Physic. Chapter : 1.

Units and Dimensions

(1) Physical quantities → Can be measured.

Classification

Based on direction (Yes / No)

vector
- Both
- eg :- Displacement

Scalars.
- only magnitude
- eg :- Distance

Based on dependancy (depend / does not depend)

Derived
eg :- m/s
m/s².
force.

fundamental
eg :- length
mass.
mole.

Physical Quantity : n.u

No. | unit

Property → 5m = 500cm
then $n_1 u_1 = n_2 u_2$
When ⇒ $u_1 > u_2$.

(2.) System of unit.

	length	Mass	time
MKS →	meter	kilogram	Second.
CGS →	Cm	gram	Second
FPS →	foot.	Pound	Second.

SI → universal System of unit.

(3) Dimension — To represent physical quantity

Velocity $\longrightarrow m/s$ $[M^0 L^1 T^{-1}]$

Acceleration $\longrightarrow m/s^2$ $[M^0 L^1 T^{-2}]$ $\longrightarrow$ Dimensional formula

(4) Unit Conversion

density $\dfrac{0.8\,kg}{m^3} = \dfrac{0.8 \times 1000\,g}{(100\,cm)^3} = 0.0008\,g\,cm^3$

$1N = 1\,\dfrac{kg\,m}{sec^2} = \dfrac{1 \times 1000\,g \times 100\,cm}{sec^2}$

$= 10^5\,g\,cm\,sec^{-2}$

$= 10^5$ dyne.

(5) Rules of Dimensional Analysis.

$5kg + 2kg = 7kg$ ✓ $\qquad u_1 + u_2 = u_3$

$5kg + 2kg = 7g$ ✗ $\qquad u_1, u_2, u_3 \in$ same unit or should have same dimensional formula.

$\left.\begin{array}{l} \sin(\theta) \\ \cos(\theta) \\ e^{\theta} \\ \log\theta \end{array}\right\}$ Dimensionless.

Application of dimensional Analysis.

(1.) Set of physical quantity can be treated as fundamental no.

Q Which of the following can be treated as set of fundamental Physical quantity.

(a) Length, velocity, time . × velocity = $\frac{\text{length}}{\text{time}}$

(b) Momentum, mass, velocity × Momentum = mass × velo-

(c) force, mass, velocity ✓

(d) momentum, time, frequency × frequency = $\frac{1}{\text{time}}$

(e) force, mass, acceleration × force = mass × accele-

(f) Energy, mass, velocity × Energy = $\frac{1}{2}mv^2$

(2) Relation between different physical quantity :-

Q If displacement depend upon acceleration and time then find the relation bet. displacement. acceleration and time,

displacement (s) $\propto$ (acceleration)^p (time)^q

$$f \propto a^p t^q$$

$$[M^0 L^1 T^0] \propto [M^0 L T^{-2}]^p [M^0 L^0 T^1]^q$$

$$M^0 L^1 T^0 \propto M^0 L^p T^{-2p} M^0 L^0 T^q$$

$1 = p$

$0 = -2p + q$

$0 = -2 \times 1 + q$

$0 = -2 + q$

$q = 2.$

$\boxed{p = 1}$

$\boxed{q = 2}$

(3) Check the correctness of given eq.

$f = \rho A v^2.$

f = force.

ρ = density

A = Area

v = velocity.

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

$RHS = [M L^{-3}][L^2][L T^{-1}]^2$

$[M L T^{-2}.]$

LHS = RHS.

(4) Convert the unit of physical quantity with the help of dimensional analysis.

1 Km = 1000 m

P = nu = Constant

$\Downarrow$

$n \propto \frac{1}{u}$

$\uparrow y \propto u \downarrow$

Inversely perportional

$\downarrow\uparrow y \propto \frac{1}{u} \downarrow\uparrow$

Directly perportional.

1 J = ______ erg

ML^2T^{-2}.

$\frac{1 kg\, m^2}{s^2} = n_2 \frac{(g) cm^2}{s^2}$.

$\frac{(1000 \cancel{g})(100 cm)^2}{\cancel{s^2}} = n_2 \frac{\cancel{g}(cm^2)}{\cancel{s^2}}$

$n_2 = 10000000$

10^7.

Formula = $n_1 u_1 = n_2 u_2$.