Unit - I

Units And Dimensions:-

Physical Quantities:-

A quantitive definition of any physical phenomenon always involves certain indeniable quantities in terms of which the laws of physics are invariably expressed. Such quantities like force, velocity, time, density, change in temp. etc are called physical quantities.

Fundamental and Derived Quantities:-

Following seven quantities are known as fundamental quantities:-

Fundamental Quantities	S.I unit
(i) Mass	Kilogram (kg)
(ii) length	Meter (M)
(iii) Time	Second (Sec)
(iv) Electric Current	Ampere (A)
(v) Thermodynamic Temperature	Kelvin (K)
(vi) Luminosity	Candela (cd)
(vii) Amount Substance	Mole (Mol)

Derived Quantities:-

All physical Quantities can be expressed in terms of seven fundament-

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-al quantities. These quantities are called derived qualities.

Ex:- Area, velocity, acceleration, force, Momentum etc.

Unit:- In order to make the measurement of a physical quantity we have to evolve a standard for that measurement so that different measurements of same physical quantity can be expressed relative to each other. That standard is called a unit of that physical quantity.

System of unit:-

Following system of measurements are commonly in use:-

a) C.G.S System:- It is a system of measurement in which the fundamental units of the measurement of length, mass and time are taken as 1cm, 1gm, 1sec respectively.

b) M.K.S System:- It is the system of measurement in which the fundamental units of length, mass and time are taken as 1m, 1kg, 1sec respectively.

(c) S.I System :- (Systemed Interna-tional) :-

C.G.S and M.K.S system have three fundamental units of mass, length and time. But in physics, there are so many quantity which cannot be ~~may~~ measured in terms of these three units. Therefore a new system of seven fundamental units called S.I unit was conceptualised which should enable us to make measurements for quantity coming across whole of physics.

D) F.P.S System :-

It is the system of measurement in which the fundamental units of length, Mass and time are 1 foot, 1 pound, 1 sec respectively.

Derieved Units :-

units of derieved quantities can be expressed in terms fundamental units. These units are called Derieved units.

Example :- (i) Area (A) = Length × Breadth

$= m \times m$

$= m^2$

(ii) Velocity (v) = $\frac{\text{Displacement}}{\text{Time}}$

= $\frac{\text{metre}}{\text{sec}}$

= m/sec

(iii) Acceleration (A) = $\frac{\text{Velocity}}{\text{time}}$ = $\frac{\text{m/sec}}{\text{second}}$

= m/sec^2

(iv) Force (F) = Mass x Acceleration

= kg x m/sec^2

= kg m/sec^2

(v) Momentum (p) = Mass x velocity

= kg x m/sec

= kg m sec

Some important practical units for measuring Microscopic Length:-

(i) 1 micron = 10^{-6} metre.

(ii) 1 Angstrom (A°) = 10^{-10} metre.

(iii) 1 fermi (fm) = 10^{-15} metre.

Dimension And Dimensional formulae Of physical quantities:-

Definition Of Dimension:- The dimension of a derived physical quantity may be defined as the powers to which its base units must be raised to represent it completely.

* Mass, length and time are considered to be the base dimensions and are denoted by [M], [L], [T]

respectively.

Dimensional formulae of physical Quantities:

(i) Mass = $[M]$
(ii) Length = $[L]$
(iii) Time = $[T]$
(iv) Area = $[L \times L]$ = length × Breadth = $[L^2] = [M^0 L^2 T^0]$
(v) Volume = length × Breadth × Thickness = $[L \times L \times L] = [L^3] = [M^0 L^3 T^0]$
(vi) Velocity = $\frac{\text{Displacement}}{\text{Time}} = \frac{L}{T} = [M^0 L^1 T^{-1}]$
(vii) Acceleration = $\frac{\text{Velocity}}{\text{Time}} = \frac{[M^0 L^1 T^{-1}]}{[T]} = [M^0 L^1 T^{-2}]$
(viii) Momentum = Mass × velocity = $[M] \times [M^0 L^1 T^{-1}] = [M^1 L^1 T^{-1}]$
(ix) Force = Mass × Acceleration = $[M] \times [M^0 L^1 T^{-2}] = [M^1 L^1 T^{-2}]$
(x) Work = Force × Distance $= [M^1 L^1 T^{-2}] \times [L] = [M^1 L^2 T^{-2}]$

Dimensional Equation:-

* An Equation written in the following manner is called dimensional eq^n.

Area = $[M^0 L^2 T^0]$

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Imp **Principle Of Homogeneity:-**

" It states that the dimensional formulae of every term on the two sides of a correct relation must be same."

Checking The Dimensional correctness of physical Relations:-

Problem:- Q. 1. Check the dimensional correctness of the relation $F = \frac{2mv^2}{r}$

Ans:- L.H.S = Dimensional Formulae of F = $[M^1 L^1 T^{-2}]$

$$R.H.S = \frac{2mv^2}{r} = \frac{[M] \times [M^0 L^1 T^{-1}]^2}{[L]}$$

$$= \frac{[M] \times [M^0 L^2 T^{-2}]}{[L]}$$

$$= \frac{[M^1 L^2 T^{-2}]}{[L]}$$

$$= [M^1 L^1 T^{-2}]$$

$\therefore$ L.H.S = R.H.S

Hence the given relation dimensionally correct.