Physical quantity

Physical Quantity is a quantity that can be measured or can be quantified.

Examples : Mass, Length, Force.

Physical quantity can be classified into,

1. Fundamental or base quantities.
2. Derived Quantities.

Derived Quantities

The physical quantities that depend on other quantities and can be derived from other physical quantities are known as derived quantities.

The units of derived physical quantities are called as derived units.

Example : Area, Volume, Density etc.

S.I System of Units

Fundamental Quantity	Unit	Symbol
Length	Meter	m
Mass	Kilogram	Kg
Time	Second	s
Electric current	Ampere	A
Temperature	Kelvin	k
Intensity of light	Candela	cd
Quantity of substance	Mole	mol
Supplementery Quantities		
Plane angle	Radian	rad
Solid Angle	Steradian	sr

Dimensional Formulas List

Physical Quantity	Formula	Dimensional Formula
Area (A)	Length x Breadth	$[M^0L^2T^0]$
Speed (s)	Distance / Time	$[M^0L^1T^{-1}]$
Velocity (v)	Displacement / Time	$[M^0L^1T^{-1}]$
Acceleration (a)	Change in velocity / Time	$[M^0L^1T^{-2}]$
Linear momentum (p)	Mass x Velocity	$[M^1L^1T^{-1}]$
Force (F)	Mass x Acceleration	$[M^1L^1T^{-2}]$
Work (W)	Force x Distance	$[M^1L^2T^{-2}]$
Energy (E)	Work	$[M^1L^2T^{-2}]$
Impulse (I)	Force x Time	$[M^1L^1T^{-1}]$
Pressure (P)	Force / Area	$[M^1L^{-1}T^{-2}]$
Power (P)	Work / Time	$[M^1L^2T^{-3}]$
Angular velocity(ω)	Angle / Time	$[M^0L^0T^{-1}]$
Angular acceleration(α)	Angular velocity / Time	$[M^0L^0T^{-2}]$
Angular momentum (J)	Moment of inertia x Angular velocity	$[M^1L^2T^{-1}]$
Torque (τ)	Moment of inertia x Angular acceleration	$[M^1L^2T^{-2}]$
Temperature	——	$[M^0L^0T^0K^1]$
Heat (Q)	Energy	$[M^1L^2T^{-2}]$
Latent heat (L)	Heat / Mass	$[M^0L^2T^{-2}]$

Fundamental or Base Quantities

The physical quantities that do not depend on other quantities and exits independently are known as fundamental or base quantities.

The units of fundamental quantities are called as fundamental units.

Example : Length, Mass, Time etc.

Units

Measurement of any physical quantity is expressed in terms of an internationally accepted certain basic standard called unit.

Four main system of representation of units are,

FPS - Foot pound second

CGS - Centimeter gram second

MKS - Meter kilogram second

SI - Internationally system of units.

Advantages of SI system

Coherent system of units i.e., units are derived by the multiplication or division of set of fundamental units.

Rational system of units i.e., uses ine unit for one physical quanity.

S.I is a decimal system and makes the calculation work easy.

S.I system is a combination of practical and theoretical work.

Dimensions

The powers to which the fundamental units are to be raised to obtain one unit of the quantity are termed as dimensions of a physical quantity.

Dimensional Formula

The expression showing the powers to which the fundamental units are to be raised to obtain one unit of a derived quantity is termed as dimensional formula of that quantity.

Dimensional formula of any quantity can be expressed as

$[M^aL^bT^c\theta^d]$

Dimensions (cont)

where,

M - Mass

L - Length

T - Time

θ - Temperature

Dimensional Constant

The constants having dimensional formulae are called dimensional constants

Ex : Plank's Constant, universal gravitational constant

Homogeneity, Applications and limitations of D.F

The physical quantity on the left side of the equations should have the same dimensions as on the right side of the equation

Application of Dimensional Formula

(a) To verify the correctness of the equation.

(b) To convert the one system of units to another system.

(c) To derive relationship among different physical quantities.

Limitations of Dimensional Method

(a) The values of dimensionless constants and proportionality constants cannot be determined using dimensional analysis.

(b) This method is not applicable if an equation is sum or difference of two or more quantities.

(c) It is not applicable to the trigonometry, logarithmic and exponential functions.

(d) It cannot be used to find proportionality constants.