac{[m]}{[V]}$, As [m] = [M] and [V] = [L^3] So [ρ] = $\frac{[M]}{[L^3]}$ = [ML^{-3}]

Question 1.9:- The wavelength of a wave depends on the speed v of the wave and its frequency f. Knowing that [λ] = [L], [v] = [L T^{-1}] and [f] = [T^{-1}], Decide which of the following relation is correct, f = v λ or f = $\frac{v}{\lambda}$.

Answer:- We can check the correctness of a physical relation by using principle of homogeneity as under:-

f = v λ [f] = [T^{-1}] [v] [λ] = [L T^{-1}] [L] = [L^2 T^{-1}] So **L.H.S. ≠ R.H.S.**	f = $\frac{v}{\lambda}$ [f] = [T^{-1}] $\frac{[v]}{[\lambda]}$ = $\frac{[L\,T^{-1}]}{[L]}$ = [T^{-1}]

Hence the given relation v = f λ is not correct.	So **L.H.S. = R.H.S.** Hence the given relation f = $\frac{v}{\lambda}$ is correct.